

# **ABSTRACTS**

## **OF LECTURES AND POSTERS**

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## Oral presentations

### 1 CHANGES IN THE TEMPOROMANDIBULAR JOINT SYSTEM FOLLOWING MAXILLARY POSTERIOR SEGMENT INTRUSION WITH ZYGOMATIC ANCHORAGE

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**AIM:** An anterior open bite is often associated with temporomandibular joint (TMJ) dysfunction due to the loss of anterior guidance and the increasing rate of interference of the posterior teeth. The purpose of this study was to evaluate the effects of intrusion of the maxillary posterior segment with zygomatic bone anchorage on the TMJ with electrovibratography (EVG) and magnetic resonance imaging (MRI).-

**SUBJECTS AND METHOD:** Thirty-six TMJs from 18 subjects with a mean age of 17.7 years who required intrusion of the maxillary posterior segment. Lateral cephalometric and posteroanterior radiographs, EVG and MRI records were obtained before (T0) and after (T1) intrusion. Wilcoxon signed ranks test was used for radiographic and EVG data evaluation and the chi-square test for MRI data evaluation.

**RESULTS:** Maxillary posterior segment intrusion of  $3.4 \pm 1.2$  mm maxillary was obtained in an average of  $6.84 \pm 1.64$  months. At the end of intrusion, all measurements that showed the facial growth direction was decreased while overbite was significantly increased. Joint sounds evaluated by EVG when opening and closing the mouth at T0 were within the normal range and showed no significant differences at T1. MRI records showed that TMJs with a normal disc condyle relationship reduced from 38.9 to 33.3 per cent, disc displacement with reduction increased from 25 to 27.8 per cent and disc displacement without reduction increased from 36.1 to 38.9 per cent ( $P < 0.001$ ). Intra-capsular effusion increased from 16.7 to 19.4 per cent, movement limitation of the condyle increased from 27.8 to 33.3 per cent after intrusion ( $P < 0.001$ ). Hypermobility of the condyle did not change.

**CONCLUSION:** EVG values did not change but disc displacements, intra-capsular effusion and movement limitation increased after maxillary posterior segment intrusion. As MRI records taken immediately after intrusion showed instability of the TMJ, records should be evaluated after fixed orthodontic treatment.

### 2 BEST SITES FOR ORTHODONTIC MINI-IMPLANT PLACEMENT: A SYSTEMATIC REVIEW

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**AIMS:** To estimate the best area for insertion of orthodontic mini-implants (OMIs) depending on studies that used computerized tomography (CT) or cone beam computerized tomography (CBCT) as diagnostic tools.

**MATERIALS AND METHOD:** PubMed, Embase, and Cochrane databases were searched to identify all relevant papers published from 1969 to September 1, 2010. An extensive search strategy was performed including the following keywords: Computerized tomography, OMIs, and root. Case reports, case series (studies with less than 10 subjects), reviews and animal studies were excluded. From the 177 articles revealed by the search (all included in PubMed), 19 articles were judged eligible for inclusion in the study. Hand search of reference lists provided two additional papers. The search protocol, performed by two authors independently, showed perfect agreement. The information derived from the 21 articles was divided into three main categories: palate, maxillary, and mandibular alveolar region (buccal and lingual). The anatomical variables assessed in each paper were identified. The anatomical variables that were assigned to any insertion site, suggested as best by each article, were summed. This sum represented the score of each mini-implant insertion site under study.

**RESULTS:** In the maxilla, the best area for insertion is first and second molar, buccally and between second premolar and first molar, palatally. In the mandible, the best area is between the first and second molar, both buccally and lingually. In the palate, the paramedian area 3-6 mm dorsal and 2-9 mm lateral to incisive foramen was identified as the best site.

**CONCLUSION:** There is considerable agreement among most studies that investigate the best area for OMIs insertion based on the anatomical characteristics of each region. The results of the present study provide sufficient evidence supporting specific insertion sites as the best choice for each region examined.

### 3 EFFECT OF RAPID MAXILLARY EXPANSION AND HEADGEAR TREATMENT ON THE ERUPTION OF PALATALLY DISPLACED CANINES: A RANDOMIZED CLINICAL TRIAL

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AIM: To evaluate the effectiveness of orthodontic treatment finalized to the maintenance/improvement the upper arch perimeter to assist in the successful eruption of palatally displaced maxillary canines (PDCs).

SUBJECTS AND METHOD: The randomized prospective design comprised 64 subjects with PDCs who were randomly assigned to three groups: HG, Cervical pull headgear (HG); rapid maxillary expansion and cervical pull headgear (RME/HG); untreated control group (CG). Panoramic radiographs and lateral cephalograms were evaluated at initial observation (T1), and after an average time period of 18 months (T2). At T2 an evaluation of success of canine eruption was performed. A superimposition study on the lateral cephalograms was undertaken to evaluate the T1-T2 changes in the sagittal position of the upper molars in the three groups.

RESULTS: The prevalence rate of successful eruption was 85.7 per cent in the RME/HG group, while it was 82.3 per cent following the use of HG alone. Both these prevalence rates were significantly greater than the success rate in untreated controls (36%). Cephalometric superimposition showed significant mesial movement of the upper first molars in the CG when compared with HG and RME/HG.

CONCLUSIONS: In presence of appropriate indications, the use of RME/HG (or HG alone) in PDC cases is able to significantly increase the success rate of eruption of the canine (almost three times more than in untreated controls).

### 4 A RANDOMIZED CLINICAL TRIAL ON EARLY VERSUS LATE TREATMENT OF DEEP BITE MALOCCLUSIONS

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AIM: To compare the effectiveness and efficiency of early versus late treatment of deep bite malocclusions.

SUBJECTS AND METHOD: Sixty deep bite patients allocated randomly to two treatment protocols for the correction of deep bite [35 patients were treated with functional appliances in the mixed dentition at the pre-pubertal stages, mean age of 8 years 9 months, followed by fixed appliances to refine the occlusion in the permanent dentition within a two-phase treatment protocol, early treated group (ETG); 25 patients were treated with fixed appliances at the pubertal or post-pubertal stages within a one-phase treatment protocol, mean age of 13 years 2 months, late treated group (LTG). Overbite was greater than 4.5 mm in both the ETG and LTG before treatment. Lateral cephalograms were taken of all subjects before therapy (T1), at the end of fixed appliance therapy (T2), and at an average interval of 2 years after the completion of comprehensive therapy (T3) when all patients had completed active growth. Student's *t*- and *z*-tests on proportions were used for statistical comparisons. The power of the study was greater than 0.90.

RESULTS: Treatment duration was significantly shorter ( $P < 0.01$ ) in the LTG (27 months) than in the ETG (42 months). The amount of deep bite correction was significantly greater ( $P < 0.001$ ) in the LTG (average 3.4 mm reduction in overbite) than in the ETG (average 2.1 mm reduction), with a greater elongation of the mandibular ramus in LTG ( $P < 0.05$ ). The prevalence rate for patients showing a normal overbite 2 years post-treatment was also significantly greater ( $P < 0.01$ ) in the LTG (92%) than in the ETG (66%).

CONCLUSIONS: Treatment of deep bite in the permanent dentition at the pubertal or post-pubertal stages with a one-phase protocol by fixed appliances is significantly more effective and efficient than treatment in the mixed dentition at the pre-pubertal stages within a two-phase protocol.

### 5 THREE-DIMENSIONAL RETROGLOSSAL AIRWAY CHANGES AFTER SAGITTAL MANDIBULAR ALVEOLAR DISTRACTION

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AIM: To evaluate three-dimensional (3D) retroglossal airway changes after sagittal mandibular alveolar distraction in Class II mandibular dentoalveolar retrusion cases.

SUBJECTS AND METHOD: Ten adult patients who had mandibular dentoalveolar retrusion with prominent pogonion. After levelling and alignment of the dental arches symphyseal osteotomies were performed and archwise distractors were placed on rectangular stainless steel archwires. Distraction continued until a Class I canine relationship was achieved.

Airway volumes were measured on pre- and post-distraction cone beam computed tomographs (CBCTs) of each patient using ITK-snap 2.1.4-RC1 and SimPlant OMS Pro Standalone 13.0 was used for cephalometric measurements. The Statistical Package for Social Sciences, version 12.0 was used to perform Wilcoxon analysis to compare pre- and post-distraction volumetric and cephalometric measurements.

RESULTS: The increases in retroglossal airway volume ( $P = 0.013$ ), in lower incisor inclination ( $P = 0.022$ ) and in GoGnSN angle ( $P = 0.005$ ) were found to be significant.

CONCLUSIONS: When sagittal alveolar distraction is used to achieve a better profile and occlusion in mandibular dentoalveolar retrusion cases, the airway volume in retroglossal area is also increased.

## 6 LONG-TERM FOLLOW-UP OF MANDIBULAR DISTRACTION OSTEOGENESIS IN HEMIFACIAL MICROSOMIA

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AIM: A prospective longitudinal long-term follow-up study of a sample of children with hemifacial microsomia treated by mandibular distraction osteogenesis (DO) with and without the addition of functional orthopaedic treatment.

SUBJECTS AND METHOD: Thirty patients with type I and II hemifacial microsomia treated with a combined orthodontic-distraction protocol. The mean age at the beginning of treatment was 7.7 years. Ten patients with an average age of 7.2 years were treated by distraction only. Vertical changes were measured on cone beam computed tomographs, postero-anterior cephalograms and panoramic radiographs taken at different time points.

RESULTS: Angular changes of infraorbital and the nasal floor plane were not significant after 5 years of age. Mandibular vertical changes showed a gradual return to asymmetry in all patients, diminished in the group treated with functional appliances, who maintained a slightly better occlusal plane, but not the mandibular symmetry.

CONCLUSION: DO should be undertaken after careful patient selection. In type I and II hemifacial microsomia a combined orthodontic-surgical treatment is strongly recommended.

## 7 THE EFFECTS OF HIGH-FREQUENCY, LOW-MAGNITUDE MECHANICAL STIMULI ON THE RAT CONDYLE

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AIM: High-frequency, low-magnitude mechanical stimuli (vibration) has been shown to induce positive responses in condylar trabecular bone. The aim of this study was to investigate the effect of vibration on condylar cartilage and trabecular bone during condylar overloading in growing rats.

MATERIALS AND METHOD: Five groups of Sprague Dawley rats divided into five groups: baseline controls, age-matched untreated animals representing normal growth, animals exposed to vibration alone, animals fitted with intraoral appliances alone, and those receiving intraoral appliances together with vibration. The baseline controls were sacrificed at day 0 and the animals in the other groups at 7, 21 and 30 days. The intra-oral appliances protruded and opened the jaws and whole body vibration platforms delivered 30 Hz, 0.3 g vibration for 20 minutes per day, 5 days per week. The right condyles were stained with Gadolinium chloride and imaged using micro-computed tomographic imaging for subsequent measurement of the mandibular condylar cartilage volume and bone morphometric parameters.

RESULTS: In the vibration group, there was a significant increase in mandibular condylar cartilage volume from baseline, peaking at day 21 ( $P < 0.01$ ), followed by a significant decrease from day 21 to day 30 ( $P < 0.01$ ). Condylar overloading, with or without vibration, caused loss of mandibular condylar cartilage integrity, and condylar bone resorption. The volume of cartilage significantly decreased ( $P < 0.01$ ) due to the cartilage breakdown. Statistical analysis using ANOVA and *post-hoc* comparisons of bone morphometric parameters showed that bone quality under condylar overloading alone significantly decreased, however it remained statistically undifferentiated from the baseline controls when vibration was added.

CONCLUSIONS: When vibration was used, the adverse effects of condylar overloading, were significantly reduced in growing rats.

## 8 EFFECT OF THREAD DESIGN ON THE LOAD TRANSFER OF ORTHODONTIC MINISCREWS ONTO BONE

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AIMS: The load transfer between orthodontic miniscrew and bone, and with that its mechanical performance, depends largely on the design of the screw thread. The aim of this study was to analyze the effect of thread design parameters (profile, e4



volume, diameter) of five widely used miniscrews with different thread designs on the load transfer mechanism from miniscrew to surrounding bone.

**MATERIALS AND METHOD:** Five orthodontic miniscrews (Aarhus™, AbsoAnchor™, M.A.S.™, Tomas® and VectorTAS™) were micro-computer tomographically-scanned and three-dimensionally reconstructed for the creation of finite element models. In order to exclude the effect of screw length and head design, the threads of all designs were virtually cut to the length of the Aarhus™ design, and the head of the Aarhus™ design replaced the other four designs' own heads. All miniscrew models were digitally embedded in a cylinder representing bone. Three external loading modes were applied: pull-out, force flexure and unscrew. The resulting peak stresses in the bone were calculated, and nine geometrical thread parameters of the five designs were measured.

**RESULTS:** For all loading modes the Aarhus™ and Tomas® designs produced the lowest peak bone stresses, while the M.A.S.™ and AbsoAnchor™ designs produced the highest. The diameter of the threaded body and the pitch angle were correlated with the peak bone stresses. The larger the diameter the smaller the stress generated by loading, the sharper the thread the smaller the stress.

**CONCLUSIONS:** The cut of the threaded part had a larger influence on the stress generated in bending and torsion than in a pull-out mode. Parameters that tend to 'distribute' material away from the longitudinal axis of the screw, will stiffen the miniscrew by an increase of its moment of inertia. This will then result in smaller deformations of the screw under loading, thereby reducing the stresses in the bone.

## 9 DURATION OF TREATMENT AND OCCLUSAL OUTCOME USING SELF-LIGATED AND CONVENTIONAL ORTHODONTIC BRACKET SYSTEMS\*\*\*

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**AIM:** To compare the effect of bracket type on duration of orthodontic treatment and occlusal outcome as measured by the Peer Assessment Rating (PAR) Index.

**SUBJECTS AND METHOD:** A multicentre prospective randomized clinical trial was carried out in two orthodontic clinics. Sixty-two subjects (32 males, 30 females, mean age 16.27 years) with a mean pre-treatment PAR of 39.40, mandibular irregularity ranging from 5-12 mm and prescribed extraction including mandibular first premolars were randomly allocated to treatment with either Damon3 self-ligated or Synthesis conventional-ligated (Ormco, California USA) pre-adjusted bracket systems. An identical archwire sequence was used in both groups excluding finishing archwires: 0.014, 0.014 × 0.025 and 0.018 × 0.025 inch copper nickel-titanium aligning archwires, followed by 0.019 × 0.025 inch stainless steel working archwires. Data collected at the start of treatment (T1) and at appliance removal (T4) included dental study casts, total duration of treatment, number of visits, number of emergency visits and breakages during treatment and number of failed appointments.

**RESULTS:** Of the 62 patients were recruited at T1, the records of 48 were analyzed at T4. Accounting for pre-treatment and in-treatment covariates, bracket type had no effect on overall treatment duration, number of visits or overall percentage reduction in PAR. Time spent in space closure did have an effect on treatment duration, whilst the pre-treatment PAR score only influenced the reduction in PAR as a result of treatment.

**CONCLUSIONS:** Use of the Damon3 bracket does not result in a reduced overall treatment time, total number of visits or better occlusal outcome when compared with conventional-ligated brackets in the treatment of crowded extraction cases.

## 10 EFFICACY OF OCCLUSAL SPLINT AND PSYCHOLOGICAL THERAPY IN PATIENTS WITH TEMPORO-MANDIBULAR JOINT DISORDERS

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**AIM:** Patients with temporomandibular joint (TMJ) disorders have both functional and psychological problems. The treatment of TMJ disorders may include orthodontic, surgical and relaxation methods. The objective of this study was to compare the efficacy of occlusal splint therapy and psychological therapy in patients with TMJ disorders.

**SUBJECTS AND METHOD:** Thirty patients with TMJ disorders (splint group) wore occlusal splints designed having regard to their needs (12-16 hours a day for 6 months). Thirty patients (PSY group) were taught relaxation exercises using Jacobson's progressive relaxation methods (20 minutes a day for 6 months). Before and after treatment in both groups the interincisal distance (IID) in the open mouth position was measured and the patients were evaluated using the Pain Severity

Scale (PSS), the Hamilton Anxiety Rating Scale (HAM-A) and the Hamilton Depression Rating Scale (HAM-D). Statistical comparison was made using the paired *t*-test.

RESULTS: The median improvement in IID (splint 11.5 mm, PSY 9 mm) showed that the splint group had more mouth opening because of more stable and functional condylar positioning. Comparison of the PSS results showed that both methods achieved muscle relaxation thus reducing orofacial pain and that they were equally effective in pain management (median reduction: splint 45 points, PSY 41 points). Comparison of HAM-A results showed that the relaxation exercises in the PSY group were more effective in anxiety management (median reduction: splint 10 points, PSY 16 points). Comparison of the HAM-D results showed that both methods were equally effective in depression management (median reduction: splint 14 points, PSY 15 points) because depression can be a cause or a consequence of a TMJ disorder.

CONCLUSIONS: The findings affirm the need of combined splint and psychological therapy in TMJ disorders. It also confirms that stress and depression are strongly linked to TMJ disorders.

## 11 A NOVEL METHOD FOR CLASSIFICATION OF MAXILLARY IMPACTED CANINE ACCORDING TO CONE BEAM COMPUTED TOMOGRAPHY

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AIM: Cone beam computed tomography (CBCT) provides detailed information about the three-dimensional position of impacted maxillary canines but the difficulty of maxillary impacted canine treatment yet to be defined. The aim of this presentation is to suggest a quantitative method for classification of maxillary impacted canine difficulty.

MATERIALS AND METHOD: After a through systematic review 10 factors that were used in eight articles for treatment assessment of impacted maxillary canine were selected. These included: age, vertical distance between the canine tip to occlusal plane, bucco-palatal position, angulation relative to the occlusal plane, transposition with the lateral or first premolar, horizontal position relative to the adjacent teeth, rotation, incisor root resorption, apex location, root dilacerations. Different ranks were specified for each factor. Values for each factor were summed to provide the degree of difficulty. In this pilot study the degree of difficulty of eight impacted teeth was determined. The patients' records were judged by five orthodontists and the ranked from easy (0) to difficult (5). The validity of the method was determined by linear regression analysis.

RESULTS: Potentially the degree of difficulty could change from 0-30. The range of degree of difficulty was between 8 to 20. Regression analysis showed high coefficient correlation between the degree of difficulty and the orthodontists' opinion ( $P < 0.001$ ). The regression equation was  $y = 0.208 X + 0.6$ .

CONCLUSION: Although orthodontists have a good general Idea about the difficulty of impacted maxillary canine, this study provides a new quantitative classification system that incorporates three-dimensional information.

## 12 DENTAL ARCH RELATIONSHIP AFTER TWO TYPES OF PALATOPLASTY IN COMPLETE UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To evaluate, in a retrospective two-group comparative study using historical controls, dental arch relationship following a modification of palatal surgery in children with a complete unilateral cleft lip and palate (CUCLP) operated by the same surgeon.

MATERIALS AND METHOD: Dental casts of 47 children (27 boys and 20 girls; mean age = 11.2 years, SD 1.9; exposed group) and 61 children (42 boys and 19 girls; mean age = 11.2 years, SD 1.6; unexposed group) with CUCLP repaired with a one-stage closure of the entire cleft deformity by a single surgeon. As part of the one-stage closure, the technique of hard palate repair differed in the two groups. In the exposed group (historical controls) a modified von Langenbeck technique was used resulting in denudation of the bone surface of the non-cleft side only; in the unexposed group a vomerplasty with tight closure of soft tissues was applied. Three raters graded the dental arch relationship and palatal morphology using the EUROCRAN Index. The strength of agreement of rating was assessed with kappa statistics. Independent *t*-tests were run to compare the EUROCRAN scores between the groups.

RESULTS: Dental arch relationship in the exposed group was less favourable than in the unexposed group (mean scores 3.04 and 2.63, respectively;  $P < 0.000$ ). Palatal morphology in both groups was comparable (mean scores 1.88 and 1.81, for the exposed and unexposed groups, respectively;  $P = 0.323$ ).

**CONCLUSIONS:** Reduction of palatal scarring resulted in a more favourable dental arch relationship. Denudation of the vomer following extensive vomerplasty did not have a negative effect on dental arch relationship.

### 13 TOOTH VERSUS MINISCREW LOADING IN ORTHODONTIC FORCE APPLICATION: AN ENERGY ANALYSIS USING THE FINITE ELEMENT METHOD

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**AIM:** Absolute anchorage during orthodontic treatment neutralizes unfavourable tooth movements caused by reaction forces. Miniscrews were designed for acceptable stationary anchorage. The main aim of this study was to assess the strain energy of involved tissues in miniscrew and tooth loading in orthodontic force application to provide a better understanding of the energy state of the involved tissues.

**MATERIALS AND METHOD:** A three-dimensional (3D) finite element model containing the first and second molars, their periodontal ligaments (PDL), spongy and cortical bone was modelled in Solidworks 2006 and transferred to ANSYS Workbench (version 11). In the first stage, a force of 2.5 N decomposed in 3D space was applied to the miniscrew (E1) and at the second stage; the same force system was applied to the first molar (E2). Strain energy of the involved tissues was assessed and compared. The ratio of energy (E1/E2) in two stages of analysis in each tissue was determined.

**RESULTS:** The lowest ratio (E1/E2) was in the first molar (= 0.0003) followed by the PDL of the first molar (0.0027) which can be interpreted as equivalent to anchorage reinforcement. This ratio was increased in the second molar (= 0.143) and its PDL (0.228). Ratios greater than one were observed in the spongy bone (= 2.348) and cortical bone (= 8.17).

**CONCLUSION:** Shifting from conventional tooth loading to miniscrew loading during orthodontic treatment decreases the energy input both to teeth and the PDL which shows its positive anchorage effect and increases the energy input in the spongy and the cortical bone which seem to tolerate it due to their mineralized structure. A degree of PDL involvement in of miniscrew loading was also noted.

### 14 COMPARATIVE ASSESSMENT OF THE SLOT MORPHOLOGY OF CERAMIC AND PLASTIC BRACKETS AFTER TREATMENT

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**AIM:** To compare the alterations in slot morphology/integrity of two main types of aesthetic brackets after clinical use.

**MATERIALS AND METHOD:** Sixteen ceramic (CR) (GAC, Mystique) and 16 plastic (PR) (American Orthodontics, Silkron) central incisor brackets with a 0.018 inch slot obtained from 16 young adult patients (8 for each group), at the end of treatment. All patients were treated by the same clinician. As controls, 12 ceramic (CC) and 12 plastic (PC) brackets of same types were also examined. Three representative measurements (right edge, middle, left edge) were obtained for each slot using a micrometric microscope. Parametric statistics were performed for analysis of the results ( $\alpha = 0.05$ ).

**RESULTS:** The intraoral exposure time varied from 5 to 20 months (mean: 12.4) and did not differ significantly between the groups ( $P = 0.73$ ). Two-way ANOVA revealed significant differences in slot dimension between the different materials ( $P = 0.00$ ), and a significant interaction between the effect of the material and its status ( $P = 0.00$ ). Bonferroni *post hoc* tests on material status effect showed significant differences: CC (95%CI: 434.5, 447.0) versus PC (95%CI: 460.2, 472.8), CC versus CR (95%CI: 453.2, 464.4), and PC versus PR (95%CI: 448.8, 458.9). Interestingly, no significant difference was detected for CR versus PR.

**CONCLUSIONS:** While plastic brackets are significantly larger than ceramic brackets before use, treatment parameters seem to affect both bracket types in such an opposing way that leads to similar slot dimensions after clinical use.

### 15 CONTRADICTIONARY TREATMENTS IN HYPERDIVERGENT CLASS II DIVISION 1: IS THE VERTICAL DIMENSION AFFECTED?

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**AIM:** To evaluate two contradictory protocols for treatment of hyperdivergent Class II division 1 malocclusions, regarding their effectiveness in controlling vertical dimension.

**SUBJECTS AND METHOD:** The subjects were retrospectively selected from two orthodontic offices that applied different treatment protocols. Patients had similar hyperdivergent skeletal pattern, skeletal age, gender, and crowding. Group A (29 patients) was treated by four premolar extractions and intrusive mechanics (e.g. high-pull headgear), whereas group B (28 patients) was treated non-extraction with no regard to vertical control (e.g. cervical headgear, Class II elastics). Twenty-seven landmarks were digitized on lateral cephalometric radiographs pre- (T1) and post- (T2) treatment and 13 measurements were assessed. Geometric morphometric methods were used to evaluate shape differences.

**RESULTS:** The upper and lower molars translated mesially and the lower incisors uprighted in the extraction group, but remained approximately unchanged in the non-extraction group. The vertical position of the molars and incisors was similar between groups at both T1 and T2. No significant differences were observed for any post-treatment skeletal measurements between the two groups, including mandibular inclination (GoGn-SN), which remained unaltered (T1: group A:  $38.4 \pm 3.8$ , group B:  $39.1 \pm 3.8$ , T2: group A:  $38.2 \pm 4.1$ , group B:  $39.3 \pm 4.5$ ). Permutation tests on Procrustes distances between skeletal shapes confirmed these results.

**CONCLUSIONS:** The present study demonstrated the limitation of conventional orthodontics to significantly alter the skeletal vertical dimension. There are probably more important factors responsible for the establishment of vertical skeletal pattern, such as neuromuscular balance and function.

## 16 ENDOSCOPIC EVALUATION OF MINISCREWS OF DIFFERENT LENGTHS IMPLANTED IN THE MAXILLARY SINUS

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**AIM:** To evaluate, via endoscopic analysis, whether or not miniscrews of different lengths implanted in the posterior maxilla penetrate the maxillary sinus.

**SUBJECTS AND METHOD:** Sinus endoscopy was employed to investigate the relationship between the maxillary sinus and miniscrews inserted at the zygomatic crest in patients undergoing orthognathic surgery. Informed consent was obtained from 13 patients, who were given a general anaesthetic prior to combined bimaxillary surgery. An otolaryngologist inserted a K. Storz endoscope into the maxillary sinus of each patient via the nasomaxillary ostium at the level of the middle meatus of the nasal fossae. Orthodontic miniscrews of different lengths and diameters were buccally inserted either between the second premolar and first molar or between the first and second molars, with a 45 degree inclination with respect to the occlusal plane. **RESULTS:** All the miniscrews assessed (8, 10, 12 mm in length) penetrated the maxillary sinus. The degree to which the apical portion of the screws intruded into the sinus varied according to screw length, angle of insertion, and cortical bone characteristics of the patient. However, despite the Schneider membrane being perforated in all cases, excellent primary stability was obtained.

**CONCLUSIONS:** Although sinus penetration appears to be more frequent than previously supposed, stability does not seem to be compromised by this type of event. Furthermore, studies on implant and miniscrew perforation of the Schneider membrane have confirmed that perforations of less than 2 mm in diameter are not serious enough to warrant miniscrew removal. Nevertheless, the clinician must accurately analyse several fundamental aspects, such as the state of the maxillary sinuses and investigate conditions such as smoking habits in the patient's records before proceeding to insertion.

## 17 CONDYLAR GROWTH AND MANDIBULAR FORWARD POSITIONING

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**AIM:** To investigate the association between condylar growth and mandibular forward positioning.

**MATERIALS AND METHOD:** A series of tracings obtained during 5-6 years around puberty from 21 subjects enrolled in an implant study\*. The tracings were enlarged to their original size. Change in the condyle was measured in its direction of growth when the tracings were superimposed on three implants which had been inserted in the mandibular body when the subjects were enrolled in the study. Mandibular forward positioning was assessed with two commonly used cephalometric parameters, one angular (SNB) and one linear (OLp-Pg). For the conventional cephalometric analysis, the tracings were superimposed along the nasion-sella line at sella. The linear measurements were made along the upper occlusal plane to its perpendicular to sella, established on the first cephalogram of the subject.

**RESULTS:** The average condylar growth change was 21.2 mm (SD 4.6 mm; range 12.3 to 28.7 mm). The average change in mandibular forward positioning assessed with SNB was 2.2 degrees (SD 1.4 degrees; range -0.5 to +5.0 degrees) and with OLp-Pg was 14.6 mm (SD 4.0 mm; range 6.5 to 21 mm). The association between condylar growth and the change in SNB was low ( $r = 0.2$  NS) and OLp-Pg moderate ( $r = 0.7^{**}$ ).



**CONCLUSION:** The amount of condylar growth around puberty was not closely associated with changes in two commonly used cephalometric variables aimed to assess changes in mandibular prognathism.

\*from Bjork and Skieller 1972, with kind permission.

#### 18 DIFFERENCES IN PROTEIN SYNTHESIS AND EXPRESSION OF NEONATAL MYOSIN HEAVY CHAIN mRNA IN THE MASSETER MUSCLE OF CLASS II AND III PATIENTS

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**AIM:** Incomplete functional adaptation could be the reason for relapse after orthognathic surgery. The developmental myosin should be important because they are expressed in undifferentiated cells and are present in the masseter muscle in adults. The aim of this study was to analyse the expression of embryonal and foetal MHC (MYH3 and MYH8) in the masseter muscle of patients before and after orthognathic surgery.

**SUBJECTS AND METHOD:** Twenty-four adult patients with mandibular prognathism (Class III, 13) or retrognathism (Class II, 11) were involved in the study. Four tissue samples were taken from the anterior and posterior part of the left and right masseter muscle before (T1) and six months after orthognathic surgery (T2). Relative quantification of MYH3 and MYH8 mRNA was performed with real time polymerase chain reaction with EF-2 as the house-keeping gene. Electrophoresis and Western blot of MYH3 protein were used for the phenotype analysis. Gene regulations were analysed with the relative expression software tool. Additional absolute quantification using the computed tomographic values was calculated and values of T1 were correlated with T2.

**RESULTS:** MYH3 (embryonal) was 5 to 20 fold upregulated from T1 to T2 in both groups ( $P > .001/0.005$ ). MYH8 (foetal) was 5.8 fold upregulated in Class II and 2.8 fold down regulated in Class III. The increase of the MYH3 protein bands for all localizations was from 64.9 to 106.8 (64%). There was a correlation of 0.66 between the T1 and T2 level of CT values in Class II patients for MYH3.

**CONCLUSION:** Functional changes in the masseter muscle lead to different regulation of the MYC depending on the malocclusion. The differences of bone morphology in the prognathic and retrognathic mandible may be related to different genetically determined mechanisms of muscle adaptation. The results suggest that the possibility of jumping the bite in Class II treatment does not just depend on condylar growth potency.

#### 19 PHARYNGEAL DIAMETERS AND NASALANCE IN PATIENTS WITH CLEFT LIP AND PALATE AFTER MAXILLARY DISTRACTION OSTEOGENESIS AND LE FORT I ADVANCEMENT

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**AIM:** To compare dimensional changes in the pharynx and speech outcome in cleft patients who underwent gradual maxillary distraction osteogenesis (DO) or one-step conventional Le Fort osteotomy (LF).

**SUBJECTS AND METHOD:** Thirteen teenagers with cleft lip/palate or with cleft palate were osteodistracted (DO) with a RED-appliance and compared with age- and cleft background matched patients treated with LF. The maxillary advancement and cross-sectional pharyngeal diameters were measured on lateral cephalograms pre- and post-surgically and a year post-surgically and compared with a Student's *t*-test. Nasalance was measurement by nasometry pre- and one year post-operatively and compared with Mann-Whitney test.

**RESULTS:** Pre-operatively the interjaw relationship was similar in both groups. The palatal plane was more posteriorly rotated in the DO group. The maxillary advancement was significantly more in the DO group (~12 mm) than in LF group (~4 mm). LF advancement was associated with posterior rotation of palatal plane. The DO advancement increased naso- (~11 mm) and oropharyngeal diameter (~5 mm). LF advancement widened the nasopharynx (~2 mm), had no effect on the oropharynx and slightly decreased the hypopharynx. At the one year follow-up the maxillary advancement was stable for both groups, while pharyngeal diameters shortened in the DO group (~2-3 mm) and further widened in the LF group (~1 mm). In the DO group 5/8 subjects had post-operatively nasalance scores of 30 per cent or above indicating hypernasality. In the LF group post-operative scores were only slightly higher than the pre-operative scores and there was no need for speech corrective surgery. However, three DO subjects needed speech corrective surgery.

**CONCLUSION:** The effect of maxillary advancement on the pharynx and speech outcome was different in the DO and LF groups. In the LF group posterior rotation of the palatal plane decreased true maxillary forward movement and the widening

of the pharyngeal airway was not significant. The marked advancement performed gradually by DO could not overcome the widening of the nasopharynx and the appearance of hypernasality.

## 20 BIOLOGICAL EVALUATION OF PRECIPITATION HARDENED ANODIC OXIDATION ORTHODONTIC MINISCREWS

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AIM: To investigate bone-adhesion ability of precipitation hardened anodic oxidation (PHAO) orthodontic miniscrews.

MATERIALS AND METHOD: A total of 48 miniscrews were placed into the buccal alveolar bone of the mandible in six male beagle dogs. Comparison was made between smooth surface and precipitation hardened anodic oxidation miniscrews (Biomaterials Korea, Seoul, Korea). Orthodontic force (250-300 g) was applied immediately. Maximum insertion torque was measured using a torque sensor (Mark-10, MGT50, USA) during installation. For the subsequent test loading periods (3 and 12 weeks), bone implant contact (BIC) and bone volume/total volume (BV/V) and mobility tests were carried out. Before and after mini-screw insertion, the surface roughness of some of miniscrews was investigated and compared using atomic force microscopy

RESULTS: After miniscrews insertion, the surface roughness of PHAO orthodontic miniscrews was decreased and more changes were observed on the thread near to the tip. PHAO orthodontic miniscrews groups showed a significant increase in BIC between 3 and 12 weeks. The BV/TV of the PHAO orthodontic miniscrew group significantly increased from 3 to 12 weeks. The mobility of the PHAO miniscrews group was not significantly different from that of the smooth surface miniscrews group. CONCLUSION: PHAO miniscrews have more stability than smooth surface miniscrews from both a clinical and histomorphometric point of view.

## 21 EFFECTS OF A FACEMASK COMBINED WITH A CHINCAP ON MANDIBULAR MORPHOLOGY IN SKELETAL CLASS III PATIENTS

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AIM: Posterior rotation of the mandible during maxillary protrusion has been suggested to affect treatment stability in skeletal Class III patients. The aim of this study was to investigate whether posterior rotation of the mandible will be eliminated with the use of a chin-cap combined with facemask therapy.

SUBJECTS AND METHOD: Forty skeletal Class III patients with maxillary retrusion and optimal vertical skeletal growth patterns, with a chronological age range of 7.4 and 14.69 years and skeletal age range of 6 and 14 years, treated with rapid palatal expansion (RPE; acrylic cap splint type of hyrax) and maxillary protrusion by Petit type facemasks applying a force of 400 g on each side. In 20 patients the chin-cap force of 200 g on each side was mounted to the facemasks by means of hooks inserted in its chin cup part as group 1 (FM+CC+RPE) for a mean treatment period of 0.80 years where in group 2 (FM+RPE) mean treatment period was 0.91 years. Pre- and post-treatment lateral cephalograms were used to study the changes of 14 landmarks and mandibular rotation using Björk's mandibular superimposition, 18 linear and 11 angular measurements were made. Three-way ANOVA with repeated measurement was used to evaluate the data with respect to time. Intra-group comparison was controlled by Duncan's multiple comparison test when necessary.

RESULTS: Statistically significant differences were found between the two groups regarding to the mandibular rotation which was anterior in group 1 and posterior in group 2 depicted by the changes in the positions of the mandibular landmarks, Björk's superimposition, SNB angle, G-axis and mandibular plane angle.

CONCLUSION: Posterior mandibular rotation induced with the use of a maxillary protrusion facemask was eliminated by adding chin-cap force.

## 22 PREDICTING SOFT TISSUE PROFILE CHANGES AFTER BIMAXILLARY SURGERY FOR CLASS III CORRECTION

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AIM: To quantify soft tissue changes with respect to underlying skeletal repositioning after bimaxillary surgery to correct Class III malocclusions.



**MATERIALS AND METHOD:** Lateral cephalograms of 80 consecutive patients (52 males, 28 females) before and 2 months after surgery. All patients had Le Fort I and bilateral sagittal split osteotomies without any adjunctive procedures. The patients were divided in three subgroups according to the pre-operative characteristics: 1) open bite patients; 2) patients with a positive overbite and the upper lip resting on the upper incisors and 3) patients with a positive overbite and the upper lip resting on the lower incisors. Trimmed means of soft to hard tissue ratios were calculated for the subgroups. Regression analysis was performed to examine the factors influencing post-surgical positions of the soft tissues.

**RESULTS:** There were strong correlations between the movements of the upper incisors and the upper lip in patients with open bite ( $r = 0.77$ ) and patients with a positive overbite and the upper lip resting on the upper incisors ( $r = 0.85$ ). The upper lip followed the maxilla at a ratio 0.5:1. When the upper lip before surgery rested on the lower incisors, the upper lip changes after surgery were not predictable. In all groups strong associations between soft and hard tissue movements of the lower lip and chin were observed. The upper lip position after surgery was influenced by age ( $P = 0.035$ ), upper lip thickness ( $P = 0.002$ ), surgical repositioning of the upper ( $P = 0.006$ ) and lower ( $P = 0.002$ ) incisors. Pre-surgical overjet (0.024), pre-operative chin thickness ( $P = 0.025$ ) and skeletal repositions at Pg ( $P = 0.000$ ) and B ( $P = 0.014$ ) had an effect on the post-operative position of chin.

**CONCLUSIONS:** Several factors with influence on soft tissue movements were identified and should be included in treatment planning.

## 23 EFFECTS OF MINISCREW WITH CLASS III TRACTION AND FACEMASK ON MAXILLARY DEFICIENCY

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**AIM:** Numerous devices have been introduced for correction of maxillary deficiency. However, no study has been conducted regarding the use of miniscrew anchorage and orthopaedic forces in the correction of maxillary deficiency. The aim of this study was to compare the effects of a facemask and miniscrew combined with Class III traction on maxillary deficiency in growing patients.

**SUBJECTS AND METHOD:** Twenty patients with maxillary deficiency and a normal mandible. Ten patients with a mean age of  $10.5 \pm 1.5$  years were treated with a facemask and upper removable appliance such that the traction force was applied from the facemask to the removable appliance. Ten patients with a mean age of  $11.3 \pm 0.8$  were treated by miniscrews combined with Class III traction and an upper removable appliance. The miniscrews were inserted bilaterally between the mandibular canines and the first premolars under local anaesthesia. Class III elastics were connected from the mandibular miniscrews to hooks on the upper appliance. A Mann-Whitney test was used to compare the cephalometric data between the two groups.

**RESULTS:** SNA and ANB in the facemask group increased by  $1.5 \pm 1.4$  ( $P < 0.006$ ) and  $1.3 \pm 0.5$  ( $P < 0.004$ ) degrees, respectively. SNA and ANB in the miniscrew group increased by  $1.8 \pm 1.1$  ( $P < 0.007$ ) and  $1.4 \pm 1.1$  ( $P < 0.006$ ) degrees, respectively. There was no significant difference between the cephalometric indices of either group except for IMPA. IMPA decreased by  $6 \pm 7.1$  in facemask group; while it increased by  $0.7 \pm 2.8$  in the miniscrew group ( $P < 0.004$ ).

**CONCLUSION:** The use of miniscrews and traction force is a new method for correction of Class III malocclusions and maxillary deficiency. This method is much smaller than bulky facemask and may increase patient compliance but treatment cannot be started as early as facemask therapy.

## 24 LONG-TERM DEVELOPMENT OF MALOCCLUSION TRAITS IN ORTHODONTICALLY TREATED AND UNTREATED SUBJECTS

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**AIM:** To analyze long-term changes in malocclusion traits and compare the development in orthodontically treated and untreated subjects.

**SUBJECTS AND METHOD:** Three hundred and eight adolescents in the intermediate, late mixed or early permanent dentition who were examined clinically at the age of 8-17 years and again 25 years later. The treated subgroup of 58 subjects had received orthodontic treatment with fixed or removable appliances or both. All subjects had a full complement of teeth, except a subgroup of 19 who had premolar extractions as a part of their orthodontic treatment plan.

**RESULTS:** The prevalence of a maxillary overjet was significantly reduced in the untreated group and the treated subgroups. The prevalence of a distal molar occlusion was significantly reduced in the subgroup treated without extractions. Comparison

of treated and untreated groups in terms of change over time showed that the development was significantly more favourable in all treatment categories regarding maxillary overjet and in the non-extraction category regarding distal molar occlusion. Subjects treated non-extraction had less favourable development than the untreated subjects regarding molar crossbite.

CONCLUSION: The long-term benefit of orthodontic treatment, with or without extractions, was confirmed regarding maxillary overjet, and the lasting effect of non-extraction treatment was confirmed regarding distal molar relationship. The pattern of changes in treated and untreated subjects indicated that long-term development and individual variation may to some extent conceal the effects of a brief orthodontic intervention.

## 25 ORTHODONTIC TREATMENT CHARACTERISTICS IN PATIENTS TREATED WITH CONVENTIONAL OR SELF-LIGATING BRACKETS: SYSTEMATIC REVIEW AND META-ANALYSIS

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AIMS: Differences between treatment with conventional brackets (CB) or self-ligating brackets (SL) have not been comprehensively reviewed. The aim of the present systematic review was to investigate the possible differences of orthodontic treatment characteristics in patients treated with CB or SLB with regards to the efficiency and effectiveness of treatment, the effects on dental arch dimensions and tooth inclination, pain experience, and deleterious effects on the dental and periodontal tissues.

MATERIALS AND METHOD: Citations to potentially relevant randomized controlled trials were located by searching the appropriate databases. The standardized mean difference with the 95 per cent confidence intervals was used to express the comparative treatment effect. The random effects method for meta-analysis was used to combine the treatment effects across studies in each category and the risk of bias was assessed.

RESULTS: In the eight trials considered appropriate for inclusion in the review no statistically significant differences were noted regarding the effectiveness of treatment, the effects on dental arch dimensions and tooth inclination, pain experience, and deleterious effects on the dental and periodontal tissues. Only one study showed an increased treatment duration and more appointments in patients treated with SLB. Investigation of the parameters relating to the risk of bias showed increased risk of bias for many of the studies included.

CONCLUSIONS: No decisive conclusions on treatment characteristic differences between patients treated with CB or SLB could be drawn for the available data. Investigation of the parameters relating to the risk of bias leads to the conclusion that the outcomes of some studies bear limited proofing ability. Greater standardization of the methodology employed is desirable in future trials.

## 26 EFFECT OF FLUORIDE ON ORTHODONTIC ROOT RESORPTION, ITS REPAIR AND ORTHODONTIC TOOTH MOVEMENT AFTER APPLICATION OF CONTINUOUS LIGHT AND HEAVY FORCES

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AIM: To quantitatively evaluate if high and low levels of fluoride in drinking water affect orthodontic root resorption and its repair on human subjects when heavy and light orthodontic forces are applied.

SUBJECTS AND METHOD: Forty-eight patients who required maxillary premolar extractions as part of their orthodontic treatment were selected from two different cities in Turkey with high and low fluoride concentration in public water of  $\geq 2$  and  $\leq 0.05$  ppm, respectively. The patients were randomly separated into four groups of 12 each: Group 1, high fluoride intake ( $\geq 2$  ppm)-heavy force (225 g); Group 2, low fluoride intake ( $\leq 0.05$  ppm)-heavy force; group 3, high fluoride intake-light force (25 g); and group 4, low fluoride intake-light force. Light or heavy buccal tipping force was applied on the upper first premolars for 28 days. At day 28, the left premolars were extracted while the right premolars were extracted after 12 weeks of retention. The samples were analysed with microcomputed tomography.

RESULTS: Fluoride reduced the volume of root resorption craters in all the groups; however, this effect was significantly different only under high force application ( $P = 0.015$ ). Similar results were found after 12 weeks of retention; fluoride reduced the average volume of root resorption craters but this effect was not statistically significant ( $P = 0.237$ ). The amount of repaired cementum was not found to be statistically different between the groups. It was also found that heavy force application caused more root resorption than light force. Fluoride did not affect the amount of tooth movement.

CONCLUSION: Fluoride may reduce the total volume of root resorption craters. This effect was significant only under heavy force application ( $P < 0.05$ ). The amount of repaired cementum after 12 weeks of retention was not different between

the groups. Moreover, root resorption was found still active in heavy force groups after 12 weeks retention period. Fluoride did not affect the rate of tooth movement.

## 27 OSTEOGENIC EFFECT OF HIGH FREQUENCY, LOW MAGNITUDE FORCES ON ALVEOLAR BONE

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AIM: It has been shown that whole body vibrations have an osteogenic potential on load bearing skeletal segments. High frequency forces of low magnitude have been demonstrated to increase trabecular bone volume in experimental animal studies. The goal of this study was to investigate if the application of high frequency, low magnitude forces on teeth changes the quality and quantity of alveolar bone in the jaws.

MATERIALS AND METHOD: Forty-eight Sprague-Dawley rats were divided into sham and experimental groups. The experimental groups were subjected to daily localized vibration for 5 minutes (under inhalation anaesthesia) on the occlusal surface of the maxillary and mandibular right first molar at a frequency of 10, 60, 120, or 200 Hz, with a magnitude of 5 microstrain and acceleration of 0.3 g. The experiments were conducted for 28 days, following which the animals were killed and the jaws collected for different studies. The alveolar bone of the upper and lower jaws was evaluated using microcomputed tomography scanning electron microscopy, fluorescence microscopy and histomorphometry.

RESULTS: High frequency, low magnitude forces applied to the occlusal surface of molars have an osteogenic effect on the surrounding alveolar bone. This effect was highest at 120 Hz and caused a 16 and 12 per cent increase in the bone volume fraction of maxilla and mandible, respectively. Histological analysis showed significant changes, including an increase in trabecular thickness, and increased mineral deposition.

CONCLUSION: Application of localized mechanical stimuli of high frequency and low magnitude to teeth has an osteogenic effect on the surrounding alveolar bone and this effect is frequency dependent.

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## 28 A MICRO-COMPUTED TOMOGRAPHIC EVALUATION OF INSERTION SITES FOR MINI-IMPLANTS

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AIMS: To report the thickness of the cortical bone in the commonly used insertion sites for mini-implants, to assess the impact of a change in the insertion angle, and to evaluate the risk of sinus perforation.

MATERIALS AND METHOD: At autopsy, 24 adult human segments containing 3-5 adjacent teeth were excised and scanned using a table-top micro computed tomographic system. Bone thickness measurements were taken at 45 and 90 degrees to the long axis of the teeth, simulating a mini-implant insertion at the mid-root level.

RESULTS: The mean cortical thickness at 90 degrees was 0.7 mm (range 0.3-1.3) buccally in the posterior maxilla; 1.0 mm (range 0.2-2.0) labially in the anterior maxilla; 1.3 mm (range 0.3-2.2) palatally in the entire maxilla; 0.7 mm (range 0.3-1.2) labially in the anterior mandible and 2.4 mm (range 0.9-4.7) in the posterior mandible buccally and lingually. A change in the insertion angle to 45 degrees increased the cortical-bone-to-implant contact by 42 per cent. At an angulation of 45 degrees the mean distance from the outer cortical bone to the maxillary sinus cavity was 5.9 mm (range 3.3-8.8) buccally and 4.6 mm (range: 2.1-7.3) palatally. At 90 degrees the sinus only rarely extended to the mid-root level.

CONCLUSION: Buccally and palatally in the maxilla and anteriorly in the mandible the thickness of the cortical bone is often less than 1 mm. In the posterior mandible the cortical bone is on the other hand frequently thicker than 2 mm. Changing the insertion angle to 45 degrees will enhance implant stability, but in the posterior maxilla also increase the risk of sinus perforation. This risk can be reduced if the mini-implants are inserted more coronally perpendicular. A recommendation would be to insert 8 mm long mini-implants in the maxilla and anterior mandible and 6 mm mini-implants in the posterior mandible.

## 29 LUBRICIN IMMUNOHISTOCHEMICAL EXPRESSION IN HUMAN TEMPOROMANDIBULAR JOINT DISC WITH INTERNAL DERANGEMENT\*\*\*

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AIM: Lubricin is a chondroprotective, mucinous glycoprotein that contributes to joint lubrication, especially to boundary lubrication, and maintains joint integrity. The present investigation aimed to study the immunolocalization of lubricin in the temporomandibular joint (TMJ) discs from patients affected by anterior disc displacement with reduction (ADDwR).

**MATERIALS AND METHOD:** Eighteen TMJ displaced discs affected by ADDwOR were processed immunohistochemically, with a polyclonal anti-lubricin antibody, used at 1:50 working dilution. The percentage of lubricin immunopositive cells (extent score= ES) and the extent of lubricin staining of the disc extracellular matrix (ECM), were evaluated. Each sample was scored for histopathological changes. The percentage of immunostained surface disc cells was the same (ES=4) in both control and ADDwOR cells and not statistically significant ( $P < 0.05$ ). In pathological specimens the percentage of lubricin-stained cells was very high with an ES of 4 with respect to the control specimens. This difference was statistically significant different ( $P < 0.05$ ). The ECM at the disc surfaces of both the pathological and normal specimens was very heavily stained (++++). Both ES and ECM staining were not statistically correlated with the TMJ degeneration score according to the Spearman's rank correlation coefficient.

**CONCLUSION:** Longstanding TMJ disc injury affects the expression of lubricin in the TMJ disc tissue and not its surfaces, moreover, lubricin immunostaining is not correlated with TMJ disc histopathological changes.

### 30 EFFECT OF MESIALIZATION ON PROCLINATION OF THE UPPER ANTERIOR TEETH USING A MESIAL-SLIDER

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**AIM:** To investigate the protrusive effect on the upper anterior teeth caused by friction of a continuous wire while using a mesial-slider.

**SUBJECTS AND METHOD:** Thirty patients (group 1, 12 males, 18 females; aged  $18.6 \pm 10.3$  years) were treated simultaneously with a mesial-slider and multibracket-appliance. The control group comprised 10 patients (group 2, 4 males, 6 females; aged  $17.3 \pm 7.4$  years) with a mesial-slider without a multibracket-appliance for space closure. Cephalometric films and impressions were taken before and after mesialization. The relationship between the degree of mesialization and proclination of the upper incisors was analysed.

**RESULTS:** The anchorage unit consisting of two mini-implants remained stable in all cases. The amount of mesialization ranged from 4.2 to 11.8 mm. As expected, no protrusion was observed in group 2 while 1.2 mm of mesialization in group 1 showed proclination of 2 degrees.

**CONCLUSIONS:** The only difference in treatment planning between the two groups was simultaneous or subsequent use of a continuous wire. In group 2 no protrusion was observed. Hence the effect of friction caused by a continuous wire is clinically relevant and should be considered in treatment planning.

### 31 EFFECT OF FLUORIDE ON SURFACE PROPERTIES AND ION RELEASE OF TITANIUM BASED ORTHODONTIC ARCHWIRES

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**AIM:** To evaluate the effects of fluoride prophylactic agents on ion release and surface roughness of orthodontic arch wires.

**MATERIALS AND METHOD:** Listerine, Colgate Plax, Topex APF gel and artificial saliva as the control group were used in order to determine the effects on five different orthodontic archwires (Nitinol SE, Bioforce Sentalloy Longuard, Beta III titanium, TMA low friction, stainless steel). The archwires were stored in solutions in a 37°C incubator for 28 days. Atomic force microscopy was used to measure the surface topography of archwires before and after the immersion tests. Atomic absorption spectroscopy was used to measure the released nickel (Ni) and titanium (Ti) ions in the solutions. The results were statistically analysed.

**RESULTS:** Ni ion was released from all wires and in all solutions except Listerine lower than the daily dietary Ni intake level. Ni ion release in Listerine solution was higher than that released in other solutions and was closer to daily dietary Ni intake level. The highest Ti ion release was found to be in Listerine solution for all wires. Coated archwires exhibited significantly more Ti ion release than uncoated counterparts. Ion implantation procedures did not reduce ion release from investigated wires. Immersed archwires showed significantly higher surface roughness values than as received archwires. Archwires immersed in Listerine exhibited significantly higher surface roughness values than the archwires immersed in other solutions. The lowest surface roughness values for all wires in all solutions were for stainless steel wire. Coated archwires had lower surface roughness values than their uncoated counterparts in all solutions. Ion implantation procedure had a favourable effect on surface roughness.

**CONCLUSION:** Metal ion release and surface topography changes of Ti based orthodontic archwires in fluoride-containing environments should be taken into consideration when the allergic background of the patient and friction between the archwire and bracket is a clinical concern.



### 32 STRATEGIES TO OVERCOME FAILURES WHEN INSERTING ORTHODONTIC MINI-IMPLANTS

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**AIMS:** Difficult access to the surgical area is often a cause of failure of orthodontic mini-implants. To overcome this difficulty, in a prospective study, the use of two surgical guides developed to insert safely orthodontic mini-implants were evaluated. The first method was used in all cases and the second, more sophisticated, just for the cases where a failure using the first procedure was scored.

**SUBJECTS AND METHOD:** Eighty-eight mini-implants (Tomas® Dentaureum, 6 or 8 mm × 1.6 mm) inserted between first molar and second premolar in both upper and lower arch, in 25 consecutive adolescents (14 to 16 years) undergoing orthodontic treatment with four premolars extractions. After space availability evaluation on periapical radiographs and plaster models, custom surgical guides were constructed on the plaster models of each patient with acrylic resin and a stainless steel sleeve serving as a guide during pilot drilling (Morea *et al.*, 2005). For the cases where a mini-implant failed, a different surgical guide, prototyped based on cone beam computed tomographic (CBCT) data was used to make the pilot drilling (Morea *et al.*, 2011).

**RESULTS:** With the first method the success rate was 92 per cent. All cases that failed were as a result of root proximity due to difficult access to the surgical area. With the second method the remaining 8 per cent of all implants were inserted without any loss; a 100 per cent success rate.

**CONCLUSIONS:** The use of surgical guides guarantees good overall success WHEN inserting orthodontic mini-implants. CBCT surgical guides, used in unsuccessful cases, can increase the success rate to 100 per cent.

### 33 THREE-DIMENSIONAL EVALUATION OF MAXILLARY SINUS CHANGES FOLLOWING RAPID MAXILLARY EXPANSION

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**AIM:** To evaluate the volumetric changes of the maxillary sinus after rapid maxillary expansion (RME) using computed tomography.

**SUBJECTS AND METHOD:** Twenty-one patients (11 girls, 10 boys) who required RME with cap splint Hyrax appliances as part of their orthodontic treatment. Volumetric measurements before expansion (t1), after retention (t2) and one year following the retention (t3) were performed using 3D tomography prototyping software (Mimics version 14.0, Materialise, Belgium). Maxillary sinus regions were isolated in every slice and then the three-dimensional (3D) images were constituted. Sinus volumes were measured and also 3D registration of the sinuses using five points as landmarks at the cranial base were performed. The acquired data were compared for the three periods using repeated measures ANOVA and *post hoc* comparisons were made by paired samples *t*-test.

**RESULTS:** Total sinus volume increase was statistically significant at all three time points ( $P < 0.001$ ). The mean increase in volume from t1 to t2 was 0.964 cm<sup>3</sup> (3.4%) and from t2 to t3, 1.911 cm<sup>3</sup> (6.5%). As a result of registration process it was seen that from t1 to t2 the maxillary sinuses moved laterally in a pyramidal shape resembling the expansion shape of the maxilla whereas from t2 to t3 the sinuses moved bodily in a lateral direction.

### 34 A LONG-TERM PROSPECTIVE STUDY OF AN ORTHODONTIC BONE ANCHOR

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**AIMS:** To investigate whether immediate loading of orthodontic bone anchors (OBA) generates more failures than delayed loading. A further aim was to evaluate the impact of different variables on the success rate of the OBAs as temporary anchorage devices in orthodontic treatment.

**SUBJECTS AND METHOD:** In a prospective registry 61 consecutive patients (37 females, 24 males) were treated with OBAs. In total 106 OBAs were placed by one experienced maxillofacial surgeon over a period of 5 years (2001-2006). An independent evaluator compared and analyzed different prospectively determined parameters: gender, age (young age group <16 years versus mature age group ≥16 years), time of loading (delayed versus immediate), jaw, location, fixation screw length, complications and orthodontic indications. The definition of success was the capacity of maintaining the function of anchorage throughout orthodontic treatment. Premature removal of an OBA due to persisting pain, infection or serious mobility was considered as a failure. Fisher's exact test for was used for analysis of associations between the categorical variables. Success and complications were evaluated using multivariate logistic regression (significance level  $P = 0.05$ ).

**RESULTS:** The success rate was 93.3 per cent. Seven 7 (6.7%) OBAs were removed prematurely. The time of loading did not influence the failure rate. A statistically higher failure rate was noted in the mandible ( $P = 0,024$ ). Anteriorly positioned OBAs exhibited a significantly higher failure rate ( $P = 0,034$ ) than OBAs positioned posteriorly. The young age group presented more OBA failures ( $P = 0.02$ ) than the mature age group.

**CONCLUSION:** Immediate loading of OBAs does not generate more failures than delayed loaded. Age, jaw and position seem to play an important role in the success of OBAs. OBAs are a reliable treatment modality to obtain absolute orthodontic anchorage.

### 35 EVALUATION OF FACIAL HARD AND SOFT TISSUE ASYMMETRY WITH CONE BEAM COMPUTED TOMOGRAPHY

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**AIM:** To determine facial hard and soft tissue asymmetries and their interaction, using cone beam computer tomography (CBCT).

**MATERIALS AND METHOD:** The CBCT data of 49 asymmetric (mean deviation:  $\geq 4$  mm; mean age:  $19.9 \pm 5.6$  years) and 39 symmetric patients (mean deviation  $< 4$  mm; mean age:  $17.8 \pm 5.5$  years) were exported to the Mimics® software program. The midsagittal plane and absolute mandibular midline was used as the reference for two-dimensional separation of the craniofacial structures and for three-dimensional (3D) separation of the mandible, respectively. Linear, surface distance, angular, volumetric and surface area measurements were performed.

**RESULTS:** The upper facial third measurements demonstrated no differences between the right and left side, whereas significant differences were observed at the dentoalveolar level ( $P < 0.001$ ). Lower face height, ramus height, mandibular effective length and corpus length of the deviated side were significantly shorter than that of the opposite side ( $P < 0.001$ ). On the deviated side, volumetric and surface area measurements of the mandible and hard tissues increased ( $P < 0.001$ ), whereas absolute mandibular measurements decreased ( $P < 0.001$ ). In the ramus originated asymmetry subgroup, gonion lateralis was located laterally and in the corpus originated asymmetry subgroup, was located superiorly on the deviated side. Significant differences were found between right and left soft tissue volume measurements ( $P < 0.01$ ). Asymmetry was more frequently identified in the lower third of the face. In asymmetric subjects, significant volumetric measurement differences were found between the mandibular segments. Morphological changes in the gonial region were observed, therefore 3D evaluation of this region using multiple landmarks should be taken into consideration for detailed diagnosis of asymmetry. In asymmetric cases, the soft tissues followed the hard tissues to a large extent in the chin region, however mandibular skeletal asymmetries seem to be compensated by the soft tissues at different levels. Symmetric subjects also showed mild mandibular asymmetries.

### 36 COMPARISON OF AIRWAY AREAS AND VOLUMES OF INDIVIDUALS WITH DIFFERENT SKELETAL PATTERNS BY CONE BEAM COMPUTED TOMOGRAPHY

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**AIM:** To compare the area and volume of the nasopharyngeal (NP), oropharyngeal (OP) and total (T) airway in healthy Class I patients with a normal vertical growth pattern and Class II patients with low, normal and high vertical growth patterns.

**SUBJECTS AND METHOD:** Cone beam computerized tomographs (CBCT) of 80 patients with different sagittal and vertical skeletal patterns were investigated. Airway areas and volumes of 20 patients with a Class I normal growth pattern were compared with airway areas and volumes of Class II patients with low ( $n = 20$ ), normal ( $n = 20$ ) and high ( $n = 20$ ) vertical growth patterns. Skeletal and airway measurements were undertaken with Dolphin 3D. Intergroup comparisons of the ages, skeletal patterns and airway measurements were performed by one-way ANOVA. Tukey test was used for determining the difference between the groups.

**RESULTS:** There was no statistically significant difference between the groups when ages were compared. Statistical evaluation of the skeletal parameters demonstrated discrimination between the groups. There were no statistically significant differences for airway area measurements, but when nasopharyngeal, oropharyngeal and total airway volumes were compared, statistically significant differences were found between the groups. Individuals with normal growth patterns (both Class I and Class II) demonstrated similar nasopharyngeal airway volumes. Subjects with low and high angle growth patterns had smaller airway volumes than the normal growers. Class I individuals had greater oropharyngeal volumes than Class II individuals apart from the growth pattern. Total airway comparison of the groups



demonstrated that Class I individuals had the largest airway volume, followed by individuals with a Class II normal growth pattern. Class II individuals distinct from the growth pattern had smaller airway volumes.

CONCLUSION: Vertical growth pattern affects nasopharyngeal and total airway volume, while a sagittal position of the jaws affects oropharyngeal airway volume.

### 37 EVALUATION OF THE POSTERIOR VERTICAL EFFECTS OF ZYGOMATIC ANCHORAGE AND ACRYLIC PLATE COMBINATION THERAPY

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AIM: To evaluate the dentoskeletal and soft tissue effects of bilateral zygomatic anchorage and acrylic plate appliance combination therapy.

SUBJECTS AND METHOD: Ten skeletal open bite patients (7 females, 3 males) with a mean age of  $19.4 \pm 0.9$  years caused by excessive vertical growth of the maxillary posterior segments and treated with intrusion of the posterior dentoalveolar segments using an acrylic plate appliance supported by bilateral zygomatic skeletal anchorages. The study was performed on lateral cephalograms taken before treatment and after intrusion; mean intrusion time  $6.2 \pm 0.3$  months. Thirty-two hard and 15 soft tissue measurements were calculated. The results were evaluated by Wilcoxon and Mann Whitney-*U* tests. Correlations between hard and soft tissue changes were evaluated by Pearson correlation test.

RESULTS: The mean intrusion for U6/HOR was  $2.89 \pm 1.17$  mm ( $P < 0.05$ ) which caused an average decrease of  $2.50 \pm 1.41$  degrees of SNGoMe ( $P < 0.05$ ) and  $2.44 \pm 1.67$  degrees of NAPog angles ( $P < 0.05$ ) which also resulted in an increase of  $1.33 \pm 0.50$  degrees in SNB ( $P < 0.05$ ) and  $1.44 \pm 1.01$  degrees in ANB ( $P < 0.05$ ). No significant changes were observed in SNA. Lower face height was also decreased on average by  $2.78 \pm 1.09$  mm ( $P < 0.05$ ). The interincisal angle was increased by  $2.78 \pm 3.49^\circ$  ( $P < 0.05$ ). The mean overbite was  $-3.9 \pm 0.4$  mm before and  $-1.7 \pm 0.6$  mm ( $P < 0.05$ ) after intrusion while the mean overjet reduced to  $1.9 \pm 0.7$  mm from  $3.8 \pm 0.9$  mm ( $P < 0.05$ ). All soft tissue measurements correlated with the mandible were improved due to counter-clockwise rotation ( $P < 0.05$ ).

CONCLUSIONS: Zygomatic anchorage and acrylic plate combination therapy was effective in decreasing excessive vertical growth of the maxillary posterior segments and correcting the skeletal open bite. The significant counter-clockwise rotation of the mandible was related to the improvement of the soft tissue profile.

### 38 VEAU-WARDILL-KILNER VERSUS MINIMAL INCISION TECHNIQUE REPAIR OF ISOLATED CLEFTS OF THE HARD AND SOFT PALATE

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AIM: To compare the Veau-Wardill-Kilner (VWK) technique with the minimal incision (MI) technique repair of isolated clefts of the hard and soft palate regarding cephalometric outcome at 5 and 10 years of age.

SUBJECTS AND METHOD: A consecutive series of 145 Caucasian children born with isolated cleft palate between 1980 and 1996. Individuals with other craniofacial malformations, apart from Pierre Robin Sequence, were excluded. The patients were treated surgically using VWK (N = 59) or MI (N = 86) palatoplasty at a mean age of 13 months, and further divided into two subgroups: clefts within the soft palate only and a notch less than 3 mm in the posterior border of the hard palate (small cleft, n = 64) and clefts within the hard and soft palate (big cleft, n = 81). A retrospective evaluation at 5 (mean age 5.5 years) and 10 (mean age 10.3 years) years of age was performed using lateral cephalograms. Eleven skeletal and one soft tissue measurement were evaluated. Two-way analysis of variance (ANOVA), three-way ANOVA with repeated measurements on one factor and a mixed model analysis were performed.

RESULTS: Only minor differences in cephalometric morphology were found between the VWK technique groups and the MI technique groups, as well as among small and big cleft length (shorter mandibular length in the MI big cleft group at 5 years, decrease of SNA angle in the small cleft groups from 5 to 10 years, an increase of facial convexity in the big cleft groups and in the VWK groups from 5 to 10 years).

CONCLUSION: The craniofacial cephalometric morphology at 5 and 10 years of age in patients with isolated cleft palate did not differ between the two surgical techniques (VWK, MI) or extension of the cleft.

#### 39 FUNCTIONAL CHANGES IN JUVENILE IDIOPATHIC ARTHRITIS PATIENTS WITH ASYMMETRIC MANDIBULAR DEVELOPMENT TREATED WITH VERTICAL DISTRACTION OSTEOGENESIS

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**AIM:** Patients with JIA and unilateral involvement of the temporomandibular joint (TMJ) will develop an asymmetric posterior face height with a variance in severity. For asymmetries that need for surgical correction, vertical elongation of the ramus by means of distraction osteogenesis (DO) is an objective. One concern is the affection of the TMJ and its function caused by the possible displacement of the condylar segment. The aim of this study was therefore to evaluate the changes in functional parameters in JIA patients treated with vertical DO for an asymmetry caused by a growth deviation of the vertical ramus.

**SUBJECTS AND METHOD:** Twenty-three patients, mean age 15.8 years with JIA and mandibular asymmetry caused by unilateral TMJ involvement treated with vertical ramus elongation after the same protocol including calculation of the vector of distraction, transfer of vector and mode of distraction. Data on subjective and objective functional conditions were collected prospectively before insertion and after removal of the distraction appliance. Furthermore, the examination was carried out 6 months after the second examination.

**RESULTS:** Subjectively, the patients did not report any significant decrease in functional capacity. For those who reported pain from the TMJ/muscles an improvement was reported after removal of the appliance. Objectively, a significant decrease in mandibular movement capacity was seen after distraction. During the follow-up the capacity increased although a difference was still seen at 6 months. No significant functional pain was observed after termination of the active distraction period.

**CONCLUSION:** DO of the vertical ramus causes a functional decrease of the TMJ although an improvement gradually takes place in the following month after removal of the DO appliance. Pain seems not to develop after DO, on the contrary functional pain appears to reduce.

#### 40 RELAPSE OF DEEP BITE CORRECTION ACCORDING TO GROWTH TYPE

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**AIMS:** To longitudinally evaluate the relapse of orthodontic correction of deep bite according to growth pattern.

**MATERIALS AND METHOD:** The pre- and post-treatment and post-retention records of 60 patients that presented with pre-treatment incisor overbites of 50 per cent and greater. The subjects were categorized into three groups of major growth types according to a thorough analysis of the pre-treatment records, which yielded 28 mesocephalic, 16 dolichocephalic, and 16 brachycephalic individuals. Data was collected by measuring casts and performing cephalometric analysis pre- and post-treatment, and at 10 years post-retention. A mixed effects repeated measures model (ANOVA) was used to investigate the differences between the three facial type groups over the three time periods.

**RESULTS:** Dolichocephalic subjects showed the least amount of deep bite relapse (0.1 mm,  $P > 0.05$ ). Conversely, both the brachycephalic (1.2 mm) and mesocephalic (1.4 mm) subjects had statistically significant relapse ( $P < 0.05$ ). All three groups showed significant differences in a number of parameters in both the post-treatment and post-retention phases. However, overbite was the only variable that showed a significantly different pattern between the groups over three time periods ( $P < 0.05$ ). Post-treatment, intergroup comparisons showed a significant increase for SNB only in the brachycephalic group ( $P < 0.05$ ), which was also stable in the post-retention. Post-retention comparison of dolichocephalics with mesocephalics yielded significant differences in overbite and vertical movement of the maxillary incisors ( $P < 0.05$ ), whereas comparison of dolichocephalics with brachycephalics showed significant differences in overbite, inter-incisal angle and L1-MP angle ( $P < 0.05$ ).

**CONCLUSION:** Facial morphology and musculature may have a direct effect on the amount of relapse as evidenced by the differences between different growth types. Orthodontists may want to consider accounting for this added relapse by overcorrection of overbite in both mesocephalic and brachycephalic patients.

#### 41 THREE-DIMENSIONAL ASSESSMENT OF PALATAL CHANGE IN A CONTROLLED STUDY OF EARLY CROSSBITE CORRECTION†

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AIM: To quantify the palatal change in three groups of children: children with a crossbite (CB) who were treated, children with an untreated crossbite (UCB), and children without a crossbite (NCB).

MATERIALS AND METHOD: Study casts of 60 Caucasian children in the primary dentition (20 CB, 20 UCB and 20 NCB), aged  $5.4 \pm 0.7$  years, were collected at baseline (T1) and at one year follow-up (T2). Both CB and UCB groups had a unilateral posterior crossbite and midline deviation. The CB group was treated using a cemented acrylic splint expander in the upper arch. The NCB group consisted of children without a malocclusion. The study casts were scanned using a laser scanner and the palatal surface area, palatal volume and symmetry of the palatal vault were evaluated and compared between the three groups.

RESULTS: At T1 the palatal volume of CB (2698 mm<sup>3</sup>) and UCB (2585 mm<sup>3</sup>) was significantly smaller than that of NCB (3006 mm<sup>3</sup>) ( $P < 0.05$ , ANOVA test). After treatment, the palatal volume of the CB group (3087 mm<sup>3</sup>) increased and did not differ significantly from the NCB group (3208 mm<sup>3</sup>), whereas at T2 the UCB group (2644 mm<sup>3</sup>) was found to have a significantly smaller palatal volume than the NCB or CB groups ( $P < 0.05$ ). The increase of palatal volume due to treatment in the CB group (389 mm<sup>3</sup>) was significantly greater than in the UCB (59 mm<sup>3</sup>) and NCB (202 mm<sup>3</sup>) groups. The palatal surface area was significantly smaller in the CB group (742 mm<sup>2</sup>) at T1 compared to the NCB group (792 mm<sup>2</sup>), but not when compared with the UCB group (764 mm<sup>2</sup>). No significant difference for palatal surface area was observed at T2. The symmetry of the palatal vault was greater than 90 per cent in all three groups.

†Winner of the W J B Houston Oral Research Award.

## 42 MOLECULAR MECHANISMS OF TOOTH MOVEMENT: EMERGING CONCEPTS

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AIMS: Orthodontic tooth movement occurs due to bone modelling induced by mechanical loading. Periodontal ligament (PDL) cells respond to mechanical strain and control bone resorption and apposition. PDL cells express prostaglandin (PGE<sub>2</sub>) when subjected to mechanical strain. Mechanisms that transduce orthodontic load to biological responses are currently unknown. The beta-catenin pathway has been implicated in osteoblasts response to their mechanical environment. The aims of this study were to determine: whether the beta-catenin signalling pathway components are functional and responsive to mechanical strain in PDL cells, whether PGE<sub>2</sub> activates beta-catenin signalling in PDL cells and the relationship between PGE<sub>2</sub> and beta-catenin signalling in the PDL cell response to mechanical strain.

MATERIALS AND METHOD: To determine whether beta-catenin signalling pathway components are functional, PDL cells were treated with LiCl or Wnt3a-conditioned media. To determine whether mechanical strain activates beta-catenin, cells were subjected to compressive strain and to determine whether PGE<sub>2</sub> activates beta-catenin, the cells were treated with PGE<sub>2</sub>. Activation of beta-catenin pathway was determined by immunofluorescence, western immunoblotting and TOPflash assay. To determine whether strain-mediated activation of beta-catenin is mediated by PGE<sub>2</sub>, cells were strained in the presence of cox-2 inhibitors.

RESULTS: Mechanical strain induces nuclear translocation of beta-catenin with subsequent TCF/LEF-dependent transcriptional activation. PGE<sub>2</sub> stimulated nuclear translocation of beta-catenin. This activation of beta-catenin signalling is mediated by PI3 kinase/AKT pathway. Expression of COX2 was increased in cells treated with LiCl or subjected to mechanical strain. Strain-mediated dephosphorylation of beta-catenin was inhibited in the PDL cells that were strained in the presence of cox-2 inhibitors.

CONCLUSION: Beta-catenin is activated by mechanical strain in PDL cells. Exposure of PDL cells to PGE<sub>2</sub> is associated with activation of beta-catenin. PGE<sub>2</sub> appeared to act through the PI3K/AKT pathway. Inhibition of PGE<sub>2</sub> synthesis showed a reduction in the strain-mediated activation of beta-catenin. Beta-catenin serves as an effector of mechanical signals in PDL cells.

## 43 THE NEXT STEP IN THREE-DIMENSIONAL IMAGING: IMAGE FUSION: INTEGRATION OF DIGITAL DENTAL CASTS IN CONE BEAM COMPUTED TOMOGRAPHIC SCANS

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AIM: The next step in three-dimensional (3D) imaging, is digital surgical planning. For orthognathic surgery, a good representation of the dentition is essential. To obtain this, digital dental casts need to be integrated into the cone beam

computed tomography (CBCT) scans. Until now different methods have been proposed. The disadvantages of these methods is either that fiducial markers are used or that the used CBCT scans give a high radiation dose to the patient. A new method is proposed to integrate digital dental casts into CBCT scans. The method uses titanium markers, which are glued to the gingiva of the patient and then a CBCT scan is made. Next impressions are made, capturing the markers in the impression on removal. The impressions are CBCT scanned and 3D reconstructions are made. The 3D reconstructions are combined to create a 3D head of the patient with a high resolution dentition. The aim of this study was to validate the proposed new method, in order to change the digital planning method to one with lower radiation exposure.

**MATERIALS AND METHOD:** To validate this method, markers were placed on 10 plaster casts. The plaster casts were scanned and impressions were taken, where the markers were captured in the impression. Next the impressions were also scanned. Measurements were performed on all three models and voxel based matching was performed on the digital models. **RESULTS:** Statistical analysis show significant differences between the three models, however, the differences were under 0.1 mm and therefore clinically irrelevant. Voxel based matching of the titanium markers showed a difference of 0.22 mm, which can be considered clinically irrelevant.

**CONCLUSIONS:** Since the significant differences are very small, they can be considered clinically irrelevant. Therefore this method is a good low radiation dose substitute for present methods.

#### 44 ACCELERATED TOOTH MOVEMENT: FROM RATS TO HUMANS

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**AIM:** Inhibition of expression of certain cytokines decreases the rate of tooth movement but the relationship between the magnitude of inflammatory response and the rate of bone remodelling and tooth movement is not clear. The objective of this study was to investigate whether small perforations of cortical bone increase the expression of inflammatory cytokines and the rate of bone remodelling and tooth movement.

**MATERIALS AND METHOD:** Forty-eight rats were divided into four groups: A force of 50 cN was applied to the maxillary first molar (O), force application plus soft tissue flap (OF), force application plus flap plus three small perforations of the cortical plate (OFP), and control group (C). After 28 days, the maxillae were analyzed by micro-computed tomography (mCT) and histology. RNA isolated at different time points was used to evaluate the expression of inflammatory markers by semi-quantitative RT polymerase chain reaction.

**RESULTS:** Local perforation of cortical bone caused an increased inflammatory reaction as shown by both histology and the expression of inflammatory cytokines. From the 92 cytokines studied, the expression of 37 cytokines increased significantly in all experimental groups with 21 cytokines showing the highest levels in the OFP group. mCT, light and fluorescent microscopy, and immunohistochemistry demonstrated higher number of osteoclasts and bone remodelling activity in the OFP group, accompanied by generalized osteopenia and increased rate of tooth movement.

**CONCLUSIONS:** Small perforations of the cortical plate significantly increase the expression of inflammatory cytokines resulting in an increase in the rate of bone remodelling and tooth movement. This effect is not limited to the area of force application and can extend to adjacent bone.

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#### 45 PERIODONTAL HEALTH IN THE PRESENCE OF ORTHODONTIC RETAINERS ASSESSED BY BIOMARKERS IN GINGIVAL CREVICULAR FLUID

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**AIM:** To evaluate if biomarkers of inflammation and periodontal remodelling are differentially expressed in the gingival crevicular fluid (GCF) of patients wearing different types of orthodontic retainers.

**SUBJECTS AND METHOD:** Thirty-one adult subjects were allocated to three different groups: group 1= 10 patients wearing fixed retainers; group 2 = 11 patients using lower removable retainers, and group 3 = 10 patients without retainers (control). The mean period of retention was 5.6 years. Periodontal health assessment and GCF collection were carried out at two sites per subject: the lingual side of the central lower incisor and the lingual side of the lower second premolar. Aliquots from diluted GCF were screened for the presence of biomarkers using microarray technique. The quantification was done



against a standard curve set for each biomarker with an eight-point serial dilution of standards. Non-parametric tests were used to compare the differences between groups and sites. Significance level considered at  $< 0.05$ .

**RESULTS:** The concentrations of interleukin-10 and interferon gamma were significantly higher in the premolar sites of patients with lower removable retainers, whereas the concentration of matrix metalloproteinase-9 was significantly higher in the GCF samples collected from the lower incisors of patients with fixed retainers in place ( $P < 0.05$ ). Intragroup evaluation demonstrated that the concentrations of biomarkers in the premolar sites were significantly higher when compared with the incisor sites only in the removable retainer group ( $P < 0.05$ ).

**CONCLUSION:** The data indicated specific alterations in the GCF composition due to the presence of orthodontic retainers.

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#### 46 DOSIMETRY OF A CONE-BEAM COMPUTED TOMOGRAPH AS COMPARED WITH A DIGITAL RADIO-GRAPHIC MACHINE

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**AIM:** Three-dimensional cone-beam computed tomography (CBCT) has rapidly gained prominence in the dental community and is quickly becoming a routine imaging modality for many orthodontic clinics. However, questions remain about the amount of radiation patients are exposed to during the diagnostic scans and those needed for advanced treatment techniques. The aim of this research was to determine the amount of radiation potentially absorbed by a patient during orthodontic imaging with a CBCT machine with various scan settings compared with a digital two-dimensional (2D) X-ray machine.

**MATERIALS AND METHOD:** Twenty-four thermoluminescent dosimeters placed at anatomic sites inside a Rando® head and neck phantom were used to record the radiation exposures delivered by a Next Generation i-CAT® CBCT machine at various scan settings, including the one used for SureSmile® treatment, and an Orthopantomograph® OP100/OC100 digital X-ray machine during panoramic and cephalometric radiography. The kV and mA parameters were fixed at the machine manufacturers recommended settings for an average adult male. Effective doses were calculated using the tissue weighting factors recommended by the 2007 International Commission on Radiological Protection.

**RESULTS:** The effective doses at various voxel sizes and field of view settings ranged from 108–129  $\mu\text{Sv}$  for standard resolution CBCT scans, 196–212  $\mu\text{Sv}$  for enhanced or high resolution full field of view scans, and 252  $\mu\text{Sv}$  for a high-resolution landscape scan with a voxel size as would be used for SureSmile® therapy. The effective doses for digital panoramic and lateral cephalometric radiographs measured 39 and 25  $\mu\text{Sv}$ , respectively.

**CONCLUSION:** CBCT, while providing proven diagnostic and therapeutic benefits, also exposes patients to a higher level of radiation than digital 2D radiography. It is important for clinicians to weigh the benefits against the risks when determining their imaging protocol.

#### 47 FIXED TONGUE APPLIANCE: A NEW APPROACH FOR MAXILLARY DEFICIENCY TREATMENT IN GROWING PATIENTS\*\*\*

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**AIM:** To show the effectiveness of a fixed tongue appliance to move the deficient maxilla to a forward position in the treatment of Class III malocclusions.

**SUBJECTS AND METHOD:** Twelve patients (average age  $9.80 \pm 0.64$  years) with a Class III maxillary deficiency with a normal mandible were treated with an intraoral fixed tongue appliance for a period  $7 \pm 2$  months. Pre- and post-treatment study models, radiographs and photographs were taken and the cephalometric data were analyzed and compared.

**RESULTS:** There was a significant difference of SNA, ANS-PNS length, nasolabial angle, U1-SN, L1-GoGn and ANS-PNS when compared with SN (all  $P < 0.05$ ).

**CONCLUSION:** The intermittent force generated by the tongue physiology and function during swallowing and normal activity could advance the deficient maxilla forward. This force might act on the maxilla between 520-1200 times and might reach to 5 ounces during tongue thrust against the tongue sprue of the fixed tongue appliance. The tongue forces were eliminated against the upper and lower anterior resulting in upper and lower lingualization which is corrected by the fixed appliance after the completion of skeletal correction.

#### 48 CRANIOFACIAL MORPHOLOGY IN DYSTROPHIN DEFICIENT MDX MICE

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**AIM:** It has been suggested that masticatory muscle weakness and their dysfunction in patients with Duchenne muscular dystrophy (DMD) may influence cranial bone growth and development and may cause changes of craniofacial complex resulting in dental malocclusions. Dystrophic muscles of mdx mice, an animal model of DMD, are also characterized by muscle weakness. The aim of this study was to examine whether the disturbed masticatory muscle function is also accompanied by the changes of geometry of the craniofacial complex, we compared craniofacial morphology of dystrophic mdx mice with those of controls during growth and adulthood.

**MATERIALS AND METHOD:** Thirty-day-old mice [mdx n = 9, controls n = 9], 100-day-old (8 versus 10), as well as 356-day-old (9 versus 15). Standardized radiographs of each head were taken, cephalometric landmarks identified and processed by the computer program FR-WIN (Computer Konkret AG, Falkenstein, Germany). Differences were assessed with a Student's *t*-test.

**RESULTS:** In mdx mice of 30, 100 and 365 days old, the maximum cranial breadth was found to be smaller when compared with the controls (mdx versus controls, mean  $\pm$  the standard error of the mean values in mm were: 30-days:  $10.54 \pm 0.12$  versus  $10.93 \pm 0.04$ ,  $P < 0.01$ ; 100-days:  $10.85 \pm 0.05$  versus  $10.98 \pm 0.03$ , and 365 days:  $10.88 \pm 0.08$  versus  $11.15 \pm 0.07$ ; both  $P < 0.05$ ). However, only the 30-day old mdx mice revealed reduced maximum cranial length ( $17.07 \pm 0.27$  versus  $19.11 \pm 0.27$ ,  $P < 0.005$ ) while the 365-day-old mdx mice had a shorter bizygomatic diameter ( $4.70 \pm 0.09$  versus  $5.03 \pm 0.05$ ,  $P < 0.05$ ).

**CONCLUSIONS:** The reduction of diameter in 30-day-old mdx mice (which display muscle weakness) suggests that muscle function may influence the geometry of the craniofacial complex during growth. Indeed, in older mdx mice most values did not deviate from the controls. This may imply that muscle regeneration and functional recovery that occurred in this age group may compensate for bone growth deficiencies during earlier stages of development.

#### 49 FUNCTIONAL TREATMENT CAN REDUCE MANDIBULAR ASYMMETRY IN UNILATERAL TEMPORO-MANDIBULAR INVOLVEMENT IN JUVENILE IDIOPATHIC ARTHRITIS

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**AIM:** To evaluate the effects of a full-time wear of orthopaedic functional appliances with the aim to reduce asymmetric mandibular growth in a cohort of juvenile idiopathic arthritis (JIA) patients with unilateral temporomandibular joint (TMJ) arthritis.

**SUBJECTS AND METHOD:** In a cohort of 54 patients diagnosed with unilateral TMJ arthritis 22 patients complied with the inclusion criteria (mean age 7.5 years). All 22 patients presented an asymmetric mandible and were treated with a distraction splint as the functional treatment (mean treatment time 57 months) aiming at normalizing growth in the affected condyle. Dental pantomograms and cone-beam computerized tomograms were obtained pre- and post-treatment. At both of these time-points the ratio between the healthy and the affected side of the mandible was evaluated related to inter-side differences in condylar height, ramus height and the total vertical mandibular height.

**RESULTS:** Orthopaedic functional treatment improved mandibular appearance and significantly reduced the mandibular asymmetries that were seen prior to the initiation of the distraction splint treatment in terms of ramus height and the total vertical mandibular height (paired *t*-tests:  $P < 0.05$ ). Comparable mandibular growth rates between the affected and non-affected sides were observed in the majority of patients.

**CONCLUSION:** Evidence was found that distraction splint treatment can reduce mandibular asymmetry in JIA patients with unilateral TMJ arthritis without intraarticular pharmacotherapy. Implementation of distraction splint therapy is suggested in the treatment of JIA patients with unilateral TMJ arthritis as it is able to support mandibular vertical growth in the affected side.

#### 50 THREE-DIMENSIONAL FACIAL SOFT TISSUE SURFACE CHANGES DURING SMILING IN PATIENTS WITH A UNILATERAL REPAIRED CLEFT LIP/PALATE

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AIM: To evaluate three-dimensional (3D) facial soft tissue surface changes during smiling in patients with a unilateral repaired cleft lip/palate.

SUBJECTS AND METHOD: A repaired cleft lip/palate group (n = 17, mean age = 22.1 years) and a control group (n = 20, mean age = 24.2 years). 3D images of the face at rest and at the peak of smiling were recorded for each subject using a 3D surface-imaging device. In each group, the 3D facial images were averaged geometrically on the basis of the anatomical features of each facial posture, and surface distance maps representing the antero-posterior distances between the two facial postures were generated. From the maps, a lip retrusion area (>3 mm) and cheek and nasal alar protrusion areas during smiling (>5 mm) were determined. To assess the size and shape of these areas, the dimensions and the vertical/horizontal ratios were calculated in each group. All measurements were standardized with the distance between the left and right eyes. RESULTS: The lips, cheek, and nasal alar retrusion/protrusion areas for the control group were 22, 26, and 1.0 per cent, respectively, whereas those for the cleft group were 8, 21, and 0.2 per cent, indicating smaller areas of lip retrusion and cheek/nasal alar protrusion during smiling in the cleft group. The vertical/horizontal ratios for the lips, cheek, and nasal alar retrusion/protrusion areas were 0.4, 1.9, and 1.7 in the control group and 0.2, 2.6, and 3.8 in the cleft group, respectively, indicating vertically shorter lip retrusion and horizontally shorter cheek/nasal alar protrusion in the cleft group.

CONCLUSION: 3D evaluation of facial soft tissue surfaces revealed that, during smiling, patients with a unilateral repaired cleft lip/palate had a smaller and vertically shorter retrusion in the lip region and a smaller and horizontally shorter protrusion in the cheek/nasal alar regions.

## 51 ENGINEERING GROWING BONE

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AIM: All current tissue engineering approaches for bone repair and regeneration explore intramembranous ossification, but skeletal development can occur by either intramembranous or endochondral bone formation pathways. The aim of this study was to implant in nude mice a cartilage scaffold to serve as a template for *in vivo* endochondral bone formation to test the hypothesis that a mature cartilage template carries all the signals necessary to induce new bone formation *in vivo*.

MATERIALS AND METHOD: Chondrocytes isolated from sterna (upper and lower region) of 14-day chick embryos were cultured for 20 days on chitosan sponges and treated with retinoic and ascorbic acid to induce maturation. Only upper sternal cells respond to these agents. Lower sternal chondrocytes were used as control. Cartilage/chitosan scaffolds were implanted subcutaneously in nude mice. Tissues collected at different times after implantation, were studied by histology, immunohistochemistry, high resolution radiography, light and scanning electron microscopy, and microcomputed tomography.

RESULTS: As early as 1 month after implantation, mineralization was observed *in vivo*, and the amount of new bone formation increased overtime in the upper sternal scaffolds. Vascularization of the scaffold was observed during bone formation. The bony scaffold increased in size during the implantation period.

CONCLUSIONS: A mature cartilage/chitosan scaffold carries all the signals to induce endochondral bone formation *in vivo*. Bone formed through this pathway has the potential to grow with the host.

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## 52 FIXED MANDIBULAR REPOSITIONING APPLIANCES FOR TEMPOROMANDIBULAR DYSFUNCTION TREATMENT\*\*

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AIM: To determine whether fixed functionals, such as the mandibular anterior repositioning appliance (MARA), with simultaneous orthodontics, can eliminate or reduce temporomandibular dysfunction (TMD).

SUBJECTS AND METHOD: Ninety-seven randomly selected patients with TMD, varying in age from 16 to 51 years. Clinical examination included: full orthodontic records, magnetic resonance images of the temporomandibular joint (TMJ) and a manual functional analysis of the TMJ according to Bumann and Stelzenmüller. The findings before and 4-9 years after treatment were compared. Treatment consisted of condylar antero-inferior repositioning with a fixed repositioning appliance and bite raising with fixed pivots (build-ups) on the second permanent molars. The patients also underwent simultaneous

physiotherapy. A requirement was that 28 teeth had erupted. Some of the adult patients were retained with fixed ramps from the upper to the lower second molars to prevent both distal movement of the mandible and dorsal bruxism. The development of the subjective complaints of the patients was graphically recorded.

RESULTS: Most significant was the reduction of facial and TMJ pain reported by 53 per cent of the patients to merely 5 per cent of the patients. Good results were also been obtained in the elimination and/or reduction of tinnitus and clicking. A reduction was also been achieved for the other problems, including headaches and open/ closed lock, etc.

CONCLUSIONS: Antero-inferior condylar repositioning with fixed functionals such as the MARA aids TMD, especially if the mandible (if necessary) is held permanently anteriorly with ramps after treatment. Of significance was the elimination and/ or reduction of joint and facial pain.

### 53 COMPARISON OF INTRA-ORAL, IMPRESSION AND PLASTER MODEL SCANNING FOR OBTAINING DIGITAL STUDY MODELS

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AIM: Due to the current technological developments, there are different digital alternatives for the traditional plaster models. These alternatives consist of either scanning a plaster model with a three-dimensional (3D) scanner or microcomputed tomography scanning of an alginate impression, or employing an intra-oral digitizer to scan the dentition of the patient directly in the mouth. The 3D laser scanner has been subject of many studies and has proven a worthy alternative to the traditional plaster model. The other two digital alternatives have not yet been subject of different sorts of validation studies. The aim of this study was to compare the new digitizing technologies with the digital model obtained from the laser-scanned plaster model.

SUBJECTS AND METHOD: Twenty randomly selected patients. Two sets of alginate impressions of each of the patients were made. The dentition of the patients was scanned with the Lava COS intra-oral digitizer (3M) according to the directions of the manufacturer. One set of alginate impressions was poured, trimmed and digitized with a 3D laser scanner. The other set was sent to a company that offers the service of scanning alginate impressions for obtaining digital models for orthodontic diagnostic purposes (Orthoproof). The two obtained digital sets of models were compared with the dataset of the laser-scanned plaster models, which was regarded as the golden standard. The 3D data comparison was performed in Geomagic Studio software. Statistical analysis was undertaken with an ANOVA.

RESULTS: Significant differences were found between the scanned impressions and the laser-scanned plaster models, whereas the models obtained from the intra-oral digitizer seemed to show no significant differences with the gold standard.

CONCLUSIONS: Digital models obtained from scanning alginate impressions showed significant differences when compared with the gold standard.

### 54 MUCOGINGIVAL INTERCEPTIVE SURGERY OF BUCCALLY ERUPTING PREMOLARS IN ORTHODONTIC PATIENTS: A RANDOMIZED CLINICAL TRIAL WITH 10-YEAR FOLLOW-UP

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AIM: The aim of this 10-year longitudinal study was to compare the width of keratinized gingiva after orthodontic therapy for buccally erupting premolars that had been pre-treated by extraction of primary teeth alone versus interceptive mucogingival surgery within a split-mouth randomised clinical trial.

SUBJECTS AND METHOD: In 13 patients (aged 9 to 12 years) who presented with bilateral buccal eruption of homologous teeth (premolars), one side was randomly treated with extraction of the primary molar and mucogingival surgery (test site), while the other side was treated only by extraction of the primary molar (control site). All subjects underwent orthodontic treatment with fixed appliances. Periodontal and orthodontic outcomes were assessed 3 months, 2 years and 10 years after initial observation, and compared by means of non-parametric statistics ( $P < 0.05$ ).

RESULTS: At baseline, prior to any treatment, there was no significant difference between the mean amount of keratinized gingiva at the test (3.06 mm) and control (2.93 mm) sites. Two and 10 years later, upon completion of orthodontic treatment and 8 years after that, there were significant differences between the test (about 3 mm) and control (less than 1.5 mm) sites in the mean width of keratinized tissue. In the control (untreated) group, four sites exhibited over 1 mm of gingival recession after orthodontic treatment.

CONCLUSIONS: Mucogingival interceptive surgery is an effective technique to maintain keratinized tissue in correspondence with buccally erupted teeth in patients scheduled for orthodontic treatment.

## 55 INTERDENTAL MANDIBULAR DISTRACTION OSTEOGENESIS

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**AIM:** Interdental mandibular distraction osteogenesis (IMDO) is a surgical technique that is suitable for treatment of routine cases of mandibular retrusion for patients 13 to 16 years of age. The aim of this research was to review the results of the IMDO technique over a 5 year period.

**SUBJECTS AND METHOD:** Twenty patients treated with IMDO using Martins distractors and monitored over 5 years.

**RESULTS:** Treatment was successful and patient satisfaction was high. The overall the results were: 1. The IMDO technique is a simpler surgical procedure compared with traditional bilateral sagittal split osteotomy (BSSO). 2. The aesthetic result is excellent with normalisation of the jaw relationship and lip posture. 3. There is less patient discomfort. 4. It is best undertaken around the ages of 13 to 15 years. 5. There is considerably less, and virtually no risk of damage to the inferior alveolar nerve and mandibular artery when compared with traditional BSSO. 6. It is easier for the surgeon to get the vectors correct so the results are better and there are fewer open bites. 6. If open bites develop the patient is actively growing which will close open bites. Also the bone callus is still remodelling so open bites close with patient clenching. 7. There is no requirement for model surgery. 8. The patient is treated before the development of dentoalveolar compensations that occur with retruded mandibles. In particular the mental protuberance does not overdevelop. 9. Space is created between the first and second molars. This space is often useful to resolve crowding. 10. Orthodontic treatment time is considerably shorter with a better result. 11. Treatment corrects the discrepancy, i.e. mandibular retrusion, and dental compensations are not necessary.

**CONCLUSION:** The IMDO technique is a simple procedure that produces notable results, enhancing aesthetics and function in patients with mandibular retrusion.

## 56 RAPID MAXILLARY EXPANSION HAS DETRIMENTAL EFFECTS ON THE SUPPORTING ALVEOLAR BONE

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**AIMS:** To evaluate the effects of rapid maxillary expansion (RME) on cortical bone thickness and alveolar bone height, and to determine the possible formation of dehiscence and fenestration in surrounding alveolar bone, by means of cone-beam computed tomography (CBCT).

**MATERIALS AND METHOD:** The CBCT records of 20 subjects; 9 boys (mean age:  $13.97 \pm 1.17$  years) and 11 girls (mean age:  $13.53 \pm 2.12$  years) who had bilateral posterior crossbites and underwent RME were selected. The hyrax type banded RME appliance was used in all patients. CBCTs were taken before (T1) and after (T2) RME. In addition, 10 of the subjects had six-month retention records. Axial slices of the CBCT images were evaluated from the buccal and palatal sides for the canines, first and second premolars and first molars at three vertical levels. Multiplanar reconstruction was used to record fenestration and dehiscence at the buccal and palatal sides and the percentages were calculated. Paired samples *t*- and Wilcoxon signed rank tests were used for statistical comparison at  $P < 0.05$ .

**RESULTS:** After active expansion, buccal alveolar bone height was reduced (mean:  $0.90 \pm 1.19$  mm). This change was not improved after the 6 month retention period. The buccal cortical bone thickness gradually decreased from baseline to the end of retention period. The palatal cortical bone thickness increased during expansion; and decreased in the retention period. During the course of treatment, the percentages of dehiscence were found to increase and fenestrations to decrease.

**CONCLUSION:** RME may have detrimental effects on the supporting alveolar bone as the thickness and height of buccal alveolar bone decreased. The greater dehiscence formation supports these results. After 6 months of retention, most of the tested variables did not recover.

## 57 EVALUATION OF FACIAL GROWTH IN CHILDREN AGED 8 TO 11 YEARS

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**AIM:** To track morphological changes in a cohort of school children aged 8 to 11 years of age using three-dimensional surface imaging.

**SUBJECTS AND METHOD:** Twenty-nine children (16 boys, 13 girls), aged from 8 to 11 years, from Šenčur Elementary School were recruited. Four surface facial images were obtained yearly using two Vivid 910 laser scanners (Konica Minolta, Tokyo, Japan). Ten facial landmarks for each surface scan were identified for each time frame. Colour deviation maps were used to identify annual surface changes. Statistical analyses (Student's *t*-test, repeated measures ANOVA, multiple linear regression) were employed to determine directional changes.

**RESULTS:** Differences in morphological characteristics between a boy's and girl's face were identified: i) mouth width at the age 11 years (difference 1.43 mm,  $P < 0.05$ ) and ii) the distance of the upper lip to E-line at the age of 10 (0.72 mm,  $P < 0.005$ ) and 11 (0.61 mm,  $P < 0.005$ ) years, while other observed parameters did not differ statistically. Colour deviation maps showed the areas of growth and development of Slovenian boys and girls. In boys there was growth in the chin area (from 8 to 11 years) and upper lip (from 10 to 11 years). In girls the growth was significant in the area of chin and upper jaw (from 9 to 10 years), but the growth pattern was slightly different from that of the boys.

**CONCLUSION:** The results obtained can be used as standard values for facial surface morphology in Slovenian children for the period of 8 to 11 years of age. The average facial shells for the boys and girls did not differ significantly; the expected earlier growth in girls compared with boys was not confirmed.

## 58 HIGH FREQUENCY OF TEMPOROMANDIBULAR JOINT-ISOLATED JUVENILE IDIOPATHIC ARTHRITIS IN CHILDREN WITH ORTHODONTIC TREATMENT NEED

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**AIM:** Craniomandibular dysfunction (CMD) is frequently (30-40%) found in children. However inflammatory changes in paediatric temporomandibular joints (TMJ) as detected by magnetic resonance imaging (MRI) may be due to isolated affection by juvenile idiopathic arthritis (JIA). Since both diseases have different therapeutic strategies, the aim of the study was to compare MRI finding with clinical examination in a blinded multidisciplinary setting and to determine isolated TMJ arthritis caused by JIA rather than CMD.

**MATERIALS AND METHOD:** Contrast enhanced TMJ MRI scans of CMD patients under 16 years at disease onset were screened for signs of TMJ arthritis by a team consisting of a TMJ-radiologist, an orthodontist and a paediatric rheumatologist, all blinded for patient data. MRI signs of TMJ arthritis were: synovial effusion, synovial contrast enhancement (synovitis), synovial hypertrophy, bone marrow oedema, condylar flattening, condylar erosions. Interobserver variability and reliability were calculated by modified Cohen-Kappa test. TMJ arthritis caused by JIA was accepted if all of the above MRI signs were present.

**RESULTS:** From the 1024 CMD patients 81 had contrast enhanced MRI of the TMJ. Out of those, nine patients were identified as having signs of JIA affection. For both JIA and non-JIA groups, interobserver variability and reliability was high (modified Cohen-Kappa value of 0.77). These results showed a 100 times higher affection of children with JIA than published earlier. The calculated frequency of isolated TMJ arthritis according to this study is 0.88 per cent.

**CONCLUSION:** A careful screening for JIA should be carried out in paediatric CMD patients to secure adequate anti-inflammatory treatment. Bearing in mind the isolated TMJ involvement, JIA seems to be much more frequent (0.88%) than previously accepted. A close cooperation with a paediatric rheumatologist and a radiologist is essential for optimal treatment planning in these patients.

## 59 LONG-TERM STABILITY OF ARCH FORM IN CONTEMPORARY ORTHODONTICS: 4 TO 25 YEARS POST-RETENTION

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**AIM:** To evaluate the long-term stability of arch form changes induced by contemporary orthodontic treatment.

**SUBJECTS AND METHOD:** Thirty-nine subjects with Class I permanent dentition malocclusions treated in a single orthodontic office using contemporary and discipline specific arch forms (Vari-Simplex). Nineteen subjects were treated non-extraction and 20 via four first premolar extractions. Computer generated arch forms were established from scanned models and the eccentricity (e) calculated to describe precise shape geometry changes. Arch form changes were compared before (T0) and after (T1) treatment and after retention (T2). Dahlberg error was calculated and Student's paired *t*- and Wilcoxon tests were used to compare the changes.

**RESULTS:** Average treatment duration was 2.3 years and retention appliances were worn for an average of 3.8 years. Average time without any retention, prior to arch form relapse evaluation, was 11.3 years, but varied from 4.5 to 25.9 years.



At T0 arch forms were parabolic in shape ( $X_e = 0.82$  to  $0.88$ ). Contemporary orthodontic treatment using the Alexander philosophy rounded out the arches and decreased the eccentricity at T1 ( $X_e = 0.75$  to  $0.83$ ). Only maxillary arch changes were significant ( $P < 0.05$ ). After cessation of active retention at T2, arch forms tended to relapse back to the pre-treatment eccentricity values ( $X_e = 0.80$  to  $0.83$ ;  $P > 0.05$ ). Only mandibular relapse in extraction cases was highly significant ( $P < 0.05$ ) and returned to near precise pre-treatment eccentricity ( $e = 0.83$ ).

**CONCLUSIONS:** Contemporary Vari-Simplex arch forms alter pre-treatment arch forms and particularly in the maxilla produce more rounded arches. When retention appliances are no longer worn, arch form relapses to pre-treatment eccentricity values. Mandibular extraction cases show the highest relapse. Eccentricity changes of  $<0.07$  are not perceived to be of clinical importance and the eccentricity values attained in this study accordingly show excellent arch form stability from 4 to 25 years post-retention.

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## 60 TOTALLY IMPACTED UPPER CANINES: EXAMINATION AND TREATMENT BASED ON THREE- VERSUS TWO-DIMENSIONAL-DIAGNOSIS

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**AIM:** To show whether and which advantages of three-dimensional diagnosis [cone beam computed tomographs (CBCT)] to two-dimensional diagnosis (panoramic radiograph) are given in the examination and treatment suggestions of impacted upper canines.

**MATERIALS AND METHOD:** Panoramic radiographs, CBCT, and casts of 21 patients with in total 30 impacted maxillary canines. Patients with syndromes or aplasia of teeth were excluded. Thirty dentists rated different parameters, such as canine position and chance of alignment, relation to and resorption of adjacent teeth. 2D photographs and models were rated first; then 3D images and casts were evaluated after an interval of at least 2 weeks. The amount of impaction was defined by two trained examiners as the gold standard according to the criteria given by Ericson and Kurol (1988).

**RESULTS:** In 64 per cent of all cases the position of the canine was rated to be equal in both kinds of images. 2D ratings showed slight accordance ( $\kappa = 0.374$ ), and 3D ratings good accordance with the gold standard ( $\kappa = 0.714$ ). Two-thirds of the apical regions of the canines could be seen on the 2D and 3D images; more than one-quarter of the canine apices could not be seen in 2D-, but only in 3D-images. Recognition of lateral incisor root resorption on the CBCT was in good accordance with the gold standard ( $\kappa = 0.634$ ); but the examiners did not see slight resorptions in 20 per cent of the cases. Eighty-two per cent of treatment suggestions (orthodontic alignment or osteotomy) were the same for the 2D and 3D images. Inclination of canines seen on the panoramic radiographs most influenced the treatment suggestion.

**CONCLUSIONS:** The advantage of 3D diagnosis (rating apical region of the canines; resorption on adjacent teeth) for treatment suggestions and procedures (access to the surgical area; direction of traction) counterbalance the higher amount of radiation. The result of this study justify CBCT diagnosis in subjects with totally impacted upper canines.

## 61 TREATMENT OF CLASS II MALOCCLUSIONS USING THE ALVEOLAR DISTRACTION TECHNIQUE

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**AIM:** The prevalence of Class II malocclusion is 27 per cent. The most common characteristic of a Class II malocclusion is mandibular retrusion. In patients who have sufficient chin projection, the labiomental fold is more prominent and alveolar retrusion is more striking. The aim of this study was to evaluate the efficiency of alveolar distraction in Class II patients with sufficient chin projection.

**SUBJECTS AND METHOD:** Twelve patients with a Class II dental relationship, normal or deep bite, retrusive point B but sufficient chin projection. During the first stage of treatment, upper and lower teeth were aligned and with the correction of the upper incisor inclinations, in most cases an overjet became apparent. Following alignment of the upper arch, the second stage of treatment began and the symphysis region was distracted using a unique archwise distractor. A piezo surgical device was used for alveolar segmentation under sedation. Distraction was completed after an achieving ideal overjet and Class I canine relationship. Three-dimensional (3D) cone beam volumetric computed tomographs were obtained; before distraction and after consolidation. Dental and skeletal changes were evaluated on 3D models.

**RESULTS:** An ideal overjet and Class I canine relationship was achieved in all subjects.

**CONCLUSION:** The proposed method may become a routine clinical procedure in selected cases.

## Poster presentations

### 62 EVALUATING MICROBIAL CONTAMINATION OF WATER SUPPLY OF DENTAL UNITS OF ORTHODONTIC AND PAEDODONTIC DEPARTMENTS

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AIM: To determine microbial contamination of the water supply of dental units at the paedodontic and orthodontic departments of Shahid Beheshti University.

MATERIALS AND METHOD: Eight dental units were randomly selected and microbial contamination of water supply was evaluated. Diagnosis was based on samples obtained 5 minutes after spraying water from the unit syringe. The samples were taken to the microbial laboratory under sterile conditions.

RESULTS: Fifty per cent of the dental units in the orthodontic department were contaminated with *Staphylococcus epidermidis*. Gram-negative bacillus also found. There was no microbial contamination in the water supply of dental units in the paedodontic department.

CONCLUSION: A possible cause for the contamination in the water supply in the dental units of the orthodontic department could be stagnation of water.

### 63 BOLTON TOOTH SIZE DISCREPANCY OF THREE MAIN ETHNIC GROUPS IN MALAYSIA: A PILOT STUDY

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AIM: Bolton analysis is one of the diagnosis tools used in orthodontic treatment planning. The main objective of this study was to investigate the applicability of Bolton's ratios in the orthodontic population of Malaysian main ethnics; Malays, Chinese and Indians.

MATERIALS AND METHOD: Convenience samples consisting of 30 pre-orthodontic study casts from each ethnic group that fulfilled the inclusion criteria. The greatest mesiodistal widths of each tooth from the first molar to the first molar for overall ratio, and canine to canine for anterior ratio were measured using digital callipers (Pro-Max by GAC) link to Hamilton Tooth Arch Software to the nearest 0.01 mm. The means of the ratios were calculated using Bolton analysis and one sample *t*-test statistical analysis was carried out to compare the means with Bolton values of anterior ratio ( $77.20 \pm 1.65$ ) and overall ratio ( $91.30 \pm 1.91$ ).

RESULTS: There were significant differences between genders of the Malay sample. For anterior ratio, both genders displayed a significant difference, with a mean Malay male anterior ratio of  $80.61 \pm 3.15$ ;  $P = 0.01$ , and Malay females ( $78.22 \pm 2.14$ ;  $P = 0.04$ ). For overall ratio, Malay males showed a highly significant difference ( $P = 0.004$ ) with mean of  $94.17 \pm 2.14$ , but there was no significant difference for Malay females ( $91.80 \pm 1.88$ ;  $P = 0.24$ ). There were also no significant differences when comparing Bolton values with Chinese anterior ( $76.56 \pm 2.68$ ;  $P = 0.20$ ) and overall ( $90.93 \pm 1.87$ ;  $P = 0.29$ ) ratios, and Indian anterior ( $77.77 \pm 2.90$ ;  $P = 0.29$ ) and overall ( $91.38 \pm 2.27$ ;  $P = 0.85$ ) ratios.

CONCLUSION: The Bolton standards can be applied to Malaysian Chinese and Indians but not to Malays orthodontic population except to Malay female in which the overall ratio is applicable. Subsequently, a specific standard should be used for the Malay orthodontic population.

### 64 LINGUAL VERSUS LABIAL ORTHODONTICS: A COMPARISON OF TREATMENT EFFECTS. PART 1

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AIM: To find out whether lingual or ceramic orthodontic brackets are preferable in aesthetic orthodontic treatment of adults when treatment effects are compared in a prospective study design.

SUBJECTS AND METHOD: Twenty-nine adult female patients with an Angle Class I malocclusion and moderate upper and lower dental arch crowding treated either with directly bonded self-ligating lingual or Inspire Ice ceramic brackets. Four patients were included in the lingual and 15 patients in the labial group. The air rotor stripping technique was used for resolution of crowding. Lateral cephalograms and dental models at the start (T1) and end (T2) of treatment. Intragroup comparisons were performed using a paired samples *t*-test while intergroup comparisons were performed with a *t*-test for independent groups.



**RESULTS:** Initial patient characteristics in terms of age, amount of crowding, dentoskeletal soft tissue measurements and treatment duration did not differ between the groups ( $P > 0.05$ ). In the labial group, upper and lower incisor inclination was increased and the lips became more protrusive ( $P < 0.05$  and  $P < 0.001$ , respectively). Maxillary and mandibular dental arch length was increased ( $P < 0.01$ ). In the lingual group, lower lip projection increased ( $P < 0.01$ ) and maxillary intercanine width and mandibular dental arch length were increased ( $P < 0.05$ ).

**CONCLUSION:** Orthodontic treatment was completed in similar treatment times in the labial and lingual groups. Incisor proclination was more pronounced in the labial group and maxillary intercanine width was increased in the lingual group. In both groups, the slightly retrusive position of the lips was changed to more normal values at the end of the treatment.

## 65 LINGUAL VERSUS LABIAL ORTHODONTICS: A COMPARISON OF PATIENT COMFORT AND SATISFACTION. PART 2

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**AIM:** To find out whether lingual or ceramic orthodontic brackets are preferable in aesthetic orthodontic treatment of adults when patient comfort and satisfaction are compared.

**SUBJECTS AND METHOD:** Twenty-nine adult female patients with an Angle Class I malocclusion and moderate upper and lower dental arch crowding treated either with directly bonded self-ligating lingual or ceramic brackets. Fourteen patients were included in the lingual and 15 in the labial group. Patient comfort was assessed by evaluating pain, tongue soreness, oral hygiene and speech problems (visual analogue scale, tongue soreness score, Löe-Silness plaque and gingival indices and digital sonography were used, respectively) at the start (T0) and 48 hours (Tb1), 1 week (Tb2) 1 one month (Tb3) after treatment. At the end of the treatment (T1) tongue soreness and oral hygiene assessments were repeated. Satisfaction was assessed by two questionnaires answered by the patients at Tb1, Tb2, Tb3 and T1. Analysis of variance in repeated measurements, generalized estimation models, chi-square and *t*-tests were used to analyze the data.

**RESULTS:** Pain severity and mouth hygiene problems increased in the first 48 hours and disappeared Tb3 in both groups. No tongue soreness was observed in the labial group but in the lingual group slight trauma occurred on the lateral sides of the tongue at Tb1 but had resolved at Tb3. Speech problems that were observed at Tb1 were no longer present in the lingual group at Tb2 and but continued in the labial group for one month. Patients were moderately dissatisfied due to discomfort at Tb1. A high level of patient satisfaction was found at T1 in both groups.

**CONCLUSION:** Patient discomfort and satisfaction values with direct lingual and labial ceramic brackets are similar during non-extraction treatment in adult females.

## 66 HYPODONTIA: A CEPHALOMETRIC STUDY INVESTIGATING THE SKELETAL EFFECTS OF PATTERN AND INCREASING SEVERITY

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**AIM:** To determine the skeletal relationships in patients with hypodontia, analysing for the effects of severity and pattern.

**MATERIALS AND METHOD:** Ethical approval was obtained and a sample size calculated. Pre-treatment lateral cephalograms from 277 hypodontia patients categorized by the number of missing teeth as mild (1–2), moderate (3–5) or severe (>6), were digitized recording angular measurements and ratios. These were compared with published norms matched for age and gender. Pattern was determined as mandibular, maxillary, bimaxillary, bilateral, anterior, posterior and antero-posterior. Linear regression models were used to assess the relationships between the number of missing teeth and cephalometric parameters, controlling for the pattern of hypodontia.

**RESULTS:** SNA, SNB and ANB reduced 0.3, 0.1 and 0.2 degrees, respectively, for every additional missing tooth; clinical significance was reached when >4, >10 and >5 teeth were missing, respectively. Mandibular to cranial base ratio (MnCB ratio) reduced 0.3 per cent for every additional missing tooth; clinical significance was reached when >10 teeth were missing. MMPA reduced 0.3 degrees for every additional missing tooth; clinical significance was reached when >7 teeth were missing. Percentage LAFH reduced 0.2 per cent for every additional missing tooth; clinical significance was reached when >7 teeth were missing. Jarabak ratio increased 0.2 per cent for each additional missing tooth; clinical significance was reached when >10 teeth were missing. Anterior hypodontia significantly decreased most cephalometric parameters.

**CONCLUSION:** Hypodontia patients demonstrated a tendency towards a Class III skeletal relationship, caused by decreased maxillary and mandibular angular prognathism and MnCB ratio, with greater effect on the maxilla than the mandible.

Clinical significance was only associated with severe hypodontia. Vertically, there was a tendency towards a reduced MMPA and percentage LAFH, again clinically relevant only with severe hypodontia. A pattern of anterior hypodontia had a significant effect on skeletal relationship.

#### 67 ACCEPTANCE OF ELECTRONIC HEADGEAR MONITORING – A QUESTIONNAIRE STUDY

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**AIM:** In orthodontics, therapy outcomes depend to a great extent on patient compliance. Therefore an electronic monitoring headgear device (Smartgear; SG) was developed to accurately gauge headgear (HG) cooperation. The purpose of the study was to evaluate the patient's and parents' acceptance of the SG in daily orthodontic practice and to compare this to a HG-only control group.

**MATERIALS AND METHOD:** In the period from September 2010 to November 2010 two sets of questionnaires were distributed in four randomly selected private orthodontic offices. All patients who had worn either a HG (control) or a SG device (test) for at least 2 months. A total of 37 SG and 56 HG patient-questionnaires as well as 28 SG and 56 HG parent-questionnaires were returned anonymously for evaluation. To determine the significance of differences between two independent groups, confidence interval, including explorative data analysis, and chi square test were applied.

**RESULTS:** With increasing age, the patient's motivation to comply tended to decrease (correlation coefficient 0.34) irrespective of the group. Overall the patient's responsibility for wearing the appliance was estimated high (86%), whereas the parents' (25.15%) and the orthodontist's (25.49%) responsibility was judged by the patients to be low. Patients wearing the SG, tended to shift the responsibility more to the therapist. The parents, however, graded the patient's responsibility as high and that of the orthodontists as low. Neither the patients nor the parents had any objections to monitoring the patient's compliance.

**CONCLUSION:** The acceptance of an electronic monitoring device by patients as well as by parents was very good. The SG tended to have a positive effect on patient cooperation and might therefore reduce overall treatment time by promoting better patient compliance.

#### 68 A COMPARATIVE STUDY BETWEEN IRANIAN AND AMERICAN NORMAL MESH DIAGRAMS

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**AIM:** Mesh analysis enables assessment of craniofacial disharmonies through identification of graphical distortion of the patient's diagram from its average. The purpose of this study was to compare normal mesh diagrams of Iranian adults with those of American white adults.

**MATERIALS AND METHOD:** Lateral cephalograms of 46 students with proportional profiles face and normal occlusion were registered in NHP. A specific normal mesh diagram according to Moorrees was designed using 33 hard and 16 soft tissue landmarks on a coordinate system. The results were compared with the mesh diagrams of American adults using an independent *t*-test.

**RESULTS:** The mean differences between Iranian and American males and females showed significant differences in X or Y for some hard and soft tissue landmarks. The chin and upper lip of Iranian males were more prominent than those of American males ( $P < 0.05$ ). Iranian females have a reduced nasolabial angle, a more prominent nose and steeper mandibular plane than American females ( $P < 0.05$ ).

**CONCLUSION:** A specific mesh diagram should be obtained for each population.

#### 69 EVALUATION OF MAXILLARY MOLAR DISTALIZATION USING A PENDULUM-LIKE APPLIANCE

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**AIM:** In order to treat Class II malocclusions without extractions, a variety of treatment modalities have been suggested for distal movement of maxillary molars. The aim of this study was to investigate the dental and skeletal effects of a pendulum-like appliance containing stainless steel springs.

**SUBJECTS AND METHOD:** Seventeen patients (12 girls, 5 boys) with a bilateral Class II molar relationship and either a normal or horizontal growth pattern (FMA: 25°). The second molars were erupted in all patients. Lateral cephalograms and

study models were obtained before treatment and after achieving a super Class I molar relationship. Wilcoxon signed-rank test was used for statistical analysis.

**RESULTS:** A significant amount of distal movement of the first molars ( $3.38 \pm 1.43$  mm) was observed. However, it was associated with significant distal molar tipping ( $13 \pm 7.02^\circ$ ). Premolar mesial movement of  $1.18 \pm 0.59$  mm, premolar mesial tipping of  $1.56 \pm 1.26$  degrees and incisor labial tipping of  $2.91 \pm 1.67$  degrees indicated that a significant amount of anchorage loss occurred. None of the skeletal changes were statistically significant ( $P < 0.05$ ).

**CONCLUSIONS:** The pendulum-like appliance is an effective method for distalizing maxillary molars. However this distalization is concomitant with significant molar tipping and anchorage loss.

## 70 EFFICACY OF TWO DIFFERENTLY DESIGNED MANDIBULAR ADVANCEMENT DEVICES IN THE TREATMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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**AIM:** To compare the efficacy of two differently designed mandibular advancement devices (MADs) in patients with obstructive sleep apnoea (OSA).

**SUBJECTS AND METHOD:** Forty-five OSA patients were recruited to this randomized crossover trial lasting 3 months per treatment arm plus a 2 week wash-out period. A monobloc and a twin block (TB) MAD were assessed for changes in clinical OSA parameters, sleep-apnoea quality of life index (SAQLI) and daytime sleepiness [Epworth Sleepiness Scale (ESS)]. A questionnaire was completed to assess compliance, side-effects and MAD preference.

**RESULTS:** The apnoea-hypopnoea index (AHI), oxygen desaturation index (ODI) and total arousal index (TAI) was significantly reduced by the monobloc MAD ( $P < 0.001$ ), whereas the reduction with the TB MAD was less pronounced but still statistically significant for AHI ( $P < 0.01$ ) and ODI ( $P < 0.05$ ). The AHI and ODI showed a significant reduction in favour of the monobloc ( $P < 0.05$  and  $P < 0.01$ , respectively) with medium effect size ( $r = 0.3$ ). SAQLI and ESS scores were significantly reduced by both MADs ( $P < 0.01$ ) with no difference between them. Compliance was poorer for the TB with more patients wearing the monobloc regularly (7 nights/week for more than 6 hours; 62% versus 46%) as well as four patients dropping out of the study while wearing the twin block. Most patients reported no side-effects with either MAD, but where they were reported, the profile of the two MADs were similar and rated as mostly mild and occurring rarely or sometimes. Patients felt that snoring and sleep quality had improved with both MADs. The majority of patients preferred the monobloc (60%) to TB (40%) with all monobloc users indicating that they would continue to wear the MAD.

**CONCLUSION:** Objective assessment of OSA clinical parameters showed greater efficacy for the monobloc MAD. Subjective assessment showed similar efficacy to improve patients' quality of life, daytime sleepiness and snoring with a similar prevalence of side-effects,

## 71 TOOTH SIZE SYMMETRY IN CLEFT LIP AND PALATE

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**AIM:** To investigate tooth size symmetry in cleft lip and palate (CLP) patients and to compare it with a control group.

**MATERIALS AND METHOD:** Study casts of 72 individuals with CLP (20 bilateral, 52 unilateral) and 53 individuals with a normal occlusion, both in the permanent dentition stages. Linear measurements of the upper and lower teeth were recorded using a digital calliper. Mesiodistal (MD), labiolingual (LL) and occlusogingival (OG) measurements were carried out by the same investigator. A paired *t*-test was utilized to analyze symmetry between the right and left sides of dental arches in each group.

**RESULTS:** In the unilateral left CLP (ULCLP) group for MD dimensions, the left central incisor, and in the unilateral right CLP (URCLP) group, the right central incisor were smaller than their counterparts, though statistically insignificant. The left lateral tooth was smaller in the ULCLP group, while differences were minimal for the central and lateral incisors in the control group. For LL measurements, the upper laterals and canines showed a statistically significant difference ( $P < 0.05$  to  $P < 0.001$ ) in the control group both in the maxilla and mandible, while it was different only in mandible in the URCLP group ( $P < 0.05$ ). For OG measurements, the lower incisor and first premolars was different in the ULCLP group both in the maxilla and mandible. The control group showed differences in the mandibular second premolar and molar dimensions.

**CONCLUSIONS:** Not only the CLP group but also the control group showed statistically significant differences between the right and left sides with regard to three-dimensional tooth dimensions. ULCLP was the most prominent sub-group of CLP showing differences between the right and left side measurements.

## 72 EFFECTS OF A HAEMOSTATIC AGENT ON THE BOND STRENGTH OF ORTHODONTIC ATTACHMENTS

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**AIM:** One of the most common complications that must be overcome in bonding of orthodontic attachments on unerupted teeth with a surgical intervention is bleeding. The blood flow into the bonding area may make the bonding procedure impossible. Haemostatic agents are widely used for avoiding bleeding around the bonding site. The effect of these agents on bond strength is questionable. The aim of this study was to determine the effect of a new haemostatic agent (Ankaferd Blood Stopper, Ankaferd Drug Inc., Istanbul, Turkey) on the shear bond strength (SBS) and bond failure interfaces *in vitro*.

**MATERIALS AND METHOD:** Fifty-five extracted human premolars randomly divided into five groups. Stainless steel orthodontic brackets (Gemini, 3M-Unitek, USA) were bonded directly with a light-cured composite resin (Transbond XT, 3M-Unitek) after acid etching in group 1. Blood Stopper (ABS) was dropped on to the teeth before acid etching in group 2. The same protocol was performed in group 3 except that the ABS contaminated teeth surfaces were lightly cleaned with wet surgical gauze. In group 4, the brackets were bonded with a self-etching primer (SEP; Clearfill, Kuraray Medical Inc, Japan). ABS was dropped on to the teeth before applying the self-etching primer in the group 5. A universal test machine was used for measurement of SBS.

**RESULTS:** One-way analysis of variance showed there were no statistical differences between the groups except for group 5. Specimens contaminated with haemostatic agent and bonded with the SEP showed significantly lower SBS than the other groups ( $P < 0.05$ ).

**CONCLUSIONS:** ABS can safely be used with acid etching during direct bonding, although SBS was decreased when SEP was used on ABS contaminated enamel surfaces.

## 73 EFFECT OF TOPICAL FLUORIDE ON WHITE SPOT LESIONS IN PATIENTS AFTER FIXED ORTHODONTIC TREATMENT

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**AIM:** Even with advances in materials and techniques in orthodontics, demineralization around brackets during orthodontic treatment continues to be a problem. The aim of this study was to evaluate effect of topical fluoride on reducing of white spot lesion.

**SUBJECTS AND METHOD:** Twenty-four patients (17 females, 7 males) with multiple decalcified enamel lesions after fixed orthodontic therapy, divided equally into a test and control group. The test group were instructed to use a 30 ml neutral 0.05 per cent sodium fluoride rinse twice a day in addition to fluoridated toothpaste. The control group were given the same fluoridated toothpaste as the test group. Photographic records were taken at the first examination and six months later. The white spot lesion area was measured using the AutoCad software program. The affected tooth surfaces were then divided into two groups based on the Gorelick classification (Class I mild demineralization, Class II moderate demineralization). One hundred and fifty five teeth were Class I and 34 Class II in the control group and 143 teeth were Class I and 79 teeth Class II in the test group.

**RESULTS:** Compared with the control group, the test group had significantly more white spot reduction ( $P < 0.001$ ) and the Class II groups had more reduction than the Class I in both the control and test groups ( $P < 0.001$ ). The mean reduction in lesion size was 8 per cent for Class I and 54 per cent for Class II in control group and 67 per cent for Class I and 81 per cent for Class II in the test group.

**CONCLUSION:** The use of the topical fluoride was beneficial in the reduction of white spot lesions.

## 74 EFFECTS OF PROTRACTION THERAPY WITH ACTIVE VERTICAL PROTRACTION APPLIANCE IN HIGH ANGLE CLASS III PATIENTS

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**AIM:** To analyze in a randomised controlled study the craniofacial and dentoalveolar effects of an Akkaya vertical protraction appliance (AVPA) during orthopaedic treatment of skeletal Class III patients characterized by maxillary deficiency.

**SUBJECTS AND METHOD:** Thirty-three high angle (SN/GoGn angle  $>38^\circ$ ) skeletal Class III patients (15 females, 18 males). Twenty of these patients (8 females, 12 males) were randomly selected as the treatment group (mean chronological



age  $9.75 \pm 1.6$  years; mean SN/GoGn angle  $40.60 \pm 1.8^\circ$ ) and the remaining 13 (7 females, 6 males) formed the control group (mean chronological age  $9.33 \pm 1.4$  years; mean SN/GoGn angle  $41.30 \pm 2.5^\circ$ ). Standardized records, including lateral and hand-wrist radiographs were obtained at the start and end of treatment and at the control periods. The average duration of treatment and the control periods was 11 and 9 months, respectively. Nineteen angular and 27 dimensional parameters were analyzed on hand-traced radiographs. Fifteen radiographs were re-evaluated for method error. Inter- and intragroup differences were analyzed with independent and paired samples *t*-tests.

**RESULTS:** Intermaxillary skeletal measurements showed significant forward movement of the maxilla without any rotational side-effects and with a significant anterior rotation of the mandible as compared with the control group. No statistically significant difference was observed in the palatal plane angle. Gonial and mandibular plane angles decreased significantly as a result of vertical force application. A significant increase of overjet and an improvement of molar relationship were also recorded in the treatment group. Significant maxillary incisor proclination and mandibular molar intrusion were determined as dentoalveolar effects. Significant soft tissue changes were also recorded as a reflection of skeletal improvement.

**CONCLUSION:** AVPA is an innovative treatment modality that provides an option for the clinician to implement sagittal and vertical forces simultaneously in skeletal Class III treatment. Future studies with comparisons with conventional facemask therapy and long-term follow-up studies are needed to efficiently evaluate the treatment effects.

## 75 CRANIOFACIAL GROWTH IN UNTREATED SKELETAL CLASS III SUBJECTS: A SEMI-LONGITUDINAL STUDY

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**AIM:** To analyze craniofacial growth changes in untreated skeletal Class III subjects characterized by maxillary deficiency in the pre-pubertal growth period.

**SUBJECTS AND METHOD:** Twenty-eight untreated skeletal Class III subjects (14 females, 14 males; mean age  $9.6 \pm 1.1$  years). Semi-longitudinal records, including lateral and hand-wrist radiographs were obtained at the start and end (mean  $0.75 \pm 0.2$  years) of the control periods. Nineteen angular and 27 dimensional parameters were analyzed on hand-traced radiographs. Fifteen radiographs were re-evaluated for method error. Intragroup differences were analyzed with paired sample *t*-tests. For further evaluation two subgroups were formed: an optimum angle group (mean  $34.03^\circ$ ) of 15 subjects (8 females, 7 males; mean age  $9.83 \pm 1.58$  years) and a high angle group (mean  $41.30^\circ$ ) of 13 subjects (6 females, 7 males; mean age  $9.33 \pm 1.92$  years) and compared with independent sample *t*-tests.

**RESULTS:** Intragroup angular evaluations revealed a statistically significant increase in SNB angle ( $+0.339$  mm, SD  $\pm 0.871$ ). No significant difference was recorded in SNA angle. Mandibular skeletal dimensions ( $+0.051$  mm, SD  $\pm 1.013$ ), posterior ( $+0.082$  mm, SD  $\pm 0.964$ ) and anterior ( $+0.067$  mm, SD  $\pm 0.935$ ) face heights increased significantly. Intergroup comparisons revealed a slight increase in gonial angle ( $+0.26^\circ$ , SD  $\pm 0.90$ ) in the high angle group whereas a slight decrease ( $-0.50^\circ$ , SD  $\pm 1.25$ ) was determined in the optimal angle group. In the optimal angle group a more significant amount of lower molar mesialization ( $+1.40$  mm, SD  $\pm 1.46$ ) and lower incisor proclination ( $+1.16^\circ$ , SD  $\pm 1.06$ ) were observed when compared with the high angle group.

**CONCLUSION:** The findings of this study highlight the importance of early treatment in high angle skeletal Class III patients.

## 76 *IN VITRO* COMPARISON OF SHEAR BOND STRENGTHS OF BRACKETS AFTER DIFFERENT ETCHING METHODS

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**AIM:** To compare the shear bond strengths (SBS) of brackets bonded to enamel surface after etching with phosphoric acid, or self-etching primer (SEP) and three different energy levels of two different erbium lasers.

**MATERIALS AND METHOD:** Two hundred human first premolars, extracted for orthodontic purposes were randomly divided into eight equal groups. After etching using the different procedures, stainless steel edgewise premolar brackets were bonded to the enamel surfaces with a light cured composite resin and shear force was applied with a universal testing machine. SBS were measured in MPa and the enamel surfaces were examined under a stereomicroscope. Descriptive data, including the mean SBS and standard deviations, were compared with one-way ANOVA. Multiple comparisons between the groups were made with Tukey HSD test. A chi square test was used for comparison of the adhesive remnant index (ARI) scores. One tooth from each group that had not undergone shear testing was used for Scanning electron microscopic examination.



**RESULTS:** Statistical comparisons of the mean SBS and standard deviations, showed non-significant differences between the phosphoric acid, SEP, 70 mJ and 90 mJ-20 Hz Er:YAG laser groups. The SBS for all groups were significantly lower than those of the phosphoric acid and SEP groups. ARI scores indicated that the failure site was mainly at the enamel-bracket interface for all laser groups. The failure sites in the phosphoric acid or SEP specimens occurred within the adhesive. For the phosphoric acid and SEP applications, generally less adhesive was left on the enamel surface for all energy levels of erbium laser applications. SEM examination showed irregular surfaces with microcracks in the laser treated groups, while the phosphoric acid and SEP groups showed more regular and homogenous surface characteristics.

#### 77 ASSESSMENT OF UPPER AIRWAY SIZE OF MAXILLARY PROTRUSION AND MANDIBULAR RETRUSION PATIENTS AFTER ORTHOPAEDIC TREATMENT

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**AIM:** To retrospectively determine whether different Class II treatments affect airway size in patients with maxillary protrusion or mandibular retrusion.

**SUBJECTS AND METHOD:** Thirty-eight Class II patients treated either with cervical headgear or a functional appliance (bionator) whose upper airway sizes were not statistically different at the start of treatment but whose sagittal skeletal jaw relationships revealed maxillary protrusion or mandibular retrusion. Twenty patients with a Class I skeletal relationship were chosen as the control group. Lateral cephalograms at the start (T1) and end (T2) of orthopaedic treatment were assessed. Intragroup comparisons were performed using a paired samples *t*-test, and intergroup comparison of the skeletal features and upper airways using one-way ANOVA, with Tukey's test as a second step, at  $P < 0.05$ .

**RESULTS:** ANB changed significantly in the treated groups. Middle airway space, SNB, Co-A and Co-Gn were significantly increased after bionator therapy ( $P < 0.05$ ). SNB and SN-1 angles were found to be different in the mandibular retrusion group when compared with both the maxillary protrusion and control groups. No statistically significant difference between the maxillary protrusion and mandibular retrusion groups was found regarding upper airway sizes after cervical headgear or bionator treatment ( $P > 0.05$ ).

**CONCLUSION:** Upper airway sizes are similar in Class II patients with different sagittal skeletal jaw relationships after cervical headgear or bionator treatment. Orthopaedic treatment did not result in changes in the upper airway either treatment types.

#### 78 EXPERIENCES OF MOTHERS OF CLEFT LIP AND PALATE BABIES TREATED WITH NASOALVEOLAR MOULDING

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**AIM:** To identify difficulties resulting from nasoalveolar moulding (NAM) appliances and the mothers' awareness related to treatment effects.

**MATERIALS AND METHOD:** A questionnaire completed by mothers (mean age:  $27.6 \pm 5.15$  years) of 40 babies with a cleft lip-palate (CLP; 26 unilateral, 14 bilateral) after NAM treatment. The questions were prepared with the aid of the Department of Psychiatry.

**RESULTS:** The mothers of 25 babies with CLP (14 unilateral, 11 bilateral) had difficulties with the appliances during correction of the nose (63%) whereas mothers of four babies had difficulties during correction of the palate (10%). The mothers of 11 babies with CLP reported no difficulties at either stage (28%). Thirty-two mothers reported that their babies were uncomfortable on the first day of the application but they quickly adapted to the appliances. Irritation of the cheeks due to the tapes was reported as another problem. Thirty-eight mothers were aware of the correction in the lip/palate/nose (95%).

**CONCLUSIONS:** The difficulties resulting from the appliances did not constitute an obstacle for the treatment of babies with CLP. The majority of mothers could observe the positive effects of NAM treatment for their babies.

#### 79 PRECISION IN CEPHALOMETRIC MEASUREMENTS: COMPARISON OF CONE BEAM COMPUTED TOMOGRAPHY AND DIRECT DIGITAL LATERAL CEPHALOGRAMS

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AIM: To determine whether cone beam computed tomography lateral cephalograms (CBCT-LC) are of equal precision in diagnosis and treatment planning as direct digital lateral cephalograms (DD-LC).

SUBJECTS AND METHOD: The records of 10 patients were randomly selected. Using InVivo5 Dental software (Anatomage, San Jose, California, USA), CBCT data of each patient was imported and the head position was reorientated digitally, then CBCT-reconstructed lateral cephalograms of the same patients were generated. A total of 20 simultaneously recorded lateral cephalograms (10 DD-LC, 10 CBCT-LC) were analyzed. Twenty six parameters (25 angular and 1 ratio) were traced on each cephalogram, and measured twice with an interval of 2 weeks by one examiner using the Viewbox® 3.1.1.13 cephalometric software (Halazonetis, Athens, Greece). A paired samples *t*-test was used to compare the mean values of differences and intraclass correlation coefficients (ICC) were calculated to determine intra-examiner and inter-group correlations.

RESULTS: Intra-examiner reproducibility for all measurements was not significantly different between the cephalogram types. Correlation coefficients were found to be high (ICC ranged from 0.862 to 0.999,  $P < 0.001$ ). The differences in measurements obtained from CBCT-LC and their DD-LC counterparts were statistically significant for seven angular variables. The differences were less than 2 degrees, which is generally within one standard deviation of normal values in conventional cephalometric analysis. The measurements related to the area around the point A were the least precise.

CONCLUSIONS: Precision was similar for both image types. The measurement differences between image types were statistically significant. The findings substantiate the benefits of CBCT cephalometry in terms of the reliability of two-dimensional cephalometric analysis.

## 80 PREVALENCE OF OPPORTUNISTIC MICROORGANISMS ASSOCIATED WITH RETAINERS

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AIM: To determine the prevalence and proportions of opportunistic pathogens harboured on orthodontic retainers.

MATERIALS AND METHOD: Firstly, *Staphylococcus spp.* and *Candida spp.* were isolated by routine bacterial culture from orthodontic retainers in comparison to their prevalence in the other areas of the mouth and in comparison with their prevalence in non-retainer wearers. Swabs were taken from the inner surface of the retainers and other mucosal surfaces of the mouth. Secondly, retainers manufactured from different materials were sampled and the microbial populations determined.

RESULTS: *Staphylococcus spp.* were isolated from 50 per cent of the retainers, including MRSA, and comprised, on average, 8.4 per cent of the microbiota. *Candida spp.* comprised 0.13 per cent of the population and were isolated from 66.7 per cent of the retainers. Neither genus was identified from non-retainer wearers. However, there were no statistical differences observed between the two tested retainers.

CONCLUSIONS: Opportunistic microorganisms could be detected from retainers; however, there were no differences between the types of appliance used. It is possible that an orthodontic retainer could be a reservoir for opportunistic pathogens and act as a source of cross infection.

## 81 EFFECT OF POLISHING THE FITTING SURFACE OF REMOVABLE ORTHODONTIC APPLIANCE MATERIALS ON BIOFILM FORMATION. AN *IN VITRO* STUDY

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AIMS: To assess the effects of different retainer materials and their surface properties on biofilm growth and whether surface modification has an impact on bacterial accumulation.

MATERIALS AND METHOD: Two commonly used retainer materials: heat and cold cured acrylic were investigated with regard to their surface characteristics including the surface roughness, hydrophobicity and surface free energy. These physico-chemical properties involved in biofilm formation were studied through laboratory based investigations on modified surfaces aiming to identify the most suitable surface, from a clinical point of view, that discourage biofilm formation.

RESULTS: The nature of the substrata had no marked effect on the attachment and the colonisation of the bacteria, however, scanning electron microscopy analysis showed that the microorganisms were still visible in rougher areas of the material after vortexing the discs to remove them.

CONCLUSIONS: Polishing the surface may not reduce bacterial colonisation but may be of importance in terms of cleaning the appliance and maintaining good oral hygiene.

82      AGENESIS OF THE MANDIBULAR THIRD MOLAR IS ASSOCIATED WITH DELAYED MATURATION OF THE MANDIBULAR SECOND MOLAR

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AIM: To test the hypothesis that delayed maturation of the mandibular first (M1) and second (M2) molars, respectively, is associated with agenesis of the mandibular third molar (M3).

SUBJECTS AND METHOD: The experimental group consisted of nine girls with isolated agenesis of M3. The control group comprised 11 girls with development of all 32 permanent teeth. All subjects were of Danish Caucasian descent and were followed longitudinally from early childhood to adult age with dental pantomograms (DPTs). The number of DPTs per subject ranged from 6 to 19, except in for one subject with only two. The total number of radiographs was 208. Development of the mandibular molars was assessed using the method of Haavikko. The error of the method was examined from duplicate assessments 3 months apart. Differences between the mean maturation, in terms of dental stage and rate of development, of M1 and M2, respectively, between the two groups were determined using a *t*-test. The level of significance was set at 5 per cent.

RESULTS: For M1, the timing and rate of root maturation was fairly similar in the two groups. For M2, the mean rate of maturation of the crown and root was not significantly different between the groups. However, the mean ages at all maturation stages studied were consistently delayed in the experimental group by about 1 year. The difference between the means in the two groups was only statistically significant for stage R1/4, probably due to the small sample size, but the hypothesis could not be rejected.

CONCLUSION: Subjects with agenesis of M3 showed normal timing and rate of root development of M1. However, based on the present pilot study, it would seem that the initiation of the development of M2 is somewhat delayed in subjects with agenesis of M3, whereas the rate of M2 development is normal.

83      SUCCESS RATE OF THREE DIFFERENT TYPES OF TEMPORARY ANCHORAGE DEVICES

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AIM: The use of temporary anchorage devices (TADs) has become common in daily orthodontic practice to treat challenging cases which otherwise would be extremely difficult or impossible to treat. The aim of this study was to determine the success rate of TADs.

SUBJECTS AND METHOD: One hundred and five orthodontic patients who received one or more TADs as a part of their treatment. The cases date from May 2005 to July 2010. The total number of TADs inserted was 267 including replacements for those that failed. Three types of TADs were used: Leone (1.5 mm wide, 10 mm long), Lancer (1.2 mm wide, 9 mm long) and Forestadent (1.3 mm wide, 10 mm long). The TADs were checked every two weeks for mobility, position, tenderness or visible swelling over a period of six months. The patients were asked to return to the clinic as soon as possible if the TADs became loose.

RESULTS: The success rate for the TADs was highest for Leone TADs (91%), while Lancer TADs survived in 78 per cent and Forestadent TADs in 87 per cent. Late mobility, shifting in position and tenderness to pressure was more commonly found for Lancer TADs followed by Forestadent and least for Leone TADs.

CONCLUSIONS: Wider TADs give a higher success rate.

84      SHEAR BOND STRENGTHS OF ORTHODONTIC BRACKETS BONDED WITH AN ORMOCER ADHESIVE

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AIM: To test the shear bond strengths (SBS) of orthodontic brackets bonded with a newOrmocer adhesive (Admira).

MATERIALS AND METHOD: Twenty-four human premolars, extracted for orthodontic reasons, randomly divided into two equal groups. The teeth were polished with pumice and all were washed and dried. In group I; the teeth were prepared with 37 per cent phosphoric acid and Transbond XT bonding agent (3M Unitek). Transbond XT adhesive paste (3M Unitek) was then applied to the bracket base and placed on the tooth. In group II, anOrmocer bonding system (Admira, Voco) was used. The teeth were prepared with 37 per cent phosphoric acid. After applying bonding agent of Admira on the teeth, Admira adhesive paste was applied to the bracket base and placed on the teeth. All brackets (Ormco) cured with a light emitting diode (Adonis) for 20 seconds. All samples were thermocycled (500 cycles, 5°C-55°C) and tested with universal testing machine. SBS values, adhesive remnant index (ARI) scores and scanning electron microscopy images were obtained

from all samples. An independent samples *t*- and chi-square tests were used to statistically analyze SBS values and ARI scores.

RESULTS: There were no significant differences between SBS values and ARI scores in either group ( $P > 0.05$ ). The mean SBS of group I (Transbond XT) was  $20.88 \pm 4.90$  MPa and  $19.42 \pm 4.63$  MPa for group II (Admira).

CONCLUSION: Materials that are used in operative dentistry can also have potential for use in orthodontic applications. One of them,Ormocer, can be used safely in orthodontic practice. This material is also more biocompatible and has a lower wear rate than the conventional orthodontic adhesives.

#### 85 USE OF A SINGLE-COMPONENT, SELF-ETCHING, FLUORIDE-RELEASING BONDING AGENT FOR ORTHODONTIC BONDING: 7TH-GENERATION

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AIM: To test the efficiency of a single-component self-etching bonding agent in orthodontic bonding.

MATERIALS AND METHOD: Twenty-four premolars, extracted for orthodontic reasons, randomly divided into two equal groups. In group I (control), the teeth were prepared with 37 per cent phosphoric acid and Transbond XT (3M Unitek) bonding agent. In group II (test), Bond Force (Tokuyama, Osaka, Japan), a single-component, self-etching, fluoride releasing bonding agent was used. All brackets (Ormco) were bonded with Transbond XT (3M Unitek) and cured with a light emitting diode (Adonis) for 20 seconds. All samples were thermocycled (500 cycles, 5°C-55°C) and tested with a universal testing machine. Shear bond strengths (SBS), adhesive remnant index (ARI) values and scanning electron microscope images were obtained for all samples. Independent samples *t*- and chi-square tests were used to statistically analyze SBS values and ARI scores.

RESULTS: Group I had statistically higher SBS ( $20.88 \pm 4.98$  MPa) than group II ( $17.23 \pm 3.66$ ) ( $P < 0.001$ ). There were no significant differences in the ARI scores for either group ( $P > 0.05$ ).

CONCLUSIONS: Although the SBS of the new generation single-component, self-etching, fluoride-releasing bonding agent were relatively low compared with traditional adhesives, it can be safely used in orthodontic practice.

#### 86 TEMPOROMANDIBULAR JOINT DISORDERS IN SKELETAL CLASS II SUBJECTS

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AIM: To assess the prevalence of signs and symptoms of temporomandibular disorders (TMD) in a group of skeletal Class II subjects seeking orthodontic treatment; and to establish the relevant skeletal pattern in Class II subjects with TMD.

SUBJECTS AND METHOD: Twenty-seven Class II (ANB  $>4$  degrees) subjects with malocclusions, selected using the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN: 3). Signs and symptoms of TMD were evaluated according to Helkimo's Anamnestic and Dysfunction Index [clinical examination of the temporomandibular joint (TMJ)], mandibular mobility, TMJ function, muscular or TMJ pain). Lateral cephalometry was used to establish the skeletal pattern. An experimental group of seven subjects with positive TMD signs and symptoms (mean age  $24.2 \pm 5.34$  years) and a control group of 20 subjects, with no signs of TMD (mean age  $26.00 \pm 7.53$  years) were evaluated. Lateral cephalometric tracings were analyzed: Parametric Student's tests with equal or unequal variations were used (variations were previously tested with Levene test).

RESULTS: A higher saddle angle (N-S-Ar angle) was noted in the experimental group when compared with the control group: mean SNB angle was decreased in the experimental group compared with the controls; mean interincisal angle was 16.23 degrees higher in the experimental group compared with the controls ( $P < 0.05$ ); overjet was larger in the experimental group than in the control group; a major midline shift was found in the experimental group when compared with the control group; overbite was decreased in the experimental group compared with the control.

CONCLUSION: A midline shift, larger overjet and overbite are factors to consider when examining Class II patients referred for orthodontic treatment, as they represent a risk factor for TMD.

#### 87 COMPARISON OF SIX CONE BEAM COMPUTED TOMOGRAPHY SYSTEMS FOR IMAGE QUALITY DETECTION OF SIMULATED CANINE IMPACTION

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AIM: To compare the subjective image quality and radiographic diagnostic accuracy for detection of simulated canine-induced external root resorption lesions in maxillary lateral incisors between six different cone beam computed tomography (CBCT) systems *in vitro*.

MATERIALS AND METHOD: A child's cadaver skull in the early mixed dentition. This skull had an impacted maxillary left canine and allowed reliable simulation. Simulated root resorption cavities were created in eight extracted maxillary left lateral incisors. Cavities of varying depths were drilled in the middle or apical thirds of each tooth root according to three set-ups: slight (0.15, 0.20, and 0.30 mm), moderate (0.60 and 1.00 mm), and severe (1.50, 2.00, and 3.00 mm). The lateral incisors, including two intact teeth, were repositioned individually in the alveolus with approximal contacts with the impacted maxillary left canine. Six sets of radiographic images were obtained with 3D Accuitomo-XYZ Slice View Tomograph, Scanora 3D CBCT, Galileos 3D, Picasso Trio, Kodak 9000 3D, and ProMax 3D for each tooth set-up. The CBCT images were acquired and subsequently analyzed by 12 observers. Linear models for repeated measures were used to compare between CBCT systems the image quality and the degree of agreement between the diagnosed severity and the true severity. RESULTS: The differences in the image quality were statistically significant ( $p < 0.001$ ). The results of the presence of root resorption scores reveal a significantly higher score for Promax when compared with Galileos and Kodak. However, the differences in the agreement between the diagnosed severity of the resorption and the true severity for all resorption sizes were not found significantly different ( $P > 0.05$ ) among the different CBCT systems.

CONCLUSIONS: High image quality is important when detecting root resorption. The CBCT systems presented high accuracy and validity with no significant difference between CBCT systems in the detection of root resorption.

## 88 COMPARISON OF PULL-OUT STRENGTH, STRESS GENERATION, AND STRESS DISTRIBUTION AROUND FOUR DIFFERENT ORTHODONTIC MINI-IMPLANT SYSTEMS

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AIMS: To investigate the effect of the intraosseous design on pull-out strength and stress distribution of four orthodontic mini-implant systems in artificial bone.

MATERIALS AND METHOD: Four brands of orthodontic mini-implants (Dual-Top JA, Korea/DT; AbsoAnchor, Korea/AA; Spider Screws K1, Italy/SK and Vector-Tas, USA/VT) of same length (8 mm) and nearly the same width (1.4 mm). The geometric features of the intraosseous part of the implants were measured using an optical microscopy ( $n = 3$ ). A pull-out strength test was performed using artificial bone blocks (20 PFS, Sawbones, Sweden) as substrate and the peak axial tensile strength was determined at a crosshead speed of 1 mm/minute in a universal testing machine ( $n = 6$ ). The stress patterns induced by the implants were assessed by transmission photoelasticity under two insertion modes (with/without individual pilot hole drilling) and two loading conditions (before/after loading with a force of 200 g, vertically to the implant axis applied by NiTi coil springs).

RESULTS: AA showed the highest intraosseous surface area (51.4 mm<sup>2</sup>) followed by SK (43.6 mm<sup>2</sup>), DT (39.3 mm<sup>2</sup>) and VT (37.6 mm<sup>2</sup>). Pull-out strength results were (N, same letters imply no statistically significant differences): AA: 138.6 (3.8) a, DT: 133.9 (5.3) a, SK: 123.4 (0.9) and VT: 117.4 (2.7). A positive correlation was found between pull-out strength and surface area ( $r = 0.63$ ,  $P < 0.01$ ). Without pre-drilling the ranking of the unloaded implants in decreasing stress order were: SK>AA>VT>DT, with some differences in stress location related to implant geometry. Drilling induced some residual stresses in AA and SK. However, after implant insertion stress concentration was reduced in the systems supported by individual drills (SK>AA>DT), all being lower than VT (no drill specified). Loading increased installation stresses in both insertion modes, especially at the cervical region (first and second thread), mesially to the loading direction.

CONCLUSION: The design of the intraosseous part of the orthodontic implants tested affects the pull-out strength and the stress distribution in the supportive hard tissue.

## 89 ZYGOMATIC SKELETAL ANCHORAGE WITH MINI-PLATES AND MINISCREW ANCHORAGE DURING MAXILLARY CANINE RETRACTION

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AIM: To compare the indirect anchorage provided by miniplates and miniscrews during canine retraction.

SUBJECTS AND METHOD: Twenty patients whose malocclusions required extraction of upper premolars, and maximum anchorage. Miniplates were used in one side of the arch and miniscrews in the other side and anchorage loss was compared.



The canines were retracted on a  $0.016 \times 0.022$  inch stainless steel archwire, a force of 150 g were applied between the molar and the canine on each side. Two sets of records were taken; before canine retraction and when canine retraction was completed. Evaluation was undertaken of dental cast models, lateral cephalometric radiographs, submental radiographs, three-dimensional computed tomographic scan, patient's tolerance of miniplates and miniscrews, the success rates of miniplates and miniscrews and any complications during canine retraction.

**RESULTS:** Significant differences were found in anchorage loss between the miniscrew and miniplate group, Mesialization of the maxillary molar in the miniplate group was (0.07 mm) less than that in the miniscrew group (0.39 mm). *En masse* retraction was observed in all patients, Tolerance of the miniplates and microscrews was the same. The success rate was 95 per cent for the miniplates and 85 per cent for the miniscrews during the period of canine retraction.

**CONCLUSIONS:** Use of miniplates is more effective than miniscrews and offer safe and effective anchorage possibilities with a high success rate with few side effects or problems during treatment, and they are well accepted by patients.

## 90 GENETIC AND BIOCHEMICAL INTERACTION IN NON-SYNDROMIC CLEFT LIP AND PALATE

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**AIM:** It has been observed that non-syndromic oral clefting could be caused by several genes at varied frequencies within different populations. However; besides genetics, biochemical blood levels are also essential in the occurrence of the clefts. The aim of this research was to investigate if there is a specific pathogenic mutation of the MSX1-variants, which is one of the most important genes responsible of clefting, in the Turkish population. Additionally, associations between oral-clefts and biochemical measures of vitamins B6 and B12 and homocysteine were assessed.

**SUBJECTS AND METHOD:** Seventy individuals with any type of cleft lip and palate; and 89 non-cleft patients as controls were genetically studied. DNA was isolated from peripheral blood and a total of four variant sites of MSX1-gene were identified: MSX1-G267C, MSX1-2F, MSX1-SNP4 and MSX1-SNP5. For the vitamin-homocysteine study, 37 infants with a non-syndromic cleft lip with/without a cleft palate were evaluated. Homocysteine, B6 and B12 concentrations in blood were analyzed.

**RESULTS:** Heterozygous and/or homozygous characteristics of the gene sites were proven to be a risk factor for the occurrence of a cleft lip and palate (CLP). For MSX1-SNP4, 44 individuals had heterozygous and 26 homozygous characteristics, while one patient was normal. A similar case was recorded for the MSX1-SNP5 site (54 heterozygous, 17 normal cleft individuals). Nine subjects in the control group had a heterozygous basis for both gene sites. Ten infants had B12 values close to the lower border of the normal range.

**CONCLUSION:** MSX1-SNP4 and MSX1-SNP5 mutations were found pathogenic for the occurrence of a CLP in this population. B6 and B12 levels were within the normal range in most infants. A slight lack in B12 in conjunction with an increase in homocysteine could be considered as a risk factor for orofacial clefts. As an increase in group B vitamins has proven to cause a decrease in the homocysteine level, females who are considering pregnancy should be informed about vitamin supplements and a well-balanced diet.

## 91 RELATIONSHIP BETWEEN PALATAL SHAPE AND CRANIOFACIAL MORPHOLOGY

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**AIM:** To demonstrate the relationship between the shape of palate and craniofacial morphology using three-dimensional (3D) reverse engineering technology.

**MATERIALS AND METHOD:** Maxillary dental casts obtained from patients referred for orthodontic treatment. Based on ANB angle, they were classified as skeletal Class I ( $0^\circ < \text{ANB} < 4^\circ$ ), skeletal Class II ( $\text{ANB} > 4^\circ$ ), and skeletal Class III ( $\text{ANB} < 0^\circ$ ). Each group had 30 subjects. Dental casts were scanned with an Orapix 3D scanner (Orapix Co Ltd, Seoul, Korea) and 3D models of the dental casts were reconstructed. To quantify the shape of the palate, palatal width, depth, length, volume and the ratio of volume/length, the ratio of volume/width were measured using a 3D reverse modelling software program (Rapidform XOR3, Inus Technology Inc., Seoul, Korea). Analysis of variance and Bonferroni test were used to determine whether significant differences existed among the groups.

**RESULTS:** Palatal depth, width and volume at the level of marginal gingiva were not significantly different among the groups. However, palatal width at the level of the basal bone in skeletal Class II group was significantly smaller than in the

skeletal Class I group ( $P < 0.05$ ). Palatal length and volume at the level of basal bone in skeletal Class III group were smaller than those in the skeletal Class I and II groups ( $P < 0.05$ ). The ratio of volume/length at the level of the basal bone was significantly smaller in the skeletal Class II and III groups than in the skeletal Class I group ( $P < 0.05$ ).

CONCLUSIONS: Patients with a skeletal Class II or III malocclusion tend to have a more constricted palate at the level of the basal bone than those with a skeletal Class I.

## 92 CRANIOFACIAL CHARACTERISTICS OF A GALICIAN ADULT POPULATION WITH A SKELETAL CLASS III MALOCCLUSION

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AIM: To investigate the morphologic characteristics of the craniofacial complex of Galician adult subjects with a Class III malocclusion.

MATERIALS AND METHOD: Lateral cephalometric radiographs of 22 patients with a Class III malocclusion (10 males, 12 females; aged 18 to 32 years) were analyzed and compared with a Class I control group.

RESULTS: Maxillary length was normal, and the maxilla was more posteriorly positioned in the Class III subjects. The mandible was within the neutral range of protrusion, and there was an increase in total mandibular length in the Class III patients. Dental aberrations in Class III malocclusion subjects were manifested essentially by a proclined maxillary incisor and a retroclined mandibular incisor

CONCLUSION: The Class III malocclusion group exhibited distinct craniofacial morphologic characteristics that were manifested in a combination of alterations in angular and linear measurements.

## 93 PHARMACOLOGICAL MANAGEMENT OF PAIN DURING ORTHODONTIC TREATMENT: A META-ANALYSIS

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AIM: To evaluate the effectiveness of non-steroidal anti-inflammatory drugs (NSAIDs) in managing pain during orthodontic treatment.

MATERIALS AND METHOD: One thousand one hundred and twenty seven studies were identified through PubMed, Cochrane Library and Google Scholar database searches. Twenty-four satisfied the inclusion criteria but only seven, all randomized controlled trials using ibuprofen or acetaminophen, had results that could be used for meta-analysis. Treatment effects (Hedges' g using random effects model) and 95 per cent confidence intervals (CI) of the pain visual analogue scores were evaluated between the treatment and control groups at 2, 6 and 24 hours after intervention, and during chewing and biting activities.

RESULTS: The pain level at 2 hours differed between the ibuprofen and placebo groups during biting (95% CI: -0.178 to -0.046) but not during chewing (95% CI: -0.551 to 0.148). At 6 hours, the ibuprofen group exhibited lower pain levels during both activities (chewing 95% CI: -0.640 to -0.123, biting 95% CI: -0.857 to -0.172). At 24 hours, no significant difference could be detected between ibuprofen and placebo (chewing 95% CI: -0.642 to 0.112, biting 95% CI: -0.836 to 0.048). No statistically significant difference could be found between ibuprofen and acetaminophen at any time point.

CONCLUSION: Ibuprofen appears to lower orthodontic pain compared with a placebo at 2 and 6 hours after separators or archwire placement, but not at 24 hours, when pain peaks.

## 94 SOFT TISSUE PROFILES IN SUBJECTS WITH CLASS I AND CLASS II DIVISION 1 MALOCCLUSIONS

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AIM: To determine the difference in thickness of the soft tissue in subjects with Class II division 1 and Class I by means of horizontal linear variables on laterolateral radiographs, and to determine differences regarding gender.

SUBJECTS AND METHOD: Fifty-six laterolateral radiographs of subjects aged 12 years. The subjects were divided into two groups. Group 1 consisted of 30 subjects who were dental and skeletal Class I (16 boys, 14 girls) and group 2 subjects with a Class II division 1 malocclusion (11 boys, 15 girls). By joining each landmark on the soft tissues with the appropriate landmark on the hard tissues five horizontal lines were obtained.

**RESULTS:** The soft tissues measured at landmark A were thicker in group 1 in relation to group 2 ( $P = 0.018$ ;  $t = 2.44$ ). In the boys in group 1 the soft tissue thickness of landmark A was thicker in relation to the girls, and the soft tissue thickness between the genders in group 2 showed differences in the thickness of the lower lip, which was thicker in boys. Analysis of the soft tissue thickness in boys in groups 1 and 2 showed that the soft tissue at landmark A was thicker in boys in group 1. Analysis of the soft tissue thickness between girls in groups 1 and 2 showed statistically significant differences in the area of landmark, Ls, which means that the upper lip showed greater thickness in the girls in group 1 in relation to the girls in group 2.

**CONCLUSIONS:** A greater thickness of the soft tissue at landmarks A and Ls was found in subjects with a Class I occlusion ( $P < 0.05$ ).

## 95 ROOT RESORPTION ON ENDODONTICALLY TREATED TEETH SUBMITTED TO ORTHODONTIC MOVEMENT

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**AIM:** To review the literature as to whether endodontically treated teeth submitted to orthodontic movement present root resorption.

**MATERIALS AND METHOD:** Relevant articles describing studies on animals and humans with a sample of more than two endodontically treated teeth were searched in PubMed, Embase and the Cochrane database. Studies published from 1950 to December 2010 were included. All types of articles were considered except letters, case reports and bibliographic reviews. The reference lists of the retrieved articles were hand assessed. Nine studies on humans and six on animals fulfilled the criteria.

**RESULTS:** Studies on humans: adequate data were found for 76 patients (39 males, 37 females) with total number of 136 endodontically treated teeth. The Begg technique presented root resorption in 4 out of 5 endodontically treated teeth studied. In all other cases the vital teeth presented more root resorption than endodontically treated teeth. There were no grounds for adequate analysis of the effect of treatment duration on root resorption as the reported root resorption in all studies was cumulative. The results from animal studies were quite variable depending on the species used. Three ferrets, four primates (rhesus monkeys), one study on Beagle dogs, 50 Wistar rats and six cats. All of the studies showed extensive root resorption, however the level of force/root surface applied was excessive therefore they should be applied on humans with caution.

**CONCLUSIONS:** Endodontically treated teeth move as readily as vital teeth. There is no difference in the frequency, appearance or extent of root resorption in non-vital teeth. Further research is necessary to elucidate the role of endodontic treatment in the root resorption. The conclusions from studies on animal models should be carefully evaluated

## 96 EFFECT OF MALOCCLUSION ON CHEWING EFFICIENCY

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**AIM:** To establish the masticatory efficiency in patients with different types of malocclusion.

**SUBJECTS AND METHOD:** Sixty-two adult subjects (32 males, 30 females) mean age 23.8 years. Twenty-seven subjects presented an Angle Class II malocclusion. Patients with missing teeth, syndromes, or any process that could impede normal function were excluded. The masticatory ability of all subjects was evaluated with a two colour chewing gum test. The patients were asked to chew on gum consisting of two chewing gum foils of different colour on each side. The thickness of the gum was 2 mm. It was chewed for 10 cycles and then discarded into a plastic bag. The spat gum was flattened to a 1 mm thickness wafer, scanned and evaluated with specialized software that computes the percentage of mix of the two colours. The second test was to chew a hazelnut and to evaluate how many masticatory cycles were needed to adequately fragment it.

**RESULTS:** The preferred chewing side was on the right. No significant differences in chewing efficiency between genders were found. A significant difference was found in the chewing efficiency of Class I subjects and those with a malocclusion ( $P = 0.036$ ). Class I subjects presented a higher degree of chewing gum mix. A statistically significant correlation was found between the number of masticatory cycles for the hazelnut and masticatory efficiency evaluated by the colour mixture of the chewing gum ( $P = 0.004$ ).

**CONCLUSIONS:** Subjects with a normal occlusion have better masticatory efficiency than subjects with a malocclusion. A Class II malocclusion seems to negatively affect masticatory efficiency. Efficiency reflects on the number of masticatory cycles necessary to break down the food for the formation of a bolus.

97 POST-TREATMENT CHANGES FOLLOWING THE USE OF ACTIVATORS IN CLASS II MALOCCLUSION CHILDREN IN RELATION TO BITE FORCE

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AIM: To investigate the value of pre-treatment maximal molar bite force as a predictive variable in determining post-treatment changes following the use of activators in Class II malocclusion children.

SUBJECTS AND METHOD: Thirty-one Class II division 1 malocclusion children (19 males, 12 females) who had undergone activator treatment for a period of 1-2 years (mean 1.7 years) were followed after the completion of treatment for at least 1 year (mean 2.2 years; SD 1). Maximal molar bite force measurements, lateral cephalograms, and study models were available from before and after activator treatment. These same records were retaken after the post-treatment follow-up period. Multiple regression analyses were used to determine the relationships between initial maximal molar bite force measurements and dental or cephalometric changes during the post-treatment period.

RESULTS: Maximal molar bite force, which had decreased during activator treatment (mean 53 N; SD 92 N), increased during the post-treatment follow-up period (mean 28 N; SD 79 N). Regarding correlations between pre-treatment bite force and its association with post-treatment dental and cephalometric changes, the following associations were found: when controlling for gender, age, and pre-treatment cephalometric values, a lower pre-treatment maximal molar bite force was associated with a greater augmentation in SNA angle (correlation of  $-0.517$ ;  $P = 0.028$ ) during the post-treatment follow-up period. Dentally, when controlling again for age, gender, and pre-treatment dental measurements, a lower pre-treatment maximal molar bite force was associated with a larger increase in overbite (correlation of  $-0.458$ ;  $P = 0.037$ ) during the post-treatment follow-up period.

CONCLUSIONS: Associations between pre-treatment bite force and post-treatment changes following activator treatment in Class II malocclusion children were found for SNA angle and overbite. Children with a weaker maximal molar bite force pre-treatment show a greater increase in SNA angle and a greater increase in overbite during the post-treatment follow-up period.

98 APPLICATION OF CHEMICAL STIMULI ON SAOS-2 HUMAN OSTEOBLASTS *IN VITRO*

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AIM: To test the influence of chemical substances in the viability and function (osteocalcin production and alkaline phosphatase activity) of human osteoblasts cultivated *in vitro*.

MATERIALS AND METHOD: SaOS-2 human osteoblasts from an osteosarcoma were cultured in normal media or media containing  $10^{-8}$  M concentrations of alendronate or  $\text{PGE}_2$ . Positive and negative controls were obtained by adding vitamin D3 or  $\text{TNF-}\alpha$  to the media. An alkaline phosphatase bioassay and enzyme-linked immunoabsorbent assays (ELISAs) for osteocalcin production were used to test osteoblast function at 48 hours. A colourimetric MTT assay was used to measure cell vitality.

RESULTS: Both alendronate and  $\text{PGE}_2$  increased cell viability but only  $\text{PGE}_2$  was significant. Non-significant changes were observed in alkaline phosphatase activity, however,  $\text{PGE}_2$  significantly increased osteocalcine production.

CONCLUSIONS: Lower concentrations of oral bisphosphonates do not have a harmful effect in the short-term on human osteoblasts.  $\text{PGE}_2$  at lower concentrations and in the short-term produces an increase in cell viability and function.

99 ANALYSIS OF DENTAL ARCH RELATIONSHIP USING THE GOSLON YARDSTICK

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AIM: The Goslon Yardstick, which has been used in intercentre collaborative studies, is a useful method that allows evaluation of the occlusal relationships in patients with unilateral cleft lip and palate (UCLP).

SUBJECTS AND METHOD: In this study, the Goslon Yardstick was applied to 81 Japanese UCLP patients. Their average age was 7 years 8 months. Five orthodontists, from two facilities, who had completed the Goslon Yardstick calibration course, evaluated the cases.

RESULTS: The evaluations were as follows: group 1 (excellent), one case; group 2 (good), 13 cases; group 3 (fair), 19 cases; group 4 (poor), 44 cases; group 5 (very poor), four cases. Fifty-nine per cent of the patients were categorized as groups 4 and



5 (poor and very poor). Intra- and interexaminer reproducibility of the Goslon scores was acceptable. Interexaminer concordance rate for group 3 was lower than that for any of the other group. The findings suggest that the group 3 cases were difficult to evaluate.

CONCLUSION: The examiners' unifying view concerning evaluation for group 3 is that it necessary to develop the Goslon Yardstick as an index of occlusion in the intercentre collaborative study of UCLP in Japan.

#### 100 TREATMENT OF SKELETAL OPEN BITE WITH FIXED APPLIANCES AND MINISCREW ANCHORAGE

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AIMS: Statistical evaluation of anterior open bite (AOB) treatment utilizing miniscrews placed between the second premolar and first molars at the buccal side and between first and second molars on the palatal side

SUBJECTS AND METHOD: Ten girls and five boys were included in the study. The treatment group had a hyperdivergent growth pattern with either a skeletal Class I or Class II relationship. The subjects were at the post-peak stage of pubertal growth spurt. Treatment was initiated with the bonding of preadjusted appliances. After the levelling and aligning phase, continuous  $0.017 \times 0.025$  inch stainless steel archwires were placed. Two miniscrews were inserted at each maxillary half, one between the second premolar and first molar at the buccal side and the other being between the first and second molars at the palatal side. Force from the buccal side was exerted on the fixed preadjusted appliances while on the palatal side, 0.6 mm diameter stainless steel round wire was bonded from the second molar to the first premolar as the tooth bearing the force to the posterior teeth. The magnitude of force from each miniscrew was 200 g.

RESULTS: An increase in overbite was achieved with the intrusion of posterior teeth. Reduction in the AOB was achieved with subsequent decreases in lower face height ( $P < 0.05$ ). There were significant increases in SNB ( $P < 0.05$ ) and significant decreases in ANB ( $P < 0.05$ ).

CONCLUSION: Successful management of an AOB malocclusion can be achieved with intrusion of the posterior teeth via miniscrew anchorage. This technique provides a non-invasive and non-compliance method of treatment for open-bite patients.

#### 101 EVALUATION OF SURGICAL-ORTHODONTIC TREATMENT OF IMPACTED MANDIBULAR CANINES

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AIM: To evaluate patients treated for impacted mandibular canines with a combined surgical and orthodontic approach.

MATERIALS AND METHOD: The cases were selected from 5100 panoramic radiographs of patients between treated between January 1998 to April 2006. Information such as gender, age at the time of surgery, site of the unerupted tooth, space availability and any other associated pathologies were recorded. At recall the condition of the mandibular canines was evaluated with panoramic radiographs. If the tooth had erupted in the right position and it was functional and asymptomatic, treatment was considered to be clinically successful.

RESULTS: Of the 5100 patients, 69 had impacted mandibular canines and but only 21 (a total of 23 teeth) were treated orthodontically. Sixteen impacted mandibular canine teeth in 14 patients erupted successfully. Two impacted canine were extracted, and one canine tooth was transplanted in its normal position. Failure of eruption was recorded in four patients.

CONCLUSION: If a mandibular canine tooth is impacted, not only is surgical exposure adequate but traction force must be applied orthodontically after surgical exposure. In addition, age influences the success of the treatment of impacted mandibular canine teeth more than the position and impaction level of the teeth.

#### 102 LONG-TERM STABILITY OF CLASS II CORRECTION IN FIXED FUNCTIONAL APPLIANCE THERAPY

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AIM: To examine the long-term stability of Angle Class II, division 1 malocclusions with successful occlusal results at the end of fixed functional appliance therapy.

MATERIALS AND METHOD: Cephalometric radiographs taken before (T1) and after (T2) treatment and a mean of 6.7 years post-retention (T3) of 14 adolescent patients treated for a significant Angle Class II division 1 malocclusion (overjet greater than 5 mm) with a Forsus Nitinol Flat Spring appliance, which was integrated with fixed orthodontic appliances.



Using cephalometric angular and linear measurements, skeletal and dental changes were assessed. Parametric (ANOVA) and non-parametric (Kruskal-Wallis) statistical analyses were used to determine any significant differences between the time periods at the 95 per cent confidence level.

**RESULTS:** Two-thirds of the achieved occlusal correction (active treatment effects) was due mainly to dental changes. Retroclination of the maxillary incisors, proclination of the mandibular incisors, mesialization of the mandibular molars and distalization of the maxillary molars were observed during active treatment (T1 versus T2). When T2 versus T3 effects were investigated, there were no statistically significant changes for SNA, SNB, ANB, interincisal, mandibular plane (MnSN) and lower and upper incisor angles. The mean changes were 0.5 mm for overjet and 0.6 mm for overbite at T2. Maximum relapse was 2 mm for both overjet and overbite. However, relapse of overjet was associated with relapse of molar and canine relationship and post-retention increase in overbite, proclination of the maxillary incisors, and retroclination of the mandibular incisors. Mandibular incremental growth was favourable both during and after treatment.

**CONCLUSIONS:** Successful correction of Angle Class II division 1 malocclusions with Forsus Nitinol Flat Spring combined with fixed appliances in adolescent patients appears to be stable.

### 103 EFFECTS OF ACTIVATOR AND A FIXED FUNCTIONAL APPLIANCE ON THE TEMPOROMANDIBULAR JOINTS IN CLASS II PATIENTS

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**AIMS:** To investigate the effects of activator and fixed functional appliance treatment on the relationship of mandibular condyle and glenoid fossa in skeletal Class II patients, and to compare the results with those of an untreated control group.

**MATERIALS AND METHOD:** The records of three groups of patients displaying an Angle Class II division 1 malocclusion characterized by an overjet greater than 5 mm. Group 1 (10 patients) had activator treatment, group 2 (10 patients) treated with a fixed functional appliance (Forsus Nitinol Flat Spring), and group 3 (10 patients) who were untreated and served as the control. Magnetic resonance images (MRI) of the right and left temporomandibular joints (TMJ) were taken in sagittal sections before (T1) and after (T2) treatment, and the differences (T2-T1) were calculated. The mean age of the patients was 12 years 7 months at the start of treatment (T1). The period between T1 and T2 was, on average, 11.3 months. The condyle/fossa relationship, including anterior and posterior joint space; condylar height and depth, were measured. The disc position was also assessed and classified as ideal, anterior normal, posterior normal and disc displacement. Data were analyzed using parametric and non-parametric statistical tests at the 0.95 level of confidence ( $P < 0.05$ ).

**RESULTS:** There were no significant differences between the groups for condylar height and condylar depth. However, there were statistically significant differences between the groups for anterior ( $P < 0.01$ ) and posterior ( $P < 0.05$ ) joint spaces at T2. The condyles were located more anteriorly in sagittal MRI sections taken at T2 than those taken at T1. Substantial disc displacement was not observed.

**CONCLUSION:** Activator and Forsus appliances do not cause unphysiologic repositioning in the TMJ.

### 104 USE OF A TISSUE ADHESIVE FOR BONDING OF ORTHODONTIC ATTACHMENTS: AN *IN VITRO* STUDY

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**AIM:** Bonding of orthodontic attachments on an impacted tooth is generally performed at the time of surgical exposure. Controlling and isolating contamination at that stage can be challenging. Cyanoacrylate tissue adhesives combine cyanoacetate and formaldehyde in a heat vacuum along with a base to form a liquid monomer. When the monomer comes into contact with moisture on the surface, it chemically changes into a polymer that binds to the two layers. The aim of this study was to determine the effects of using a tissue adhesive (ethyl-2-cyanoacrylate) on the shear bond strength (SBS) of orthodontic attachments.

**MATERIALS AND METHOD:** Stainless steel buttons were bonded to extracted human molar teeth according to one of four protocols. Groups 1 and 2: the teeth were etched with 37 per cent phosphoric acid for 30 seconds and 11 buttons were bonded with light-cured Transbond XT (3M Unitek, Monrovia, California, USA) and 11 buttons with the tissue adhesive (Epiglu, Meyer-Haake, Wehrheim, Germany). Groups 3 and 4: the teeth were etched with 37 per cent phosphoric acid for 5 seconds and the same number of buttons were bonded with Transbond XT and the tissue adhesive. A universal test machine was used for measurements of *in vitro* SBS.

**RESULTS:** Analysis of variance showed significant differences between the mean SBS of the groups ( $P < 0.001$ ). Group 4 showed significantly lower bond strength values than the other three groups. The Adhesive Remnant Index scores indicated that the tissue adhesive groups predominantly failed at the enamel-adhesive interface, whereas the failure site was frequently at the bracket-adhesive interface for the composite resin.

**CONCLUSION:** Although the tested tissue adhesive is not a suitable bonding material for routine orthodontic practice, its potential for use as a bonding agent on impacted teeth should be further investigated.

#### 105 THE ROLE OF HYPODONTIA IN THE DEVELOPMENT OF SKELETAL PATTERNS

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**AIM:** The role of hypodontia and its specific location in the development of skeletal maxillomandibular relationships is not clear and studies on the subject are scarce. The purpose of this research was to compare the skeletal relationships of a sample of orthodontic patients with hypodontia of the permanent teeth in different locations with two reference groups of subjects without hypodontia.

**MATERIALS AND METHOD:** Panoramic radiographs, lateral telerradiographs and lateral cephalograms of 200 orthodontic patients with hypodontia. The location of the hypodontia was: anterior upper teeth (UA),  $n = 80$ ; posterior teeth (GP),  $n = 85$ ; lower anterior teeth (LA)  $n = 15$  and anterior and posterior teeth (A+P)  $n = 20$ . Two groups matched according to age and gender were used as the controls: reference group 1 (malocclusion): orthodontic patients from the same population without hypodontia, and reference group 2 (normocclusion): cephalometric norms of Ricketts and McNamara. Sagittal and vertical cephalometric measurements were analyzed in all groups. ANOVA or  $t$ -tests were used for statistical analysis of variables.

**RESULTS:** Significant differences between some vertical and sagittal cephalometric measurements between the total hypodontia sample and group 1 were found: vertical measurements in the GP group, sagittal measurements in the AS group and vertical and sagittal measurements in A+P group (all  $P < 0.05$ ). There were no significant differences between the hypodontia sample and reference group 2.

**CONCLUSIONS:** The findings confirm that the results depend not only the location of the hypodontia, but also on the reference sample used for comparison.

#### 106 EVALUATION OF TWO DIGITAL MODEL SOFTWARE PROGRAMS. ARE THEY BOTH RELIABLE AND ACCURATE?

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**AIM:** Model analysis is essential for precise diagnosis in orthodontics. The aim of this study was to compare the measurements made on standard plaster models (the current gold standard for cast measurements) with their digital counterparts constructed with two different digital model software programs, as well as to evaluate the accuracy, reliability and advantages-disadvantages of the two software programs.

**MATERIALS AND METHOD:** Two examiners measured the mesiodistal widths, intercanine and intermolar widths and Hays Nance and Bolton analyses, on the initial plaster models of 10 patients. Measurements were repeated three times with an interval of at least two weeks. The same plaster models were sent to two companies (O3DM, Poland; Orthomodel, Turkey) to obtain digital models. The same examiners repeated all the measurements using the two digital model software programs. Every effort was made to make the measurements as accurate as possible with no attention to the time spent for measuring. The measurements were compared statistically using the intraclass correlation coefficient (ICC), and by calculating the mean values and difference between methods.

**RESULTS:** Measurements made on plaster models with a digital calliper had intra and interreliability with ICC values above 0.95 in 95 per cent CI for both investigators and were accepted as the current gold standard for comparison with the digital model measurements. ICC values were above 0.85 in 95 per cent CI in comparison of O3DM and Orthomodel, showing that they are reliable. Measurements on digital models were smaller than those on plaster models except for intercanine and intermolar widths; in the majority of measurements, the magnitude of the differences was less than 0.5 mm.

**CONCLUSION:** Even though both digital model software programs appear to be clinically acceptable alternatives to conventional plaster models.

#### 107 INFLUENCE OF DEMINERALIZED ENAMEL AND DIFFERENT PRE-TREATMENT METHODS ON SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS

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AIM: To evaluate, *in vitro*, and compare the influence of demineralized and variously pre-treated demineralized enamel on the shear bond strength (SBS) of orthodontic brackets.

MATERIALS AND METHOD: Five groups (n = 12) of bovine enamel specimens with artificially formed carious lesions were treated with an infiltrating resin (group 1: Icon, DMG, Germany) or with highly concentrated fluoride preparations (group 2: Elmex gelee, 1.23% F, Gaba, Switzerland, and group 3: Clinpro White Varnish, 5% F, 3M Espe, Germany). The samples of group 4 were only demineralized and kept untreated in artificial saliva. Non-demineralized control specimens (group 5) were kept in artificial saliva. After the respective pre-treatments, the brackets were bonded on all specimens with a self-curing acrylic resin (ScandiQuick, Scandia, Hagen, Germany). After bonding, SBS was evaluated with a universal testing machine. Statistical analysis was performed by one-way ANOVA followed by a *post hoc* Scheffé test.

RESULTS: SBS in group 1 was significantly higher compared with groups 2, 3 and 4. The other groups did not significantly differ from each other.

CONCLUSION: The SBS of brackets bonded on demineralized enamel is reduced compared with sound enamel. It can be assumed that pre-treatment with an infiltrating resin before re-bonding a bracket on demineralized enamel will increase SBS.

#### 108 EFFECT OF MANDIBULAR DEFORMATION ON THE STABILITY OF ORTHODONTIC MINI-IMPLANTS DURING SIMULATED TOOTH CLENCHING\*\*\*

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AIM: To compare the effect of deformation by the action of masticatory muscles on strain of the cortical bone around orthodontic mini-implants (OMIs) placed between the lower right second premolar and first molar.

MATERIALS AND METHOD: Three finite element models (model A-low angle, model B-average, and model C-high angle) were constructed using computed tomographic images of three adults with different mandibular plane angles. The polar moments of inertia were observed to evaluate the resistance to mandibular bending. Isotropic or orthotropic material properties were applied to mandibular cortical bone

RESULTS: The polar moments of inertia of the interdental mandibular cross-sections in model B (31231.4 mm<sup>4</sup> ~ 36786.7 mm<sup>4</sup>) were larger than those of models A and C (17617.2 mm<sup>4</sup> ~ 30817.2 mm<sup>4</sup>). The average polar moments of model C (15170.7 mm<sup>4</sup>) in the distal area of the right and left lower second molars was 52.2 per cent of that of models A and B (29064.4 mm<sup>4</sup>). The mandibular deformation was similar when isotropic or orthotropic material properties were applied. The gonial angle area was everted in model A and increased in model C. Compressive strain on the cortical bone around the OMI was mainly distributed at the mesial of the lower first molar and distal of the lower second premolar. Compressive strain on the cortical bone around the OMI was highest in model C.

CONCLUSIONS: It would assist in increasing the success rate of OMIs if information about the shape of mandible or the magnitude of masticatory force is taken into account.

#### 109 MOLAR INTRUSION AND ROOT RESORPTION

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AIM: Molar intrusion is essential to correct an open bite in patients with increased vertical dimensions. However, it is important to verify the amount of root resorption due to intrusion. The aim of this study was to radiographically compare apical root resorption of the maxillary first molars with two different intrusion techniques.

MATERIALS AND METHOD: Radiographic records of post-adolescent patients treated by molar intrusion. Twenty-nine patients with an open bite malocclusion due to excessive eruption of posterior segment were included. The main study group was randomly divided into two subgroups. Intrusion was performed in group A (n = 15, mean age: 19.3 years) using a rapid molar intruder (RMI) with an intrusion force of 350 g per side, and in group B (n = 14, mean age: 20.8 years) by miniscrew anchorage (TAD) and closed nickel titanium coil springs with 300 g of intrusion force per side. Radiographs were obtained

before (T0) and after (T1) intrusion. Mean root resorption was calculated for all teeth individually using standardized periapical radiographs taken with parallel technique. A paired *t*-test was used for comparison of the mean root resorption at T0 and T1. Independent samples *t*-tests were used to compare the differences in root resorption. The Statistical Package for Social Sciences, version 18.0 for Windows (SPSS Inc, Chicago, Illinois, USA) was used to analyze the data.

RESULTS: Mean root resorption was statistically significant after intrusion in group A ( $0.96 \pm 0.54$ ,  $0.86 \pm 0.54$ ,  $1.32 \pm 1.03$  and  $1.14 \pm 0.85$  mm for UR6, UL6, LR6 and LL6, respectively), and for group B,  $0.87 \pm 0.62$ ,  $0.69 \pm 0.37$ ,  $1.07 \pm 0.7$  and  $0.92 \pm 0.58$  mm for UR6, UL6, LR6 and LL6, respectively. However there was no statistically significant difference between the groups for the root resorption ( $P < 0.05$ ,  $P < 0.01$ ,  $P < 0.001$ ).

CONCLUSIONS: Intrusion of the molars with the two treatment approach caused statistically significant apical root resorption. However there was no statistically significant difference between the groups in terms of root resorption.

#### 110 THIN-PLATE SPLINE ANALYSIS OF CRANIOFACIAL MORPHOLOGY IN SUBJECTS WITH ADENOID OR TONSILLAR HYPERTROPHY

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AIM: To compare the skeletal features of subjects with adenoid hypertrophy (AG) with those of children with tonsillar hypertrophy (TG) using thin-plate spline (TPS) analysis.

MATERIALS AND METHOD: Lateral cephalograms of 20 subjects (9 girls and 11 boys; mean age  $8.4 \pm 0.9$  years) with AG and 20 subjects (10 girls and 10 boys; mean age  $8.2 \pm 1.1$  years) with TG. The TPS software computed the average configurations of the craniofacial landmarks for all the subjects. Average configurations were subjected to a cross-sectional comparison between AG and TG. Statistical analysis of shape differences was performed by means of permutation tests with 1000 random permutations on Goodall F statistics. Statistical computations for centroid size analysis were performed with a computer software program and the differences in size in the two groups were tested by means of Mann-Whitney *U*-tests.

RESULTS: There were statistically significant shape differences in facial configuration for the comparison between AG and TG ( $P = 0.034$ ). AG showed an upward dislocation of the anterior region of the maxilla, a more downward/backward position of the anterior region of the mandibular body and an upward/backward displacement of the condylar region. Conversely TG showed a downward dislocation of the anterior region of the maxilla, a more upward/forward position of the anterior region of the mandibular body and a downward/forward displacement of the condylar region. Significant differences in size were found between the groups; centroid size was significantly greater in TG when compared with AG ( $P = 0.043$ ).

CONCLUSION: Subjects with AG exhibited features suggesting a more retrognathic mandible while those with TG showed features suggesting a more prognathic mandible.

#### 111 COMPARISON OF SPACE ANALYSIS ON PLASTER CASTS AND VIRTUAL ORTHODONTIC MODELS

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AIM: To evaluate the accuracy and the duration of space analysis measuring digital models using computer aided design (CAD) software as compared with measurements performed on corresponding stone models with a sliding calliper.

MATERIALS AND METHOD: Pre-treatment plaster dental casts of 30 patients selected from a private orthodontic office. Inclusion criteria were: a complete adult dentition, non-extraction treatment, no proximal restorations or caries, no banded molars and no interproximal enamel reduction. Measurements were performed by one investigator on the plaster casts using a sliding calliper (Zürcher Modell, Dental Liga, Köln, Germany) and were repeated on the corresponding scanned digital cast using CAD software (OrthoCAD, Cadent, Carlstadt, New Jersey, USA). Intraexaminer variance for both methods was determined by repeated measurements of 10 corresponding pairs. The following parameters were evaluated: Bolton 12 analysis, transverse measurements, overbite, overjet and the time taken for all the measurements.

RESULTS: When comparing digitized with conventional plaster models, a slight (0.4 mm) but statistically significant difference in tooth size space analysis was found with digital measurements being smaller than manually measured ones. However, the magnitude of these differences ranged from  $-0.28$  to  $0.48$  mm and can be considered to be clinically irrelevant. There was also a significant difference in the time needed for performing the analysis: digital analysis  $409 \pm 89$  seconds, calliper analysis  $887 \pm 111$  seconds. Thus, the digital procedure results in a time saving for model evaluation of 46 per cent.

CONCLUSION: The accuracy of the software for measurement of digital models is clinically acceptable when compared with traditional plaster study model analyses and needs significantly less time.



## 112 USE AND SUCCESS RATE OF MINISCREWS AND MINIPLATES IN ORTHODONTICS

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AIM: To investigate the use and success rate of miniscrews and miniplates in orthodontics.

MATERIALS AND METHOD: Eighty-nine orthodontists volunteered to answer a comprehensive questionnaire that consisted of 10 questions concerning their current use of miniscrew including selection criteria, insertion site, the aim of the insertion, failure rate and potential reasons of the failure.

RESULTS: The majority of orthodontists considered the most important factor in the selection criteria is choosing the appropriate dimensions for the miniscrew according to the insertion site (89%). The other important factors were: head design with slot (56%), self-drilling type (49%) and the clinical positive feedbacks (42%) of miniscrews. Molar distalization was found to be the primary purpose of application (27%). The other alternative movements which were the most chosen were determined as canine distalization (31%), incisor retraction (22%) and incisor intrusion (12%). The success rate was reported to be between 75-100 per cent. The potential reasons for failure were reports as: oral hygiene deficiency (71%), external force application (29%) and excessive force (25%).

CONCLUSION: Selection of the most appropriate type of screw and hygienic care of insertion site is emphasized for the long-term success of mini screw anchorage.

## 113 OSTEOPROTEGERIN AND RECEPTOR ACTIVATOR OF NUCLEAR FACTOR-KAPPA LIGAND LEVELS IN GINGIVAL CREVICULAR FLUID UNDER CONTINUOUS ORTHODONTIC FORCE

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AIM: The osteoprotegerin (OPG)-receptor activator of nuclear factor-kappa ligand (RANKL) axis is a key regulator of bone turnover activity. The aim of this study was to examine the expression of OPG and RANKL in gingival crevicular fluid (GCF) on the mesial (tension) and distal (compression) sides under orthodontic force.

SUBJECTS AND METHOD: Patients were subjected to oral hygiene instruction, scaling and root planning prior to orthodontic treatment. After first premolar extractions, 18 maxillary canines were tipped distally by Sentalloy coil springs with a force of 150 g. GCF was sampled from the mesial and distal gingival crevices of each canine separately at baseline, and after 1, 24 and 168 hours, and 1 month after initial force application. OPG and RANKL levels were analyzed by ELISA.

RESULTS: There was no significant difference for the total amount of OPG and RANKL at the mesial and distal sides. The expression of OPG and RANKL concentrations were regulated differently at the mesial and distal sides. A statistically significant difference in the concentration of OPG was found among sides in the 1 hour period ( $P < 0.05$ ).

CONCLUSION: The concentration of OPG revealed a significant up-regulation at the mesial side 1 hour after force application, which may indicate the acute reaction of periodontal ligament cells towards tension. Future studies with different magnitudes and durations of force are needed to evaluate the response of OPG and RANKL to mechanical loading.

## 114 LONG-TERM STABILITY OF DENTOALVEOLAR, SKELETAL AND SOFT TISSUE CHANGES AFTER NON-EXTRACTION TREATMENT WITH A SELF-LIGATING SYSTEM

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AIM: To prospectively evaluate the effects of Damon3 self-ligating brackets on skeletal, dental, and soft tissues, and to determine the changes in upper and lower arch widths.

SUBJECTS AND METHOD: Twelve patients (9 females, 3 males) with a mean age of  $13.02 \pm 2.21$  years who underwent non-extraction treatment with Damon3 self-ligating brackets (Ormco, Glendora, California, USA). Orthodontic study models and lateral cephalograms were obtained at the beginning (T1) and end (T2) of treatment, and six months (T3) and two years (T4) after treatment. The lateral cephalograms were assessed for treatment related changes in skeletal and soft tissues and incisor inclination and position. Transverse dimensional changes in intercanine, interpremolar and intermolar dimensions using the Peer Assessment Rating (PAR) index were assessed on dental casts at T1, T2, T3, and T4. A Wilcoxon non-parametric test was used for statistical analysis.



**RESULTS:** All transverse dimension increases were statistically significant ( $P < 0.01$ ) except for lower intercanine width. Whereas there was no relapse at T3 for any dimensions, there was some significant relapse in the long-term especially in maxillary widths ( $P < 0.05$ ). While Mx1-SN angle was increased between T3-T4, Mx1-Pal angle was decreased between T2-T3 ( $P < 0.05$ ). IMPA angle was increased at T1-T4 ( $P < 0.05$ ). Md1-NB was increased significantly at T1-T2, T1-T3, and T1-T4 ( $P < 0.05$ ), whereas the upper lip was protruded at T1-T4 and T2-T3, the lower lip was protruded only at T2-T3 ( $P < 0.05$ ). The mean percentage reductions in PAR values were 96.95, 97.01 and 96.23 for T1-T2, T1-T3, and T1-T4, respectively. **CONCLUSIONS:** Although there were minor statistical changes in the measurements, these were not clinically significant. Fixed orthodontic treatment with Damon3 brackets does not cause significant changes in the hard and soft tissues.

#### 115 TREATMENT EFFECTS OF TWIN BLOCK AND HERBST APPLIANCES IN CLASS II DIVISION 1 MANDIBULAR RETROGNATHIC PATIENTS

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**AIM:** To evaluate the skeletal and dentoalveolar changes induced by Herbst and twin block (TB) therapy of Class II division 1 mandibular retrognathism.

**SUBJECTS AND METHOD:** Sixty Class II division 1 mandibular retrognathic patients divided into three groups. Forty patients were randomly allocated to one of two functional appliance treatment groups. The mean treatment time was  $15.81 \pm 5.96$  and  $16.20 \pm 7.54$  months for Herbst and TB groups, respectively. The observation period of the control group was  $15.58 \pm 3.13$  months. Pancherz's analysis was used for cephalometric evaluation. Lateral cephalometric measurements of the groups were compared at T0 and T1 using analysis of variance, and treatment/observation differences (T1-T0) were evaluated with a paired samples *t*-test at the  $P < 0.05$  level.

**RESULTS:** Most of the investigated variables in the treatment groups showed statistically significant changes at the end of functional appliance therapy. Mandibular base and composite mandibular length increases were statistically significant between the TB and control group. The TB group showed the greatest increase in composite mandibular length among the groups, and the difference was statistically significant between the Herbst and control groups. Compared with the controls, upper incisor retraction, upper molar distalization and lower incisor protrusion were found to be statistically significant in the Herbst group.

**CONCLUSION:** The treatment effects in the TB group were due mainly to mandibular skeletal changes. In the Herbst group both skeletal and dental changes contributed to the Class II correction.

#### 116 A METHOD TO PREDICT LOWER THIRD MOLAR ERUPTION ON PANORAMIC RADIOGRAPHS

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**AIMS:** To develop an easy and reproducible method for predicting lower third molar eruption on panoramic radiographs.

**MATERIALS AND METHOD:** Profile and panoramic radiographs, taken before orthodontic treatment, of 33 males and 23 females (mean age 22.3 years) from an orthognathic and a non-orthognathic group of orthodontic patients. The frequency of eruption of the lower third molar was 56 per cent. Cephalometric analyses including the mandibular angle were performed according to Björk on the profile radiographs. Likewise, cephalometric measurements including the mandibular angle and the linear distance from interdental (id) to the anterior ramus border (olr)) were performed on panoramic radiographs. The width of the lower second molar was analyzed and the mean value used as a reference to calibrate the linear measurements on the panoramic radiographs.

**RESULTS:** A close association was seen between the distances and angles measured on the profile and panoramic radiographs. There was a close association between the eruption of the lower third molar and the parameter id to olr. Use of the mean value of the lower second molar width for calibration, allowed a graphic illustration of the relationship between id-olr and the probability of eruption of the lower third molar was made for practical clinical use.

**CONCLUSION:** An easy and reproducible method for predicting lower third molar eruption was found by combining the parameters id to olr and the width of the second molar on panoramic radiographs.

#### 117 CEPHALOMETRIC ANALYSIS OF PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA AND SNORING, TREATED WITH A MANDIBULAR PROTRUDING DEVICE

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AIM: To evaluate, in a prospective cephalometric study, the influence of a mandibular protruding device (MPD) following 10-years nocturnal use in patients with obstructive sleep apnoea (OSA)/snoring.

SUBJECTS AND METHOD: At the 10-year follow-up, a total of 65 patients out of initial 77 subjects were available and subjected to the cephalometric evaluation, 45 MPD-users and 20 previous MPD-users (reference group). Cephalograms taken at baseline in an upright position, with an analogue technique, were digitized for comparison with digital cephalograms from the 10-year follow-up. Analysis of the consistency in the cephalometric readings showed no systematic errors. The cephalometric analyses focused on the position of the incisors, the hyoid bone, and routine skeletal measurements.

RESULTS: The MPD-user group, showed the following mean differences (standard deviation) from baseline to the 10-year follow-up: overjet [-1.5 mm (1.9);  $P < 0.001$ ] and overbite [0.7 mm (1.4);  $P = 0.002$ ] were reduced. The upper incisors (ILs/SN) were retroclined ( $-4.2^\circ$  (4.0);  $P < 0.001$ ) and the lower incisors (ILi/ML) were proclined [ $+3.2^\circ$  (5.0);  $P < 0.001$ ]. The mandibular protrusion (SNB) was slightly reduced [ $-0.6^\circ$  (1.4);  $P = 0.01$ ]. The mandibular length (CdPg) increased [ $+5.1$  mm (6.8);  $P < 0.001$ ] and the linear distance between the hyoid and mandibular plane (hyML) increased [ $+3.3$  mm (2.9);  $P < 0.001$ ]. The reference group retained their initial cephalometric values for all measurements except for CdPg and hyML, which increased [ $+6.1$  mm (6.0);  $P < 0.001$  and  $+3.8$  mm (3.7);  $P = 0.001$ ], respectively.

CONCLUSIONS: Nocturnal use of an MPD over a 10-year period caused alterations in bimaxillary incisor inclination. No such changes were seen in the reference group. In both groups the position of the hyoid bone was lowered and the mandibular length increased.

#### 118 CONSIDERATIONS REGARDING THE INFLUENCE OF EMOTIONAL STRESS ON TEMPOROMANDIBULAR DISORDERS

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AIM: Emotional stress, described by Selye as 'the non-specific response of the body to any demand made upon it', is regarded by many as one of the initiating or perpetuating factors of temporomandibular disorders (TMD). The aim of this clinical research was to investigate possible correlations between the level of emotional stress experienced by the patient and specific signs and symptoms of TMD.

SUBJECTS AND METHOD: Forty-nine subjects (26 females, 23 males), with an age range between 19 and 25 years. Each subject underwent a complete clinical and radiological evaluation, prior to orthodontic treatment. The anamnesis interview included 10 questions regarding the perception of stress level in each patient's life (The Perceived Stress Scale, proposed by Cohen *et al.*, 1988). The data were analyzed with the Statistical Package for Social Sciences, using the Spearman correlation test and the Mann-Whitney test.

RESULTS: Of the patients, 38.7 per cent were asymptomatic, 51 per cent presented mild, 8.2 per cent, moderate, and 2.1 per cent severe TMD, according to Helkimo. Higher scores on the Perceived Stress Scale correlated with pain on muscular palpation in male patients and with increased anamnesis headache incidence in females.

CONCLUSIONS: Increase in the stress level during a certain period of time also influences the functionality of the stomatognathic system.

#### 119 PAIN EXPERIENCE DURING WIRE ENGAGEMENT/ DISENGAGEMENT IN A SELF-LIGATING AND CONVENTIONAL BRACKET SYSTEM

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AIMS: Patient comfort is reported to be one of the advantages of self-ligating brackets (SLB). This generally refers to the discomfort experienced during force application, while the process of wire engagement/disengagement is often neglected. Although this process constitutes only a fraction of the entire treatment time, it influences the patient's overall comfort and treatment satisfaction. The aim of this study was to investigate the difference in pain experienced during wire engagement and disengagement between SLB and standard brackets.

SUBJECTS AND METHOD: Eighteen pre-orthodontic patients. In their selection, particular care was given to symmetric malocclusion on both sides of the dental arches. A split-mouth design was employed, with one random side being treated with Smartclip SLB and the other side with conventional brackets and wire ligatures. Throughout the course of treatment, the patients were asked to rate the discomfort experienced during the processes of wire engagement and disengagement on a visual numeric scale (VNS).

**RESULTS:** The results were not normally distributed. The median values on the VNS were 2 with an interquartile (IQR) of 3 for the SLB side and 1 with an IQR of 2 for the standard side. Differences between the two sides were significant ( $P = 0.03$ ) for wire engagement and highly significant ( $P < 0.01$ ) for disengagement. For the SLB side, increasing ratings on the VNS were observed when moving from round to rectangular and levelling to working wires. These differences were highly significant for both wire engagement and disengagement ( $P = 0.006$  and  $0.005$  respectively). No significant differences between wire qualities were found for standard brackets.

**CONCLUSIONS:** During wire changes, the design of the Smartclip system may lead to more discomfort for the patient when compared with conventional brackets.

#### 120 SKELETAL EFFECTS OF A FATIGUE RESISTANT DEVICE AND AN ACTIVATOR IN THE TREATMENT OF CLASS II DIVISION 1 MALOCCLUSIONS

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**AIM:** To evaluate the skeletal effects of the Forsus™ FRD EZ (3M Unitek, Monrovia, California, USA) appliance and the Andresen activator in actively growing patients presenting with a Class II division 1 malocclusion.

**SUBJECTS AND METHOD:** Sixty subjects (study group,  $n = 40$ , control group,  $n = 20$ ). Inclusion criteria were: Class II division 1 malocclusion, retrognathic mandible, normal or low-angle growth pattern, and peak growth period. The patients were divided into three equal groups. The first study group were treated with the Forsus appliance and the second group underwent treatment with an Andresen activator. The control group were untreated. Lateral cephalometric films were taken after the levelling phase and just after removal of the Forsus appliance in the first group. In the second group, the radiographs were obtained before and at the end of 6 months of appliance use. The control group of individuals were followed for the same amount of time.

**RESULTS:** Both appliances enhanced mandibular growth, helped increase the length of the mandible and had a restraining growth effect on the maxilla. Anterior face height increased in both treatment groups, whereas posterior face height had a significant increase but only in the activator group. The palatal plane rotated in a clockwise direction in the Forsus group. Overbite and overjet were reduced in both treatment groups.

**CONCLUSION:** Both appliances proved effective in the treatment of growing individuals with Class II malocclusions with mandibular retrognathism.

#### 121 SHEAR BOND STRENGTH EVALUATION OF ORTHODONTIC BRACKETS BONDED TO NATURAL TEETH

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**AIM:** It is difficult to establish a numerical value for the minimum bond strength required for safe clinical orthodontic performances, because the values are dependent on several factors. The aim of this study was to analyze the different variables involved in determination of the shear bond strength (SBS) of brackets bonded to natural teeth and to organize these logically and schematically.

**MATERIALS AND METHOD:** A literature review was carried out using PubMed to evaluate the actual knowledge on orthodontic bracket adhesion to natural teeth and the *in vitro* laboratory SBS determination. The research keywords were: 'shear bond strength' 'test' 'orthodontic' 'bracket', and related citations. Because of clearness and form and content completeness, 143 articles were selected.

**RESULTS:** A great variability in experimental methods, materials and in testing instruments and environment data settings was found. All variable analyses were organized in accordance with the laboratory experimental protocols.

**CONCLUSIONS:** There is a necessity to standardize research methodologies and guidelines to allow a real scientific estimation of the SBS according to different materials and clinical assessments. This research resulted in the formulation of a supplementary laboratory work sheet.

#### 122 SUCCESS RATE OF CLASS II SUBDIVISION HERBST TREATMENT

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**AIM:** To investigate the treatment and post-treatment success rate of Herbst-Multibracket appliance treatment in Class II subdivision compared with symmetric Class II malocclusions.

**SUBJECTS AND METHOD:** Twenty-two Class II subdivision (right-left-molar difference  $>0.75$  cusp widths = ASYM) and 22 symmetric Class II subjects ( $> 0.75$  cusp widths bilaterally = SYM), matched according to gender and pre-treatment hand wrist radiographic stage. Herbst treatment lasted for an average of 9 months and the subsequent MB treatment for 14 months. The retention period was at least 12 months (mean 36 months). Dental casts from before (T1), after (T2) treatment and after retention (T3) were evaluated.

**RESULTS:** At T2 a bilateral Class I or super Class I molar relationship (0.25 cusp widths mesial) was seen in 73 per cent of the subjects in the ASYM and 77 per cent of the subjects in the SYM group. At T3 the corresponding values were 64 (ASYM) and 73 (SYM) per cent, respectively. The remaining subjects exhibited either a uni- or bilateral Class II molar relationship of up to 0.5 cusp widths (ASYM: 23%, SYM: 27%) or a uni- or bilateral Class III molar relationship of 0.5 cusp widths (ASYM: 14%, SYM: 0%). While the initial values (T1) for overjet differed moderately (ASYM: 6.3 mm, SYM: 7.8 mm), no difference was seen either after treatment (ASYM: 2.7 mm, SYM: 2.3 mm) or after retention (ASYM: 3.0 mm, SYM: 3.4 mm).

**CONCLUSION:** Class II subdivision Herbst treatment is similarly as successful as symmetric Class II Herbst treatment. However, a slight overcompensation of the molar relationship (Class III tendency) is more frequent in Class II subdivision patients.

### 123 CROSSBITE TREATMENT OF ADULTS WITH THE THERMOPLASTIC TECHNIQUE

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**AIM:** To illustrate the use of the Invisalign system in adult patients with a posterior crossbite.

**SUBJECTS AND METHOD:** Ten adults aged 25 to 35 years with a Class I malocclusion, a Class I molar relationship, midline discrepancy, normal skeletal pattern and a posterior crossbite. The orthodontic treatment plan was carried out by means of interproximal enamel reduction in the lower arch and expansion in the upper arch avoiding the use of quadhelix or rapid maxillary expansion to achieve correction of the posterior crossbite without auxiliaries using exclusively Invisalign aligners.

**RESULTS:** The mean treatment time was 15 months with a further 6 months for case refinement to settle the occlusion. At the end of orthodontic treatment, the posterior crossbite was corrected and the midlines centred.

**CONCLUSION:** The Invisalign technique could represent an effective treatment option in adult subjects with a posterior crossbite.

### 124 GONIAL ANGLE ASSOCIATED WITH VERTICAL DISORDERS

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**AIM:** To evaluate the mandibular morphological characteristic (gonial angle) in individuals with vertical disorders and normal occlusion.

**SUBJECTS AND METHOD:** Ten patients were selected according to intra- and extraoral examination and by overbite size. Lateral telerradiographs of 45 patients of both gender, aged 13-15 years, divided into three groups according to the size of the overbite: group 1 patients with an open bite where the overbite was 1 mm, group 2 patients with a deep bite where the overbite was more than 4 mm, group 3 (control group) subjects with a normal incisal bite.

**RESULTS:** Go angle was increased in group 1 ( $134.65 \pm 5.17^\circ$ ), decreased in group 2 ( $115.85 \pm 4.38^\circ$ ) while in group 3 it was  $125.05 \pm 5.40$  degrees.

**CONCLUSION:** The most important change in mandibular morphology is in Go angle, which was largest in the open bite group.

### 125 ASSOCIATION BETWEEN MALOCCLUSION SELF-ASSESSMENT AND LEVEL OF SATISFACTION TWO TO FIVE YEARS POST-TREATMENT

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**AIM:** To evaluate patient satisfaction two to five years after active orthodontic treatment and its association with aesthetic self-assessment of the initial malocclusion.



**MATERIALS AND METHOD:** One hundred twenty questionnaires concerning the level of satisfaction after treatment were mailed to patients who had finished their orthodontic treatment more than two years previously. Forty-four answers were collected. The questionnaire was supplemented with 12 photographs, 10 representing the standard photographs used for assessment of the Index of Orthodontic Treatment Need (IOTN); aesthetic component and two individualized photographs depicting the initial and final frontal intraoral view of the patient's own dentition. All photographs were delivered as black and white copies and identically cropped. The patients ranked the photographs according to their opinion about the aesthetics; the most attractive ranking 1 and the least attractive ranking 12. The results were analyzed with Statistica 9.1 (StatSoft®, Inc., Tulsa Oklahoma, USA and StatXact 4, Cytel Software Corporation, Cambridge, USA). The level of satisfaction was intercorrelated to the grading of the pre-treatment photograph.

**RESULTS:** 1) The association between initial self-assessment and level of satisfaction was weak ( $r_s = -0.15$ ,  $P = 0.36$ ). 2) Eighty per cent of the 44 patients were satisfied with the treatment (95% confidence interval for the proportion: 65-89%). 3) Ninety-three per cent of the 44 patients thought that the treatment was worth the effort (95% confidence interval for the proportion: 81-98%).

**CONCLUSION:** Self-assessment of initial malocclusion is a poor predictor for post-treatment satisfaction level.

## 126 EARLY TREATMENT OF CLASS III MALOCCLUSION WITH THE FRÄNKEL APPLIANCE – A THREE-DIMENSIONAL SOFT TISSUE EVALUATION

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**AIM:** To evaluate the effectiveness of Class III malocclusion treatment in the early mixed dentition period with the Fränkel appliance using three-dimensional (3D) soft tissue analysis.

**SUBJECT AND METHOD:** A 7 year-old girl with Class III malocclusion. Clinical examination, facial and intraoral photographs, dental casts, dental pantomogram, lateral cephalogram and soft tissue analysis of the girl's face were taken at baseline (T0) and after 18 months of orthopaedic treatment with the Fränkel appliance (T1). The facial scans (T0, T1) were superimposed over the average facial template, constructed using facial scans of 30 girls, aged  $6.9 \pm 0.6$  years at T0 and  $8.4 \pm 0.6$  at T1. Differences in facial morphology were assessed quantitatively and qualitatively. Further, palatal surface area and volume and area and volume of the mouth floor were measured on 3D images of the study casts.

**RESULTS:** At T0 3D analysis showed a prognathic chin and retrognathic upper lip area compared with the average face. After treatment the 3D soft tissue analysis showed a less prominent chin and the facial appearance became almost similar to the average face (T1). The dimensions of the upper and lower jaw also increased. The increase in the upper arch was greater than in the lower arch.

**CONCLUSIONS:** Class III malocclusions can be successfully treated by modifying growth pattern with the Fränkel appliance in the early mixed dentition. The appliance stimulates growth of the maxilla, alters the posture of the mandible and therefore improves facial appearance. Contemporary 3D soft tissue imaging has the advantage of allowing assessment of facial morphology and enables objective comparison of faces and dental casts before and after treatment.

## 127 UPPER LATERAL ANTERIOR INCISOR AGENESIS TREATED WITH IMPLANTS - A RETROSPECTIVE FOLLOW-UP STUDY

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**AIM:** To evaluate the long-term effects of implant treatment in the upper incisor region and the survival rate of the implants after at least 5 years.

**SUBJECTS AND METHOD:** Thirty-six patients (17 males, 19 females) with congenitally missing upper lateral incisors. The mean age of the patients at the follow-up examination was  $27.3 \pm 7.9$  years. All the patients were treated between 2001 and 2004. In total 54 implants (mean age 7.3 years) and implant-supported crowns were examined. Established clinical criteria were used to assess the implant-supported crowns (California Dental Association Index; CDA) and the surrounding soft tissue adaptation. Standardized intra-oral photographs were taken of the implants ( $n = 54$ ) to evaluate whether they were in an infraposition compared with the photographs taken at baseline ( $n = 25$  implants). The height of the papillae and the infilling of the interproximal area in connection to the implant-supported crowns were also analysed.

**RESULTS:** Adaptation of the soft tissue around the implant-supported crowns was similar to the adjacent natural teeth. There was a difference in vertical height between 19/25 of the implants and the neighbouring teeth compared with baseline. No implants were lost and no implant-supported crowns had been fractured or replaced. One implant had a fistula. Two implants did not have interproximal papillae. Seven papillae occupied  $<1/2$  of the interproximal room, 28  $>1/2$ , and 71 papillae all of the whole interproximal space and corresponded well to the adjacent dental papillae. The CDA rating for marginal integrity, anatomic shape, surface and colour was excellent.

**CONCLUSION:** The implant survival rate in this study was 100 per cent. Implant-supported crowns showed high values according to the CDA index. Soft tissue adaptation and filling of the papillae had an acceptable level compared with neighbouring teeth. Some of the implants were in infraposition.

## 128 DIGITAL PHOTOGRAPHIC ASSESSMENT OF DIMENSIONAL INTEGRITY OF GYPSUM MODELS

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**AIM:** To determine intra-arch dimensional integrity, through digital photography, in the projected [two-dimensional (2D)] distances between selected reference points in a gypsum model of a fully dentate maxillary arch.

**MATERIALS AND METHOD:** A reference mark was made with a rosehead tungsten carbide bur (0.4 mm diameter) on both canines (palatal aspect) and both second molars (distobuccal) in a full-arch maxillary acrylic typodont. Impressions were recorded ( $n = 5$ ) in each of the following impression materials: hand mix alginate (Blueprint, Dentsply), machine mix alginate (impEssix, Dentsply) and clinical silicone (Extrude, Kerr). The models were poured after 10 minutes in a standardized-mix of gypsum (Orthodontic Stone type 3, Whip Mix). The models were paired with the typodont under a digital camera (Canon EOS 1000D, EF 24-85 mm) to present a perpendicular alignment of the occlusal surface to the optical axis; a digital photograph (RAW/TIFF) was recorded of each combination. The mean segmental 2D differences were calculated directly on-screen using the image editing software (Adobe Photoshop CS5).

**RESULTS:** The mean 2D projected segmental differences between typodont and model ranged from 0.1 (1) to 1.0 (5) per cent. The differences were not significant between the three impression materials ( $\alpha = 0.05$ ).

**CONCLUSIONS:** Dimensional integrity of gypsum casts duplicated from a typodont may not depend on the choice of impression material (within the parameters investigated). General-purpose image editing software may be appropriate for 2D analysis of orthodontic casts.

## 129 TREATMENT OF PERIODONTALLY COMPROMISED PATIENTS WITH THE USE OF PASSIVE SELF-LIGATION SYSTEM – AN ALGORITHM

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**AIM:** Now days more adults are having orthodontic treatment. However older subjects may have problems of bone resorption, root resorption, gingival recession and tooth mobility. Passive self-ligating brackets have been developed to minimise frictional forces, thus reducing the force to the teeth, which is important in patients with periodontal problems. The aim of this study was to compare periodontal status before and after orthodontic treatment.

**SUBJECTS AND METHOD:** One hundred and twenty six patients, with a healthy periodontium (groups I and II), early periodontitis (groups III and IV), moderate periodontitis (groups V and VI) treated with self-ligating brackets [Damon3/3MX, Ormco (groups I, II and II)] and conventional pre-adjusted edgewise brackets [Mini Wick Alexander Ormco, Inspire Ice Ormco, Clarity 3M (0.18 inch slot) (groups II, IV and VI)]. Their ages ranged from 22 to 47 years. Periodontal status was clinically determined (plaque index, papilla bleeding index, tooth mobility, gingival index). A computed tomographic (CT) scan was obtained before and after orthodontic treatment.

**RESULTS:** Statistically significant differences were found in the amount of recession: greater than 0.24 mm decreased in group V ( $td = 3.48$ ;  $P < 0.05$ ) and 0.04 mm ( $P > 0.05$ ) and increased in group VI after orthodontic treatment. PBI 0.7 score increased ( $P < 0.05$ ) in group VI during alignment and levelling, in relation to 0.1 score increased in group V group ( $P < 0.05$ ). Having analyzed all the data an algorithm was developed for treating periodontally compromised patients with the use of passive self-ligating system, which includes: clinical examination and gingival biotype analysis; bone structure evaluation (CT-scan); treatment strategy and biomechanics, according the CT-scan evaluation; archwire sequence and position of the archwire stops.

**CONCLUSION:** Passive self-ligation has an advantage over conventional pre-adjusted edgewise bracket systems in subjects with periodontal problems. Light forces positively affect the gingival tissue. Using the above algorithm good occlusal and periodontal results were achieved in subjects with severe bone loss.

130 EFFECT OF PRIMER PRE-CURING ON THE BRACKET FAILURE RATE: A PROSPECTIVE *IN VIVO* STUDY

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AIM: To evaluate *in vivo* the effects of primer precuring on bracket failure rate during a 12-month observation period.

SUBJECTS AND METHOD: Twenty-eight patients with a mean age of 15 years 4 months. Four hundred and ninety-eight brackets were bonded by one operator with a split-mouth design, with precuring or non-precuring of the primer (Transbond XT Primer, 3M Unitek, Monrovia, California, USA). The survival rate of the brackets was estimated by Kaplan-Meier analysis. Bracket survival distributions with respect to bonding procedure, dental arch, type of tooth (incisor, canine, and premolar) and patient gender were compared using the log-rank test.

RESULTS: The bond failure rates for primer precuring and non-precuring were 0.8 and 0.4 per cent, respectively. No significant difference was found between precuring and non-precuring of the primer using the log-rank test ( $P = 0.566$ ). Furthermore, canine and premolar teeth displayed a lower survival rate than incisor teeth ( $P > 0.05$ ). Survival rates did not show significant differences between the upper and lower dental arches or patient gender ( $P > 0.05$ ).

CONCLUSION: Precuring the primer before placing the bracket and the adhesive did not show any advantage concerning bracket survival rate.

131 SOFT TISSUE CHANGES FOLLOWING PROTRACTION APPROACHES WITH AND WITHOUT RAPID PALATAL EXPANSION

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AIM: To evaluate and compare soft tissue changes following reverse headgear (RHg) and RHg plus rapid maxillary expansion (RME) therapy with each other and with an untreated Class III control group.

SUBJECTS AND METHOD: Both RHg (10 girls, 6 boys, mean chronological age 11,1 years) and RME (12 girls, 4 boys, mean chronological age 10.8 years) groups included 16 skeletal Class III patients with maxillary deficiency. The control group included 18 skeletal Class III patients (7 girls, 11 boys, mean chronological age 10.2 years) who were observed for 9.7 months. The average treatment time was 13.2 months for the RHg group and 14.7 months for the RME group. Hard and soft tissue linear and angular measurements were made on lateral cephalograms of each patient at the beginning and end of the treatment/observation period. Intra- and intergroup differences were analyzed by paired *t*- and Student's *t*-test, respectively.

RESULTS: The increase in the sagittal depth of the maxilla, nose depth and upper lip length were significant in treatment groups. Forward movement of projected labrale inferius point in the control group showed a significant difference when compared with the RHg group. The upper lip relative to the aesthetic plane increased in the treatment groups while there was no significant change in the control group. The increase in the RHg group was greater than in the RME group. The inclination of the soft tissue chin decreased in the RME group, whereas it increased in the control group. The decrease in mentolabial angle was more distinctive in the treatment groups.

CONCLUSION: RHg treatment, with or without RME, revealed significant changes in nose depth and the position and length of the upper lip. Forward movement of the upper lip however, was more prominent with RHg treatment only. Soft tissue profile followed the changes in the sagittal depth of the underlying hard tissues.

132 RELATIONSHIP BETWEEN MOVEMENT OF THE MANDIBULAR INCISOR AND MANDIBULAR SYMPHYSIS IN HIGH ANGLE CASES

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AIM: To retrospectively examine if the movement of the mandibular incisor affects the supporting mandibular alveolar bone and mandibular symphysis in high angle subjects treated with fixed orthodontic appliances.

MATERIALS AND METHOD: Pre- and post-treatment lateral cephalograms of 31 patients who were classified as high angle regarding their pre-treatment values of Sn/GoGn angle. All patients had a growth spurt of less than 2 per cent according to the evaluation of their pre-treatment hand-wrist radiographs. Fourteen patients were treated with extractions (4 boys 10 girls; 14 years 10 months) and 17 patients without extractions (4 boys, 13 girls; 14 years 7 months). The labio-lingual inclination of the mandibular incisor and the thickness of the alveolar bone at alveolar crest ridge (A), the apical third of

mandibular incisor (C) and the root apex (R) were measured. Statistical analysis within and between groups was carried out using the paired *t*- and Student's *t*-test, respectively.

**RESULTS:** The retrusion of mandibular incisor in the extraction group and the protrusion in the non-extraction group were statistically significant. Total bone thickness at level A in both groups was significantly decreased. Although the intergroup differences were not statistically significant, bone thickness at the labial and lingual portion at level C, the lingual portion at level R, and total bone thickness at levels A, C and R were significantly decreased in the extraction group compared with the non-extraction group.

**CONCLUSION:** In high-angle cases, bone resorption was observed at different levels of the symphysis, especially with extraction treatment. Therefore, the anatomy of the symphysis and the sagittal bone thickness should be considered during treatment planning and the possible effects of mandibular incisor movement on the supporting bone should be observed during treatment.

### 133 MAXILLARY INCISOR INCLINATION – RELATIONSHIP WITH FACIAL AXIS IN AN ORTHODONTIC POPULATION

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**AIMS:** To determine maxillary incisor inclination and its relationship with the facial axis (PtGn-U1) in a group of individuals subjected to an orthodontic treatment and the variation of this angle before and after treatment and 7 to 15 years after the end of active orthodontic treatment.

**SUBJECTS AND METHOD:** Thirty-eight subjects, with a mean age of 25.2 years, who had undergone orthodontic treatment more than 7 years but less than 15 years previously (mean 10.3 years). The angle PtGn-U1 was measured by three examiners on lateral radiographs, with a computer cephalometric analysis program, at three different times: before (T0), and after (T1) active orthodontic treatment; T2 – actually. Different parameters such as treatment with or without extractions, presence of retention, initial malocclusion and facial type were also considered.

**RESULTS:** The mean PtGn-U1 angle measurement at T0 was –3.22 degrees, at T1 0.64 and –0.89 degrees at T2. For Class I malocclusion subjects the PtGn-U1 angle was within a range close to zero degrees. Different means of the PtGn-U1 angle were observed at T1, depending on the initial malocclusion.

**CONCLUSION:** Different compensations of maxillary incisor inclination were found in the different malocclusions and their evolution over the years. Different angular measurements were observed immediately after active orthodontic treatment related to the type of malocclusion. At the long-term observation different measurements were observed for patients with the same initial malocclusion but who were not retained.

### 134 EVALUATION OF THREE COMPOSITES WITH DIFFERENT DEGREES OF FLOWABILITY FOR BONDING FIXED LINGUAL RETAINERS

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**AIM:** To evaluate the resistance to shear forces of three composites with different degrees of flowability used for cementing two types of wire used as lingual retainers.

**MATERIALS AND METHOD:** One hundred and twenty bovine incisors and 120 10 mm lengths of wire (60 stainless steel 0.032 inch round wire and 60 0.0195 inch braided wire). Six groups were established: Transbond-XT (TXT)/round wire, Transbond-LR (TLR)/ round wire, Transbond-SLV (TSLV)/ round wire, TXT/braided wire, TLR/ braided wire, TSLV/ braided wire. The wires were bonded using a polyethylene tube with an internal diameter of 4 mm to which notches were added to aid retention during bonding. Resistance to shear forces was measured using a universal testing machine. Data were analysed with the Kruskal Wallis and Mann-Whitney tests ( $P < 0.05$ ).

**RESULTS:** No significant differences in bond strength were detected between the three composites when used on the round wire ( $P > 0.05$ ). With the braided wire, the bond strength achieved by TXT was significantly lower than that of TLR ( $P < 0.05$ ) and TSLV ( $P < 0.05$ ). When the bond strengths of the two wire types bonded with the same composite were compared, there was no significant difference when TXT was used ( $P > 0.05$ ), whilst with both TLR and TSLV bond strength was significantly higher with the braided than the round wire ( $P < 0.05$ ).

**CONCLUSIONS:** When round wire was bonded, the three composites achieved bond strengths that were not significantly different. When braided wire was bonded with these composites, TLR and TSLV produced similar bond strengths, which were significantly greater than that produced by TXT. TXT produced a similar bond strength regardless of wire type, whilst TLR and TSLV produced significantly greater bond strength with braided wire.



### 135 A COMPARISON OF SKELETAL MATURATION IN HYPODONTIA PATIENTS AND CONTROLS ASSESSED BY CERVICAL VERTEBRAE MATURATION CHANGES

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**AIM:** To investigate if there is a difference in skeletal maturation between hypodontia and control patients and whether skeletal maturation is affected by the severity of hypodontia.

**MATERIALS AND METHOD:** A single-centre retrospective cross-sectional study of lateral cephalograms. Three hundred and sixty patients (aged 9 to 17 years) were recruited and divided into two groups, with and without hypodontia. The hypodontia group was further divided into three subgroups (mild, moderate and severe) based on the severity of the hypodontia. There were 90 patients in each of the four groups: mild, moderate, severe and controls. The cervical maturation stage (CVM) stage was determined for all 365 patients as described by Baccetti *et al.* (2005). A pilot study was conducted to determine the repeatability of the method for both qualitative (Cohen's kappa) and quantitative data (Bland and Altman diagrams). As the data was not normally distributed, non-parametric statistical tests were employed to analyse the data.

**RESULTS:** The age, gender and CVM stage were found to have a statistically significant relationship whereby as the subject grew older their CVM stage increased. Females were more advanced in their development than males of the same age. There was no statistically significant relationship between the CVM stage and the presence or absence of hypodontia. There was also no relationship between the age, gender or CVM stage of the patients, and the severity of hypodontia.

**CONCLUSIONS:** There was no difference in the skeletal maturation between patients with and without hypodontia. Furthermore there was no difference between the skeletal maturity of those patients with different severities of hypodontia.

### 136 MECHANICAL PERFORMANCE OF DIFFERENT ORTHODONTIC ADHESIVE SYSTEMS

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**AIMS:** To evaluate torsion bond strength and the biological properties of three different orthodontic adhesive systems.

**MATERIALS AND METHOD:** Thirty extracted bovine teeth were dissected in to two parts with a microtome; the 60 sections were then randomly divided into three groups of 10 teeth to which self-ligating brackets (Time 2, American Orthodontic, Sheboygan, Wisconsin, USA) were bonded with three different orthodontic adhesives: Transbond XT (3M Unitek, St Paul, Minnesota, USA); Concise (3M Unitek) and Eagle Spectrum (American Orthodontic). The Adhesive Remnants Index was used to evaluate fracture properties. Scanning electron microscopy and energy dispersive spectroscopy were used to assess the possible presence of Ca<sup>++</sup> on the composite resin. A small punch test was performed on all the materials to investigate their mechanical performance. Statistical analysis was performed by means of one-way analysis of variance in order to compare the three groups ( $P < 0.05$ ).

**RESULTS:** Mechanical torsional tests provided the following results [mean values and standard deviation (SD)]: 258.33 Nmm (SD 23 Nmm) for Transbond; 233.33 Nmm (SD 41 Nmm) for Concise and 251 Nmm (SD 50 Nmm) for Spectrum. Mechanically there was not a statistically significant difference between the three groups ( $P > 0.05$ ). Transbond and Concise tended to damage the enamel during debonding more than Spectrum. This could be related to the more marked ability of these two materials to be deformed in comparison with Spectrum, as suggested by the small punch test.

**CONCLUSIONS:** Even though the three different orthodontic adhesive systems basically showed similar values for torsional bond strength, the results indicate that the tested materials showed a different biological behaviour.

### 137 PRIMARY STABILITY AND HISTOMORPHOMETRIC ANALYSES OF ORTHODONTIC MICRO-IMPLANTS

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**AIM:** To compare and correlate factors influencing primary stability of orthodontic micro-implants.

**MATERIALS AND METHOD:** Self-tapping (ST) and self-drilling (SD) implants were placed into bovine iliac bone blocks after computed tomography measurements on cortical bone thickness and bone density (Hounsfield units). Insertion torque (IT) of the implants was quantified and the subjective resistance to insertion was simultaneously scored by one operator. Periotest measurements were undertaken on placement of the implants. Histomorphometric bone-implant contact (BIC %) of each implant was measured. Between-group comparisons were undertaken using the Mann-Whitney *U*, independent *t*-, and chi-square tests at the 95 per cent confidence level followed by Spearman's correlation analyses to explore possible correlations between these factors.

**RESULTS:** IT values and subjective assessment scores of SD and ST implants were similar ( $P = 0.552$  and  $P = 0.324$ , respectively). The difference between Periotest measurements was significant only for Periotest 3 measurements ( $P = 0.013$ ). The BIC of the SD group (87.60) was higher than that of ST group (80.73) ( $P = 0.046$ ). There was a positive correlation between BIC and cortical bone thickness in SD and ST ( $r = 0.909$ ,  $P = 0.00$  and  $r = 0.823$ ,  $P = 0.001$ , respectively). A positive correlation was detected between IT and cortical bone thickness in SD and ST ( $r = 0.544$ ,  $P = 0.00$  and  $r = 0.516$ ,  $P = 0.001$ , respectively). There was a negative correlation between IT and Periotest values, predominantly in SD ( $P < 0.05$ ). The difference between subjective scores was comparable in both groups ( $P < 0.05$ ). There was a positive correlation between BIC and IT values of SD and ST ( $r = 0.657$ ,  $P = 0.02$  and  $r = 0.839$ ,  $P = 0.001$ , respectively).

**CONCLUSIONS:** The primary stability of ST and SD implants was comparable, although the bone mass around the SD implants was greater. There seems to be a positive correlation between BIC, cortical bone thickness and IT and a negative correlation between torque and Periotest values.

### 138 INFLUENCE OF OVARIECTOMIZATION AND OESTROUS ON TOOTH MOVEMENT IN CATS

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**AIM:** To investigate the effects of ovariectomization and the oestrous cycle on tooth movement in cats, and to examine the relationship between oestradiol, calcium, phosphorus, alkaline phosphatase (ALP) and orthodontic tooth movement.

**MATERIALS AND METHOD:** Eighteen healthy female cats divided into three groups. A hysterectomy was performed for sterilization on the first group cats; the second group consisted of anoestrous cats, while the third group included cats in the oestrous cycle. Miniscrews,  $1.6 \times 6$  mm, were implanted in the zygomatic bone of the cats. A closed coil spring with a force of 175 g was placed between the miniscrew and canine tooth with a ligature guide wire. The activation continued during 12 days. At the end of activation, miniscrew and coil springs were removed. The distance between the miniscrew and distal side of canine tooth was measured using an electronic calliper. The measurements were performed on days 0, 6 and 12. Blood was collected from all three groups on day 0. Additional blood was collected from the oestrus group on days 6 and 12.

**RESULTS:** The lowest amount of tooth movement was measured in the oestrous group. There was a positive correlation between the serum calcium level, phosphorus level and the tooth movement. The lowest and highest ALP levels were determined in the ovariectomized and anoestrous group, respectively.

**CONCLUSION:** Oestradiol could have an effective role in restricting tooth movement. It was difficult to determine relationship between the serum ALP level and tooth movement.

### 139 DENTAL AGE ASSESSMENT IN ORTHODONTIC PATIENTS WITH AND WITHOUT SKELETAL MALOCCLUSIONS

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**AIM:** To investigate dental development in an orthodontic patient population with and without different sagittal skeletal malocclusions.

**MATERIALS AND METHOD:** A retrospective study 525 orthodontic patients. Dental age was determined on the panoramic radiographs and compared with the findings of Demirjian et al. Statistical analyses were performed using paired and Student's t-tests.

**RESULTS:** Both genders were advanced in dental maturity compared with the reference samples ( $P = 0.000$ ). The mean difference between chronological and dental age in orthodontic patients with different skeletal malocclusions was approximately twice more than the mean difference in the controls. However, it was statistically significant for females in the Class III group ( $P = 0.021$ ).

**CONCLUSION:** Orthodontic patients with sagittal skeletal malocclusions were approximately twice as advanced when compared with patients without sagittal skeletal anomalies.

### 140 EFFECTS OF ORTHODONTIC TREATMENT WITH FIXED APPLIANCES ON THE CARIES EXPERIENCE OF HIGH AND LOW CARIES RISK GROUPS

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AIM: To test the hypothesis that there is no differences between the changes in caries experience in an orthodontic patient population with a high and low caries risk.

MATERIALS AND METHOD: Data were obtained from clinical and radiographic examinations of 186 orthodontic patients being treated with a fixed appliance in both arches. The subjects were divided into two groups based on their pre-bonding decayed, missing and filling permanent teeth (DMFT) scores and caries risk susceptibility. Statistical analyses were performed using Wilcoxon and Mann-Whitney *U* tests.

RESULTS: Changes in DMFT values were  $0.39 \pm 0.66$  and  $1.46 \pm 1.24$  for THE low and high caries risk groups, respectively. These changes were statistically significant ( $P < 0.001$ ). The differences in DMFT scores between the groups were statistically significant ( $P < 0.001$ ). Males were found to have higher DMFT values when compared with females. This difference was significant for the low risk group ( $P < 0.001$ ), but not for the high risk group ( $P > 0.05$ ).

CONCLUSION: The hypothesis is rejected; the difference in DMFT scores between the caries risk groups was statistically significant. Although the patients in both groups managed maintenance of their oral hygiene, after treatment it was worse than that pre-treatment. Conventional oral hygiene procedures, especially for patients with a high caries risk, are less useful in preventing caries lesions and patients must follow a very rigid oral hygiene protocol during orthodontic treatment with fixed appliances.

#### 141 LONG-TERM EFFICACY OF EARLY CLASS III TREATMENT WITH A FACEMASK, WITH OR WITHOUT PALATAL EXPANSION

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AIMS: To analyze the long-term effects produced by facemask protraction therapy, with or without palatal expansion, in skeletal Class III malocclusion subjects, and to compare these results with the values found in an untreated control group.

SUBJECTS AND METHOD: Thirty-three patients with a Class III malocclusion, divided into three groups: group 1, 10 subjects: rapid maxillary expansion and facemask; group 2, nine subjects: facemask only; group 3, 14 subjects: control sample with untreated Class III malocclusions. Cephalometric radiographs were taken before (T1) and after (T2) treatment and approximately two years post-treatment (T3). Differences between the groups were determined with analysis of variance.

RESULTS: At T3 the sagittal maxillary advancement produced by facemask therapy, with or without expansion, appeared to be stable (SNA: Gr.1:  $-0.3^\circ$ ; ns, Gr.2:  $+0.9^\circ$ ; ns; Harvold Mx: Gr.1  $+1.78$  mm, ns, Gr.2:  $+2.14$  mm,\*, A-McNamara L: Gr.1:  $+0.5$  mm, ns, Gr.2:  $+1$  mm, ns). Nevertheless, significant mandibular changes were noted both in the treated groups and in the untreated sample (Harvold Md: Gr.1:  $+4.40$  mm, ns, Gr.2:  $+6.22$  mm,\*\*, Gr.3:  $+7.64$  mm, \*\*\*; Po-McNamara L: Gr.1:  $+3.50$  mm \*, Gr.2:  $+5.47$  mm, ns, Gr.3:  $+3.29$  mm, ns). Statistical analysis showed a significant increase in face height but only in group 3 (Harvold Hf:  $+4.46$  mm, \*\*\*).

CONCLUSIONS: Similar favourable changes in sagittal intermaxillary relationships were observed after protraction with the facemask, whether associated or not with palatal expansion. During the post-treatment period, craniofacial growth in the treated patients was similar to that of untreated Class III controls. Long-term, the treated subjects tended to resume a Class III growth pattern though the correction of the malocclusion was often maintained, more so when over-correction was achieved.

#### 142 COMPARISON OF THE REVISION RATE OF SECONDARY ALVEOLAR BONE GRAFTING BETWEEN ORTHODONTIC AND NON-ORTHODONTIC PREPARATION IN CLEFT LIP AND PALATE PATIENTS

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AIM: Alveolar bone grafting is required for all cleft patient to provide bone support for eruption of the dentition. Prior to surgery, orthodontic treatment is indicated in some patients while placing a cancellous bone graft before orthodontic treatment is undertaken in others. The main purpose of this study was to compare the revision rate of alveolar bone grafting in cleft lip and palate patients with orthodontic preparation and non-orthodontic preparation and to identify the reason why some patients require repeat surgery.

MATERIALS AND METHOD: The dental record of 101 patients with a unilateral cleft lip and palate were examined. The details recorded were: demographic data, the need for revision, intraoral condition prior surgery, surgical procedure and the cause of revision. The data were then compared using Fisher's exact test.

RESULTS: There were 34 patients in the non-orthodontic preparation group and 67 patients in the orthodontic preparation group. The average age at bone graft was 11.6 and 12.8 years, respectively. The patients undergoing alveolar bone graft had, overall, a 14.8 per cent revision rate. The revision rate for non-orthodontic preparation was 20.6 per cent, which was not

statistically different from the 11.9 per cent revision rate for the orthodontic preparation group ( $P > 0.05$ ). The causes of the revision were: 20 per cent post-operative infection and 80 per cent inadequate bone support at the grafted site.

**CONCLUSION:** There was no difference in revision rate between the orthodontic and non-orthodontic preparation group. The intraoral condition prior to grafting and the different surgical procedures did not have an effect on the success of alveolar bone grafting.

#### 143 EVALUATION OF SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS BONDED WITH NANO-FILLED RESTORATIVE MATERIALS

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**AIM:** To evaluate the shear bond strength (SBS) of metal orthodontic brackets bonded with three different nanocomposites compared with a traditional orthodontic adhesive (Transbond XT; 3M Unitek, USA)

**MATERIALS AND METHOD:** Eighty extracted first premolars divided into four groups. Metal brackets were bonded to enamel surfaces the teeth according to the manufacturer's instructions. The samples in group 1 were bonded with Transbond XT as the control, group 2 with Filtek™ Supreme XT (3M Espe, USA), group 3 with Aelite™ Aesthetic Enamel (Bisco, USA) and group 4 with Gradia direct™ (GC, Japan). All samples were stored in water at 37°C for 24 hours. After thermocycling 2000 times, SBS testing was performed using a universal testing machine (Zwick). ANOVA was used to compare the SBS of all groups.

**RESULTS:** The mean SBS was  $6.91 \pm 2.13$ ,  $6.04 \pm 2.01$ ,  $8.44 \pm 2.09$  and  $4.67 \pm 1.95$  MPa for groups 1, 2 3, and 4, respectively. Although Aelite Aesthetic Enamel revealed the greatest SBS, the difference was not significantly higher compared with Transbond XT ( $P = 0.96$ ).

**CONCLUSIONS:** Some nanocomposite restorative materials show sufficient SBS for bonding orthodontic brackets.

#### 144 FACTORS ASSOCIATED WITH INITIAL STABILITY OF ORTHODONTIC MINISCREWS

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**AIM:** To study the success rates of miniscrew stability (from placement to orthodontic force application) and investigate factors affecting initial stability.

**MATERIALS AND METHOD:** Four hundred and nine miniscrews in 168 patients. Potential confounding variables investigated were: gender, placement site (maxilla or mandible), type, length and diameter of the miniscrew. The outcome variable was initial stability, defined as the stability of the miniscrew prior to orthodontic force application. The logistic regression model fitted using generalized estimating equations (GEE) was used to examine the association between factors and initial stability. The analyses were performed using Stata version 10 and a  $P$  value of 0.05 was used to determine statistical significance.

**RESULTS:** The overall success rate was 91.0 per cent. The results of the univariate analysis by the GEE method showed that the odds of miniscrews in the mandible to achieve initial stability was higher than those in the maxilla (OR: 2.84, 95%CI: 1.18 to 6.84,  $P = 0.020$ ). The other factors (gender, type, length and diameter of miniscrews) showed no statistically significant association with initial stability. Considering all factors in the multivariate analysis, the significant result for placement site remained, i.e. the odds of a miniscrew in the mandible to achieve initial stability was higher than those in the maxilla (OR: 2.72, 95%CI: 1.08 to 6.87,  $P = 0.034$ ).

**CONCLUSIONS:** Even though the initial stability of miniscrews was clinically acceptable, patients must be routinely warned of possible failures and the need for re-insertion. The success rate was higher in the mandible than in the maxilla and this may be attributed to the thicker and denser cortical bone in the mandible.

#### 145 HISTOMORPHOMETRIC ANALYSIS OF ROOT RESORPTION ASSOCIATED WITH CORTICOTOMY-FACILITATED TOOTH MOVEMENT

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AIM: To evaluate the risk of root resorption due to increased bone turnover rate and the enhanced rate of tooth movement in corticotomy assisted tooth movement in a rat model.

MATERIALS AND METHOD: Eighty-one healthy adult male rats divided into three groups: corticotomy (CORT), tooth movement (TM), or a combination (CTM). Selective alveolar decortication was performed on the buccal and palatal cortices adjacent to the upper left first molar while tooth movement was accomplished by moving the upper left first molar mesially with a Sentalloy® coil spring. After an active phase of 6 weeks, the appliances were removed. Histomorphometric analysis was performed to study the amount of root resorption on the tension as well as on the compression side of the first molar as a result of tooth movement.

RESULTS: Seven days after initiation of tooth movement, resorption areas at the compression side increased in the TM ( $0.3 \pm 0.4\%$ ) as well as in the CTM ( $1.1 \pm 1.7\%$ ) groups, with no significant difference between the groups ( $P > 0.05$ ). Through to day 21, the resorption areas steadily increased on the compression side with no significant differences between the groups. In the CORT group, peak resorption was observed at 28 days. On the tension side no significant resorption was observed in the TM and CTM groups. All treated sites returned to baseline at the end of the treatment with no residual resorption.

CONCLUSION: The CTM group showed similar patterns of root resorption compared with conventional tooth movement. No significant negative side-effects on orthodontically induced root resorption could be found due to the increased alveolar metabolism during corticotomy treatment.

#### 146 EFFECT OF CURING TIME ON BISPHENOL A RELEASE AND DEGREE OF CURE OF AN ORTHODONTIC ADHESIVE

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AIM: To evaluate the effect of curing time on Bisphenol A release and the degree of cure of an orthodontic adhesive (Transbond XT) using a halogen light curing unit.

MATERIALS AND METHOD: Premolar brackets were bonded to freshly extracted premolars and subjected to high performance liquid chromatography to assess Bisphenol A release and Fourier transformation infrared spectroscopy to assess the degree of cure. The brackets were cured for 10, 20 or 40 seconds.

RESULTS: Decreased curing time led to increased Bisphenol A release and a lower degree of cure. These findings were statistically significant.

CONCLUSION: Orthodontic composites are far from inert even when cured for 40 seconds.

#### 147 EFFECT OF FLUORIDE-RELEASING VARNISH ON ENAMEL DEMINERALIZATION AROUND BRACKETS: AN *IN VIVO* STUDY

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AIM: Enamel decalcification is a common negative sequela of orthodontic treatment. The aim of this prospective clinical study was to evaluate the effect of a fluoride-releasing varnish on enamel demineralization during orthodontic treatment.

SUBJECTS AND METHOD: Twenty-four patients (mean age 14 years 4 months) who required orthodontic treatment. The maxillary and mandibular anterior teeth were evaluated for demineralization. The fluoride-releasing varnish (Ortho-coat, Pulpdent, Watertown, Massachusetts, USA) was applied to 144 experimental teeth as recommended by the manufacturer. The remaining 144 teeth served as the controls. The patients were followed for 12 to 21 months, i.e. from the start (T0) to the end (T1) of fixed appliance treatment. Digital photographs taken at T0 and T1 were assessed by three evaluators for demineralization.

RESULTS: Eight of the experimental teeth and four of the control teeth had enamel decalcification at T0. At T1 decalcification was observed in 77 of the 144 experimental teeth. In addition, 73 of the 144 control teeth exhibited decalcification.

CONCLUSIONS: No statistical difference was found in the incidence of decalcification between the experimental and control teeth at the end of orthodontic treatment.

#### 148 CLEAR ALIGNER THERAPY IN THE TREATMENT OF SEVERE CROWDING AND MIDLINE DEVIATION

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AIM: To test the efficacy of clear aligner therapy (CAT) in patients with severe crowding and midline discrepancies due to severe localized crowding.

**SUBJECTS AND METHOD:** Twenty adults patients, aged 25 to 35 years, with mild Class II malocclusions with significant midline discrepancies (mean deviation 4 mm) due to severe localized crowding. Orthodontic treatment was accomplished by means of CAT. All patients had panoramic and lateral radiographs taken at the beginning (T1) and end (T2) of treatment, and the expected results ([three-dimensional (3D) projection] were superimposed with the real results obtained by means of a 3D scan of the final models.

**RESULTS:** The mean treatment time was 12 months excluding refinement. At T2 the midline shift was corrected with acceptable root parallelism and a good functional and aesthetic balance. 3D model superimposition showed expansion of the arches and a translatory movement for midline correction.

**CONCLUSIONS:** CAT could represent a valid treatment option in subjects with dentoalveolar asymmetries as a result of the staging of orthodontic movement and the biological force release.

#### 149 TREATMENT RESULTS OF FAN-TYPE RAPID AND RAPID MAXILLARY EXPANSION WITH A MODIFIED ACRYLIC BONDED EXPANSION APPLIANCE ON DENTOFACIAL STRUCTURES

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**AIM:** To investigate the effects of fan-type rapid and rapid maxillary expansion (RME) with a modified acrylic bonded expansion appliance on the dentofacial structures in the treatment of transverse maxillary deficiency in the mixed dentition period.

**SUBJECTS AND METHOD:** The fan-type rapid expansion group had an anterior constricted maxillary width with normal intermolar width and the RME group had a bilateral constricted maxillary width. The fan-type group consisted of 20 patients at a mean age of  $8.96 \pm 1.19$  years and the RME group 22 patients at a mean age of  $8.69 \pm 0.66$  years. The treatment time was  $19.77 \pm 2.02$  days for fan-type group and  $22.82 \pm 2.52$  days for the RME group. The patients in both groups were instructed to activate the screw one-quarter turn twice a day for the first week followed by a quarter turn once per day. Dental casts of both jaws and lateral and frontal cephalometric radiographs were taken before and after expansion and three months after completion of expansion. The data was first compared using repeated measurements analysis of variance then a paired samples *t*-test was used to evaluate the effects of treatment and retention. An independent samples *t*-test was used to determine differences between the groups.

**RESULTS:** The maxilla moved downward and forward in both groups after expansion therapy. The nasal cavity and maxillary width were more expanded in the RME group than in the fan-type group. There was only minimal relapse in the RME group. There was significant labial tipping of the upper incisors in the fan-type group.

**CONCLUSION:** Expansion of intercanine width was similar in both groups, but the expansion of intermolar width was significantly greater in the RME than in the fan-type group.

#### 150 EFFECTS OF LOAD CYCLING AND THERMOCYCLING ON THE SHEAR BOND STRENGTHS OF ORTHODONTIC COMPOSITES

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**AIM:** To compare, *in vitro*, the effects of mechanical loading and thermocycling on the shear bond strength (SBS) of four orthodontic composites.

**MATERIALS AND METHOD:** According to the manufacturers' recommendation, the four different orthodontic composites (Light Bond™, Bisco Ortho LC™, Transbond XT™, Kurasper F™) were used to bond brackets to 96 human mandibular incisors. The teeth were divided into two groups: After 24 hours, the brackets in group 1 were debonded. Mechanical loading (50,000 times) and thermocycling (10,000 times) were carried out in group 2. The brackets were debonded using a universal Instron testing machine. SBS values were recorded in Newton and converted to Mega Pascal (N/mm<sup>2</sup>). Statistical analysis was performed by one-way analysis of variance (ANOVA) and Tukey's HSD and Independent sample *t* tests. Failure type was compared a Mann Whitney *U* test.

**RESULTS:** There were statistically significant differences among the composite types in SBS in group 1, but no significant differences for failure type. Again, there were statistically significant differences among the composite types in SBS in group 2. All composites compared before and after mechanical loading and thermocycling showed statistically significant reductions in SBS values ( $P < 0.05$ ). Kurasper F showed the greatest decrease.

**CONCLUSION:** As the SBS of orthodontic composites was affected by mechanical loading and thermocycling, this may be important for the success of bonding. It is necessary to develop reliable *in vitro* test methods for orthodontic materials.

## 151 TOOTH-COLOUR ASSESSMENT WITH FIXED ORTHODONTIC TREATMENT: A CLINICAL STUDY

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**AIM:** To prospectively assess *in vivo* colour alterations of natural teeth associated with fixed orthodontic treatment.

**SUBJECTS AND METHOD:** Twenty-two patients treated with fixed appliances bonded with four light-cured resins assessed using a split-mouth design. The spectrophotometric data were recorded from a standardized labial circular area of the lower right and left central and lateral teeth, before bracket bonding and 6 months after debonding-cleaning procedures. The lower right lateral tooth was bonded with Green Gloo™, the right central with Light Bond™, left central with Kurasper F™ and the left lateral with Transbond XT™, respectively. The colour parameters of the Commission Internationale de l'Eclairage — L\*, a\*, and b\* (lightness, red/green, and blue/yellow) were measured for each adhesive, and the corresponding colour differences ( $\Delta E$ ) between the interval groups were calculated. The colour changes were assessed with one-way analysis of variance and Tukey HSD and paired *t*-test.

**RESULTS:** Orthodontic treatment was associated with changes in colour parameters. The L\* values decreased ( $P < 0.001$ ), whereas the a\* and b\* values increased ( $P < 0.001$ ) at the end of the 6 month period. All measured teeth demonstrated significant colour changes ( $\Delta E$ ); their mean differences ranged from 2.12 to 2.37  $\Delta E$  units.

**CONCLUSION:** The colour of natural teeth is changed in various ways after a 6 month period of fixed orthodontic treatment.

## 152 LINGUAL INDIRECT BONDING: A CLINICAL SURVIVAL ANALYSIS OF TWO DIFFERENT CUSTOMIZED BRACKET SYSTEMS

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**AIM:** To compare the survival rate of preformed lingual brackets bonded with customized KommonBase resin pad extensions, and custom-made lingual brackets.

**SUBJECTS AND METHOD:** Thirteen patients (300 brackets) were indirectly bonded with STb brackets (Ormco) with the KommonBase system (group 1); while 14 patients (308 brackets) were indirectly bonded with Incognito (3M Unitek) (group 2). The KommonBase system consists of an individualized anatomical extension of the resin pad over the whole lingual tooth surface, adapted to a preformed bracket; while in the Incognito system the bracket base itself is customized to fit the morphology of the tooth; both allowing for easy direct repositioning in case of debonding. The standard bonding protocols recommended for each system were respected (group 1: OrthoSolo (Ormco) and Flow-Tain LV (Reliance); group 2: Maximum Cure (Reliance). The patients were followed for a period of 12-16 months. The cumulative survival of the brackets was analyzed with the Kaplan–Meier method. The log-rank test was used to compare survival curves.

**RESULTS:** The overall success rate for both groups at the end of the observation period was 92 per cent (24 debondings in group 1; 22 debondings in group 2). No statistically significant difference could be observed between the survival curves of either group ( $P = 0.34$ ). The highest percentage of bracket failures occurred 3-6 months after bonding in group 1, and within the first month in group 2. The upper molars were the most prone to debond. In the majority of debondings in group 1, the resin pad extension remained on the bracket, allowing for easy direct rebonding.

**CONCLUSIONS:** Both anatomically customized lingual bonding systems, either through the extension of the resin pad, or through the individualization of the bracket itself, performed equally well.

## 153 CEPHALOMETRIC PATTERNS OF PRIMARY NOCTURNAL ENURESIS: A POLYSOMNOGRAPHIC STUDY

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**AIMS:** Primary nocturnal enuresis (PNE) is a multifactorial disease related to sleep related breathing disorders (SRBD). Studies have shown that craniofacial pattern can be a reliable method to predict the risk for SRBD in enuretic children. This study analyzed cephalometric features to verify the degree of SRBD identified by polysomnography (PSG) and to find their correlation in children with PNE.

**SUBJECTS AND METHOD:** Eighteen subjects with PNE (12 boys; mean age  $10.05 \pm 2.1$ ) and 10 healthy children (6 boys) matched for age ( $P = 0.953$ ) and gender ( $P = 0.953$ ). Lateral cephalometric analysis, including oropharyngeal evaluation and

an overnight PSG, were performed. The apnoea-hypopnoea index (AHI) and oxygen desaturation index (ODI) were calculated. Statistical analysis was performed by *t*-, chi- square, and Pearson's correlation tests.

RESULTS: The enuretic children showed higher AHI and ODI ( $P = 0.001$  and  $P = 0.006$ , respectively) and increased divergency angle S-N^Go-Me ( $P < 0.001$ ). The following parameters were reduced: anterior cranial base length Se-N ( $P = 0.003$ ), mandibular body length Go-Pg ( $P = 0.018$ ), distance of the hyoid from the Frankfort plane, AH-FH ( $P = 0.019$ ) and cranial base, AH-SN ( $P = 0.012$ ), tongue length, from base to the tip, V-T ( $P = 0.013$ ). Pearson's analysis showed correlation between S-N^Go-Me and AHI ( $P = 0.021$ ) and ODI ( $P < 0.001$ ) and negative correlations between Se-N and AHI ( $P = 0.044$ ) and ODI ( $P = 0.001$ ), Go-Pg and AHI ( $P = 0.046$ ) and ODI ( $P = 0.001$ ), Phw1-Psp and AHI ( $P = 0.027$ ) and ODI ( $P = 0.043$ ).

CONCLUSIONS: Enuretic children had some cephalometric features that correlated with SRBD.

#### 154 LONG-TERM RESULTS AFTER DISTRACTION OSTEOGENESIS WITH A FACEMASK ACCORDING TO THE X-Y COORDINATE

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AIMS: Distraction osteogenesis (DO) is gaining popularity, particularly in cleft lip and palate (CLP) patients. Various devices and technique have been reported for this method. The aim of this study was to evaluate the long-term results after DO in CLP patients, treated with an external device – facemask. The advantages of this device are not only the capacity to move the maxilla forward and downward but also the possibility to change the vector of movement during distraction.

SUBJECTS AND METHOD: Twelve CLP patients with maxillary hypoplasia treated with orthodontics and DO with a facemask. Lateral cephalograms taken at three time points: before treatment (T0), after the active phase of distraction (T1) and 5 years or more after distraction (T2) were analyzed. Cephalometric landmarks and measurements were taken according to the X-Y coordinates. The amount of anterior and vertical movement of the landmarks due to maxillary distraction was represented as a linear measurement in millimetres.

RESULTS: The maxilla after active DO (T0-T1) was advanced forward resulting in a positive overjet and improvement of aesthetics and function. The mean amount of distraction at skeletal point A for all patients was 4.2 mm (range: 5-11.5 mm), for soft tissue point A' 4.26 mm and for upper lip (UL) point 4.13 mm. The result at T2 indicated a change in direction of the initial values at skeletal and soft tissue landmarks of maxilla.

CONCLUSIONS: DO is an effective method in the treatment of maxillary deficiency in CLP patients. The long-term results suggest that there is a slight tendency to the relapse in the position of the maxilla. Changes in bony landmark were accompanied by changes in soft tissue position; however the soft tissue showed less stability.

#### 155 EARLY ORTHODONTIC TREATMENT OF IMPACTED MAXILLARY CANINES: COULD WE PREDICT AND PREVENT IMPACTION?

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AIMS: To predict ectopia of the maxillary canines with clinical and radiographic localization of non-erupted upper canines, and to prevent impaction with extraction of primary canines as an early orthodontic treatment method.

SUBJECTS AND METHOD: Early detection of an ectopic eruption path and possible impaction of the maxillary canines was carried out in 20 patients aged 8 to 10 years. The examination was based on a combination of: clinical examination, i.e. digital palpation of the canine bulge, and complete radiographic examinations using sectors and angular measurement to predict a possible impaction of the maxillary canines.

RESULTS: The primary canines were extracted in patients with mesially inclined permanent canines, pressing on to the roots of the lateral incisors resulting in distal tipping. Due to this early orthodontic treatment the permanent canines uprighted and erupted into their correct positions in the arch in 12 of the subjects, providing sufficient space was available.

CONCLUSIONS: Early diagnosis of impacted canines can significantly reduce complications, including surgical exposure and orthodontic alignment as well as root resorption of the lateral incisors. In specific cases, extraction of the primary maxillary canines can prevent impaction of the permanent maxillary canines.



156 A METERING ELEMENT FOR DETECTING STRAINS *IN VIVO* DURING MANDIBULAR ANTERIOR REPOSITIONING APPLIANCE TREATMENT

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AIM: In treating Class II patients with fixed functionals, such as the mandibular anterior repositioning appliance (MARA), unknown forces occur at the appliance and transmitted to the anchoring teeth and adjacent dentition. The aim of this study was to develop a sensor that is able to measure the forces that develop in the MARA.

MATERIALS AND METHOD: A finite element simulation was done to identify the most suitable positions for two sensors that were to be placed on the MARA. The sensors were fixed to the appliance in such a way that would disturb neither the mastication of the patient nor the electronic device in its function. Vertical and horizontal strains were measured with two silicon strain gauges coated to withstand the oral conditions. A portable electronic evaluation device was obtained and software for saving and visualizing the gathered data was developed. *In vivo* analysis was carried out to identify the specified measuring range.

RESULTS: An operational metering element for detecting strains in the MARA *in vivo* has been successfully developed and is currently being used to gain data from patients treated with the MARA. Recent *in vivo* tests have shown that the vertical forces were much smaller than expected and were immediately followed by horizontal forces.

CONCLUSION: It is now possible to measure *in vivo* forces generated by the MARA both in the horizontal and vertical dimension. This will enable studies to be undertaken that will show how to prevent undesired high forces to anchoring teeth and subsequently undesired side effects to the dentition.

157 MAXIMIZING EFFICIENCY OF BONE-ANCHORED RAPID MAXILLARY EXPANSION: A FINITE ELEMENT STUDY

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AIMS: As an alternative to rapid maxillary expansion (RME), bone anchorage has the potential to produce more skeletal effects and less unwanted side-effects on the dentoalveolar structures. The aims of this study were to simulate and evaluate the effects of different modalities on a newly developed patient-specific craniofacial finite element (FE) model for maximizing the efficiency of bone anchored RME.

MATERIALS AND METHOD: An integrated craniofacial model was reconstructed using a three-dimensional (3D) image processing software, Mimics Innovation Suite (version 14.0). Each anatomic structure, sutural and periodontal connection areas, which form the craniofacial system, were segmented, separated, modelled and integrated in accordance with the anatomic reality of computed tomographic data of 12 year-old boy. Patient-specific material characteristics were assigned and 3D model was transferred to FE software, Ansys (version 12.1) for simulative analysis. The combined therapeutic effects of the variables which were localization of the bone anchors (posterior, medial or anterior), mode of applied force (intermittent or continuous) and anchorage composition (solid or hybrid) on the same FE model were analyzed with different simulations.

RESULTS AND CONCLUSION: Stress and displacement patterns of the craniofacial structures during the simulations of different modalities were compared and interpreted to determine the best treatment option. The use of a continuous force module with correct anchorage localization and composition allows safer and more efficient therapeutic results.

158 HOW DO WE MOVE TEETH AFTER ALL: THE ROLE OF POLYCYSTIN-1 IN MECHANICALLY INDUCED ALVEOLAR BONE REMODELLING

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AIM: The compression and tension theory within the periodontal ligament (PDL) leading to alveolar bone remodelling and ultimately to tooth movement cannot support emerging data from the molecular behaviour of PDL cells. Rather, a loading-unloading theory seems more appropriate in explaining recent advances. To this end the role of Polycystin-1 (PC-1) and Polysystin-2 (PC-2) as key mechanosensors was examined in stressed human PDL cells.

MATERIALS AND METHOD: Human PDL fibroblasts were isolated and cultured from healthy extracted teeth. Immunofluorescence was performed for PC-1, PC-2, cilia, PC-1 co-localization w/cilia. Experiments were performed between passages 3-5. Cells were stretched for 0, 1/2, 1, 3 and, 6 hours. Western-blot analysis was performed for ERK, PC-1, PC-2, NFATc1, phospho-NFATc1.

RESULTS: P-1 and PC-2 were expressed in PDL cells. Co-localization of cilia and PC-1 was also detected. In cytoplasmic extracts phospho-NFATc1 decreased at 20 minutes and 1 hour and increased again at 3 and 6 hours.

CONCLUSIONS: This is the first study examining the role of PC-1 and PC-2 as mechanosensor molecules in stressed PDL cells. The results reveal the implication of PC-1 and PC-2 in the mechanical stretching of PDL fibroblasts as well as the signal transduction pathway involved, indicating their function in mechanically induced alveolar bone remodelling hence further substantiating the theory of loading-unloading within the PDL.

#### 159 AN *IN VITRO* ANIMAL STUDY OF MEASUREMENT RELIABILITY USING TWO DIFFERENT CONE BEAM COMPUTED TOMOGRAPHY SCANNERS

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AIM: To assess the reliability of measurements taken on images obtained with different CBCT scanner and DICOM elaboration software

MATERIALS AND METHOD: A recently sacrificed lamb's head was split along the sagittal midline and several gutta-percha points were fixed in 10 internal points. Seven sagittal and eight vertical measurements were undertaken three times by one operator using a digital calliper. The two parts were then joined with cyanoacrylate glue. Gutta-percha points were also fixed in four medial and three bilateral external points. Ten sagittal vertical and three transverse measurements were made. The head was scanned with a Kodak 9500 and an iCAT classic cone beam computed tomographic, using different scanning parameters. DICOM images were reconstructed with InVivoDental Anatomage software and the same measurements were repeated and statistically analysed.

RESULTS: There was no clinically significant difference between the measurements of the images obtained with the two scanners.

CONCLUSIONS: A number of CBCT scanners are available. Detector technology and algorithm precision influence image quality. The results show that when reference points can be easily and clearly located such as with gutta-percha points, there was no clinically significant difference between the two scanners. Further studies are needed to investigate image reliability with less radio-opaque structures such as the soft tissues.

#### 160 EFFICACY OF A COMBINED ZINC-GLUCONATE AND CETYLPYRIDINIUM-CHLORIDE ORAL-RINSE AND TOOTHPASTE IN PREVENTING GINGIVITIS

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AIM: To assess, in patients undergoing fixed orthodontic appliance treatment, the efficacy of a zinc-gluconate and cetylpyridinium-chloride oral-rinse used either with or without toothpaste, in preventing gingivitis.

SUBJECTS AND METHOD: Twenty-four healthy non-smokers, without periodontal pathology, randomly divided into three equal groups. The study started (T0) two weeks after a professional oral hygiene, instruction and motivation session. The plaque Index (PI), gingival index (GI) and periodontal probing depth (PPD) were recorded. The control group (A) used dental floss and a toothbrush without toothpaste; group B additionally used twice a day a zinc-gluconate and cetylpyridinium-chloride mouthrinse; and group C also used a zinc-gluconate and cetylpyridinium-chloride toothpaste. After one month (T1) measurements were recorded, a professional oral hygiene session was performed and group B and C were crossed. Finally after one month (T2) measurements were again recorded by the same operator blinded to the research and analyzed by a third blind operator.

RESULTS: PI and GI were statistically ( $P < 0.05$ ) higher in group A than in group B; moreover they were higher in the group B than in group C. There was no statistically significant difference regarding PPD.

CONCLUSIONS: The zinc-gluconate and cetylpyridinium-chloride mouthrinse used in this study was effective in preventing plaque accumulation and gingival inflammation in periodontally healthy orthodontic patients. Its efficacy was augmented when associated with a zinc-gluconate and cetylpyridinium-chloride toothpaste.

#### 161 EVALUATION OF FINAL PHASE TREATMENT OUTCOMES IN COMPLETE CLEFT LIP AND PALATE PATIENTS WITH AND WITHOUT SURGERY

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AIM: To assess the outcome of the final phase of treatment in cleft lip and palate patients with orthodontic treatment alone (OTA) or with orthognathic surgery combined with pre-surgical orthodontics (COS). A secondary objective was to determine the improvement in the occlusion of the two alternatives of treatment.

SUBJECTS AND METHOD: Twenty-seven OTA patients and seven COS cleft patients who had completed their respective treatments. The peer assessment rating (PAR) index was used on the pre- and post-treatment study models to interpret the objectives. A Mann-Whitney *U* test was used to compare the post-treatment improvement in PAR scores between the OTA and COS groups. Comparison of PAR index score improvement categories in both groups was made using Fisher's exact test.

RESULTS: The post-treatment PAR index score for the OTA group ( $2.67 \pm 2.27$ ) was not significantly different from the COS group ( $2.43 \pm 1.51$ ). The PAR index score improvements were not significantly different for the OTA ( $29.59 \pm 8.79$ ) and COS ( $37.43 \pm 8.79$ ) groups. There was no significant difference in the degree of PAR index score improvements between the OTA and COS groups. Two cases (7.41%) in the OTA group presented excellent orthodontic treatment outcomes whereas other cases (92.59%) were classified as having great orthodontic improvement. For the COS group, all cases (100%) demonstrated great reduction of the malocclusion.

CONCLUSION: The post-treatment PAR index scores for final treatment outcome evaluation were excellent in both groups. There was no difference in the degree of improvement in the occlusion in the final phase of treatment between the two groups. Two patients who underwent OTA had an excellent or total improvement of the malocclusion while the others in both groups had a significant orthodontic improvement.

## 162 IN VITRO CYTOTOXICITY OF ORTHODONTIC ADHESIVE RESINS

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AIM: To evaluate the cytotoxicity and monomer leaching from four orthodontic composites: Concise (3M Unitek, Monrovia, USA), Transbond XT (3M Unitek), Eagle Spectrum (American Orthodontics, Sheboygan, USA) and Greengloo (Ormco, Glendora, USA).

MATERIALS AND METHOD: BALB 3T3 cells were exposed to polymerized and unpolymerized samples of the four orthodontic resins. Morphological changes were evaluated, by inverted optical microscopy, after 24 hours exposure. Cellular viability was evaluated, by Alamar Blue assay, after 24, 48 and 72 hours of exposure. High performance liquid chromatography (HPLC) was used to measure the amount of monomer released by the samples over 24, 48 and 72 hours. Data were analyzed using one-way analysis of variance with Bonferroni *post hoc* test for multiple comparisons with a significance level of 0.05. RESULTS: All tested materials were cytotoxic. The Alamar Blue assay showed the following results concerning cellular viability: Eagle Spectrum (70% at 24 hours, 60% at 48 hours and 50 % at 72 hours) > Transbond XT (60% at 24 hours, 55% at 48 hours and 40% at 72 hours) > Concise (40% at 24 hours, 30 % at 48 hours and 20% at 72 hours) > Greengloo (15% at 24 hours, 10% at 48 hours and 5% at 72 hours). The Alamar Blue assay also showed that the unpolymerized samples were more cytotoxic than the polymerized samples ( $P < 0.05$ ). Analyses of the monomer leaching, evaluated by HPLC, showed that TEGDMA was more eluted than Bis-GMA.

CONCLUSIONS: The cytotoxicity of all four investigated orthodontic resins may have clinical relevance. Since monomer elution significantly influences cytotoxicity, it is important that the correct curing procedure is used to improve the material conversion.

## 163 MESENCHYMAL STEM CELL PROLIFERATION ON COMPOSITE SCAFFOLDS FOR BONE REGENERATION

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AIM: Therapies based on tissue engineering seem to be among the most promising approaches to help the regeneration of bone tissue. The aim of this research was to evaluate mesenchymal stem cell (MSC) proliferation and differentiation on a hydroxyapatite/polycaprolactone (HA/PCL) scaffold developed for bone regeneration.

MATERIALS AND METHOD: HA/PCL scaffolds were fabricated by means of a phase inversion/salt-leaching technique. The bone marrow derived mesenchymal stem cells (BMSC) and dental pulp mesenchymal stem cells were seeded on three-dimensionally porous scaffolds and, after 1, 7, 14, 21 and 28 days, MSCs proliferation was measured by Alamar Blue assay

and osteoblast differentiation was evaluated by measuring alkaline phosphatase (ALP) levels. The morphology of the cell-scaffold constructs was analyzed by scanning electron microscopy (SEM) and histology (haematoxylin and eosin stain) after 15 and 35 days.

**RESULTS:** Cell proliferation strongly increased over culture time with a significant difference between the two cell lines and between cell growth in the basic medium and those grown in the osteogenic medium. ALP values showed that the stem cells, in particular BMSC, differentiated into the osteoblastic line. It was possible to observe on the SEM micrographs, at day 15, that the cells had migrated through the pores into nearly every corner of the scaffold and were able to adhere and proliferate onto the wall of the pores, and that on day 35, the cells produced a large quantity of collagen fibrils.

**CONCLUSION:** The approach of combining MSCs and composite scaffolds with high porosity and a three-dimensional structure is a promising strategy to design and develop materials for bone regeneration.

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#### 164 A MODEL TO INVESTIGATE GINGIVAL RECESSON AND TOOTH MOVEMENT

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**AIMS:** Whether orthodontic arch expansion is an aetiological factor in the development of gingival recession is unclear. In a large epidemiological study, the prevalence of >1 mm recession in persons > 30 years was 58 per cent. Ambiguous conclusions can be drawn from the available clinical (retrospective) studies correlating orthodontic treatment and the prevalence and severity of gingival recession. The aim of the present pilot study was to establish a model to evaluate parameters of possible importance for the prevalence and/or severity of gingival recession during arch expansion.

**MATERIALS AND METHOD:** Nineteen male albino Wistar rats with a mean body weight of 428 g. To generate mainly translational buccal tooth movement, a biomechanical approach of expansive force combined with torque control was applied. Several types of transpalatal springs were used to exert high and low force on two or four molars. The appliance was directly bonded or attached to 0.018 × 0.025 inch tubes. A transpalatal bar prevented opening of the midpalatal suture and served as a landmark for measuring. The active time span was 17 to 87 days. Four animals were excluded due to loss of the appliance after 1, 4, 17 and 29 days. The analysis was based on microcomputed tomography (μCT), histology and histomorphometry.

**RESULTS:** μCT evaluation showed that the molars moved buccally, mainly translational, up to one tooth width. Failure of torque control lead mainly to rotational movement.

**CONCLUSIONS:** A model to move rat molars in a buccal translational way with different magnitudes of orthodontic force was established. With this model further research investigating the aetiology of gingival recession and orthodontic tooth movement is possible.

#### 165 BIOMECHANICAL ANALYSIS OF TORQUE CAPABILITIES OF LINGUAL BRACKETS

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**AIM:** Measurement of the torque play and torque effectiveness of titanium molybdenum (TMA) and stainless steel (SS) wires in upper incisor lingual brackets

**MATERIALS AND METHOD:** Various TMA (0.0175 × 0.0175, 0.0170 × 0.025, 0.0182 × 0.0182 and 0.0182 × 0.025 inch) and SS wires (0.016 × 0.022, 0.016 × 0.024 and 0.018 × 0.025 inch) were fixed with an elastic module and twisted in five normal (Hiro, Incognito™, Joy®, Kurz 7th generation, STb™) and two self ligating brackets (Evolution SLT®, In-Ovation® L M™) with a custom made testing machine between -20 and +20 degrees in a one-bracket model. The torque play, effective torque play at 1.0, 2.5 and 5.0 Nmm of torque moment and bracket slot size were measured.

**RESULTS:** All brackets showed a divergent slot size compared with the nominal 0.018 inch (0.457 mm): Evolution SLT® (<0.452 mm), Incognito™ (0.460 ± 0.002 mm), In-Ovation® L M™ (0.469 ± 0.001 mm), Hiro (0.469 ± 0.010 mm), STb™ (0.471 ± 0.002 mm), Kurz 7th generation (0.473 ± 0.002 mm) and Joy® (>0.498 mm). All brackets, except Evolution SLT®, showed torque play even with the most slot-filling wire, TMA 0.0182 × 0.025 inches: Evolution SLT® (0 ± 0°), Incognito™



( $2.2 \pm 1.1^\circ$ ), Hiro ( $5.1 \pm 3.0^\circ$ ), In-Ovation® L M™ ( $6.3 \pm 2.2^\circ$ ), STb™ ( $6.6 \pm 1.8^\circ$ ), Kurz 7th generation ( $7.1 \pm 0.8^\circ$ ) and Joy® ( $12.0 \pm 0.8^\circ$ ). The least effective torque play was for Incognito™ with almost all wires. The torque play and effective torque play of STb™ and Kurz 7th generation were similar. The common TMA  $0.0175 \times 0.0175$ , SS  $0.016 \times 0.022$  and SS  $0.016 \times 0.024$  inch wires showed high torque play (up to  $24.3^\circ/23.0^\circ/21.2^\circ$ ) and effective torque play. TMA  $0.0182 \times 0.025$  inch wire showed similar torque play to TMA  $0.0182 \times 0.0182$  inch wire, but was capable of applying bigger moments. The torque effectiveness of TMA  $0.0182 \times 0.025$  and SS  $0.018 \times 0.025$  inch wires was similar.

CONCLUSIONS: Only few bracket-wire combinations provided acceptable torque control with an elastic ligature.

#### 166 EXTENT OF ROOT RESORPTION AND TOOTH MOVEMENT AFTER APPLICATION OF ASCENDING AND DESCENDING MAGNETIC FORCES. A MICRO-COMPUTED TOMOGRAPHIC STUDY\*\*\*

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AIM: To evaluate root resorption and tooth movement in ascending and descending forces generated by magnets.

MATERIALS AND METHOD: Twenty maxillary first premolars from 10 humans were subjected to ascending (25 to 225 g) and descending (225 to 25 g) forces using a split-mouth design over a 12-week period. Buccal movement of one premolar was subjected to ascending force (magnets in attraction) and the contralateral premolar to descending force (magnets in repulsion). Polyvinyl siloxane impressions were taken at week 0, 4 and 12 to record tooth movement. After 12 weeks, the teeth were extracted, scanned with using microcomputed tomography at  $16.9 \mu\text{m}$  resolution, reconstructed in three dimensions, and the root resorption craters were localised and quantified.

RESULTS: The cube root of total volume of root resorption with ascending force was 1.030 mm and the descending force 1.056 mm; there was no statistically significant difference between them. In comparison with a previous study using light (25 g) and heavy (225 g) buccally directed orthodontic force over a 12 week period, both the ascending and descending magnetic forces showed higher root resorption than the heavy force over a 12-week period; however, this was not statistically significant. The location of root resorption on the palatal surface was significantly less than on the buccal surface (0.061 versus 0.116,  $P = 0.026$ ) and the mesial surface (0.061 versus 0.126,  $P = 0.008$ ). The cervical, middle, and apical thirds of the root did not show a statistically significant difference in the amount of root resorption. The rate of tooth movement following ascending and descending force application was not statistically significant.

CONCLUSIONS: There was no statistically significant difference in the amount of tooth movement after application of ascending and descending force. Although the ascending and descending forces generated more root resorption than heavy force over 12 week period;

#### 167 WHITE SPOT LESIONS ON TEETH WITH ORTHODONTIC BRACKETS: FORMATION AND PREVENTION

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AIM: Decalcification or white spot lesion (WSL) development of the enamel surface is an important iatrogenic effect of fixed orthodontic appliance therapy. The aim of this study was to evaluate demineralized WSL during orthodontic treatment.

SUBJECTS AND METHOD: Thirty-five patients with fixed orthodontic appliances. Twenty were treated with tooth mousse and 15 with a high concentration of fluoride.

RESULTS: No significant difference was found between the groups, indicating that the efficacy of the two fluoride varnishes was similar.

CONCLUSIONS: Fluoride is the most potent cariostatic agent available that can prevent the development of lesions. All orthodontic patients must brush daily with fluoride toothpaste. Daily use of a fluoride mouth rinse is also recommended. Topical fluoride in the form of solutions, varnishes, or gels should be applied around the brackets. Applying tooth mousse is also beneficial.

#### 168 RELATIONSHIP BETWEEN DENTAL AGE, CHRONOLOGICAL AGE AND ANTHROPOMETRIC MEASUREMENTS IN CHILDREN

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AIM: Conventional methods for estimation of the growth and development of children are anthropometric measurements of the whole body and body parts. Anthropometric measurements are interconnected, so that with growth and development the change of one parameter causes changes in the other parameters. The aim of this research was to determine the dependence between dental and chronological age with anthropometrics measurements related to gender in a group of children from Bosnia and Herzegovina.

SUBJECTS AND METHOD: Two hundred girls and boys aged 6 to 8 years. Dental age was determined as the average of the sum of the existing permanent teeth from the participants aged 6, 7 and 8 with the aim of analyzing physical growth and development. Commonly accepted anthropometric indices were used: height and weight, which were measured according to the methodology of the International Biological Programme.

RESULTS: The mean values of dental age coincided with chronological age as well as the anthropometric measurements in all three age groups. There was a high interdependence of dental and chronological age (72.2% for boys and 71.9% for girls).

#### 169 TREATMENT OF MAXILLARY SAGITTAL DEFICIENCY WITH TOOTH-BORNE DISTRACTION AND POSTERIOR SEGMENTAL SAGITTAL DISTRACTION OSTEOGENESIS

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AIM: To evaluate the treatment effects of distraction osteogenesis using the posterior segmental sagittal distraction osteogenesis (PSSDO) technique with a custom made tooth-borne distraction device on growing patients in the permanent dentition with a skeletal Class III malocclusion and maxillary sagittal deficiency.

SUBJECTS AND METHOD: Four boys and nine girls with a mean chronological age of 14.6 years and a mean bone age of 15.7 years. For PSSDO a custom made tooth-borne distraction device was prepared. A posterior segmental osteotomy was performed between the first and second premolars. After a latency period of 7 days distraction was performed with a distraction rhythm of  $2 \times 0.2$  mm/day and a distraction rate of 0.4 mm/day. After a consolidation period of 12 weeks, the tooth borne device was removed and fixed orthodontic treatment commenced. Lateral cephalometric films from before treatment, before surgery, after distraction and after consolidation were analysed. Study models obtained before treatment, before surgery and after distraction were also analysed. Repeated measurement variance analysis and Friedman test were used to evaluate significant changes in the measurements. Multiple comparison and Wilcoxon signed rank tests were used to determine differences.

RESULTS: The distraction device was activated 8.05 mm. At the end of treatment the increase in maxillary length was 4.88 mm, and the maxilla was successfully advanced in the sagittal plane. The anterior crossbite was corrected in all patients with a 7.5 mm increase in overjet. The increase in maxillary arch length was 14.66 mm, and sufficient space was obtained to relieve crowding without extractions. The soft tissue profile was improved. The results were stable at the end of the consolidation period.

#### 170 ENAMEL THICKNESS AND ROOT CANAL TAPER IN MAXILLARY SECOND PREMOLARS OF A 3000 YEAR OLD SKULL\*\*\*

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AIM: To determine the enamel thickness and root canal taper in maxillary second premolars (single-root teeth) of people living in China 3000 years ago using microcomputed tomography ( $\mu$ CT). This research could also accumulate information for the evolution of human tooth.

MATERIALS AND METHOD: Twenty maxillary second premolars (mean age = 18 years; range 15-25 years) were scanned using  $\mu$ CT. After three-dimensional reconstruction and accurate positioning, the enamel thickness and root canal taper was measured using technical software.

RESULTS: Enamel thickness of samples showed that the lingual cusp enamel was the thickest for all regions ( $1.11 \pm 0.07$  mm), the distal enamel was thicker than the buccal ( $P < 0.01$ ). The average taper of the cervical, middle and apical regions were: 0.13, 0.33 and 0.12 buccolingually and -0.22, 0.31, and 0.08 mesiodistally.

CONCLUSIONS: Enamel thickness was quite distinct in different cross-sections of maxillary second premolars, and they were thicker in the functional region than in non-functional region. The taper of the canals in buccolingual orientation was greater than that in mesiodistal orientation in these specimens. The root canals were not continuous for cone-shaped canals, and the canal tapers were significantly different among parts in buccolingual direction.

# 171 PERCEPTION OF SMILE AESTHETICS: COMPARISON BETWEEN DENTISTS, PHYSICIANS AND LAY PERSON

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AIM: To determine universal aesthetic parameters in the evaluation of smile aesthetics.

MATERIALS AND METHOD: A questionnaire was created to collect statistically significant data. Five different types of smiles were photographed in order to evaluate their appeal: (a) a smile with crowded teeth and white spots; (b) a smile with a skeletal Class III, monolateral crossbite and deviation of the midline; (c) a smile with a diastema and a divergent dento-dental ratio; (d) a smile with vertical maxillary excess (gummy smile); (e) a treated smile (ideal). The questionnaire was completed by 216 subjects of different professional categories (generic dentists, orthodontists, physicians) and 210 subjects of different ages and jobs. The data was then imported into the Statistical Package for Social Sciences, version 14, using a method of univariate statistical analysis.

RESULTS: For the total sample gender did not influence the choice of smile. Only smile 'a' was influenced by age. When the dentists and physicians were compared with laypersons, profession influenced the choice of smiles 'a', 'b' and 'e'. In the comparison of generic dentists and orthodontists, age influenced the choice of smile 'e' and gender the choice of smiles 'c' and 'd'. There was a difference in the responses in the choice of smiles 'b', 'd', 'e'.

CONCLUSIONS: Gender and age does not influence the choice of a smile. Smile 'e' was considered the most pleasant by a higher percentage of physicians and dentists, whereas, a higher percentage of laypersons evaluated smile 'b' as being the most attractive. There was a difference of opinion between generic dentists and orthodontists, but in most cases the orthodontists agreed on the preferences.

# 172 EFFECT OF LOW LEVEL LASER THERAPY ON BONE REGENERATION OF THE MIDPALATAL SUTURE AFTER RAPID MAXILLARY EXPANSION

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AIM: To evaluate the effects of low level laser therapy (LLLT) on bone regeneration in the midpalatal suture after rapid maxillary expansion (RME).

SUBJECTS AND METHOD: Thirteen patients aged between 10 and 15 years with maxillary transverse deficiency (> 5 mm) and a bilateral or unilateral posterior crossbite. All patients underwent RME with a Hyrax expander. The subjects were divided into two groups: control (n = 15) and laser (n = 15). The Hyrax appliance was activated by turning the screw one turn in the morning and another turn in the evening. A diode laser (3 W,  $\lambda = 810$  nm,  $\Theta = 3.5$  cm<sup>2</sup>) was used. The laser was applied in continuous mode for 15 seconds at each point in five sessions with intervals of 48 hours. The delivered energy was 45 j and energy density was 13 j/cm<sup>2</sup>. The laser probe was placed behind the cingulum of the incisors. Multislice low dose computed tomographic scans were taken 6 weeks later after final laser application and 12 weeks later in the control group. Density was measured in Hounsfield units.

RESULTS: The difference in bone density of the midpalatal suture between the control and laser group was not statistically significant ( $P > 0.05$ ). Bone density in midpalatal suture of two sample groups was almost equal.

CONCLUSION: LLLT shortens the retention period and accelerates bone regeneration in the midpalatal suture during RME. Hence there is no need to wait 3 months or more, which may negatively affect patient cooperation.

# 173 PALATALLY IMPACTED MAXILLARY CANINES: FACTORS INFLUENCING TREATMENT DURATION AND COST

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AIM: To investigate the relationship between the initial positions of palatally impacted maxillary canines on panoramic radiograph and the duration of orthodontic treatment. A further aim was to calculate the costs and economic outcome of treatment.

MATERIALS AND METHOD: Data from patient records and panoramic radiographs of 66 consecutive adolescents with the diagnosis of palatally impacted maxillary canines (unilateral 51 patients, bilateral 15). All the patients were treated with either forced eruption followed by fixed orthodontic appliances or only with fixed appliances between the years 2001-2009.

**RESULTS:** The average duration of treatment for unilateral impacted canines was  $20.8 \pm 7.2$  months and for bilateral cases  $25.5 \pm 9.3$  months. There was a strong correlation between the initial position of the canine in the different zones ( $P < 0.001$ ), the distance between the canine cusp tip and the occlusal plane ( $P < 0.001$ ), the inclination of the canine ( $P < 0.001$ ) and uni- or bilateral impaction ( $P = 0.004$ ) with the duration of treatment. Gender and age of the patients had no influence on treatment duration. The cost of treatment for 66 patients was €92 170, unilateral cases €1 270 and bilateral cases €1 885. The total annual cost of treatment of palatally impacted maxillary canines in Sweden was calculated as 25 million Swedish kronor.

**CONCLUSIONS:** If the canine was impacted in zone 1 or 2, treatment duration averaged 15 months; if the canine was impacted in zone 3, treatment duration averaged 19 months; if the canine was impacted in zones 4 or 5, treatment averaged 25 months. This information makes it possible to estimate the duration of treatment by studying the panoramic radiograph and provide patients with accurate information concerning treatment time.

#### 174 ALTERED EXPRESSION OF GENES INVOLVED IN TOOTH ERUPTION IN PATIENTS WITH CLEIDOCRA- NIAL DYSPLASIA

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**AIMS:** The dental follicle plays an important role in tooth eruption by providing key regulators of osteogenesis and bone resorption. Patients with cleidocranial dysplasia (CCD) exhibit delayed tooth eruption in combination with increased bone density in the maxilla and mandible, suggesting disturbances in bone remodelling. The aim of this study was to determine the expression of genes involved in tooth eruption and bone remodelling in dental follicles from CCD patients and normal subjects.

**MATERIALS AND METHODS:** Thirteen dental follicles were isolated from five, unrelated CCD patients and 14 dental follicles were obtained from 10 healthy individuals. All teeth were in the intraosseous phase of tooth eruption. The expression of RUNX2, RANK, RANKL, OPG, and CSF-1 genes was determined by quantitative RT-polymerase chain reaction.

**RESULTS:** In CCD patients the mRNA levels of RUNX2, RANK and OPG were significantly elevated compared with the control group. Accordingly, the ratios of RANKL/OPG and RANKL/RANK mRNAs were significantly decreased in CCD patients.

**CONCLUSIONS:** The observed alterations in the expression and/or ratio of RANK, RANKL and OPG in the dental follicle of CCDs suggest a disturbed paracrine signalling for bone remodelling that probably contributes to the impaired tooth eruption seen in these patients.

#### 175 INFLUENCE OF MIXING METHODS AND DISINFECTANT ON THE PHYSICAL PROPERTIES OF ALGINATE IMPRESSION MATERIALS

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**AIM:** To quantify, *in vitro*, the effect of manual versus automatic mixing, and use of a disinfectant on various mechanical properties (tensile strength, elastic recovery, detail reproduction) of three alginate impression materials.

**MATERIALS AND METHOD:** Two of the alginates tested were developed for orthodontic purpose: Orthotrace® (Cavex Holland BV, Haarlem, Netherlands) and Orthofine® (Zeist, Netherlands). The third was a conventional alginate CA37FS® (Cavex). The alginates were either mixed by hand or automatically using a Cavex alginate mixer II® according to the manufacturer's recommendations. Mixing was performed at room temperature using tap water. The material was allowed to set in a water bath at 35°C ( $\pm 1^\circ\text{C}$ ), simulating intraoral setting conditions. Half of the samples were disinfected before testing. The disinfectant used was Cavex ImpreSafe® which has a bactericide, virucide and fungicide function. The specimens were exposed for 3 minutes in a 3 per cent solution and then tested according to the ISO standard specifications for dental alginate impression materials. Descriptive statistics as well as one-way analysis of variance were performed (SAS Institute, Cary, North Carolina, USA).

**RESULTS:** Evaluation of tensile strength and elastic recovery of different samples, either hand mixed versus automatically mixed or disinfected versus not disinfected, resulted in significant differences for all materials except for Orthofine®. The mixing procedure did not affect the physical properties tested and use of disinfectant did not significantly influence tensile strength.

**CONCLUSION:** The mixing method used significantly affected the elastic recovery and tensile strength of the alginates



tested while the effect of using a disinfectant was less explicit. The tensile strength of Orthotrace® and CA37FS® was almost twice that of Orthofine®.

#### 176 COMPUTERIZED AXIOGRAPHY FOR TEMPOROMANDIBULAR JOINT EVALUATION IN PATIENTS WITH SAGITTAL MALOCCLUSIONS

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AIM: To evaluate the advantages of computerized axiography for temporomandibular joint (TMJ) examination in patients with malocclusions in the sagittal plane.

SUBJECTS AND METHOD: Nineteen patients with sagittal malocclusions: 10 with a Class II division 1 malocclusion and nine with a Class III malocclusion. For all patients computerized axiography of the TMJ was performed after a short preliminary clinical evaluation according to the 6-question Hamburg Cranio-Mandibular Dysfunction screening.

RESULTS: Patients with Class II malocclusions had an increased condylar path angle compared with those with a Class III malocclusion. A clear tendency to translation movement limitations characterized by shortening of the condylar path up to 4 mm was observed in patients with a Class III malocclusion.

CONCLUSIONS: Computerized axiography allows evaluation of the condylar position in the glenoid fossa and three-dimensional imaging of the trajectories of TMJ movements. The technical advantages of this method are: fast and easy electronic sensor attachment, possibility of data back-up, computer friendly, data output for different articulators of various manufacturers that can be used for a splint fabrication. Orthodontic treatment planning should take into consideration different TMJ characteristics in patients with sagittal malocclusions. A Class II malocclusion can be an indication for a detailed TMJ evaluation.

#### 177 EVALUATION OF THE CHARACTERISTICS OF ENAMEL CRACKS AFTER BRACKET REMOVAL

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AIM: To evaluate and compare the characteristics of enamel cracks of adult patients before and after removal of metal brackets.

MATERIALS AND METHOD: Forty-five extracted human teeth that satisfied the inclusion criteria (intact buccal/labial enamel with no white spots, no pre-treatment with chemical agents, no previous orthodontic treatment, no damage caused by extraction procedure, patients aged 35-55 years old who demonstrated similar initial enamel characteristics. After scanning electron microscopy examination the teeth were divided into three groups of equal size: group 1, teeth with enamel cracks, group 2, teeth without initial enamel cracks, and group 3, a control group to study the effect of dehydration on existing or the formation of new cracks. The buccal/labial enamel surface was divided into three zones of equal height (1st zone – cervical third, 2nd zone – middle third, 3rd zone – occlusal third) for detailed mapping of enamel cracks. For all the teeth in groups 1 and 2, the same bonding and debonding procedures of metal brackets were conducted. The length and width of the longest enamel cracks were measured for all teeth before and after removal of the brackets. Changes of the location of the cracks were also evaluated. In group 3, the teeth were subjected to the same analysis, but not bonded. Statistical analyses were carried out using the Statistical Package for Social Sciences, version 17.0.

RESULTS: The mean overall width of the cracks after bracket removal was 3.84 µm greater than before the bonding procedure. A difference was also noticed between the width of the cracks in 1st and 3rd zones after bracket removal. New enamel cracks were found in six of the 15 (40%) examined teeth.

CONCLUSIONS: The greatest changes in the width of enamel cracks after removal of metal brackets appear in the cervical third of the tooth.

#### 178 DIFFERENCES IN SKULL PARAMETERS OF CLASS II DIVISION 2 CHILDREN

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AIM: To study age-related change intensity in the cerebral and facial parts of the skull of Angle's Class II division 2 children to detect morphological structures differing from their normal growth intensity in the period of the primary dentition.

**MATERIALS AND METHOD:** Sixty-two teleroentgenograms were obtained of the head in lateral projection. Thirteen longitudinal and 14 vertical parameters were measured of the facial and cerebral parts of skull of 30 children (7-12 years of age) during the primary dentition and of 32 children (12-15 years of age).

**RESULTS:** The intensity of age-related changes of many longitudinal and vertical parameters of the skull were significantly different from normal

**CONCLUSIONS:** The obtained data showed that children with an Angle Class II division 2 malocclusion should be treated as early as possible.

#### 179 ORTHODONTIC TREATMENT NEED: INTRA- AND INTER-EXAMINER AGREEMENT OF FOUR INDICES

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**AIMS:** Various indices are used to define orthodontic treatment need and outcome. The aim of this study was to evaluate intra- and inter-examiner agreement using four different orthodontic indices for orthodontic treatment need.

**MATERIALS AND METHOD:** A set of 190 study casts representing the malocclusions of patients in a postgraduate clinic, were evaluated pre- (T0) and post- (T1) treatment. Two orthodontic residents were calibrated in the Index of Orthodontic Treatment Need (IOTN), the Index of Complexity, Outcome and Need (ICON), the Peer Assessment Rating (PAR) Index and Swedish Dental Board Index (SWE). The residents individually rated the casts. The results were statistically analysed with a single estimate of intraclass correlation coefficient (ICC) and/or kappa statistics (K).

**RESULTS:** Intraexaminer agreement between both residents was very good (K >0.80) and (ICC >0.90) for all four indices. Interexaminer agreement of the IOTN at T0 for the aesthetic and dental components was moderate (K = 0.51; 55%) and (K = 0.54; 86%) respectively. At T1 the agreement for aesthetic component was very good (K = 1.0; 100%) and for the dental component moderate (K = 0.5295; 79%). For ICON complexity and ICON improvement the agreement was moderate (K = 0.56; 55%) and good (K = 0.65; 61%) respectively. The agreement for PAR using ICC was good at T0 and T1, ICC = 0.74; 0.70. Agreement concerning treatment need using SWE was moderate at T0 and T1 (K = 0.47; 70%); (K = 0.48; 92%).

**CONCLUSION:** The four indices studied showed very good intraexaminer agreement. Generally interexaminer agreement was moderate except for the PAR and ICON improvement, which both showed good agreement. The interexaminer difference (which could be up to 45%) must be taken into account when determining orthodontic treatment need.

#### 180 MICROBIAL CONTAMINATION OF MANUAL TOOTHBRUSHES DURING TREATMENT WITH MULTI-BRACKET APPLIANCES

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**AIM:** To evaluate the retention of caries-associated microorganisms on two manual toothbrushes with different bristle designs (conventional and tapered) and to assess the influence of multibracket (MB) appliances on microbial contamination of the brush head.

**SUBJECTS AND METHOD:** One hundred healthy subjects (50 MB-patients, 50 subjects without MB) participated after giving prior informed consent. All participants were non-smokers, had a caries-free permanent dentition and followed no anti-infective medication during the testing phase. Each received a toothbrush (elmex® interX medium short head or meridol®), toothpaste (elmex®) for exclusive use, and an information sheet with standardized brushing instructions. After 14 days of regular tooth brushing, the brushes were collected and washed-out. The suspension was incubated on selective agar plates and the number of *Streptococcus mutans* colonies, Lactobacilli and *Candida albicans* for each brush head was assessed. Subjective perceptions concerning gum bleeding, cleaning efficacy and brushing comfort were compiled using a questionnaire.

**RESULTS:** Regarding the retention of microorganisms, no differences could be detected between the two bristle designs. However, the amount of *S. mutans* was significantly higher on brushes used by MB-patients ( $P < 0.005$ ). The number of Lactobacilli and *C. albicans* was minimal in all cases and thus not suitable for statistical evaluation. No differences relating to gender, brushing comfort or cleaning efficacy were seen. However, MB-subjects reported more gingival bleeding.

**CONCLUSION:** During treatment with MB appliances, toothbrushes were contaminated more intensely with *S. mutans* independent of bristle design. Accordingly, more frequent replacement of toothbrushes should be recommended for patients undergoing MB-treatment.

### 181 EFFECT OF LIGHT EMITTING DIODE MEDIATED PHOTOBIO-MODULATION THERAPY ON EXPERIMENTAL TOOTH MOVEMENT IN RATS

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**AIM:** To evaluate the effects of light emitting diode (LED)-mediated-photobiomodulation therapy (LPT), on the rate of orthodontic tooth movement, in rats.

**MATERIALS AND METHOD:** Twenty male 45-50 day old Wistar rats were separated into two groups (control and LPT). Both groups were subjected to external forces on the maxillary first molars, and 25 cN of force was applied between maxillary left molar and incisor with a coil spring. In the study group, LPT was applied with an energy density of 20 mW/cm<sup>2</sup> over a period of 10 consecutive days directly over the area of movement of the first molar teeth. The distance between the teeth was measured with a digital calliper on days 0 (T0), 10 (T1), and 21 (T2). Mann-Whitney *U* and Wilcoxon tests were used for statistical evaluation at the  $P < 0.05$  level.

**RESULTS:** When tooth movement during T1-T0 and T2-T1 were compared for both groups a statistically significant difference was found in the LPT group ( $P = 0.016$ ). The amount of tooth movement of  $1.31 \pm 0.36$  mm in first time period (during application of LPT) was significantly higher than in the second time period ( $0.24 \pm 0.23$  mm) in the LPT group. Statistical analysis showed significant differences between two groups at T2 ( $P = 0.017$ ). The magnitude of movement in the LTP group was higher ( $1.55 \pm 0.33$  mm) compared with the control group ( $1.06 \pm 0.35$  mm).

**CONCLUSION:** LPT has the potential of accelerating orthodontic tooth movement.

### 182 THREE-DIMENSIONAL EVALUATION OF THE UPPER AIRWAY FOLLOWING RAPID MAXILLARY EXPANSION

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**AIM:** Rapid maxillary expansion (RME) is a well-documented orthodontic treatment modality for the correction of transverse maxillary deficiency. Recent advances in cone beam computed tomography (CBCT) and related software have made it possible to visualize and to measure the upper airway as a solid structure. The aim of this study was to compare the changes in transverse nasal width, oropharynx (OP) airway volume and nasal passage (NP) volume in a group of growing patients before and after treatment for maxillary constriction using RME, with a matched control group, using CBCT.

**SUBJECTS AND METHOD:** Two groups were formed, each with 35 patients (15 males, 20 females), a RME group (mean age  $14.02 \pm 1.46$  years) and a control group (mean age  $14.10 \pm 1.44$  years). All patients had CBCT scans taken at the beginning (T0) and end (T1) of treatment. Transverse, sagittal and interdental linear measurements and three-dimensional volumetric measurements were performed on the CBCT images using the InVivoDental 5.0 program (Anatomage Inc., San Jose, California, USA). To assess differences among the matched pairs, a paired *t*-test with the significance level set at 5 per cent and the Wilcoxon signed rank test for non-parametric paired samples were used.

**RESULTS:** No statistically significant difference was observed between the groups for OP and NP airway volume at T0. At T1 NP volume in the RME group ( $7527.00 \pm 2278.60$  mm<sup>3</sup>) was significantly greater than the control group ( $6415.86 \pm 2297.86$  mm<sup>3</sup>). RME treatment produced a statistically significant increase in all measured transverse and interdental dimensions. Statistically significant increases were observed for OP and NP airway volumes between T0 and T1 in both groups. The mean increase in NP volume was significantly larger in the RME ( $1719.89 \pm 1510.71$  mm<sup>3</sup>) than in the controls ( $833.09 \pm 1032.24$  mm<sup>3</sup>).

**CONCLUSIONS:** RME results in a significant increase in NP volume.

### 183 AIRWAY VOLUMES FOR DIFFERENT DENTOFACIAL SKELETAL PATTERNS

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**AIM:** To evaluate the nasal passage (NP) and oropharyngeal (OP) volumes in patients with different dentofacial skeletal patterns.

**SUBJECTS AND METHOD:** One hundred and forty patients (70 males, 70 females), divided into three groups as Class I (C1) ( $1 < ANB < 3$ ), Class II (C2) ( $ANB > 3$ ) and Class III (C3) ( $ANB < 1$ ), and then further divided into four groups as SNA

angle  $>80^\circ$ , SNA angle  $<80^\circ$ , SNB angle  $>78^\circ$  and SNB angle  $<78^\circ$  to evaluate how positional changes in the maxilla and mandible affect OP and NP variables. Differences between groups were determined using the Kruskal-Wallis test. Correlations between the variables were tested using Pearson's correlation coefficient. A linear multiple regression test was applied to create a model for the airway volumes, separately.

RESULTS: OP volume of C2 subjects ( $6292.84 \pm 2709.92 \text{ mm}^3$ ) was significantly lower when compared with C1 ( $7762.30 \pm 2783.66 \text{ mm}^3$ ) and C3 ( $8042.86 \pm 2407.73 \text{ mm}^3$ ) subjects. The only statistically significant difference for NP volume was observed between the C1 and C2 groups. None of the airway variables were affected with regard to maxillary position. However, mean OP airway volume of subjects with retruded mandibular positions was statistically significantly smaller when compared with subjects with higher SNB angles. No difference was observed for the remaining variables with regard to mandibular position. The area of the most constricted region at the base of the tongue (minAx) had a high potential in explaining OP volume whereas NP volume models were not as successful as their OP counterparts. However, minAx was also entered into the NP volume equations as an explanatory variable.

CONCLUSIONS: Airway volumes differ significantly between different skeletal malocclusions. The anteroposterior position of the mandible seems to influence airway volume, especially the oropharyngeal volume.

#### 184 FAILURE RATE OF SELF-LIGATING AND EDGEWISE BRACKETS WITH DIFFERENT BASE DESIGN: A PROSPECTIVE *IN VIVO* STUDY

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AIM: To compare the clinical performance of self-ligating and edgewise brackets with different base designs during an 18-month period.

SUBJECTS AND METHOD: In 39 patients, 688 American Orthodontics (AO) Time2 self-ligating brackets with an integral quadra grip base were bonded with a split-mouth design, using Transbond Plus self-etching primer (SEP) or a conventional two-step etch and Transbond XT primer (CM). In 38 patients, 686 AO Mini Master Series edgewise brackets with a mesh base were bonded in the same way as above. The survival rate of the brackets was estimated by Kaplan-Meier analysis. Bracket survival distributions with respect to bracket type, bonding procedure, dental arch, type of tooth (incisor, canine and premolar) and patient gender were compared using the log-rank test. Bond failure location was determined with the Adhesive Remnant Index (ARI).

RESULTS: Bond failure rates of SEP and CM were 3.3 and 1.7 per cent, respectively. No significant difference was found between the bonding procedures using the log-rank test ( $P = 0.059$ ). The bond failure rates of Time2 and Mini Master Series brackets were 3.8 and 1.3 per cent, respectively. A significant difference was found between the brackets ( $P = 0.004$ ). Furthermore, canine and premolar teeth displayed a lower survival rate than the incisor teeth ( $P = 0.001$ ). No significant difference was observed for the ARI scores of bracket type and bonding procedure ( $P > 0.05$ ).

CONCLUSION: Survival rate was affected by bracket type and base design; however, it was not affected by the bonding procedure.

#### 185 CLINICAL AND RADIOGRAPHIC ASSESSMENT OF MOLAR DISTALIZATION USING A NEWLY DESIGNED INTRAORAL DISTALIZER\*\*\*

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AIM: To assess the type of maxillary first molar movement produced by a newly designed distalizer (Bi-directional distalizer; 0101695540).

SUBJECTS AND METHOD: Twelve patients in the permanent dentition with a Class II molar relationship. No specific gender was selected. Pre- and post-distalization lateral cephalograms were used to assess first molar movement and acrylic caps with metal markers to determine the right and left sides.

RESULTS: The mean amount of distal movement was 3.57 mm (maximum: 5.5 mm, minimum: 2 mm). The mean amount of distal molar tipping was 1.68 degrees (maximum:  $3.56^\circ$ , minimum:  $0.0^\circ$ ). An intrusive component was found in combination with distal movement.

CONCLUSION: Movement of the molars was a combination of distal movement with minor tipping, which can be considered as distal bodily movement since there was no significant correlation between the distalization distance and the change in molar angulation with the reference planes. An intrusive component was found in combination with distal movement. This is favourable as one of the drawbacks of distal movement of the molars is bite opening resulting from distal tipping of the molars. This is not the issue with the bi-directional distalizer as the intrusive component is found to counteract this drawback.



## 186 CHANGES IN SKELETAL GROWTH OF ANTERIOR OPEN BITE PATIENTS

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**AIM:** To evaluate morphological changes during growth of subjects with an anterior open bite (AOB) malocclusion.

**SUBJECTS AND METHOD:** Seventy-one patients (42 females, 29 males, average age 20.2 years) with an AOB. Standard cephalometric analysis was performed on lateral cephalograms. The data were divided into four age groups: 12-15, 15-18, 18-21 and 21-36 years. Three occlusal planes were studied: OcL, the standard plane crossing the contact between the molars; OcL1, a constructed plane between molar and upper incisor contact; OcL2, a constructed plane between molar and upper incisor contact.

**RESULTS:** Significant increases were found in the following parameters: OcL/ML (SD  $5.14 \pm 2.25$ ), OcL1/ML (SD  $6.38 \pm 2.23$ ) and OcL2/VsP (SD  $3.96 \pm 1.41$ ) and decrease in the following: OcL/NL (SD  $-3.49 \pm 1.5$ ), OcL1/NL (SD  $-5.28 \pm 1.34$ ) and VsP/OcL1 (SD  $-4.17 \pm 1.25$ ). There were significant increase of <NS/ML (SD  $7.87 \pm 1.34$ ) and FH/ML (SD  $9.29 \pm 1.69$ ) in all groups of patients, as well as an increase of <N/Go/Me ( $6.67 \pm 1.97$ ). The upper incisors were protruded (SD  $-5.41 \pm 1.78$ ) and interincisor angle was decreased (SD  $-18 \pm 2.2$ ). In the 12-15, 15-18 and 21-36 age groups there was significant decrease of dentoalveolar height of the first lower permanent molar (SD  $-11.32 \pm 2.24$ ).

**CONCLUSION:** The above findings prove the influence of skeletal changes in an AOB. The most important role is OcL1 position and its impact on malocclusion. The role of the mandible plane is significantly high as well as its rotation during growth. This should be taken into consideration when planning treatment of AOB patients.

## 187 VERTICAL SKELETAL DIMENSIONAL CHANGES IN NON-GROWING PATIENTS WITH THE USE OF CLASS III ELASTICS

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**AIM:** To identify the relationship between craniofacial patterns and the changes in skeletal dimension of patients with a Class III malocclusion with treatment with Class III elastics.

**MATERIALS AND METHOD:** Twenty craniofacial measurements were obtained from the lateral radiographs of 12 patients, six hyper- and six hypodivergent, before and after elastic use.

**RESULTS:** Pearson correlation test showed no significant changes between the measurements before and after treatment for any of the variables.

**CONCLUSION:** The use of Class III elastics is not contraindicated in non-growing patients.

## 188 LIP POSITION AND VERTICAL SKELETAL PATTERN IN FEMALE PATIENTS WITH A CLASS II DIVISION 1 MALOCCLUSION

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**AIM:** The soft tissue profile, including lip position is important in orthodontic diagnosis, treatment planning and assessment of the result. The purpose of the study was, therefore, to establish if there is any correlation between anteroposterior lip position and vertical skeletal pattern.

**MATERIALS AND METHOD:** Thirty-eight lateral cephalograms of post-pubertal female subjects with a Class II division 1 malocclusion, according to CVM method, aged 14 years 8 months to 20 years 6 months were analyzed. Lips position was assessed with four analyses (Rickets E line, Steiner, Holdaway and Sn-Pg' line). NL,ML angle and N-Sp'/Sp'-Gn were used for the vertical skeletal pattern.

**RESULTS:** The findings showed that for linear and angular measurements of upper and lower lip position, the upper lip is more protrusive and the lower lip retrusive. There was a statistically significant correlation between upper and lower lip position and skeletal vertical pattern, assessed by N-Sp'/Sp'-Gn ( $P < 0.05$ ), but no correlation with ML,NL angle.

**CONCLUSION:** The sagittal position of the upper and lower lip, in post-pubertal female subjects with a Class II division 1 malocclusion, can be influenced by the skeletal vertical pattern.

189 DIGITAL PLAQUE IMAGING ANALYSIS FOR EVALUATING EFFICACY OF AN ANTIMICROBIAL/ POWER BRUSH REGIMEN IN PATIENTS WITH FIXED ORTHODONTIC APPLIANCES

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AIM: To clinically evaluate, in a randomized, examiner-blind, two treatment clinical study, the effect of the combined use of a therapeutic dentifrice and rinse plus power brush on plaque of orthodontic patients with fixed appliances using the digital plaque imaging analysis (DPIA) methodology.

SUBJECTS AND METHOD: Fifty orthodontic subjects (12 years old and above) with fixed appliances in the upper and lower dental arch were randomly assigned to one of the treatment groups: a combination regimen with 0.454 per cent stannous fluoride sodium hexametaphosphate dentifrice (Crest® Pro-Health™), a rotating-oscillating powered brush (Oral-B® Triumph brush with an Ortho and interdental brush head), and 0.07 per cent cetylpyridinium chloride rinse Crest® Pro-Health™ or a regular brush (Indicator P35) and standard fluoridated dentifrice (Blendax). The subjects were instructed to use the assigned products twice a day for their daily oral hygiene at home. Percentage plaque level was evaluated by DPIA at baseline and after 2 and 4 weeks.

RESULTS: Forty-seven subjects with mean (SD) age of 13.9 (1.41) years (40% females, 60% males) completed all three study visits. The groups were balanced ( $P = 0.542$ ) at baseline, with percentage plaque means of 50.6 and 47.2 in the combination regimen and control groups, respectively. The plaque reduction for the regimen group was 47.2 and 46.4 per cent at weeks 2 and 4, respectively, compared with 4.2 and 6.4 per cent for the control. Relative to baseline, the regimen group exhibited significant ( $P < 0.0001$ ) reductions in percentage plaque at all time points. Between-group comparisons showed significantly ( $P < 0.002$ ) less plaque for the regimen relative to control. Both treatments were well-tolerated, and no subject discontinued product use early because of a treatment-related adverse event.

CONCLUSION: A regimen of stannous fluoride dentifrice and cetylpyridinium chloride mouthrinse with a power brush resulted in significant improvements in plaque control in this orthodontic population versus standard fluoridated dentifrice.

190 STIMULATION OF NEW BONE FORMATION DURING DISTRACTION OSTEOGENESIS – A SYSTEMATIC REVIEW\*\*\*

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AIM: How to stimulate new bone within the distracted bone segment for reduction of consolidation period is recently a challenging topic. The aim of this study was to review the literature on bone inducing materials during distraction osteogenesis (DO).

MATERIALS AND METHOD: A literature search of PubMed was conducted for the period 1966 to 2010 using the subject headings terms ‘distraction osteogenesis’, ‘bone regeneration’, ‘bone formation’, ‘mandible’ and ‘maxilla’ which were also crossed with various combinations.

RESULTS: Forty-seven studies satisfied the inclusion criteria. DO was successfully performed in 29 studies on rabbits, seven on rats, six on dogs, three on sheep, one on the minipig and on the goat, with various protraction rates. DO was performed in the mandible in 44 studies, the maxilla in two studies and mandibular alveolus in one study. To improve osteoinduction, 37 different therapies or materials were used. Recombinant human bone morphogenetic protein-2 that was used in eight studies was the most popular bone inducing material. The results showed that these materials were applied locally in 42 animal studies, systemically in four studies and systemically and locally in one study. In 41 investigations, bone formation was improved in the osteoinduction groups compared with the control groups, whereas in six studies there were no statistically significant differences between groups.

CONCLUSIONS: A combination of DO with osteoinduction could shorten orthodontic treatment time as a result of a reduction in the consolidation period. More research is required to clarify the dose-effect relationship and mode of application (systemic or local) before routine use on humans.

191 FINITE ELEMENT ANALYSIS OF CHANGES DURING SIMULTANEOUS INTRUSION AND RETRACTION OF ANTERIOR TEETH WITH MINISCREW SUPPORT

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AIM: To investigate the possible effects of forces on teeth during a clinical scenario in which extraction space closure is to be achieved by maximum retraction and intrusion of incisors simultaneously using miniscrew support.

MATERIALS AND METHOD: Three three-dimensional (3D) finite element models were digitally constructed. Stress level in the periodontal ligament and initial tooth displacements were obtained during analyses. The first model, a single incisor tooth, was subjected to a single intrusion force reported to be optimal. Stress level at the apex was later used as a reference for comparison with other two models. The other two models were complete dental arches, except for the first premolars. One of these models was based on segmented arch mechanics with miniscrews placed bilaterally between the upper first molars and second premolars and bearing a cantilever for anterior intrusion that extended from the posterior segment. The other model was based on continuous arch mechanics, having the same miniscrew configuration and an additional miniscrew between the upper centrals for direct application of intrusive force. A total of nine consecutive analyses with different force magnitudes were conducted on these models.

RESULTS: Stress levels on the anterior tooth apices of both complete arch models remained relatively low compared with the reference model. The segmented arch model in which an intrusive force of 75 g was applied between the canine and lateral incisor and 50 g of distally directed force, displayed the most balanced simultaneous intrusion and retraction. Miniscrews in the posterior area counteracted the adverse effects of the cantilever. In the continuous arch model, intrusion of the posterior teeth and rotation of whole arch was observed; decreasing the frictional force between the archwire and brackets seemed to diminish these effects.

CONCLUSION: Segmented arch mechanics allows more control over unwanted tooth movements by appropriate application of intrusive and retrusive forces.

## 192 CEPHALOMETRIC EVALUATION OF THE DEVELOPMENT OF THE CRANIAL BASE AND RELATED STRUCTURE DURING THE PRENATAL PERIOD

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AIM: To determine developments of the cranial base and related structures and their growth rate changes from the second trimester to full-term in a large series of fetuses by means of cephalometric method.

SUBJECTS AND METHOD: One hundred and fifty six (80 females, 76 males) fetuses aged between 15-40 weeks of gestation and free of any external anomaly were selected. Lateral cephalometric films were taken of each fetus using a dental digital panoramic and cephalometric X-ray machine. Eight linear and nine angular parameters were measured on the lateral cephalometric films using Easy Dent 4 Viewer software program.

RESULTS: Anterior (N-S) and posterior (S-Ba) cranial base lengths showed linear increases. Cranial base angle (N-S-Ba°) also showed a statistically significant increase between the groups from the second trimester to full term. The maxilla and mandible demonstrated similar growth patterns in the sagittal direction. The vertical plane angles of the maxilla and mandible (SN-PP°; SN-MP°; PP-MP°) did not show any significant change. The ratio of maxillary length to mandibular length remained stable.

CONCLUSION: Cranial base angle increased during the prenatal period and the maxillomandibular sagittal relationship grew at a steady rate to preserve the Class II relationship after the 15th gestational week. Presenting the actual measurements in addition to the angular parameters would be a guide for clinicians to diagnose cases with severe or borderline anomalies prenatally.

## 193 THE ALVEOLAR AND SYMPHYSEAL REGIONS IN CLASS II DIVISION 1 ANOMALIES WITH DIFFERENT VERTICAL GROWTH PATTERNS

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AIMS: To investigate the alveolar and symphysis region in hyper-, hypo- and normodivergent Class II division 1 subjects.

MATERIALS AND METHOD: The pre-treatment lateral cephalograms of 165 young adult female patients with a skeletal Class II division 1 anomaly with mandibular retrognathism and a convex profile divided into three groups: hyperdivergent (GoGnSN >35; n = 58), hypodivergent (GoGnSN <29; n = 19) and normodivergent (GoGnSN: 29-35; n = 34). These Class II groups were compared with a Class I group (n = 54). Symphysis width and height, upper (1/PP) and lower (1/MP) incisor angle, maxillary palatal width, mandibular and maxillary incisor and molar alveolar heights were measured on the lateral

cephalograms. In addition, the width of the (thinnest region of the) symphysis at the level of the point B (B-B') was evaluated. Kruskal-Wallis and Mann-Whitney *U* tests were used to compare the groups.

**RESULTS:** Morphological differences of the symphyseal region between Class II and Class I malocclusion subjects were found. Symphysis width was wider in the hypodivergent Class II than those of the other Class II and Class I groups, while symphysis height was similar among the groups. Maxillary palatal width, 1/PP and upper and lower molar alveolar heights were also found to be similar among the groups. B-B' width was higher in the hypodivergent group than in the other groups, but it was not statistically significant. 1/MP angle was higher in all Class II groups compared with the Class I group.

**CONCLUSION:** Symphysis width rather than symphysis height is the major factor in the differential diagnoses of the Class II division 1 cases with mandibular retrognathism. Caution should be exercised in protruding the lower incisors for all Class II cases to avoid relapse, periodontal problems and root resorption.

#### 194 LONG-TERM STABILITY OF BICORTICAL MINISCREWS – A RETROSPECTIVE STUDY

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**AIM:** To evaluate the long-time stability of bicortical miniscrews (BM) inserted in the mandible.

**MATERIALS AND METHOD:** The records of patients with molar extractions, agenesis of premolars and skeletal anchorage with BM for space closure. The factors: treatment time, complication and success rate were investigated. In total 60 patients (female/male: 2/1) with 93 BM were evaluated.

**RESULTS:** The treatment age ranged between 10.5-56.5 (mean: 23.5) years. The average treatment time with BM was 12.6 ± 6 months. In 89.25 per cent a successful (long-time stability) outcome was observed. Complications ranging from poor oral hygiene to mucogingival inflammations were observed in 16.13 per cent. In 10.75 per cent these complications, as well as idiopathic factors, led to loosening of the miniscrew, defined as a failure. The insertion of BM for skeletal anchorage showed a high success rate with complications in few cases.

**CONCLUSION:** Based on the findings of this retrospective study, bicortical insertion seemed to have a positive influence on miniscrew stability.

#### 195 EFFECTS OF HYPODONTIA ON CRANIOFACIAL STRUCTURES AND MANDIBULAR GROWTH PATTERN

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**AIM:** To examine the craniofacial structures in subjects with hypodontia and to reveal any differences that may occur, when agenetic teeth are only found in the maxilla, the mandible or in both jaws.

**SUBJECTS AND METHOD:** Fifty children (33 girls, 17 boys) aged between 9 and 13.5 years were analyzed and assigned to three subgroups. Group 1, upper jaw hypodontia, group 2, lower jaw hypodontia and group 3, hypodontia in both jaws. Eleven angular and three indices measurements from lateral encephalographs and two linear measurements from dental plaster casts were calculated. All data was statistically analyzed, parameters of  $P < 0.05$  per cent were investigated for each subgroup. Modified standard values following norms established by Segner and Hasund served as the controls. The results were calculated with the Student's *t*-test for paired samples.

**RESULTS:** Compared with standards, the study group showed bimaxillary retrognathism and a reduction of lower anterior face height. Moreover both overbite and overjet were significantly increased. Other values were within the normal ranges. For the subgroups, differences in the means of SNA, SNB and overjet between the groups were observed. Analysis of the mandibular growth pattern according to Björk revealed that neither vertical nor horizontal patterns are dominant in hypodontia patients.

**CONCLUSIONS:** In certain dentofacial parameters, differences exist between subjects with hypodontia and those with a full dentition. Agenesis may have a negative influence on the sagittal development of the jaw and lower face and may be responsible for increased overbites.

#### 196 ORTHODONTIC ADHESIVES: INFLUENCE OF FILLER LEVEL ON BACTERIAL ADHESION, BOND STRENGTH AND COLOUR STABILITY

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AIM: To evaluate the effect of different filler content of orthodontic adhesives on colour stability, shear bond strength (SBS), adhesive remnant index (ARI), and bacterial adhesion.

MATERIALS AND METHOD: Four experimental adhesive groups were created: (1) urethane dimethacrylate containing 0 (2) 30, (3) 50, and (4) 70 vol% SiO<sub>2</sub> filler. Cylindrical specimens were incubated with *streptococcus mutans* and colonies were quantified using a luminescence kit and a platereader. Other samples were exposed to artificial ultraviolet (UV) light for 72 hours. Ketchup, coke and tea were chosen as the food colourants and colour measurements were performed according to the CIE L\*a\*b\* system. SBS and ARI scores were examined after bonding stainless steel brackets to extracted human third molars using the four adhesives. Means and standard deviations were calculated. Statistical analysis was performed using the Mann-Whitney *U*-test. The level of significance was set at  $\alpha = 0.05$ .

RESULTS: After exposure to food dyes or UV light, the higher filled adhesives presented the smallest and the unfilled adhesive the highest colour changes. Higher adhesive filler levels revealed greater bond strength between the enamel and stainless steel brackets. Bacterial adhesion was also influenced by varying the filler level of the adhesives.

CONCLUSIONS: The properties of orthodontic adhesives could be strongly influenced by varying filler level. Bacterial adhesion, SBS, and discolouration were altered using different contents of SiO<sub>2</sub>.

#### 197 A NEW CONCEPT FOR ANB ANGLE BASED ON FLOATING NORMS

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AIM: To develop a new formula to determine individual ANB angle based on the characteristics of different facial types.

MATERIALS AND METHOD: Eighty lateral radiographs of Brazilian individuals with a normal occlusion (skeletal Class I) of both genders aged between 11 and 17 years. The sample was divided into three groups according to the facial type: mesofacial, dolichofacial and brachyfacial. The following cephalometric variables were assessed: ANB, SNA, ML-NSL, facial axis (FA), total face height (TFH) and lower face height (LFH). A multiple regression and *t*-test (5%) was used.

RESULTS: Angular cephalometric variables, facial axis, TFH, SNA, ML-NSL were found to be suitable for the statistical calculation. The calculated values of ANB using the new formula ( $3.84 \pm 1.47^\circ$ ) were identical to those of ANB when measured directly on cephalograms ( $3.84 \pm 1.86^\circ$ ); the paired *t*-test between these two values ( $P = 0.98378$ ) also confirmed this new formula to be appropriate. The established formula with SNA, ML-NSL, facial axis and TFH:  $ANB = 13.1865 + (-0.3855 FA) + (-0.3696 TFH) + (0.4262 SNA) + (0.3327 ML-NSL)$  as independent variables proved to be adequate for determining the individual ANB angle and much more appropriate and specific to the different facial types.

#### 198 PERCEPTION OF ORTHODONTIC PATIENTS TOWARDS APPLIANCE VISIBILITY IN AN IRANIAN POPULATION

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AIM: To evaluate the patients' perception regarding the appearance of their orthodontic braces.

SUBJECTS AND METHOD: Four hundred and ninety two orthodontic patients (females 72%, males 28%) with a mean age of 18.4 years participated in this cross-sectional study. All the patients had been treated with fixed orthodontic appliances by means of metal brackets. Neither aesthetic brackets, nor lingual techniques have been utilized in any of the patients. The data was gathered by asking the patients to fill out a questionnaire. All the patients had been treated under the supervision of the same orthodontist by standard edgewise technique.

RESULTS: This study revealed that about fifty percent of patients did not mind their braces being visible while 33.8 per cent of the patients would rather have their treatment carried out by an invisible technique. On the other hand, 13.7 per cent of the patients preferred having visible metal brackets placed upon their teeth. However, there was no significant difference between male and female in the results of this study ( $P = 0.2$ ).

CONCLUSION: Most Iranian patients do not have any problems with non-aesthetic braces.

#### 199 ATTITUDE OF IRANIAN ORTHODONTISTS TOWARDS TEMPOROMANDIBULAR DISORDERS

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AIM: Temporomandibular disorders (TMD) are the main cause of pain of non-dental origin in the oro-facial region, including the head, face and related structures. Temporomandibular joint disorders present difficulties from the point of view of

detection and diagnosis as well the management of their treatment. The aim of this study was to determine the attitude of Iranian orthodontists towards TMD in their private practices.

**SUBJECTS AND METHOD:** Seventy Iranian orthodontists from the Iranian Association of Orthodontists were asked to complete a questionnaire regarding orthodontics/TMD.

**RESULTS:** Only 34 per cent of orthodontists were willing to commence orthodontic treatment for patients suffering from TMD and seeking treatment just to alleviate TMD, while 81.2 per cent would carry out treatment if the patient had a malocclusion needing orthodontic treatment accompanied by TMD. Fifty-five per cent report having experienced development of TMD in their patients after or during orthodontic treatment.

**CONCLUSION:** Some Iranian orthodontists are aware of the importance of the relationship between orthodontic treatment and TMD and that orthodontic treatment could prevent TMD. Nearly half of Iranian orthodontists have experienced development of TMD during treatment that did not exist at the beginning.

## 200 A THREE-DIMENSIONAL ANALYSIS OF CLASS II MALOCCLUSIONS REQUIRING SURGERY

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**AIM:** To describe a social programme financed by the URCAM (French National Medical Insurance) aimed at improving identification, diagnosis, follow-up, and treatment of borderline surgical orthodontic cases. The long-term target is to define good practice behaviour and to encourage orthodontists to avoid not focusing too narrowly on orthodontic solutions to the exclusion of other modalities such as surgery, and to avoid the overuse orthodontic camouflage techniques. The participating orthodontists were able to select a wide sample of 'limit surgery' cases (312 patients in the programme).

**SUBJECTS AND METHOD:** A Class II sub-sample (40 subjects), compared with reference sample of 40 subjects was studied using three-dimensional (3D) cephalometric analysis (Treil and Faure), with maxillofacial landmarks tied with trigeminal anatomy. The median profile of the Class II surgical patients and its relationships with other pathologies (as it evolved during the growth period) was determined.

**RESULTS:** The principal findings were: The surgical Class II patients had a deformity that was caused in part by maxillary protrusion and in part by a mandibular deficit. The more severe cases showed both an anterior vertical deficit and posterior rotation due to shortening of the ramus. The surgical limit can be determined for most determinant parameters. Comparison of 3D and conventional analysis in only two dimensions showed the benefits that can be derived from this new method.

## 201 THREE-DIMENSIONAL ANALYSIS OF SURGICAL CLASS III DISHARMONY: DESCRIPTION AND UNDERSTANDING OF THE PATHOLOGY

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**AIM:** To describe the social programme financed by the URCAM (French National Medical Insurance) aimed at improving identification, diagnosis, follow-up, and treatment of borderline surgical orthodontic cases. The long-term target was to define good practice behaviour and to encourage orthodontists to avoid therapeutic obsession by not focusing too narrowly on orthodontic solutions to the exclusion of other modalities such as surgery and to overuse orthodontic camouflage techniques. Participating orthodontists were able to select a wide sample of 'limit surgery' cases (312 patients in the programme).

**SUBJECTS AND METHOD:** A Class III sub-sample (34 subjects), compared with reference sample of 40 subjects was studied using three-dimensional cephalometric analysis, with maxillofacial landmarks tied with trigeminal anatomy.

**RESULTS:** The surgical Class III of the sample was due mainly to mandibular protrusion and not to maxillary retrusion. The more severe cases presented both an anterior vertical linear excess and hypodivergence due to ramus excess. The hierarchy of the most determinant parameters were almost the same as in Class II, but as a parameter of anteroposterior position, a chin landmark is implicated in the Class II sample. A restricted set of decisive parameters can be proposed with validity for Class II and Class III disharmonies.

## 202 AESTHETIC ASSESSMENT OF FACIAL GOLDEN PROPORTIONS THROUGH THREE-DIMENSIONAL VIRTUAL FACE MODELLING

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AIM: To evaluate if faces with golden proportion according to Ricketts are actually considered the most beautiful.

MATERIALS AND METHOD: In a single blind study, 50 examiners (laypeople, dentists and odontologists) answered a questionnaire on their perception of facial proportions. A new three-dimensional (3D) software for cartoon animation, FaceGen Modeller, was used to create the images to be evaluated. It allows creation of a vectorial 3D virtual face from a frontal photograph: each part of the head can be manipulated independently. Each of five virtual faces was modified through four vertical vectorial controls. Sets of seven vertical proportions of the same parameter for the same subject were obtained. The faces in each set were randomly placed in the questionnaire to avoid the error of tendency towards the central value. The examiners gave scores from 1 (most attractive) to 7 (least attractive) to the seven faces of each set. The concordance rate between the examiner's score and the expected golden ratio face was analysed: C = concordance,  $D \pm 1 = 1$  deviation from the expected face,  $D \pm 2 = 2$  deviations.

RESULTS: There was a mild tendency to judge the faces with golden proportions as more attractive. However, two groups of faces among the five could be distinguished. One in which there was strong concordance between golden proportion and the perception of beauty of the examiners (C: 55.56%,  $D \pm 1$ : 33.33%,  $D \pm 2$ : 11.11%,  $D \pm 3$ : 0%) and the second in which the most attractive proportions were not related to golden ratio (C: 8.33%,  $D \pm 1$ : 25%,  $D \pm 2$ : 33.33%,  $D \pm 3$ : 25%). Their difference with Fisher's test was highly significant ( $P = 2.27 \cdot 10^{-27}$ ). Moreover, laypeople generally judged faces which respect golden proportions as the most beautiful.

CONCLUSIONS: Although there is a tendency to perceive golden proportions of the face as the most beautiful, some faces are judged attractive even if their proportions differ from the golden ratio. Therefore, the presence of a universal standard of beauty seems questionable.

## 203 ANALYSIS OF DENTOALVEOLAR AND SKELETAL CHANGES IN ANTERIOR OPEN BITE WITH A MODIFIED BIONATOR APPLIANCE

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AIM: To present the modified bionator appliance (MBA) for correction of an anterior open bite and Class II malocclusion.

SUBJECTS AND METHODS: Thirty-one patients (15 boys, 16 girls, mean age 8 years 9 months) with an open bite, Class II malocclusion and functional disorders treated with the MBA. The dentoalveolar and skeletal changes that occurred were compared on lateral cephalograms taken before (T1) and after (T2) active treatment.

RESULTS: The MBA resulted in a statistically significant increase in upper incisor retraction (U1/NA  $-3.5$  mm, U1/PP  $-8.1^\circ$ ), lower incisor retraction (L1/NB  $-5.1^\circ$ ,  $-2.9$  mm, L1/MP  $-5.3^\circ$ ,  $2.7$  mm) and interincisal angle ( $8.6^\circ$ ). SNB angle increased and ANB angle decreased.

CONCLUSION: The MBA is a functional orthodontic-orthopaedic appliance that is a useful and effective therapeutic alternative for the treatment of an anterior open bite with abnormal tongue function and a skeletal Class II malocclusion.

## 204 DOES MALOCCLUSION AFFECT THE MASTICATORY MUSCLES?

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AIM: To evaluate and compare masseter muscle thickness and bite force in patients with an Angle Class I occlusion and an Angle Class II malocclusion.

SUBJECTS AND METHOD: Sixty-two adult subjects (32 males, 30 females) with a mean age 23.8 years. Twenty-seven subjects presented an Angle Class II malocclusion. Patients with missing teeth, syndromes, previous orthodontic treatment or any process that could impede normal function were excluded. Masseter muscle thickness was evaluated by ultrasound scanning. Bite force measurements were undertaken during a single session for each subject, using a hydraulic pressure occlusal force gauge and measured unilaterally on the preferred chewing sides of the patients' jaw in the first molar region during a few seconds of maximal clenching. The maximum bite force was measured three times on each side. Measurements of muscle thickness and bite force were repeated after a 2–3 minutes interval in which the patients chewed a piece of gum for 10 chewing cycles, and a piece of wax (1 mm thickness).

RESULTS: No significant differences were found in masseter muscle thickness or bite force between genders. The preferred biting side was on the right in 90 per cent. No significant differences were found in muscle thickness on either occasion. A statistically significant difference was observed in the mean masticatory force before and after chewing.

CONCLUSIONS: Malocclusion does not seem to affect masseter muscle thickness in patients with a Class II malocclusion.

However, maximum bite force is negatively influenced in subjects with a Class II malocclusion, which suggests a negative effect of malocclusion in masticatory function

## 205 DETERMINATION OF CEPHALOMETRIC AND DENTAL CAST MEASUREMENTS IN THE FACIAL AESTHETICS OF TURKISH ADOLESCENTS

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AIM: Although aesthetic improvement is the most frequently reported reason for seeking orthodontic treatment, and although orthodontic treatment is most frequently performed during adolescence, only limited research has been performed on the evaluation of facial aesthetics in adolescents and on changes in facial aesthetics as a result of orthodontic treatment. Therefore, it was the overall aim of this study to investigate cephalometric and dental cast measurements in the facial aesthetics of adolescents

SUBJECTS AND METHOD: Sixty patients, aged 9 to 17 years, were selected, using randomized stratification for Angle Class. From each individual, a set of photographs was prepared showing three views: frontal resting, frontal smiling and lateral resting photographs simultaneously for pre- and post-treatment separately. A panel comprising 50 parents and 50 orthodontists was constructed. Each set of pre-treatment photographs of one individual, together with the reference set, was shown for 10 seconds and the panel members were asked to assess facial aesthetics in relation to the reference set on which the visual analogue score (VAS) was indicated, on a VAS from 0 to 100.

RESULTS: The aesthetic component (AC) of the Index of Orthodontic Treatment Need (IOTN) and horizontal sum for orthodontist, only AC/IOTN for parents were useful in the evaluation of facial aesthetics. Various model and cephalometric measurements and dental aesthetics were different between the attractive and non-attractive patients.

CONCLUSION: Overall facial aesthetics in adolescents does not depend on any single facial feature. The evaluation of facial aesthetics is too complex to be explained by separate facial features or their combination.

## 206 COMPUTER ESTIMATION OF THE DENTITION FOR PATIENTS WITH MESIAL OCCLUSION

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AIM: The diagnosis and treatment of patients with mesial occlusion of the dentition with the use of computer programs.

SUBJECTS AND METHOD: Twenty patients with mesial occlusion aged 9-12 and 12-15 years were examined and estimation of the occlusion was also undertaken using a computer program Estimation of harmoniousness occlusion of dental arches. The direction of the occlusal plane was studied for patients with mesial occlusion using the computer. Occlusion was studied for patients with a mesial occlusion. The estimation of the direction of the occlusal plane and its change during orthodontic treatment were investigated.

RESULTS: The estimation of occlusion was precisely undertaken; the direction the occlusal plane with mesial occlusion was produced. The syndrome group anomalies of the dentition as a result of mesial occlusion of dental rows was determined.

CONCLUSIONS: Computer program allow diagnostic evaluation with greater accuracy.

## 207 GENERAL HEALTH-RELATED QUALITY OF LIFE AND ORAL HEALTH IMPACT AMONG AUSTRALIANS WITH A CLEFT COMPARED WITH POPULATION NORMS

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AIM: To evaluate, in a cross section prospective study, general health related quality of life (HRQoL) and oral health-related quality of life (OHRQoL) among adults treated for a cleft to determine age and gender differences, and to compare against population norms.

SUBJECTS AND METHOD: Non-syndromic cleft patients treated by the Australian Craniofacial Unit from 1975 to 2009 were recruited (n = 112). The response rate was 79 per cent (n = 88). HRQoL was measured using the short form (SF) 36 questionnaire. OHRQoL was measured by the Oral Health Impacted Profile (OHIP)-14 questionnaire. State-based and national norms were used for comparative purposes.

RESULTS: There were no significant age or gender differences in the cleft sample's SF-36 and OHIP-14 scores. When compared against South Australian 2002 state-level norms, cleft participants scored higher on physical functioning and physical role function but lower on vitality and mental health. The prevalence of having experienced one or more of the



OHIP-14 items 'fairly often' or 'very often' was 2.7 times higher than national-level estimates, while extent was 2.8 times and severity 1.7 times higher.

CONCLUSIONS: The OHRQoL among studied cleft patients was poor compared with population-level estimates. The HRQoL showed mixed results, with the vitality and mental health components being poorer in the cleft group compared with population-level estimates. These results indicate that treatment for orofacial clefting does not entirely remove the factors contributing to poor HRQoL and OHRQoL.

## 208 EVALUATION OF FACIAL AESTHETICS AND PERCEIVED NEED FOR FURTHER TREATMENT AMONG ADULTS WITH CLEFT AS ASSESSED BY CLEFT TEAM PROFESSIONALS AND LAY PERSONS

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AIM: To compare, in a cross-sectional study, the ratings of professionals and lay people with and without a cleft regarding the facial aesthetics of adult patients previously treated for orofacial clefting. The necessity for further treatment, as perceived by the respective groups, was also compared.

SUBJECTS AND METHOD: Professionals (2 plastic surgeons, 1 dentist, 1 orthodontist, 1 psychologist) and lay people (1 male, 1 female adult without a cleft; 1 male, 1 female adult with a cleft) were recruited to rate photographs of 80 non-syndromic cleft patients treated by the Australian Craniofacial Unit from 1975 to 2009. Facial aesthetics was measured using a visual analogue scale ((VAS 0-100 mm). High values indicate good aesthetics. The necessity for further treatment was also measured using a VAS (0-100 mm). High values indicate high perceived need for further treatment.

RESULTS: The professionals rated facial aesthetics significantly lower and had a lower perception of need for further treatment than the raters with and without a cleft. Lay people with a cleft rated facial aesthetics significantly higher and had a lower perceived need for further treatment than lay people without a cleft. The non-surgical professionals rated facial aesthetics significantly lower and had a lower perceived need for further treatment than the surgical professionals.

CONCLUSIONS: Differences exist in the facial aesthetics ratings and perceived need for further surgery between professionals, and lay people with and without a cleft. This should be considered when managing cleft treatment expectations.

## 209 EFFECTIVENESS OF COMPREHENSIVE FIXED APPLIANCE TREATMENT COMBINED WITH A FATIGUE RESISTANT DEVICE IN CLASS II PATIENTS

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AIM: To assess the dental, skeletal, and soft tissue effects of comprehensive fixed appliance treatment combined with the Forsus Fatigue Resistant Device (FRD) in Class II patients.

SUBJECTS AND METHODS: Thirty-two Class II patients (mean age  $12.7 \pm 1.2$  years) treated consecutively with the FRD protocol, analyzed prospectively, and compared with a matched sample of 27 untreated Class II subjects (mean age  $12.8 \pm 1.3$  years). Lateral cephalograms were taken before (T1) and at the completion (T2) of comprehensive therapy. The mean duration of comprehensive treatment was  $2.4 \pm 0.4$  years. Statistical comparisons were carried out with the Student's *t*-test ( $P < 0.05$ ). The power of the study exceeded 0.90.

RESULTS: The success rate was 87.5 per cent. The FRD group showed a significant restraint in the sagittal skeletal position of the maxilla (also at the soft tissue level), a significant increase in mandibular length, and a significant improvement in maxillomandibular sagittal skeletal relationships. The treated group exhibited a significant reduction in overjet and a significant increase in molar relationship. The lower incisors were significantly proclined and intruded, while the lower first molars moved significantly in a mesial and vertical direction.

CONCLUSIONS: The FRD protocol is effective in correcting Class II malocclusions with a combination of skeletal (mainly maxillary) and dentoalveolar (mainly mandibular) modifications.

## 210 ASSESSMENT OF THE ACCURACY AND REPEATABILITY OF LANDMARKS USING THREE-DIMENSIONAL SOFTWARE

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AIM: The most important error in three-dimensional (3D) cephalometric analysis is landmark identification. Each landmark exhibits a characteristic pattern of error that contributes to measurement inaccuracy. The aim of this study was to analyze the repeatability of landmark identification using 3D cephalometric software.

MATERIALS AND METHOD: Cone beam computed tomograms of 10 orthognathic patients [5 males, 5 female, mean age  $\pm$  standard deviation (SD):  $18.9 \pm 1.2$  years). To evaluate the repeatability of the system a total of 21 hard tissue landmarks were defined on each patient three times with an interval of 1 week by three experts: two in orthodontics (A, B), and one in cephalometry (C).

RESULTS: The SD for the x, y and z axis for operator A was 0.17, 0.18 and 0.20 mm; for operator B 0.22, 0.35 and 0.27 mm and for operator C 0.42, 0.34 and 0.28 mm.

CONCLUSIONS: The repeatability of the 3D landmarks identified by three different operators is very high if the cephalometric landmarks are precisely defined in the three planes of space. The accuracy and repeatability of the 3D landmarks is an important starting point for reliable 3D cephalometry. Further evaluations are necessary to better define the 3D cephalometric reference system.

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## 211 EARLY ALVEOLAR BONE GRAFTING HAS A NEGATIVE EFFECT ON THE MAXILLARY DENTAL ARCH DIMENSIONS IN COMPLETE UNILATERAL CLEFT LIP AND PALATE

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AIM: To evaluate maxillary dental arch dimensions in pre-school children with a complete unilateral cleft lip and palate (UCLP) after early alveolar bone grafting.

MATERIALS AND METHOD: Intercanine and intermolar width, length of the dental arch and inclination of the major and lesser segments were measured directly on the dental casts of 42 children (27 boys, 15 girls; mean age = 5.2 years, SD 0.5; early-grafted group), 30 children (18 boys, 12 girls; mean age = 5.8 years, SD 0.8; non-grafted group), and 40 children (25 boys, 15 girls, mean age = 5.8, SD 0.4; non-cleft control group). Children from the early- and non-grafted groups had a complete UCLP repaired with a one-stage closure of the entire cleft. Alveolar bone grafting was performed in the early-grafted group between 2 and 4 years (mean = 2.4, SD 0.6). A one-way ANOVA model with *post-hoc* Tukey's multiple comparison procedures were used to identify intergroup differences.

RESULTS: The lesser segment in the early-grafted group was more palatally inclined in comparison with the non-grafted and control groups. Intercanine width had a tendency to be reduced in the early-grafted group relative to the non-grafted group.

CONCLUSIONS: Early bone grafting results in a larger collapse of the lesser fragment.

## 212 REGENERATION OF THE CONDYLE NEEDS THE ARTICULAR DISK

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AIM: It has been demonstrated that a functional appliance induces condylar regeneration even after condylectomy and eliminates subsequent reduced growth of the mandible. This study examined the function of the articular disk during condylar regeneration after unilateral condylectomy and subsequent application of a functional appliance in growing rats.

MATERIALS AND METHOD: Twenty growing rats were subjected to unilateral condylectomy and then half of these animals also underwent discectomy. A functional appliance was applied to half of the rats in each group to induce condylar regeneration. Four weeks after initiating the experiment, morphometric analyses of the mandible were performed using a rat and mouse cephalometer and microcomputed tomography. The mandibular condyles were removed under general anaesthesia for histomorphometric analysis.

RESULTS: After 4 weeks, rats that had undergone unilateral condylectomy and discectomy demonstrated reduced growth of the mandible. However, reduced growth of the mandible was not eliminated even after application of a functional appliance. Regeneration of the condyle was demonstrated in all rats in the condylectomy and condylectomy plus appliance groups. The shape of the condyle in all rats in the condylectomy/appliance group was equivalent to that of the contralateral normal condyle, whereas the shape was deformed in the condylectomy group. Four layers of condylar cartilage were also clearly

detected in the condylectomy/appliance group. However, histomorphometric analyses did not demonstrate regeneration of the condyle in either of the two discectomy groups despite application of a functional appliance in one of the groups.

CONCLUSIONS: The articular disk is crucial in the regeneration of the damaged condyle, suggesting that defect or damage of the articular disk influence mandibular growth and regeneration or repair of the condyle.

#### 213 DENTAL AGE ESTIMATION IN CHILDREN: COMPARISON OF TWO DEMIRJIAN SCORES BASED ON FOUR TEETH

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AIM: To test the applicability of the two Demirjian's (1976) self-weighted scores based on four teeth from left side of the mandible in Bosnia and Herzegovina children and to expand age prediction models for this population.

MATERIALS AND METHOD: In cross-sectional, retrospective study, the dental pantomograms (DPTs) of 805 girls and 636 boys, aged between 4 and 15 years, were scored following the two Demirjian scores based on rating one of eight stages (A-H) of calcification of four different teeth from left side of the mandible; PM1, PM2, M1, M2; and I1, PM1, PM2, M2. Dental age was obtained by finding the age at which the 50th percentile value equalled the maturity score. Kappa statistic and intraclass correlation coefficient (ICC) were used for testing intra- and interobserver repeatability of mineralization stages and dental age by assessment of 10 per cent (N = 144) of the DPTs. In addition, different regression models were tested for estimation of age as a function of maturity score for both scores and genders, separately.

RESULTS: The mean Cohen kappa values were 0.82 for intra- and 0.81 for inter-observer agreement of mineralization stages. ICCs were 0.980 for intra- and 0.978 for inter-observer repeatability for PM1, PM2, M1, M2 teeth and 0.982 for intra- and 0.981 for inter-observer repeatability for I1, PM1, PM2, M2 teeth. Both scores overestimated the dental age in this sample; the mean overestimation was 0.82 years (SD 0.97) for girls and 0.53 years (SD 0.88) for boys for PM1, PM2, M1, M2 teeth and 1.07 years (SD 0.94) for girls and 0.67 years (SD 0.88) for I1, PM1, PM2, M2 teeth.

#### 214 UNDIAGNOSED ANOREXIA AND BULIMIA IN ORTHODONTIC PRACTICE

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AIM: Extensive damage to the teeth may result from self-induced vomiting, a condition regularly associated with some eating disorders (ED) such as anorexia and bulimia. In the most serious cases, repeated contact with gastric acid can produce severe dental abrasion and rampant caries. Less commonly, facial deformity secondary to salivary-gland swelling is observed. Concerned about their appearance, patients with an ED may seek orthodontic care before medical treatment. The characteristic pattern of dental and oral signs can be an important diagnostic key in ED patients whose surreptitious vomiting is not associated with weight loss.

MATERIALS AND METHOD: Since 2001, screening for dental and oral signs of ED in all patients over 11 years of age has been carried out by postgraduates. The examination protocol includes inspection of the knuckles for calluses produced by the teeth when the fingers are used to induce vomiting. When a previously undiagnosed ED is suspected, the patient is encouraged to seek psychiatric help. Orthodontic treatment is not initiated until significant improvement in vomiting or complete recovery has occurred.

RESULTS: From January 2001 to December 2009, 11 (2 males, 9 females, age range 13 to 42 years) out of 5,028 patients attending for consultation, without a previous diagnosis of an ED, showed dental signs of acid abrasion. Seven accepted referral to a psychiatrist, who diagnosed ED in every case (1 anorexia, 6 bulimia).

CONCLUSION: Orthodontists can be the first to discover ED and consequently must be trained to encourage patients to seek psychiatric help. The role of orthodontists in secondary ED prevention, early diagnosis, and prompt intervention must be emphasized in postgraduate programmes.

#### 215 INCISO-APICAL CURVATURE OF THE TOOTH AND THE RESULTING INFLUENCE OF VERTICAL BRACKET POSITION ON TORQUE EXPRESSION

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AIM: A number of factors may modify torque expression of the bracket, including the design of the bracket and the wire and their manufacture, the location of the bracket, especially its vertical position; and tooth anatomy. The aim of this study was to analyze the influence of tooth curvature in the inciso-apical direction (R) on the effect caused by bracket adhesion at different vertical positions on the incisal edge and its subsequent impact on bracket torque expression. An additional aim was to establish a mathematical formula to represent 'real torque' applied by clinicians.

RESULTS: Bracket torque changes as a function of 'angle  $\alpha$ ' which in itself depends on distance 'd,' which represents the vertical position of the bracket. The formula that could describe this phenomenon is:

$$\alpha = \frac{d}{2\pi R} \times 360$$

Logically, this formula must be considered to be the mathematical expression of an anatomical reality that can only be approximately reflected by a geometric figure.

CONCLUSION: As the curvature of the vestibular surface in the inciso-apical direction increases, so does the potential impact caused by changing the vertical position of the brackets.

## 216 CHANGES ASSOCIATED WITH CLASS II DIVISION 1 AND CLASS II DIVISION 2 MALOCCLUSIONS

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AIM: Malocclusions that are result of skeletal structure changes (dental and alveolar) impact of the soft tissue characteristics. The aim of this study was to identify dentoalveolar angular and linear parameters in patients with Class II division 1 and Class II division 2 malocclusions.

MATERIALS AND METHOD: Ninety-five lateral teleroentgenograms (35 subjects with a Class II/1 malocclusion, 35 with Class II/2 malocclusion and a control group of 25 subjects with a normal occlusion). The following dentoalveolar parameters were measured: angular: Is/Sp, Is/SN, Ii/Mp, Ii/FH, Is/APg, Ii/APg; linear: Is-APg, Ii-APg, Is-NPg, Ii-NPg.

RESULTS: There was a persisting inclination of the maxillary incisors in the Class II/1 subjects, and a retroclination of the same incisors in the Class II/2 subjects. The values in both groups indicated a mild retrusion of the mandibular incisors.

CONCLUSION: The position of the lower incisors against the mandibular plane is important for predicting stability after orthodontic treatment.

## 217 EVALUATION OF ANXIETY AND PAIN DURING RAPID MAXILLARY EXPANSION

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AIMS: To investigate pain, stress and anxiety during the expansion and retention phase of rapid maxillary expansion (RME) in children, and to ascertain whether this is associated with age, gender or pain pressure.

SUBJECTS AND METHOD: Forty subjects (20 males, 20 females) aged 10-14 years who demonstrated either unilateral or bilateral dental crossbites as a result of maxillary constriction during the permanent dentition period and who undergone RME with a Hyrax appliance. To determine the anxiety levels of the patients the 'Spielberger's State-Trait Anxiety Inventory for Children' was used. Salivary samples were collected for stress hormone (cortisol) level determination. The patients completed two scales and saliva samples were collected before and after the first phase of treatment and after retention. A visual analogue scale was used for pain determination after activation of the expansion screw. Pain pressure threshold was determined with an algometer before treatment.

RESULTS: The differences were statistically significant within-day ( $P < 0.001$ ) and within-hours ( $P < 0.001$ ) in cortisol levels during treatment. Pain pressure threshold was statistically significant between genders ( $P < 0.05$ ) and skeletal maturity stages ( $P < 0.05$ ). State and trait anxiety scale scores were similar with respect to gender ( $P > 0.05$ ) at all times. There were statistically significant differences in state-trait anxiety levels between the pre- and post-treatment stages ( $P < 0.05$ ). Gender, skeletal maturity, anterior and posterior maxillary perception of pain were found to be statistically significant at several different treatment times.

CONCLUSION: RME treatment leads to changes in patients' state-trait anxiety levels and salivary cortisol levels.



## 218 EXPRESSION OF MYOGENIC REGULATORY FACTORS IS ALTERED IN MASTICATORY MUSCLES OF DYSTROPHIN DEFICIENT MICE

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**AIM:** The activity of myogenic regulatory factors (MRF) and muscle growth factors increase in muscle that regenerates and may correspond to some specific changes. Little is known about their role or at least their mRNA expression in the process of regeneration in masticatory muscles of mdx mice (model of Duchenne muscular dystrophy).

**MATERIALS AND METHOD:** Using Taqman RT polymerase chain reaction mRNA expression of MRFs as myogenin, MyoD1 (myogenic differentiation 1), and of the muscle growth factors myostatin, IGF1 (insulin-like growth factor) and MGF (mechano-growth factor) in masticatory muscles masseter, temporal, and tongue of mdx mice (n = 6 - 10, each group) were examined.

**RESULTS:** The myogenin mRNA expression in mdx masseter and temporal muscle was found to be increased ( $P < 0.05$ ) whereas the myostatin mRNA expression in mdx masseter ( $P < 0.005$ ) and tongue ( $P < 0.05$ ) was found to be diminished, as compared with the controls. The amounts of IGF and MGF mRNA in mdx mice remained unchanged. Within the mdx animal group, gender differences of mRNA expressions were also found. Increased mRNA expression of myogenin and MyoD1 was found females compared with males in mdx masseter and temporal muscle while myostatin was increased in masseter and tongue muscle ( $P < 0.001$  for all comparisons). Similar gender differences were found also within the control groups.

**CONCLUSIONS:** Intermuscular differences in the mRNA expression pattern of myogenin and myostatin in mdx mice imply that dystrophinopathy affects skeletal muscles differentially. The finding of gender differences of mRNA expression of the examined factors may indicate the importance of hormonal influences on muscle regeneration.

## 219 SKELETAL AND OCCLUSAL CHARACTERISTICS OF ADENOID HYPERTROPHY

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**AIM:** To verify the influence of adenoid hypertrophy on dentofacial growth and developmental in children.

**MATERIALS AND METHOD:** Lateral cephalograms of 34 adenoid hypertrophic (AH) and 33 patients with Class I malocclusions and physiological breathing (PB). Standardized lateral cephalograms were taken in the natural head position, centric relation, and relaxed lip posture. Group differences were statistically evaluated by a Student's t-test at the  $P < 0.05$  level.

**RESULTS:** The sum of the posterior angle (N-S-Art + S-Art-Go + Art-Go-Me), FMA, FMIA, MP/PP, Y-axis, N-Me, ANS-Me and Mx1-NA) measurements were greater in the AH group. However, SNA, SNB, SN-Pg, NA-Pg, IMPA, SN/PP, Jarabak's ratio, Herzberg-Holic ratio, overjet and overbite were greater in the PB group.

**CONCLUSION:** The influence of adenoid hypertrophy on dentofacial development is significantly related to airway obstruction and resulting in greater head extension. While the upper jaw moves anticlockwise, the lower jaw shows backward and clockwise rotation during growth.

## 220 A NEW MAXILLARY PROTRACTION PROTOCOL: FACEMASK THERAPY COMBINED WITH SURGICALLY ASSISTED RAPID PALATAL EXPANSION

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**AIMS:** To present an effective treatment method for subjects with reduced or no sutural activity, and a maxillary sagittal and transverse deficit.

**SUBJECTS AND METHOD:** A total bilateral maxillary osteotomy was performed in four adolescent patients. A zygomatic plate-screw anchorage system was used as rigid skeletal anchorage to attach the elastics for orthopaedic force to the maxilla and a distractor to rapidly expand the maxilla. The zygomatic plate-screw anchorage system was placed on the lateral vestibular wall of the maxilla at approximately the level of the first and second premolar apices. Following a 5-day latency period, protraction was started a rate of 1 mm/daily. Simultaneously a Petit-type facemask was used to apply a force of 500 g bilaterally to achieve an orthopaedic effect during a 6 week period. Palatal expansion was ended after two weeks when the transverse deficiency was corrected. After the six weeks, the extraoral force was reduced to 150 g for retention. The consolidation period ranged from 3 months, depending on the extent of distraction. This period was concluded when there

was radiographic evidence of calcification of the distracted callus. At the end of this period, the distractor was removed with under local anaesthesia. Cephalometric superimposition was evaluated using Björk's method.

**RESULTS:** In all patients, a positive overjet was established and the overbite was somewhat reduced. As a result of advancement and expansion of the maxilla, 'fullness' of the midfacial region and a good soft tissue profile with improvement of facial harmony was achieved. In both planes, jaw relationship and function were also corrected.

**CONCLUSION:** This maxillary protraction protocol was effective in adolescent patients with maxillary sagittal and transverse deficit. There was no risk of relapse as the patients had minimum or no sagittal and horizontal growth potential. This treatment modality is an alternative to orthognathic surgery.

## 221 COMPARISON OF A MODIFIED TANDEM TRACTION BOW APPLIANCE AND FACEMASK THERAPY IN TREATING CLASS III MALOCCLUSIONS

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**AIM:** To evaluate and compare the effects of modified tandem traction bow appliance (TTBA) and facemask (FM) in patients with a Class III malocclusion.

**MATERIALS AND METHOD:** Pre-post treatment/ pre-post observation lateral cephalograms of 68 subjects with a skeletal and dental Class III malocclusion. Twenty-three patients (11 girls, 12 boys; mean age  $10.4 \pm 0.26$  years) treated with a Delaire-type FM and 22 patients (10 girls, 12 boys; mean age  $10.1 \pm 0.30$  year) treated with a modified TTBA. The remaining 23 children (9 girls, 14 boys; mean age  $9.06 \pm 0.26$ ) were observed without treatment for 23 months. The average treatment time was 10 months for the FM group and 12 months for the modified TTBA group. The average observation period in the control group was 10 months. Intergroup differences were evaluated with variance analysis and Duncan test and intragroup differences with a paired *t*-test.

**RESULTS:** Increases in SNA, CoA and ANB were significantly greater in the treatment groups compared with the control group. ANB angle showed a significantly greater increase in the FM group than in the modified TTBA group. Improvement in overjet in the treatment groups showed a significant difference when compared with the control group; however there were significant difference between the two treatment groups for this parameter. Mesial movement of the upper molar and incisor was found to be greater in the FM group compared with the modified TTBA group. Distal movement of the lower molar and lower incisor was greater in TTBA group.

**CONCLUSION:** Both appliances are effective in the treatment of Class III malocclusions. The appliances had similar skeletal effects. However, dental changes were more pronounced in the mandible in the TTBA group, whereas the effectiveness of the FM on the maxillary dentition was greater.

## 222 CEPHALOMETRIC COMPARISON OF MANDIBULAR POSITIONING WITH TWO DIFFERENT MANDIBULAR ADVANCEMENT DEVICES IN ADULTS WITH OBSTRUCTIVE SLEEP APNOEA

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**AIM:** To cephalometrically compare the positioning of the mandible with two differently designed mandibular advancement devices (MADS) in subjects with obstructive sleep apnoea (OSA).

**SUBJECTS AND METHOD:** Forty-five OSA patients were recruited to this randomized cross-over trial lasting 3 months per treatment arm plus a 2 week wash-out period using a monobloc (MB) and a twin block (TB) MAD. Lateral cephalograms were taken at baseline and at the start of each treatment arm with the device *in situ*.

**RESULTS:** The mandible was sagittally advanced by  $10.6 \pm 2.7$  mm with the MB and by  $11.1 \pm 3.2$  mm with the TB. Vertical advancement with the MB was  $4.9 \pm 3.3$  mm and  $5.1 \pm 3.5$  mm with the TB. There was a significant difference in hyoid bone position (RGN-H) for both MADs from baseline (MB  $35.7 \pm 5.1$  mm; TB  $35.2 \pm 5.5$  mm;  $P < 0.01$ ) as well as hyoid to the mandibular plane (H-MNPL) (MB  $16.1 \pm 6.5$  mm, TB  $14.9 \pm 6.3$  mm;  $P < 0.01$ ). There were significant differences in soft palate thickness (SPT) from baseline with both MADs (MB  $10.5 \pm 2.2$  mm; TB  $10.4 \pm 2.1$  mm,  $P < 0.05$ ). The depth of the hypopharyngeal airway space from vallecula to the lower pharyngeal wall (V-LPW) was also significantly different from baseline with the TB ( $16.4 \pm 5.8$  mm,  $P < 0.05$ ). No significant differences in craniofacial and airway measurements were found between the two MADs.

**CONCLUSION:** The findings of this study revealed the existence of craniofacial and upper airway soft tissue differences in relation to the use of both appliances from baseline but not between the two MADs.

## 223 CANINE TORQUE AND BODILY MOVEMENT: THREE-DIMENSIONAL ANALYSIS USING THE FINITE ELEMENT METHOD\*\*\*

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**AIM:** Orthodontic treatment is carried out by applying force systems, which consists of two parts: force and moment. Neither force nor moment alone can determine the type of tooth movement. The M/F ratio can be considered as the reliable criteria to predict tooth movement. The relationship between the alveolar bone loss and the location of the centre of resistance (CR) is assessed numerically. When the situation remains the same, the distance between the CR and the point of force application remains constant. Geometrically, the aforementioned distance can be modified when the torque changes. The main goal of this research was to assess the relationship between the M/F ratio needed to produce the desired tooth movement and the torque of the tooth

**MATERIALS AND METHOD:** A three-dimensional model of an upper canine was described and constructed according to the Ash dental anatomy in solid works 2006. The model consisted of a uniform thickness periodontal ligament of 0.25 mm, and bone. The torque was then modified to produce different situations. The distance between the point of force application and the CR produces rotation. This rotation occurs in two directions and is to tip the tooth at the direction of tooth movement and the other is to rotate the tooth around the long axis. The correct M/F ratios to neutralise both of these rotational tendencies were applied at each phase of torque modification. Analysis was undertaken using ANSYS Version 10.

**RESULTS:** M/F ratio for bodily movement ranged between 8.19 and 8.80 for 45 degrees of torque and upright position, respectively, and between 1.54 and 0.5 for anti-rotation in the same situation, both of which can be interpreted appropriately.

## 224 RELATIONSHIP BETWEEN THE VOLUME OF ROOT RESORPTION AND THE AMOUNT OF TOOTH MOVEMENT

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**AIM:** To investigate if the volume of root resorption craters is related to the amount of tooth movement.

**MATERIALS AND METHOD:** In a standardized experimental orthodontic tooth movement in 30 subjects, 58 premolars were moved buccally during 8 weeks with the application of a force of 1 N. Forty-three contralateral premolars, not subjected to orthodontic tooth movement, served as the controls. Plaster models from before and after experimental tooth movement were digitized and superimposed, in order to evaluate the amount of tooth movement. At the end of the experimental period the premolars were extracted and scanned in a micro-scanner with a resolution of 9 µm. Three-dimensional reconstructions were obtained and volumetric measurements of the resorption craters were generated using software by defining manually on the corresponding axial slices the hull or outer limit of the resorbed area. Differences in tooth movement and in the volume of root resorption craters between the experimental and control group, were tested using an unpaired *t*-test. Correlation between the volume of root resorption and the amount of tooth movement was determined with Pearson's correlation coefficient.

**RESULTS:** The amount of tooth movement of the orthodontically moved teeth ( $2.38 \pm 1.22$  mm) and the controls ( $0.29 \pm 0.20$  mm) was significantly different ( $P < 0.001$ ). The mean volume of resorption per tooth in the control group was 0.54 mm<sup>3</sup> and in the experimental group 1.11 mm<sup>3</sup>, the difference being statistically significant ( $P < 0.002$ ). The volume of root resorption was correlated with the amount of tooth movement ( $R = 0.331$ ;  $P < 0.001$ ).

**CONCLUSION:** More resorption, as measured by volumetric analysis, was observed in the experimental than in the control group. The volume of resorption was correlated with the amount of tooth movement.

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## 225 MANDIBULAR GROWTH CHANGES IN UNTREATED SUBJECTS WITH CLASS II MALOCCLUSION

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**AIM:** Subjects with various dentoskeletal disharmonies grow differently in both the amount and direction of growth of the craniofacial structures. Untreated Class II division 1 malocclusions with mandibular retrusion show significant deficiency in the amount of mandibular growth. The purpose of this study was to compare the amount of mandibular growth in untreated Class II division 1 subjects with different types of mandibular retrusion.

**SUBJECTS AND METHOD:** Fifty-eight untreated dentoskeletal Class II division 1 subjects (27 boys, 31 girls) with mandibular retrusion: ANB angle more than 4 degrees and SNB angle less than 78 degrees, respectively. Children with maxillary protrusion (SNA greater than 84°) were excluded. Standardized high quality lateral cephalometric radiographs were analyzed at a mean of 8.7 (T1) and 10.4 (T2) years. A customized digitization regimen was used for all cephalograms. The sample was divided into groups based on type of mandibular retrusion: a dimensional group with a short mandibular body length, a rotational group with a clockwise mandibular rotation, and a positional group with a posterior position of the mandible. Statistical comparisons of the growth changes in the three groups were performed with Mann-Whitney *U* tests.

**RESULTS:** The mandibular growth changes were different from group to group. No statistical differences were found, with the exception of mandibular body length, which had a greater increase in the Dimensional group compared with the rotational and positional groups ( $P < 0.01$ ).

**CONCLUSION:** These findings may shed light on growth expectations in untreated subjects with different types of mandibular retrusion.

## 226 CONDYLAR DIRECTION AS A PREDICTOR OF TREATMENT OUTCOME IN MANDIBULAR RETROGNATHISM

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**AIM:** To identify pre-treatment cephalometric variables for the prediction of individual mandibular outcomes of functional jaw orthopaedics (FJO) followed by fixed appliances in Class II patients treated at the peak in mandibular growth.

**SUBJECTS AND METHOD:** Fifty-one subjects (24 females, 27 males) with a Class II malocclusion. First-phase therapy was accomplished with a twin block in 16 subjects, a stainless steel crown Herbst in 15 subjects, and an acrylic splint Herbst in 20 subjects. Lateral cephalograms were available at the start of treatment with FJO and at the completion of fixed appliance therapy. All subjects received FJO at the peak in mandibular growth (CS 3 at T1). Individual responsiveness to Class II treatment, including FJO, was defined on the basis of the T2-T1 increment in total mandibular length (Co-Gn) when compared with untreated Class II subjects.

**RESULTS:** Discriminant analysis identified a single predictive parameter (Co-Go-Me°) with a classification power of 80 per cent. Pre-treatment vertical and sagittal parameters were not able to improve the prediction based upon the mandibular angle.

**CONCLUSIONS:** A Class II patient at the peak in skeletal maturation (CS 3) with a pre-treatment Co-Go-Me less than 125.5 degrees is expected to respond favourably to treatment, including FJO. A Class II patient at CS 3 with a pre-treatment value for Co-Go-Me greater than 125.5 degrees is expected to respond poorly to treatment, including FJO. These results were tested on a different group of Class II patients and the classification power was still around 80 per cent.

## 227 EVALUATION OF DENTAL ARCH ASYMMETRY IN THE MIXED DENTITION

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**AIM:** To quantify and describe maxillary and mandibular intraarch asymmetry in children in the mixed dentition and to determine if a relationship exists between intra- and interarch asymmetry.

**MATERIALS AND METHOD:** Dental casts of 60 Caucasian children between 7 and 11 years of age with dental transverse asymmetry. The method of Maurice was used to assess asymmetries using the median palatal plane and transverse palatal plane perpendicular to each other.

**RESULTS:** Asymmetry greater than 2.0 mm was observed for any one landmark in 25 per cent of the sample. Transverse asymmetries exceeded anteroposterior asymmetries in magnitude and prevalence. A high association between the positions of anteroposterior and transverse interarch landmarks indicated that the arches had similar dimensions.

**CONCLUSIONS:** Significant asymmetries were found in 30 per cent of subjects with narrowed upper dental arches and crowding in the anterior segment. Early diagnosis and treatment is necessary to correct the occlusal relationship to avoid abnormal growth changes.

## 228 FACEMASK TREATMENT: EFFECTS ON THE SIZE AND POSITION OF THE MAXILLA AND MANDIBLE

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AIM: The facemask is an orthopaedic appliance used in Class III patients to achieve maxillary protraction. The aim of this research was to examine the effect of facemask treatment on the changes in the position and size of the maxilla and mandible in cleft lip and palate (CLP) and non-CLP Class III patients.

SUBJECTS AND METHOD: Ninety-nine Class III (decreased SNA, normal or decreased SNB) individuals: 34 non-CLP and 19 CLP treated subjects, and 46 untreated controls. All patients were treated with a facemask until a satisfactory maxillary position and overjet were achieved. Molar bands with a palatal and vestibular arch were placed on the first permanent or second primary upper molars. Force (between 300 and 500 g) was applied in the area between the upper lateral incisors and canines. Force direction was between 15 and 45 degrees facing down and forward in relation to the occlusal plane, depending on the position of the maxilla and the overbite. The patients were advised to wear the mask 12 to 14 hours/day. Lateral cephalographs were obtained immediately before and after treatment. Cephalometric parameters SNA, SNB, Cmx, Cmd, Rmd were analyzed. Before and after values were compared in each group using the Student's *t*-test. The difference in treatment effects between the groups was analyzed using the Wilcoxon test.

RESULTS: SNA showed a significant increase in the subjects and a decrease in the controls. SNB showed significant a decrease in subjects and an increase in controls. Cmx increased insignificantly and Cmd increased significantly in both subjects and controls. Rmd increased significantly in non-CLP subjects, and insignificantly in CLP subjects and controls. Comparison of the changes between subjects and controls showed statistical significance for SNA, SNB, Cmd and Rmd.

CONCLUSION: Facemask treatment has a favourable effect on the position of the maxilla and mandible. However, no favourable effect on the size of the maxilla and mandible was noted.

## 229 TRANSVERSE DIFFERENCES OF ARCH FORM IN CLASS III MALOCCLUSIONS

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AIM: Generally in Class III cases a narrowed maxilla, a posterior crossbite, and an anterior crossbite are observed. The aim of this study was to evaluate the differences in dental arch length and depth in subjects with a narrowed maxilla, compared with those with a normal occlusion.

MATERIALS AND METHOD: Dental models of 98 patients (36 boys, 62 girls) with a Class III malocclusion, a narrowed maxilla, a dental Class III molar and canine relationship, posterior crossbite and full occlusion. The models of 21 subjects (17 girls, 4 boys) with an ideal Class I occlusion, full occlusion and in permanent dentition were used as the control group. Twenty-five linear and ratio measurements were evaluated. The significance of the differences from the statistical analyses (*t*-test) was tested.

RESULTS: In the Class III group intercanine and interpremolar lengths were significantly less compared with the control group, while intermolar length measurements were similar. Mandibular and maxillary anterior arch depth was also statistically significantly decreased in the Class III group.

CONCLUSION: It appears that the contraction of maxillary intercanine and interpremolar lengths is a result of utilising the anchorage from mandible. The reduction of mandibular anterior arch depth could be due to retrusion of the mandibular incisors.

## 230 EVALUATION OF NASAL CAVITY VOLUME CHANGES AFTER SURGICAL ASSISTED RAPID MAXIL-LARY EXPANSION

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AIM: To assess the effects of rapid maxillary expansion (RME) and surgical-assisted (SA) RME on maxillary dental arch, nasal cavity dimensions and volume using three-dimensional simulation and modelling programs.

SUBJECTS AND METHOD: Fifteen patients (6 females, 9 males; mean age: 13.8 years) treated with RME and nine patients (4 females, 5 males; mean age: 16.2 years) with SARME. All patients underwent a standardized protocol of expansion with a bonded acrylic RME appliance. The average amount and duration of expansion were  $8.1 \pm 1.39$  mm and  $20.4 \pm 3.8$  days for RME, and  $8.9 \pm .53$  mm and  $18.4 \pm 3.1$  days for SARME. Computed tomographic (CT) scans were obtained before treatment (T0) and after 6-months from the end of expansion (T1) with the cross-sectional tomogram, Proscan (Planmeca Oy, Helsinki, Finland). All CT data were transferred to a computer; nasal cavity and maxillary teeth segmented with using Mimics and Simplant Ortho (Materialise, Belgium) software. Nasal cavity volume and maxillary area changes were evaluated at T1 and T2. Statistical analyses were performed using SPSS 15.00 program. The difference between the measurements at T0 and T1 were undertaken with a paired *t*-test and between the groups assessed with a Student's *t* test.

**RESULTS:** Following RME treatment, the statistically significant effects of RME and SARME were: mean increases in interpremolar and intermolar distances; mean increases in the width of the nasal floor near the midpalatal suture and nasal cavity and mean increases in total nasal volume. As the maxillary structures separated, the outer walls of the nasal cavity moved laterally resulting in an increase in internasal volume in both groups (12.14%, 14.75%, respectively;  $P < 0.001$ ). There were no statistically significant differences between the groups at T1.

**CONCLUSIONS:** RME, with or without surgery was effective in patients with nasal respiratory problems and maxillary transverse deficiency.

## 231 SHORT-TERM RESULTS OF DISTRACTION OSTEOGENESIS OF THE MAXILLA ON NASAL CAVITY AND PHARYNGEAL AIRWAY SPACE

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**AIM:** To describe volumetric changes in the nasal cavity and nasopharyngeal area after surgical-orthodontic treatment of patients with maxillary hypoplasia using distraction osteogenesis (DO) with internal maxillary distractors.

**SUBJECTS AND METHOD:** Four patients, aged 18 to 33 years (mean 25.5 years). The cephalometric, stereolithographic three-dimensional (3D) skull prototype model (SLA) and 3D computerized tomographic images examinations revealed severe a Class III malocclusion and anterior with/without a posterior crossbite with an excessive negative-overjet (mean:  $11.4 \pm 3.5$  mm). The SLA model obtained through a cross-sectional tomogram (Proscan; Planmeca OY, Helsinki, Finland) was built by Spectrum-Z510, Colour3D-Printers (Z-Corporation, Burlington, USA) using Mimics and Simplant-Ortho (Materialise, Belgium) software. Simulation of the osteotomies and placement of distraction devices was performed on models, and then surgical guides were used to transfer the planning to the patient during surgery. Photographs, lateral cephalometric radiographs and computed tomographic (CT) data were obtained pre-operatively (T0) and 6-months after DO (T1). A Le Fort I osteotomy was performed under general anaesthesia, and maxillary distractors were placed bilaterally. After a latency period of 7 days, distraction was begun at a rate of  $0.5 \text{ mm} \times 2/\text{day}$  for approximately 18 days. After correction of the negative overjet, all patients underwent a consolidation period of 60 days with the distractors in place.

**RESULTS:** DO was successful in all cases, resulting in a mean sagittal bone gain measured parallel to the skull base of 9.5 mm (range: 7.5-15.0) in the patients treated with intraoral distractors. In all cases, 3D-volumetric measurements related to nasal cavity and nasopharyngeal area showed significant increases compared with T0. The reconstruction of the bony structures was as accurate as planned on the SLA models.

**CONCLUSION:** DO resulted in volumetric nasal, maxillary and nasopharyngeal growth after the distraction phase.

## 232 POLYSOMNOGRAPHIC EVALUATION OF PATIENTS AFTER BIMAXILLARY ORTHOGNATHIC SURGERY

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**AIM:** To determine the effects of bimaxillary orthognathic surgery (BOS) on pharyngeal morphology and respiratory function during sleep.

**SUBJECTS AND METHOD:** Twenty-one patients in whom skeletal Class III malocclusions were corrected by maxillary advancement ( $4.3 \pm 1.7$  mm) and mandibular setback ( $6.5 \pm 2.5$  mm). All patients underwent a one-night sleep study for polysomnographic (PSG) evaluation. Sleep parameters were recorded on a 32-channel polygraph. In the sleep studies, standard recording parameters, including the apnoea-hypopnoea index (AHI), sleep onset, sleep efficiency, sleep stage weakness, sleep stage 1st, 2nd, 3rd, 4th and rapid eye movement (REM), arterial oxygen saturation ( $\text{SaO}_2$ ) and arousals were used. The data obtained from PSG evaluation of the pre- and post-operative period were compared in terms of the effect of apnoea and sleep quality. A paired *t*-test was used for statistical analysis.

**RESULTS:** No significant difference was found between AHI in the pre- and post-operative period. Although mandibular setback produced a significant narrowing at the oro- and hypopharynx, maxillary advancement caused a significant widening at naso- and velopharynx levels. Sleep quality pre-operatively was more disturbed than post-operatively. Sleep efficiency improved significantly after surgery; the sleep onset period, sleep stage weakness and sleep stage 1st and 2nd was longer before than after surgery; arousals, which leads to sleep fragmentation, were more pre-operatively than post-operatively. Pre-surgery, an insufficient 3rd and 4th period of sleep might result in daytime sleepiness, sleep fragmentation and REM. Decreased  $\text{SaO}_2$  during sleep observed pre-surgery was increased after surgery.

**CONCLUSION:** Even though none of the examined patients presented with snoring or obstructive sleep apnoea post-surgery, there is an increased possibility in patients with already compromised airways.

#### 234 EFFECTS OF A MANDIBULAR ADVANCEMENT DEVICE WITH DIFFERENT MANDIBULAR PROTRUSION POSITIONS ON OBSTRUCTIVE SLEEP APNOEA

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**AIM:** Mandibular advancement devices (MADs) have become a common treatment for obstructive sleep apnoea (OSA) and are used as an alternative to continuous positive airway pressure devices. The aim of this study was to assess the influence of different mandibular protrusion positions (MPP) on OSA.

**SUBJECTS AND METHOD:** Fourteen subjects [body mass index (BMI):  $28.3 \pm 3.3$ ] diagnosed with mild/moderate OSA. Seven OSA patients (5 males, 2 females; mean age:  $51.5 \pm 9.2$  years; AHI:  $18.7 \pm 7.9$ ) received an adjustable MAD (aMAD). The MAD consisted of two hard acrylic-resin splints with two adjustable screws to change the MPP in the anteroposterior direction. The patients underwent four polysomnographic (PSG) recordings with their MAD *in situ* at different MPPs. For the other seven patients (5 males, 2 females; mean age:  $49.2 \pm 8.5$  years; AHI:  $16.9 \pm 7.7$ ), a non-adjustable MAD (nMAD) was fabricated and the same PSG protocol with an average duration of 4 weeks between subsequent recordings was applied. All statistical tests were performed with the Statistical Package for Social Sciences, version 15.0. To demonstrate the difference between aMAD and nMAD, paired Student's *t*-tests were used and for the effect of MPPs, ANOVA.

**RESULTS:** Subjective compliance to the side-effects caused by the MADs was significantly better for aMAD compared with nMAD. PSG evaluations prior to and with MADs *in situ* revealed a significant decrease in the apnoea-hypnoea index (AHI) and an increase in minimum oxygen saturation. There was, however, no significant difference between the groups. In the aMAD group, the mean AHI values differed significantly between the MPPs. The greatest MPP resulted in a significant reduction of the AHI with respect to the start position. In the nMAD group, there were no significant improvements between second, third and fourth PSG evaluations.

**CONCLUSION:** Objective testing showed the aMAD at the greatest MPP and the nMAD had a similar efficacy in terms of AHI reduction. Patients reported improvements with both devices; however, better compliance and less side-effects were apparent for the aMAD when both devices were compared.

#### 235 INTRUSION OF THE UPPER POSTERIOR TEETH WITH MINISCREW IMPLANT ANCHORAGE

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**AIM:** Overeruption of the upper molars and premolars following loss of the opposing tooth is a common clinical finding. In such cases, when the interocclusal space is reduced, intrusion of the upper posterior teeth with miniscrew implants to correct a canted occlusal plane could be a new treatment strategy for mandibular prosthetic treatment with implant supported fixed dentures. The aim of the study was to determine the effectiveness of miniscrew anchorage for intrusion of the posterior upper teeth to gain sufficient interocclusal space for implant supported fixed partial mandibular dentures.

**SUBJECTS AND METHOD:** Seven patients (aged 29 to 57 years; mean 45.7 years) with overerupted maxillary posterior teeth. Four self-drilling miniscrew implants (two for the buccal alveolar bone region and two for the posterior palatal area) were inserted. A force of 80 g was applied using an elastomeric chain to each overerupted maxillary posterior tooth with buccal and palatal miniscrew implants anchorage. The elastomeric chain was replaced every three weeks. Lateral cephalograms were obtained pre-intrusion and immediately after completion of the intrusion. The cephalometric films were measured and compared. Osseointegrated implants were then placed in the opposing posterior mandibular region and prosthetic treatment was finalized with three unit implant supported fixed partial dentures, 3 months after implant surgery.

**RESULTS:** The upper posterior teeth were intruded an average of 4 mm according to the mesiopalatal tuberculum of the cusp of the first maxillary molars in a mean active treatment time of 4.8 months. A good occlusion was achieved with implant supported mandibular fixed partial dentures after a mean period of 11 months.

**CONCLUSION:** Miniscrew implant anchorage can be effectively used for intrusion of the upper posterior teeth in a reduced treatment time and with enhanced patient comfort to obtain sufficient interocclusal space and allow construction of implant supported fixed partial dentures for the posterior mandibular region.

### 236 EVALUATION OF PREMAXILLARY DEFICIENT PATIENTS AFTER MAXILLARY ANTERIOR SEGMENTAL DISTRACTION OSTEOGENESIS

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**AIM:** To describe the volumetric changes in the nasal cavity and maxillary bone after maxillary anterior segmental distraction osteogenesis (MASDO) in patients with premaxillary deficiency.

**SUBJECTS AND METHOD:** An individual tooth-borne distraction device was used for the advancement of the maxillary anterior segment. Fifteen patients underwent bilateral distraction under general anaesthesia and maxillary distractors were placed bilaterally. Photographs, lateral cephalometric-radiographs and three-dimensional (3D) computerized tomographic (CT) images (Proscan Planmeca OY, Helsinki, Finland) were obtained pre-operatively (T0) and 6-months after distraction (T1). All CT data were transferred to a computer using Mimics and Simplant-Ortho (Materialise, Belgium) software. A paired *t*-test was used for statistical analysis.

**RESULTS:** The maxillary anterior complex was moved to the planned positions without any complications after MASDO. 3D analysis revealed that the premaxilla moved forward and upward and the length of palatal plane increased. There were significant volumetric differences in the nasal cavity and maxillary bone between T0 and T1.

**CONCLUSION:** MASDO is an effective surgical orthodontic treatment option for a retruded maxilla. Patients undergoing to MASDO should be screened for obstructions related to nasal cavity and evaluated using 3D CT.

### 237 COMPARISON OF PALATAL HEIGHT AND WIDTH AT DIFFERENT STAGES OF DENTAL DEVELOPMENT

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**AIM:** To compare palatal height and width at different stages of dental development in subjects with an 'ideal' (normal) occlusion.

**MATERIALS AND METHOD:** Study casts of 205 randomly selected Iranians (94 males and 111 females) between the ages of 3 and 20 years without a history of orthodontic treatment. The casts were divided into three groups: primary (n = 19), mixed (n = 52) and permanent (n = 134) dentitions. Palatal height and width were measured at two levels (level I = intermolar, level II = intercanine) using a Korkhaus divider and digital callipers. The palatal index values were calculated at these levels. The data were analyzed with a Student's *t*-test.

**RESULTS:** At level I, palatal height increased in subjects in the permanent dentition compared with the primary dentition. At level II, palatal height decreased in the mixed dentition subjects compared with those in the primary and permanent dentitions. At level I, palatal width progressively increased from the primary to the mixed to the permanent dentition, although at level II, palatal width was increased in the permanent dentition compared with the mixed dentition. At levels I and II, the palatal index decreased in the mixed compared with the primary and permanent dentitions. At level I, the palatal index was increased more in the permanent than in the primary dentition; however, at level II this increase was not statically significant.

**CONCLUSION:** The findings of this study showed relatively different results compared with other investigations. These can be explained by the difference in intermolar width in racial groups. Thus in clinical assessments the values from anthropometric studies of the local geographical region should be used.

### 238 CORRELATION BETWEEN CHILDREN'S SPINAL DEFORMITY AND FAULT IN POSTURE WITH SAGITTAL MALOCCLUSION

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**AIM:** Poor posture has been suggested to be a factor contributing to the beginning and aggravation of a malocclusion. The aim of this study was to identify correlations between children's spinal deformity and posture with sagittal malocclusion.

**SUBJECTS AND METHOD:** Thirty patients aged 6-12 year with sagittal a malocclusion (15 Class II, 15 Class III). Computer optical topography was used for diagnosis. To determine correlations, measurements of parameters on a lateral cephalometric radiograph and the data from computer optical topography were used.

**RESULTS:** There is a correlation between Co-Go and the severity of lordosis and kyphosis in Class II malocclusion subjects



( $r = 0.9$ ;  $P < 0.001$ ). ANB depends on the severity of lordosis and kyphosis ( $r = 0.7$ ;  $P < 0.001$ ) and on rotational deformation of body  $r = 0.7$  ( $P < 0.001$ ). SNB depends on rotational body deformation ( $r = -0.7$ ;  $P < 0.001$ ). Patient with a Class III malocclusion have a correlation between Co-Go and the severity of lordosis and kyphosis ( $r = 0.8$ ;  $P < 0.001$ ), the severity of lordosis and ANB ( $r = 0.7$ ;  $P < 0.001$ ) and SNB and the orientation and position of the shoulder blades ( $r = -0.8$ ;  $P < 0.001$ ).

CONCLUSION: Spinal deformity and fault in posture are correlated with a sagittal malocclusion.

## 239 A NEW APPLIANCE FOR RAPID MAXILLARY EXPANSION IN HYPERDIVERGENT PATIENTS

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AIM: To test the clinical efficacy of the G-Expander, a new device for rapid maxillary expansion in hyperdivergent growing patients.

SUBJECTS AND METHOD: For this preliminary study 12 patients (7 females, 5 males, mean age 9.3 years) with maxillary constriction, hyperdivergent skeletal pattern (mean value of Sn/GoGn  $39.7^\circ$ ) and consequent open bite, were selected. All patients were treated with the G-Expander that has bands on the upper first molars connected to the expansion screw by means of 0.8 mm stainless steel wire arms. The connecting arms were covered by resin, which extended to the occlusal surface of the primary teeth to control the vertical dimension. The G-Expander was bonded only on the maxillary molars bands in order simplify the hygiene procedure and the removal of the appliance. No composite is used in the resin part. At the end of expansion the G-expander was left bonded at least for 7 months. Cephalometric radiographs and dental casts were obtained at the beginning of treatment (T1) and at the end of expansion (T2).

RESULTS: Treatment in all patients resulted in a correct transverse dimension and a normal overbite. The mean maxillary arch expansion in the molar region was 8.6 mm (measured on the dental cast T1-T2) while vertical growth was maintained; the mean value of Sn/GoGn changed from  $39.7$  to  $38.5$  degrees.

CONCLUSION: The G-expander proved to be reliable in treating the transverse deficiency in the hyperdivergent growing patient, maintaining the vertical control by molar intrusion and upper incisor extrusion and avoiding the adverse hygiene effects of the McNamara expander.

## 240 RELIABILITY OF FRONTAL ANTERIOR LIMIT LINE DETERMINATION FOR ORTHODONTIC DIAGNOSIS

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AIM: To determine the reliability of evaluating the anteroposterior position of the maxillary central incisors in relation to the forehead. Andrews proposed a technique of visually determining a vertical line (frontal anterior limit line = FALL) that passes through the midpoint of the clinical forehead parallel to the frontal plane. Assuming that this line forms an integral part of human perception and three-dimensional orientation, its distance to the facial axis of the maxillary central incisors is assessed. The present study investigated the reliability of this method and its application in orthodontic diagnosis.

SUBJECTS AND METHOD: Sixty volunteers including orthodontists, postgraduate students of orthodontics, and undergraduate students of dentistry were divided into three groups. All were asked to clinically examine a number of participants from a profile view. The students in group 3 were additionally tested for their ratings based on profile images. The evaluations performed by this group were repeated after 1 week to see whether a learning effect had taken place. The Statistical Package for Social Sciences, version 17, was used to determine inter- and intraexaminer reliability by calculating the intraclass correlation coefficient (ICC).

RESULTS: Interexaminer agreement between the postgraduates in groups 1 and 2 was found to be good (ICC .52 and .45). Between the students in group 3, agreement was initially weak (ICC.21) but was found to have improved when repeating the evaluations 1 week later (ICC .46). Assessments made by clinical examination were less reproducible than the measurements obtained on profile images.

CONCLUSIONS: Aesthetics is an important part of orthodontic diagnosis. The method proposed by Andrews promotes a shared notion of defining harmony in profile views. The results of this investigation suggest that determining a profile-specific vertical line involves a learning curve.

#### 241 A SOLUTION FOR ANALYZING OCCLUSAL FUNCTION IN CRANIOMANDIBULAR DISORDERS\*\*\*

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**AIM:** The role of occlusal factors in the aetiology of craniomandibular disorders has long been debated. It is important for clinicians to have a tool that precisely records occlusal contacts, and to identify the intensity and kinematics of these in computer graphics. The T-Scan device appears to be a valuable aid for computerized occlusal analysis, as it uses sensors that are very thin (60 µm) for the detection and transduction of cybernetic occlusal contacts. The aim of this study was to evaluate the performance of the device on patients referred with significant articular symptoms.

**SUBJECTS AND METHOD:** 30 symptomatic patients were evaluated using the T-scan III. The recordings were performed in static (maximum intercuspation or retruded contact) and dynamic (lateral and protrusion). The values obtained were displayed and examined using computer software.

**RESULTS:** The results confirm the data reported in the literature on the ability of the system in revealing location, intensity and direction of occlusal contacts in static and dynamic joints. The software appears to be easy to manage and effectively displays the recorded data. The method also encourages communication with the patient, understanding of the symptoms and the progress of therapy.

**CONCLUSIONS:** The advantage of the registration of occlusal contacts using this equipment, compared with traditional detection achievable with the use of wax paper or articulation, is that it enables evaluation of the intensity of contacts, particularly their timeline in static and dynamic (lateral and protrusion). This is important when performing a balancing occlusal removal or additions, with and without the splint. The system is also effective in visualizing the results on a PC monitor, with significant benefits for the operator.

#### 242 TEMPORARY ANCHORAGE DEVICES: ADVANTAGES IN ORTHODONTIC CORRECTION OF MAXILLARY CANINE-FIRST PREMOLAR TRANSPOSITION

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**AIM:** The incidence of maxillary canine-premolar transposition is reported to be approximately 0.4 per cent. Acceptance of the malposition provides aesthetic and functional disadvantages, but remains the predominate treatment. The aim of this study was to describe first premolar-canine transposition.

**SUBJECTS AND METHOD:** According to a retrospective literature study of 2000 articles, four different cases of transposition involving the first premolar and canine are described. Treatment of transposed teeth was performed without extractions. The patients' ages at the beginning of treatment varied from 10 years 1 month to 13 years 5 months. After treatment, the first patient had alignment of the teeth in their transposed positions with reshaping of the occlusal surface of the premolar. Another patient underwent orthodontic tooth movement to correct the intra-arch position and the last two cases were treated with temporary anchorage devices. These can achieve tooth movement outside the occlusal plane where the bone is thicker.

**RESULTS:** Treatment times varied from 12 to 36 months with an average of 28 months. Recession was observed at the gingival margins of the repositioned canines in two subjects and root contour irregularities occurred at the end of the treatment in the two other cases. Cone beam computed tomography scans showed, in one subject, labial triangular bone resorption.

**CONCLUSIONS:** Achievement of optimal function and aesthetics in cases with tooth transposition requires the utmost care in the design of the treatment. Torque control and movement of the transposed teeth while preserving the vestibular cortical bone plate and the gingival level are difficult. The dental age of the patient should also be considered. Early diagnosis of upper canine-premolar transposition should permit treatment without extraction or alignment.

#### 243 THREE-DIMENSIONAL ANALYSIS OF STEP BEND: FINITE ELEMENT STUDY

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**AIM:** To investigate the active and reactive forces and moments in an applied force system to minimize side effects.

**MATERIALS AND METHOD:** Three models were designed in Solid Works 2008. A step bend of 0.5 mm (round stainless steel), a model of two central incisors with their supporting structure (periodontal ligament, spongy bone and cortical bone), and two blocks with a space and a wire with a combination of two step bends to modify tooth angulation. The models

were then transferred to ANSYS workbench version 11.0 for calculation. Different positions of the step bend and the force systems produced by them were assessed

**RESULTS:** A gradual decrease of force produced by the step bend between 316 and 308 g was shown to exist in the central and extreme step bend position. The moment followed almost the same pattern starting from 15.125 N.mm in the centre bend position to 14.134 N.mm in the extreme position. With the combined step bend model, extrusive/lingual movement on one side and Intrusive/labial movement on the other and tipping of the crowns was also shown.

**CONCLUSION:** A step bend is not sensitive to its position and almost the same force system is produced in different bend positions

#### 244 EVALUATION OF MAXILLARY AND MANDIBULAR ARCH DIMENSIONS AND ARCH FORMS IN CLEFT PALATE PATIENTS

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**AIMS:** To investigate arch dimensions in primary and secondary cleft palate (CP) patients and non-cleft patients, to determine mathematical equation most appropriately representing upper and lower arch forms in primary and secondary CP patients and non-cleft patients, and to determine arch dimensions and arch form differences associated with cleft type and age.

**MATERIALS AND METHOD:** Images of the occlusal surfaces of orthodontic casts taken from 144 unilateral, 74 bilateral primary and secondary CP patients and 100 non-cleft patients were transferred to Mathlab 7.0® software. The groups were classified as; newborn, 4-8 months, 12-18 months, primary, mixed and permanent dentition. In order to determine the differences associated with cleft type and age; arch widths, arch lengths and midline deviation were measured. Based on the correlation between parabola, third, fourth, sixth and eighth order polynomial functions and points on occlusal images, mathematical equations most appropriately representing upper and lower arch forms were determined by the least square optimization method. Arch forms obtained from CP and non-cleft groups were superimposed and differences associated with cleft type and age were defined.

**RESULTS:** Although maxillary anterior arch width in unilateral and bilateral primary and secondary CP newborns was similar to non-cleft patients, maxillary posterior arch width was greater. Maxillary arch dimensions in right and left-sided unilateral primary and secondary CP patients were similar. Mandibular arch dimensions were affected by maxillary arch dimensions. The mathematical equation most appropriately representing arch forms is eighth order polynomial function. The arch form differences in unilateral and bilateral primary and secondary CP newborns were not present at 12-18 months.

**CONCLUSIONS:** Pre-operative orthopaedic treatment is effective in aligning the maxillary segments and reducing cleft size. Although maxillary arch dimensions of CP patients are smaller than non-cleft patients, arch forms obtained by pre-operative orthopaedic treatment are conserved.

#### 245 EVALUATION OF CANINE DISTALIZATION WITH MINISCREWS

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**AIM:** Anchorage control is important in maximum anchorage cases. The aim of this study was to evaluate changes in canine distalization with miniscrews.

**SUBJECTS AND METHOD:** Twenty non-growing patients with an Angle Class II dental pattern in which the upper two first premolars were to be extracted. For space closure maximum anchorage was necessary. Miniscrews were used for anchorage control in 10 patients and a transpalatal arch (TPA) in the other 10 patients. The miniscrews were placed between the upper first molars and second premolars on both sides. The diameter and length of the miniscrews was 1.6 and 8 mm, respectively. For canine distalization a Gjessing retraction spring was used. Lateral cephalometric radiographs were taken before and after distalization. For evaluation of the changes, 10 parameters, including the upper canines and molars, were used. Within-group comparison was performed using the Wilcoxon signed rank test and for between-group comparison the Mann-Whitney *U* test.

**RESULTS:** In both groups, overjet and canine distalization showed statistically significant changes. In the miniscrew group, while the amount of distalization was, on average, 6.65 mm, it was 5.05 mm in the TPA group. The amount of distalization in the miniscrew group was higher than in the TPA group. Molar anchorage loss was recorded in both groups but to a lesser extent in the miniscrew group. Comparison of the anchorage loss in the two groups showed that the difference was not statistically significant.

**CONCLUSION:** In maximum anchorage cases, canine distalization using miniscrew anchorage is a successful treatment

technique with less anchorage loss and greater canine distalization.

#### 246 THREE-DIMENSIONAL EVALUATION OF SYMPHYSIS MORPHOLOGY IN PATIENTS WITH DIFFERENT VERTICAL SKELETAL PATTERNS

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AIM: Symphysis morphology may show different characteristics in different vertical patterns. The aim of this study was to evaluate symphysis morphology in a group of patients with different vertical skeletal pattern using cone-beam computed tomography (CBCT).

MATERIALS AND METHOD: The CBCT records of 60 subjects with a Class I skeletal pattern were selected. The subjects were divided into three subgroups according to their SnGoMe angles as high, normal and low. The height, depth, anterior distance, posterior distance, height/depth and surface area were measured for all subjects CBCT. Analysis of variance (ANOVA) was used for inter-group comparison. After ANOVA, evaluation of the differences between groups was made with the LSD test.

RESULTS: Statistically significant differences were found in height between the normal and low angle groups. The low angle group showed statistically significant difference in anterior distance relative to the high and normal angle groups. The height/depth ratio was also higher than in the normal and low angle groups. For area assessment, a statistically significant difference was found between the normal and high angle groups.

CONCLUSION: Class I patients with different vertical skeletal patterns may have different symphysis morphology.

#### 247 EVALUATION OF THE EFFECTIVENESS OF RICKETTS' LONG-RANGE GROWTH PREDICTION METHOD IN FACIAL-SKELETAL PREDICTION

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AIM: Long-range growth prediction plays an essential role in determination of an individual's future facial type. The aim of this study was to evaluate the adequacy of the long-range growth prediction method of Ricketts in facial-skeletal structure prediction of Anatolian individuals.

MATERIALS AND METHOD: The data of 46 subjects who had not undergone orthodontic treatment. Their baseline average age was 9.5 years. The second cephalograms were repeated 5 years later under similar conditions. The sample was divided into three main groups: a male group, a female group and a general group, and two subgroups: prediction and actual groups. To confirm the validity of the method; 15 cephalometric parameters were measured on the actual and predicted tracings. The level of the relationship between the prediction and actual measurements was evaluated with Pearson's correlation coefficient.

RESULTS: Except for condylion axis in the female group, all parameters showed high correlation between the prediction and actual measurements. The prediction method for all measurements was observed to be very near to the actual measurements.

CONCLUSION: The long-range growth prediction method was found to be very successful in all groups. In the achievement of determination of the type of an Anatolian Turk's face in the future, this prediction method might be very useful in orthodontic treatment planning.

#### 248 EVALUATION OF LOWER FIRST MOLAR POSITION RELATED TO GROWTH AND DEVELOPMENT IN A TURKISH POPULATION

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AIM: From the mixed to the permanent dentition, significant physiologic events occur which affect the position of the first molars in the dentoalveolar arch. The aim of this research was to evaluate positional changes of the lower first molars according to growth and development from the mixed to the permanent dentition in a Turkish population

MATERIALS AND METHOD: The records of 51 patients (30 girls, 21 boys), who not undergone orthodontic treatment and who had normal occlusion. All patients had two records, including cephalometric radiographs and dental casts. The first records were obtained in the mixed dentition (T1) and the second in the permanent dentition (T2) 5 years after the first records. The cephalometric sagittal parameters investigated were: PTV-LL6, PTV-LR6, Id-LL6, IdLR6, D-LL6, D-LR6. The right and left segmental length and depth and intermolar width were measured on the dental casts. Twelve different



parameters were evaluated to compare the records. The difference between T1 and T2 were evaluated by paired *t*-test and that between the male and female groups at T1 were with an independent *t*-test.

RESULTS: Evaluation of left and right lower first molar movement revealed sexual dimorphism. All parameters showed significant differences except for D-LL6 in the male group. In the female group significant differences were seen in comparison of all 12 parameters.

CONCLUSION: The lower first molars considerably changed their location in the sagittal plane during transition from the mixed to the permanent dentition.

## 249 ORTHODONTIC TREATMENT FROM THE PATIENTS' AND PARENTS' PERSPECTIVES

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AIM: To confirm both patient and parent motivation before orthodontic treatment is a crucial for successful orthodontic therapy. With the information of patients' and parents' expectations the treatment strategy can be designed more accurately. The aims of this investigation were to survey impulse factors of patients and parents for orthodontic treatment and to find out the influence of age and gender.

SUBJECTS AND METHOD: A referred population of 584 children, (356 girls, 228 boys, aged from 7 to 18 years). Both patients and parents completed two different questionnaires that had similar questions designed to assess motivation for orthodontic treatment. A chi-square test was used for statistical analysis.

RESULTS: In the patient and parent groups the main motivational factor for orthodontic treatment was desire to improve aesthetics (65 and 50.5%, respectively). There was no relationship between gender and age in patients' questionnaire ( $P > 0.05$ ). In the parents group, there were statistical differences in the answers due to age ( $P = 0.001$ ) and gender ( $P = 0.013$ ) of their children.

CONCLUSIONS: Facial aesthetics is the main factor for orthodontic treatment from both the patients' and parents' perspectives. Additionally, age and gender of a child is distinct factors for parents seeking orthodontic treatment for their child.

## 250 ORTHODONTIC TREATMENT NEED IN A SAMPLE OF EASTERN MEDITERRANEAN CHILDREN

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AIM: To establish orthodontic treatment need according to the Index of Orthodontic Treatment Need (IOTN), and to determine its association with socio-economic status, gender and dentition type in a sample of eastern Mediterranean children.

SUBJECTS AND METHOD: Five hundred and eighty four children, aged from 7 to 18 ( $12.89 \pm 2.48$ ) years, (356 girls and 228 boys). None of the children had previously undergone orthodontic treatment. The IOTN was used to assess orthodontic treatment need. Chi-square tests were used to analyse the IOTN results by socio-economic status, gender and dentition type.

RESULTS: A definite need (grade 5) was recorded for 26.7 per cent of the subjects and no treatment need (grade 1) for 12.0 per cent. A normative need for orthodontic treatment was more common in deprived children than in their affluent counterparts. There was no significant difference between the genders. During the mixed dentition, normative treatment need values were lower than those in the permanent dentition.

CONCLUSIONS: Socio-economic status affects normative orthodontic treatment need. Early development of progressive malocclusion symptoms should be treated at an early stage.

## 251 ORTHODONTIC TREATMENT NEED AND DENTAL INDIFFERENCE SCORES IN AN ORTHODONTICALLY REFERRED POPULATION

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AIM: To determine the relationship between orthodontic treatment need and dental indifference scores in an orthodontically referred population.

SUBJECTS AND METHOD: Five hundred and eighty four children (356 girls, 228 boys), aged from 7 to 18 years

(12.89 ± 2.48 years),. None of the children had previously received any orthodontic treatment. The Index of Orthodontic Treatment Need (IOTN) was used to determine orthodontic treatment need of patients. Dental indifference scores were assessed with Dental Indifference Scale (DIS). Pearson's correlation coefficient was calculated to determine the relationship between IOTN and DIS scores.

RESULTS: Pearson's correlation coefficient was 0.015, indicating no significant correlation between IOTN and DIS scores ( $P > 0.05$ ).

CONCLUSIONS: No relationship between orthodontic treatment need and dental indifference scores was determined.

## 252 TREATMENT ALTERNATIVE FOR SPACE DEFICIENCY IN THE ANTERIOR SEGMENT OF THE DENTAL ARCH IN THE EARLY MIXED DENTITION

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AIMS: The planned sequence of primary teeth extractions, followed by extraction of certain permanent teeth (usually first premolars), widely referred to as Hotz's 'eruption guidance', is a method to relieve or eliminate severe crowding. However, it is difficult to predetermine future effects on the patient's profile aesthetics and soft tissue response.

MATERIALS AND METHOD: Ten clinical cases of 7-year old patients with space deficiency of 5-6 mm in each dental arch and definite indications for serial extraction therapy. After orthodontic diagnosis and family anamnesis, a treatment plan that included extractions was rejected. Full bracket orthodontic treatment was not initiated in the early mixed dentition but in some patients an appliance to stimulate apical base growth was used. Following eruption of the permanent first premolars, sectional or full-fixed appliances treatment was initiated.

RESULTS: The total monitoring and treatment period was  $7 \pm 0.5$  years. The results showed that growth and contemporary orthodontic methods can provide sufficient space, thus avoiding the extraction of permanent teeth.

CONCLUSIONS: Reconsideration of the serial extractions approach is suggested and the dental arches should remain intact throughout so enhancing natural growth and development.

## 253 ASSOCIATION BETWEEN HYPODONTIA AND TAURODONTISM

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AIM: Inclusion of taurodontism within the group of dental anomaly patterns (DAP) has been met with controversy. The aim of this study was to investigate the association between hypodontia and taurodontism to support its possible inclusion in the DAP.

MATERIALS AND METHOD: The presence of taurodontism of tooth 36 was analyzed on dental pantomograms of 100 patients with hypodontia and 100 control subjects. The inclusion criteria were: complete root formation of tooth 36 and optimal radiographic quality. To define taurodontism, a visual method was used, consisting of a chart comparison with four images depicting a normal pulp chamber, hypotaurodontism, and moderate and severe taurodontism. Possible associations between taurodontism and agenesis were assessed by means of Fisher's exact test.

RESULTS: Nine per cent of patients with hypodontia and 3 per cent of control cases had pulp sizes that were consistent with the visual diagnosis of taurodontism. This difference did not reach statistical significance.

CONCLUSION: Although the presence of taurodontism was higher among the patients with hypodontia than in the controls, the differences observed did not permit the unquestionable inclusion of this anomaly in the DAP. Further studies are required to clarify this possible association.

## 254 PERCEPTION OF CLEFT LIP AND PALATE PATIENTS AND THEIR GUARDIANS OF PROCEDURES RELATED TO SECONDARY BONE GRAFTING

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AIM: During 2009 a total of 13 cleft lip and palate (CLP) patients from the South East Region of Sweden underwent secondary bone grafting from the iliac crest to the cleft area. The CLP child will meet a multidisciplinary team at the University Hospital, Linköping, according to treatment regime, from birth to adulthood. Due to the number of collaborators in contact with the child the quality and perception of information may vary. The aim of this study was to evaluate the perception of given information during the surgical procedure and furthermore, to evaluate the perception

of morbidity.

**SUBJECTS AND METHOD:** All patients who underwent a secondary bone graft in Linköping during 2009 (n = 13) were included. Structured questionnaires were distributed to the child and their guardian. The responders were asked questions regarding the quality of information provided before surgery and the morbidity related to the surgery. The questionnaires were analysed and evaluated.

**RESULTS:** Twelve out the 13 families responded. The mean age of the patients was 11 years, 4 month (range 9-13 years). The CLP child was to a higher degree more satisfied with the quality of given information in comparison with their guardians. The CLP child perceived the pain after surgery from the iliac crest donor site as more pronounced than from the cleft region. There was a high degree of consistency in perceived morbidity among CLP children and the guardians' opinion regarding the child's pain.

**CONCLUSION:** There was a high degree of overall satisfaction regarding the given information. However, some of the guardians asked for additional information.

## 255 EVALUATION OF CONDYLAR ASYMMETRY IN UNILATERAL CLEFT LIP AND PALATE

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**AIM:** To investigate the condylar and ramal asymmetry in unilateral cleft lip and palate patients three-dimensionally using cone beam computed tomography (CBCT).

**SUBJECTS AND METHOD:** A cleft and a control group each consisting of 20 individuals closely matched with regard to age and sagittal and vertical skeletal measurements. All measurements were undertaken with the Dolphin 11.0 Premium 3D software program from the Dicom output of a CBCT. Independent *t*-tests were used to establish statistically significant differences between the groups.

**RESULTS:** There was no statistically significant difference between the groups in index measurements. When linear measurements of the two groups were compared, right side condylar, ramal and total measurements, left side ramal and total measurements and condylar sagittal and transverse measurements on both sides demonstrated statistically significant differences between the groups. There were no statistically significant differences between condylar and ramal measurements when the cleft and non-cleft sides in the cleft lip and palate patients were compared.

**CONCLUSION:** There are no statistically significant differences between unilateral cleft lip and palate (UCLP) patients and non-cleft patients that have same skeletal patterns in condylar asymmetry indexes. UCLP patients demonstrate different condylar and ramal measurements than non-cleft patients with same skeletal patterns.

## 256 THREE-DIMENSIONAL FACIAL SOFT TISSUE GROWTH OF 6 TO 17 YEAR OLD JAPANESE PERUVIAN CHILDREN

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**AIM:** A cross-sectional study to characterize morphological soft tissue facial changes in growing children of Japanese-Peruvian descent using three-dimensional (3D) technology.

**MATERIALS AND METHOD:** 3D facial photographs were generated for 101 Japanese-Peruvian children aged 6 to 17 years in Lima, Peru. All photographs were taken in a neutral position by stereophotogrammetry (3dMD®, Atlanta, Georgia, USA). Seventeen facial landmarks and 12 linear measurements were selected. Descriptive statistics were carried out and the acquired mages were morphed using dense correspondence algorithms and Procrustes principle.

**RESULTS:** All measurements demonstrated significantly positive growth rates except for the interocular width for females. Males presented larger facial dimensions than females and similar growth rates for eye width, lower face width, upper face width, lower lip chin length and nose length. Males had larger facial dimensions with greater growth rates for nose width, upper lip length, upper vermillion length and interocular width. Females demonstrated a gradual facial growth in size and shape from 6 to 17 years, whereas male facial growth was accelerated from 12 to 14 years. Female facial development was characterized by an initial increase in vertical length, followed by an increase in width, resulting in a more rounded face. Male facial growth showed an initial increase in width, followed by a longer period of increase in vertical length, resulting in a narrower, longer face.

**CONCLUSIONS:** The timing and spatial growth characteristics of facial soft tissue are gender-specific. This study demonstrated the versatility of stereophotogrammetry in evaluation of facial surface characteristics and also provided normative values for the selected facial soft tissue measurements.

## 257 EARLY APPROACHES TO ANTERIOR CROWDING

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**AIM:** To evaluate patients with anterior crowding in the early mixed dentition phase and to analyse dental and skeletal changes in these treated with different removable appliances and eruption guidance.

**MATERIALS AND METHOD:** Lateral cephalograms and dental casts of 14 children (10 girls, 4 boys). The mean age of the subjects was  $8.3 \pm 0.74$  years (range 7-10 years). The patients were observed for 4 years and when necessary different removable appliances are used. Lateral cephalograms, dental impressions and photographs were taken at first appointment and at the end of the 4 year observation period. Angular and linear variables were established on the lateral cephalograms and measured using Dolphin Imaging software. The dental casts were scanned and analysed using the Orthomodel digital model program in three-dimensions. For statistical assessment the paired *t*-test was used (SPSS 10.0 program).

**RESULTS:** Lateral cephalogram analysis showed changes of IMPA ( $P < 0.01$ ), L1-NB (mm) ( $P < 0.01$ ), L1-NB ( $^{\circ}$ ) ( $P < 0.001$ ), U1-SN ( $P < 0.05$ ), Pg-NB ( $P < 0.05$ ), U1-L1 ( $P < 0.01$ ) to be statistically significant. There were no statistically significant changes for SNA, SNB, ANB, SNGoGn, FMA, U1-NA (mm), U1-NA ( $^{\circ}$ ). The results of the digital model analysis showed that changes of the mandibular and maxillary irregularity index and intercanine width values were statistically significant ( $P < 0.001$ ). Upper and lower intermolar width changes were also statistically significant ( $P < 0.01$ ). Overbite and overjet changes were not statistically significant ( $P > 0.05$ ).

**CONCLUSION:** Treatment of anterior crowding in the early mixed dentition has a number of benefits, including better use of the patient's growth potential, reduced anterior crowding and a reduced need for extractions, reduced time of fixed orthodontic treatment, lower risk of adverse iatrogenic effects and better and more stable results.

## 258 THE EFFECTS OF LOW-LEVEL LASER THERAPY ON PAIN ASSOCIATED WITH FIXED ORTHODONTIC TREATMENT

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**AIM:** To analyse the effect of single low-level laser therapy (LLLT) as a new alternative on pain perception associated with fixed orthodontic treatment.

**SUBJECTS AND METHOD:** Twenty-six patients included in this prospective study were assigned to two groups based on the degree of crowding. The patients in group 1 (8 females, 5 males; mean age, 16.3 years) having 0-4 mm crowding, received a single course of LLLT (LaserSmile, Biolase; wavelength 810 nm, power output 3 W) for 15 seconds in one half of the upper dental arch. Selection of the right or left halves was randomized. The other half of the arch received placebo laser treatment. For patients in group 2 (7 females, 6 males; mean age, 17 years) having 5-7 mm crowding, the same procedure was followed. Irradiation was carried out after insertion of the fixed appliances and engagement of 0.014 inch superelastic nickel titanium archwires. In both groups the intensity and quality of pain perception during different functions was evaluated during 1 week after LLLT using visual analogue scale and a standardized questionnaire. Data was analysed with the Statistical Package for Social Sciences version 10.1 using the Mann-Whitney *U* and Fisher's exact analysis.

**RESULTS:** For both groups pain levels showed the highest scores at 6-24 hours. The patients experienced the highest pain levels when the upper and lower teeth contacted. However the relationship between age, gender and pain perception was not statistically significant ( $P > 0.05$ ). The effectiveness of LLLT on pain perception between the irradiated and placebo sides was not statistically significant.

**CONCLUSIONS:** There was no significant effect of LLLT (9 J/cm<sup>2</sup>) on pain perception associated with fixed orthodontic treatment. Further studies using different levels are required to determine the appropriate dose.

## 259 FAMILIAL INCIDENCE OF NON-SYNDROMIC CLEFT LIP AND PALATE IN THE SOUTH OF IRAN

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**AIM:** To determine the familial incidence of non-syndromic or isolated cleft lip, with or without cleft palate (NSCL/P), and to analyze the relationships between the type of NSCL/P in the affected individual and his/her parents.

**SUBJECTS AND METHOD:** The records of patients referred between February 2008 and September 2010 were retrospectively reviewed and analyzed. Detailed histories were collected regarding the familial incidence of NSCL/P. For all



of patients, the relationship between the type of NSCL/P and the sociodemographic and personal characteristics of the affected person and her/his cleft relatives was obtained.

**RESULTS:** There were 28 individuals with a CL, 91 with a CLP (joined in one group) and six with a CP ( $P < 0.001$ ). Thirty-nine per cent had at least one affected relative; the remaining individuals presented a negative history ( $P < 0.001$ ). There were differences between the cleft groups according to the type of cleft and positive familial history ( $P < 0.001$ ). In both groups, the relatives with higher incidence of NSCL/P were close relatives and/ or cousins, with the same pattern of distribution between the two groups ( $P = 0.158$ ).

**CONCLUSIONS:** Most frequently, fissures result from CL/CLP with no familial history. However, CL/CLP was found in familial cases with cousins more likely to be affected. Familial background may be considered as a predisposing factor in the occurrence of such a disturbance.

## 260 BOLTON TOOTH SIZE DISCREPANCY BETWEEN CLASS I AND CLASS III MALOCCLUSION

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**AIM:** To assess tooth size discrepancy in the anterior and posterior segments between Class I and Class III malocclusion subjects.

**MATERIALS AND METHOD:** Pre-treatment dental casts of 120 Class III and 120 Class I malocclusion patients from a private orthodontic office. Each group consisted of an equal number of males and females. Exclusion criteria were: missing or supernumerary, malformed or peg-shaped teeth, previous extractions or poor and malformed fillings and spacing between the teeth. All of the subjects were in permanent dentition period. The greatest mesiodistal widths of the teeth from the central to the first molar in both arches were measured using a digital calliper with an accuracy of 0.01 mm. Bolton anterior and overall ratios were calculated. Comparison between the groups and genders were conducted using paired *t*-tests.

**RESULTS:** Discrepancy was relatively high for both Class I and Class III malocclusions (19.2% and 28.9%, respectively). There was a significant difference between the Class I and Class III groups either in anterior or in overall ratio. No statistically significant difference was found between males and females in either group.

**CONCLUSION:** There is more dental discrepancy in anterior and overall tooth ratios in Class III compared with Class I individuals.

## 261 EFFECT OF CROWN-ROOT ANGLE ON STRESS DISTRIBUTION ON THE MAXILLARY CENTRAL INCISOR PERIODONTAL LIGAMENT

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**AIM:** Different crown-root angulations of the maxillary central incisors can be assumed as a potential reason for many underscored outcomes of orthodontic treatments. The aim of this study was to determine the effects of different crown-root angles on the stress distributions in maxillary central incisor periodontal ligament (PDL) during application of intrusive and retraction forces using a three-dimensional finite element method (FEM).

**MATERIALS AND METHOD:** Two models of a maxillary central incisor were constructed using ANSYS software: one with an angle of 166.7 degrees (as a example of the maxillary central incisor in a Class II division 2 patient) and the other with an angle of 173.4 degrees (normal angulation). Each sample was loaded twice with an intrusive (25 g) and retraction (50 g) force through the ideal position of brackets.

**RESULTS:** FEM results showed little difference between stress distributions in two models during intrusion (ten thousandth) compared with retraction (thousandth). In application of retraction force, stress concentration on the curved tooth was less than.

**CONCLUSION:** To produce similar patterns of stress in the PDL, orthodontists can apply 1.18 times heavier retraction forces on the maxillary central incisors in Class II division 2 patients compared with Class I patients.

## 262 FACE-FORMER THERAPY AND ITS EFFECTS ON UPPER BODY POSTURE

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**AIMS:** To investigate whether or not myofunctional training with the face former, in addition to the muscles of the stomatognathic system, also affects the muscles of the locomotor system and whether this effect is reflected in improved body statics.

**SUBJECTS AND METHOD:** Forty-five participants divided into two groups. While the first group presented with craniomandibular dysfunction (CMD) symptoms and face former therapy was therefore indicated, this was not the case with group 2. No symptoms of CMD were diagnosed so that this group served as the controls. Myofunctional training with the face former extended over six months. At the beginning and end of training upper body statics were measured in both groups using a three-dimensional back scanner (Diers Formetric). Multivariate analysis with Bonferroni correction was employed for statistical data analysis.

**RESULTS:** Parameters important for the description of upper body posture, such as surface rotation, lateral deviation, kyphotic and lordotic angle as well as pelvic torsion and tilt did not change significantly. Only trunk inclination ( $P = 0.007$ ) decreased significantly in the face former group. Body posture in the control group did not show significant changes.

**CONCLUSIONS:** The findings confirm the relationship between myofunctional exercises and their effect on body posture. Myofunctional training using the face former can achieve improved erectness of the trunk in patients with orofacial dysfunction.

## 263 EFFECTS OF LOW MASTICATORY LOADING ON THE RESPONSE PROPERTIES OF TEMPOROMANDIBULAR JOINT-NOCICEPTORS IN GROWING RATS

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**AIMS:** The mammalian facial skeleton is optimized for countering or dissipating masticatory stress. Many studies have shown that physiological loading on the temporomandibular joint (TMJ) during growth is important for promoting growth of the mandibular condyle and for maintaining the normal function and structure of the TMJ. However, the functional characteristics of TMJ-nociceptors under non-physiological loading are still unclear. The purpose of this study was to investigate the effects of low mechanical loading by feeding a liquid diet on the response properties of TMJ-nociceptors in growing rats.

**MATERIALS AND METHODS:** Forty-two male Wistar rats (2 weeks old) were randomly divided into a control group ( $n = 21$ ) and an experimental group ( $n = 21$ ) soon after weaning. The control group was fed chow pellets, while the experimental group was fed a liquid diet. Pressure stimulation (ca. 100 g) was applied to the TMJ in an axial direction by pushing with a force transducer. The firing activities of single motor units (MUs) were recorded using monopolar tungsten microelectrodes from the trigeminal subnucleus caudalis, which contains the cell bodies of trigeminal sensory neurons that transmit nociception, when the rats were 5, 7 and 9 weeks old. The firing threshold, initial/steady-state and decline rate of the firing frequencies were calculated. The statistical differences between the two groups, at different ages, were compared using the Mann-Whitney *U*-test with a 95 per cent significance level.

**RESULTS:** A total of 42 MUs were recorded and analyzed. Both the firing threshold and the decline rate in the experimental group were significantly lower than those in the control group at each age. The initial/steady-state frequencies in the experimental group were significantly higher than those in the control group at each age.

**CONCLUSIONS:** Low mechanical loading by feeding a liquid diet during growth affects the functional characteristics of TMJ-nociceptors.

## 264 THREE-DIMENSIONAL-COMPUTED TOMOGRAPHIC ASPECTS OF CRANIOFACIAL ABNORMALITIES IN THE OCULO-AURICULO-VERTEBRAL SPECTRUM

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**AIM:** To evaluate the maxillofacial asymmetry in oculo-auriculo-vertebral subjects three-dimensionally with particular regard to the mandible.

**MATERIALS AND METHOD:** Computed tomographic data sets of 18 patients (7 to 23 years of age) were analyzed according to the Katsumata classification system by calculating asymmetry indices for well defined anatomical landmarks. In this process the midface pathology was described qualitatively. With respect to mandibular malformation, temporomandibular joint (TMJ) volume, maximum horizontal diameter of the condyles, TMJ rotation and the trabecular bone density of the TMJ as well as the ramus height and the corpus length were measured utilizing the tools of the VoXim®  
e106

software. The comparison of the measurements between the affected and non-affected side was based on the Wilcoxon signed rank test ( $P < 0.05$ ).

**RESULTS:** The findings confirmed asymmetric relationships of the midface and marked asymmetric discrepancies of all mandibular landmarks. The mean difference in TMJ volume was 1.12 ml, which coincide with a mean TMJ reduction of 33 per cent on the affected side. On the basis of this result, the TMJ hypoplasia could be classified into three levels of severity. Accordingly the mean difference in horizontal TMJ diameter was 3.69 mm accompanied by TMJ rotation discrepancies of 14.85 degrees on average with a pronounced inclination of the affected TMJ. Ramus height showed mean differences of 7.78 mm and total mandibular length of 13.69 mm by comparing the affected and non-affected side of the mandible.

**CONCLUSION:** Three-dimensional craniofacial analysis provides an excellent insight into unilateral facial deficiencies in all three dimensions. This is important for the management of orthodontic and orthognathic surgery procedures and for estimating forthcoming developments in these cases of severe abnormalities.

## 265 TOPOGRAPHY OF DISPLACED UPPER CANINES – A THREE-DIMENSIONAL MULTIPLE SLICE COMPUTED TOMOGRAPHY STUDY

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**AIM:** The precise localization of impacted upper canines in the sagittal, transverse and vertical dimension is of importance in diagnosis and treatment planning. The aim of this study was to demonstrate how the topography of displaced canines can be depicted in the reference planes using multiple slice computed tomography (MSCT).

**MATERIALS AND METHOD:** Twenty-one MSCTs of patients who had undergone orthodontic treatment were examined. All patients had at least one displaced upper canine (displaced canines  $N = 31$ , not displaced canines  $N = 11$ ). Twenty-one canines were palatally and 10 labially displaced. The MSCT-data were evaluated by four examiners on two different days. For the segmentation and definition a three-dimensional-reference system, VoXim® 6.1 (IVS Solutions AG Chemnitz) was used. Accuracy and precision were ascertained with difference plots and ANOVA.

**RESULTS:** The tooth axis of the displaced teeth showed in the frontal plane an angle of 18.8 degrees ( $P = 0.05$ ), in the sagittal plane an angle of 13.6 degrees ( $P = 0.01$ ) and in the occlusal plane an angle of 51.6 degrees ( $P = 0.001$ ). If the localization of the tooth germ was correct, the angles measured were 8.9 degrees to the frontal plane, 6.9 degrees to the sagittal plane and 68.2 degrees to the occlusal plane. Regarding palatal displacement, the inclination to the sagittal plane was, on average, 15.0 degrees (1.2-49.7) with a distance of 7.9 mm (1.2-13.9). If the canine showed labial displacement, the angle was 8.3 degrees (1.4-23.8) with a distance of 11.0 mm (5.4-19.6).

**CONCLUSION:** The advantages of using 3D-MSCT-data are superimposition-free imaging that enables evaluation of the exact location of the displaced tooth regarding adjacent dental and skeletal structures. Using the program VoXim® 6.1, the 3D position of a displaced tooth can be graphically illustrated and metrically analyzed using an individual 3D-reference system according to the sagittal, transverse and vertical plane.

## 266 USING AN EYE-TRACKER TO MEASURE RADIOGRAPHIC IMAGE INTERPRETATION EFFICIENCY OF NEWER AND EXPERIENCED CLINICIANS

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**AIM:** Panoramic radiographic images are an important part of a patient's orthodontic record. Although they are a valuable screening tool for normal dental development and potential abnormalities, clinicians are rarely taught a systematic method of image interpretation during their training. The aim of this study was to investigate and compare the image interpretation methods of clinicians with different levels of experience.

**MATERIALS AND METHOD:** Two groups of clinicians: 10 with less than five years of clinical experience (newer clinicians) and 10 with more than five years of clinical experience (experienced clinicians). All clinicians were asked to interpret the same five panoramic images, two of which showed areas of pathology or abnormality, whereas the other three were without significant findings. An eye-tracking device was used to record the interpretation methods. Differences between the groups were tested for statistical significance using two sample *t*-tests with values of  $P < 0.05$  considered statistically significant.

**RESULTS:** The interpretation path of newer clinicians identified more areas of pathology or abnormality in portions of the image other than the dentition. Areas of pathology or abnormality within in the dentition were entered equally by the

interpretation paths of both groups. Newer clinicians had significantly longer interpretation times as they often had no pattern to interpretation and their interpretations included more fixation points and covered more image area. Experienced clinicians were quicker with interpretation and showed more of an interpretation pattern.

CONCLUSIONS: Newer clinicians are more complete (interpret the entire image), have more fixation points, and spend a longer time interpreting. Experienced clinicians show a more systematic approach to interpretation but tend to be less complete.

## 267 EXPRESSION OF CHEMOKINES AND CHEMOKINE RECEPTORS DURING ORTHODONTIC TOOTH MOVEMENT

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AIM: Chemokines are small chemotactic cytokines involved in inflammatory reactions and produced by various cell types (leukocytes, fibroblasts, epithelial and endothelial cells). While they were discovered on the basis of their activity as leukocyte chemo-attractants, they were found to play an important role in bone remodelling by recruiting osteoclasts. Since bone remodelling and inflammation occur during orthodontic tooth movement, it is important to evaluate the expression of chemokines during this process. The goal of this study was to investigate the expression of different chemokines and their receptors during different stages of orthodontic tooth movement.

MATERIALS AND METHOD: Thirty Sprague Dawley rats divided into control and experimental groups. In the experimental group, forces were applied to the maxillary first molar using a NiTi coil spring (50 cN). In the control group the coils were not activated. The maxillae were dissected and RNA was isolated at different times after initiation of force application. Expression of chemokines and chemokine receptors was evaluated by quantitative RT-polymerase chain reaction.

RESULTS: Expression of 12 chemokines increased 2 to 26 fold. Chemokines expressed early during force application included: Ccl 20, Ccl 2, Ccl 12, Ccl 5, while other chemokines (Ccl 9, Cxcl 11, Ccl 25 and Cxcl 10) increased at later stages. In addition, the expression of the chemokine receptors, Cx3cr1, Ccr1, Ccr5 and Ccr2, was elevated at the early stages.

CONCLUSION: Chemokine expression was elevated as early as 12 hours after orthodontic force application, and high levels were maintained during 14 days of tooth movement. This expression pattern suggest the recruitment and presence of different cell types into the area of tooth movement, at particular stages: lymphocytes, macrophages, osteoclasts at the earlier stages, osteoclasts, osteoblasts, fibroblast and endothelial cells two weeks later.

## 268 EFFECTIVENESS OF THE SUPERELASTIC BEHAVIOUR OF NICKEL-TITANIUM ARCH WIRES DURING ALIGNMENT

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AIMS: Nickel-titanium (NiTi) archwires are widely used during alignment. Due to their super-elastic behaviour it is generally expected that they generate small and constant forces and moments. Used as alignment wires, however, they are primarily engaged in bending mode. To utilize their super-elastic behaviour it is necessary to expose them to a sufficient degree of bending deformation, i.e. the bending radius has to fall below a critical value. The aim of this study was to evaluate whether NiTi archwires actually reach the super-elastic unloading plateau in typical clinical situations and, if so, to which degree the material works in super-elastic (i.e. stress-induced martensitic) state.

MATERIALS AND METHOD: By means of their specific Little's Irregularity Index three maxillary and three mandibular casts with three degrees of incisor crowding were selected. Using the SuperFlex bending measurement system, 22 commercially available 0.014 inch NiTi archwires were analyzed with respect to the critical bending radius needed to enter the super-elastic unloading plateau. The shapes of the ligated wires were three-dimensionally digitized and the respective local bending radii were calculated using a computer algebra system.

RESULTS: In medium crowding, between 15 and 40 per cent of the material volume was capable of entering the super-elastic unloading plateau. With local bending radii beyond 22 mm none of the tested materials was in super-elastic state.

CONCLUSIONS: The major volume fraction of orthodontic archwires remained in the austenitic, linear-elastic state. The superelastic behaviour of currently used orthodontic NiTi wires will only be minimally effective.



269 CHANGES IN THE MAXILLARY SINUSES BEFORE AND AFTER RAPID MAXILLARY EXPANSION\*\*\*

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AIM: To evaluate the rate of change of maxillary sinuses before and after rapid maxillary expansion (RME) measured using three-dimensional cone beam computed tomography (CBCT) and to determine if CBCT is a more accurate and effective method for these measurements.

SUBJECTS AND METHOD: Fifteen patients between 14-16 years of both genders with an orthodontic diagnosis of skeletal unilateral crossbite treated with a Hyrax fixed appliance. After definition and measurement of the maxillary sinus content before and after RME, changes in the content of the sinuses, were measured using CBCT (Scanora 3D).

CONCLUSIONS: The findings showed that after RME changes occurred in the maxillary sinuses.

270 THE EFFECT OF OVARIECTOMY ON TOOTH MOVEMENT AFTER ORTHODONTIC FORCE APPLICATION IN RATS\*\*\*

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AIM: Orthodontic treatment is not only for young patients but also older patients. Post-menopausal woman sometimes require orthodontic treatment. The aim of this study was to quantify and evaluate the three-dimensional tooth movement in ovariectomized rats.

MATERIALS AND METHOD: Five, 10-week-old, female Wistar rats that underwent ovariectomy (OVX) were included in the experimental group, and five others without OVX as the controls. Four weeks after OVX, nickel-titanium closed-coil springs were applied mesially to the maxillary first molars. Micro-computed tomographs were taken on day 0, 1, 3, 7, 14, 21 and 28 under general anaesthesia.

RESULTS: Experimental tooth movement gradually increased with time in both the controls and OVX group during 28 days. However, tooth movement in the OVX group was greater than that of the control group throughout the experiment. The amount of tooth movement gradually increased from day 0 until the end of the experiment. The initial tooth movement after 24 hours of force application was  $0.03 \pm 0.01$  mm in the control group and  $0.06 \pm 0.01$  mm in the OVX group. There were statistically significant differences in the amount of tooth movement between the groups. In addition, superimposition of the images of the sagittal, axial (crown and root levels) and coronal views showed more tipping tooth movement in the OVX group.

CONCLUSION: Initial teeth movement was observed after 24 hours of orthodontic force application, and tooth movement in the OVX group was more rapid than that in the control group during 28 days. In addition, tipping tooth movement in the OVX group was steeper than that in the control group.

271 LONGITUDINAL EVALUATION OF SLEEP-RELATED BREATHING DISORDERS IN AN ORTHODONTIC POPULATION

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AIM: To investigate the evolution of sleep-disordered breathing (SDB) in children and adolescents having undergone orthodontic treatment in a university setting.

MATERIALS AND METHOD: Questionnaires on sleep and day-time behaviour were administered to 83 subjects at two time points: at the screening session, when they were admitted for treatment (T0), and four years later, when most of them were in retention, but some subjects were still in active treatment or growth follow-up (T1). The mean age of the subjects at T0 was 13 years. Data analysis involved: (i) exploratory data analysis to identify the main patterns; (ii) Bivariate analysis using chi square tests to examine the association between nominal/ordinal variables; (iii) Multivariate analysis using linear logistic regressions for continuous and binary outcomes. In all these statistical models, potential confounding factors were controlled.

RESULTS: Most of the subjects that initially did not present symptoms of SDB remained symptom-free following orthodontic treatment, whereas those that at T0 presented symptoms of SDB continued to manifest them at T1. Twelve per cent of the subjects developed symptoms of SDB during the study, but none of the orthodontic treatments investigated (non-extraction versus two-premolar or four-premolar extractions) was statistically significantly associated with them.

**CONCLUSIONS:** Orthodontic treatment involving extractions has been incriminated as being responsible for development of sleep apnoea. The present study shows that SDB in an orthodontic population is mostly constant before and after orthodontic treatment, and that the new cases that develop are not related to any type of orthodontic treatment.

**272      SOFT AND HARD TISSUE CHANGES FOLLOWING TREATMENT OF CLASS II DIVISION 1 MALOCCLUSION WITH AN ACTIVATOR VERSUS TRAINER**

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**AIM:** To compare, in a prospective randomized clinical trial, the cephalometric changes between two functional appliances the modified activator versus the Trainer®.

**SUBJECTS AND METHOD:** Sixty patients, randomly and equally divided, into the two treatment groups. After 14 months of treatment the effects of the two appliances on the skeletal, dentoalveolar and soft tissues were determined on lateral cephalograms.

**RESULTS:** The activator group showed better skeletal improvement than the trainer group. The improvement was evident in the significant increase of the total length of the mandible ( $P = 0.00$ ), corpus length ( $P = 0.00$ ) and ramus height ( $P = 0.00$ ). Facial convexity improved significantly with the activator and to a lesser extent with the trainer ( $P = 0.00$ ). Similar dentoalveolar effects were found in the incisor region. The soft tissue profile was improved in the activator group but not in the trainer group.

**CONCLUSIONS:** The activator is more effective than the trainer in treating Class II division 1 malocclusions.

**273      SURGICAL CORRECTION OF SEVERE FACIAL ASYMMETRY WITH DISTRACTION OSTEOGENESIS**

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**AIM:** Severe facial asymmetry represents a surgical challenge that is not sufficiently resolved with standard orthognathic surgical corrections.

**SUBJECTS AND METHOD:** Five patients with severe facial asymmetry (3 Goldenhar syndrome, 1 post-irradiation hemifacial atrophy and 1 undiagnosed) were surgically corrected with mandibular distraction osteogenesis (DO), then after 6 months correction of the maxilla (Le Fort I and elongation) together with the removal of the distraction device. Aesthetic correction with angular and zygoma on-lay grafts was carried out for the first three patients in the second phase of the surgery and in the other two subjects in the third stage.

**RESULTS:** Surgery resulted in correct facial bone symmetry and dental occlusion but the problems of soft tissues still existed. The advantage of mandibular DO was improved symmetry in the vertical dimension of the mandibular ramus and preservation of alveolar inferior nerve sensitivity. The results (mean 3 years after the last surgical correction) are stable.

**CONCLUSIONS:** Orthognathic procedures in the correction of severe facial asymmetries should include mandibular distraction for better bone symmetry and sensitivity preservation. There are still problems with on-lay bone graft substitutes and their material as well as with facial soft tissue augmentations.

**274      THREE-DIMENSIONAL *IN VIVO* EVALUATION OF BRACKET POSITIONING: REPRODUCIBILITY**

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**AIM:** Precision in brackets placement is essential, especially in the straightwire system. However, todate all published studies are two-dimensional and *in vitro*. The aim of this study was to evaluate the three-dimensional (3D) reproducibility of bracket positioning *in vivo*.

**MATERIALS AND METHOD:** A modified bonding procedure was identified in order to remove the brackets from the teeth without enamel lesions. The procedure was tested on five extracted teeth analyzed with scanning electron microscopy (SEM), in order to verify the presence of the fracture sites, and energy dispersive spectrometry, in order to detect calcium (Ca++) on the adhesive material removed during debonding of the brackets. Thereafter, direct bonding was carried out in both arches of two volunteers with different types of malocclusions on two occasions one week apart. The bonding procedures were repeated by six operators, stratified on the basis of their orthodontic experience. A 3D scanner (MicroScribe 3D digitizer) was used to determine the brackets positions. Intra- and interoperator variability was analyzed; the influence of the operator's clinical experience and malocclusion were also assessed.

RESULTS: A mean of  $5.5 \pm 1.7$  degree (intraoperator) and  $6.1 \pm 5.4$  degrees (interoperators) for angular discrepancies,  $0.4 \pm 0.3$  mm (intraoperator) and  $0.5 \pm 1.2$  mm (interoperators) for vertical discrepancies, and  $1.1 \pm 1.9$  mm (intraoperator) and  $1.2 \pm 1.0$  mm (interoperators) for mesiodistal discrepancies were found in placement of the orthodontic brackets. The influence of orthodontic experience was not statistically significant.

CONCLUSIONS: The reproducibility of brackets positioning does not appear to be related to clinical experience. The mesiodistal positioning of brackets is related to the ability to access to the dental arch areas.

## 275 DEBONDING CHARACTERISTICS OF CERAMIC BRACKETS: A PRELIMINARY REPORT

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AIM: To evaluate the debonding characteristics of Inspire Ice ceramic brackets.

SUBJECTS AND METHOD: Ten female and six male patients (age range: 14-20 years). In these patients, 288 Inspire Ice brackets (Ormco Corp., Orange, California, USA) were debonded with the Inspire Ice debonding instrument. This debonding instrument, a plastic debonding plier, was designed for single-patient use only. Debonding was performed according to the manufacturer's instructions. Bracket fracture and adhesive remnant index (ARI) scores were recorded.

RESULTS: The ARI scores were predominantly 3 (67%), namely at the adhesive/bracket base interface. ARI scores of 2 and 1 were 20.1 and 12.5 per cent, respectively. Bracket fracture was not observed during the debonding procedure; however, abrasion of plier blades was a problem, particularly after the debonding of one arch.

CONCLUSION: Intact plier blades are important for safe debonding. Abraded plier blades hinder firm grasping and engagement of the Inspire Ice debonding instrument under the occlusal and gingival tie-wings. Thus, debonding should be performed with a specific sequence: (1) Debond brackets without hooks. (2) Debond brackets with hooks; however, grasp the brackets under the occlusal and gingival mesial tie-wings only. (3) Brackets with wing fractures should be debonded last.

## 276 ASYMMETRIC RAPID MAXILLARY EXPANSION BY A LOCKED MODIFIED ACRYLIC BONDED APPLIANCE IN THE MIXED DENTITION

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AIM: To investigate the dentoskeletal effects of a locked modified acrylic bonded rapid maxillary expansion (RME) appliance, used for asymmetric maxillary expansion to correct a true unilateral posterior crossbite.

SUBJECTS AND METHOD: Fourteen girls and 16 boys in the mixed dentition (mean age:  $8.74 \pm 0.56$  years). An acrylic lock mechanism was added to the acrylic bonded RME appliance to reinforce anchorage of the teeth on the non-crossbite side, including the mandibular posterior teeth. When the intended amount of expansion was achieved on the crossbite side, the appliance was removed and a removable plate was used for 3 months for retention. The mean expansion time was 27.47 days. Posteroanterior cephalograms were taken before and after expansion, and after retention in centric relation. Linear and angular measurements were used to investigate the dentoskeletal changes and to compare the crossbite and non-crossbite side on transverse dimension. The changes were evaluated by repeated measurements analysis of variance and a paired sample *t*-test.

RESULTS: Although relapse was determined after the retention period, significant differences were observed in nasal cavity width, maxillary basal width, and maxillary and mandible intermolar width in the transverse plane ( $P < 0.05$ ). Comparison of changes between the crossbite and non-crossbite sides showed that maxillary dental and skeletal, and nasal cavity measurements on the crossbite side were greater than those on the non-crossbite side ( $P < 0.05$ ). There was no significant difference in mandibular basal width ( $P > 0.05$ ).

CONCLUSION: Within the limits of this study, the results suggest that maxilla and upper intermolar width were expanded asymmetrically and true unilateral crossbites were successfully treated. Asymmetric expansion of the maxilla can be controlled with the lock mechanism.

## 277 EFFECTS OF BUCCAL MINISCREW SUPPORT ON THE UPPER FIRST PERMANENT MOLARS DURING PALATAL BONE ANCHORED DISTALIZATION

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**AIM:** Tipping or rotation of the upper first molars during distalization results in loss of anchorage and prolonged treatment. The aim of this research was to compare the effects of additional buccal force supported by a miniscrew to premolar anchorage during distalization of the upper first molars with palatal bone anchorage with two palatal miniscrews.

**SUBJECTS AND METHOD:** Twenty-four subjects with a bilateral Class II molar relationship. Their mean age was 15.7 years at the beginning of the study and the mean distalization period was 0.73 years. Palatal force was induced by nickel titanium (NiTi) open coils on a 0.9 mm palatal arch fixed to two palatal miniscrews. Additional buccal force was from a modified Lokar appliance supported by a buccally placed miniscrew on one side and NiTi open coils placed on a segmental arch soldered to the activator tube on molar band with a step-down bend soldered to the premolar band and palatal arch on other side. Total buccal and palatal forces on the upper first molars were 200 g. Nineteen angular and 24 linear measurements on lateral cephalograms; two angular and 15 linear measurements on upper orthodontic model photocopies were evaluated. Paired *t*- and Wilcoxon's tests were used for intragroup comparison and a Student's *t*-test for comparison of left and right sides.

**RESULTS:** Regarding distalization of the upper molars, no significant difference was found between the methods on the two sides where distal movement of the upper first premolars was significantly different.

**CONCLUSION:** Additional buccal force with miniscrew anchorage does not have a significant effect on miniscrew supported palatal molar distalization, but is advantageous in preventing molar rotation and premolar movement.

## 278 DO WE NEED TO MEASURE DIRECTLY ON PLASTER CASTS?

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**AIM:** For ethical reasons plaster casts (PCs) are preferred over cephalometrics in the evaluation of tooth movement. The aims of this study were to determine if there are significant differences between measurements made on PCs, photocopies (P) and three-dimensional models (3DM) after molar distalization. The effects of the change in the occlusal plane resulting from premature contacts after distalization on these measurements were also evaluated.

**MATERIALS AND METHOD:** Thirty PCs obtained after molar distalization with a modified Lokar appliance. Two anterior palatal miniscrews were used for anchorage. The first photocopies (P1) were obtained with casts placed passively resting on the copier surface whereas the second ones (P2) were obtained with anterior tooth contact. Points contacting the copier surface were registered and used to generate two 3DMs with different positions for each PC (DM1 and DM2). Eight linear and two angular measurements were made directly on the casts, P1, P2, DM1 and DM2 using the palatal suture and a line constructed with two palatal screws as the reference lines. The reliability of the methods was evaluated with interclass correlation coefficient (ICC), and comparison of the measurements using repeated measures ANOVA.

**RESULTS:** ICCs were between 0.71 and 0.98. No significant difference was found between the measurements made directly on casts and P1. For P2, all anteroposterior measurements, for DM1 transverse and anteroposterior measurements related to the premolars and anteroposterior measurements related to the molars only on one side and for DM2 anteroposterior measurements for the molars and premolars on one side were significantly different from the measurements made directly on casts ( $P < 0.05$ ).

**CONCLUSION:** In the evaluation of tooth movement where the occlusal plane changes due to premature contacts after molar distalization, photocopies obtained passively provide the closest measurements to those made directly on casts.

## 279 TEMPOROMANDIBULAR JOINT DEFECTS IN TREACHER COLLINS SYNDROME – AN INVESTIGATION IN MICE

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**AIM:** Treacher Collins syndrome (TCS) is an autosomal dominant defect with mutation in the TCOF1 gene resulting in cranioskeletal hypoplasia due to insufficient generation of neural crest cells. Along with other craniofacial abnormalities, patients with TCS suffer from defects in the formation of the temporomandibular joint (TMJ). This research was undertaken to study TMJ defects in more detail using the mouse model of TCS to investigate the developing TMJ with the aim of understanding how congenital TMJ defects arise.

**MATERIALS AND METHOD:** Six-week-old heterozygous *Tcof1* deficient mice on a dolichos biflorus agglutinin background were analysed using microcomputed tomography and by histology, to assess whether these mice have any defect in the formation of the TMJ.



**RESULTS:** A variety of defects, including fusion of the articular disc to the glenoid fossa and ossification of the disc were observed in the *Tcof1* mutant mice. The defects were often unilateral and did not appear to prevent the mice from feeding normally.

**CONCLUSION:** TMJ defects observed in *Tcof1* mutant mice mimic those observed in patients with TCS, making these mice an excellent model for studying congenital TMJ defects.

## 280 EFFECTS OF FIRST AND SECOND ORDER GABLE BENDS ON ORTHODONTIC LOADING

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**AIM:** Optimization of space closure and reduction of side-effects during orthodontic treatment require the quantification of load systems. This report presents the three-dimensional measurements of load systems produced by commercially available closing T-loop archwires modified with various first and second order gable bends. The objective was to quantify the effects of the gable bends on the load systems of the archwires used for *en masse* space closure following maxillary canine retraction. **MATERIALS AND METHOD:** Sixteen spring designs were tested on an orthodontic force tester fitted with a custom-made dentoform with brackets that simulated the clinical scenario. The archwires were attached to the brackets and activated following standard clinical procedures. At each activation, all three force and all three moment components acting on the left canine and lateral incisor were measured.

**RESULTS:** The first and second order gable bends showed low coupling effects when used independently. When combined, the results became difficult to predict. In general, the lingual force was dominant; higher on the canine than on the incisor. The mesial force on the canine and the distal force on the incisor were smaller than the lingual force, implying that the major tooth displacement is in the lingual direction. Gable magnitudes drastically alter the moments, thereby directly affecting the moment-to-force ratios.

**CONCLUSION:** Gable bends significantly alter the load systems on the canine and incisor. The effects of certain gable bends are distinctive, so that they can be used as the guidelines for load system adjustments.

## 281 PERCEPTION OF NASOLABIAL ANGLE AESTHETICS BY DIFFERENT GROUPS OF ASSESSORS

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**AIM:** To determine if the modification of the nasolabial angle influences the aesthetic evaluations of the facial profile assessed by orthodontists, general dentists, fine art students and laypersons.

**MATERIALS AND METHOD:** A photograph of a male profile in repose with a nasolabial angle within accepted parameters of normality (90°) was digitally modified using Adobe Photoshop C3 (Adobe Systems Inc, San Jose, California, USA) to create a second image with a nasolabial angle of 85 degrees and a third with an angle of 95 degrees. The three photographs were evaluated by the following groups of assessors: orthodontist (20 males, 20 females), general dentists (20 males, 20 females), fine art students (20 males, 20 females) and laypersons (20 males, 20 females). Each image was given a mark: 1 if it was considered aesthetically acceptable, 2 if it was moderately acceptable and 3 if it was aesthetically unacceptable. Data were analysed with the Kruskal-Wallis test ( $P < 0.05$ ).

**RESULTS:** No significant ( $P > 0.05$ ) differences were detected between the different groups with regard to their aesthetic assessment of the photograph of the 90 degree nasolabial angle (the median amongst all assessors was 1), the 85 degree nasolabial angle (median amongst all assessors = 2) and the 95 degree nasolabial angle (median amongst all assessors = 2).

**CONCLUSIONS:** Orthodontists, general dentists, fine art students and laypeople perceived modifications to the nasolabial angle in the same way. The four groups qualified the photograph of the normal nasolabial angle as aesthetically acceptable; variations to the nasolabial angle of 5 degrees, whether above or below the normal angle, were perceived as moderately acceptable.

## 282 ANTIBACTERIAL PROPERTIES OF A SELF-ETCHING ADHESIVE WITH POSSIBLE USE IN ORTHODONTICS

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**AIM:** Patients wearing fixed orthodontic appliances are susceptible to enamel decalcification, which is preventable using antimicrobial adhesives for bracket bonding. The aim of this study was to determine the antibacterial capacity of a self-

etching adhesive containing glutaraldehyde, IBond, against *Streptococcus mutans* and *Lactobacillus gasseri*, the main causes of dental caries.

**MATERIALS AND METHOD:** The inhibitory effects of the adhesive against *S. mutans* and *L. gasseri* were examined using the agar diffusion method with Whatman No. 1 disks loaded with 15 µl of adhesive, ultraviolet polymerized, layered on previously inoculated BHI and MRS plates incubated at 37°C, 48 hours microaerobically. Bacterial adhesion was studied with scanning electron microscopy. The adhesive's effect on bacterial morphology was assessed in samples from two areas of the halo of inhibition surrounding the disks with 30 µl of adhesive: inside and periphery. A sample at a distance from the halo was used as the control. Photomicrographs were obtained with a phase contrast Olympus BH-2 microscope.

**RESULTS:** IBond produced a clear and even inhibition halo against *S. mutans* and *L. gasseri*. *S. mutans* and *L. gasseri* attach to polymerized IBond, and are thus biofilm-forming bacteria on this material. The control experiment with IBond and dead cells showed that *S. mutans* have a greater passive adhesive quality than *L. gasseri* probably due to the capsular polysaccharide in the former microorganism. Viability tests showed no viable cells (bacteriolysis) within the inhibition halo produced by IBond for both bacteria. At the periphery of the inhibition halo both microorganisms presented irregular morphology.

**CONCLUSIONS:** IBond showed clear antibacterial activity against *S. mutans* and *L. gasseri* and accordingly it can reduce microbial decalcification of tooth enamel.

## 283 EFFECTS OF DIFFERENT STRENGTHS OF STATIC MECHANICAL STRAIN ON VIABILITY, DIFFERENTIATION AND PROLIFERATION OF HUMAN PERIODONTAL FIBROBLASTS

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**AIM:** Static mechanical strain is thought to mimic that found *in vivo* during orthodontic treatment on the tension site during tooth movement. The object of the current study was to investigate the changes in viability, proliferation, differentiation and collagen type-I production of human periodontal ligament fibroblasts (HPdLF) depending on the applied strength of static mechanical strain (SMS).

**MATERIALS AND METHOD:** HPdLF were loaded to SMS *in vitro* using a Flexercell strain unit. Different strengths (1, 5 and 10%) of SMS were loaded to the HPdLF for 12 hours. Viability of HPdLF were verified by MTT assay. Gene expression of alkaline phosphatase (ALP; osteogenic differentiation), cyclin D1 (proliferation) and collagen type-I were investigated using real-time polymerase chain reaction (RT-PCR) methods. The data were analyzed using the Statistical Package for Social Sciences, version 18.0.

**RESULTS:** MTT assay demonstrated that viability of HPdLF was not influenced by any strengths of static mechanical strain. RT-PCR showed that 5 per cent of SMS lead to an increase of gene expression of ALP (0.44 versus 1.63,  $P < 0.001$ ), cyclin D1 (0.34 versus 1.43,  $P = 0.002$ ) and collagen type-I (1.2 versus 1.35,  $P = 0.1$ , n.s.) compared with control cells. Ten per cent of SMS lead to a lower increase of ALP, cyclin D1 and collagen type-I than 5 per cent of SMS. One per cent of SMS slightly increased the gene expression of ALP, but had no significant influence on the expression of cyclin D1 and collagen type-I.

**CONCLUSIONS:** Static mechanical strain does not influence the viability of HPdLF. Moderate forces leading to 5 per cent strain of HPdLF during orthodontic therapy might result in the highest proliferation, osteogenic differentiation and collagen type-I release of HPdLF on the tension site of tooth movement.

## 284 THE CHALLENGE OF DEFINITION AND INDICATION OF FEATURE POINTS IN THREE-DIMENSIONAL DENTAL MODELS\*\*\*

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**AIM:** To explore the digitized point indication process on three-dimensional (3D) dental plaster casts and to explore the effect of local optimization. With standardized manipulation and practices, reliable measurements can be obtained from plaster casts. When indicating tooth cusps, the practitioner is aided by his/her stereoscopic vision and professional intuition. Linear measurements with a calliper involve two landmarks simultaneously. 3D models are practically always represented on a two-dimensional (2D) flat screen and landmarks are indicated separately using local information only. Therefore, measurements based on digital models are fundamentally different from 'real world' measurements. The aim of this presentation is to propose a standardized 2D view and a local search algorithm for optimal point indication.

**MATERIALS AND METHOD:** Thirteen digital models were obtained from plaster casts (OrthoProof) and exported to a

locally developed 3D point indication tool (Matlab® 2008a) incorporating standard projection and standard projection combined with local search. Nine linear measurements between tooth cusps were obtained from the original plaster casts and from indications by two experienced orthodontists. Statistical analysis was based on descriptive statistics, correlation analysis and non-parametric Friedman's ANOVA with the Tukey-Kramer difference criterion.

RESULTS: For four of the nine linear measurements, those based on the digital indications were significantly different from the manual measurements ( $P = 0.001$ ). The local search augmented the minimal test-retest correlation for the digital linear measurements from  $r = 0.978$  to  $r = 0.998$ . The minimal correlation for a digital linear measurement between the two raters was  $r = 0.960$  for the standard projection and  $r = 0.991$  for the local search algorithm.

CONCLUSION: Linear measurements in the real world can differ significantly from those obtained through the digital indication methods proposed. Through standardization extremely reliable digital measurements are achieved. Local search notably improves reliability.

## 285 ORTHODONTIC TREATMENT NEED IN IRANIAN SCHOOLCHILDREN USING THE INDEX OF ORTHODONTIC TREATMENT NEED

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AIM: To evaluate orthodontic treatment need using the Index of Orthodontic Treatment Need (IOTN) among 11-14 year-old students of Hamadan schools in 2010 and to find the correlation between the Dental Health Component (DHC) and Aesthetic Component (AC).

SUBJECTS AND METHOD: A cross-sectional descriptive study was conducted on 721 randomly selected students (361 males, 360 female) who had not undergone orthodontic treatment DHC assessment was carried out by a calibrated examiner. AC was determined using the 10-standard photograph collection shown to students. The two components were compared using the Kappa index.

RESULTS: According to DHC, out of the 721 cases surveyed, 48.7 per cent of students had a mild treatment need, 25.1 per cent a moderate need and 26.2 per cent a definite need. The most frequently observed malocclusion was contact point displacement. According to the AC, 88.1 per cent of students had mild treatment need, 7.8 per cent a moderate need and 4.2 per cent a definite need. There was no correlation between the DHC and AC (kappa value= 0.069).

CONCLUSION: Although the IOTN is a valid screening tool, patient's perception to orthodontic treatment does not always correlate with professional assessment. According to the result of this study the DHC should be used in epidemiology studies rather than the AC.

## 286 EFFECTS OF FACEMASK AND REVERSE CHIN CUP THERAPY ON MAXILLARY DEFICIENCY

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AIM: Treatment to correct the dentofacial disharmony associated with a Class III malocclusion is challenging. Numerous devices have been introduced for correction of Class III malocclusion and maxillary deficiency. The aim of this study was to compare the dentoskeletal effects resulting from facemask and reverse chin cup therapy in treating Class III malocclusions with maxillary deficiency in growing patients.

SUBJECTS AND METHOD: Forty-two Class III patients randomly divided into two equal groups. All patients had maxillary deficiency and a normal mandible. Twenty-one patients (10 males, 11 females) with a mean age of  $8.9 \pm 1.4$  years were treated with a facemask and upper removable appliance such that the traction force was applied from the facemask to the removable appliance. Twenty-one patients (9 males, 12 females) with a mean age of  $9.2 \pm 1.1$  years were treated by reverse chin cup. This appliance consisted of a high pull cap, a chin cup with two vertical hooks, a removable appliance on the upper jaw, and two elastics that connected the hooks of the cup to the hooks of the removable appliance. Cephalograms were taken at the beginning and end of treatment. A Mann-Whitney test was used for statistical evaluation of data between two groups. RESULTS: SNA was increased by  $1.1 \pm 1.5$  degrees ( $P < 0.001$ ) and  $1.4 \pm 1.5$  degrees ( $P < 0.001$ ) in the facemask and reverse chin cup groups, respectively. IMPA decreased by  $3.2 \pm 6.5$  degrees in the facemask group ( $P < 0.04$ ) and by  $2.5 \pm 4.6$  degrees in the reverse chin cup group ( $P < 0.02$ ). No statistically significant differences were seen between the changes of the two groups.

CONCLUSION: Both reverse chin cup and facemask therapy were effective in the treatment of maxillary deficiency. However, the reverse chin cup seems more favourable for patients due to its smaller size.

287 A COMPARATIVE STUDY OF EARLY DIAGNOSIS IN SURGICAL OUTCOME IN UNILATERAL CLEFT LIP AND PALATE

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AIMS: To evaluate the dental arch relationships of children with complete unilateral cleft lip and palate (UCLP) with early surgical repair outcome in the Northeastern part of Thailand and to compare it with the results from other centres.

SUBJECTS AND METHOD: Forty-six complete UCLP patients and available 5-year study models whose primary repair had been performed within Khon Kaen University. These study models were assessed twice by two examiners independently using the 5-year-old Index. Agreement of rating was determined with weighted kappa statistics; both intra- and inter-examiner agreements were high, indicating good reproducibility.

RESULTS: The surgical outcome was graded as poor or very poor for 60 per cent of patients and excellent, good, or fair for 40 per cent of patients.

CONCLUSION: The results of this Thailand study compare unfavourably with those of Bristol, Oslo and western Australia.

288 REGENERATION AND DEGENERATION AND APOPTOSIS IN JAW BONES AND GINGIVAL TISSUES OF PATIENTS WITH DENTOFACIAL DEFORMITIES

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AIM: To detect the growth factors, extracellular matrix proteins, degeneration enzyme, gene proteins and apoptosis in jaw bone growth zones in Class II and Class III patients with dentofacial deformities and to compare them with a control group.

MATERIALS AND METHOD: During orthognathic surgery, tissue samples from 20 patients with skeletal Class II and 20 patients with skeletal Class III jaw discrepancies of the tuberosity of the maxillae, samples of the anterior and posterior mandibular ramus posterior were taken, as well as from the lower jaw gingival transitory fold in the second molar region. Five patients who underwent extractions of impacted third molars were included in the control group. Tissue samples were stained to detect TGF- $\beta$ , BMP2/4, FGFR1, VEGF, OC, OP, MMP2, barx1, msx2 and wnt1 expression. Distribution of these factors was detected semi-quantitatively. To analyse the data, descriptive statistical methods were used.

RESULTS: There was rich expression of TGF $\beta$ , BMP2/4, OC and OP in the bone tissue from the tuberosities, as well as from the anterior and posterior parts of the ramus. Expression of FGFR1 was more pronounced just in the soft tissues from the lower jaw gingival transitory fold in the second molar region. Less pronounced was barx1, msx2 and wnt1 gene protein expression, while VEGF and MMP2 were found only in some tissue samples. More apoptotic cells were observed in the bone and soft tissues of the controls, but less and relatively equal in the skeletal Class II and Class III patients.

CONCLUSIONS: The parameters important for bone tissue morphogenesis, such as TGF- $\beta$ , BMP2/4, FGFR1 and VEGF, OC, OP, MMP2, barx1, msx2, wnt1 and apoptosis are different in jaw bone growth zones in various dentofacial deformity groups.

289 THE PROCESS, QUALITY AND EFFICIENCY OF ORTHOGNATHIC THERAPY IN THE UNITED KINGDOM

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AIM: To evaluate the process, duration, quality, and efficiency of orthognathic treatment provided in the east of England.

MATERIALS AND METHOD: A retrospective analysis of consecutive cases of subjects who underwent orthognathic surgery in 2008. Inclusion criteria included pre- and post-surgery orthodontic treatment. There was no standardisation in orthodontic treatment protocol.

RESULTS: Twelve orthodontic units submitted data for a total of 120 patients. Sixty-four per cent were Class III, 35 per cent Class II division 1, and 1 per cent Class II division 2. The overall extraction rate, excluding third molars, was 58 per cent. The median age at bond up was 17 years. The mean total number of orthodontic attendances was 23. The median length of pre-surgical orthodontics was 23.0 months and for post-surgical orthodontics 7.0 months. The median length of total treatment was 29.0 months and there was wide inter-unit variation. The mean wait for surgery was 3.6 months. Class of



skeletal base, transfer of operator and treatment unit affected treatment duration. The median pre- and post-treatment peer assessment rating (PAR) score was 43 and 4, respectively. The median change in PAR score was 38.5 i.e. 90.6 per cent. The median PAR efficiency factor (reduction in PAR score divided by treatment time in months) was 1.24. Factors that affected percentage reduction in PAR score included: type of orthognathic surgery, diagnosis, and the treating unit.

CONCLUSIONS: Combined orthognathic therapy was both effective and efficient, although wide inter-unit variations occurred in the latter. Factors affecting treatment duration, quality and efficiency have been established. The data provided will improve the consent process and treatment efficiency.

## 290 VARIATIONS OF PERIODONTAL PARAMETERS IN LOWER INCISOR CROWDING

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AIM: To describe the changes in the gingival structures of patients with lower incisor crowding.

SUBJECTS AND METHOD: The following parameters were recorded in 15 patients aged 13 to 16 years with lower incisor crowding: plaque index (PI) of the lower anterior teeth, gingival index (GI), probing depth (PD), oral hygiene index (OHI) and the width of the keratinized and attached gingiva.

RESULTS: PI, GI and PD were modified in comparison with a control group, revealing the necessity of orthodontic treatment. There was a significant increase in the width of the keratinized and attached gingiva for all 15 patients.

## 291 DIN 13990-1/-2: AN ATTEMPT TO STANDARDIZE BOND STRENGTH TESTING. A VERSATILE TESTING PROCEDURE?

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AIM: Numerous studies have investigated shear bond strength (SBS) of orthodontic adhesives, with conflicting results due to the variations in study design. However, it is in the interest of manufacturers and practitioners alike to use standardized testing procedures that yield reproducible results. This is the intention of DIN 13990-1/-2.

MATERIALS AND METHOD: Transbond XT (3M Unitek), Fuji Ortho LC (GC) and Beauty Ortho Bond (Shofu) were tested according to DIN 13990-1/2. Part 1. Bonding of the adhesive-attachment (AA) interfacial surfaces and adhesive-enamel (AE) were investigated. For this purpose adhesive cylinders 3 mm in diameter were bonded to the mesh base of brackets (Discovery, Dentaaurum) or to the surface of permanent bovine incisors partially embedded in Technovit (Kulzer) after conditioning with 35 per cent H<sub>3</sub>PO<sub>4</sub> or self-etching primer (Transbond SEP, 3M Unitek). Part 2. The entire bonding system attachment-adhesive-enamel (AAE) was tested for SBS after bonding brackets to bovine incisors with the above-mentioned adhesives. A light emitting diode (Bluephase 20i, Ivoclar) was used for light-curing the adhesives for 5 seconds. The number of specimens per group was 10. A universal testing machine (Zwick Z010, Ulm, Germany) was used at 1 mm/minute to determine the SBS after 15 minutes or 24 hours in 37°C water with or without thermocycling (TC) (5°C, 55°C, 20 seconds dwell time, ×500).

RESULTS: (only for Transbond XT): The SBS [Mean ± SD (MPa)] at AA after 15 minutes was 13.1 ± 2.3, at 24 hours 33.2 ± 6.4 and 24 hours TC 30.0 ± 6.2. For AE at 15 minutes it was 15.9 ± 2.6, 24 hours 25.4 ± 3.8 and 24 hours TC 28.1 ± 1.9 and for AAE 16.4 ± 5.3, 25.6 ± 5.1 and 24.3 ± 6.9, respectively.

CONCLUSION: DIN 13990-1/-2 yields reproducible data with different materials and examines the various interfaces and is hopefully widely used in the future.

## 292 RELATIONSHIP BETWEEN QUALITY OF LIFE AND DENTOFACIAL AWARENESS IN TURKISH ADOLESCENTS

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AIM: To investigate the association between quality of life and dentofacial awareness in Turkish adolescents.

SUBJECTS AND METHOD: One hundred and twenty five adolescents (41 males, 84 females) aged 11 to 18 years (mean: 14.48 ± 1.77 years). The Dental Health (DHC) and Aesthetic (AC) components of the Index of Orthodontic Treatment Need

were used to assess the adolescents' objective and subjective treatment needs. Awareness of dental and facial disorders was determined using the Dentofacial Awareness Scale (DFA). To determine the effect of quality of life, a shortened version (12 items) of the Oral Health Related Quality of Life (OHRQoL) index was used. Descriptive statistics, chi-square and Spearman rank-order correlation coefficients were used for data analysis with statistical significance set at  $P < 0.05$ .

**RESULTS:** The percentage of adolescents with DHC grades 4-5 (great need) was 36 whereas with AC grades 8-10 (great need) it was 13.6. While DFAS scores were low (0-9) in 74.4 per cent of participants, the OHRQoL scores were high (37-60) in 60 per cent of adolescents. Weak but statistically significant, negative correlations were found between OHRQoL scores and dentofacial awareness ( $r = -0.306$ ,  $P < 0.01$ ). The findings showed that statistically significant correlations also existed between OHRQoL scores and the following subcomponents of DFA: the prominence of the upper chin ( $r = -0.226$ ,  $P < 0.05$ ), the size of the nose ( $r = -0.218$ ,  $P < 0.05$ ), the length of the face ( $r = -0.280$ ,  $P < 0.01$ ), a 'gummy' smile ( $r = -0.186$ ,  $P < 0.05$ ). A statistically significant correlation was also found between OHRQoL scores and facial appearance satisfaction ( $r = 0.292$ ,  $P < 0.05$ ).

**CONCLUSION:** The results emphasize the significant correlation between quality of life and perceptions of their facial appearance in adolescents.

## 293 PREDICTION ACCURACY OF IMAGING SOFTWARE IN CLEFT ORTHOGNATHIC SURGERY – A PILOT STUDY

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**AIM:** The reliability of computer assisted imaging software for orthognathic patients have been evaluated but not for cleft orthognathic surgery. The aim of this study was to assess the reliability of imaging software following Le Fort I advancement in repaired cleft lip/palate (CLP) patients.

**SUBJECTS AND METHOD:** As a pilot study, five patients with repaired CLP who underwent Le Fort I advancement and non-cleft patients who underwent a similar orthognathic procedure were evaluated by manual tracing and digitization. Reliability and reproducibility were carried out for both methods using a paired *t*-test.

**RESULTS:** Significant differences were observed in both hard and soft tissue measurements. Sub nasal and the upper lip regions showed variations.

**CONCLUSIONS:** Computer generated images may be suitable for patient education but must be used with caution. Significant efforts are needed to improve the accuracy of imaging software in cleft orthognathic patients.

## 294 A BRIEF SKELETAL IMAGING SYSTEM

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**AIM:** To develop software in which general skeletal pattern can be gained on a screen image by combining dental pantomograms (DPTs), extra-oral lateral photo, and a study model. Software has been developed in which the general skeletal pattern can be obtained on a screen image by combining DPTs, extra-oral lateral photographs, and study models. The aim of this study was to evaluate the accuracy of the established image by comparing it with the conventional lateral cephalograms.

**MATERIALS AND METHOD:** Lateral cephalograms, DPTs and lateral extra-oral photographs of 20 patients were synthesized on a screen image using the newly developed software. Appropriate cephalometric landmarks were outlined on the screen and conventional cephalometric values were obtained. These values were then compared with the corresponding cephalometric values obtained from the lateral cephalogram of the same patient. Statistical analysis was undertaken using the Student's *t*-test.

**RESULTS:** Similarity was found for many of the cephalometric values between both methods; however, inconsistency was found in particular cephalometric values.

**CONCLUSIONS:** It was difficult to gain same 'cephalometric values' using the newly developed software as those from conventional lateral cephalograms, however, it is thought to be of clinical value in dental practice to evaluate brief skeletal pattern using newly developed software.

## 295 THE EFFECTS OF DIFFERENT FORCE DIRECTIONS ON MAXILLARY PROTRACTION

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AIM: To evaluate the dentofacial effects of different force directions on maxillary protraction.

SUBJECTS AND METHOD: Two groups, each containing 15 cases. The average chronological age was  $11.39 \pm 0.77$  years and  $12.13 \pm 1.35$  years for the first and second groups, respectively. All subjects had an Angle Class III molar relationship with a negative overjet or an edge-to-edge incisor relationship. Activation-deactivation rapid palatal expansion (A/D-RPE) procedure was applied in all patients before reverse headgear (RH) wear. In this A/D-RPE procedure the screw was activated twice daily for 1 week. Subsequently, the screw was deactivated twice daily for 1 week. This A/D-RPE procedure was repeated once more. A total force of 700 g was then applied from the hooks of the facebow to the pre-labial bar of the RH in the first group. The direction of the protraction force was parallel and 15 mm above the occlusal plane. In the second group a total force of 700 g was applied from the hooks mesial to the maxillary canines to the pre-labial bow with a downward and forward pull of 15 degrees to the occlusal plane. During the first 3 months the RH was used for 16-18 hours/day. For the second 3 months the RH was worn for 12 hours/day and for the following 6 months for 6 hours/day with the same force level.

RESULTS: Correction of the Class III malocclusion with a pronounced maxillary skeletal contribution was obtained for both groups. Anterior movement of point A for the first and second groups was 4.67 and 4.73 mm, respectively ( $P > 0.05$ ). Force application above the occlusal plane resulted in less molar extrusion, less total and lower anterior face height increase along with a diminished forward and upward maxillary rotation when compared with downward force application.

CONCLUSION: A protraction force applied 15 mm parallel and above the occlusal plane resulted in a reduced anterior maxillary rotation when compared with the downward force application.

## 296 EFFECTS OF FACEMASK AND RAPID MAXILLARY EXPANSION ON PHARYNGEAL DIMENSIONS: A PILOT STUDY

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AIM: Skeletal Class III anomalies are associated with maxillary retrusion, mandibular protrusion, or both. In subjects with maxillary deficiency, early treatment with maxillary protraction appliances shows promising results, in terms of upper airway enlargement. The aim of this prospective study was to analyze the effects of rapid maxillary expansion (RME) and facemask (FM) therapy on the sagittal pharyngeal dimensions in subjects with a Class III malocclusion.

SUBJECTS AND METHOD: Five females and five males with an average age of 10.17 years with Class III maxillary retrusion, negative overjet, concave facial profile. A combination of bonded RME and FM appliances were used for treatment. The duration of treatment was approximately 8-9 months. The first radiograph (T0) was taken before FM therapy and the second (T1) after achieving a positive overjet. Pre- and post-treatment cephalometric radiographs were hand traced and analysed using predetermined airway parameters. The normality of the data was checked using the Kolmogorov-Smirnov test. As the data was normally distributed, parametric tests were used. In order to evaluate the differences between T0 and T1 a paired samples *t*-test was performed.

RESULTS: The nasopharyngeal (PNS-ad1, PNS-ad2) and oropharyngeal (SPS, MPS) airway measurements showed a statistically significant increase.

CONCLUSION: Maxillary expansion together with protraction of the maxilla improved naso- and oropharyngeal airway dimensions in the short term.

## 297 RELATIONSHIP BETWEEN CRANIOFACIAL MORPHOLOGY AND ORAL FUNCTION ON MASTICATORY MOVEMENT DURING CHEWING OF PEANUTS

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AIM: Although the assessment of masticatory function needs evaluation not only in terms of the chewing stage, but also the bite and transport stage and the clearance stage, the relationship between masticatory function and malocclusion have been investigated focusing on the chewing stage. In order to study the entire mastication stage, the present research investigated the correlation of the masticatory efficiency, times and duration to the occlusal force and contact area, saliva secretion, the lip-closing force and the craniofacial morphology.

SUBJECTS AND METHOD: Twenty-two adult females without a history of orthodontic treatment were randomly selected. Masticatory times were determined by the duration and efficiency in chewing peanuts 10 and 20 times, saliva secretion, the occlusal force and contact area, using a sensitive sheet, the lip closing force using multidirectional a lip-closing force metre and craniofacial morphology using lateral cephalograms were investigated.

RESULTS: The masticatory efficiency in chewing 10 times showed significant positive correlations with SNA and SNB, and

the masticatory efficiency for 20 times showed significant positive correlations with occlusal force, occlusal contact area and SNA. These results suggest that in the biting and transport stage, a long upper and lower dental arch length, including a large mouth volume, might have a large biting and transport capacity. In the mastication stage, the large occlusal force and contact area might have a large grinding capacity, and the large maxillary length might have a large mixing capacity of saliva and peanuts.

CONCLUSIONS: Masticatory efficiency when chewing peanuts 10 times was related to the anteroposterior positions of the maxilla and mandible, and for 20 times to the occlusal force and contact area and the anteroposterior position of the maxilla.

## 298 THREE-DIMENSIONAL EVALUATION OF SKELETAL STRUCTURES AFTER RAPID MAXILLARY EXPANSION\*\*\*

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AIM: Rapid maxillary expansion (RME) is a common treatment option in orthodontics. The maxillary dental arch usually expands after RME treatment. There are few studies that have examined three-dimensionally the morphological changes in the maxillary skeletal complex after RME. In this study such changes were investigated using three-dimensional cone beam computed tomography (3D-CBCT).

MATERIALS AND METHOD: 3D-CBCTs were obtained before and after RME in 10 Japanese patients, and the volumetric data were analyzed using stereotaxic 3D-CT software; the reference planes were determined, and the head position was standardized. The transverse distances of the dentoalveolar structures and maxillofacial skeleton were measured to determine the 3D morphological changes after RME. The morphological changes were also visualized by 3D-superimposition using 3D-CT imaging software. Skeletal differences were projected into colour maps on the 3D-CT volumetric data.

RESULTS: RME resulted in significant expansion of the dentoalveolar structure and maxillofacial skeleton, including the zygomaticomaxillary suture. The 3D-model produced by 3D-superimposition allowed easy understanding of the skeletal changes in the maxillary skeletal complex, and the colour map images were confirmed by the results of statistical analysis.

CONCLUSION: The RME appliance effectively expands the dentoalveolar structure and maxillofacial skeleton. Furthermore, 3D-CBCT is useful for 3D evaluation of RME-induced morphological changes in the skeletal structures.

## 299 CEPHALOMETRIC EVALUATION OF RELATIONSHIP BETWEEN BICONDYLAR POSITION AND OCCLUSAL ASYMMETRY

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AIM: To describe dental arch dimensions, determine maxillary and mandibular interarch asymmetry, and evaluated the morphologic relationship of the maxillary and mandibular skeletal structures, the position of the condyle and occlusal plane tilt in subjects with a crossbite and normal occlusion.

SUBJECTS AND METHOD: Eighty patients, 40 with a unilateral posterior crossbite, and 40 with a normal occlusion. The age of the patients ranged between 12 and 20 years. Transverse clinical observation was complemented with gnathometric analysis on the study models where the median palatal plane was used as a reference for transverse measurements, and facial Ricketts posteroanterior cephalometrics analysis, clinical facial, maxillary and mandibular width, craniofacial angle which showed crossbite type and asymmetry degree, occlusal plane tilt and condylar malposition.

RESULTS: Gnathometric analysis showed that patients with a unilateral posterior crossbite had a narrow maxillary dental arch with lingual inclination of the maxillary buccal teeth, dental asymmetry and midline discrepancies. Cephalometrics measurements showed that the patients with a transverse disharmony had constriction of the maxillary corpus and a skeletal, lingual crossbite. The angle that shows the type of crossbite (ZI-Ago-JI), had large values, 19.8 degrees in the unilateral crossbite subjects, 18 of which had divergence of the occlusal plane with temporomandibular joint problems which often cause functional deficiencies in the orofacial region.

CONCLUSION: Successful treatment of patients with transverse discrepancies depends on skeletal, functional, or dental changes. Skeletal asymmetries are preferably treated with a combination of orthodontics and orthognathic surgery, and dental, minor skeletal asymmetries and functional mandibular asymmetries by orthodontic therapy.



### 300 TRACE ELEMENT COMPOSITION OF HUMANS

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AIM: To study elemental composition of humans and identify pathology.

SUBJECTS AND METHOD: Twenty-five patients (20-44 years of age) divided into three groups: group 1, 10 patients diagnosed with primary adentia, group 2, 15 patients with a diagnosis of retention, and group 3 (control) 15 subjects who considered themselves relatively healthy. A survey was conducted of patients, which included: casts, diagnostic photographs, radiographs: the contact of bones of the skull in lateral projection and intermaxillary positions, as well as biochemical analysis of saliva and osteodensytometria.

RESULTS: Comparative analysis of saliva showed that the amount of calcium in the group 1 of 0.5-0.6 mg/dL was  $\times 2$  lower than in group 3. In the subjects in group 2 the amount of calcium was 0.9 mg/dL, which is also low. Saliva phosphorus in the biochemical composition of all groups was within normal limits. With regard to osteodensytometria, the subjects and groups 2 and 3 had indices of bone mineral density within the normal range. In group 1 patients the indices were reduced by 68 per cent from the normal.

CONCLUSION: A decrease in the level of calcium in the bones can lead to adentia of some teeth. A trace element imbalance in the body can affect the dental systems, and may be a causative factor in retention and adentia.

### 301 PREVALENCE AND PATTERNS OF TOOTH AGENESIS IN A GREEK ORTHODONTIC POPULATION

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AIM: Tooth agenesis is one of the most common developmental anomalies in humans (prevalence: 0.3-10.1% excluding third molars). The objective of this study was to evaluate prevalence and patterns of tooth agenesis among Greek orthodontic patients.

SUBJECTS AND METHOD: The files of the Orthodontic Department of the University of Athens were searched from September 1994 to July 2009 to identify patients with agenesis of permanent teeth. The medical and dental history and dental pantomograms of 1327 untreated patients were studied. The records of 84 patients identified as having syndromes, clefts or other congenital anomalies combined with dental agenesis were excluded. Finally, 1243 patients were included. Descriptive and comparative statistics were used to analyze and the data.

RESULTS: The age distribution of the sample ranged between 7 and 45 years. The prevalence of congenitally missing teeth (CMT) was 10.22 per cent (5.71% females, 4.51% males). There were in total 437 CMT and on average 3.44 teeth were missing per person. The most commonly absent tooth was the mandibular second premolar (93 teeth, 57 patients) followed by the maxillary lateral incisor (86 teeth, 53 patients), whereas the most rarely absent tooth was the maxillary central incisor (2 teeth, 1 patient) followed by the mandibular first premolar (8 teeth, 6 patients). Oligodontia (6 or more CMT) ranged from 6 to 20 teeth, with a prevalence of 15.75 per cent (7.87% females, 7.87% males) in the hypodontia sample. Symmetry of CMT was predominant: 110 pairs for bilateral symmetry and 48 pairs for symmetry between two antagonistic quadrants.

CONCLUSIONS: The patterns and prevalence of tooth agenesis in the present sample were generally more severe compared with other populations. This can be partly explained by the fact that teeth are more likely to be missing in orthodontic patients than in the general population.

### 302 THREE-DIMENSIONAL ANALYSIS OF ORTHODONTIC TOOTH MOVEMENT AND ROOT RESORPTION IN RAT MOLARS

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AIM: Orthodontic force application on rat maxillary first molars has been used as an animal model for the analysis of root resorption and tooth movement. However, the maxillary rat first molar has five roots and the location of root resorption craters and the severity of root resorption on each root differ. In this study, the rate of tooth movement and root resorption was investigated for each molar root following continuous force application.

MATERIALS AND METHOD: Mesially directed forces (10, 25, 50 and 100 g) were applied to maxillary first molars using nickel-titanium closed-coil springs. Time-lapse microtomographs were taken and tooth movement was quantified in the

sagittal, frontal and axial planes. After 14 days, the molars were extracted and the surface areas, depth and volume of the root resorption craters were measured using scanning electron and laser scanning microscopes. Finite element analysis (FEA) was also performed.

**RESULTS:** The largest and deepest resorption craters were observed in the distobuccal root followed by distopalatal, middle-buccal, middle-palatal, and mesial root. From day 10, greater tooth movement was observed when a force of 10 g was applied. FEA showed that the centre of rotation in the molar is located in the centre of the five roots at the apical third of the molar roots. As heavier forces were applied, greater root resorption occurred.

**CONCLUSIONS:** Three-dimensional analysis of root resorption and tooth movement in the rat molar showed that light mesially orientated forces, produced more tooth movement and less root resorption compared with heavier forces. Although the initial tooth movement after the application of different force magnitudes until day 3 was not remarkably different, 10 g of force produced more tooth movement compared with heavier forces. The distobuccal root showed the greatest root resorption following 10, 25, 50 and 100 g of continuous orthodontic force.

### 303 EVALUATION OF ANTERIOR OPEN BITE AND REVERSE OVERJET USING THE AESTHETIC COMPONENT OF THE INDEX OF ORTHODONTIC TREATMENT NEED

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**AIM:** To determine the attractiveness of an anterior open bite (AOB) and reverse overjet using the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN).

**SUBJECTS AND METHOD:** Eighty-four educated parents of patients from a dental clinic (47 males, 37 females) and 75 undergraduate dental students (30 males, 45 females). They were asked to rate the attractiveness of photographs of an AOB and reverse overjet according to the AC of the IOTN. A chi-square test was performed to evaluate any differences between genders and between the two groups of participants.

**RESULTS:** Eighty one per cent of parents rated a mild AOB and a mild reverse overjet as an acceptable aesthetic appearance of the teeth, while these types of malocclusions were deemed to be attractive by only 49 per cent of dental students. The differences between two rater groups were significant at  $P < 0.001$ . A severe AOB and severe reverse overjet were rated as unacceptable and unattractive by 87 per cent of parents and 96 per cent of dental students. Dental students rated these severe malocclusions at the more unattractive end of the scale ( $P < 0.001$ ).

**CONCLUSION:** Both a mild AOB and reverse overjet were rated as more acceptable malocclusions by dental students and parents. However severe AOBs and reverse overjets were not considered as attractive or aesthetically acceptable by two groups of judges.

### 304 EFFECTS OF INCREASED OCCLUSAL VERTICAL DIMENSION ON MOTOR REPRESENTATIONS WITHIN THE FACE MOTOR CORTEX OF ADULT RATS

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**AIMS:** Clinicians have long been interested in the vertical changes associated with prosthodontic/orthodontic treatment. Increased occlusal vertical dimension (iOVD) may modulate mastication such as in the masticatory cycle and the firing properties of the jaw-muscle spindles. However, little is known about the changes in motor representation within the facial primary motor cortex (face-M1) after iOVD. Thus, this study was conducted to determine the effects of iOVD on face-M1 using intracortical microstimulation (ICMS).

**MATERIALS AND METHOD:** Thirteen-week-old male Wistar rats ( $n = 18$ ) randomly divided into control ( $n = 6$ ) and iOVD ( $n = 12$ ) groups. The iOVD group received a 2 mm build-up of composite resin on the maxillary molars. The electromyographic (EMG) activities from the left and right anterior digastrics and masseter as well as the genioglossus muscles elicited by ICMS within the right face-M1 were recorded 1 and 2 weeks after iOVD. The significance of the differences in the number of sites and the positions of the centre of gravity within the face-M1 at which ICMS evoked EMG activity between the two groups was evaluated using a multivariate analysis, followed by a *post-hoc* Bonferroni-adjusted pairwise test ( $P < 0.05$ ).

**RESULTS:** The number of sites at which ICMS evoked EMG activity in the left anterior and/or genioglossus muscles was significantly increased at 1 and 2 weeks, as was that in the right anterior digastric muscle at 1 week in the iOVD group. Moreover, there was a significant lateral shift of the centre of gravity of effective ICMS for the left anterior digastric and genioglossus muscles within the face-M1. A similar significant change was not found in the masseter muscle.

**CONCLUSIONS:** These results suggest that a significant neuroplastic change within the rat's face-M1 occurs in association with iOVD. This may be related to the animal's ability to adapt to a change in the oral environment.

**305 SKELETAL CHANGES DUE TO ZYGOMATICOMAXILLARY BUTTRESS CORTICOTOMY AND RAPID MAXILLARY EXPANSION\*\*\***

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**AIM:** To evaluate the skeletal widening of the maxilla after expansion with zygomaticomaxillary buttress corticotomy in mature patients and to compare these changes with the results after conventional rapid maxillary expansion (RME) in immature patients.

**SUBJECTS AND METHOD:** Two groups, each containing 10 patients. The first group of mature patients had undergone bilateral zygomaticomaxillary buttress corticotomy and the second with immature patients, conventional RME. The expander device in both groups was the cap splint Hyrax. The corticotomy procedure was performed approximately 5 mm above the apices of the teeth just to the zygomatic maxillary buttress, ending just anterior to the pterygoid fissure. The study was carried out on posteroanterior (PA), lateral cephalograms, occlusal radiograms and study models. Midpalatal suture separation was determined on the occlusal radiograph taken post-expansion.

**RESULTS:** PA measurements of corticotomy group, showed that all changes in the internasal, interjugal and intermolar width were significant. In the mature patients the mean increase in interjugal width was 5 mm and in internasal width 2.05 mm, while in immature patients the changes were 4.5 and 2.67, respectively. The measurements after expansion on the lateral cephalograms of both groups were insignificant. Study model analysis showed that in mature patients there was a significant change in the depth of the palate that decreased by 2.61 mm in the molar area while in the RME group the change was insignificant. These findings indicated that in the surgical group there was greater lateral bending of the maxillary halves

**CONCLUSION:** A zygomatic corticotomy is a useful technique to increase the transverse dimension of the palate in skeletally mature individuals.

**306 CHANGES IN THE TEMPOROMANDIBULAR JOINT AFTER MAXILLARY PROTRACTION WITH A BONE-ANCHORED FACEMASK**

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**AIM:** To investigate changes in temporomandibular joint (TMJ) after maxillary protraction with a bone-anchored facemask in Class III patients.

**SUBJECTS AND METHOD:** Fifteen patients, mean age  $12.1 \pm 1.43$  years, undergoing 8 weeks of repetitive rapid maxillary expansion and contraction, followed by maxillary protraction anchored with miniplates. A force of 350-400 g per side was applied in a forward and downward direction to the occlusal plane. Magnetic resonance imaging (MRI) was performed before treatment and immediately after maxillary protraction in all patients. Disc displacement during mouth opening and closing, condyle position at maximum mouth opening, degenerative changes in the condyle/glenoid fossa/articular disc and the presence of effusion were evaluated in the MRI examinations.

**RESULTS:** Before treatment, 28 TMJs in 14 patients showed a normal disc position and two TMJs in one patient were diagnosed as having anterior disc displacement with reduction. After maxillary protraction, anterior disc displacement with reduction was found in four TMJs of three patients and a disc displacement without reduction in one TMJ. None of the condyles reached further than the posterior slope of the articular eminence at maximum mouth opening. One TMJ diagnosed as having limited condylar movement before treatment improved. There were no visible signs of effusion or degenerative change due to treatment in any of the TMJ MRIs.

**CONCLUSIONS:** Bone-anchored facemask treatment after repetitive rapid maxillary expansion and contraction did not have detrimental effects on the TMJs indicating pathology in general.

**307 DENTOFACIAL EFFECTS OF LOWER INCISOR AND FOUR PREMOLAR EXTRACTIONS**

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AIM: To investigate the skeletal, dental and soft tissue changes that occur due to orthodontic treatment with one lower incisor or four premolar extractions.

SUBJECTS AND METHOD: Sixteen patients (mean age:  $23.43 \pm 4.36$  years) with an Angle Class I malocclusion patients with a mean age of  $23.43 \pm 4.36$  years treated with one lower incisor extraction were included in the first group and 16 patients showing the same malocclusion with a mean age of  $18.37 \pm 3.36$  years and treated with four first premolar extractions were included in the second group. The pre- and post-treatment digital lateral cephalometric radiographs were analyzed using VistaDent cephalometric software. The data was statistically analyzed with the Statistical Package for Social Sciences software using Independent-*t* and Mann Whitney-*U* tests.

RESULTS: At the end of treatment, there were no significant differences between the groups except for the sum of the posterior angles ( $P < 0.05$ ), L1-NB distance ( $P < 0.01$ ) and L1-NB angle ( $P < 0.01$ ), which were decreased in the second group. The sum of the posterior angles ( $P < 0.05$ ) and ANS-Me distance ( $P < 0.01$ ) showed a significant increase in the first group. Wits appraisal ( $P < 0.05$ ) increased significantly, while U1-Na distance ( $P < 0.05$ ) and L1-NB angle ( $P < 0.01$ ) decreased significantly in the second group. Overjet and overbite remained statistically unchanged in both groups. Furthermore, ULip-E and LLip-E distances did not show a significant change in either group.

CONCLUSIONS: Greater lower incisor retroclination and retrusion was observed in the patients treated with four premolar extractions compared with those treated with one lower incisor extraction. However, similar results were observed in the facial soft tissues with both techniques. Therefore, lower incisor extraction can be an alternative to four premolar extractions when the desire is to obtain localized treatment effects with minimal changes in the dental arches.

### 308 EVALUATION OF THE LONG-TERM EFFECTS OF REVERSE HEADGEAR THERAPY IN SKELETAL CLASS III PATIENTS

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AIM: To evaluate and compare the long-term results in patients treated non-extraction with reverse headgear (RH) therapy with and without the use of fixed appliances.

SUBJECTS AND METHOD: Thirty-four patients who had a skeletal Class III malocclusion due to maxillary retrusion or a combination of maxillary retrusion and mandibular protrusion whose mean bone age was 11.86 years at the beginning of treatment, and whose growth potential was close to or had ceased at the end of the long-term follow-up. The patients were divided into two groups; 17 (group 1) in whom no additional orthodontic was undertaken after RH therapy and 17 (group 2) in whom fixed orthodontic treatment without extractions was carried out after RH therapy. Lateral cephalograms and hand-wrist radiographs were taken at the start (T0) and end (T1) of treatment and at long-term follow-up (T2). Statistical evaluation was made using parametric and non-parametric test according to the compatibility results.

RESULTS: At T1, in both groups, there was maxillary forward displacement and also at T2, but of a lesser amount. Between T0-T1 the mandible showed poster rotation in group 2, while in group 1 no significant change in the anteroposterior position of the mandible was observed. At T2 all patients returned to their original growth patterns, as a result of the significant increase in SN/GoGn angle and the Y-axis during the treatment and the significant decrease during the follow-up period.

CONCLUSION: No difference was found between the groups at the long-term follow-up regarding stability.

### 309 AB/PALATAL PLANE ANGLE VERSUS ANTERO-POSTERIOR DYSPLASIA INDICATOR: THE LESS THE PROCEDURE, THE LESS THE MISTAKE\*\*\*

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AIM: The conjunctive use of the ANB angle, the Wits appraisal and the anteroposterior dysplasia index (APDI) is recommended as a clinically appropriate method for the assessment of jaw relationships. Since it was found that AB/palatal plane (PP) angle had the same results as APDI, the aim of this research was to prove that A-B/PP angle can be used instead of APDI which is obtained from the facial angle plus or minus the A-B plane angle and again plus or minus the PP angle, and to evaluate interchangeability among the four parameters, ANB angle, Wits appraisal, APDI and AB/PP angle.

SUBJECTS AND METHOD: Seventy-five treated individuals, with skeletal Class I, Class II and Class III malocclusion. Each group consisted of 25 subjects. One hundred and fifty pre- (T1) and post- (T2) treatment cephalograms were traced. The ages of the patients ranged from 9 to 20 years, 10 to 22 years and 8 to 24 years for the Class I, Class II and Class III groups, respectively at T1. The following parameters were measured: ANB angle, Wits appraisal, APDI and AB/PP angle. The interchangeability among the four parameters was evaluated by correlation analysis for T1, T2 and the difference between T2 and T1 values (T2-T1) in all groups.



**RESULTS:** Correlation coefficients between the APDI and AB/PP was  $r = 1$ , at T1, T2 and T2-T1 in the Class I and III groups and at T1 in the Class II group. The  $r$  values were high and statistically significant ( $P < 0.001$ ), at T2 ( $r = 0.890$ ) and T2-T1 ( $r = 0.836$ ) in the Class II group. Correlation coefficients between AB/PP angle and other parameters were statistically significant in all groups at T1, and in the Class II and III groups at T2-T1.

**CONCLUSION:** The A-B/PP angle can be used to evaluate changes occurring with treatment in Class II and III subjects and for diagnosis and treatment planning in all groups, instead of APDI and other parameters.

### 310 A COMPARISON OF NORMATIVE AND SELF-PERCEIVED ORTHODONTIC TREATMENT NEED

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**AIMS:** Orthodontic treatment is elective and depends on the perception of both the patient and the treating orthodontist. Evaluation of normative and self-perceived orthodontic treatment need helps in planning orthodontic services and estimating the required resources and manpower. The aim of this study was to investigate and compare the opinions of patients, parents and orthodontists about the need for orthodontic treatment.

**SUBJECTS AND METHOD:** Two hundred and sixty two patients and their parents referred for orthodontic consultation. The Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN) was used to determine the self-perceived treatment need of the patients and parents and the Dental Health Component (DHC) to determine normative treatment need.

**RESULTS:** A definite treatment need was found in 72.9 and 37.4 per cent of the children on the basis of the DHC (DHC grade 4-5) and AC (AC grade 8-10) components of the IOTN, respectively. The assessment of self-perceived treatment need by parents placed 35.1 per cent of the children in AC grade 8-10 (definite need) whereas 35.5 per cent of the children rated their own teeth in this subgroup. There were no statistically significant differences between the IOTN values of boys and girls when gender distribution was considered.

**CONCLUSION:** The need for orthodontic treatment far exceeds the actual availability. Therefore, when deciding whether or not a patient should be orthodontically treated both the desire of the patient (and/or parent) and the opinion of the orthodontist must be taken into account. Priority should be given to patients with the highest treatment need.

### 311 THREE-DIMENSIONAL ANALYSIS OF PALATAL MORPHOLOGY AND UPPER AIRWAY VOLUME IN OBSTRUCTIVE SLEEP APNOEA

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**AIM:** Airway orientation and morphology affect the development of the palate, thus dental arch form and palatal morphology may differ between subjects with different respiratory characteristics. The aim of this study was to evaluate the correlation between the palatal morphology and pharyngeal airway volume in obstructive sleep apnoea (OSA) patients and compare them with non-snoring non-apnoeic control subjects.

**MATERIALS AND METHOD:** Three-dimensional (3D) graphic representations of maxillary dental casts from 15 OSA patients (mean age:  $41 \pm 4$  years) and 15 control subjects (mean age:  $38 \pm 3$  years) were correlated with 3D analysis of pharyngeal computed tomographic (CT) imaging. Intermolar and intercanine widths as well as the palatal depths were also evaluated on the dental casts. The naso-, oro- and hypopharyngeal volumetric measurements were performed on 3D CT scans. Pearson correlation coefficient and multiple logistic regression analyses were carried out. A Mann-Whitney  $U$  test was performed for intergroup comparisons.

**RESULTS:** Patients with OSA had a smaller oropharyngeal volume and smaller upper airway volume compared with the control group ( $P < 0.001$ ). Similarly, palatal volume was significantly smaller in the OSA patients compared with the controls ( $P < 0.001$ ). In addition they had narrower intermolar and intercanine widths compared with the control group subjects ( $P < 0.001$ ). Patients with OSA had a narrower maxilla and relatively smaller airways as well as larger tongues. Palatal height was significantly greater in OSA patients compared with the controls ( $P < 0.001$ ). In OSA patients a positive correlation was found between palatal morphology and pharyngeal dimensions.

**CONCLUSION:** A clear pattern of association exists between OSA and a smaller upper airway and smaller palatal volume. Palatal morphological differences as well as upper airway morphology differences exist between patients with OSA and control group subjects.

### 312 SATISFACTION WITH ORTHODONTIC TREATMENT

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**AIM:** To examine the satisfaction of patients with their orthodontic treatment. In order to illustrate whether there are differences in satisfaction through time, the results of the patients treated in 2008 and 2009 were compared with results of patients treated in 2000 using the same questionnaire.

**MATERIALS AND METHOD:** A validated questionnaire containing 38 questions to measure the patient's perspective on treatment outcome and 20 questions about patient satisfaction was used. A 5-point response format was applied. The total scale was divided into six subscales on the basis of item content. All patients under 30 years ( $n = 220$ ), who finished orthodontic treatment in 2008 and 2009, were sent a questionnaire. The response rate was 55 per cent (34.8% males, 65.2% females). The mean age of the subjects was 17.23 years (SD 3.76).

**RESULTS:** The internal consistency of the total scale and the six subscales of the questionnaire was satisfactory. Respondents scored highest on items about satisfaction with the doctor-patient relationship (4.24, SD 0.63) and lowest on items with regard to their satisfaction with psychosocial improvement (2.88, SD 0.87). No gender differences in mean scores on the subscales were found. Compared with the sample of 2000, the results showed significantly ( $P < 0.01$ ) lower values on all subscales, with only one exception. Only on the subscale 'psychosocial', females in the present study scored similar to females in 2000.

**CONCLUSIONS:** The doctor-patient relationship remains the most important factor contributing to patient satisfaction. However, the results show that patients are overall less satisfied with their orthodontic treatment than almost a decade ago. Only the satisfaction on psychosocial values in females was sustained. Further research is needed to explain these findings.

### 313 THE CRANIOFACIAL PROFILE IN PATIENTS WITH MAXILLARY CENTRAL INCISOR MACRODONTIA

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**AIMS:** The frequency of unilateral or bilateral macrodontia is 0.1-0.2 per cent. Orthodontic treatment is a challenge involving psychosocial and occlusal aspects. Cephalometric analysis of patients with macrodontia was not found in the literature. The aim of this study was to analyze the craniofacial profile in patients with macrodontia of THE permanent maxillary central incisors.

**MATERIALS AND METHOD:** Profile radiographs from 21 children, 11 (3 females, 8 males) with unilateral and 10 (1 female, 9 males) with bilateral macrodontia. The material was referred from community dental clinics in Denmark to the Department of Orthodontics, Copenhagen. Cephalometric analysis was performed according to the method of Solow. The thickness of the frontal bone, length of the nasal bone, shape of sella turcica, cranial base angle and SNA angle were measured as well as the length of the anterior cranial fossa (s-n), length of the palate (sp-pm), and the anterior maxillary height (n-sp). A one-sample *t*-test was used to compare the values to an age- and gender-correlated reference material (Axelsson *et al.*, 2003, 2004).

**RESULTS:** Significantly increased values were found in the distances s-n, sp-pm, and n-sp, the cranial base angle, thickness of the frontal bone, nasal bone length and the length of sella turcica. SNA angle was significantly smaller.

**CONCLUSION:** Macrodontia is not a local phenomenon; it also involves significant deviations in craniofacial morphology that should be considered in orthodontic treatment planning.

Axelsson S, Kjær I, Bjørnland T, Storhaug K 2003 Longitudinal cephalometric standards for the neurocranium in Norwegians from 6 to 21 years of age. *European Journal of Orthodontics* 25: 185–198

Axelsson S, Storhaug K, Kjær I 2004 Post-natal size and morphology of the sella turcica. Longitudinal cephalometric standards for Norwegians between 6 and 21 years of age. *European Journal of Orthodontics* 26: 597–604

### 314 A RETROSPECTIVE OVERVIEW OF TREATMENT CHOICE AND OUTCOME IN SUBJECTS WITH ARRESTED ERUPTION OF THE MANDIBULAR SECOND MOLARS

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AIM: To retrospectively analyze treatment choice and outcome in patients with retention/impaction of the mandibular second molar.

MATERIALS AND METHOD: Radiographs from three large community dental clinics of 106 patients (60 males, 46 females) with 126 retained/impacted permanent mandibular second molars treated during 1985–2005 were evaluated for treatment choice and outcome. Follow-up questionnaires were sent to dentists in cases where treatment outcome could not be determined from the radiographic material received. Clinical evaluation was not possible as the patients were no longer associated with the dental clinics. The cases were categorized accordingly: (A) no treatment; (B) orthodontic treatment; (C) surgical exposure of the second molar; (D) removal of the third molar; (E) removal of the second molar and (F) other treatments. The treatment outcome was defined as acceptable when all molar cusps were in occlusion and unacceptable when not all molar cusps were in occlusion.

RESULTS: Sixty-six cases showed acceptable and 23 cases unacceptable results. In 37 cases, the radiographic material could not document the outcome nor was evaluation of the final outcome possible due to the patient's young age. Remarkable were the high percentages of unacceptable treatment outcome, 25.9 per cent in group D (removal of third molar) and 23 per cent in group E (removal of second molar).

CONCLUSIONS: The choice between removal of the second or third molar is complex. In approximately 25 per cent of the cases the treatment outcome was unacceptable. As the material was collected before new advanced methods of surgical and/or orthodontic uprighting had been introduced, this percentage would be expected to be lower today. Even so, it is recommended that future studies focus on conditions influencing the choice of which molar to extract in patients with retained mandibular second molars.

### 315 DEVELOPMENT OF CONTROLLED FLUORIDE RELEASING ELASTOMERIC RINGS FOR ORTHODONTIC APPLICATIONS

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AIM: Development of white spot lesions is a concern when treating patients with poor oral hygiene. When dealing with non-compliant patients, controlled fluoride release would be beneficial in preventing demineralization by providing fluoride ions to the area adjacent to the brackets. The purpose of this study was to develop a novel approach for controlled release of fluoride from elastomeric o-rings.

MATERIALS AND METHOD: FDA approved biocompatible polyethylene co-vinyl acetate (PEVA) was used as the target elastomer. Samples (N = 3) were prepared by adding 0.08 to 0.6 g NaF powder into 4.2 g PEVA/20 mL tetrahydrofuran (THF) solution. After NaF addition, the mixture was sonicated for 2 hours, poured into a Petri dish and bench-dried to form a thin film. NaF incorporated polymer samples were dipped into 21 per cent w/v PEVA/THF solution once or twice to further prepare single- or double-coated samples, respectively. After drying the samples were individually inserted into 50 mL of buffer solution, and fluoride ion concentration was measured with an ion selective electrode over 30–45 days. In order to determine the temperature effect, the fluoride released was tested both at 20 and 37°C. Fluoride release profiles were compared with the target release profile generated by an optimal dose of 1.2 µg F/elastomeric ring/day. In addition, cross-sectional areas of samples were examined using scanning electron microscopy (SEM).

RESULTS: A marked increase in the rate of fluoride release was observed at the higher temperature tested ( $P < 0.05$ ). At 37°C, favourable release was observed for the single-coated films with 0.4 and 0.6 g of NaF and double-coated films with 0.6 g of NaF. SEM showed fluoride distribution within the delivery matrix consistent with the observed fluoride release profiles.

CONCLUSIONS: The findings present great potential toward the next generation fluoride delivery systems for the prevention of white spot lesions during orthodontic treatment.

### 316 EFFECTS OF RAPID-SLOW MAXILLARY EXPANSION ON MIDDLE EAR PRESSURE OF CHILDREN WITH MAXILLARY CONSTRICTION AND CONDUCTIVE HEARING LOSS

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AIM: No study has determined if rapid followed by slow maxillary expansion (R-SME) (also termed 'semi-rapid' expansion) has an effect on middle ear pressure of the children with maxillary constriction and conductive hearing loss (CHL). Thus, this study aimed to determine the effects of R-SME on middle ear pressure of these children.

**SUBJECTS AND METHOD:** Seventeen children (mean age  $13.56 \pm 1$  years) with narrow maxillary arches and CHL. Rigid acyclic bonded maxillary expansion appliances were used to expand the narrowed maxillary arches. The maxillary halves were separated by activating the screw of the appliance twice a day for six days. After this, activation of the screw was continued three times a week until sufficient expansion was obtained (mean: 3.45 months) and then, it was used as a retainer for six months. All of the subjects underwent fixed appliance treatment after retention. Middle ear pressures were determined by means of tympanometric records. Four records were taken: before R-SME (T1), after maxillary expansion (mean = 3.45 months; T2), after the retention period (mean = 6 months; T3), and after fixed appliance treatment (approximately 2 years; T4). The data were analyzed by means of ANOVA and least square difference tests.

**RESULTS:** Middle ear pressure decreased significantly after maxillary expansion (T2-T1;  $P < 0.05$ ), and this decrease remained relatively stable during the last three periods. No significant changes were observed during the retention and fixed appliance treatment periods (T3-T2, T4-T3, T4-T2).

**CONCLUSION:** R-SME has a positive and significant effect on middle ear pressure of the children with transverse maxillary deficiency and CHL.

### 317 ANTERO-POSTERIOR CEPHALOMETRIC CHANGES AFTER CLASS II TREATMENT: ACTIVATOR VERSUS HEADGEAR

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**AIM:** Skeletal and dental discrepancies in a Class II malocclusion are generally treated by altering (restriction or stimulation of) the growth pattern of the patient. The aim of the present study was to determine the effects of activator or headgear treatment on maxillary and mandibular growth, and to determine the superiority of these treatment modalities.

**SUBJECTS AND METHOD:** Fourteen children (mean age,  $13.54 \pm 1.85$  years) with a Class II division 1 malocclusion treated with the Andresen activator, and 15 patients (mean age,  $11.56 \pm 0.97$  years) having the same malocclusion treated with headgear (HG). Fifteen subjects (mean age,  $11.56 \pm 1.21$  years) with a Class I occlusion were included as a control group. Cephalometric head films were obtained from all subjects before (T1) and after (T2) treatment/observation. Twelve linear and seven angular parameters were measured on the radiographs to determine treatment and growth changes. These changes were compared by means of ANOVA and least square difference tests.

**RESULTS:** HG application restricted the maxillary growth ( $P < 0.05$ ), but did not stimulate mandibular growth. Activator treatment increased mandibular growth ( $P < 0.01$ ), but had little restraining effect on the maxilla. In addition, activator treatment significantly retroclined the maxillary incisors and proclined the mandibular incisors ( $P < 0.001$ ). More favourable soft tissue profile changes ( $P < 0.01$ ) were observed in the activator group.

**CONCLUSION:** Class II correction was achieved by molar distalization in the HG group, but by skeletal and dental changes in the activator group. Activator therapy has some advantages such as increased mandibular growth and more favourable effects on the soft tissue facial profile.

### 318 PERMANENT DEFORMATION LEVEL BASED ON INITIAL DEFORMATION AND TIME AFTER LIGATION

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**AIM:** As nickel titanium (NiTi) wire has the ability to deliver light continuous force, it is used as the initial wire for levelling in orthodontics. However despite its superelasticity, permanent deformation of NiTi wire is often observed in crowded dentition, which could affect/slow initial alignment. The aim of this study was to measure the permanent deformation of NiTi wire according to the vertical level differences of teeth, time and repetitive thermal changes to understand of optimal application of NiTi wire in subjects with severe crowding.

**MATERIALS AND METHOD:** One hundred eight sets of three brackets were bonded on a 7.55 mm acrylic board, considering the average size of male adult teeth. Following bonding, a middle placed bracket was displaced in a gingival direction according to each condition or 3, 5 and 7 mm (each 36 set), which reproduced a vertical displacement of the teeth. Two types of NiTi wires, 0.012 and 0.014 inch, were used and ligated to the brackets with an elastic module (each 18 set). Ligated wires on each bracket (each 6 set) were thermocycled 250, 500 and 1000 cycles, which corresponds to 1, 2, and 4 weeks. For the control group the same type of wire-bracket modules were used which had been immersed in distilled water for the same period.

**RESULTS:** Compared with the control group, the thermocycled group showed more deformation. The wire with larger vertical differences showed larger permanent deformation ( $P < 0.05$ ). Additionally, 0.012 inch NiTi wire showed more permanent deformation than 0.014 inch NiTi wire under the same conditions ( $P < 0.05$ ).



**CONCLUSION:** Permanent deformation of NiTi wire is closely related to severe crowding, smaller wire diameter and repetitive thermal change. The clinician must understand these factors that affect wire properties.

319 COMPARISON OF ALVEOLAR BONE LOSS AROUND INCISORS IN SKELETAL CLASS III PATIENTS

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**AIM:** To test the hypothesis that there is no difference in vertical alveolar bone loss and alveolar bone thickness around the maxillary and mandibular central incisors in surgical skeletal Class III patients and normal occlusion subjects.

**SUBJECTS AND METHOD:** Group I comprised 20 Korean adults with a normal occlusion and no detectable periodontal diseases (10 males, 10 females, mean age 24.5 years) and group II, 17 Korean patients undergoing orthognathic surgery with a skeletal Class III malocclusion and an anterior open bite (9 males, 11 females). Three-dimensional cone beam computed tomographic images were taken before orthodontic treatment. Sagittal slices at the labiolingual widest point of the maxillary and mandibular right central incisor were evaluated. Measurement of the amount of vertical alveolar bone loss and alveolar bone thickness of the labial and lingual plate at the root apex was made using Invivo5 program (Anatomage Inc., San Jose, California, USA).

**RESULTS:** Group II showed significantly more bone loss group I. The mandibular incisors showed more alveolar bone loss than the maxillary incisors, especially at the lingual side in group II ( $P < 0.05$ ). Alveolar bone thickness was significantly thinner in the mandibular incisors in group II than in group I, especially at the lingual side of the mandibular incisors, while the maxillary incisors exhibited an opposite result ( $P < 0.05$ ). The percentage of vertical bone loss to root length was statistically significant different between groups I and II, showing more bone loss in the lower incisors in group II ( $P < 0.001$ ).

**CONCLUSIONS:** The hypothesis is rejected. For skeletal Class III patients, care should be taken to avoid aggravating pre-existing alveolar bone loss in the anterior teeth, especially in the mandible.

320 COMPARISONS OF OCCLUSAL FORCE ACCORDING TO OCCLUSAL RELATIONSHIP, SKELETAL PATTERN, AGE AND GENDER

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**AIM:** To evaluate the occlusal force and contact area and to find associating factors in Koreans.

**MATERIALS AND METHOD:** Occlusal force and contact area in maximum intercuspation were measured using the Dental Prescale system in 651 subjects (15 with a normal occlusion, 636 with various malocclusions) divided into subgroups according to the skeletal pattern, Angle molar relationship, age and gender.

**RESULTS:** Occlusal force of the normal occlusion group ( $744.5 \pm 262.6$  N) was significantly higher than those of the malocclusion group ( $439.0 \pm 229.9$  N,  $P < 0.05$ ). Occlusal force was similar regardless of differences in ANB angle or Angle molar classification; however the increase in vertical dimension significantly reduced occlusal force ( $P < 0.05$ ).

**CONCLUSIONS:** Occlusal force was significantly lower in the malocclusion group compared with the normal occlusion group, and in females compared with males, but it was not affected by age, anteroposterior skeletal pattern or molar classification. Although a hyperdivergent facial pattern indicated lower occlusal force compared with a hypodivergent facial pattern, the differences in skeletal pattern were not the primary cause of its decrease, but a secondary result induced by the differences in occlusal contact area according to the facial pattern.

321 PATTERN AND PREVALENCE OF HYPODONTIA IN KOREANS

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**AIM:** To evaluate the pattern and prevalence of hypodontia in the Korean population and its association with dental and skeletal polymorphisms.

**MATERIALS AND METHOD:** Dental casts, panoramic radiographs, and lateral cephalograms of 1622 Korean subjects (611 males, 1011 females) were used to evaluate the pattern and prevalence of hypodontia as well as its association with the

congenital absence of the third molar. The changes in tooth size and skeletal characteristics of the hypodontia group were evaluated using cast/cephalometric analysis and compared with the standard values of Koreans with a normal occlusion.

RESULTS: The prevalence of hypodontia in Koreans was 11.2 per cent. The mandibular lateral incisor and second premolar were the most frequently absent teeth. Congenital absence of the third molar was observed more frequently in the hypodontia group than in the non-hypodontia group. The prevalence of hypodontia in Class III malocclusion subjects was significantly higher than in those with a Class I or Class II malocclusion.

CONCLUSION: The pattern and prevalence of hypodontia can vary in different ethnic groups. In Koreans, the special features of hypodontia were its association with a higher level of congenital missing third molars and a skeletal Class III malocclusion.

### 322 ASSESSMENT OF DENTOALVEOLAR COMPENSATION IN FACIAL ASYMMETRY INDIVIDUALS

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AIM: To assess dentoalveolar compensation in facial asymmetry individuals using integration of cone beam computed tomographic (CBCT) images and laser scanned dental cast images.

SUBJECTS AND METHOD: Thirty adults with asymmetric mandibles and 20 adults with symmetric mandibles. CBCT and laser scanned dental cast imaging were integrated with THE registration technique. The positions of the teeth and the angles of the canine and first molar were assessed from a reference coordinate. The differences between the deviated and non-deviated side were analyzed by paired *t*-test between the two groups. The differences were also statistically analyzed according to menton deviation using Pearson's correlation analysis.

RESULTS: The experimental group showed differences (dev.-ndev.) in the position and angulation of the canine and first molar between the facial asymmetry and control group. Menton deviation showed a positive correlation with the differences (dev.-ndev.) of the angle of the maxillary and mandibular first molar, a negative correlation with the differences of the vertical position of the maxillary first molar, the transverse position of the mandibular canine and the transverse and vertical positions of the mesiolingual cusp of the mandibular first molar.

CONCLUSIONS: The upper and lower canines and first molars in facial asymmetry individuals compensated for the deviated/non-deviated side variations.

### 323 GROWTH DIRECTION IN BIOBLOC AND FIXED APPLIANCE TREATMENT

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AIM: To investigate vertical growth changes after Biobloc and fixed appliance treatment in growing patients.

SUBJECTS AND METHOD: Eleven Japanese subjects (3 boys, 8 girls), average age before treatment  $8.6 \pm 1.3$  years. Nine subjects had a Class I malocclusion and two a Class III treated non-extraction. The average treatment times were: Biobloc  $1.5 \pm 0.8$  years, fixed appliances  $2.7 \pm 0.8$  years. Vertical growth were measured using lateral cephalogram taken before treatment and at the end of Biobloc/fixed appliance treatment. The radiographs were superimposed at Sella along SN, and these Gnathion were connected at each stages, and measured to the SN plane. These degrees are named 'growth direction' by Mew.

RESULTS: The average degrees at the end of Biobloc treatment were  $59.08 \pm 26.88$ , and at the end of fixed appliance treatment  $75.50 \pm 18.51$ . The lowest subject treated with the Biobloc 15 degree and with fixed appliance treatment 40 degrees. in fixed treatment. Highest in Biobloc was 95 and 102 in fixed.

CONCLUSION: Biobloc treatment might result in a lower degree of growth direction than fixed appliance treatment, however, it is difficult to get below 45 degrees.

### 324 NON-SYNDROMIC OLIGODONTIA: A REVIEW OF GENE MUTATIONS

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AIM: To identify all known gene mutations associated with non-syndromic oligodontia in humans.

MATERIALS AND METHOD: Electronic databases (PubMed, Medpilot, Web of Science, DIMDI) were systematically searched for studies published until November 2010 (search terms: oligodontia, tooth agenesis, genes, mutations). Additionally, a hand search of the orthodontic and molecular biology literature and of the reference lists of the e130

selected articles was performed. No language restriction was applied. A three-step selection procedure (title-abstract-full text) was carried out independently by two reviewers (DK and MH). After each step the cases of disagreement were discussed until a consensus was reached. Only human *in vivo* studies on non-syndromic oligodontia were included.

**RESULTS:** The selection procedure resulted in the inclusion of 30 publications. To date five genes have been identified as being involved in non-syndromic oligodontia: PAX-9 (paired-box-gene 9), MSX1 (muscle segment homeobox 1), AXIN-2 (axis inhibition protein 2), EDA (Ectodysplasin-A) and WNT10-mutations (signalling protein). The mutations vary largely among genes: 20 different MSX1 mutations, 14 EDA mutations, five mutations of the WNT10 gene sequence, 18 different PAX9 sequence variants and one mutation of the AXIN-2 gene have been described.

### 325 A DEVICE FOR DIAGNOSIS OF TEMPOROMANDIBULAR JOINT PATHOLOGY

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**AIM:** To improve methods for diagnosis of temporomandibular joint (TMJ) pathology in patients with transverse occlusion. **SUBJECTS AND METHOD:** Fifty-four patients 15-18 years of age. Clinical and radiographic examinations were undertaken and study models were obtained. The apparatus, Mio-stim (Biotronics, Italy) with a digital, three-dimensional treatment using electric pulses, and computer software, which generates high-frequency and low frequency pulses, with the ability to modulate the signal width, was used to determine the optimal position of the mandible.

**RESULTS:** On clinical examination set facial asymmetry with a right mandibular shift was found in 65 per cent of subjects. Sixty-four percent were radiographically diagnosed as having the mandibular articular head located in the articular fossa. In most patients radiographic analysis of the head in frontal projection confirmed the right shift of the mandible. The interincisal point of the upper jaw was aligned with the median line of face but in the lower jaw it was shifted to the right by 1.8-3.0 mm (65% cases) and to the left by 1.5-2.0 mm. The optimum ratio of dentition of upper and lower jaws was determined using electromyostimulation, which was held on the given program. After myostimulation, values of interincisival lines misalignment of upper and lower jaws dropped to 0.5-0 mm ( $P < 0.05$ ).

**CONCLUSIONS:** it is recommended to use Mio-stim before orthodontic treatment of patients with a crossbite in combination with a transverse incisal occlusion, caused by an abnormality position of the lower jaw.

### 326 TEMPOROMANDIBULAR JOINT AND MUSCLE STATUS OF THE MAXILLOFACIAL AREA USING KINESIOGRAPHY

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**AIM:** The characteristics of mandibular movement depend on the status and condition of the elements of temporomandibular joints (TMJ), muscles of the maxillofacial area, and type of occlusion. The study of mandibular motion physiology plays an important role in identifying dental pathology, including the state of TMJ. The aim of this research was to study the indicators of mandibular motion.

**SUBJECTS AND METHOD:** Ninety-three subjects divided into three groups (group 1, 7-9, group 2, 10-12 and group 3, 13-15 years) with physiological occlusion and 46 subjects (13-15 years) with distal occlusion. A computerized device Kinesiograph (Biotronics, Italy) that graphically recorded three-dimensional movements of the mandible was used.

**RESULTS:** The trajectory of lowering and lifting of the mandible ranged from 50.03 mm in group 1 to 67.68 mm in group 3, the diagonal movement of the mandible from 43.58 to 54.39 mm; angular values differed. The maximum and average speed of lowering the mandible increased with age. The mandible extended to a greater distance (from 7.53 to 9.28 mm) with age. In patients with distal occlusion during lowering-lifting of the mandible the values were reduced: diagonal movement (18%), trajectory of lowering (13.2%) and lifting (12.8%). In 100 per cent of subjects, movement of lowering the mandible starts from its forward movement. The trajectory length of mandibular motion forward and back increased by 22 and 23 per cent, respectively. In patients with distal occlusion, kinesiography revealed changes related to the size of the mandible and especially TMJ movement.

**CONCLUSIONS:** The findings suggest opportunities for kinesiography for detecting mandibular motion. Indicators of mandibular movements in patients with distal occlusion significantly differ from those of individuals with physiological occlusion, which is determined by the TMJ and muscles.

### 327 INTERDISCIPLINARY PROTOCOL IN THE DIAGNOSIS AND TREATMENT OF PATIENTS WITH MAXILLOFACIAL FUNCTIONAL DISORDERS

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**AIM:** To propose a single unified interdisciplinary protocol for the diagnosis and treatment of patients with functional disorders of the maxillofacial region.

**SUBJECTS AND METHOD:** During 1996 to 2011 years 1482 patients were examined. Symptoms and complaints indicated functional disorders of the temporomandibular joints (TMJs), masticatory muscles, functional occlusion, loss of centric relation, nervous regulation imbalance and violation of adaptation. Occlusal disturbances in combination with functional pathology were found in 62.4 per cent of patients. Successful treatment was achieved in 78.8 per cent of cases, including 29.2 per cent where an orthodontic component was used.

**RESULTS:** The multidisciplinary algorithm of treatment of patients with functional disorders of the maxillofacial region, included the following stages: detailed functional diagnosis of the maxillofacial region and level of health as a whole (consultation of endocrinologist, neuropathologist, ear, nose and throat specialist, physiotherapist, psychologist, psychotherapist); reconstruction of centric relation and intrajoint relations of the TMJ by means of occlusal equilibration and splint therapy; orthodontic treatment of the maxillofacial region aimed at reaching maximum intercuspation in centric relation, which was reproduced before and fixed by occlusal onlays on separate teeth, correlation of occlusal curves; prosthesis of defects in stable jaw centric relation without symptoms of functional disorders, by constructions made by indirect technology in articulator, by the prototype of wax-ups and provisional constructions.

**CONCLUSION:** Multidisciplinary algorithm of treatment at all stages is necessary for consistent, rational and effective treatment.

### 328 CYTOTOXIC AND OESTROGENIC ASSESSMENT OF POLYCARBONATE BRACKETS

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**AIM:** To investigate the biological effects of polycarbonate and fibre-reinforced plastic aesthetic brackets through the assessment of cytotoxicity, cell proliferation, activation of oxidative stress mechanisms and oestrogen-dependent effects.

**MATERIALS AND METHOD:** Three representative cell lines were used; 3T3 (murine fibroblasts), MCF 7 (breast cancer) and Hela (cervical cancer) that were incubated with various concentrations of these materials including control (saline) for 24 to 48 hours. Supernatants were analysed for lactate dehydrogenase activity to assess cell death and for the reduction of the tetrazolium salt WST to formazan by cellular dehydrogenases to measure proliferative responses. Cell extracts were also analyzed for ps2 levels, a marker of oestrogen-associated proliferation, using quantitative real time-polymerase chain reaction. Apoptotic markers were studied by immunocytochemistry and Western blotting and the involvement of oxidative stress mechanisms was assessed by measuring nitric oxide synthase (NOS) activity.

**RESULTS:** A significant induction of cell death and concurrent decrease in cell proliferation was noted in the fibreglass group ( $P < 0.05$ ). In the cell lines (3T3 and HeLa), that do not express oestrogen receptors, the ps2 levels remained unaffected. However, MCF7 cells that are oestrogen receptive showed a significant decrease in ps2 levels after incubation with fibreglass, suggesting that cell death induced by fibreglass involves activation of oestrogen signalling pathways. Measurement of NOS activity did not show any differences in any conditions tested suggesting that oxidative stress mechanisms are equally activated after the addition of all compounds and are not associated with fibreglass-induced cytotoxicity.

**CONCLUSIONS:** Fibreglass-containing plastic brackets showed cytotoxic effects that are oestrogen-receptor mediated.

### 329 TISSUE REGENERATION TECHNIQUES COMBINED WITH ORTHODONTIC TREATMENT: A SYSTEMATIC REVIEW

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AIMS: Tissue regeneration techniques combined with orthodontic treatment may provide a valid solution in complex clinical scenarios. The aim of the present study was to investigate treatment parameters regarding the interdisciplinary management of periodontally compromised patients by the combination of orthodontics and tissue regenerative techniques.

MATERIALS AND METHODS: The Medline and Cochrane Databases were searched from 1969 to November 2010. A complex search was performed based upon various combinations of relevant keywords including: 'orthodontics', 'periodontal', 'tissue regeneration', 'GTR', 'GBR', in all fields (Limits: Humans).

RESULTS: From the 2205 articles found, 2015 were excluded by title as irrelevant to the study subject. A further 122 studies were excluded after abstract and 65 studies after full text reading, mainly because they reported less than three patients. The reference lists of the retrieved articles were hand searched for relevant studies but did not reveal any additional articles. Finally, four studies were identified as appropriate for inclusion. These included one systematic review and three prospective case studies with limited study samples (3-14 patients). All studies reported quite satisfactory results with significant improvement of periodontal parameters, such as pocket probing depth, clinical attachment level, and radiographic bone fill.

CONCLUSIONS: The combination of orthodontics with tissue regeneration techniques can lead to satisfactory results in cases where other options are probably not applicable. However, this promising approach has been evaluated primarily by case studies. Further research is required in order to provide these promising treatment alternatives in an evidence-based framework.

### 330 HYPODONTIA AND THIRD MOLAR AGENESIS: IS THERE ANY RELATIONSHIP?

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AIM: Hypodontia is the most common dental abnormality. Because the teeth most often missing are second premolars and upper lateral incisors, it has been called incisor-premolar hypodontia and this type of hypodontia is observed more often in females. Third molar agenesis is another type and usually accepted as agenesis. Previous studies have shown that third molar agenesis is associated with the incidence of other missing teeth and has been assumed not to be an isolated anomaly. The aim of this study was to compare the prevalence of third molar agenesis in patients with incisor-premolar hypodontia compared with subjects without hypodontia to investigate whether the cause of third molar agenesis is same as incisor-premolar hypodontia.

SUBJECTS AND METHOD: Ninety-four patients (23 males, 71 females) with agenesis of the upper lateral incisors (48) and second premolars (46) were selected from 2357 records. Another sample of 94 patients (23 males, 71 females) without hypodontia was selected from same records as the control group. An additional 109 subjects (77 males, 29 females) were added to the control group to increase the subject number and homogenize the group for gender, and to evaluate whether females were affected more or less from third molar agenesis. A dental pantomograph of each patient was used to determine the presence or absence of teeth. Differences in the frequency of third molar agenesis between genders and between the groups were assessed by Chi-square test.

RESULTS: The prevalence of third molar agenesis did not show any difference between the groups ( $\chi^2$ : 1.052;  $P > 0.05$ ). The incidence of incisor-premolar hypodontia was found to be significantly different between genders ( $\chi^2$ : 24.511;  $P < 0.0$ ) while no significant difference for third molar incidence was found between genders ( $\chi^2$ : 3.089;  $P > 0.05$ ).

CONCLUSIONS: The aetiology of incisor-premolar hypodontia and third molar agenesis seems to be different, except in syndromic or oligodontia cases.

### 331 CAN TRANSVERSE MAXILLARY DEFICIENCY CAUSE CERVICAL VERTEBRAL ANOMALIES?

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AIM: The literature shows a correlation between vertebral morphologic anomalies and oral respiration. In addition, some craniocervical alterations have been found to be associated with impaired nasal respiration. One aetiological factor that causes transverse maxillary deficiency (TMD) is respiratory problems. Di Vece *et al.*, reported significant correlation between TMD and cervical vertebral defects. The aim of this study was to investigate the relationship between TMD and cervical vertebral anomalies (CVA).

SUBJECTS AND METHOD: Forty-seven Turkish patients (17 males, 30 females) with TMD and 47 patients (15 males, 32 females) with adequate maxillary transversal dimensions. A visual assessment of the cervical column was made using lateral cephalograms. Characteristics of the cervical column were classified according to Sandham. A normal appearance was

determined when the first four vertebrae could be traced as separate entities, with all anatomical components present. Differences in the occurrence of CVA between the groups and between genders were assessed by chi-square independent test. RESULTS: Significant differences were found between the groups for occurrence of any type of CVA ( $\chi^2$ : 0.058;  $P$  = 0.810). In the TMD group, 10.6 per cent of the subjects had fusion in the cervical column, and 14.9 per cent posterior arch deficiency. In the control group, 17 per cent of the subjects had fusion of the cervical column, and 8.5 per cent posterior arch deficiency. One subject in the control group had both fusion and a posterior arch deficiency.

CONCLUSIONS: Contrary to the literature, it would not be correct to attribute TMD as a risk factor for CVA.

### 332 VARIATION IN THE DIRECTION OF MANDIBULAR RELAPSE AFTER SAGITTAL SPLIT RAMUS OSTEOTOMY

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AIM: A skeletal Class III malocclusion is the most major dentofacial jaw deformity in patients subjected to the treatment with orthognathic surgery in Japan. A sagittal split ramus osteotomy (SSRO) is one of the most popular surgical procedures for the correction of skeletal Class III deformities. Although the surgical technique has been extensively modified and improved, relapse following surgery is a frequent complication. It is thus important to understand the tendency of relapse after surgery in treatment planning, however, there have been few report about the patterns of mandibular repositioning after surgery. The aim of this study was to investigate the patterns of mandibular displacement and to explore the relationship after surgery among those in three directions.

SUBJECTS and METHODS: Sixty Japanese adult patients diagnosed with skeletal mandibular prognathism who underwent mandibular setback surgery by bilateral SSRO. Lateral cephalograms, taken before, and 3 and about 12 months after surgery were analyzed.

RESULTS: Thirty-two of the 60 patients who showed relapse after surgery were divided into three groups according to the direction of mandibular displacement. One group showed a relapse in the same direction (38%) as mandibular setback. The remaining two groups exhibited a relapse in the opposite (46%) and downward (16%) directions. With respect to horizontal mandibular displacement, the second group showed a significantly smaller distal movement than the other two groups ( $P$  < 0.05). Among the measurement pre-surgery, SNA angle was significantly greater in the second group with the relapse in the opposite direction, than in the first group with relapse in the same direction ( $P$  < 0.05).

CONCLUSIONS: More than half of the patients showed relapse one year post-surgery. The relapse pattern varied in the unstable groups. Relapse was, in most cases, within the range of mandibular movement by surgery. The amount of mandibular setback was significantly less in the group with relapse in the opposite direction than in the other groups.

### 333 TREATMENT OUTCOME OF ORTHODONTIC UPRIGHTING OF IMPACTED MANDIBULAR MOLARS: A SYSTEMATIC REVIEW

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AIM: To identify the effectiveness of orthodontic treatment approaches described in the literature for uprighting impacted mandibular terminal molars.

MATERIALS AND METHOD: The Medline and Cochrane databases were searched from 1969 to October 2010. A complex search was performed based upon various combinations of relevant keywords including: 'molars', 'mandible', 'orthodontics', 'uprighting', 'impaction', in all fields (Limits: humans).

RESULTS: From the 1598 articles found, 1496 were excluded by title as irrelevant to the study subject. The reference lists of the retrieved articles were hand searched for relevant studies but did not reveal any additional articles. An additional 55 studies were excluded after abstract and 44 studies after full text reading, mainly because they reported less than four patients. Finally, three studies were identified as appropriate for inclusion. One was a prospective case study, but without follow-up and two were retrospective case studies. Each included a sample of less than 20 patients. These studies reported contradictory findings regarding treatment outcome in orthodontic uprighting of inclined mandibular molars.

CONCLUSIONS: Even though there is such small number of relevant papers, the estimated treatment outcome differs considerably. There is a strong lack of evidence in the literature regarding the evaluation of orthodontic uprighting of mandibular terminal molars making the need for further research in this field imperative.

### 334 THE EFFICIENCY OF A CONTEMPORARY MEDICINAL AND PREVENTIVE REMEDY IN ORTHODONTIC PATIENTS

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AIM: To examine the efficiency of 'Tooth Mousse' which is produced from cow milk caseins and contains Recaldent™, which contains casein phosphopeptide and amorphous calcium phosphate in patients during and after fixed appliance treatment.

SUBJECTS AND METHOD: Fifteen patients aged 13-23 years with enamel demineralization (white spot lesions). Seven of the subjects were undergoing orthodontic therapy and eight had completed treatment. Tooth Mousse was used twice a day in the morning and evening after brushing the teeth. All patients underwent clinical examination using the method of vital enamel staining, simplified oral hygiene index (OHI-S and the DMF Index. In addition a biochemical investigation of the mixed saliva was performed.

RESULTS: There was a significant improvement in oral hygiene at 2 months following the use of Tooth Mousse, i.e. OHI-S changed from 2.78 to 0.54, an increase in  $\text{Ca}^{2+}$  ions in the mixed saliva ( $P < 0.05$ ), the improvement in colour and restoration of the enamel layer. There was no significant change in the DMF Index and  $\text{PO}_4^{3-}$  concentration ( $P > 0.05$ ).

CONCLUSION: Regular use of Tooth Mousse contributes to remineralization of the tooth enamel at early stages of decay and prevents its further spread.

### 335 CHANGES OF FUNCTION DURING INTERDISCIPLINARY FUNCTIONAL ORIENTATED ORTHODONTIC TREATMENT

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AIM: The majority of patients with orthodontic treatment need are children and adolescents. It is well known that craniomandibular dysfunction (CMD)/temporomandibular dysfunction (TMD) symptoms increase at the age of 12 to 15 years, but only a few studies exist which focus on the changes of functional findings during interdisciplinary orientated orthodontic treatment concepts.

MATERIALS AND METHOD: Sixty-one consecutive finished orthodontic cases between 10 and 17 years of age from two CMD specialized orthodontic practices. Orthodontic relevant structures regarding the musculoskeletal system were evaluated at the beginning and end of orthodontic treatment. According to the Functional and Structural Analysis (FSA) of the diagnostic software 'easy CMD/Clinical Management Device'. The influences of occlusion and skeletofacial growth were also investigated. Statistical analysis was carried out using the signed rank test.

RESULTS: Initial inspection showed pathological functional findings in 44.26 per cent patients, of which 11.11 per cent had generalized muscular pain of the head and neck. Capsulitis of the temporomandibular joint was observed in 19.67 per cent. At the end of treatment the CMD symptoms were significantly reduced. Generalized myalgia was eliminated in 66.67 per cent, and capsulitis signs in 75.0 per cent. Nearly all patients showed a decrease in pathological functional findings. There was no significant correlation between occlusal, skeletofacial and FSA findings.

CONCLUSIONS: In children and adolescents unrecognized pathological functional findings often exist. A significant reduction of these occurs during orthodontic treatment by interdisciplinary functional diagnosis and treatment. Untreated patients of this age group in the literature show in average an increase of pathological functional findings.

### 336 CRANIAL BASE MORPHOLOGY IN ADULT PATIENTS WITH A HORIZONTAL SKELETAL DISCREPANCY

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AIM: To ascertain the primary determinants of anteroposterior skeletal disharmony and to establish the respective roles of cranial base morphology and jaw lengths.

MATERIALS AND METHOD: Two hundred and two pre-treatment lateral cephalograms of orthognathic patients were digitised using a customised software program. Comparisons were made between the Class II and III groups and with published British Class I norms.

**RESULTS:** Following a repeatability study, the data were analysed. Multiple regression analyses found statistically significant differences ( $P < 0.01$ ) between the Class II and Class III females for the mean lengths of N-Art, N-S, Cd-ANS, Cd-Pog and the mean LAFH%. For the male groups, significant differences were present for the mean lengths of Cd-Pog, the mean angle N-S-Art and the mean LAFH%. Logistic regression analysis found the statistically significant variables ( $P < 0.001$ ) in determining the Class of malocclusion to be: Cd-ANS, Cd-Pog and MMPA. Construction of an equation with the logistic regression coefficients to determine the Class of malocclusion was found to predict the study sample well for both Class II and Class III. Pearson's correlation coefficients between the parameters of Class of malocclusion revealed a large number of statistically significant results. On closer examination, many of the parameters did not reveal a satisfactory goodness of fit ( $r^2 < 50\%$ ). Chi-squared analysis showed that significantly fewer of the Class II cohort (51%) compared with the Class III cohort (78.8%) presented with N-S-Art  $< 125$  degrees ( $P < 0.001$ ). In comparison with the Class I published norms, some statistically significant differences were detected between the parameters assessing cranial base morphology and jaw lengths.

**CONCLUSION:** Differences in cranial base morphology between Class II and Class III malocclusions for this orthognathic cohort were observed. However, the significant determinants of the anteroposterior skeletal discrepancy appear not to lie in the cranial base structures, but are more related to jaw length.

### 337 COMPARATIVE ANALYSIS OF MAXILLARY LATERAL INCISORS THROUGH THE CENTURIES

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**AIM:** To show the reduction in the width and length of the maxillary lateral incisors during the IV, XVII and XIX centuries to the present.

**MATERIALS AND METHOD:** Human skulls from the IV, XVII and XIX centuries and 1500 randomly selected gypsum models of present day individuals in the Former Yugoslav Republic of Macedonia. Measurements were carried out with sliding callipers (compass) and statistically processed and photographically documented.

**RESULTS:** Comparison of the size of the maxillary lateral incisors between the skulls and study models showed a decrease of 12 per cent. There was no statistical significance in the width of the lateral maxillary incisors in the skulls, although 38 per cent were of a smaller size. With regard to gender, there was no statistical significance although female incisors were slightly smaller (from 4 to 5 mm) for around 3, 6 per cent. The lateral maxillary incisor of the female skulls showed a decrease of 7.5 per cent.

**CONCLUSION:** Monitoring the evolutionary development of the entire orofacial system, as well as the size of the teeth, especially the phylogenetic reduction of the lateral maxillary incisors.

### 338 MAGNETIC RESONANCE IMAGING OF THE TEMPOROMANDIBULAR JOINT IN PATIENTS WITH SAGITTAL MALOCCLUSIONS

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**AIM:** To perform temporomandibular joint (TMJ) evaluation in patients with sagittal malocclusions using magnetic resonance images (MRI).

**MATERIALS AND METHODS:** Thirty TMJ MRIs were analyzed: 10 of patients without malocclusions or clinical signs and symptoms of temporomandibular dysfunction (TMD; controls), 12 patients with a severe Class II division 1 malocclusion and eight with a severe Class III malocclusion. Analysis was performed according to Fischbach.

**RESULTS:** Almost all patients with clinical TMD signs showed degenerative changes and internal derangement on the MRIs. Ninety per cent of Class II patients presented anterior disk displacement of various entities (9 to 11 o'clock position according to Fischbach). In three of them complete anterior dislocation was observed. In 35 per cent of Class II patients anterior disk displacement without reduction was noted. During maximal mouth opening signs of condylar hypermobility were observed in 96 per cent of these subjects. Class III malocclusion patients had similar findings but at a significantly lower range. Disk displacement was noted in 73 per cent of cases. There was a reduction during mouth opening in almost all patients. Condylar hypermobility was observed only in 24 per cent of the Class III patients.

**CONCLUSIONS:** Patients with Class II division 1 malocclusions have more extensive degenerative changes of the TMJ than those with Class III malocclusions as showed on the MRIs. It is therefore advisable to perform a thorough TMJ examination in all patients with severe Class II malocclusions.



### 339 ACCURACY OF ALIGNER TREATMENT IN THE ANTERIOR REGION – A FIRST METRIC STUDY

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**AIMS:** To compare plaster casts to their corresponding digital ClinCheck models at baseline i.e. pre-treatment and to compare the achieved tooth movement at the end of aligner therapy (Invisalign®) to the digitally predicted tooth movement. **MATERIAL AND METHOD:** Pre- and post-treatment casts as well as the initial and final ClinCheck models of 50 patients (15-63 years of age) were analysed. All patients were treated by using Invisalign technology (Invisalign®, Align Technology, S.C., California, USA). The evaluated parameters were: overjet, overbite, dental midline shift, upper and lower anterior arch length and intercanine distance. *P*-values were adjusted for multiple testing (Bonferroni method, global level of 5%). All parameters for achieved versus predicted tooth movement were tested for equivalence within a clinically relevant confidence interval of  $\pm 1$  mm.

**RESULTS:** Slight deviations were found between pre-treatment casts and initial ClinChecks, ranging from  $-0.08$  mm on average ( $\pm 0.29$ ) for overjet, up to  $-0.28$  mm on average ( $\pm 0.46$ ) for upper anterior arch length. There was a larger difference between the achieved and predicted parameters, ranging from  $0.01$  mm on average ( $\pm 0.48$ ) for lower anterior arch length, up to  $-0.7$  mm on average ( $\pm 0.87$ ) for overbite. All parameters were equivalent except for overbite ( $-1.02$ ;  $-0.39$ ). The difference between the achieved and predicted tooth movement showed a moderate correlation to pre-treatment overbite (Spearman-Rho correlation coefficient:  $-0.362$ ).

**CONCLUSIONS:** The initial digital ClinCheck model provides sufficient accuracy when compared with the initial plaster cast regarding the measured parameters. The achieved tooth movement was in accordance with the predicted movement for all parameters except for overbite. Tooth corrections in the vertical plane seem to be more difficult to achieve than others.

### 340 ASSESSMENT OF CONDYLAR MORPHOLOGY USING CONE BEAM COMPUTED TOMOGRAPHY IN PATIENTS WITH DENTOFACIAL ANOMALIES

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**AIM:** To assess temporomandibular joint (TMJ) condylar morphology from cone beam computed tomography (CBCT) data according to research diagnostic criteria for temporomandibular disorders (RDC/TMD) in Class II and Class III patients and to compare the results with controls. In addition the role of malocclusion and age in the prevalence of degenerative changes in condyles was evaluated.

**SUBJECTS AND METHOD:** Twenty-eight patients with severe Class II jaw relationships, 44 with a severe Class III jaw discrepancy; 45 individuals with Class I jaw relationships as control group. Patients with clinically evident asymmetries, previous orthodontic treatment, TMD symptoms such as pain, and limited jaw movements were excluded. CBCT (iCAT) examination of the craniofacial area was performed before treatment. The data were analyzed using the iCAT vision program and morphology of the condylar head was evaluated using RDC/TMD, to assess the presence of following signs: condylar hypoplasia, condylar hyperplasia, articular surface flattening, subcortical sclerosis, subcortical cyst, surface erosion, osteophyte, generalized sclerosis, loose joint body, deviation in form and ankylosis. To assess condylar changes according to age, the subjects were divided in to two age groups: 16- 20 and 21- 30 years. All the data were analyzed by one operator. Pearson's chi-square test and ANOVA statistical analyses were used.

**RESULTS:** Twenty-seven per cent of Class I, 86 per cent of Class II and 57 per cent of Class III subjects had at least one degenerative change in the condyles. The incidence of condylar changes was the highest in the Class II group, with statistical significance. No statistically significant differences were found in the prevalence of condylar changes between the two age groups.

**CONCLUSIONS:** Degenerative changes of the condyle were more common in patients with a skeletal Class II jaw relationship. Patient's age does not appear to play an important role in the prevalence of degenerative changes in the condyles.

### 341 FACIAL MORPHOLOGY CHARACTERISTICS IN CHILDREN WITH CLASS III MALOCCLUSION IN THE EARLY MIXED DENTITION

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AIM: To evaluate morphological facial characteristics in Class III patients in the early mixed dentition period.

SUBJECTS AND METHOD: Forty-three children with a Class III malocclusion (CIII; 20 males, 23 females; mean age  $7.2 \pm 0.79$  years) and 105 children non-CIII (NCIII) (61 males, 44 females; mean age  $7.3 \pm 0.77$  years). Three-dimensional images of the faces were obtained with a laser scanner and processed using Rapidform software with sub-routines. Average faces were constructed for the NCIII boys and girls groups. Each CIII child was superimposed on the corresponding average facial template between the inner canthi and subnasale (A1), subnasale and the outer commissures of the lips (A2), the outer commissures of the lips and pogonion (A3). The software collects average distances (AvgD) with standard deviations among facial shells and percentages of shells overlapping within 0.5 mm. Differences between each CIII and the average NCIII face in the restricted areas were statistically evaluated using Student's *t*-test ( $P < 0.05$ ).

RESULTS: Distinct facial differences were observed between the two groups, showing only 24.6-31.2 per cent shell to shell overlapping for boys and 28.7-31.7 per cent for girls. CIII patients showed a more retrognathic face in comparison with the average facial template NCIII (AvgD =  $-0.53$  mm), the difference in the upper lip area was statistically significant ( $P = 0.001$ ). CIII girls showed a less prominent face in the cheek and nose area ( $-0.13$  mm) in comparison with the boy's CIII face ( $-0.11$  mm), while the upper lip in boys CIII face ( $-0.57$  mm) was more retrognathic than the girl's CIII face ( $-0.51$  mm). However, the differences were not statistically significant ( $P > 0.05$ ).

CONCLUSIONS: CIII children in the mixed dentition period have a more retrognathic facial appearance compared with the average face of NCIII children. According to the results, orthopaedic traction of the upper jaw should be considered in treatment planning of CIII malocclusions in the early mixed dentition period.

#### 342 MOLAR HEIGHT AND DENTOALVEOLAR COMPENSATION IN ADULT SUBJECTS WITH A SKELETAL OPEN BITE

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AIM: Intrusion of the posterior occlusal segments with the aid of temporary anchorage devices is often indicated in adult patients with a skeletal open bite. This treatment approach is based on an assumption that the value of molar height in these patients is greater than in the 'normal population'. The aim of this study was to evaluate the skeletal and dentoalveolar components in adult subjects with a skeletal open bite with or without dental compensation.

SUBJECTS AND METHOD: Sixty-nine adult females divided into three groups according to their skeletal vertical relationships and overbite. A total of 15 variables (5 angular, 10 linear) were evaluated. Values in the dentally compensated open bite group (COBG), the dentally non-compensated open bite group (NCOBG) and the control group (CG) with normal vertical skeletal relationships and overbite were compared by means of Bonferroni tests for intergroup comparisons.

RESULTS: The COBG and NCOBG showed significantly greater incisor and molar heights in both jaws than the CG. No significant difference in upper or lower molar heights was found between the COBG and NCOBG. The incisor height was significantly greater in COBG compared with NCOBG. The elongation in the incisor region was accompanied by significant narrowing of the lower anterior alveolar process in both skeletal open bite groups. Proclination of the upper incisors was significantly less in the COBG than in the other groups.

CONCLUSION: Dentoalveolar components consisting of incisor elongation and inclination play a significant role in compensating for a skeletal open bite configuration in adult subjects. Increased molar height is a common finding in adults with a skeletal open bite. Intrusion of the lateral segments is a viable treatment option in skeletal open bite patients. The use of bony anchorage can be useful in this regard.

#### 343 FUNCTIONAL ADAPTATION OF MASSETER MUSCLE STEM CELLS

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AIMS: To investigate changes in masseter muscle satellite cells (stem cells) in response to functional demands. It was expected that the number of satellite cells would increase in response to increased function.

MATERIALS AND METHOD: Twelve 5-week-old male Sprague-Dawley rats divided into a soft diet (SD,  $n = 6$ ) and a hard diet group (HD,  $n = 6$ ). After two weeks the rats were killed, and the left masseter and digastric muscles (used as control muscle in which no change was expected) were processed for paraffin embedding. The right superficial masseter and digastric muscles were directly frozen. Transverse paraffin sections were stained with haematoxylin and eosin for tissue survey. Frozen sections were double-stained for collagen IV (muscle fibres) and Pax7 (satellite cells). Nuclei were visualized

using DAPI. Nuclei, fibres, and satellite cells were counted in the digastric and masseter. Differences between the muscles were compared with a paired *t*-test. A normal *t*-test was used for differences between HD and SD.

RESULTS: As expected there were no differences in the digastric muscle between rats on a SD or a HD. The masseter muscle in the HD group had a smaller surface area than in the SD group ( $P = 0.014$ ), but more satellite cells per fibre ( $P = 0.027$ ) and per surface area ( $P = 0.043$ ).

CONCLUSION: The masseter muscle adapts to functional demands not only in muscle structure but also with an increase in satellite cells. This might be related to increased remodelling under functional loading.

#### 344 INFLUENCE OF RETENTION TIME, POST-RETENTION TIME AND EXTRACTIONS ON RELAPSE OF INCISOR CROWDING

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AIM: Assessment of the relationship between post-retention crowding in the upper and lower anterior segment and retention duration (RT), post-retention period (PR) and extraction versus non-extraction treatment. The hypothesis was that there was no relationship between these variables and relapse of crowding.

SUBJECTS AND METHOD: Sixty-four successfully treated subjects with moderate to severe pre-treatment crowding in the upper and lower anterior segment. Retention involved fixed canine-to-canine bars in the mandible and removable Hawley retainers in the maxilla. Photographs of plaster models pre-treatment ( $13 \pm 4$  years), post-treatment and long-term ( $35 \pm 8$  years, at least 3 years post-retention) were analyzed by measuring the irregularity index (II) and anterior arch length discrepancy (ALD) with a modified viewbox program. RT varied from no retention to 5.6 years, PR from 3 months to 33 years. Formulas expressing the relationship between RT and PR were tested.

RESULTS: The ratio  $PR^2:RT^2$  showed the strongest association with relapse. In the maxilla both ALD and II relapse showed a significant correlation with the ratio  $PR^2:RT^2$ , in the mandible this was only the case for the II. Mandibular long-term II and PR were also significantly correlated. A significant negative correlation between maxillary II relapse and extraction was found. Both jaws showed a significant negative correlation between II relapse and the amount of II correction. Regression analysis showed that the ratio  $PR^2:RT^2$  predicted 36 per cent of the ALD relapse in the maxilla, and for the II relapse 22 per cent and 11 per cent for the maxilla and the mandible, respectively.

CONCLUSION: A longer retention duration and shorter post-retention period were related to less relapse of crowding in the upper and lower anterior segment; this relationship was stronger in the maxilla. In both jaws moderate crowding showed more relative relapse than severe crowding. In the maxilla extractions were associated with less II relapse.

#### 345 POST-RETENTION DEVELOPMENT OF CORRECTED MODERATE TO SEVERE CANINE AND INCISOR ROTATIONS

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AIM: Assessment of long-term post retention changes of corrected rotations of canines and incisors, hypothesizing no post-retention stability.

SUBJECTS AND METHOD: Sixty-three subjects successfully treated without pericision or overtreatment with at least one pre-treatment incisor or canine rotated 15 to 49 degrees, sample size: 205 teeth. Retention involved fixed canine-to-canine bars in the mandible and Hawley retainers in the maxilla. Photographs of plaster models pre-treatment (13 years), post-treatment and long-term (32 years) were analyzed by measuring tooth rotations related to a projected individual arch. Retention was 3 to 5.6 years, post-retention time on average 11 years and at least 3 years. Originally mesial and distal rotations and antimeres were pooled.

RESULTS: Lower lateral incisors and upper canines showed a pre-treatment preference for mesial and lower canines for distal rotations. Pre-treatment rotations were most frequent in the upper laterals (30%) and lower canines (25%). Frequency of stability was 86 per cent for the upper and 66 per cent for lower canines, other teeth showed frequencies between 37 and 47 per cent. For the maxillary central incisors and canines originally mesial rotations showed a higher relapse frequency than distal rotations. Relapse varied between 2 and 29 degrees, or to 54 per cent, the lower incisors showing 40 to 50 per cent. Average relapse for the originally distally rotated upper canines was only 1.3 degrees and for the originally mesially rotated lower laterals 12 degrees. Ongoing post-retention rotation was found in 18 per cent of the teeth, most frequently in lower canines and upper laterals and varied between 2 and 13 degrees. No over relapse was found. Five originally corrected lower incisors showed spontaneous post-retention rotations of 18 to 33 degrees. Only the upper canines showed a correlation between the original (mesial) rotation and amount of relapse.

CONCLUSION: Stability is possible and is frequent for canines but unpredictable for other teeth. The average relapse is approximately 8 degrees but mostly below 50 per cent.

### 346 RELIABILITY AND VALIDITY OF PREDICTED TREATMENT PLAN IN PATIENTS WITH CLEFT LIP AND CLEFT PALATE

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AIM: To evaluate reliability and validity of the formula for orthodontics and surgery prediction (FOSP) in the prediction of treatment, i.e. whether additional orthognathic surgery or orthodontic treatment alone is required in cleft patients.

MATERIALS AND METHOD: Pre-treatment lateral cephalograms of 105 non-syndromic cleft lip and/or palate patients, 46 males and 59 females, with identifiable final received treatment plans from expert judgment. ANB angle, U1-APOG (mm), and L lip-Nperp. (mm) were measured, placed into the FOSP and calculated for the D score. Receiver operating characteristics were used to identify the optimal cut-off D score for classifying the predicted treatment need. A paired comparison of predicted treatment and actual treatment was performed to evaluate the reliability of the FOSP, using Cohen's kappa statistics. The validity of the predicted treatment plan derived from the FOSP was determined, using the actual received treatment as a reference.

RESULTS: The mean age of subjects at the time the pre-treatment lateral cephalograms were taken, was  $12.97 \pm 4.46$  years. The number of subjects with unilateral cleft lip and palate (CLP), bilateral CLP, cleft lip with or without cleft alveolus and cleft palate only were 61 (58.1%), 23 (21.9%), 19 (18.1%) and two (1.9%), respectively. The reliability of the FOSP was found to have a moderate strength of agreement, the kappa value observed at 0.50 with 95 per cent of confidence intervals (CI) was between 0.33-0.66. Validity of the FOSP was satisfactory for 79 subjects, or approximately 75.2 per cent of all study subjects were correctly identified.

CONCLUSION: The FOSP may be useful as a clinical tool for prediction and guidance counselling of orthodontic treatment need in cleft patients.

### 347 AGENESIS OF THE SECOND PREMOLAR ASSOCIATED WITH DELAYED MATURATION OF THE MANDIBULAR CANINE AND FIRST PREMOLAR

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AIM: To test the hypothesis that delayed maturation of the mandibular canine (C) and first premolar (P1) is associated with agenesis of the mandibular second premolar (P2).

SUBJECTS AND METHOD: The control group consisted of 12 girls (age range 3-15½ years) with the development of all 32 permanent teeth. All subjects were of Danish Caucasian descent followed longitudinally with dental pantomograms (DPTs). The number of radiographs per subject ranged from 6 to 14. The total number of DPTs was 115. The experimental group consisted of 15 Danish Caucasian girls (age range 6-12 years) with isolated agenesis of P2. Each subject had one DPT. Development of C and P1 was assessed using the method of Haavikko. The error of the method was examined from duplicate assessments 6 months apart. The mean ages at the various stages of dental development in the two groups were plotted and compared. Because of the small sample size, statistical analysis of the differences between the means in the two groups could only be carried out for the stages R1/4, R½, and R3/4 using a *t*-test. The level of significance was set at 5 per cent.

RESULTS: The mean maturation of C and P1 was consistently delayed by 1-1½ year for the developmental stages examined (Crc, Ri, R1/4, R½, R3/4, and Rc) in the group with agenesis of P2 compared with the control group. Statistical analysis revealed that the differences between the means for the stages tested were significant for both C and P1. Thus, the hypothesis could not be rejected.

CONCLUSION: This pilot study would seem to indicate that subjects with agenesis of P2 have a delay in the development of C and P1, indicating that the dental field for the developing canine and premolars is affected in subjects with agenesis of P2.

### 348 STEM CELLS FROM DENTAL PULP IN ORTHODONTICS: OPTIMIZING CRYOPRESERVATION TECHNIQUES

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AIM: To optimize and improve the technique of cryopreservation of dental pulp and mesenchymal stem cells (DP-MSCs) derived from intact dental tissues, in order to establish a stem cell bank.

MATERIALS AND METHOD: Twenty-three 23 teeth (16 permanent, 7 primary), extracted for orthodontic reasons, divided into two groups: control group (group 0; 8 teeth) and experimental group (15 teeth) which in turn were divided into three groups: cryopreservation of digested pulp (group A, 6 teeth), cryopreservation of elements intact (group B, 6 teeth), cryopreservation of whole pulp (group C, 3 teeth). The removal of the pulp was made, after opening with Instron testing machine, under a sterile laminar flow hood.

RESULTS: Group 0: The average value of the population doubling time (PDT), was 2.23 days (53.52 hours). Group A: The average value of PDT for the five samples considered was 3.24 days (77.76 hours). Group B: It was not possible to set up a cell culture from three samples as the DP-adherent MSCs did not show any growth. The average value of the PDT of the three remaining samples was 2.43 days (58.32 hours). Group C: The mean PDT of the three samples was approximately 2.25 days (54 hours).

CONCLUSIONS: DP-MSCs derived from frozen digested pulp have characteristics of an immunophenotype similar to those derived from fresh pulp but with a lower rate of proliferation. Cryopreservation of the whole pulp, is the technique of choice for long-term preservation of DP-MSCs, as it allows minimum manipulation of dental tissues and maintains good proliferation and expression of typical mesenchymal markers.

### 349 BRITTLE FRACTURE OF TEETH EXTRACTED FOR ORTHODONTIC REASONS TAKEN AS A SOURCE OF STEM CELLS

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AIM: The presence of stem cells in the dental pulp, in both primary and permanent teeth is widely documented in the literature. The aim of this study was to produce an experimental protocol to obtain the dental pulp tissue from the tooth at both coronal and root level.

MATERIALS AND METHOD: Nine teeth extracted for orthodontic reasons. A cut, 2 mm in length, was made and a wedge was inserted to apply a controlled force via an Instron 5848 microtester. The teeth were subjected to tests, including the force exerted (steady increase of force over time) and impress movement (progression of force values with increasing time). The time set for the tests was from 20 to 100 seconds.

RESULTS: The most effective technique to fracture a tooth is the force exerted, with the adoption of physical limitations. The load necessary to fracture a tooth depends on its size and morphology and the geometry of the form. The range of force required to fracture a tooth varied from 0.181359 KN for primary teeth to 1.50003 KN for the permanent lower first premolar.

CONCLUSIONS: The Instron 5848 microtester is suitable for the application of the forces concerned, its software can run tests in a safe, preserving the pulp of the tooth by contact with the wedge (by fixing the physical limits), thus limiting the risk of bacterial contamination. The remaining problem is the risk of overheating of the pulp during the creation of the notch, and the lack of precision in the control of the root apex during the formation, which may cause propagation of fractures. Careful analysis of the results indicates that the method described as effective and valid for obtaining cell populations from teeth, either primary or permanent.

### 350 MALOCCLUSION AND HELKIMO'S INDEX: CORRELATION WITH BODY POSTURE

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AIM: Whether there are correlations between the stomatognathic system and body posture remains controversial. The aim of this study was to investigate whether malocclusion traits and Helkimo's Index show detectable correlations with body posture alterations in children and young adults.

SUBJECTS AND METHODS: A total of 1,178 11-to-19-year-old subjects divided into four groups: 1) controls; 2) malocclusion; 3) Helkimo index  $\geq 5$ ; and 4) malocclusion and Helkimo's Index  $\geq 5$ . Dental occlusion assessment included: overbite, overjet, posterior crossbite, scissor bite, mandibular crowding and dental Class. Body posture assessments were performed by static analyses of body inclination and trunk asymmetry according to the dynamic Fukuda stepping test. Univariate and multivariate statistical analyses were performed.

RESULTS: Although at the univariate level both the trunk asymmetry and Fukuda stepping test showed significant differences among the groups, the multivariate level revealed that age and gender were mostly responsible. The only significant

correlation seen was for the malocclusion and Helkimo's Index  $\geq 5$  group; these subjects had a positive (worse) trunk asymmetry and a negative (better) Fukuda stepping test performance. With further multivariate analyses of each single malocclusion trait/Helkimo's index  $\geq 5$  (irrespective of the groups), only an increased overbite showed a statistically significant association with a slightly better Fukuda stepping test performance.

CONCLUSIONS: Given the small number of significant associations, the present study does not support the existence of clinically relevant correlations for malocclusion traits and Helkimo's Index  $\geq 5$  with body posture in children and young adults.

### 351 PERIODONTAL PATHOGENS IN PATIENTS TREATED WITH DIFFERENT BRACKET DESIGNS

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AIM: To detect the presence of periodontopathogens in the subgingival microbiota of patients with two different brackets type (self-ligating and conventional brackets).

SUBJECTS AND METHOD: Thirty patients aged between 12 and 17 years [20 with self-ligated brackets, (Damon 3MX, Ormco Corp., Glendora, California, USA), and 10 with conventional brackets (Sprint, Forestadent, Pforzheim, Germany)] for at least 3 months. Subgingival plaque samples were collected in dry field conditions with sterile paper points for 20 seconds and immediately transferred from the periodontal sulcus into a transporting box from the proximal sites of the five index teeth. These five samples were pooled so that the results were species specific and not site specific. The plaque samples were sent to a specialized laboratory, using the micro-Dent® test (Hain Lifescience GmbH, Nehren) which combine DNA amplification with subsequent detection using DNA probes. Once the bacterial DNA has been isolated bacterial detection was performed by polymerase chain reaction. The presence of five putative periodontopathogenic species were detected: *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Bacteroides forsythus* and *Treponema denticola*. The individual pathogens were marked as: undetected, slightly positive, positive and strongly positive. Statistical analysis was performed using descriptive and non-parametric analysis using the Mann Whitney test.

RESULTS: There was significant difference between the Damon3MX and Sprint brackets ( $P = 0.0006$ ) for *A. actinomycetemcomitans*, while the other species did not show significance between the groups. Eighty per cent of subjects with conventional brackets had a positive or strongly positive count of *A. actinomycetemcomitans*, while in Damon group this was only 15 per cent.

CONCLUSION: There was significant difference between Damon and conventional brackets regarding the presence of *A. actinomycetemcomitans*. Other species showed higher, but not significant values in subjects with conventional brackets

### 352 LONG-TERM OBSERVATION OF MIDFACE CHANGES IN SKELETAL CLASS III PATIENTS AFTER ORTHOGNATHIC SURGERY

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AIM: The result of orthognathic surgery is difficult to predict because there are only a few ways to diagnose, and the landmarks are not easy to identify. The observation of midface soft tissue three-dimensional (3D) changes after orthognathic surgery may allow prediction of soft tissue change and can be the guide of the surgical planning. The purpose of this study was to determine the significant elements in soft tissue changes after orthognathic surgery,

MATERIALS AND METHOD: Soft tissue changes before (T0) and after 1 (T1) and approximately 4 years (T2) following Le Fort I osteotomy in Class III malocclusion patients were compared. The material comprised the 3D computed tomographs of 14 patients diagnosed as Class III malocclusion. Eight subjects were observed at T2.

RESULTS: There was significant anterior advancement of the nasal and paranasal area after orthognathic surgery. At T2 there was small amount of rebound in the vertical changes of pronasale and subnasale ( $P < 0.05$ ). Comparison of T0 and T1 measurements showed a significant correlation between the anteroposterior changes of pronasale, subnasale, paranasal area and the anteroposterior changes of ANS and point A. The most related variable was ANS ( $P < 0.01$ ). Followed by ANS movement, the proportion of the changes of pronasale, subnasale, and paranasal area was 31.7, 35.7 and 70.5 per cent each. When the paranasal area was subdivided into 16 points, the changes of the paranasal area according to the advancement of the hard tissue tended to increase at the median and inferior area of the midface. The amount of PNS impaction showed small amount of rebound.

353 EFFECTS OF THE DIAMETER AND SHAPE OF ORTHODONTIC MINI-IMPLANTS ON MICRODAMAGE IN THE CORTICAL BONE

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AIM: To investigate the effects of the diameter and shape of orthodontic mini-implants (OMIs) on microdamage in the cortical bone during implant insertion.

MATERIALS AND METHOD: Twenty-eight self-drilling OMIs (Biomaterials Korea Inc, Korea; 6 mm in length, 1.5 and 2 mm in diameter, and cylindrical and tapered shapes; classified into 1.5C, 2C, 1.5T and 2T) were inserted with a surgical motor in the tibias of New Zealand white rabbits (mature males, mean age = 6 months, mean weight = 3.1 kg, N = 7). Four OMIs of each type per rabbit were randomly inserted. Maximum insertion torque (MIT) was measured. Immediately after insertion of the OMIs, the block bone with the OMI was harvested. Cortical bone thickness was measured using micro-computed tomography, and histomorphometric analyses of the number of cracks (NC), accumulated crack length (ACL,  $\mu\text{m}$ ), maximum radius of the crack (MRC,  $\mu\text{m}$ ), and longest crack (LC,  $\mu\text{m}$ ) were performed. Kruskal-Wallis test and Mann-Whitney U-test with a Bonferroni correction were done for statistical analyses.

RESULTS: An increase of diameter (1.5C<2C, 1.5T<2T) and the presence of tapering (1.5C<2T) resulted in an increase of MIT values, NC and LC ( $P < 0.01$ , respectively). Similarly, with increase of diameter [(1.5C, 1.5T) < (2C, 2T)], there was increase of ACL and MRC ( $P < 0.001$ ). However, there were no differences in the values of MIT, NC, ACL, MRC, and LC between cylindrical and tapered shaped OMIs with same diameter (1.5C and 1.5T, 2C and 2T).

CONCLUSION: OMIs with a larger diameter and a tapered shape resulted in greater microdamage to the cortical bone, which can affect bone remodelling and implant stability.

354 CHANGE IN LOWER LIP THICKNESS IN MOUTH BREATHING CHILDREN AND ADOLESCENTS

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AIM: The lips probably constitute one of the most important parts in determining the first impression of someone. The aim of this study was to assess the effects of mouth breathing on growth of the lower lip in children and to investigate changes in thickness according to age.

SUBJECTS AND METHOD: Ninety-three mouth breathing children without any systemic disease, aged 8-18 years and a control group of 97 non-mouth breathing children. Lateral cephalograms of the subjects were taken in the natural head position. The thickness of the upper and lower lips was measured.

RESULTS: The mouth breathers had significantly thicker lower lips than those of the control group. The lower lips had a thicker tendency than the upper lips. There was no gender difference.

CONCLUSION: Mouth breathing children have thicker lower lips compared with those who do not breathe through their mouth. It is speculated that this tendency will worsen if the breathing pattern persists.

355 QUANTITATIVE COMPARISON OF MORPHOLOGICAL FEATURES OF THE MANDIBLE BETWEEN NORMAL OCCLUSION AND CLASS III MALOCCLUSION

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AIM: To compare structural differences of the mandible between subjects with normal occlusion and Class III malocclusion. Using a three-dimensional (3D) reconstruction model combined with quantitative analyses in physical anthropology, the differences between genders and types of malocclusion were examined.

SUBJECTS AND METHOD: Fourteen male (MI) and 14 female (FI) adults with a Class I normal occlusion and 24 male (MIII), 24 female (FIII) Class III malocclusion subjects. 3D models of each group were fabricated via computed tomography (CT) scans. Measurements were made of linear distances, angles and cross-sectional area of the mandibular structure. The data were organized and regression analyses were conducted for quantitative analysis. Independent variables (X) were adjusted and scaled using the slope of the linear regression equation ( $Y = aX+b$ ) to evaluate the relative developmental pattern of each specific area (Y) of the mandible to that of other groups. Independent variables (X) herein refer to cranial base length (Na-Ba), mandibular length (Co-Me), and volume of the mandible not containing the crowns of the teeth.

**RESULTS:** Mandibular length was positively correlated with an increase in cranial base length (Na–Ba) in MIII while MI showed a slight negative allometry. As the volume of mandible increased, corpus depth also increased with a higher slope in MIII than MI. Corpus width exhibited a higher slope in MI compared with FI. Body length increased slightly in FIII, but a slight decrease was observed in FI. For comparison of the measurements showing no regression equation, each independent variable ratio (ratios of mandible to independent variables) and additional ratios implying structural features were acquired. **CONCLUSION:** With this approach, the structural features of the mandible independent of size effects can be understood which is useful for clinical application such as diagnosis, treatment planning and simulations.

### 356 MAXILLARY ALVEOLAR BONE GROWTH OF KOREAN GIRLS AGED FROM 6 TO 14; AN 8-YEAR LONGITUDINAL STUDY

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**AIM:** Maxillary and mandibular growth changes have an effect on the results of orthodontic treatment in growing patients. Previous studies have verified the differences in growth pattern between the mandible and maxilla. Especially, the growth pattern of maxillary alveolar bone (MAB) is influenced by various bony parts of face and cranium. However, there are few studies on the growth pattern of the MAB. Therefore, this study aimed to analyze the MAB growth pattern of Koreans.

**MATERIALS AND METHOD:** Longitudinal data from 50 Korean girls. Lateral cephalometric films taken annually at 6-14 years of age, except the 10 year-old, (total 400 films) were used. The subjects had a normal dentition and occlusion. Six parameters concerning MAB were obtained using a digitizer (Intuos4, Wacom, Canada) and software (V-ceph5.5, osstem implant, Korea). Statistical analysis was undertaken using analysis of variance test, Pearson's correlation coefficients test and multiple regression analysis with the Statistical Package for Social Sciences, version 11.5 (SPSS Inc., Chicago, Illinois, USA).

**RESULTS:** The average value of dentofacial parameters gradually increased during the study period, although the growth rate decreased with age. The growth pattern of MAB was very closely related to chronological age, however different with skeletal growth pattern. The prediction equation of MAB growth amount using multiple regression analysis was also calculated.

**CONCLUSIONS:** From these results, the growth amount of MAB can be predicted with the help of previous data. Annual data of MAB are useful for the prediction of MAB growth. More data regarding the skeletal maturation index are needed for precise analysis to assist in comprehensive dental treatment.

### 357 PREVALENCE AND TREATMENT TIMING OF IMPACTIONS IN AN ORTHODONTIC POPULATION.

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**AIM:** To investigate the prevalence of impacted teeth in an orthodontic population and to compare the length of orthodontic treatment of subjects with impacted maxillary canines with a matched control group without impactions.

**SUBJECTS AND METHOD:** A total of 1154 files of all patients treated between 1994 and 2010, were reviewed. After exclusion of syndromic patients, the final sample comprised 1051 patients. Impactions were detected using panoramic radiographs and dental records. In order to investigate whether maxillary canine impaction delays orthodontic treatment, a control sample of 31 patients was selected. The latter matched the impacted group for age, gender and malocclusion. A Student's *t*-test was used to compare treatment time between the groups.

**RESULTS:** Excluding third molars, 5.4 per cent of orthodontic patients had at least one impacted tooth. The most frequently affected teeth were the maxillary canines (64%), followed by the second mandibular premolars (9%) and the mandibular canines (9%). Considering impacted maxillary canines, bilateral impaction was observed in 12 patients, and unilateral impaction in 26 patients. Eleven of them were located on the right and 15 on the left side. Twenty-nine patients with impacted canines were female and nine were male. Two impacted canines were diagnosed as ankylosed during the course of treatment. The mean treatment duration for the group with impacted canines was 3.30 years (SD 1.19), while for the control group it was 2.15 years (SD 0.86). The difference was not statistically significant ( $P = 0.087$ ).

**CONCLUSIONS:** Tooth impaction was detected in 5.4 per cent of the orthodontic patients. Maxillary canines were the teeth more often impacted. Females seem to be more often affected than males. The tendency for a longer treatment time for patients with impacted maxillary canines was not statistically significant.



358 *IN VIVO* STUDY OF AN ENGINEERED SKELETAL MUSCLE TISSUE ANALOGUE FOR USE IN THE MANAGEMENT OF CRANIOFACIAL ABNORMALITIES†

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**AIMS:** To investigate the suitability of three different muscle-derived cell populations for craniofacial tissue augmentation. **MATERIALS AND METHOD:** Primary cell cultures were developed from muscle-derived cells that were extracted from limb muscle biopsies obtained from male New Zealand White rabbits. Three cell populations were isolated by the preplate technique: a parent population (mixed myoblasts and fibroblasts), early adherent population (fibroblast-rich) and late adherent population (myoblast-rich). Cell passages from a3 to 6 were used. The cells were seeded on biomimetic constructs that were fabricated from rat-tail type I collagen and plastically compressed. Acellular constructs were used as controls. The extraction timepoints were 1, 3 and 5 weeks. The constructs were sectioned and stained.

**RESULTS:** Semi-quantitative analysis of cell response was measured. The cellular product of the seeded populations was variable. The most successful population in cell spread and survival was the parent population with desmin stained sections revealing significant myogenic cell presence. Late adherent cells were inconsistent in terms of cellular presence. Early adherent cells were unsuccessful in establishing any degree of myogenesis. Acellular sections did not reveal any infiltration of myogenic cells from the host tissue. All populations showed migration towards the host tissue, which possibly could be due to lack of nutrient presence within the core of the constructs.

**CONCLUSIONS:** Parent population was the most promising for constructing a viable native tissue analogue. However, there was a migration tendency towards the blood vessel-rich granulation tissue. This could possibly be explained by the morphology of the construct permitting cell tracking along the collagen surface and lack of nutrient presence within the construct.

†Winner of the W J B Houston Poster Research Award.

359 CORRELATION BETWEEN ANGIOGENESIS, CONDYLAR GROWTH AND BODY GROWTH USING AN ANIMAL MODEL OF SPRAGUE DAWLEY RATS

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**AIM:** The Sprague Dawley (SD) rat model was used to compare angiogenesis of the condyle, growth of the condyle and growth of the rats at different ages to reveal the correlation between angiogenesis and normal growth, which can give a better understanding on condylar growth control.

**MATERIALS AND METHOD:** Thirty-five 30-day-old female SD rats, body weight  $100 \pm 5$  g at the start of experiment were divided into five groups. Seven rats of each group were sacrificed on days 7, 14, 21, 30, and 60. Body weights of the rats were recorded at the time of sacrifice, and gross measurement of the mandibles was carried out after sample fixation. Condyle samples were decalcified, paraffin embedded, and sectioned for immunostaining analysis. Von Willebrand Factor VIII was used to detect newly formed capillaries. Captured images were analyzed using a computer-assisted image analyzing system. Microvessel densities (MVD) in a frame of  $300 \times 100$  mm area in the erosive layer of the posterior condylar cartilage were recorded and calculated.

**RESULTS:** With the increase of rat age from day 37 to day 60, the body weights of the rats increased significantly, and the length of the condylar process increased significantly from day 37 to day 51, and from day 51 to day 90. However, the number of newly formed capillaries in the erosive layer of the condylar cartilage decreased with age.

**CONCLUSION:** The number of new capillaries in the erosive layer of condylar cartilage decreased with age in rats, although the condylar process grew significantly, and the body weights of the rats increased significantly. This corresponds to a decreased growth potential of the condyle with the increase in age.

360 STABILITY OF CLASS II OPEN BITE TREATMENT IN PATIENTS WITH TEMPOROMANDIBULAR JOINT INTERNAL DERANGEMENT

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**AIM:** To compare cephalometric changes during the retention period between orthognathic surgery patients and orthodontically treated patients, who had a Class II open bite with internal derangement (ID) of the temporomandibular joint (TMJ).

**SUBJECTS AND METHOD:** Thirty-four adult patients with Class II open bite malocclusions and TMJ ID confirmed with magnetic resonance image (MRI) before treatment. They were divided into two groups; group 1 (18 females, 1 male) treated by orthognathic surgery and group 2 (13 females, 2 males) treated orthodontically. Computerized lateral cephalometric analysis was carried out at three stages: pre-treatment, post-treatment, and at least 1 year after debonding. Statistical analysis of the data was undertaken with Mann-Whitney and Wilcoxon tests.

**RESULT:** There was a significant difference in the amount and pattern of relapse change during the retention period between groups 1 and 2. In group 1, a significant decrease of mandibular body length and clockwise rotation of the mandible occurred with a decrease in overbite. Proclination of the mandibular incisors were shown as compensation for the skeletal change in group 1. There was no significant skeletal change except a decrease in ramus height in group 2. Although the amount of skeletal change was small, there was a tendency to mandibular backward rotation in group 2. A marked increase in overjet was observed in group 2 during the retention period.

### 361 SOFT TISSUE LASER USE IN ORTHODONTICS: PERCEPTIONS OF ORTHODONTISTS, PERIODONTISTS, AND GENERAL DENTISTS

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**AIM:** Soft tissue laser use by orthodontists has recently increased, with performance of procedures traditionally referred to other dental professionals. The purpose of this study was to compare the attitudes of orthodontists, periodontists, and general dentists regarding the use of soft tissue lasers by orthodontists.

**MATERIALS AND METHOD:** A survey was sent to orthodontists (N = 970), periodontists (N = 983), and general dentists (N = 987) in the United States to determine their opinion of orthodontists' use of lasers.

**RESULTS:** Overall, among the respondents, 28 per cent reported using a soft tissue laser in their practice and this frequency did not vary among practitioner groups ( $P = 0.56$ ). Periodontists (59%) were significantly less likely than orthodontists (93%) and general dentists (88%) to agree that laser use by orthodontists was appropriate in general ( $P < 0.001$ ). For each of the eight specific laser procedures investigated, the degree of appropriateness was rated significantly lower by periodontists ( $P < 0.001$  for each). There were also differences in ratings between orthodontists and general dentists for two of the procedures ( $P < 0.001$ ). For both orthodontists ( $P = 0.001$ ) and periodontists ( $P = 0.008$ ), there was a significant relationship between their own personal laser use and approval of use by orthodontists. Orthodontists were more likely to believe laser use would increase referrals to their practice ( $P = 0.003$ ), while periodontists more often thought it would decrease referrals to an orthodontist's practice ( $P < 0.001$ ). Periodontists reported having more formal education ( $P < 0.001$ ) and more continuing education ( $P < 0.001$ ) in laser use than the other groups. Orthodontists were significantly less likely than the others to charge a fee for a laser procedure ( $P < 0.001$ ).

**CONCLUSIONS:** Significant differences were found among orthodontists, periodontists, and general dentists concerning the appropriate use of soft tissue lasers by orthodontists. Effective communication among practitioners is important for achieving optimal patient care.

### 362 THE INTERPROXIMAL INTERFACES OF THE HUMAN PERMANENT DENTITION

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**AIM:** The interproximal contact (IC) is a keystone in the Begg theory and in Andrews' six keys to normal occlusion. However, the anatomical characteristics of the IC between the teeth have never been described. The aim of this study was to develop a novel method to measure IC *in vivo*.

**SUBJECTS AND METHOD:** IC was examined in 30 adult subjects, with intact interproximal contacts. Elastomeric separators were placed in the anterior dentition for 3 hours and in the posterior for 24 hour. After removal of the separators, a segmental impression was taken. Subsequently, the segmental impression was sectioned in coronal slices. Each slice contained two adjacent proximal walls with a common CA interface. The slides were placed on a view box and a standardized digital image of each side of the slice was captured, using standardized transmission illumination. The CA interface was defined as the thinnest polyvinyl-siloxane layer that allowed the maximal transmission of light. All ICs of the permanent dentition were spatially screened according to shape, size, location and orientation.

**RESULTS:** IC size, shape and orientation differed significantly ( $P < 0.001$ ) between groups of teeth. The IC was more buccally located in 87.5 per cent of the teeth and many correlations were found between several IC variables. Incisors and

canines were characterized by a vertical ovoid shaped CA, premolars and molars by a horizontal ovoid shaped CA. The high correlation between CAs and the proximal wall size suggests that the diversity in CA size is related to the diversity in proximal wall size and that tooth morphology dictates CA size and may be shape.

CONCLUSIONS: Some CA morphometric characteristics are related to the role of CA array in force transmission (CA-BO), others to tooth morphology (CA/PW) and to the effect of attrition (CA shape). This study demonstrated that several dental malalignments are related to IC characteristics.

### 363 THREE-DIMENSIONAL DENSITOMETRIC ANALYSIS OF MAXILLARY SUTURAL CHANGES INDUCED BY RAPID MAXILLARY EXPANSION

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AIM: To prospectively evaluate the density of the midpalatal and transverse sutures as assessed by low-dose computed tomography (CT) before rapid maxillary expansion (RME; T0), at the end of active expansion (T1) and after a retention period of 6 months (T2).

SUBJECTS AND METHOD: Seventeen pre-pubertal subjects (mean age 11.2 years) with constricted maxillary arches. The total amount of expansion was 7 mm in all subjects. Multislice low-dose CT scans were taken at T0, T1, and T2. On the axial CT scanned images six regions of interest (ROIs) were placed along the midpalatal and transverse sutures (MpS Ant, MpS Mid, MpS Post, MpS/TS, TS left, TS right,) and two in the maxillary and palatal bony areas (MB, PB). Density was measured in Hounsfield units (HU). Mann-Whitney *U* and Friedman ANOVA with *post-hoc* tests were used ( $P < 0.05$ ).

RESULTS: The three ROIs in the midpalatal suture showed a significant decrease in density from T0 to T1, a significant increase from T1 to T2, and lack of statistically significant differences from T0 to T2. Both ROIs located in the transverse suture showed a significant decrease in density from T0 to T1 that was followed by a non-significant increase in density from T1 to T2.

CONCLUSIONS: At the end of active phase of expansion a significant reduction in density along the midpalatal and transverse sutures was observed in all subjects. The sutural density of the midpalatal suture at T2 indicated reorganization of the midpalatal suture while the density along the transverse suture increased without reaching pre-treatment values, probably due to different morphology between midpalatal and transverse sutures. The findings support the hypothesis that orthopaedic stimulation of the midpalatal suture significantly influences the transverse suture, with clinical implications regarding the benefit of palatal expansion in subjects requiring maxillary protraction.

### 364 BONE AGE ESTIMATION IN ORTHODONTICS. A NEW APPROACH IN CERVICAL VERTEBRAE MATURATION METHOD

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AIM: To investigate, the relationship between cervical bone age, chronological age and hand-wrist skeletal age which is considered to be the most reliable method for measuring the degree of skeletal maturity.

MATERIALS AND METHOD: Lateral cephalometric and left hand-wrist radiographs of 393 Caucasian children from 8 to 18 years old. On the hand-wrist radiographs average values of the children's skeletal age as described by Schopf, based on the classification of Björk Grave and Brown were used. Cervical vertebral bone age was also depicted, using the method described by Mito *et al.* Pearson correlation coefficients and regression analysis were calculated to assess the linear relationship between chronological, cervical bone and hand-wrist skeletal age.

RESULTS: Cervical bone age correlated significantly with both chronological and hand-wrist skeletal age for each gender. The correlation coefficient between cervical bone age and hand-wrist skeletal age for females ( $r = 0.81$ ) and males ( $r = 0.76$ ) was higher than that between cervical bone age and chronological age (females  $r = 0.73$ ; males  $r = 0.72$ ). Regression analysis indicated that the relationship between cervical bone age and hand-wrist skeletal age was stronger than that between cervical skeletal age and chronological age for both genders. Based on the results, extending the age range to 18 years old, a new formula to assess cervical bone age, separately for Caucasian males and females was created. A computerized analysis created to automatically calculate cervical bone age in order to increase the accuracy and objectivity. CONCLUSION: Cervical bone age reflects skeletal status, because it can approximate hand-wrist skeletal age and increase the accuracy of the CVMS method by evaluating the length of time between the skeletal stages.

### 365 QUALITY OF LIFE AND ORTHODONTIC TREATMENT OUTCOME IN ADULTS

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**AIMS:** To determine the improvement of patients' oral health related quality of life (OHRQoL) after orthodontic treatment and its association with occlusal changes and patients' perceptions of overall oral health improvement.

**SUBJECTS AND METHOD:** A cohort of 186 orthodontic patients obtained from a consecutive sample of 347 young adults. Patients' OHRQoL were assessed before (T0) and 6 month after (T1) orthodontic treatment using the short form Oral Health Impacted Profile (OHIP-14) and the United Kingdom Oral Health related Quality of Life measure (OHQoL-UK). Patients' occlusions were determined both at T0 and T1 using the Index of Complexity and Treatment Need (ICON) and the Peer Assessment Rating (PAR) index. Patients' global ratings on their perceptions of oral health improvement were obtained at T1 using a 5-point Likert-scale.

**RESULTS:** Both patients' OHRQoL scores and occlusal indices scores improved significantly ( $P < 0.001$ ). At T1, 65 subjects (34.7%) rated their oral health as 'very much improved', 79 (42.2%) as 'much improved', 29 (15.5%) as 'a little improved', 10 (5.3%) as 'no change' and four (2.1%) as 'a little worse'. There were significant correlations between improvement in OHRQoL scores and improvement in occlusion scores. In logistic regression of this study, patient's global rating on oral health improvement could be best predicted by OHIP-14 and PAR score changes ( $R^2 = 0.23$ ).

**CONCLUSION:** These findings confirm the significant improvement in QoL from orthodontic treatment. Patients' perception on oral health improvement after orthodontic treatment could be explained by OHRQoL s and occlusal indices changes.

### 366 PREVALENCE OF SUPERNUMERARY TEETH: A RADIOGRAPHIC STUDY IN HELLENIC AIR FORCE ACADEMY STUDENTS

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**AIM:** Supernumerary teeth are a common developmental disturbance of human dentitions. The aim of this investigation was to assess the characteristics of non-syndromic supernumerary teeth in a young adult population.

**MATERIALS AND METHOD:** The panoramic radiographs of 1,636 military students (mean age:  $18.6 \pm 0.44$ ) obtained between 1995-2009 were explored for the presence of supernumerary teeth. The type and location of supernumeraries were also recorded.

**RESULTS:** Thirty-five supernumerary teeth were observed in 24 military students (prevalence rate: 1.5%). The ratio of extra teeth located in the maxilla and mandible was 2.2:1. The most frequent location was the distomolar region in the upper arch and premolar region in the lower arch. Overall, the most common type of supernumerary tooth was the upper distomolar. Single supernumeraries occurred in 15 subjects (63%) while two and three extra teeth were found in seven and two examinees (29 and 8%, respectively). Regarding morphology, half of the supernumerary teeth were of atypical shape and size.

**CONCLUSION:** The prevalence rate of supernumerary teeth in this sample of Greek young adults was 1.5 per cent. The most common supernumerary tooth was the upper distomolar.

### 367 INFLUENCE OF AGE AND GENDER IN PERCEPTION OF FACIAL PROFILE AESTHETICS

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**AIM:** Facial aesthetics is one of the main treatment goals of orthodontics. However, perception of anatomical features with an aesthetic component is influenced by subjectivity. The aim of this study was to prove the hypothesis that facial profile perception and preferences are influenced by the evaluator's age and gender.

**MATERIALS AND METHOD:** The facial attractiveness of five different computer-modified profiles of the same individual was assessed by two different groups of evaluators. The first group was comprised of 150 youths assigned to either a sample of 'children' (6 to 12 years old) or of 'teenagers' (13 to 18 years), while the second group consisted of 150 adults (older than 18 years). Differences between both groups according to their gender and age were statistically analyzed by means of Fisher's exact test,  $P$  value, and non-parametric Wilcoxon test.

**RESULTS:** According to the age of the evaluators, children judged the retrusive maxillary and mandibular profiles more positively than adults. The facial profile presenting mandibular protrusion appeared to be the least preferred by both groups.



The evaluation pattern of the adolescents was similar to that of the adults. With regard to the gender of the evaluators, females perceived maxillary retrusion to be less attractive than males ( $P = 0.0100$ ).

CONCLUSION: Aesthetic perception evolves with age, with adolescents and adults sharing a similar view of facial anomalies, while children tend to be less influenced by such features.

### 368 A NEW CONCEPT OF ANATOMIC LINGUAL ARCH FORM

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AIM: To describe a natural and anatomic lingual arch form obtained from subjects with normal occlusion that could be used, with other criteria, in the construction of personalized set-ups for the lingual straightwire technique.

MATERIALS AND METHOD: Fifty-eight pairs of dental casts of the arches of 58 southern Europeans (37 females, 21 males) with ideal natural occlusions. After the reference points of the dental arches were identified and marked, the dental casts were scanned. The exact position of the models on the scanner was established using an acetate sheet with a Cartesian reference system. For each image, 14 reference points ( $x, y$ ) were measured and recorded. The measurements were processed with software to select the polynomial function that best described the shape of the dental arches. The ninth-degree polynomial function was selected to represent the lingual arch form of both arches. Distribution analysis of the  $x$  and  $y$  values of each tooth in each arch resulted in the creation of three groups (small, medium, and large) to verify the most appropriate measures of the central tendencies of the data.

RESULTS: Statistical analysis showed no significant gender difference in the medians of the six parameters used to measure depth and width in both arches. A representation of the variability of the lingual curve of the sample was created to document at least three sizes of the representative curve of the central tendency for the data. No statistically significant differences in shape were found between males and females, when considering the medians as a measure of the central tendencies.

CONCLUSIONS: Three lingual curves (small, medium, and large) for the maxillary and mandibular arches, representing the mean values of the sample, were developed and can be used as guides for the set-up in the lingual straightwire technique

### 369 THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF A CENTRAL LOWER INCISOR UNDER LABIAL AND LINGUAL LOADS

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AIM: To evaluate any mechanical differences between labial and lingual application of an orthodontic bracket by creating a virtual simulation comprising a lower incisor surrounded by its bony support and subjecting it to various loading conditions.

MATERIALS AND METHODS: A cone-beam computed tomography (CBCT) scan of a lower incisor was employed to create first a three-dimensional geometric model and then a finite-element model of the tooth, complete with its bony support and periodontal ligament (PDL). Various single (horizontal, vertical and lateral) and combined (horizontal and vertical; horizontal, vertical and anticlockwise) forces and moments were then applied to this model on each side of the tooth at the centre of the clinical crown. In order to evaluate the effect of the various forces considered, instantaneous displacement in a labiolingual direction and the stress generated in the bone and PDL as a result of this movement were measured and used to compare the two sites of loading.

RESULTS: The side of application of force influenced dental movement only when an intrusive component was present. Thus, in these cases, bracket placement site should be determined by the desired result. The simulations performed also evidenced greater bodily movement when a vertical force was present on the lingual surface. In general, this movement was of the tipping type when combined forces were applied, but greater bodily intrusion was observed on application of combined forces and an anticlockwise moment to the labial surface.

### 370 RELATIONSHIP BETWEEN MOUTH BREATHING, LIP COMPETENCE AND DEVELOPMENT OF MALOCCLUSION

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AIM: To evaluate the association of nasal or nasopharyngeal pathology, electromyographic activity of the orbicularis oris and the development of malocclusion.

**SUBJECTS AND METHOD:** One hundred and forty six children with nasal or nasopharyngeal pathology and a control group of 40 children with no history of mouth breathing. The study included clinical examination, dental cast analysis, cephalometric analysis, otorhinolaryngologists' examination, and recording of electromyographic (EMG) activity of the upper and lower orbicularis oris. The lips were considered as competent when the EMG signs during rest were between 0-50  $\mu$ V. Statistical analysis was performed using the software package, Statistica 5.0.

**RESULTS:** The average EMG activity of the upper and lower orbicularis oris was greater among children with nasal or nasopharyngeal pathology (134.8  $\mu$ V) compared with the control group (20.2  $\mu$ V;  $P < 0.01$ ). Malpositions of the upper (64.0% and 21.2%,  $P < 0.001$ ) and the lower (32.0 and 12.1%,  $P < 0.01$ ) incisors was more frequent in children with incompetent lips, than among children with competent lips. The average overjet in the group with incompetent lips was statistically significantly greater ( $2.67 \pm 0.32$  mm), than in those with competent lips ( $5.56 \pm 0.22$ ;  $P < 0.001$ ). An increased overjet was also more common among children with incompetent lips (89.0 and 18.2%;  $P < 0.001$ ). A narrower upper dental arch was more frequent among children with incompetent lips compared with the competent lip group ( $P < 0.01$ ).

**CONCLUSIONS:** Nasal or nasopharyngeal pathology, which causes mouth breathing, increases EMG activity of the upper and lower orbicularis oris and influences the development of a malocclusion such as an increased overbite, posterior crossbite and malposition of the incisors.

### 371 LIP PROFILE PREFERENCES OF ASIAN AMERICANS

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**AIM:** The perception of beauty is subjective and greatly influence by societal trends, media and culture. The aim of this study was to evaluate how Asians, non-Asians, and orthodontists in America view aesthetic soft tissue Asian lip profiles. The null hypothesis was that there is no difference in the perception of lip profile aesthetics of Asian patients between Asian laypersons, non-Asians laypersons, and orthodontists.

**MATERIALS AND METHOD:** A survey was constructed using the profile photographs of one adult male and one adult female Asian American patient taken from the orthodontics clinic records. Using Dolphin Imaging 3D, the original photographs were digitally altered. The lips in each photograph were moved in increments forward and backwards to produce five images (-4, -2, 0, 4 and 8 mm). Each evaluator was asked to rank, from 1 to 5, each collection of photographs where 1 was most preferable and 5 was least preferable. There were a total of 10 survey questions. The survey was administered to 111 Asian Americans, 115 Caucasians, and 389 orthodontists. Repeated-measures mixed-model and cluster analyses were used to analyze the data.

**RESULTS:** All three groups surveyed were similar in their assessment. A retrusive lip profile for the Asian male was preferred, and a slightly protrusive lip profile for the Asian female was preferred across all groups. Generally, orthodontists preferred slightly more retrusive lips compared with the other two groups. The groups of evaluators that showed statistical differences were Chinese and Filipino laypersons.

**CONCLUSION:** Cluster analysis also revealed significant variation in the results, giving credence to the belief that individual patient preference should be assessed in addition to understanding social norms.

### 372 WEB TECHNOLOGY IN ORTHODONTIC EPIDEMIOLOGY. A PREVALENCE STUDY OF MIDLINE DIASTEMAS IN A SLOVAK POPULATION

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**AIM:** To determine the prevalence of a midline diastema in a Slovak population using photographic documentation collected during an Internet campaign.

**MATERIALS AND METHOD:** An interactive web page was designed to evaluate the standard of oral hygiene. One thousand eight hundred and nine photographs of the anterior region were sent by participants to this web page. These photographs were screened for an upper midline diastema. Three hundred and sixty photographs were excluded due to low quality or other visible problems in anterior region such as missing teeth, removable or fixed dentures and large fillings. Children younger than 8 years of age were also excluded. The final sample included 1447 patients (487 males, 960 females) divided into three groups. Group 1 included children aged 8 to 11, group 2 children and young adults aged 12 to 34 years, and group 3 adults aged 35 years and older.

**RESULTS:** The prevalence of an upper midline diastema in group 1 was 14.0 per cent, in group 2, 9.0 per cent and in group 3, 13.7 per cent. There were no statistically significant differences in prevalence between males and females in all groups.  
**CONCLUSION:** These findings are similar to those obtained by conventional examination. This methodology is appropriate for epidemiological studies of some orthodontic anomalies.

### 373 COMPLICATIONS CONNECTED WITH THE USE OF TEMPORARY ANCHORAGE DEVICES

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**AIM:** To identify common complications connected with the use of temporary anchorage devices (TADs) and their prevalence in patients treated with miniscrews to translate dental elements or to level the curve of Spee.

**MATERIALS AND METHOD:** One hundred and nine mini-implants, 59 in the maxilla and 50 in the mandible. The implants were used in patients between the ages of 12 and 62 years, who required absolute skeletal anchorage during orthodontic treatment. The mini-implants, all 8 mm length (IMTEC 3M Unitek), were placed between 4 and 10 mm from the gingival margin. All patients followed the same positioning protocol. All patients received similar hygiene instructions.

**RESULTS:** Pain during insertion of the mini-screw was noted in 14 cases: the level of pain varied from mild to light and was easily controlled with an additional mepivacaine administration. Eighteen patients lost a mini-implant spontaneously during therapy or the TAD was removed due to mobility. In 16 cases trauma of the soft tissue occurred. In five cases insertion of the mini-implant impacted the root of the adjacent teeth. None of the complications resulted in permanent clinical damage to the teeth.

**CONCLUSIONS:** Although during the use of TADs some minor complications due to surgical positioning and soft tissue trauma may occur, these can be considered a safe procedure for orthodontic treatment in cases requiring maximum anchorage.

### 374 USE OF TEMPORARY ANCHORAGE DEVICES FOR DENTAL UPRIGHTING

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**AIMS:** The use of temporary anchorage devices (TADs) in dental uprighting offers new possibilities for the treatment of severely inclined teeth. The opportunity to utilize bone anchorage allows appropriate treatment progression neutralizes side effects shown by alternative mechanics and to reach safely scheduled treatment scores. The aim of this research was to compare uprighting mechanics using traditional mechanics with miniscrews.

**MATERIALS AND METHOD:** Twenty-eight mandibular teeth that were uprighted were evaluated: 15 patients were treated with miniscrews and the other 13 with standard mechanics. The force to upright the teeth was delivered using an elastic chain or sectional wire with loops, depending on clinical needs. Anchorage displacement, treatment time, and patient satisfaction and comfort were evaluated.

**RESULTS:** Treatment time using miniscrews was reduced, the number of appliances was reduced and comfort ameliorated compared with other mechanics. Satisfaction and comfort at the end of treatment was higher in the TAD group.

**CONCLUSIONS:** Uprighting treatment was faster and safe using miniscrews. The use of miniscrews avoided common side effects of therapy such as displacement of the anchorage teeth. The possibility to use sectional mechanics with TADs optimized aesthetic results, especially in adults. The miniscrews did not cause severe complications and were well tolerated by patients.

### 375 INFLUENCE OF SECULAR TRENDS IN THE DEVELOPMENT OF PERMANENT TEETH FROM 1977 TO 2007

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**AIM:** The secular acceleration of growth with regard to changes in the morphology of the head and face, dimensions of the dental arches and teeth and development of teeth, is present in the orofacial region. The purpose of this study was to evaluate the influence of seculars trend on the development of permanent teeth from 1977 to 2009.

**MATERIALS AND METHOD:** One thousand two hundred panoramic radiographs of children aged from 6 to 17 years. In group A, 600 subjects (300 males, 300 females) the radiographs were taken from 1977 to 1979, and in group B, 600 subjects (300 males, 300 females) 2007 to 2009. Dental age was determined according to Demirjian's method.

RESULTS: Mineralization of permanent teeth in all segments was statistically greater in group B ( $P < 0.001$ ). The central incisors and first molars were statistically significant in the H stage of mineralization in group B ( $P < 0.001$ ) and the first and second premolars at G stage in the same group. All four third molars were statistically significant in the B stage of mineralization in group B ( $P < 0.001$ ).

CONCLUSIONS: Secular trends have a positive influence on the development of the permanent teeth.

### 376 UPPER CANINE ANOMALIES: GENETIC APPROACH

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AIM: Limited data has been published concerning the congenital absence of the permanent canines. Congenital absence of the permanent upper bilateral canines is an extremely rare condition. The aim of this study was to determine possible relationships among consanguine of this anomaly through an anamnestic and genetic investigation.

SUBJECT AND METHOD: A female patient (proband) with congenital bilateral permanent upper canines agenesis. Thirteen members of her family were studied. Six panoramic radiographs and the anamnesis of all the components of the family were collected and the genealogical tree was reconstructed. Finally blood samples of the 14 subjects enrolling both healthy and unhealthy subjects were analyzed.

RESULTS: Anamnesis excluded blood relationships among the members of the family. Clinical evaluation of the members of the family has demonstrated dental anomalies specific to the maxillary canine teeth in the females: The agenesis was observed in two individuals; complete or incomplete tooth impaction in four members and ectopic eruption in two patients. The proband presented with permanent upper bilateral canines. All had a normal primary dentition.

CONCLUSIONS: Dental anomalies can cause functional and aesthetic problems.

### 377 USE OF TEMPORARY ANCHORAGE DEVICES TO CORRECT SEVERE CLASS III MALOCCLUSIONS, WITHOUT ORTHOGNATHIC SURGERY

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AIM: Many Class III patients are unable to afford orthognathic surgery, or are happy with their facial appearance, but wish to improve their dental alignment, to prevent further wear to the anterior teeth. Lower premolar extractions have been the traditional method to treat these patients. This presentation will show an alternative technique.

MATERIALS AND METHOD: Cephalometric review of 20 consecutive cases, via a clinical audit, treated successfully via upper arch development and full fixed appliances, with the use of temporary anchorage devices (TADs) in the lower jaw, and a NiTi closing coil for *en masse* retraction of the mandibular dentition. It is important to place high torque brackets, in the lower incisor region, and or positive torque bends, to the retraction archwire, to counteract lingual tipping of teeth and to enhance bodily retraction of lower incisors. Low torque brackets are employed in the upper incisor region, to prevent flaring of the upper incisor teeth and encourage labial root torque.

RESULTS: Cephalometric evaluation showed a forward rotation of the occlusal plane with minimal retroclination of the lower incisor teeth, and an ideal Class I buccal segment relationship. All patients were happy with the changes to their facial profile.

CONCLUSION: This non-surgical orthodontic technique should be offered to Class III patients seeking a non-surgical approach for the correction of their negative overjet.

### 378 SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS BONDED WITH THREE DIFFERENT ADHESIVES – A PILOT STUDY

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AIM: To assess the shear bond strength (SBS) of orthodontic brackets bonded with two light and one self-cure adhesive.

MATERIALS AND METHOD: Thirty extracted molars were randomly divided into three equal groups and brackets were bonded to the teeth according to three protocols: In the first group after etching with phosphoric acid the No-Mix self-cure orthodontic bonding system (Dentaurum, Germany) was used. In the second group the brackets were bonded with self-



etching, light-cure Contec SE (Dentaurum) adhesive. In the third group the teeth were treated with phosphoric acid and the brackets bonded with light-cure resin Blugloo (Ormco, USA). After bonding the teeth were stored in distilled water for 24 hours and then debonded with an Instron testing machine with a crosshead speed of 2 mm/minute to assess SBS. The results were tested with ANOVA, NIR and Levene test at the  $P = 0.1$  level.

RESULTS: The mean SBS in the first group was 5.67 MPa (range: 1.86 to 9.23 MPa) and in the second group 4.91 MPa (0.99–8.67 MPa). SBS in the third group was significantly higher ( $P = 0.1$ ) higher compared with the other two groups with a mean value 9.20 MPa (7.55–13.27 MPa).

CONCLUSION: Light-cure adhesive used on etched enamel resulted in satisfactory bonding of orthodontic brackets but the findings require further investigation.

### 379 DETERMINATION OF IDEAL RATIOS, ANGLES AND DIVINE PROPORTIONS IN THE FACIAL AESTHETICS OF TURKISH ADOLESCENTS\*\*\*

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AIM: Although aesthetic improvement is the most frequently reported reason for seeking orthodontic treatment, and although orthodontic treatment is most frequently performed during adolescence, only minimal research has been performed on the evaluation of facial aesthetics in adolescents and on changes in facial aesthetics as a result of orthodontic treatment. Therefore, it was the aim of this study to investigate ideal ratios, angles and divine proportions in the facial aesthetics of adolescents

SUBJECTS AND METHOD: Sixty patients, aged 9 to 17 years, were selected, using randomized stratification for Angle Class. From each individual, a set of photographs was prepared showing three views: frontal resting, frontal smiling and lateral resting photograph simultaneously for pre- and post-treatment separately. Two panels consisting of 50 parents 50 orthodontists were constructed. Each set of pre-treatment photographs of one individual, together with the reference set, was shown for 10 seconds and the panel members were asked to assess facial aesthetics in relation to the reference set of which the visual analogue score (VAS) score was indicated, on a VAS from 0 to 100.

RESULTS: Orthodontists tended to direct their attention to certain portions of the face, such as the mandibular the sagittal position, the distance between the eyes and facial length; while parents focused only on the distance between the eyes and facial length. There was no correlation between aesthetic rating and the divine proportion in various facial ratios according to both orthodontist and parents.

CONCLUSIONS: Overall facial aesthetics in adolescents does not depend on any single facial feature. The evaluation of facial aesthetics is too complex to be explained by separate facial features or their combination.

### 380 CHANGES IN VERTICAL DIMENSIONS DURING TREATMENT WITH FIXED ORTHODONTIC APPLIANCES

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AIM: To determine changes in the vertical dimensions during treatment with fixed appliances in patients with an increased angle B (SpP/MP).

SUBJECTS AND METHOD: Twenty patients (14 females, 6 males) all with increased values of angle B (<20 degrees) before orthodontic treatment. Seven were Class I, seven Class II, and six Class III. Cephalometric tracings were carried out for each patient before and after treatment. The following parameters were measured and analyzed: angle B (SpP/MP), OCcP/NS, SpP/OCcP and OCcP/MP and vertical analysis for the position of the central incisors and molars according to Schwarz. For each parameter the average value, standard deviation and coefficient of variation were calculated. To determine statistically significant differences, a Student's *t*-test was used.

RESULTS: During treatment angle B did not change (increasing value), but the malocclusion in the vertical direction was decreased with changes in the occlusal plane. Angles OCcP/NS (18.99 and 18.00°, respectively) and OCcP/SpP (10.3 and 8.79°, respectively) decreased during treatment, while OCcP/MP increased (18.03 and 19.09°, respectively). The vertical position of the central incisors and last molar in occlusion was changed in correlation with the change of the occlusal plane.

CONCLUSION: An aesthetically and functionally acceptable occlusion (correct overbite and overjet) was achieved as a result of changes in the dentition (mostly by extrusion of the incisors).

### 381 THE ROLE OF POLYCYSTIN-1 AND CELL CYCLE PROTEINS IN LOADING OF CONDYLAR CARTILAGE TISSUE

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**AIM:** The chondrocytes of the condylar cartilage proliferate, hypertrophy and undergo apoptosis, being replaced by osteoblasts through the cell cycle. Converging results consolidate Polycystin-1 (PC1) is a pivotal factor in the proliferating process of all type of cells. The aim of the present study was to explore the possibility and extent by which mechanotransduction events affect on the expression levels of the PC1 and the cell cycle proteins CyclinD1, P27, Geminin and Ki-67 in the condylar cartilage.

**MATERIALS AND METHOD:** Fourteen-day-old female Wistar rats were divided into two groups: the first group was fed with soft diet and the second group with a hard diet. Sections of the rat temporomandibular joints were obtained on day 21 (weaning day) and investigated immunohistochemically at different time points, 6, 24 and 48 hours.

**RESULTS:** The data showed that PC1 is expressed in condylar cartilage cells, and its expression decreases in the early hypertrophic zone. It is more intense in the hypertrophic zone under loading and over time while it increases in the proliferating zone. CyclinD1 expression increases in the proliferation zone and decreases in the hypertrophic zone under mastication loading and over time. The result for P27[kip1] expression was completely the opposite. Geminin expression in the proliferating zone and over time, and increases in the early hypertrophic and hypertrophic under loading and over time. Ki-67 expression decreased in all layers at the 24 hours and under loading, while changes were more intense in the proliferating and early hypertrophic zone.

**CONCLUSIONS:** Altered mechanical load triggers differentiation phenomena within the condylar cartilage tissue under mastication loading and over time ultimately affecting condylar cartilage growth.

### 382 ATOMIC FORCE MICROSCOPY EVALUATION OF SURFACE ROUGHNESS OF NEW AND RETRIEVED NICKEL TITANIUM ARCHWIRES

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**AIM:** To evaluate the surface roughness of nickel titanium (NiTi) orthodontic archwires, before and after clinical use, by means of atomic force microscopy (AFM).

**MATERIALS AND METHOD:** Five NiTi wires were considered: (Sentalloy and Sentalloy High Aesthetic, GAC International; Titanium Memory, Titanium Memory Aesthetic and Everwhite, American Orthodontics). The wires were analyzed before and after one month of clinical use by patients with aesthetic brackets (Radiance, American Orthodontics). For every group, 20 areas each of five samples were analyzed by AFM (Perception, Assing, Italy) operating in contact mode. Three-dimensional images were processed by Gwiddion software and the roughness average (Ra), root-mean-square (Rms) and maximum height (Mh) values of the scanned surface profiles were recorded. Differences among the groups were statistically evaluated by one-way analysis of variance (ANOVA) with Tukey's *post hoc* test and by paired sample *t*-test ( $P < 0.05$ ).

**RESULTS:** The Ra, Rms and Mh values are expressed as the mean  $\pm$  standard deviation. Among 'as-received' archwires Everwhite (Ra =  $22.5 \pm 6.2$ ; Rms =  $29.8 \pm 9.1$ ; Mh =  $226.9 \pm 75$ ) resulted in a less rough surface than other wires (ANOVA,  $P < 0.05$ ), followed by Titanium Memory (Ra =  $32.7 \pm 12$ ; Rms =  $41.9 \pm 14.9$ ; Mh =  $299.5 \pm 75.7$ ), Titanium Memory Aesthetic (Ra =  $50.3 \pm 15.2$ ; Rms =  $61.7 \pm 18.4$ ; Mh =  $416.3 \pm 251.9$ ) and Sentalloy (Ra =  $71.1 \pm 15.4$ ; Rms =  $87.4 \pm 19.7$ ; Mh =  $497.8 \pm 153.4$ ). Sentalloy High Aesthetic was the most rough (Ra =  $133.5 \pm 10.8$ ; Rms =  $165.8 \pm 9.8$ ; Mh =  $949.6 \pm 192.1$ ) (ANOVA,  $P < 0.05$ ). After clinical use, a considerable increase of surface roughness was found (*t*-test,  $P < 0.05$ ).

**CONCLUSIONS:** The coated archwires, Everwhite and Titanium Memory Aesthetic, showed lower surface roughness than Sentalloy High Aesthetic before and after clinical use. Further investigations should focus on the correlation between these findings and the sliding resistance of wires in brackets.

### 383 INVOLVEMENT OF ETB RECEPTORS IN EXPERIMENTAL TOOTH MOVEMENT IN RATS

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AIM: Many mediators are involved in bone modelling processes during orthodontic tooth movement (OTM). Among them are endothelins. They act on two subtypes of endothelin receptors: ETA and ETB. The aim of this study was to determine the role of ETB in bone modelling during OTM using rats with deletion of the gene for ETB.

MATERIALS AND METHOD: Twenty-four male Wistar rats (11-12 weeks old) divided into two equal groups. The experimental group consisted of rats with deletion of the gene for ETB (Knock out ETB rats - KOETB rats), and the control group rats with the gene for ETB (Wild type ETB rats- KOBWT rats). In both groups a superelastic closed coil spring (GAC International, 25 cN) was placed between the upper left first molar and upper incisors. The distance between the teeth was measured on days 0, 7, 14, 21, 28, 35 and 42. Tooth movement was subsequently calculated. On day 42 the animals of both groups were sacrificed and samples of the maxilla containing all three molars were taken for histological analysis. Alveolar bone volume covered with osteoblasts and osteoclasts were determined histomorphometrically.

RESULTS: Tooth movement in the KOETB animals was significantly less on days 7\*, 14\*, 18\*\*, 35\*\* and 42\*\* compared with the KOBWT animals (\* $P < 0.01$ , \*\*  $P < 0.05$ ). Alveolar bone volume covered with osteoblasts and osteoclasts on the pressure and tension side was not significantly different on day 42 between either group.

CONCLUSIONS: ETB are involved in bone modelling processes during OTM in rats. Since alveolar bone volume covered by osteoclasts and osteoblasts did not differ among the control and experimental groups, it is proposed that the absence of ETB influences the activity of cells.

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#### 384 A CONTROLLED STUDY ON MAXILLARY DENTAL ANOMALIES IN UNILATERAL CLEFT LIP AND PALATE SUBJECTS

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AIM: To evaluate the prevalence of dental abnormalities of the primary and permanent maxillary dentitions in children affected by unilateral cleft of the lip and palate (UCLP).

SUBJECTS AND METHOD: One hundred and eleven Caucasians (38 females, 73 males, aged 10 years and 4 months  $\pm$  1 year 7 months) affected by non-syndromic UCLP. The control sample comprised 1,000 subjects (482 males, 518 females) without a UCLP or any other congenital syndrome. The diagnosis of dental anomalies was corroborated by longitudinal records in case these were needed. All comparisons were carried out by means of  $z$ -tests on proportions.

RESULTS: The prevalence rate for missing primary lateral incisors in the UCLP subjects was 8.1 per cent, and 27.9 per cent for the permanent lateral incisors.. The second premolar was absent in 5.4 per cent of the UCLP subjects. Statistical analysis revealed significant differences for the prevalence rates of all dental anomalies compared with the control group, except for second premolar agenesis.

CONCLUSIONS: In UCLP subjects the most prevalent missing teeth were the lateral incisors. The dental anomalies occurred predominantly in the cleft area, thus suggesting that the effect of the cleft disturbance is more local than general on the dentition.

#### 385 THIN-PLATE SPLINE ANALYSIS OF TREATMENT EFFECTS OF BONE-ANCHORED MAXILLARY PROTRACTION IN GROWING CLASS III PATIENTS

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AIM: To morphometrically investigate the effects of bone-anchored maxillary protraction (BAMP) in the treatment of growing patients with Class III malocclusions.

SUBJECTS AND METHOD: The shape and size changes in the craniofacial configuration of a sample of 26 children with Class III malocclusions consecutively treated with the BAMP protocol were compared with a matched sample of 25 children with untreated Class III malocclusions. All subjects in the two groups were at a pre-pubertal stage of skeletal development at the time of first observation. The average duration of treatment was 14 months. Statistical analysis was performed by means of permutation tests.

RESULTS: Significant treatment-induced modifications involved both the maxilla and mandible. The most evident deformation consisted of marked forward displacement of the maxillary complex with more moderate favourable effects in the mandible ( $P < 0.01$ ). No changes were detected in the vertical dimension. The significant changes in shape were associated with significant differences in size in the group treated with the BAMP protocol.

**CONCLUSIONS:** The use of a bone-anchored orthopaedic protocol is able to induce significant favourable shape and size changes in the maxilla and mandible of growing Class III patients as revealed by morphometric analysis that allows for statistical evaluation of craniofacial modifications.

### 386 OBSERVATIONS ON MIDFACE DISCREPANCIES IN PATIENTS WITH ACHONDROPLASIA

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**AIM:** Achondroplasia is an autosomal, dominant, genetic disorder. Its gene has full penetration. Achondroplasia appears in 1 over 15-27 000 live births. Characteristic features of achondroplasia are seen in newborns, the most characteristic sign is posture shortening, due to limb shortening.

**MATERIALS AND METHOD:** Cephalometric parameters from 18 patients (11 females, 7 males) were analysed. In all cases achondroplasia was confirmed, clinically and genetically. Cephalometric analysis included angles and proportions between linear dimensions. Statistical analysis was conducted, which included calculating the mean value of each cephalometric parameter. Normality was also calculated. The correlations between the cephalometric parameters were analyzed.

**RESULTS:** The largest differences in values were noted for angles: S-N-A (mean 79.2°), NL-NSL (mean 2.3°), ML-NL (mean 34.2°). The mean values for linear dimensions were also not within the normal range: N-SP/SP-GN was 62.2 per cent and S-GO/N-GN 65.1 per cent. Correlation analysis showed high values for pairs, ML-NSL to S-GO/N-GN (−0.95) and S-N-A to S-GO/N-GN (0.91).

**CONCLUSION:** The highest level of change was related to maxillary retrognathism, and the vertical linear dimensions. The commonly described mandible prognathism was not observed.

### 387 CLASS II DIVISION 2: ONE CLINICAL ENTITY?

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**AIM:** A Class II division 2 malocclusion is defined as a Class II dental relationship with retroclination of the upper central incisors. The lower incisors can be either proclined or retroclined. This difference can influence treatment planning. The objective of this study was to compare these 'subgroups' in order to understand the reasons behind this difference.

**MATERIALS AND METHOD:** Pre-treatment lateral cephalograms of Class II division 2 patients who fulfilled the following criteria: at least 20 years old, no previous orthodontic treatment, not more than one permanent molar missing, and upper central incisor inclination less than 95 degrees. A total of 37 patients were originally digitized, traced and analysed using cephalometric software. Six of these patients were males and were excluded in order to simplify the statistical evaluation. A two-step cluster analysis was used to separate the sample into two groups, the lower incisor proclination group (LIP; n = 17,  $\mu$  = 97.8°) and the lower incisor retroclination group (LIR; n = 14,  $\mu$  = 82.6°).

**RESULTS:** LIP patients had higher ANB ( $P$  = 0.043) and overjet ( $P$  = 0.010) values. There was no difference in the position and the size of the maxilla, but the LIP group had inferior SNB ( $P$  = 0.012) and a shorter mandibular body ( $P$  = 0.002). BNPg was also inferior in the LIP group ( $P$  = 0.012). No vertical skeletal difference was detected. Upper incisor retroclination was more marked in the LIR group ( $P$  = 0.002).

**CONCLUSIONS:** In this sample of Class II division 2 adults, lower incisor proclination was associated with a small mandible, whereas lower incisor retroclination was associated with a normally sized mandible with a posterior position of the alveolar process in relation to the chin. This may reflect different aetiologies of the Class II division 2 malocclusion.

### 388 GALWAY AND ROSCOMMON, IRELAND: CLEFT-AFFECTED CHILDREN'S UPTAKE OF DENTAL SERVICES

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**AIM:** A multispecialist joint-clinic, servicing the west of Ireland, was established in University College Hospital, Galway in the mid-1990s. Specialist services included plastic surgery, speech therapy, Ear Nose Throat specialties and orthodontics. The aim of this study was to profile this clinic, with particular focus on cleft-affected children born and resident in the counties of Galway and Roscommon, since January 1st 2000.



**MATERIALS AND METHOD:** A retrospective analysis was carried out on all data on cleft-affected children, held in the Regional Orthodontic Department, Galway.

**RESULTS:** One hundred and forty one cleft-affected children, who had attended the clinic, were identified, with 97 (69%) resident in Galway, 34 (24%) in Mayo and 10 (7%) in Roscommon. Fifty-three cleft-affected children were identified in the study period, with a county breakdown of: Galway 37, Mayo 12 and Roscommon four. Fifty-one were Caucasian and two non-Caucasian, both resident in Roscommon. There were 30 males and 23 females giving a M:F ratio of 1:0.77. The highest incidence was in 2001, with 11 births. For the focus group, uptake of specialist paediatric dental services, available only in Galway city, was found to be 16 Galway, (4 males, 10 females) and one Roscommon, (female).

**CONCLUSIONS:** A joint approach to the management of cleft-affected children has been established in the west of Ireland, combining medical, dental and related services. Specialist dental services involving orthodontics and paediatric dental services are provided by the State, at no cost, to this special dental needs group. Uptake of these essential dental services was variable and requires review.

### 389 BEAUTY IS NOT IN THE EYE OF THE BEHOLDER

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**AIM:** To determine the contemporary perception of the ideal facial profile position, related to orthognathic surgery options, and to test the influence of gender, age, sexual orientation, educational and professional background of the raters.

**MATERIALS AND METHOD:** Digital profile photographs of a female and a male model with skeletal Angle Class I relationships were obtained. Incremental modifications of the anterior lower face based on the standards defined by Schwartz (1958) were performed. With fixed vertical proportions and a balanced sagittal intermaxillary relationship, nine different anteroposterior positions of the face were judged for attractiveness. An online web survey was set up using a visual analogue scale to score the profiles from 0 to 100, with reference to a profile arbitrarily assigned a score of 50. The profiles were scored by 1707 raters (69% females, 31% males, aged between 18 and 77 years). The sample consisted of 90 per cent heterosexuals and 10 per cent lesbian, gay, bisexual, transgenders (LGBTs), 5 per cent orthodontists and 1 per cent surgeons. Non-parametric tests were performed for age, professional status, gender and sexual preference. The level of significance was set at  $P < 0.05$  for all analyses.

**RESULTS:** The female raters scored the male anterior profiles more attractive ( $P < 0.001$ ) and the male retruded profiles less attractive ( $P = 0.002$ ) than male raters. Young raters ( $\leq 30$  years) scored the male protruded profiles as more attractive than older raters ( $> 30$  years;  $P = 0.008$ ). There were no significant differences between heterosexuals and LGBTs for the female and male profiles. There were significant differences between orthodontists, surgeons and laymen, more for the female profile than for the male profile.

**CONCLUSIONS:** Compared with the straight average profile (Schwartz, Obwegeser and Marentette), there is a contemporary shift of preference towards a straight protruded profile, more for male than for female facial profiles.

### 390 BONE CELL ACTIVITY DURING ORTHODONTIC TOOTH MOVEMENT IN A TYPE 2 DIABETES RAT MODEL

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**AIM:** Type 2 diabetes mellitus is a metabolic disorder considered to also affect bone metabolism. During orthodontic tooth movement bone is resorbed on the pressure side and new bone is formed on the apposition side. Therefore, the aim of the present study was to examine the amount of tooth movement and biochemical parameters of bone turnover in Goto-Kakizaki rats, a type 2 diabetes animal model, during orthodontic tooth movement.

**MATERIALS AND METHOD:** Male rats were divided into four groups: Wistar control group ( $n = 8$ ), Goto-Kakizaki control group ( $n = 8$ ), Wistar appliance group ( $n = 8$ ) and Goto-Kakizaki appliance group ( $n = 8$ ). Animals of the last two groups were fitted with a superelastic closed coil spring appliance placed between the first and second molars and the incisors in the upper jaw. The appliance was replaced weekly. Tooth movement was measured weekly on days 0, 7, 14, 21, 28, 35 and 42, respectively. On day 42 animals of all four groups were sacrificed and the upper jaws were taken for further

analyses. Gene expression levels for cathepsin K, a marker of osteoclast activity, and osteocalcin, a marker of osteoblast activity, were determined by means of RT-PCR.

RESULTS: No statistically significant difference was observed in orthodontic tooth movement between either appliance group. The physiologic distal drift of the molars was greater in Goto-Kakizaki rats than in Wistar rats ( $P < 0.05$ ). Increase in osteoclast activity was observed only in the Wistar appliance group ( $P < 0.05$ ). Osteoblast activity was decreased in the Goto-Kakizaki appliance group compared with the Goto-Kakizaki control group ( $P < 0.05$ ).

CONCLUSION: During orthodontic force application no difference in the amount of tooth movement between the Wistar and Goto-Kakizaki appliance groups was observed. However, the results suggest that the response of osteoclasts and osteoblasts during orthodontic tooth movement in rats with type 2 diabetes is compromised.

### 391 PREVENTIVE MEASURES FOR BIOFILM FORMATION ON ORTHODONTIC COMPOSITE†

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AIM: To modify orthodontic composite with a quaternary ammonium monomer to decrease biofilm formation.

MATERIALS AND METHOD: The modified-composite was prepared by mixing 3-(methacryloylamino) propyl trimethylammonium chloride solution into Transbond XT light-cured composite at weight-weight percentages (w/w) from 0 to 28 per cent. The bactericidal activity and time-kill kinetics of the modified-composite, with or without salivary conditioning films, against five streptococcal strains was tested by direct contact test. The cytotoxicity effect of the modified-composite on human skin fibroblast was assessed by the growth in the culture medium exposed to the modified composite for 7 days. Bond strength of the modified-composite to enamel was investigated with a universal testing machine.

RESULTS: The modified-composite showed strong bactericidal activity against five streptococcal strains without salivary conditioning film. The minimum contact killing percentage for *S. sanguinis* was 20 per cent w/w, and 16 per cent w/w for *S. mutans* and *S. sobrinus*. Time-kill determination indicated a high killing efficiency; and more than 99 per cent of bacterial cells were killed within 15 minutes at the minimum contact killing percentage. Although the effects were attenuated, the saliva-coated modified-composite still exhibited growth inhibition at 24 per cent w/w for *S. sanguinis* and 20 per cent w/w for *S. mutans* and *S. sobrinus*. No cytotoxic effect of the modified-composite was observed at 20 per cent w/w on human skin fibroblasts. Bonding strength of the modified composite was 6.3 and 6.8 MPa at 20 and 16 per cent w/w, respectively.

CONCLUSION: Quaternary ammonium monomer can be effectively incorporated into orthodontic composite to prevent biofilm formation without cytotoxicity.

†Winner of an EOS poster award.

### 392 TEMPOROMANDIBULAR JOINT CONDITION UNDER THE RAPID MAXILLARY EXPANSION APPLIANCES

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AIM: To determine changes in condyle position under the influence of various fixed appliances for rapid maxillary expansion (RME) in the transverse plane.

SUBJECTS AND METHOD: Twenty-two patients aged 11-16 years with symmetrical narrowing of the maxilla during late mixed dentition and permanent dentition. A Class-II malocclusion was diagnosed in 10 individuals, and 72.7 per cent of them demonstrated temporomandibular joint (TMJ) pathology. Twelve subjects (73.4%) diagnosed with a Class III malocclusion demonstrated TMJ pathology. Fifty per cent of the patients with Class II and Class III malocclusions were treated with a Hyrax appliance, and another 50 per cent with an orthodontic appliance supported by an occlusal splint. Changes that occurred after use of the RME appliances were measured and analyzed by standard and lateral cephalometric analysis. Comparison of the following quantitative parameters were carried out: maxillary width (JR-JL), intermolar distance (B6-B6), measurement of maxillary first molar angulation; position of the maxillary molar in relation to the palatal plane (B6 to palatal plane), anterior face height (ANS-Me) (cephalometric imaging in lateral projection). The position of condyle was analysed by computed tomography before appliance insertion and immediately and 6 months after their removal. Following parameters were analysed: Straight projection: 1. Skeletal: maxillary width; 2. Dental: change of upper first molar angulation; Lateral projection: 3. Skeletal: lower frontal face height ANS-Me; 4. Dental: position of B6 in relation to the palatal plane. 5. Changes in joint space depending on appliance type and terms of imaging.

RESULTS: Immediately after appliance removal, it was observed that parameter 1 increased in all patients, on average, by 4.7 mm. Parameter 2 showed 21.7 per cent less inclination of load bearing teeth following use of the occlusal splint appliance.

Parameter 3, in patients with a Class II malocclusion, increased, in general, by 4.4 mm with the use of a Hyrax appliances and with the occlusal splint by 1.7 mm. Patients with a Class III malocclusion demonstrated an increase of 3.7 mm

### 393 DEHISCENCE AND FENESTRATION EVALUATION IN PATIENTS TREATED WITH FIXED AND REMOVABLE FUNCTIONAL APPLIANCES

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AIMS: To compare the presence of dentoalveolar defects after Forsus FRD EZ and bionator appliances.

MATERIALS AND METHOD: Forty cone beam computed tomographs of 20 patients, 10 treated with a fixed functional appliance, Forsus FRD EZ, and 10 with a removable functional appliance, bionator. For the Forsus group, pre-treatment cone-beam computed tomographic images were taken after the levelling stage of treatment and post-treatment images after six months. For the bionator group pre- and post treatment images taken six months after the first records were used. Sagittal and vertical evaluation of the treatment groups was assessed. The i-CAT software program was used for evaluation of dehiscences and fenestrations. Panoramic screen slices taken from the roots of the upper and lower incisors, canines, premolars and first molars either buccally or lingually were investigated. All of the variables were tested with the Statistical Package for Social Sciences, version 16.0.

RESULTS: Statistically significant results were obtained in comparison of pre- and post-treatment records.

CONCLUSION: Treatment with functional appliances might lead to dehiscence and fenestrations in patients.

### 394 PREVALENCE OF ANTERIOR CROSSBITES IN ORTHODONTIC PATIENTS

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AIM: An anterior crossbite is a common symptom among Class III malocclusion subjects. The aim of this study was to determine the prevalence of an anterior crossbite among orthodontic patients.

MATERIALS AND METHOD: Clinical charts of 432 consecutive patients (between 6 and 24 years of age who underwent orthodontic treatment between 2008-2009) were retrospectively reviewed and simple statistical interpretation of the data was undertaken.

RESULTS: From the 432 cases only 115 (26.62%) manifested one of the clinical forms of a Class III malocclusion. Of these 115 patients, 45 had from an anatomical Class III, 16 a functional form and 54 an anterior crossbite. The clinical charts were also classified with regard to age groups: 6-9 years (the first phase of the mixed dentition) which consisted of 42 patients, 9-12 years (the second phase of the mixed dentition) with 33 subjects and above 12 years of age with 40 patients. The distribution of the patients with regard to age was somewhat equal. From the 115 patients with Class III malocclusions 101 (87, 83%) had associated anomalies and only 14 the singular clinical form.

CONCLUSIONS: Early treatment is more affective.

### 395 ASSOCIATION BETWEEN DENTAL AND SKELETAL MATURATION STAGES IN CROATIAN SUBJECTS

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AIM: To investigate the relationship between the stages of calcification of teeth and the cervical vertebral maturity stages.

SUBJECTS AND METHOD: Two hundred and ninety five subjects (129 males, 166 females). The mean age for the sample was  $13.36 \pm 2.65$  (range 7-18 years). Dental age was evaluated from panoramic radiographs according to the method of Demirjian. Cervical vertebral maturation was determined on lateral cephalometric radiographs using cervical vertebrae maturation stages (CVS). For assessing the relationship between cervical vertebral and dental maturation, percentage distributions of the stages of calcification for each studied tooth were calculated.

RESULTS: Only in the first stage of CVS, were boys and girls of the same age. In all other stages (CVS 2- CVS 6) girls were 0.98 (range 0.23-1.86) younger than boys. Gender differences in the mineralization pattern were also observed. It was found that the dental maturation finished earlier in the female subjects. The highest correlation coefficient between dental and skeletal maturity was for second premolars.

CONCLUSIONS: The mineralization pattern of second premolars could be considered as a guideline for prediction of the pubertal growth spurt. Dental maturation stages might be clinically useful as a reliable indicator of facial growth.

### 396 TEMPORARY ANCHORAGE DEVICE STABILITY: AN EVALUATION OF THREAD SHAPE

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**AIM:** The resistance to extraction of temporary anchorage devices (TADs) depends on various factors (miniscrew design, shear strength, bone density); in this research the thread shape factor (TSF) is introduced for evaluation of the mechanical properties of TADs.

**MATERIALS AND METHOD:** Three TADs were evaluated in a total of 27 tests: Mini Impianto Autoforante (Leone, 1.75 mm diameter, 8 mm length); Orthoscrew (Leader Ortodonzia, 1.65 mm diameter, 9 mm length) and MAS (Miniscrew Anchorage System, 1.3 mm diameter, 11 mm length). For each TAD images were acquired via a 20.00-kV scanning electron microscope to measure their respective mean depth of thread (D), pitch (P) and relationship (TSF). Pullout tests were then carried out using a testing machine on an organic bone analogue (having three different cortical thicknesses: 2.2, 1.4 and 1.1 mm). A crosshead speed of 2 mm/minute was applied. A two-way ANOVA with interaction was performed to determine differences between miniscrews and thickness. A *post-hoc* analysis for single comparisons was assessed and Scheffè test, for homogeneity of variances not rejected. ATamhane test was carried out if homogeneity of variances assumption was not met. Univariate linear regression models were fitted to evaluate the relationship between outcomes and, separately, TSF, D and P. A value of  $P < 0.05$  was considered statistically significant.

**RESULTS:** Statistically significant differences between miniscrews were found regarding 'load at peak' and 'load at break' ( $P = 0.005$  and  $P = 0.015$  respectively) while there were no differences between thickness ( $P = 0.25$  and  $P = 0.07$  respectively). The effect of the miniscrews was not conditioned by levels of thickness ( $P = 0.63$ ). From univariate linear regression, TSF, D and P were statistically significant to predict load at peak while TSF and D were statistically significant to predict load at break.

**CONCLUSIONS:** TSF showed a statistical significance for describing the mechanical competency of TADs.

### 397 EFFECTS OF RAPID MAXILLARY EXPANSION ON SPHENO-OCCIPITAL SYNCHONDROSIS

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**AIM** To evaluate the changes in sphenooccipital synchondrosis features 1 year after rapid maxillary expansion (RME) therapy, in order to assess the influence that these changes, if any, have on sagittal and vertical skeletal cephalometric variables.

**SUBJECTS AND METHOD:** All patients were selected retrospectively and consecutively. The RME group comprised 30 Caucasian patients (13 males, 17 females). These patients underwent RME with two turns a day (0.20 mm per turn) until the posterior crossbite was overcorrected. The Haas expander was left on the teeth as a passive retainer for an average of 6 months. Comparisons were made with an untreated control group of 15 subjects, matched by age, gender and vertebral skeletal maturity (CVM method, stage 1 to 3). Cephalometric analysis was performed. The sphenooccipital synchondrosis variables were: N-S-Ba°, SOS-Ba, SOS-S, S-Ba, Ba-N. Four skeletal variables for sagittal and vertical evaluation (SNA°, SNB°, S-N/Go-Me°, AFH/PFH%) were selected. Descriptive statistics were computed for each variable. Patient data were compared that from the untreated group using *t*-tests. Method error was also determined.

**RESULTS:** Statistically significant differences in cranial base angle, SOS-Ba and S-Ba were found between the RME and control group. No anteroposterior or vertical skeletal changes were associated with sphenooccipital synchondrosis and cranial base angle changes.

**CONCLUSION:** RME has a statistically significant effect on sphenooccipital synchondrosis. These changes do not seem to be significant in the vertical and sagittal planes.

### 398 ADHESIVES FOR BONDED MOLAR TUBES: A COCHRANE SYSTEMATIC REVIEW

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**AIM:** To evaluate the effectiveness of the adhesives used to attach bonded molar tubes (BMT) in terms of failure rate during treatment and decalcification.

**MATERIALS AND METHOD:** The Cochrane Oral Health Group Trials Register, the Cochrane central Register of Controlled Clinical Trials (CENTRAL), (The Cochrane Library 2010)), Medline via Ovid and Embase via Ovid were searched with no



restrictions regarding language or date of publication. Randomised controlled trials with full arch fixed appliance(s) with molar tubes bonded to first or second permanent molars were included. Trials on BMTs were included where the following were compared: two types of adhesives used to bond BMTs; BMT or band allocated to the same tooth type in the same arch; BMTs or bands allocated to the same tooth type in different patient groups. The selection of papers, decisions about eligibility and data extraction were carried out independently and in duplicate without blinding to the authors, adhesives or results. All disagreements were resolved by discussion.

**RESULTS:** Two trials were included which presented data on first failure at the tooth and patient level; pooling of data from either source showed a statistically significant difference in favour of molar bands (hazard ratio 2.92 (95%CI 1.80-4.72)) and risk ratio 2.30 (95%CI 1.56-3.41) respectively. One trial showed a statistically significant difference in favour of molar bands for decalcification.

**CONCLUSIONS:** The failure rate of BMT with either a chemically- or light-cured adhesive was considerably higher than that of molar bands cemented with glass ionomer cement. Less decalcification was observed on first permanent molars banded with glass ionomer cement than with light-cured adhesive. Given the limited data, further evidence is required with different adhesive systems/ different molar tube designs.

#### 399 CORRELATION BETWEEN SOFT AND HARD TISSUE LANDMARKS IN 14 TO 18 YEAR-OLD IRANIANS WITH A CLASS II DIVISION 1 MALOCCLUSION

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**AIMS:** Aesthetics is one of the major demands of orthodontic patients. Therefore, aesthetic orthodontics with special attention to soft tissues is considered as a new philosophy and approach. The purpose of this study was to investigate the correlation between selected hard tissue structures and soft tissue landmarks.

**MATERIALS AND METHOD:** Thirty-six pre-treatment lateral cephalograms from 14-18 year-old Iranian girls with a Class II division 1 malocclusion with all permanent teeth erupted and no apparent syndrome. All cephalograms were taken with the same machine, and similar magnification. Eleven cephalometric hard and 10 soft tissue landmarks were measured. Analysis of the data was conducted using Pearson correlation and multiple regression procedures.

**RESULTS:** A significant correlation was observed between some dentoskeletal parameters and soft tissue structures. In the upper lip, the thickness in the base was related to ANB ( $P = 0.032$ ) and upper incisor position ( $P = 0.032$ ), whereas, the vermilion was affected by the position of the lower incisors ( $P = 0.032$ ). Basal soft tissue thickness of the lower lip was related to the position of the lower incisors ( $P = 0.015$ ), while the vermilion was related to the position of the upper incisors ( $P = 0.001$ ). Upper lip height was associated with Wits appraisal ( $P = 0.003$ ) and lower incisor position ( $P = 0.037$ ), whereas lower lip height was affected by FMA ( $P = 0.019$ ) and lower incisor position. Mentolabial angle had the highest coefficient with hard tissue structures such as FMA, ANB, and the position of the upper and lower incisors. No relationship was detected between chin height, nasolabial angle and hard tissue parameters.

**CONCLUSION:** According to correlations between soft tissue and dentoskeletal structures that tend to compensate for hard tissue problems, both factors should be considered when diagnosing or treating orthodontic patients

#### 400 APPLICATION OF A NEW APPLIANCE FOR SIMULTANEOUS EXPANSION OF THE UPPER ARCH AND DISTALIZATION OF THE UPPER MOLARS

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**AIM:** A new appliance was designed combining features of the Haas (Hyrax) appliance with acrylic splits and the Pendex (Pendulum) appliance with tungsten molybdenum alloy distalizing springs. It is designed for simultaneous expansion of the maxilla and distalization of upper permanent molars. The aim of this research was to assess the safety and effectiveness of the new appliance.

**SUBJECTS AND METHOD:** Between 2009 and 2010, 15 patients (4 boys, 11 girls) were enrolled in the study. Their mean age was 11.6 years (range 9.5-12.5 years). All of the patients had a narrow maxilla and maxillary crowding. In six patients there was a complete absence of space for the upper second premolars and in nine a complete and partial absence of space for the upper canines. Six patients had Class III malocclusion.

**RESULTS:** During an average follow-up period of 4.3 months no adverse effects connected to the new appliance were observed. Moreover, there were none of adverse effects typical for Pendex appliance treatment, such as: excessive protrusion of the upper incisors, tendency for crossbite, or extrusion of the permanent upper molars. During treatment the average distalization both upper permanent molars was 3.94 mm.

**CONCLUSIONS:** The new appliance is safe and allows achievement of the planned treatment in a shorter period of time compared with conventional treatment options. However, further studies on larger group of patients are needed.

#### 401 EVALUATION OF THE AMOUNT OF ERUPTION OF THE FIRST MOLARS IN HYPODONTIA CASES

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**AIM:** To clarify the amount of eruption of first molars in hypodontia cases treated with removable functional orthodontic appliances.

**SUBJECTS AND METHOD:** Twelve patients (6 males, 6 females, range of number of affected teeth: 1-6), diagnosed with maxillary protrusion and orthodontically treated. The control group comprised 14 patients (5 males, 9 females) with the diagnosis of maxillary protrusion without congenitally missing permanent teeth, in whom similar removable functional appliances were used. Conventional cephalometric analysis on lateral roentgenographic cephalograms from before and after appliance use was performed.

**RESULTS:** The mean amount of vertical change of the maxillary and mandibular first molar was +2.4 and +2.6 mm, respectively in the hypodontia group, and +2.5 and +1.9 mm, respectively, in the control group, with no significant differences observed between the groups. In three subjects with a congenital missing tooth in the maxillary dentition alone, the amount of change in the maxillary first molars was large. In six cases in which a congenital tooth defect was present in the mandibular dentition alone, the amount of change in the mandibular first molars was also large. Furthermore, in three cases in which congenital missing teeth were noted in both the maxillary and mandibular dentitions, the amount of change in the maxillary first molars was marked.

**CONCLUSION:** The present findings suggest the possibility that although bite raising was achieved through the use of functional appliances in the hypodontia group, the amount is influenced by the sites of the congenitally missing permanent teeth.

#### 402 CEPHALOMETRIC ANALYSIS IN DOWN SYNDROME PATIENTS

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**AIM:** As they are now able to receive treatment under national health insurance, the number of Down syndrome (DS) patients seeking orthodontic treatment is increasing in Japan. The purpose of this study was to identify the occlusal status and craniofacial morphology in DS patients.

**MATERIALS AND METHOD:** Lateral cephalometric radiographs, facial and oral photographs and plaster models of 10 male DS patients aged 8-17 years. Cephalometric measurements were compared with average values in literature.

**RESULTS:** The anteroposterior occlusal relationship was characterized by maxillary protrusion in two cases, an acceptable overjet in one and an anterior crossbite in seven. Vertically, an open bite was observed in one subject, a tip-to-tip bite in three, and an acceptable overbite in six. One patient had a deep bite. Few anterior crossbite cases were severe, although one showed skeletal mandibular protrusion with an open bite. A lingual crossbite was caused by maxillary contraction in 4 cases. Crowding of anterior teeth was observed in six subjects. Spacing of anterior teeth due to congenital tooth absence was observed in four. Angle Classification was Class I in 30 per cent, Class II in 35 per cent and Class III in 35 per cent. Brachyfacial was the most common face type as the facial axis was larger than average ( $P < 0.01$ ) and the gonial angle smaller ( $P < 0.05$ ). No significant difference was observed in SNA, SNB, or ANB compared with average values. Lateral cephalograms revealed characteristic mild maxillary retrusion and slight mandibular protrusion. The labial inclination of U1 and L1 was excessive ( $P < 0.05$ ). Overjet was  $-0.5 \pm 5.6$  mm and overbite  $0.9 \pm 1.9$  mm, both smaller than average ( $P < 0.01$ ).

**CONCLUSIONS:** DS is characterized by mandibular protrusion caused by a brachyfacial type and inclination of upper and lower incisors. Therefore, occlusion in these DS patients was characterized by a mild anterior crossbite with a short overbite.

#### 403 MECHANICAL STRESS ON THE PERIODONTIUM INFLUENCES EXPRESSION OF AQUAPORIN-5 IN THE RAT SUBMANDIBULAR AND SUBLINGUAL SALIVARY GLANDS

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**AIMS:** Previous studies have shown that a reduction of mechanical stress on the periodontium induces reduced salivary secretion and morphological changes in the salivary glands of the rat. However, the details of the mechanisms responsible for these changes in salivary gland function are still unknown. Aquaporins (AQPs) are membrane proteins that form water channels, and aquaporin-5 (AQP5) plays an important role in water transport. The purpose of this study was to investigate the effect of mechanical stress on the periodontium on the expression of AQP5.

**MATERIALS AND METHODS:** Seven-week-old male Wistar rats (n = 36) were randomly divided into control (n = 18) and experimental (n = 18) groups. In the experimental group, all right maxillary molars were extracted to eliminate mechanical stress on the periodontium in the molar region. All rats were fed a powdered diet. The rats were sacrificed at 1, 2 and 4 weeks after the procedure. The right submandibular and sublingual glands were rapidly isolated and weighed. Tissue samples were fixed by immersion in 4 per cent paraformaldehyde overnight, and then embedded in paraffin and cut into 5 µm thick serial sections. The sections were stained with Mayer's haematoxylin and eosin. The expression of AQP5 was detected by immunohistochemistry.

**RESULTS:** The wet weight of the submandibular and sublingual glands was not significantly different between the two groups. Morphological analyses showed a hypertrophic change in acinar cells in the experimental group. Immunohistostaining of AQP5 was detected on the apical membrane and intercellular secretory canaliculi of acinar cells in both groups. Immunohistochemical analysis revealed a change in AQP5 expression in all of the animals in the experimental group.

**CONCLUSIONS:** Mechanical stress on the periodontium plays an important role in water transport in the rat submandibular and sublingual glands.

#### 404 AGE-RELATED PERIOSTEAL BONE MODELLING INDUCED BY RAT INCISOR MOVEMENT

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**AIM:** Orthodontic side effects induced orthodontic tooth movement such as root resorption and bone dehiscence are usually associated with bone modelling in the periosteal side of alveolar bone. The aim of this study was to compare the pattern of bone modelling.

**MATERIALS AND METHOD:** The pattern of bone modelling was histologically examined in different age groups and duration of force application when orthodontic force (40 g) was applied to the incisor of young (12 weeks) and adult (8-12 months) rats using double helical spring

**RESULTS:** In the 7 day group, active bone modelling, represented by a scalloped surface, was observed on the periosteal side of the crestal and middle alveolus at the compressed side in the young group, while similar changes were observed only on the crestal area in the adult group. In the young group, the number of proliferating cell nuclear antigen (PCNA) positive cells increased greatly in the crestal area and middle alveolus compared with the control group in the 3, 7, and 14 day groups, while they decreased in the 21 day group. In the adult group, PCNA positive cells appeared localized on the crestal area throughout time. In the young group, FGFR2 positive cells were observed more on crestal and middle alveolar processes than control group on 3, 7, 14 days groups. In the adult group these cells appeared on the crestal and middle alveolus on the 3 day group, but mainly on the crestal area on 14 days group.

**CONCLUSION:** it is speculated that orthodontic tooth movement may stimulate cell proliferation and differentiation on the periosteal side of compressed alveolar bone, and this response may lead to prominent bone modelling prior to tooth movement in the young group, compared with the relatively delayed and diminished response in the adult group. The decreased bone modelling response in the adult group may be considered as a factor that restrains the excessive buccolingual tooth movement.

#### 405 ANTHROPOMETRIC MEASUREMENTS AS SUBSTITUTES FOR MCNAMARA'S CEPHALOMETRIC MAXILLOMANDIBULAR UNIT MEASUREMENTS

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**AIMS:** As cephalometric measurements cannot be performed for screening purposes, orthodontists usually have to use either photographic or anthropometric measurements. Finding a valid and reliable alternative could be of value in such occasions. The purpose of this study was to evaluate the correlation between McNamara's cephalometric unit difference and a proposed soft tissue equivalent.

**SUBJECTS AND METHOD:** Soft tissue measurements were performed of 36 randomly selected subjects by two investigators using a redesigned anthropometric ruler. The soft tissue measurements included the external auditory meatus to subnasale (Por-Sn), the external auditory meatus to soft tissue pogonion (Por-Pog), and the difference between them (Udiff). These

measurements were considered as equivalents to cephalometric indices in McNamara's anteroposterior measurements, including maxillary (Co–A) and mandibular (Co–Gn) unit length and their Udiff, respectively.

RESULTS: Measurement reliability with the anthropometric ruler was excellent. All soft tissue variables had an intraclass correlation coefficient (ICC) above 0.90. There was a high and significant correlation between cephalometric and anthropometric measurements ( $P < 0.01$ ). The ICC between (Por–Sn) and (Co–A) was 0.890, 0.869 between (Por–Pog) and (Co–Gn), and 0.819 between Udiff' and Udiff.

CONCLUSION: The proposed anthropometric method showed good correlation with cephalometric equivalents and the results show that this method could be used for screening purposes, especially when a low-cost, non-invasive method is required. However it cannot be considered a substitute for cephalometry in diagnostic and treatment purposes.

#### 406 INFLUENCE OF MENTON DEVIATION IN THE PERCEPTION OF FACIAL AESTHETICS

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AIM: To analyse how menton deviation influences perceptions of facial aesthetics amongst four groups: orthodontists, general dentists, fine art students and lay people.

MATERIALS AND METHOD: A frontal facial photograph of an individual was digitally manipulated using Adobe Photoshop C3 (Adobe Systems Inc, San Jose, California, USA) to produce varying degrees of menton deviation (0, 3, 6 and 9 mm). The images were assessed by orthodontists (20 males, 20 females), general dentists (20 males, 20 females), fine art students (20 males, 20 females) and laypersons (20 males, 20 females). Each image was awarded a mark of 1 if it was considered aesthetically acceptable, 2 if it was moderately acceptable and 3 when it was thought aesthetically unacceptable. Data were analysed with the Kruskal-Wallis ( $P < 0.05$ ) and Mann-Whitney tests applying the Bonferroni correction ( $P < 0.008$ ).

RESULTS: Evaluation of the 0 mm menton deviation photograph made by orthodontists (median = 1) and general dentists (median = 1) was significantly different ( $P < 0.008$ ) from that of laypersons (median = 2). No significant differences were found between the four groups in the evaluation of images with 3 and 6 mm menton deviation ( $P > 0.05$ ). The evaluation of the image showing a 9 mm menton deviation was significantly different ( $P < 0.008$ ) amongst orthodontists (median = 3) and general dentists (median = 3) compared with fine art students (median = 2) and laypersons (median = 2).

CONCLUSIONS: Both orthodontists and general dentists apply the same criteria for evaluating the aesthetics of menton deviation. Fine art students have criteria which fall between those of dental professionals and laypersons.

#### 407 INFLUENCE OF FOOD SIMULATED LIQUIDS ON BOND STRENGTH OF BRACKETS BONDED WITH A HEMA-FREE AND HEMA-CONTAINING SELF-ETCHING PRIMER

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AIM: To evaluate the effect of food simulating liquids on the shear bond strength (SBS) of brackets bonded with a HEMA-free and a HEMA-containing self-etching primer.

MATERIALS AND METHOD: Brackets were bonded to 280 bovine incisors which were divided into two groups: Adper Prompt-L-Pop (Adper PLP)/Transbond-XT; Transbond Plus self-etching primer (TSEP, HEMA-free)/Transbond-XT. Each group was evaluated under different storage conditions: 24 hours in water, thermocycling (T), T/12-weeks in water, T/12-weeks in 10 per cent ethanol, T/12-weeks in 50 per cent-ethanol, T/12-weeks in 3 per cent acetic acid, T/12-weeks in olive oil. SBS was measured with a universal test machine. Bond strengths for each bonding procedure were compared individually under the different storage conditions by means of Kruskal-Wallis ( $P < 0.05$ ) and Mann-Whitney tests, applying the Bonferroni correction ( $P < 0.002$ ). The SBS of the two bonding procedures were compared across the seven different storage conditions using a *t*-test ( $P < 0.05$ ), when the data fulfilled the criteria for normality, or with the Mann-Whitney test ( $P < 0.05$ ) when data was not normally distributed.

RESULTS: TSEP and Adper PLP showed significantly higher bond strength at 24 hours than T/12-weeks in 50 per cent-ethanol ( $P = 0.000$ ). For Adper PLP, the bond strength at 24 hours was significantly higher than T/12-weeks in water ( $P = 0.000$ ). No significant differences were observed between the two bonding procedures for the different storage conditions ( $P > 0.05$ ).

CONCLUSIONS: The SBS of Adper PLP (a HEMA-containing SEP) decreased significantly after T/12-weeks in water. Brackets bonded with both TSEP and Adper PLP showed significantly higher bond strengths at 24 hours than at T/12-weeks in 50 per cent ethanol.



#### 408 THREE-DIMENSIONAL EVALUATION OF THE EFFECT OF LOW INTENSITY LASER THERAPY AFTER RAPID MAXILLARY EXPANSION

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AIM: To evaluate the potential of a diode GaAs laser (low level laser therapy; LLLT) for reducing relapse after rapid maxillary expansion (RME).

SUBJECTS AND METHOD: Eighteen patients randomly selected and divided into two equal groups, a control group without LLLT and an experimental group with LLLT. Models were collected at different time points: before and after RME and after 15 days, 45 days, 3 months and 9 months. The models were then laser scanned for three-dimensional assessment of the stability of RME. The 3D models were analysed for the following data: palatal volume (PV), surface area, height (PH), depth (PD) and inclination (PI) and right (RMCT) and left (LMCT) molar crown tipping

RESULTS: Higher values of relapse were identified through the changes of palatal volume, surface area, height and depth in the unlased more than in the lased group. LLLT after RME reduces relapse of palatal dimensions.

#### 409 CAN DENTISTS RELY ON SIMPLE VISUAL OBSERVATION TO PREDICT THE REQUIRED SPACE IN THE MIXED DENTITION?

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AIM: Predicting the size of unerupted canines and premolars, beside the assessment of space to accommodate them, is fundamental to orthodontic diagnosis and treatment planning during the mixed dentition period. Several mixed dentition analyses have been developed that rely on radiographic measurements, proportionality tables or a combination of both methods. Many practitioners however evaluate the space available in mixed dentition patients simply by observation, which is easier and quicker. This study evaluated the accuracy and reliability of space prediction estimation by simple visual observation (SVO).

SUBJECTS AND METHOD: Eight general dental practitioners blindly assessed study models and panoramic radiographs of six arches (12 quadrants) in the mixed dentition using the SVO method. Follow-up study models in the permanent dentition were used to measure the actual size of the canines and premolars. Validity and interexaminer reliability of these assessments were computed.

RESULTS: Intraclass correlation coefficient showed low interexaminer reliability ( $\alpha = 0.32$ ). The mean absolute error in the prediction of practitioners was 3.46 mm (minimum = 1.32, maximum = 5.30).

CONCLUSION: The findings demonstrated low reliability and mostly low accuracy for the SVO method in predicting space conditions in mixed dentition patients by dentists.

#### 410 THREE-DIMENSIONAL STEREOPHOTOGRAMMETRIC ASSESSMENT OF ORTHOGNATHIC SURGERY

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AIM: Adult patients with skeletal maxillomandibular discrepancies can only be treated with orthodontic treatment combined with orthognathic surgery. In this study the changes on facial soft tissues that occurred following orthognathic surgery were examined and assessed relative to traditional analytical methods. The aim of this study was to compare the soft and hard tissue data acquired at the pre- and post-operative stages and to provide information about the changes occurring as a result of surgery.

MATERIALS AND METHOD: Three-dimensional (3D) stereophotogrammetric facial images of eight patients, who needed orthognathic surgery, were obtained pre-operatively and six months following the surgery along with traditional records, in the visual imaging laboratories of Bogazici University Electric and Electronic Engineering Department (Inspeck Mega Capturor II, Inspeck Inc., Montreal, Canada). Surface registration was performed on the pre- and post-operative data of each patient on the forehead. The changes in nasal tip, upper lip, lower lip, bialar distance and chin-tip were investigated. The data were compared by Pearson correlation test.

RESULTS: With mandibular set-back the mean mandibular retraction was 2 mm; lower lip point moved  $-3.16$  mm ( $P < 0.001$ ), the chin tip moved 2.85 mm ( $P < 0.05$ ) backwards and nasal tip raised insignificantly. The mean maxillary

advancement value was 3.13 mm and accordingly upper lip moved 0.81 mm ( $P < 0.01$ ) forward and bialar distance was increased 2.53 mm.

CONCLUSION: 3D facial soft tissue analysis provides information on overall facial shape change resulting from surgery, which is not available with traditional cephalometrics. This additional information can assist with surgical outcome assessment.

#### 411 REPEATABILITY AND REPRODUCIBILITY OF ROOT LENGTH MEASUREMENT FOR CONVENTIONAL AND PHOSPHOR PLATE DIGITAL RADIOGRAPHS

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AIMS: To compare digital and conventional long-cone periapical radiographic imaging techniques for root length measurements and to assess the impact of X-ray tube angulation changes on the measurements

MATERIALS AND METHOD: Upper and lower articulated models, containing eight anterior teeth for the upper and lower arch each, were used to simulate a patient undergoing fixed appliance treatment. Long-cone periapical radiographic images of the upper and lower labial segment were taken at standardised angulations to the occlusal plane at 0, 5, 10, 15, 20 degrees using conventional film and phosphor plates; the latter were digitised. In order to assess measurement error within and between the two methods, three radiographs (both conventional and digital) were taken and the tooth length was measured twice. Callipers and rulers were used for measurement on the conventional films and Romexis computer software for measurements of the digital images.

RESULTS: There were no clinically significant differences between the lengths of the images of the teeth using conventional or digital radiographs. There was good correlation for changes of tooth length measurement for the two methods for the tube shift (1 mm per 5° change); these changes in tooth length measurement were greater than the measurement error ( $0.14 \pm 0.1$  mm) and the method error (coefficient of variance being 0.015).

CONCLUSION: There are no clinically significant differences between digital and conventional radiographic technique for assessing tooth length. A change in the positioning of the X-ray tube changes the estimate of tooth length on periapical film. This could lead to a poor estimate of the amount of orthodontically induced root resorption, if no appropriate adjustments are made.

#### 412 MODIFIED CLEAR ALIGNER THERAPY IN EXTRACTION TREATMENT

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AIM: The Invisalign system was initially developed to correct moderate crowding, to resolve simple malocclusions and to produce dental tipping. The aim of this presentation is to illustrate the use and efficacy of modified clear aligner therapy (CAT) in extraction treatment.

SUBJECTS AND METHOD: Five adult patients aged 30 to 35 years, with a Class I malocclusion, bimaxillary protrusion, normal skeletal pattern and increased overjet and overbite. Four first premolars were extracted and during space closure modified CAT was used. In order to achieve lateral and posterior tooth movements with root control, bonding on the first molars and premolars with a sectional arch, aesthetic brackets and 0.18 inch stainless steel wire was carried out.

RESULTS: Treatment for all patients resulted in a Class I canine and molar relationship.

CONCLUSIONS: The modified CAT is an efficient method of treating extraction cases.

#### 413 INFLUENCE OF RAPID MAXILLARY EXPANSION ON FIRST PERMANENT MOLAR INCLINATION – A LASER SCAN ANALYSIS

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AIM: To quantify the inclination change of the first molars during rapid maxillary expansion (RME) with cemented acrylic splint devices using a three-dimensional (3D) laser scan technique.

MATERIALS AND METHOD: 3D scan model recordings of 26 children in the mixed dentition (14 females, 12 males) with an average of 8 years 2 months. All subjects had transverse deficiencies and were at the same stage of dental development.

Initially they were treated with identical cemented splint expanders until the maxillary molar palatal cusps were in contact with the mandibular buccal cusps. Dental casts were made before treatment and 6 months after expansion and retention. After scanning, individual and total changes of inclination and expansion rates of the first maxillary molars were determined using anatomical crown marks and geometric procedures. Measurement associations were examined through Student's *t*-test, Intraclass Correlation Coefficient (ICC) and Pearson's coefficient (*r*) of correlation (PCC).

RESULTS: The average expansion distance was 7.07 mm (SD 2.02 mm). Total inclination change between the first permanent molars was 3.41 degrees (SD 2.06°). The mean individual inclination change of the right permanent molars was +1.79 degrees (SD 1.40°) and on the left side +1.60° (SD 1.17°). Both did not significantly exceed +2 degrees ( $P < 0.05$ ), confirming the null hypothesis. PCC revealed a weak positive correlation between expansion increase and the extent of molar inclination change ( $r = 0.46$ ;  $P = 0.015$ ). The same method showed high coincidence between all three investigators ( $r = 0.82 - 0.87$ ,  $P = 0.015$ ). An ICC of above 0.99 ( $P < 0.01$ , confidence interval 95 per cent) at all measured parameters confirmed the measuring method's reliability.

CONCLUSIONS: The main result of this study is a relatively stable inclination of the first upper permanent molars, using rigid expansion screws and cemented splint devices during the mixed dentition.

#### 414 RELATIONSHIP BETWEEN BALANCE OF UPPER AND LOWER LIP-CLOSING FORCES AND LATERAL CRANIOFACIAL MORPHOLOGY

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AIM: Lips, buccinators and tongue pressure are related to tooth position, dental arch form and craniofacial morphology. Although the relationship between whole lip-closing force and craniofacial morphology has been investigated, the relationship between the balance of upper and lower lip-closing forces and craniofacial morphology is unclear. Therefore, the present study investigated the relationship between the balance of upper and lower lip closing power and craniofacial morphology using the multi-direction lip-closing closing force meter, which can be used simultaneously from eight directions.

SUBJECTS AND METHOD: Forty-four healthy female subjects without orthodontic treatment history were randomly selected from our orthodontic patients. Lip-closing forces were measured using the multidirectional lip-closing force meter. Lateral cephalograms were obtained in the intercuspal position. The correlations of the whole upper and lower lip-closing forces, and the ratio of upper to lower lip-closing force to the lateral craniofacial morphology were analyzed.

RESULTS: The whole upper and lower lip-closing forces showed a significant positive correlation to the interincisal angle and significant negative correlations to IMPA, the ramus height, the upper and lower facial heights, and the protrusion and vertical height of upper and lower lips.

The ratio of upper to lower lip-closing force showed a significant positive correlation to IMPA and negative correlations to the facial angle and FMIA.

CONCLUSION: These results suggest that the strong upper and lower whole lip-closing force tends to have a large upper and lower incisal inclination, especially lingual inclination of lower incisor, the short ramus height and the short upper and lower face height, the small protrusion and short vertical height of upper and lower lips. The ratio of upper to lower lip-closing force might be related to the compensation of lower incisor lingual inclination in the mandibular protrusion.

#### 415 PATTERN OF USE OF BONDED MOLAR TUBES AMONG IRISH SPECIALIST ORTHODONTISTS

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AIM: To assess the current use of bonded molar tubes (BMTs) among Irish specialist orthodontists via a questionnaire.

MATERIALS AND METHOD: A questionnaire was designed, piloted and then used to assess the current pattern of use of BMTs among Irish orthodontists. The questionnaire included the following sections: demographics, pattern of use of BMTs, reasons for use of BMTs and techniques for placement of BMTs. Ninety-five questionnaires were distributed.

RESULTS: Demographics: 70 orthodontists (48 males, 22 females) replied (74% response rate) with a mean of 9.8 years in orthodontic practice. All were currently using BMTs with 74 per cent adopting as clinical practice in the previous 8 years. The BMT brand most commonly used was American Orthodontics (37%). Seventy-one per cent of orthodontists used BMTs routinely on first permanent molars in more than 60 per cent of their cases. The most significant factors that influenced clinicians to use BMTs included; more convenient to place at the same time as brackets (94%), easier to involve partially erupted teeth (89%). BMTs would not be used by clinicians if there was a risk of occlusal interferences (72%), difficulty

gaining isolation (62%) or access (56%). The direct bonding technique was used by 100 per cent of clinicians. Fifty-one per cent used the recommended bonding time of 30 seconds. Light cure primer was used by the majority of clinicians with self-etching primer being used by 17 per cent. Light cured composite was the bonding material of choice (97%).

CONCLUSIONS: BMTs are now the first molar attachment of choice among Irish orthodontists. Direct bonding is the technique of choice with light cure primer and composite being the preferred bonding materials.

#### 416 STATISTICAL ANALYSIS OF 500 PATIENTS

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AIM: Bimler stoichiometric data of the upper first premolars and the upper first molars indexes of 89 out of 500 patient cases was taken and a comparison of each of these cases was made considering the overall length of treatment. In addition the amount of spreading indicated by indices between the time the treatment started and the time the treatment ended.

MATERIALS AND METHOD: Eighty-nine of 500 previously reported cases were randomly chosen. The longest length of treatment among these cases was 2,607 days. The difference between the indicated indices between the start and end of treatment for each case were compared and indexed by length of treatment.

RESULTS: It is unclear if spreading actually continues for long-term treatments. There is significant spreading during an initial short period and then the movement levels off. After approximately 4 years further spreading is apparent.

CONCLUSION: There are changes induced by Bimler treatment.

#### 417 FUNCTIONAL ADAPTABILITY OF TEMPOROMANDIBULAR JOINT MECHANORECEPTORS AFTER AN INCREASE IN RAT OCCLUSAL VERTICAL DIMENSION

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AIMS: The clinical success of orthodontic/prosthetic treatment may be associated with the vertical changes in occlusion. A change in the occlusal vertical dimension may be an effective treatment choice for functional and/or aesthetic purposes. However, long-term stability after treatment with increased occlusal vertical dimension (iOVD) is still controversial on a long-term basis. The aim of this study was to test the possibility of functional adaptability in temporomandibular joint (TMJ) mechanoreceptors long-term after iOVD.

MATERIALS AND METHOD: Sixty 13-week-old male albino Wistar rats divided into a control and iOVD group (30 animals each). The vertical dimension between the maxillary and mandibular molars in the iOVD group was increased by 2.0 mm with a build-up of resin on the maxillary molars. Single-unit activities of TMJ mechanoreceptors were evoked by passive jaw movement. Recording was performed from the gasserian ganglion at 1 day and 1, 3, 5, 7 and 9 weeks after the establishment of iOVD. The effects of iOVD on TMJ units were assessed using the firing threshold, the maximum instantaneous firing frequency and the average firing frequency.

RESULTS: Compared with the control group, the firing threshold was significantly lower at 1, 3 and 5 weeks after iOVD in the iOVD group. There were no significant differences in the firing threshold at 1 day, or 7 or 9 weeks. The maximum instantaneous firing frequency was significantly higher at 1, 3 and 5 weeks after iOVD in the iOVD group, but there were no significant differences at 1 day, or 7 or 9 weeks. There were no significant differences in the average firing frequency during the experimental period.

CONCLUSIONS: TMJ mechanoreceptors in adult rats may ultimately adapt to iOVD.

#### 418 PREVALENCE OF TEMPOROMANDIBULAR DYSFUNCTION IN ATHLETES – A PILOT STUDY

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AIM: To determine sports related temporomandibular dysfunction (TMD).

SUBJECTS AND METHOD: Forty-five males aged 18-25 years without a previous history of orthodontic treatment and with no oral prosthesis divided into three groups: group I, control, comprised subjects not involved in sports, group II, combat sport athletes and group III, non-combat sport athletes. History questionnaires and clinical examinations were undertaken. Clinical examination included dental and temporomandibular joint (TMJ) examinations.

RESULTS: According to Angle's classification of occlusion, there was no statistical difference in the distribution of Class. Prevalence of parafunction (clenching) was 26 per cent in group I, 66.6 per cent in group II and 60 per cent in group III. The



presence of TMJ clicking in group I was 13 per cent and, in both groups II and III, 33 per cent. TMJ crepitation was present in small percentages (6.6) in both groups of athletes, but not in the control group.

CONCLUSION: There is an increased incidence of TMD in athletes.

#### 419 HAAVIKKO'S METHOD AND REFERENCE CENTILE CURVES FOR AGE ESTIMATION IN 4-15 YEAR OLD CHILDREN

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AIM: To evaluate Haavikko's (1974) method based on a Finnish sample for dental age estimation in Bosnian-Herzegovian children and to create reference centile curves with the LMS method for clinical, legal and forensic use.

MATERIALS AND METHOD: In cross-sectional, retrospective study, the dental pantomograms (DPTs) of from 805 girls and 636 boys, aged between 4 and 15 years, were studied. The method is based on scoring teeth, 41, 44, 46, and 47 up to 10 years of age and 13, 43, 44, and 47 in children over 10 years of age, with one of 12 mineralization stages. Dental age is then computed from Haavikko's tables as the mean of all four teeth. Kappa statistics and intraclass correlation coefficient (ICC) were used for testing intra- and interobserver repeatability of mineralization stages and observed dental age by assessment of 10 per cent (N = 144) of the DPTs. In addition, 1st, 3rd, 5th, 50th, 95th, 97th and 99th centile curves of chronological age against the dental age were constructed for girls and boys separately using the LMS method [Cole and Green (LMS ChartMaker Software, Medical Research Council, UK)].

RESULTS: Haavikko's method underestimated the dental age in Bosnian-Herzegovian children. The mean underestimation was -0.33 (SD 0.72) years in girls and -0.12 (SD 0.82) years in boys. Cohen kappa scores were 0.79 and 0.80 for intra- and interobserver agreement, respectively, for mineralization stages and average measures for ICC for dental age were 0.98 and 0.90 for intra- and interobserver agreement, respectively.

#### 420 PAIN, DISCOMFORT AND USE OF ANALGESICS AFTER EXTRACTION OF THE PRIMARY CANINES IN CHILDREN WITH PALATALLY DISPLACED CANINES

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AIM: To describe pain, discomfort, dental anxiety and use of analgesics following extraction of the primary canine in children with a palatally displaced canine (PDC).

SUBJECTS AND METHOD: Fifty-five children aged 10-13 years with PDCs (n = 34 bilateral, n = 20 unilateral) were randomized to have extraction or non-extraction of the maxillary primary canine. Forty-four children: 20 boys (11.5 ± 1.2 years) and 24 girls (11.2 ± 1.2 years) were randomized for extraction and only these were included in the trial. The children rated pain intensity and discomfort, limitations in daily activities and analgesic consumption during the first evening and one week after the extraction. Dental anxiety was assessed before extraction, using the dental anxiety scale (DAS). A matched reference group of 44 children, without PDC and no previous extraction of the primary canine also completed the DAS.

RESULTS: There were no significant differences between the study and reference group regarding earlier treatment experiences. Post-extraction experience of pain and discomfort was low. Girls reported significantly more pain during the first evening compared with one week after the extraction ( $P = 0.05$ ) and significantly more pain in the first evening than during the intervention ( $P = 0.05$ ). Analgesics were used by 35 per cent of the boys and 50 per cent of the girls during the first evening after the extraction. A high correlation was detected between the items: DAS, previous invasive dental treatment and the items: experience of pain and discomfort during injection, extraction, the first evening and one week after the invention. Post-operative effects on the daily life were limited.

CONCLUSION: Extraction of the primary canine as an interceptive treatment in patients with PDC seems not to cause high levels of pain and discomfort. Despite that, about 30 per cent of the children used analgesics in the first evening after the extractions.

#### 421 EXTRUSION OF RETAINED AND DYSTOPIC TEETH USING MINI-IMPLANT-BORNE MECHANICS

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AIMS: Extrusion of retained and dystopic teeth often has side-effects on the dentition. For instance, intrusion of the adjacent teeth or even tipping of the occlusal plane may occur. Other undesirable effects in the sagittal or transverse dimension are unwanted movements or tipping of the anchorage-unit. Is it possible to reduce or to avoid these side-effects using orthodontic mini-implants?

SUBJECTS AND METHOD: Twenty-eight patients with 37 retained and dystopic teeth in the upper arch. One or two mini-implants were inserted in the anterior palate; overall 36 mini-implants were placed. Mechanics employing direct or indirect anchorage were utilised. Extrusive forces were applied by TMA-levers or overlay-mechanics.

RESULTS: Thirty-six of the displaced teeth were successfully extruded and aligned (97.3%). Thirty-three of the mini-implants remained stable until the end of treatment (91.7%). Only in two cases were side-effects observed (92.8% success rate), mainly as tipping of the teeth included in the anchorage unit in cases where indirect anchorage mode was employed.

CONCLUSIONS: Using orthodontic mini-implants significantly increased the stability of anchorage. Typical side-effects, such as tipping or intrusion of adjacent teeth, could be nearly avoided. In the few cases where side-effects were observed, indirect anchorage was employed. However, loss of implants only occurred when using direct anchorage and high anchorage loads. As a consequence, the preferred anchorage mode seems to depend on the individual clinical situation: in patients with more than one dystopic tooth indirect anchorage proved to be more stable. To provide higher anchorage capacity the insertion of two mini-implants is recommended.

#### 422 COMPRESSION AND TENSION STRESS AROUND TEETH BY ANTERIOR RETRACTION WITH IMPLANT ANCHOR

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AIM: To determine compression and tension stress around teeth and roots using photoelastic stress analysis. Anterior retraction with an implant anchor in sliding mechanics was predominant in this study.

MATERIALS AND METHOD: A photoelastic model was fabricated comprising brackets and wire, alveolar bone made of photoelastic epoxy resin and plastic teeth. A retraction hook was soldered to the wire between the lateral incisors and canines. An implant anchor was inserted between the second premolar and first molar. Three lengths of hook (2, 5, or 10 mm) and implant anchors in two positions (4 or 8 mm) were established. Stress was applied using an elastic chain. Measurement of compression and tension stress around the tooth root was carried out with a digital photoelasticity scanner.

RESULTS: With the 2 mm hook in the anterior region of the central and lateral incisors and canines, compression stress was observed at the distal apex and mesial or labial crest. Tensional stress was concentrated at the distal apex and mesial or labial crest. In the molar region, compression stress was detected at the apex. In contrast, with the 8 mm hook, the reverse of that observed with the 2 mm hook was noted, with an interchange between tension and compression stress. With the 4 mm hook, compression stress was distributed uniformly along the lingual and distal surfaces, while tension stress was observed at the labial and mesial surfaces of the anterior teeth. Compression and tensional stresses were intermingled at the apex of the molars. Vertical positioning of the implant anchor had little effect.

CONCLUSION: Compression stress around the tooth root is mainly influenced by the length of hook. This result suggests that torque in the anterior teeth and rotation of the occlusal plane are controlled by the length of hook.

#### 423 THREE-DIMENSIONAL ANALYSIS OF MANDIBULAR MORPHOLOGY FOR EVALUATION OF FACIAL ASYMMETRY

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AIM: To identify the morphological characteristics of the mandible by comparing the deviated and non-deviated sides using three-dimensional computed tomography (3D-CT) in patients with facial asymmetry requiring orthognathic surgery.

MATERIALS AND METHOD: 3D-CT images of 36 patients with facial asymmetry were analyzed using 3D planning software for orthognathic surgery. Seventeen measurement points were set. These points were set bilaterally where applicable. A total of 10 items were measured, including five angular and five distance measurements. The deviated and non-deviated sides were measured, and values were compared using the paired Student's *t*-test. Multi-regression analysis was also performed to evaluate the deviation of the mandibular midline and the items measured.

RESULTS: Total mandibular length, mandibular body length, mandibular ramus length, and condylar length were significantly greater on the non-deviated side. Pitch, roll, and yaw of the mandibular ramus were significantly greater on the deviated side. Multiregression analysis revealed that differences in mandibular ramus length, mandibular body length, and

mandibular ramus pitch were the main variables that affected deviation of the mandibular midline.

**CONCLUSION:** In patients with facial asymmetry, a comparatively larger mandibular ramus, mandibular body, and condylar length were observed on the non-deviated side compared with the deviated side, with the mandibular ramus rotated anteromedially along the supero-inferior, left-right, and anteroposterior axes. These differences between the deviated and non-deviated sides in the morphological characteristics of the mandible resulted in mandibular deviation and rotation. The findings also suggest that deviation of the mandibular midline was significantly affected by mandibular ramus length, mandibular body length, and mandibular ramus pitch.

#### 424 HABITUAL OCCLUSION COMPARED WITH THE CENTRIC CONDYLAR POSITION ON BODY POSTURE AND POSTURAL CONTROL

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**AIM:** To compare the effect of two different occlusion positions, habitual and centric, with regard to the upper body posture and the postural control in temporomandibular dysfunction (TMD) patients.

**SUBJECTS AND METHOD:** In 30 subjects (19 females, 11 males) with TMD symptoms, three-dimensional back scanning was performed using a photo-optometric method of measurement (Diers) as well as static equilibrium distribution measurement (Diers). The measurements were carried out both in habitual and centric occlusion. Statistical analysis of the data was conducted with the BIAS software program (version 9.0). For the calculations, the Wilcoxon-matched-pairs and Friedman tests were used.

**RESULTS:** In centric condylar position an elevation in the cervical and upper thoracic spine area occurred in comparison with habitual occlusion. In this area, the two parameters 'kyphosis angle' ( $P = 0.04$ ) and 'flèche cervical' ( $P = 0.00$ ) reduced. The other parameters of upper body posture evaluated were not statistically significant. No changes in postural control were demonstrated statistically.

**CONCLUSION:** There is a relationship in patients with TMD symptoms between occlusal position and upper body posture, whereas a change in the cervical and upper thoracic area does not have an effect on postural control. The occlusal pattern during habitual occlusion seems to be frequently pathologic compared with the position in centric relation. It is therefore recommended to plan orthodontic treatment in subjects with TMD symptoms in centric relation. Further investigations are necessary to analyze more accurately the effect of occlusal position on the musculoskeletal system and the postural control.

#### 425 DIFFERENTIAL RESPONSE PROPERTIES OF THE HUMAN PERIODONTAL-MASSETERIC REFLEX OF THE ANTERIOR TEETH

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**AIMS:** Although the periodontal-masseteric reflex (PMR) is evoked bilaterally even when stimulated unilaterally, the mechanism that underlies this bilateral cooperation in the PMR remains unclear. The present study was designed to clarify whether this bilateral cooperation differs between incisors and canines.

**SUBJECTS AND METHOD:** Five healthy adults without malocclusion. Surface array electrodes were placed bilaterally on the masseter muscle to simultaneously record the firing activities of single motor units (MUs) from both sides. The subjects were instructed to lightly clench (i.e., 10% of maximum voluntary contraction) with visual feedback for 1 minute. During clenching, a 0.5 N mechanical stimulation was applied in a ramp-and-hold fashion to the right maxillary incisor and canine lingolabially to evoke the PMR. The task consisted of 10 second rest and 2 second stimulation periods that were alternately repeated four times. Unitary activity was plotted with respect to the background activity and firing frequency to obtain both a regression line and correlation coefficient (CC). The slope of the regression line (sRL) and the CC between the incisor and canine, and those between the right and left sides were compared.

**RESULTS:** Twenty-seven pairs of MUs were recorded of the right and left masseter muscles. With regard to the receptive field, the sRL was significantly steeper and the negative CC was significantly larger for the incisor than the canine driven PMR. Regarding laterality, there was no significant difference in the incisor-driven PMR, whereas the negative CC for the contralateral canine driven PMR was significantly larger than that for the ipsilateral one.

**CONCLUSIONS:** The PMR during biting differs depending on both the receptive field and laterality. Differential peripherally driven reflexive control of the jaw-closing muscle may be involved in the precise and sophisticated execution of masticatory movement.

#### 426 ENAMEL COLOUR CHANGES FOLLOWING BONDING OF METALLIC FIXED LINGUAL RETAINERS

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**AIMS:** To test the null hypothesis that enamel colour does not significantly change following bonding of metallic fixed lingual retainers, and tooth type does not significantly affect this colour change *in vitro*.

**MATERIALS AND METHOD:** Thirty non-carious teeth, five each of the upper central and lateral incisors (U1 and U2), upper canine (U3), lower central and lateral incisors (L1 and L2) and lower canine (L3). The middle third buccal enamel surfaces were colourimetrically evaluated before and after bonding of PentaOne (Masel) co-axial wire segments on the lingual aspects of the teeth using Transbond XT (3M Unitek). Three measurements were made from each tooth and averaged. The Commission Internationale de l'Eclairage colour parameters ( $L^*a^*b^*$ ) were recorded using Vita EasyShade and colour differences ( $\Delta E$ ) were calculated. The results were statistically analyzed using ANOVA and Tukey test ( $P < 0.05$ ). The clinical detection threshold for  $\Delta E$  value was set at 3.7 units.

**RESULTS:**  $\Delta E$  values were as follows; U1: 4.3, U2: 6.3, U3: 2.7, L1: 2.4, L2: 4.7, and L3: 2.1. The highest  $\Delta E$  value was found in the U2 group and  $\Delta E$  values were above the threshold value for the U1, U2 and L2 groups.  $\Delta E$  value recorded in the U2 group was significantly higher than in the L1 and L3 groups ( $P < 0.05$ ).

**CONCLUSION:** The hypothesis was, in part, rejected. Bonding of a metallic fixed lingual retainer induced clinically perceptible enamel colour changes in the upper central and lateral incisors and lower lateral incisors *in vitro*.

#### 427 RELIABILITY OF ARCH LENGTH DISCREPANCY MEASUREMENTS AND BOLTON STANDARDS

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**AIM:** Computer based record keeping is routine in many orthodontic offices. Computer-based digital models have the potential to replace plaster casts, eliminate model storage. Plaster casts have long been the gold standard for measuring mesiodistal tooth dimensions and calculating the Bolton Index for tooth size discrepancies, as well as for determining intra-arch space discrepancies. The aim of this study was to determine differences in arch length discrepancies and Bolton standards between digital and plaster models of the mandible and maxilla.

**MATERIALS AND METHOD:** One hundred and fifty pairs of plaster and digital pre-treatment models. The mesiodistal tooth widths were measured (first molar to first molar, maxillary and mandibular) on plaster and digital models (Orthomodel V 1.01). Bolton standards were evaluated for each model. The plaster models were measured using digital callipers and digital measurements were performed using the Orthomodel software. Space analysis was calculated for both types of models. All measurements were carried out by three examiners. Statistical analysis was performed using NCSS 2007 software. The resulting values were compared with an independent *t*-test and interclass correlation coefficient.

**RESULTS:** No significant differences were found between the two methods in arch length discrepancies and Bolton standards in the mandible and maxilla ( $P > 0.05$ ). Intra- and interexaminer reliability was high for both models.

**CONCLUSION:** Measurement of arch length discrepancies on digital models and plaster models are compatible with each other.

#### 428 OCCLUSAL PLANE INCLINATION: PERCEPTIONS OF DENTAL PROFESSIONALS AND LAYPERSONS\*\*\*

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**AIM:** To determine if occlusal plane inclination is detectable and influences the aesthetic evaluations of orthodontists, general professionals and laypersons.

**MATERIALS AND METHOD:** A frontal photograph of a smile with 0 degrees of occlusal plane inclination in relation to the bipupillary plane was modified using Adobe Photoshoph C3 (Adobe systems Inc, San Jose, California, USA). Two images of the smile were created with occlusal inclinations of 2 and 4 degrees, respectively, which were evaluated by orthodontists with over 10 years experience ( $n = 40$ ) and laypersons aged between 40 and 50 years ( $n = 40$ ). The proportion of male-female subjects was 20:20 in each group. Each image was awarded a mark, giving a value of 1 if it was considered aesthetically acceptable, a value of 2 if it was thought moderately acceptable and a value of 3 if it was aesthetically unacceptable. Data were analysed with Kruskal-Wallis ( $P < 0.05$ ) and the Mann-Whitney tests applying the Bonferroni correction ( $P < 0.0017$ ).

**RESULTS:** No significant differences were found ( $P > 0.05$ ) between the three groups in the evaluation of the 0 and 2 degree



occlusal inclination images (median amongst orthodontists = 1, dental professionals = 1 and lay persons = 1). When occlusal plane inclination was 4 degrees the orthodontists' evaluation (median = 3) was significantly different from that of dental professionals (median = 2) and laypersons (median = 2).

CONCLUSIONS: An occlusal plane inclination of 2 degrees was not detectable by dental professionals and laypersons. An occlusal plane inclined 4 degrees was detectable by all three groups; orthodontists evaluated this image as aesthetically unacceptable whereas dentists and laypersons found it moderately acceptable.

#### 429 VOLUMETRIC ASSESSMENT OF SECONDARY ALVEOLAR BONE GRAFTING IN UNILATERAL CLEFT LIP AND PALATE PATIENTS

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AIM: To evaluate the long-term stability of secondary alveolar bone grafting in unilateral cleft lip and palate (UCLP) patients in terms of volumetric measurements.

SUBJECTS AND METHOD: Twenty individuals with a UCLP aged between 8 and 13 years. Autogenous bone grafting derived from iliac crest was performed after orthopaedic treatment. Maxillofacial computed tomographic data were obtained immediately pre-operatively and 1 and 3 years post-operatively. Mimics V12 software was used to measure the volume of the defective side in order to determine the amount of defect closure.

RESULTS: The volume of the defect was decreased 77.9 per cent ( $P < 0.001$ ) 1 year post-surgery. Utilization of the new bone formed in the grafting area resulted in successful canine eruption. Three years after grafting, the amount of closure was 74 per cent. There was a significant correlation between the size of the cleft and the success of the alveolar bone grafting ( $P < 0.001$ ). Both results showed successful bone fill of the alveolar defect by using secondary alveolar bone grafting harvested in iliac crest.

CONCLUSION: Autogenous bone grafting utilized the new bone formation and tooth eruption.

#### 430 BIOMECHANICAL ANALYSIS OF SAGITTAL MAXILLARY ADVANCEMENT USING INTERNAL MAXILLARY DISTRACTORS

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AIM: To investigate the biomechanical effects of sagittal maxillary advancement in patients with or without a bilateral cleft lip and palate (BCLP).

MATERIALS AND METHOD: Finite element models (FEM) of these patients were developed from spiral computerized tomography scan data. An anterior displacement with a magnitude of 6 mm was applied on maxilla where the distractors were placed to simulate the clinical situation. The surface mesh of the models was developed using Mimics software transferred to ANSYS software and developed into three-dimensional volume elements (Solid 92). Approximately 800 000 nodes and 600 000 elements were used and the material model of the maxillary cortical bone was defined as orthotropic. After a Le Fort I osteotomy was performed on the model, maxillary advancement was simulated in six steps with 1 mm advancement in each step, a total of 6 mm advancement.

RESULTS: At the zygomaticoalveolar crest in the FEM of non-cleft subjects, the obtained stress values were 68 MPa, whereas for the model with a BCLP it was 74 MPa. In the sagittal plane there were higher negative y-displacements in the dentoalveolar regions indicating that these portions of the craniofacial complex were displaced forward.

CONCLUSION: A detailed FEM based on computed tomographic scanning images of skulls with and without a BCLP, including bone and soft tissue structures, is a reliable model for studying and understanding the mechanism and function of sagittal advancement of the maxilla with internal maxillary distraction osteogenesis.

#### 431 TOOTH SIZE DISCREPANCY AND ARCHFORM: IS THERE A RELATIONSHIP?

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AIM: To investigate if there is a relationship between the presence of significant tooth size discrepancies (TSDs) and archform in an Irish orthodontic population.

MATERIAL AND METHOD: Eight hundred and fifty pre-treatment sets of orthodontic models were screened from which 240 were selected comprising 30 female and 30 male sets for each malocclusion (Class I, Class II division 1, Class II division 2, and Class III). Using digital images of these models (ESM Digital Solutions Ltd., Swords, Ireland), mesial and distal landmarks were entered to allow automatic calculation of overall and anterior Bolton TSDs using Orthoanalyzer software. The images were classified into two groups according to Bolton TSD, independent of the degree of crowding. Group 1 consisted of cases that had significant Bolton TSDs and group 2 images that did not. Mean images of archforms were generated for the upper and lower arches using landmarks placed on the mesiobuccal cusp tips of the first molars, buccal cusp tips of premolars, cusp tips of canines and mid incisor edges of the incisors. The individual archforms in each of the two groups were classified as one of the following three forms; square, tapering or ovoid.

RESULTS: There was no significant difference between the mean upper and lower archforms for the groups with and without significant TSDs. There was no statistically significant difference in the prevalence of archform type within the upper groups ( $P = 0.3305$ ) or lower groups ( $P = 0.631$ , Fisher test).

CONCLUSIONS: This cohort did not show a statistically significant relationship between the presence of TSDs and either upper or lower archform. Further investigation of well-aligned arches in groups with and without significant TSD from this population is required.

#### 432 EVALUATION OF THE RELATIONSHIP BETWEEN MANDIBULAR THIRD MOLAR POSITION AND MANDIBULAR INCISOR IRREGULARITY

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AIM: To evaluate the effect of the mandibular third molars on the stability of the mandibular incisors in subjects treated with and without premolar extractions.

SUBJECTS AND METHOD: Fourteen extracted, 12 non-extracted [pre-treatment (T1) mean age: 13.9 years] who had successful treatment and fully erupted third molars after retention (T3). Third molar angulation and Ganss ratio (the distance between the distal border of the second molar and the anterior border of the ramus measured on the occlusal plane, in proportion to the width of the third molar crown) were evaluated on T1, post-treatment (T2) and T3 digital panoramic radiographs using the Line Editor program. Irregularity index and transverse dimensions were measured on the digital models. T1-T2 and T2-T3 periods were compared with a Mann Whitney  $U$  test.

RESULTS: Third molars angulation: At all treatment periods no significant differences were found between the groups. Retromolar space: At T2, Ganss ratio was greater in the extraction group. However, at T3 and between T3 and T2 there was no significant difference between the groups. Irregularity Index: At T1, the mean value for the extraction group was 7.23 mm and in non-extraction group 3.91 mm, which was significantly different. However, at T3, THE average relapse was not significantly different (extraction group, 2.69 mm, none extraction group, 2.18 mm). Transverse measurements: for all periods there were no differences between the groups, but at T2 intermolar measurement was significantly smaller in the extraction group than in non-extraction group.

CONCLUSION: As a result of third molars angulation values, Ganss ratio and irregularity index scores were not different in either group at T2 or T3. Third molar eruption and long-term mandibular incisor stability were not related to extraction or non-extraction treatment.

#### 433 EVALUATION OF LONG-TERM POST-TREATMENT CHANGES WITH THE AMERICAN BOARD OF ORTHODONTICS OBJECTIVE GRADING SYSTEM AND CEPHALOMETRIC ANALYSIS

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AIM: To evaluate post-treatment changes using the Objective Grading System (OGS) of the American Board of Orthodontics on digital models and cephalometric radiographs.

MATERIALS AND METHOD: Pre- (T1) and post- (T2) treatment and post-retention (T3; minimum 5 years) cephalometric radiographs and orthodontic models of 70 patients (mean age: 13.1 years). Patients treated by extraction and non-extraction therapy were selected without a gender difference. Cephalometric radiographs were traced to determine the skeletal and dental changes. Dental casts were scanned using the 3 shape®D250 laser scanner and digital models were obtained. T2 and T3 OGS scores were measured on the study casts. T1-T2 and T2-T3 periods were compared by paired  $t$ -tests.

**RESULTS:** Significant changes in cephalometric measurements were found for SN mandibular plane angle and NB/L1 angle. Between T2 and T3 the increase in SN mandibular plane angle was significant. Because this parameter was insignificant between T1 and T2, the increase in the vertical dimension was related to growth. Between T1 and T2, the increase in NB/L1 angle was significant, but insignificant between T2 and T3. Since there was no change in IMPA during any period, lower incisor inclination was stable at T3. According to the OGS, T2 and T3 treatment was successful and changes of OGS scores, from T2 to T3 were not statistically significant.

**CONCLUSIONS:** Although vertical dimensions increase due to growth, successful post-treatment results prevent relapse.

#### 434 EVALUATION OF THE RELATIONSHIP IN LOWER INCISOR IRREGULARITY, CONDYLAR-INCISAL ANGLE AND AGE

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**AIMS:** To determine the mean value of the condylar-incisal (CI) angle in a group of patients with a Class I malocclusion and to evaluate the relationship in lower incisor irregularity, CI angle and age using cone-beam computed tomography (CBCT) scans.

**MATERIALS AND METHOD:** CBCT images of 126 subjects between 16 and 58 years of age (female n = 68; mean age: 24.3 ± 9.3 years, and male (n = 57; mean age: 22.2 ± 7.3 years). The distribution was similar and the mean age of all subjects was 23.1 ± 8.3 years. The CBCT images were taken using iCAT® (Imaging Sciences International, Hatfield, Pennsylvania, USA). For each lower incisor tooth, the CI angle was measured separately by means of a 3D software system (Dolphin Imaging 11.0 Premium, California, USA). Lower incisor irregularity measurements were performed according to Little's irregularity index and three irregularity subgroups were generated. For statistical evaluation, independent samples *t*-test and analysis of variance (ANOVA) were used at the *P* < 0.05 level. Pearson correlation coefficients were also calculated.

**RESULTS:** Statistically significant gender difference was determined only in the CI angle of left lateral incisor teeth (*P* = 0.022). ANOVA comparisons indicated no statistically significant difference in age and CI angles of the four lower incisors in the different irregularity groups (mild, moderate and severe). Additionally, correlation analysis showed no statistically significant correlation among three investigated parameters.

**CONCLUSION:** The mean value of the CI angle differs between 88 and 93 degrees. No statistically significant difference in age and CI angles of the four lower incisors was determined in different irregularity groups. No significant correlation was found among the investigated parameters.

#### 435 PERCEPTION OF LOWER INCISOR CROWDING BY THREE ASSESSOR GROUPS

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**AIM:** To determine what level of lower incisor crowding is perceived as aesthetically acceptable to laypersons, dentists and orthodontists.

**MATERIALS AND METHOD:** A full-face smiling digital image of a >40 year old Caucasian female with good anterior tooth display and minimum confounding factors, was captured using an EOS 30D high performance camera. Using Photoshop, the image was modified to produce seven levels of lower anterior crowding (0-12 mm in 2 mm increments) from an uncrowded original. Each level of crowding was presented in three views (full face smiling, three-quarter face smiling and teeth only) for evaluation by panels of dentists (n = 15), orthodontists (n = 17) and laypersons (n = 30). Twenty-one images were randomized in a web-based questionnaire and rated according to attractiveness using a visual analogue scale (VAS) and Likert scale. The VAS questions were analysed using linear models and the Likert-scale questions using generalized linear models for a multinomial distribution with a cumulative logit link function.

**RESULTS:** All groups of assessors were able to detect a 2 mm increase in lower incisor crowding (*P* < 0.001). Laypeople and dentists considered the appearance less than attractive around 6 mm of crowding but generally would not seek treatment until closer to 10 mm of crowding, whereas orthodontists were more likely to seek treatment at 6 mm of lower incisor crowding. Although orthodontists were found to be the most generous in attractiveness rating they also had the lowest threshold when it came to seeking treatment.

**CONCLUSION:** Laypeople and dentists differ from orthodontists in their perceived aesthetic threshold to seek treatment for lower incisor crowding. Orthodontists had the lowest aesthetic threshold when it came to seeking treatment.

436 SKELETAL AND DENTOALVEOLAR EFFECTS OF MODIFIED APPLIANCES ON DISTALIZING MOLARS

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AIM: To compare the skeletal and dentoalveolar effects of modified Veltri and First Class appliances.

SUBJECTS AND METHOD: Forty patients with a bilateral Class II molar relationship. Lateral cephalometric radiographs and study models taken before treatment, after distalization and during the stabilization period were investigated. The modified Veltri group comprised 11 females and nine males (mean age:  $13.64 \pm 1.46$  years) and the First Class appliance group 12 females and eight males (mean age:  $13.83 \pm 1.43$  years).

RESULTS: There was no statistically significant difference between groups ( $P > 0.05$ ) when the amount of distalization and distalization times were compared. Distalization of 2.16 mm was achieved in  $4.29 \pm 0.97$  months with the modified Veltri appliance and 2.42 mm in  $4.20 \pm 0.86$  months with the First Class appliance. The amount of distal tipping was statistically significantly different between the groups ( $5.21^\circ$  in the modified Veltri group and  $1.19^\circ$  in the First Class group). The amount of anchorage loss was statistically significant for the incisors ( $P < 0.01$ ). During the stabilization period, upper second premolars and incisors tended to move back to their original positions in both groups.

CONCLUSION: The First Class appliance is preferable than the modified Veltri appliance when distalizing molars intraorally.

437 REPRODUCIBILITY OF FACIAL SOFT TISSUE LANDMARKS ON FACIAL IMAGES CAPTURED ON A THREE-DIMENSIONAL CAMERA\*\*\*

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AIM: The reproducibility of facial landmarks is important to ensure that three-dimensional (3D) facial measurements are accurate and can be applied clinically. The aim of this study was to evaluate the reproducibility of facial soft tissue landmarks using a non-invasive stereophotogrammetry 3D camera.

MATERIALS AND METHOD: Twenty-four soft tissue landmarks on 3D facial images of 30 adult subjects (age range, 18-40 years) captured using a Vectra-3D camera were viewed and analyzed using Mirror software. The landmarks were identified, recorded and measured twice on each 3D facial image by one examiner with a 2 week interval. Intraclass correlation coefficient (ICC) and paired *t*-tests were performed for each landmark to test intraexaminer reproducibility.

RESULTS: ICC for all 24 soft tissue landmarks ranged from 0.683 to 0.965 indicating moderate to high reliability and reproducibility. Paired *t*- and Mann Whitney tests also showed that there were no significant difference for any of the 24 facial soft tissue landmark measurements ( $P = 0.171 - 0.990$ ).

CONCLUSIONS: Identification of landmarks on facial images captured using a Vectra-3D camera is highly reproducible. This device can be useful in treatment planning and provide accurate information for clinical decision making.

438 BOND STRENGTH OF A NEW BACTERIOSTATIC ADHESIVE SYSTEM: AN *IN VITRO* EVALUATION

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AIM: Fixed orthodontic appliances prevent patients from cleaning all surfaces of their teeth. This can then easily lead to dental plaque, which may cause decalcifications and even dental caries. In order to prevent bacterial activity and decalcification, fixed appliances and especially bonding agents that have antibacterial or bacteriostatic characteristics are gaining popularity. One most important factor of the clinical efficiency of bonding agents is shear bond strength (SBS). The aim of this *in vitro* study was to comparatively determine the SBS and bond failure interfaces of a new bacteriostatic bonding system.

MATERIALS AND METHOD: Twenty-six extracted human premolars randomly divided into two groups. The same stainless steel orthodontic brackets and acid etching procedure were used. Thirteen teeth were bonded with Transbond XT light-cured adhesive resin (3M-Unitek, USA), while, SeLECTDefence primer and bonding composite (Element 34 technologies inc, USA) were used for the other 13 specimens. A universal testing machine with a crosshead speed of 5 mm/minute was used for measurement of SBS values. A Student's *t*-test for paired samples was used to analyse the bond strength data at the 95 per cent confidence interval level.

RESULTS: Although the bond strength of the bacteriostatic bonding system was significantly lower than Transbond XT ( $P$



< 0.05), the SBS of the bacteriostatic system was within the acceptable range for clinical use.

CONCLUSIONS: The SeLECTDefence system could be used for orthodontic bracket bonding, but bond strength is lower than that of Transbond XT.

#### 439 LINEAR ANALYSES OF OROPHARYNGEAL AIRWAY CHANGES AFTER MANDIBULAR TOOTH-BORNE SYMPHYSEAL DISTRACTION

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AIM: To evaluate the effects of mandibular symphyseal distraction osteogenesis (DO) on the pharyngeal airway, using lateral cephalometry.

SUBJECTS AND METHOD: Twelve patients (4 males, 8 females) with a skeletal Class I or Class II pattern and 6-7 mm discrepancies in lower anterior region, who were unsuitable for tooth extraction. Mandibular midline DO was performed using a tooth supported distractor that was consisted of a Hyrax-type screw placed at the lingual side of the lower jaw. The amount of distraction for each patient was 1 mm ( $0.5 \times 2$  mm) per day, a total of 7 mm. Standardized lateral cephalometric radiographs were obtained before and after mandibular distraction. Treatment changes were determined by means of linear and angular measurements. The angular measurements were: SNA, SNB, ANB, SN/GoGN and linear measurements: U (uvula)-MPW (middle pharyngeal wall), PASmin, LPW (lower pharyngeal wall)-V (vallecula), APW-PPW, APW'-PPW', HY- Cv3ia, hyoid and GoMe.

RESULTS: There was no statistically significant change in the oropharyngeal airway after mandibular midline distraction.

CONCLUSION: Three-dimensional imaging techniques are preferable to two-dimensional lateral cephalograms for evaluation of the oropharyngeal airway.

#### 440 EFFECT OF PRE-ORTHODONTIC TRAINER TREATMENT ON CLASS I PATIENTS WITH ANTERIOR CROWDING

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AIM: Studies assessing the clinical effects of the T4K™ (The Pre-Orthodontic Trainer; Myofunctional Research Co., Queensland, Australia) in the growing child are limited. The aim of this study was to evaluate the dentoskeletal treatment effects induced by T4K™ on Class I anterior crowding cases.

SUBJECTS AND METHOD: Eight patients (4 girls, 4 boys, mean age: 9.1 years) with a Class I anterior crowding malocclusion treated with the T4K™. The patients were instructed to use the trainer for one hour daily plus overnight while sleeping. Pre- (T0) and post- (T1) treatment dental casts and lateral cephalometric radiographs were obtained 10 months after application. The amount of crowding of the mandibular incisors was assessed using the irregularity index. SNA, SNB, ANB, GoGn/SN, I-NL, I-ML, interincisal angle and overjet were compared on the T0 and T1 cephalograms. Paired-sample *t*-tests were used to compare differences between T0 and T1.

RESULTS: At T1, skeletal changes were not statistically different. The patients showed significant changes, including a decreased irregularity index and increased lower incisor-mandibular angle ( $P < 0.05$ ).

CONCLUSION: As the T4K™ appliance results in basically dentoalveolar changes, it can be used as treatment choice for child patients, and facilitates possible fixed-orthodontic therapy.

#### 441 EFFECTS OF CONTINUOUS VERSUS INTERMITTENT CONTROLLED ORTHODONTIC FORCES ON ROOT RESORPTION

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AIM: This prospective randomized clinical trial compared the effects of controlled intermittent and continuous forces on root resorption.

SUBJECTS AND METHOD: Twenty-five patients requiring the extraction of upper first premolars, due to crowding. A buccally directed continuous force of 150 g was applied to the premolars on one side in all patients for 15 weeks. On the

other side an intermittent force (28 day on 7 day off) of the same magnitude was applied to the premolars. After the extractions, surface analysis was performed via micro-computed tomography (Sky Scan 1172, Belgium) and specially designed software (CHull2D) for direct volumetric analysis. Buccal premolar movement and the degree of rotation were also measured on the images of the study casts.

**RESULTS:** Total resorption volume with continuous force application was significantly higher than that of the intermittent force application ( $P < 0.05$ ). Resorption volumes of the buccal and lingual surfaces were significantly higher in the continuous force group when compared with the intermittent force group ( $P < 0.05$ ). Continuous force application caused significantly more resorption at the middle third of the root ( $P < 0.01$ ) and more buccal and lingual cusp movement and rotation.

**CONCLUSION:** Intermittent force causes less resorption than continuous force; however, intermittent force produces less tooth movement when compared with continuous force.

#### 442 EVALUATION OF GEOGRAPHICAL DISTRIBUTION OF PATIENTS REFERRED TO YEDITEPE UNIVERSITY ORTHODONTIC CLINIC

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**AIM:** To evaluate the geographical distribution of patients referred to the Department of Orthodontics, of Yeditepe University using the geographical information system (GIS).

**MATERIALS AND METHODS:** The records of patients referred between 2003-2009 were integrated into the GIS 'Arcview 9.3 GIS'. With the orientational mapping technique, gender, age and skeletal abnormality of the patients were shown in thematic maps.

**RESULTS:** The records of 2534 referred patients referring from 39 townships of Istanbul and from other 36 cities were evaluated. The patients mostly came from Kadıköy (19%), Kartal (12%), Üsküdar (12%) and Maltepe (11%).

**CONCLUSION:** The clinic of Yeditepe University provides orthodontic services to the Marmara region, primarily to the Anadolu side of Istanbul.

#### 443 PERIODONTAL HEALTH OF PATIENTS DURING ORTHODONTIC TREATMENT WITH CUSTOM FABRICATED ALIGNERS

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**AIM:** Orthodontic tooth movements are strongly related to interactions of teeth with their supportive periodontal tissues and orthodontic treatment is sometimes considered a predisposing factor for periodontal disease. The purpose of this study was the evaluation of the periodontal health of patients during treatment with clear custom fabricated aligners.

**SUBJECTS AND METHOD:** Eighteen patients (mean age =  $16.38 \pm 3.22$  years) enrolled for clear aligner treatment with a skeletal and dental Class I malocclusion and 3 to 4 mm of mild upper and lower arch crowding. Each patient had three consecutive custom-fabricated aligners at every appointment. The patients were instructed to wear their aligners at least 18 hours per day and to change them with the following one every 10th day until the next appointment. All patients had six sets of appliances during the 6 month treatment period. The patient's oral health was evaluated with reference to the plaque and gingival indices, sulcus probing depth and gingival recession at baseline and at months 1 and 3 and at the end of the sixth month. All indices were documented buccomesially, buccodistally, mid-buccally and mid-lingually in each quadrant from central incisor to first the molar. Descriptive statistics were generated and compared by a paired sample *t*-test for parametric variables and Wilcoxon signed rank test for non-parametric variables.

**RESULTS:** There was a significant reduction in the plaque index between the beginning and final follow-up measurements ( $P < 0.05$ ). Gingival index, sulcus probing depth and gingival recession parameters showed no significant differences ( $P > 0.05$ ).

**CONCLUSIONS:** Although all teeth and parts of the keratinized gingiva are covered nearly all day with customized fabricated aligners, no periodontal pathology or gingival recession occurred during the treatment period. This may be due to the fact that aligners are removable, permitting unobstructed oral hygiene, the young age range of the treatment group and the short-term follow-up.

#### 444 PREVALENCE OF MALOCCLUSION PATTERN IN A TURKISH POPULATION: AN EPIDEMIOLOGICAL STUDY

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**AIMS:** To determine the frequencies of different type of malocclusions, to compare mean ages and gender distributions of patients with different growth patterns and to evaluate the percentage rate of extraction–non-extraction cases, orthognathic surgery, asymmetry and cleft lip and palate cases and impacted teeth.

**MATERIALS AND METHOD:** Patient records were chosen and classified according to gender, age, sagittal and vertical growth pattern and different treatment modalities. The most significant principal components, accounting for cephalometric evaluation, were the divergence of the skeletal pattern and the anteroposterior maxillomandibular relationship. Various linear and angular measurements were carried out to obtain a comprehensive description of the craniofacial pattern and to classify each patient. The cephalometric criteria included: GoMe-SN angle, sum of internal angles, Jarabak ratio, ANS-Me/N-Me ratio, gonial ratio, Frankfort mandibular angle (FMA), the sella-nasion point A angle (SNA), sella-nasion point B (SNB), and ANB angle.

**RESULTS:** One thousand three hundred and eighty four were examined. The prevalence of Class I, Class II and Class III malocclusions was 27.6, 56.2 and 16.2 per cent, respectively. The percentages of different treatment regimens such as cleft lip-palate, orthognathic surgery and extraction were 1.2, 9.1 and 27.1 per cent, respectively. Asymmetry was observed in 2.5 per cent and impacted teeth in 0.4 per cent of the subjects. Comparison of the mean ages and sagittal relationship was found to be statistically significant different in the Class II malocclusion groups ( $P < 0.05$ ), whereas no statistically significant gender differences were found among these subjects. No statistically significant differences were observed between a vertical developmental pattern and age-gender distribution.

**CONCLUSION:** The majority of referred patients were found to have a skeletal Class II (56.2%) sagittal relationship with vertically normal developmental pattern (47.1%).

#### 445 TRAPULPAL TEMPERATURE CHANGE DURING DEBONDING

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**AIM:** To determine the amount of energy required to remove ceramic brackets safely without causing intrapulpal damage using an Er:YAG laser with the scanning method.

**MATERIALS AND METHOD:** Part 1: Eighty bovine mandibular incisors with ceramic brackets were randomly assigned to four equal groups, one control and three study groups. In the study groups, brackets were debonded after lasing with 2, 4 and 6 W, whereas debonding was performed without lasing in the control group. Shear bond strengths (SBS) and adhesive remnant index (ARI) scores were recorded. Part 2. Thirty human premolars with ceramic brackets were randomly divided into three groups of 10, as 2, 4 and 6 W of energy. Intrapulpal temperature was measured at same lasing times by a thermocouple.

**RESULTS:** Statistically significantly lower SBS were found in the study groups compared with the control. A negative correlation was observed between bond strengths and ARI scores, such that as SBS decreased ARI scores increased.

#### 446 TREATMENT EFFECTS ON DENTOFACIAL STRUCTURES OF A UNIVERSAL SPRING AND FATIGUE RESISTANT DEVICE

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**AIM:** To compare the dentoskeletal and soft tissue changes produced by the Sabbagh universal spring (SUS<sup>2</sup>) and the Forsus fatigue resistant device (FRD) in late adolescent patients with a Class II malocclusion, and to quantify them in comparison with an untreated control group.

**SUBJECTS AND METHOD:** Fifty-nine patients with a skeletal and dental Class II malocclusion due to a retrognathic mandible, normal or low-angle growth pattern, post-peak growth period and no extracted or congenitally missing permanent teeth. Of these, 20 were treated with a SUS<sup>2</sup>, 20 with Forsus FRD and the remaining 19 subjects formed the untreated control group. One hundred and eighteen lateral cephalometric radiograms were taken before placement and after removal of appliances in both treatment groups and at the beginning and after six months in the control group.

**RESULTS:** There was no significant vertical or sagittal skeletal effect on the maxilla or mandible with their appliance. The effects observed for the SUS<sup>2</sup> and Forsus FRD groups were related to the maxillary and mandibular dentoalveolar component. Retrusion and extrusion of the maxillary incisors as well as the protrusion and intrusion of the mandibular incisors were found to be statistically significant in both treatment groups.

**CONCLUSION:** Both appliances corrected the Class II discrepancies through maxillary and mandibular dentoalveolar changes.

#### 447 REAL-TIME CELL ANALYSIS OF THE CYTOTOXICITY OF ORTHODONTIC ACRYLIC MATERIALS ON GINGIVAL FIBROBLASTS\*\*\*

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**AIM:** To evaluate the cytotoxicity of three different orthodontic acrylic materials and two different polymerization methods on gingival fibroblasts.

**MATERIALS AND METHOD:** Orthoacryl EQ (Dentaurum), Orthoplas (Vertex) and O-80 (Imicryl) were prepared with two different polymerization methods (douching and salt-paper). Sixty 2 × 3 (5 mm) mm cylinders fabricated using different acrylics and methods were divided into six groups. Gingival fibroblasts were isolated from human gingival connective tissue of systemically healthy individuals. The materials were incubated in Dulbecco modified Eagle medium (DMEM) culture medium for 72 hours according to ISO 10993-5 standards (surface area to volume ratio of the specimen to cell-culture medium; 3 cm<sup>2</sup>/ml). Gingival fibroblasts were maintained with DMEM containing 10 per cent foetal bovine serum. A real-time cell analyzer (xcelligence) was used to evaluate cell survival. After seeding 200 µL of the cell suspensions into the wells (20 000 cells/well) of the E-plate 96, gingival fibroblasts were treated with bioactive components released by acrylic materials (1/1 and 1/2 dilutions) and were monitored every 15 minutes for a period for 121 hours. The data was analyzed by one-way analysis of variance and Tukey-Kramer multiple comparison tests.

**RESULTS:** Gingival fibroblastic viability was not affected at 21 and 32 hours ( $P > 0.05$ ), but was significantly reduced in all groups at 68 and 108 hours ( $P < 0.001$ ) when compared with the control group.

**CONCLUSION:** Longer exposure time to components released by acrylic materials may have cytotoxic effects in the oral environment.

#### 448 CONDYLE POSITION AND CENTRIC RELATION RECORDS AND COMPUTED TOMOGRAPHY IMAGING IN CLASS II DIVISION I PATIENTS

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**AIMS:** To determine the direction and magnitude of shifts between centric occlusion (CO) and central relation (CR) positions at the level of condyles, to report condyle positions in the glenoid fossa using cone beam computed tomographic (CBCT) imaging before the start of fixed functional treatment in patients with a Class II division 1 malocclusion.

**SUBJECTS AND METHOD:** Twenty-seven patients with a Class II division 1 malocclusion with a mean age of 13 years, 6 months. All patients were to be treated with a fixed functional orthodontic appliance. All records [CO (maximum intercuspation) bite registration, CR bite registration (described by Roth), SAM anatomic facebow, CR mounting of the models on the SAM articulator, MPI records and CBCT imaging) were taken before treatment. **RESULTS:** Condylar position in CO relative to CR was generally located posteroinferiorly in MPI registrations. The right condyle was found to be displaced 70.3 per cent posteroinferiorly, 18.5 per cent inferiorly, 3.7 per cent anteroinferiorly, 3.7 per cent anterosuperiorly and 37 per cent posteriorly. The left condyle was found to be displaced 74 per cent posteroinferiorly, 11.1 per cent inferiorly, 7.4 per cent centrally and 7.4 per cent anterosuperiorly. CBCT images showed only two patients whose condylar positions were concentric. Posterior joint space of the right condyle was larger in 70.3 per cent of patients and for the left condyle in 62.9 per cent.

**CONCLUSIONS:** CR-CO sagittal discrepancy was greater than the physiologic limit (2 mm) for 16 patients (right condyle) and 15 patients (left condyle), with the greatest deviation in the vertical plane. The condyle was positioned anteriorly in the glenoid fossa in patients with a Class II division I malocclusion.



#### 449 MANDIBULAR LINGUAL FIXED RETAINER SURVIVAL: A RANDOMIZED CONTROLLED TRIAL OF TWO ADHESIVES

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**AIM:** To comparatively assess the survival of lingual retainers bonded with either a chemically or light cured adhesive system over a 12-month period.

**SUBJECTS AND METHOD:** Two hundred and twenty patients were randomized using random permuted blocks to either Maximum Cure two part liquid adhesive and Excel two part paste (Reliance Orthodontics, Illinois, USA) or to Assure light cure liquid and Flowtain paste in two layers (Reliance Orthodontics). Light curing was accomplished by curing for 9 seconds per tooth with a plasma light (Ortholite, 3M Unitek, Minnesota, USA). All patients received a bondable lingual retainer (Tru-Chrome multistranded wire, Rocky Mountain Orthodontics, Colorado, USA). The recorded main outcome was first failure on any tooth. The patients were scheduled to be followed at 1, 3, and 6 months, and then every 6 month from the bonding date until the first patient reached 3 years from the trial onset. Data were analyzed using statistical methods of survival analysis including the log rank test and Cox regression.

**RESULTS:** The failure was similar among the two treatment groups over the 18 month period from the onset of the trial (chemically cured adhesive 32/110 or 29% and light cured adhesive 30/110 or 27%,  $P > \chi^2 = 0.86$ ). The hazard ratio was 0.95 95%CI: 0.58, 1.57 and the  $P$  value = 0.86. The instant failure probability (=hazard) was almost the same between the adhesive groups (5% lower in the Flowtain versus the Excel group with a relatively wide CI indicating a range of 42 per cent lower to 57 per cent higher hazard, a non-significant finding  $P = 0.86$ )

**CONCLUSION:** The preliminary data indicate that there is no evidence that the survival of mandibular lingual retainers differs between chemically and photocured adhesives over an 18 month period.

#### 450 CONVENTIONAL AND SELF-LIGATING APPLIANCES: EFFECT ON MANDIBULAR INTERMOLAR DISTANCE IN ADOLESCENT NON-EXTRACTION CASES

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**AIM:** To compare intermolar width at the completion of alignment of the crowded mandibular dental arch in non-extraction adolescent cases between conventional and self-ligating brackets.

**SUBJECTS AND METHODS:** Fifty patients were included using the following inclusion criteria: non-extraction treatment in both arches; eruption of all mandibular teeth; no spaces in the mandibular arch; mandibular irregularity index from canine to canine greater than 2 mm; and no therapeutic intervention planned involving intermaxillary or other intra- or extraoral appliances including elastics before the end of the observation period. Patients were randomized in two groups: the first received a conventional and the other a passive self-ligating appliance, both with a 0.022 inch slot. The amount of crowding of the mandibular dentition was assessed using the Irregularity Index. Intermolar width was investigated with statistical methods of linear regression analysis. On an exploratory basis, the effect of appliance type on intercanine width was also assessed. Additionally, the effect of appliance type on time to alignment, as well as the effect of crowding on time to alignment, were assessed using the Cox proportional hazards model.

**RESULTS:** No difference in intermolar width was found between the two bracket systems ( $\beta = 0.30$ , 95%CI:-0.3,0.9,  $P = 0.30$ ). No difference in intercanine width was observed between the two bracket systems ( $\beta = 0.33$ , 95%CI:-0.8,0.1,  $P = 0.15$ ). The time to reach alignment did not differ between appliances systems (hazard ratio = 0.68, 95%: 0.4,1.2,  $P = 0.21$ ), whereas the amount of crowding was a significant predictor of the required time to reach alignment (hazard ratio = 0.88, 95%:0.8,0.9,  $P = 0.02$ ).

**CONCLUSIONS:** The use of conventional or self-ligating brackets does not seem to be an important predictor of mandibular intermolar width in non-extractions cases when the same wire sequence is followed.

#### 451 INFLUENCE OF ORTHODONTIC TREATMENT WITH FIXED APPLIANCES ON THE FORMATION OF THE PERMANENT TEETH

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AIM: To estimate the influence of orthodontic treatment with fixed appliances on the root formation of permanent teeth. SUBJECTS AND METHOD: Forty patients aged 10-15 years before and after orthodontic treatment of anterior crowding with fixed appliances. Eighty pre- and post-treatment dental pantomographs were studied. The teeth and roots axis slope angles were defined according to Weber (1990).

RESULTS: Before treatment 25 per cent of the patients had the crown axis of upper jaw extrapolated to the root axis. In the lower jaw, the same was registered in only 5 per cent. For 23 per cent of the total number of maxillary teeth and for 42 per cent of the mandibular teeth, the lower crown axis did not coincide with the axis of the root. Therefore, in patients with anterior crowding the correct formation of the root was disturbed. Correction of crowding was achieved in 8 to 18 months. The number of patients with combined axes of the teeth remained the same. The number of teeth with non-coincidental crown and root axes with the vertical axis of the tooth decreased: 26 per cent in the upper jaw, 44 per cent in the lower jaw. CONCLUSION: Orthodontic treatment with fixed appliance does not have a negative influence on root formation.

#### 452 SKELETAL AGE: EXPRESS DIAGNOSIS USING THE MATURATION STAGES OF THE LOWER TEETH

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AIM: To analyse and compare methods of determination of maturation stages of Class I and Class II patients with crowding. SUBJECTS AND METHOD: One hundred 9-22 year old patients with crowding. The formation stages were studied on panoramic radiographs using the method of Demirjian (1973). Some parameters of the cervical vertebrae were measured (C2, C3 and C4) using the method of Baydas (2004: body length, anterior and posterior body heights, anterior and posterior intervertebral spaces and inferior depth of the bodies. Cervical maturation stages were determined using the method of Lamparski (1972) modified by O'Reilly and Yanniello (1988). Active growth stages and future growth were determined using the method of Hassel and Farman (1995). Lower second premolar and canine roots maturation stages were examined on the panoramic radiographs according to Demirjian (1973). Correlation-regression analysis of the examined parameters was undertaken.

RESULTS: The patients were divided into six groups according to their cervical maturation stages. Vertebral body size analysis showed that the inferior depth of C2 body relatively increased from the first to the third stage, C3 from the second to the fifth stage and C4 from the third to the fifth stage. Inferior depth reached its maximum value in the fifth stage, following which only an increase of body height occurred. There was also a gradual increase in the ratio of anterior and posterior heights to the length. During vertebral body maturation consecutive canine and second premolar root formation occurred. In all patients in the sixth stage of vertebral maturation was stage H root formation of the canines and second premolars.

CONCLUSION: Root formation stages of the lower second premolars and canines can be used in express diagnostics for skeletal age determination.

#### 453 TREATMENT OF 12-15 YEAR OLD CLASS III MALOCCLUSION PATIENTS\*\*\*

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AIM: To study morphometric indices of 12-15 year old patients before and after orthodontic treatment of a Class III malocclusion.

SUBJECTS AND METHOD: Forty-five patients aged 12-15 years with a Class III malocclusion treated with a Postnikov appliance (patent 92323 from 20 March 2010, Russia). For all lateral cephalograms were measured before and after treatment and the following were analyzed: N-Se, A'-Snp, Go-Pg, <SNA, <SNB, <ANB, <SpPMP, < $\alpha$ , <ArGoMe, <NSeAr, <SArGo, sum Björk.

RESULTS: The length of external base of the skull (N-Se) increased by 4.96 per cent in comparison with the norm ( $P < 0.05$ ); the length of the maxillary body (A'-Snp) increased by 7.46 per cent ( $P > 0.05$ ); the length of the mandibular body (Go-Pg') increased by 9.24 per cent ( $P < 0.01$ ), <SNA increased by 2.3 per cent ( $P > 0.05$ ), <SNB by 2.23 per cent ( $P < 0.05$ ) and <ANB by 19.4 per cent ( $P < 0.05$ ). <SpP-Mp increased by 13.46 per cent from the norm ( $P < 0.05$ ) and interincisor angle by 4.52 per cent ( $P > 0.05$ ). The angle Ar-Go-Me significantly increased by 4.05 per cent ( $P < 0.05$ ) and it was determined that the base of the mandibular plane was referred downward and forward. The other parameters were within the limits of the mean norm value. Thus the significant increase of Go-Pg' and angles SNB and SpP-MP confirms the clinical diagnosis and determines the anomaly of a Class III malocclusion.

**CONCLUSIONS:** In the examined patients the Class III malocclusion was caused by a mesial position of the mandible and its dentoalveolar form. A significant increase of the mandibular body length indicates more intensive mandibular growth, probably because of the reverse overbite. Normalization of the malocclusion using the Postnikov apparatus was achieved as a result of changes in the interposition of the maxillary and mandibular anterior teeth and the position of the mandible.

#### 454 DIMENSIONAL CHANGES IN MAXILLARY SINUSES AND THE PHARYNGEAL AIRWAY IN CLASS III PATIENTS – A PILOT STUDY

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**AIM:** To investigate the dimensional changes of the maxillary sinuses and the pharyngeal airway (PA) in Class III patients undergoing bimaxillary orthognathic surgery.

**SUBJECTS AND METHOD:** Nine patients with mean age of 27.4 years, diagnosed with a skeletal Class III deformity. All patients underwent bimaxillary surgery (maxillary impaction and/or advancement and mandibular setback). Two cone beam computed tomographs (CBCTs) were available for all patients, the first taken before and the second three months after surgery. Three-dimensional airway, right and left maxillary sinus models of the patients were constructed using Mimics software. The limits of the PA were determined using the appropriate anatomical landmarks and reference planes. The volumetric changes of the total, upper and lower PA and maxillary sinuses were measured, using the same software. The results were statistically analysed using paired *t*-tests.

**RESULTS:** The mean upper, lower, and total PA volumes before surgery were (in mm<sup>3</sup>): 8604.92 ± 2665.34, 13147.59 ± 5381.07, 21752.52 ± 7515.14, respectively, and after surgery 9767.73 ± 3428.11, 13866.86 ± 6286.58, 23634.60 ± 8764.14, respectively. An increase in upper, lower and total PA volume, which was not statistically significant, was observed. The mean volume of the right and left sinuses before the surgery were: 15202.80 ± 4434.15 and 16678.6 ± 3585.04, respectively, and after surgery, 13778.19 ± 4830.16 and 15081.73 ± 4033.70, respectively. There was a significant difference in the volume of the left sinus that decreased by a mean of 1596.87 mm<sup>3</sup> (*P* = 0.029).

**CONCLUSION:** There is no significant difference in the volume of PA after bimaxillary surgery. However, there is a decrease in the total volume of the sinuses, resulting from a decrease especially in the volume of the left sinus. More indicative results, however, may occur from a larger sample.

#### 455 DISTALIZATION OF THE UPPER FIRST MOLARS WITH THE PENDULUM APPLIANCE IN THE MIXED DENTITION

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**AIM:** Molar distalization is used to gain space in the sagittal level. One of the non-compliant distalization appliances is the frictionless, intramaxillary Pendulum K. The risk of root resorption or inhibition of root development during orthodontic treatment is always present, especially when fixed appliances are used. The objective of this study was a metric comparison of tooth and root lengths in the second molar region before and after molar distalization with a Pendulum K. The aim was to evaluate whether different dentition stages have an impact on the root development of second molars.

**SUBJECTS AND METHOD:** Thirty-six patients (14 males, 22 females) were treated with a Pendulum K appliance for molar distalization. Treatment progress was documented on dental casts and two dental pantomograms (time point T1: before the start of molar distalization; time point T2: immediately after completion of molar distalization). The patients were separated into two different groups: PG1 (n = 18; mean age 11.8 years, mean duration of treatment 18.8 weeks) second molars in the developmental stage or erupting, anchorage on premolars; PG2 (n = 18; mean age 12.7 years, mean duration of treatment 20.2 weeks) second molars fully erupted, anchorage on premolars.

**RESULTS:** None of the cases showed a negative influence on root development during treatment but there was a significant elongation of root length. There was a slight difference between PG1 and PG2 insofar as lengthening was greater in PG2, but not statistically significant.

**CONCLUSIONS:** The Pendulum K can be used during all stages of second molar root development. Moreover, the findings show that the stage of fully erupted second molars seems to be particularly favourable. Nevertheless the initial forces must be controlled to avoid unphysiologically high stress on the teeth involved.

#### 456 EVALUATION OF TREATMENT OUTCOME IN PATIENTS WITH A CLEFT LIP AND/OR PALATE

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**AIM:** To assess the level of satisfaction of cleft patients and their parents with the aesthetic and functional outcome of cleft treatment.

**SUBJECTS AND METHOD:** Thirty-two successfully treated cleft patients, five cleft palate (CP), 21 unilateral cleft lip and palate (UCLP), and six bilateral cleft lip and palate (BCLP) treated from January 1994 to May 2010, and their 32 respective parents. The patients and their parents answered a 10 question questionnaire: five questions relevant to aesthetics and five to function. Their answers were recorded on a 100 mm visualized analogue scale. The number of surgical operations was recorded for each patient. Statistical analysis included comparison between the answers of the patients and parents, comparison among those of the different cleft groups and correlation between the number of surgical operations with the level of satisfaction.

**RESULTS:** Significant differences in the level of satisfaction were found between the three groups (CP, UCLP, BCLP) when evaluating the nose and lip aesthetics. Patients with CP appear to be more satisfied with the appearance of their lip, followed by UCLP patients. BCLP patients were the least satisfied. Parents of patients with CP and BCLP were more satisfied with the nose aesthetics than those of patients with UCLP. The number of surgical interventions varied between groups and did not affect overall satisfaction with the treatment outcome. The aesthetics of the upper lip was the only exception.

**CONCLUSIONS:** Patient satisfaction is in general coincident with that of their parents. The satisfaction of the three groups with varying degrees of cleft severity differs significantly when evaluating the appearance of the nose and upper lip.

#### 457 PROFESSIONALS' AND LAYPERSONS' APPRECIATION OF CLEFT LIP AND PALATE TREATMENT OUTCOME

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**AIMS:** To analyse the aesthetic evaluations of laypersons and orthodontists of head photographs of various treated cleft patients, to identify certain cephalometric and anthropometric variables which could be related to their rating and to compare facial aesthetic ratings to those of cleft patients and their peers.

**MATERIALS AND METHOD:** A set of five photographs of the heads of 12 Caucasian patients with a unilateral cleft lip and palate who had completed the surgical treatment protocol (frontal, both laterals, three-quarter right and left) taken under standardized conditions were presented to 12 adult laypersons, 12 orthodontists and 12 maxillofacial surgeons. For each photograph the judges had to answer four questions on a visual analogue scale. The answers of the raters were compared with those of the cleft patients and of their parents registered during an interview.

**RESULTS:** The greater distance of the upper lip from the aesthetic plane seemed to affect the judgement of surgeons ( $P = 0.009$ ) while SNB ( $P = 0.016$ ) affected the assessment of surgeons and laypersons. There was a high correlation between the assessment of the nose by laypersons and SNA ( $P = 0.007$ ). Orthodontists agreed in their assessments of nose aesthetics with the peers of the cleft patient, while for assessment of the aesthetics of the upper lip the judges had a greater correlation with cleft patients than with their peers.

**CONCLUSIONS:** Both surgeons and orthodontists report a greater satisfaction with treatment outcome and evaluate the cleft consequences with less severity than laypersons. A more retruded position of the mandible influenced the judgments both of laypersons and surgeons, while SNA plays an important role in the assessment of aesthetics of the nose by laypeople.

#### 458 CROWN INCLINATION OF THE MAXILLARY INCISORS AS DELIVERED BY THREE DIFFERENT BRACKET SYSTEMS

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**AIMS:** To evaluate crown inclination of the upper incisors following treatment with three commercially available bracket systems, and to compare the prescribed and obtained inclination.

**MATERIALS AND METHOD:** The crown inclination (torque) of the maxillary incisors was assessed on post-treatment digital models of 108 randomly selected patients. The patients had been treated with three different bracket systems and finished in the recommended rectangular finishing wire: passive self-ligating (Damon® 3MX;  $n = 28$ ), active self-ligating



(In-Ovation® C & R; n = 23) and conventional brackets (Orthos™; n = 33). All systems had a slot size of 0.22 × 0.28 inches. The variation between the contralateral sides was compared for each bracket type. The deviation of the obtained inclination, expressed in absolute values, was compared with that of the prescribed value.

**RESULTS:** There was no significant difference in the mean torque values among the three different groups for any of the four incisors. However, there was a tendency for smaller mean torque values for the central incisors (steeper) and larger for the lateral incisors (more proclined) for the passive self ligating group, giving the clinical impression of a more “flared” lateral incisor. There was a pronounced deviation and a statistically significant difference between the prescribed and obtained torque for all teeth in all groups. The variation of the values within all groups was very large when looking at the standard deviations and the raw data.

**CONCLUSIONS:** There was no significant difference in upper incisor crown inclination among the patients treated with the bracket systems tested, but there was a substantial difference between the obtained and prescribed values, indicating that discussion on the correct prescription has little clinical significance.

#### 459 A NOVEL METHOD FOR VOLUMETRIC ASSESSMENT OF TOOTH WEAR USING THREE-DIMENSIONAL REVERSE ENGINEERING TECHNOLOGY

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**AIM:** To introduce a newly developed method of measuring tooth wear and to evaluate the volumetric changes of tooth wear during orthodontic treatment using three-dimensional (3D) reverse engineering technology.

**MATERIALS AND METHOD:** Dental casts obtained from 56 patients (23 males, 33 females; mean age: 21.8 ± 5.1 years) who underwent orthodontic treatment with extraction of the bilateral maxillary and mandibular premolars. The dental casts were obtained before and after orthodontic treatment and scanned with a laser surface scanning system (Orapix Co., Ltd, Seoul, Korea). The 3D digital models of the dental casts were reconstructed and imported to a 3D reverse modelling software program (Rapidform XOR3, Inus Technology, Seoul, Korea). The 3D images of the canines before and after orthodontic treatment were superimposed using the best-fit method with the middle third of the labial and lingual surface of each canine as the registration area. The volumetric differences of the canines before and after treatment were calculated.

**RESULTS:** Mean volumetric change after orthodontic treatment was 2.048 ± 1.311 mm<sup>3</sup> (mean ± the standard deviation). The mean amount of tooth wear in males (2.277 ± 1.478 mm<sup>3</sup>) was larger than in females (1.888 ± 1.178 mm<sup>3</sup>). However, the differences were not significant. The amount of tooth wear was not significantly different between the upper and lower arch or between the right and left side.

**CONCLUSIONS:** Tooth wear during orthodontic treatment can be accurately quantified by measuring the volumetric change on 3D digital models. Canine wear was, on average, 2.048 mm<sup>3</sup> after orthodontic treatment.

#### 460 THREE-DIMENSIONAL STUDY OF SPECIFIC SHAPES OF THE NASOPHARYNGEAL AIRWAY IN PRE-ADOLESCENTS

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**AIM:** To investigate three-dimensional nasopharyngeal airway (NA) shape in the frontal plane in children, and to assess whether a significant relationship exists between NA shape and the various craniofacial patterns.

**SUBJECTS AND METHOD:** Fifty-five healthy preadolescents (mean age: 11.34 ± 1.68 years) divided into three groups based on their ANB angles and molar relationship. Using cone-beam computed tomography (CBCT), the cross-sectional areas and volume of the NA were measured and compared with cephalometric variables created from CBCT. A cluster analysis was performed with the measurements of the NA on the adenoid plane. All measurements between genders and the NA measurements between groups based on NA shapes were compared using independent *t*-tests. Scheffé's test was carried out to compare the NA measurements of all subjects across Class I, II, and III malocclusions. Pearson's correlation coefficient was performed to estimate any relationships between the NA and craniofacial morphology.

**RESULTS:** With cluster analysis, the subjects were re-classified as leaf and long boat types based on NA shapes and compared among types. The volume of NA was smaller in subjects with a Class III than in those with a Class I malocclusion (*P* < 0.05) and smaller in the group with a long boat shape than in the group with a leaf shape (*P* < 0.01). The cross-sectional area of NA was significantly correlated with FMA, gonial angle and mandibular body length (*P* < 0.05).

CONCLUSION: Children with Class II and III malocclusions are associated with a small volume and a long boat shape of NA compared with those with a Class I malocclusion.

461 NON-COMPLIANCE APPLIANCES: TREATMENT OF DENTAL OR DENTO-SKELETAL CLASS II

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AIM: To describe the use of Hilger's Pendulum appliance for distalization in Class II cases and the correlation with an increase in temporomandibular disorders during and after treatment.

SUBJECTS AND METHOD: Sixteen patients (11 females, 5 males) aged 12.3 to 15 years of age with a dentoskeletal Class II malocclusion. After clinical examination and condylar position analysis with the CPI, treatment was carried out non-extraction with molar distalization for correction of the Class II malocclusion using a Hilger's Pendulum appliance. The post-treatment records were compared with those obtained pre-treatment.

RESULTS: The results indicated that, although there were patients who at the beginning of treatment had a coincidence of CO-CR or a CO-CR discrepancy. At the end of therapy they all showed a significant registration with the CPI with the condyles moved towards lower and often back from the glenoid cavity, leaving the disc free to move in the space created after molar distalization. All patients were affected by this movement except for two, for whom it was necessary to remove the appliance because they had intra-articular pain during the distalization. For these two patients the treatment plan was modified with extractions of two upper premolars.

CONCLUSIONS: Data needs further development.

462 LONG-TERM SUCCESS AND FAILURE OF AUTOTRANSPLANTED PREMOLARS

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AIM: To evaluate long-term success and failure of autotransplanted premolars, followed up to 30 years.

SUBJECTS AND METHOD: One hundred patients treated with autotransplantation due to tooth aplasia and tooth loss. All patients (9.2-14.4 years, mean 12.8), 53 boys and 47 girls, had one-rooted premolars transplanted from one region to another. In total 118 premolars were transplanted in root stages with an open apex wider than 1 mm. Primary healing and follow-up were tested using a Siemens electrometric pulp tester to detect pulpal reinnervation and standardized radiographs to test transplant healing and root development generally. Assessments were carried out at 1, 4, 8, 12 and 24 weeks and thereafter yearly after transplantation. Transplants were moved or rotated orthodontically 3-9 months after transplantation.

RESULTS: Complicated problems were moved to other regions that were easier to solve orthodontically. Most transplanted premolars showed normal tooth eruption, compared with the contralaterals. Transplants induced tooth eruption and bone induction. Transplants erupted before visible root formation and before visible alveolar bone formation. Furthermore, marginal gingiva was transferred with both papillae. The success and failure rates for all transplants were 93.1 and 6.9 per cent, respectively. Premolars transplanted as maxillary incisors had a higher incidence of failures (15%) than premolars transplanted to the mandibular premolar regions (7.6%).

CONCLUSION: Marginal gingiva was transferred with both papillae. Transplantation induced tooth eruption and bone induction. Transplantation of one-rooted premolars carried out by a trained oral surgeon had a long-term success of 93.1 per cent.

463 MORPHOMETRIC EVALUATION OF THE FRONTAL SINUS IN RELATION TO AGE AND GENDER

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AIM: To evaluate the shape and size of the frontal sinus in relation to gender and age.

MATERIALS AND METHOD: Lateral cephalometric radiographs of 196 patients, (100 females, aged  $11.7 \pm 2.53$ , 96 males aged  $12.0 \pm 2.15$ ). The frontal sinus was traced and sinus height, width and area were measured. Geometric morphometric analysis [generalized Procrustes alignment and principal component analysis (PCA) of the shape variables] was performed. Two observers analyzed the radiographs without significant interobserver differences. Sinus area was

averaged between observers. Comparison between the groups was performed using *t*- and Mann-Whitney *U* tests. Correlation coefficients between age and other variables (sinus area, height, width and centroid size) were calculated. PCA was performed on the shape variables (shape space), and on the shape variables augmented by the logarithm of centroid size (form space).

**RESULTS:** Sinus area and width was larger in males than females. There was no evidence of gender differences for the other variables. Sinus area showed the highest correlation to age ( $R^2$ : females 0.22, males 0.20). Permutation tests showed a statistically significant difference in shape between the genders. Correlation of shape variables with age was statistically significant in both shape and form space. The highest correlations were observed in form space ( $r^2$ : females 0.20, males 0.25), but the 95 per cent prediction intervals were wide (females 7.4 to 16.5, males 8.0 to 15.5).

**CONCLUSIONS:** Small differences regarding shape and size could be detected between the genders, however variability was high. Frontal sinus size and shape showed a statistically significant correlation with age, but cannot be used to reliably infer chronological age or gender (e.g. in forensics) within the age range of the present study.

#### 464 RAPID MAXILLARY EXPANSION IN GROWING SUBJECTS: EFFECTS ON THE PALATAL AREA

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**AIM:** To evaluate the effects of rapid maxillary expansion (RME) on palatal area as assessed by low-dose computed tomography (CT) before treatment (T0), at the end of active expansion (T1) and after a retention period of 6 months (T2).

**SUBJECTS AND METHOD:** Seventeen prepubertal subjects (mean age: 11.2 years) with constricted maxillary arches. The total amount of expansion was 7 mm in all subjects. Multislice low-dose CT scans were taken at T0, T1, and T2. On the axial CT scanned images a circular line passing through the external aspect of the palatal cortical plate of the first upper right and upper left molar was drawn and the area inside the circle registered at all three observation times. Friedman ANOVA with post-hoc tests was used ( $P < 0.05$ ).

**RESULTS:** The circular area showed a significant increase from T0 to T1 ( $525.6 \pm 125.2 \text{ mm}^2$  and  $691.3 \pm 97.7 \text{ mm}^2$ , respectively) as a consequence of opening of the midpalatal suture after RME. A significant increase from T0 to T2 ( $525.6 \pm 125.2 \text{ mm}^2$  and  $721.1 \pm 92.7 \text{ mm}^2$ ) and lack of statistically significant differences from T1 to T2 ( $691.3 \pm 97.7 \text{ mm}^2$  and  $721.1 \pm 92.7 \text{ mm}^2$ , respectively), was observed.

**CONCLUSIONS:** At the end of the active phase of expansion a significant increase of the palatal area was observed in all subjects. Opening the midpalatal suture using orthopaedic forces resulted in an increase in the transverse dimension of the maxilla. After the six month retention period the palatal area demonstrated a stable increase due to deposition along the midpalatal suture in both the anterior and posterior parts of the maxilla.

#### 465 COMPARISON OF LOWER INCISOR INCLINATION ON LATERAL CEPHALOMETRIC RADIOGRAPHS AND DIGITAL MODELS

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**AIMS:** To compare lower incisor inclination to the occlusal plane on three-dimensional (3D) digital models and conventional lateral cephalograms.

**MATERIALS AND METHOD:** 3D digital models (DigiModel, OrthoProof, Nieuwegein, Netherlands) and cephalometric radiographs from 50 consecutive patients. Two independent examiners measured the angle of the long axis of the most proclined lower incisor to the occlusal plane on lateral cephalometric radiographs and on orthogonal sagittal cuts through the same tooth on 3D models. For both measurements a commercial program (OnyxCeph 2.7, Image Instruments GmbH, Chemnitz, Germany) was used. The occlusal plane was defined by the distobuccal cusps of the lower first molars and the incisal edge of the most proclined lower incisor. Spearman correlations and paired *t*-tests were calculated.

**RESULTS:** The correlation between the cephalometric and 3D model measurements was 0.884 for examiner 1 and 0.852 for examiner 2. The mean difference between the cephalometric measurements and the 3D model measurements was statistically significant ( $1.2 \pm 2.5^\circ$ ,  $P < 0.01$ ) for examiner 1 but not statistically significant ( $0.8 \pm 3.1^\circ$ ,  $P = 0.06$ ) for examiner 2. These differences seem to be at the level of the interobserver error. The interobserver difference was statistically significant for lateral cephalometric measurements ( $1.8 \pm 2.8^\circ$ ,  $P < 0.01$ ) and for 3D model measurements ( $2.1 \pm 2.8^\circ$ ,  $P < 0.01$ ).

**CONCLUSIONS:** Digital models seem to be a valid alternative in appreciating lower incisor inclination relative to the occlusal plane.

#### 466 BIOFILM FORMATION ON WIRES USED FOR BONDED FIXED RETAINERS AND THEIR SUSCEPTIBILITY TO ORAL ANTIMICROBIALS

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AIM: To compare biofilm formation on different types of wires used for orthodontic bonded fixed retainers and to investigate the influence of toothpaste alone or with a mouthrinse on biofilms.

MATERIALS AND METHOD: Five different types of orthodontic wires used for bonded fixed retainers were exposed to saliva and biofilm formation after 4 and 48 hours was evaluated, together with the effects of a toothpaste treatment and toothpaste treatment followed by a mouthrinse application. The amount of biofilm was determined by plate counting. Surface topography of the wires and biofilms were evaluated by scanning electron microscopy.

RESULTS: Single-strand wires attracted only slightly less oral biofilm *in vitro* than multistrand wires, with no significant difference between a single-strand stainless steel or gold wire. Oral biofilms formed on stainless steel single-strand wires however, were much more susceptible to oral antimicrobials (five-to-six log-units reduction in CFUs) than on single-strand gold wires, whereas biofilms on multistrand wires were hardly affected by exposure to oral antimicrobials, such as NaF, sodium lauryl sulphate or essential oils.

CONCLUSION: The use of single-strand wires in orthodontics is to be preferred above multistrand wires, not so much because they attract less biofilm, but because biofilms on single-strand wires are not protected against oral antimicrobials in the niches and crevices of multistrand wires. Similarly, stainless steel and gold single-strand wires attract equal amounts of biofilm, but stainless steel is to be preferred because of the larger susceptibility of biofilms on stainless steel to oral antimicrobials.

#### 467 TEMPORARY FIXED FUNCTIONAL APPLIANCES: PLANAS/GRIBEL PHILOSOPHY

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AIM: To illustrate the different ways of application of direct Planas tracks on the primary teeth to correct functional mandibular deviations that often cause anterior asymmetries and anterior crossbites. Such functional alterations if untreated could result in dentofacial deformities correctable only with orthognathic surgery.

SUBJECTS AND METHOD: Ten patients between aged 5 to 10 years age (8 with a unilateral crossbite, two with an anterior crossbite) treated by direct Planas tracks. Therapy consisted of equalization of the right and left masticatory functional angles.

RESULTS: In all patients correction of the mandibular deviation and correct masticatory pattern were achieved.

CONCLUSION: To enable neuro-occlusal rehabilitation it is necessary to recognize the stimuli that the masticatory and respiratory functions provide to the stomatognathic system and to detect the neural terminations receivers of these stimuli (trigeminal, articular, muscular, periodontal, mucosal). In this way it is possible to stimulate or inhibit them in order to obtain a normal stimulus producing correct function and anatomy.

#### 468 DEVELOPMENT OF AN ACTIVATED NANOSTRUCTURED BIOMATERIAL FOR RECONSTRUCTIVE SURGERY\*\*\*

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AIMS: Bone reconstruction and tooth regeneration are some of the aims in tissue engineering. An *in vivo* model was developed to compare two different biomembranes: natural platelet-rich fibrin (PRF) membranes produced from blood centrifugation, which are used in maxillofacial surgery and artificial PEM films, which are polyelectrolyte multilayers developed as potential bioengineered drug-delivery substitutive tissue, and can be functionalized with biologically active molecules.

MATERIALS AND METHOD: Mouse PRF membrane preparation was adapted from human PRF membrane protocol. Transplants of tooth germs on both PRF and PEM biomembranes were grafted on living mice, allowed to develop for two weeks, then extracted. Histological, and molecular biology analyses were performed in order to define differentiation status and molecular signatures of the grafts.

RESULTS: Both type of membranes allowed germ transplants to develop and differentiate into well-organised tooth structures. The teeth developed similarly under both conditions, but bone differentiation surrounding tooth transplant was wider with PRF-transplants.



CONCLUSION: The study design validates a preliminary animal-model, and shows the positive effects of PRF membranes on bone differentiation *in vivo*. On this basis, PEM membranes will be activated with defined components to improve their efficiency in tissue regeneration.

#### 469 A STUDY OF THE DENTITION AND MODELLING OF THE OCCLUSAL PLANE WITH RESPECT TO REFERENCE PARAMETERS

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AIMS: Construction of the occlusal plane with respect to the reference parameter, N-Po; to examine the status of the dentition of patients with physiological and distal occlusion relative to the corresponding plane N-Po; and to determine the relationship of parameters N-Po-Ui; N-Po-Li; N-Po-Uc; N-Po-Lc; N-Po-Um; N-Po-Lm; N-Po-Ocp on the formation of the occlusal plane.

MATERIALS AND METHOD: Lateral teleroentograms in lateral projection of 46 patients with physiological and distal occlusion of the permanent teeth, allowed determination of the angular morphological parameters characterizing the position of the incisors (N-Po-Ui; N-Po-Li), canines (N-Po-Uc; N-Po-Lc) and first molars (N-Po-Um; N-Po-Lm) of the upper and lower jaws, the position of the occlusal plane relative to the reference parameter, N-Po.

RESULTS: The formation of the occlusal plane was defined by an increase in the angular parameters characterizing the position of incisors, canines and first molars of the upper and lower jaws by an average of  $3.5 \pm 0.5$  mm,  $1.5 \pm 0.2$  mm and  $2.1 \pm 0.4$  mm, respectively. There was a strong correlation between N-Po-Ocp with indicators in the status of dentition with respect to N-Po. The angular parameters of N-Po-Ui; N-Po-Li; N-Po-Uc; N-Po-Lc; N-Po-Um; N-Po-Lm can simulate the position of the occlusal plane.

CONCLUSIONS: Increasing the angular parameters in patients with distal occlusion of dentition contributes to counterclockwise rotation of the occlusal plane counterclockwise.

#### 470 QUANTIFICATION OF THE ACID ETCHED ENAMEL PATTERN WITH SCANNING ELECTRON MICROSCOPY

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AIM: To quantify the proportion of different types of the acid etched enamel patterns *in vitro*.

MATERIALS AND METHOD: The enamel surfaces of 38 extracted non-carious human premolars were acid-etched and bonded with premolar brackets using light cured liquid resin and Transbond XT composite paste according to the manufacturer's instructions. All teeth were decalcified in 20 per cent formic acid, leaving behind only the cured liquid and composite resins on the brackets. Type 1 or 2 etched enamel patterns are implicated in mechanical interlocking of enamel adhesion. A type 3 pattern is amorphous and unrelated to enamel adhesion. The surfaces were examined under scanning electron microscopy, with  $10 \times 10$  grid boxes best fitting each specimen. The areas of type 1 or 2 acid etched enamel pattern on each specimen were expressed in percentage of the entire liquid resin area of each specimen within the corresponding grid. Standard deviations (SD) of the number of specimens were plotted to assess the reproducibility of the data obtained.

RESULTS: On average, a type 1 or 2 etch pattern occupied only 26 per cent of the bonding area. The SD was 26 per cent indicating a wide variation in the proportion of a type 1 or 2 etch pattern. Only 3 out of 38 (8%) specimens had more than 85 per cent of the bonding area with a type 1 or 2 etch pattern whereas 8 out of 38 (21%) specimens had only a type 3 pattern. The remaining 27 out of 38 (71%) have 8 to 59 per cent of type 1 or type 2 patterns in their bonding areas. Reproducibility of this technique was confirmed by observing the levelling of the SD after examination of 29 specimens.

CONCLUSIONS: In an *in vitro* environment, the proportion of acid etched enamel patterns implicated in mechanical interlocking with orthodontic adhesive is small and highly variable or even non-existent.

#### 471 POST-TREATMENT STABILITY AFTER SEMI-RAPID MAXILLARY EXPANSION THERAPY

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AIM: Various expansion protocols have been used for maxillary expansion, all of which have advantages and disadvantages. Semi-rapid maxillary expansion (SRME) has been found to promote greater post-expansion stability, given an adequate

retention period. It delivers a constant physiological force until the required expansion is obtained. The purpose of this study was to investigate the effects of SRME in older adolescents and adults.

**SUBJECTS AND METHOD:** A Haas-type SRME appliance was used in 10 patients. The expansion was performed by one-quarter screw turns twice a week. The average treatment time was 2 months. Maxillary dental casts from were analyzed using standard orthodontic methods. The cast were analyzed before treatment (T1), at appliance removal (T2) and 5 years after appliance removal (T3).

**RESULTS:** Upper intercanine and intermolar distances were increased and the molars were tipped buccally. T2 values were therapeutically acceptable. The values at T3 were stable.

#### 472 EFFECT OF BLEACHING ON THE SHEAR BOND STRENGTH OF A FLUORIDE-RELEASING SEALANT

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**AIM:** To evaluate the effect of bleaching on shear bond strength (SBS) at 24 hours and 3 months after bonding using a fluoride-releasing sealant.

**MATERIALS AND METHOD:** Eighty human molars were randomly assigned into bleached (study) and non-bleached (control) groups. Forty five per cent carbamide peroxide (Opalescence Quick, Ultradent, Utah, USA) was first applied to the bleached teeth followed by five applications of 20 per cent CP gel at 24 hour intervals. The teeth were then stored in artificial saliva at 37°C for two weeks, and were bonded using either a regular primer and Transbond XT® adhesive, or Pro Seal sealant (R) and Transbond XT adhesive. The bonded teeth were stored in artificial saliva and subjected to shear testing at 24 hours or 3 months using a Zwick Universal test machine. ANOVA and simple *t*-tests were used for statistical comparison.

**RESULTS:** In the control group, SBS at 24 hours was  $18.0 \pm 4.1$  and  $19.2 \pm 3.4$  MPa for the regular primer and ProSeal, respectively ( $P > 0.05$ ). The study group had a SBS of  $21.9 \pm 2.8$  and  $22.6 \pm 4.4$  MPa for the regular primer and ProSeal, respectively ( $P > 0.05$ ). Significant differences were observed between the study and control groups in comparison of the bonding procedures ( $P < 0.05$ ). Three month shear testing indicated that the mean SBS of the non-bleached group using ProSeal was significantly lower than the others ( $P < 0.05$ ). There was also a significant difference between the 24 hour and 3 month SBS of the control group with ProSeal ( $P < 0.05$ ). Interestingly, 15 per cent of the bleached teeth exhibited enamel fractures during the 3-month testing.

**CONCLUSION:** Bleaching two weeks prior to bonding significantly increased SBS regardless of the use of either primer or ProSeal sealant. Due to potential enamel fracture during debonding, bleaching should be postponed until after the completion of orthodontic treatment.

#### 473 AXIOGRAPHY AND MAGNETIC RESONANCE IMAGING IN THE DIAGNOSIS OF TEMPOROMANDIBULAR JOINT PATHOLOGY

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**AIM:** To compare magnetic resonance imaging (MRI) and computerized axiography (CA) tracings to determine the sensitivity and agreement, considering MRI as the gold standard.

**MATERIALS AND METHODS:** Three hundred and forty six TMJs of 173 patients (53 males, 120 females, mean age  $\pm$  standard deviation:  $33.2 \pm 2.6$  years) with temporomandibular disorders were selected and underwent clinical assessments, MRI and CA.

**RESULTS:** CA sensitivity was 68 per cent for normal TMJs, 27 per cent for TMJs with disc displacement and 8 per cent for TMJs with osteoarthritis. The agreement between the two examinations (K index) was: weak for normal TMJs (0.16), acceptable for anterior disc displacement with reduction (0.28), little for anterior disc displacement without reduction (0.10), and very little for osteoarthritis (0.01).

**CONCLUSIONS:** The sensitivity and agreement of the two examinations was low, showing poorer results as pathology of the TMJ increased. It is important to underline that MRI is a static examination, suitable for imaging of the TMJ while CA is a dynamic investigation detecting the functional assessment and compensation of the joints. MRI and CA should be considered as complementary examinations that are important for a full diagnosis of the TMJ pathology.

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#### 474 CLINICAL EXAMINATION AND RADIOGRAPHY FOR ALVEOLAR BONE GRAFT EVALUATION IN CLEFT LIP AND PALATE PATIENTS

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**AIM:** To test the agreement between a newly developed clinical examination method and commonly used radiographic methods for assessing alveolar bone graft outcomes in the patients with clefts of the lip and palate.

**SUBJECTS AND METHOD:** Cleft patients who underwent alveolar bone graft were selected to test for agreement among the newly developed clinical examination method and radiographic methods. Two well-trained examiners were used in this study. The new clinical method consisted of two evaluative criteria with scoring weightings: (1) probing depth for the teeth adjacent to the cleft and (2) residual defects at the alveolar bone graft site. The two commonly used radiographic scales in this study were Bergland and Chelsea scales. Reliability testing was carried out with intraclass correlation coefficient (ICC) and kappa statistics for both assessments. The degree of agreement between the clinical and radiographic evaluation results was calculated using kappa statistics and McNemar's chi-square.

**RESULTS:** Inter- and intrareliability tests of the two clinical criteria produced the same ICC values 0.88-1.00 for the first criterion and a kappa value 0.89-1.00 for the second criterion. Inter- and intrareliability tests for the two radiographic scales also were the same: kappa value 0.86-1.00 for the Bergland scale and 0.85-1.00 for the Chelsea scale. Comparison of the 'acceptable-unacceptable' proportions between the clinical and radiographic examination methods using McNemar's chi-square showed non-significant differences ( $P = 0.317-1.00$ ). Kappa value also showed good agreement, 0.68-0.77.

**CONCLUSION:** As the new clinical examination method produced a good level of agreement compared with the radiographic methods, it could be used as an alternative screening tool for alveolar bone graft assessment. The potential benefits of this new method are to reduce radiation exposure and the financial cost to the patient's family.

#### 475 COMPARISON OF DENTAL ARCH-WIDTH CHANGES WITH THE THREE-DIMENSIONAL MODELLING METHOD

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**AIM:** To compare dental arch-width changes in patients treated with fixed appliances with or without extractions.

**MATERIALS AND METHOD:** Thirty-seven sets of pre- and post-treatment dental models of patients. All patients had a skeletal Class I relationship. Eighteen patients (mean age: 14.78 years) were treated with four first premolar extractions, and 19 patients (mean age: 14.89 years) without extractions. Measurements were performed on three-dimensional scanned dental models. Maxillary and mandibular arch width was measured at the canines, second premolars and first molars. A paired *t*-test was used to evaluate treatment changes in each group and an independent samples *t*-test to compare the treatment changes between the two groups.

**RESULTS:** The mandibular interpremolar width was significantly decreased and the mandibular intercanine width increased in the extraction group after treatment ( $P < 0.05$ ). However, all measurements were maintained in the non-extraction group ( $P > 0.05$ ). Mandibular interpremolar width was also different between the groups ( $P < 0.05$ ).

**CONCLUSION:** Extraction therapy resulted in a narrower mandibular interpremolar width and a wider mandibular intercanine width.

#### 476 LATERAL CEPHALOMETRIC CHARACTERISTICS OF PATIENTS WITH TEMPOROMANDIBULAR JOINT DISORDERS

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**AIM:** To determine the relationship between craniofacial structures and temporomandibular (TMJ) disorders using lateral cephalometric measurements.

**SUBJECTS AND METHOD:** Fifty-one patients with distal occlusion were divided into two groups based on the results of magnetic resonance imaging (MRI). Group I comprised 35 patients showing signs of TMJ disorders and group II included 16 patients without symptoms of TMJ dysfunction. Forty-one cephalometric measurements of each subject were analyzed.

**RESULTS:** Comparative analysis of the mean values showed no statistically significant difference between either group. A wide range of individual variations and complexities of dentoalveolar and skeletal modifications associated with TMD were

found. The data revealed statistically significant differences for groups I and II in ANS-Ant arc ( $P < 0.01$ ); Wits ( $P < 0.05$ ) and N/A/Pg ( $P < 0.001$ ). Furthermore patients with TMJ dysfunction had Pg-Ant arc, Go-Post arc, L1/FH ( $P < 0.05$ ); U1/Opt ( $P < 0.001$ ); UL/Opt, U1/FH, S-Go/N-Me, UL-E and LL-E ( $P < 0.01$ ) values different from normal.

CONCLUSION: Cephalometric parameters determined in this study could be used as key factors for evaluating the presence or tendency to TMJ dysfunction even without clinical symptoms.

#### 477 CLEAR ALIGNERS IN CLASS II AND III SURGERY

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AIMS: Does three-dimensional (3D) imaging help to enhance orthodontic surgery planning and increase the treatment certainty? The aim of this study was to determine the advantages of 3D images and 3D CAD-CAM techniques during treatment control.

MATERIALS AND METHOD: Besides typical examples on orthodontic orthognathic surgery cases with angle Class II and III, treated only with Invisalign aligners, the application of 3D radiographic and 3D clincheck will be demonstrated. The treatment objective will be compared with the final results. CT, DVT and MRI. Data sets were viewed with Simplant and Osirix software.

RESULTS: 3D imaging gives new perspectives to treatment planning. 3D radiographic and magnetic resonance enhanced the quality of the initial findings and gave better process during treatment control.

CONCLUSION: Whereas radiation exposure is increased with digital 3D-radiographic imaging, improved results of combined orthognathic surgery treatment, and a lower the rate of complications are obtained. 3D clincheck predictions are helpful to achieve good coordination with the post-surgical occlusion, resulting in improved stability and less refinement after surgical intervention. 3D applications help to coordinate interdisciplinary work and assist the patient in understanding treatment.

#### 478 RESPIRATION INHIBITION AFFECTING MAXILLARY GROWTH REDUCTION

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AIM: Does pharyngeal airway restriction affect growth of the maxilla? Which findings can be ascertained? Is there a relationship between the extent of obstruction and developmental disorders of the maxilla?

MATERIALS AND METHOD: The narrowest transverse area of the pharynx was measured on transverse magnetic resonance images. The results were compared with the transverse width of the maxilla and its pathological findings.

RESULTS: The analysis of 18 patients with maxillary deficiencies compute a square footage of 19 to 70 mm<sup>2</sup> for female and 25.5 to 49.5 mm<sup>2</sup> for male patients. The reference control group with a normally developed maxilla and no ear, nose and throat (ENT) findings or anamnesis had distinctly better pharyngeal areas with measured values from 195 to 225 mm<sup>2</sup>.

CONCLUSION: Respiratory obstruction induces developmental disorders of the maxilla. Interdisciplinary aspects, such as ENT, obstructive sleep apnoea and cardiologic (heart attack) are probable, whereas with an increase in age a reduction of the retropharyngeal space occurs.

#### 479 ROOT RESORPTION IN ORTHODONTICS – GENETIC SUSCEPTIBILITY?

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AIMS: External root resorption (ERR) can be observed in association with orthodontic treatment. The aetiology of root resorption is complex. Some inflammatory mediators, controlled by specific genes, have been associated with bone resorption and in the recruitment of osteoclasts during orthodontic movement (Lee *et al.*, 2007; Abass *et al.*, 2008; Bastos *et al.*, 2009) and the association between polymorphisms in the interleukin-1B gene and ERR during orthodontic treatment has been referenced in the literature. The aim of this presentation involves a male Caucasian aged 15 years, with a positive family history of generalized ERR associated with orthodontic treatment (one sister).

MATERIALS AND METHODS: A literature search was performed of PubMed with the keywords ‘dental orthodontics resorption genetics’. The search was limited to the last 10 years and the English, French and Spanish languages. Twelve



articles were identified of which four were excluded. Seven additional articles were identified from the list of related articles. As there was positive family history of ERR genetic testing was performed for determination of single polymorphisms for the IL1B gene (TGP).

RESULTS: Genetic testing revealed the presence of an allele of the IL1B gene – a positive result for ERR. The absence of external aetiological factors associated with orthodontic treatment was suggestive of possible individual genetic susceptibility.

CONCLUSIONS: The identification of individuals with increased susceptibility to ERR should be considered during orthodontic treatment planning, to allow adjustments necessary in terms of the magnitude of force to be applied and the duration of treatment.

#### 480 QUALITY OF ALGINATE IMPRESSIONS: A PROSPECTIVE AUDIT

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AIM: To evaluate the quality of alginate impressions taken for study model construction obtained by clinicians and a trainee orthodontic therapist.

MATERIALS AND METHOD: A sample of 60 consecutive sets of alginate impressions and wax bite records taken by nine clinicians were assessed by two technicians. A trainee orthodontic therapist's records were compared to the overall department records. The audit was carried out at Addenbrooke's Hospital in 2009.

RESULTS: Compliance with standards are shown below.

	Trainee Therapist (%)	Department (%)
Evidence of disinfection	100	100
Patient data complete	100	98
Correct tray size	72	88
No detachment from tray	100	98
Correct positioning of tray	83	93
No air blows	88	70
No drags	80	85

The overall outcome was satisfactory.

#### 481 THE CERVICAL VERTEBRAE AS INDICATORS FOR DETERMINATION OF MANDIBULAR GROWTH DIRECTION

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AIM: Craniofacial morphology is reportedly correlated to the position of the head in relation to the cervical column. The first cervical vertebra represents the transition between the skull and the axial skeleton. Therefore, the aim of this study was to determine whether the anatomy of the first two cervical vertebrae-atlas and axis could be used to determine mandibular growth direction on lateral cephalometric radiographs, which are routinely used in orthodontic practice.

MATERIALS AND METHOD: Lateral cephalometric radiographs of 200 patients, both genders, with normal occlusion and a skeletal Class relationship (ANB 2-4°). The females were aged 10 to 13 years and the males 12 to 15 years. On each radiograph 22 variables for the mandible, cervicovertebral anatomy, intervertebral space and head posture were analysed.

RESULTS: The height of the atlas dorsal arch was significantly correlated with the mandibular growth direction ( $P < 0.001$ ). The heights of the anterior atlas arch ( $P < 0.001$ ), the axis dorsal arch ( $P < 0.001$ ) and the odontoid process ( $0.01 > P > 0.001$ ) were negatively correlated with mandibular growth direction. Intervertebral space did not show a statistically significant correlation ( $P > 0.05$ ). There was a negative correlation between the atlas dorsal arch and craniocervical angle, and a positive correlation with the cervical inclination angle ( $0.05 > P > 0.01$ ); thus children with a low dorsal arch have more extended head posture. Head posture was positively correlated with mandibular growth direction and the children with an extended head had backward mandibular rotation and vertical growth ( $0.01 > P > 0.001$ ).

CONCLUSIONS: It is possible to use cervicovertebral anatomy to predict mandibular growth direction as an additional tool for diagnosis and treatment planning.

#### 482 IMPORTANCE OF TEMPOROMANDIBULAR JOINT EVALUATION FOLLOWING SURGICAL ORTHOGNATHIC TREATMENT

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**AIM:** A bilateral sagittal split osteotomy is employed for surgical correction of mandibular prognathism. The maintenance of the proximal mandibular segment in its pre-surgical condylar position is important in the stability of the surgical result and in reducing adverse effects on the temporomandibular joint (TMJ). The present research aimed to evaluate TMJ changes following orthognathic surgery for severe Class III malocclusions.

**SUBJECTS AND METHOD:** Twenty consecutive young adults with severe Class III anomalies, who had received combined orthodontic and orthognathic surgical treatment. The cone beam computed tomographic (CBCT) method used for TMJ evaluation enabled comparative analysis of TMJ morphology data in two separate moments – before and after surgery. Patient positioning parameters for CBCT were pre-defined in order to obtain the same axial sections in two different examination moments, thus enabling comparative analysis. Distances from the centre of the condyle to the border of the glenoid cavity were measured at 00, 300, 600, 1200, 1500, 1800 as described by Pullinger and Hollinger for measurements on conventional radiographs.

**RESULTS:** Changes were found in the position of the condyle in the glenoid cavity 6 weeks post-surgery compared with the situation before surgery, but with no statistical significance (except for the left side at the 300 evaluation).

**CONCLUSIONS:** A standardized CBCT method would be a valuable tool to substantiate the quality of surgical interventions and increase expertise, with beneficial treatment outcomes, as the manual repositioning of the proximal fragment is the most used repositioning method. Minor changes might be neutralized by the adaptive capacity of the TMJs.

#### 483 THE HERBST-MODIFICATION APPLIANCE FOR PATIENTS WITH DISTAL MALOCCLUSION AND TEMPOROMANDIBULAR JOINT DYSFUNCTION

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**AIM:** Working out algorithms of diagnosis and treatment of patients with distocclusion.

**SUBJECTS AND METHOD:** Forty-five adults (age 15-40 years) with distocclusion divided into four groups depending on presence and characteristics of temporomandibular joint (TMJ) complaints. Clinical, TMJ axiography, cephalometric radiographs and magnetic resonance tomographs (MRT) were obtained.

**RESULTS:** Before treatment 84.4 per cent of the patients had clinical signs of TMJ dysfunction, while 48.8 per cent did not have any complaints. Patients demonstrated increasing dynamics of mandibular head deformation and dislocation, changes in subchondral compact plates, default of mandibular mobility; changes of disk location and structure, limited reposition, degenerative changes in bilaminary zone; and chewing muscle asymmetry. According to MRT, 4.5 per cent of patients demonstrated changes of the spongy structure and subchondral compact plate of the mandibular head which was not found on radiographs. After treatment, positive changes were demonstrated: normalisation of the mandibular head location (27.8-33.3%), tendency to forward location (42.2-50%); normalisation of mandibular mobility (66.7-77.8%) and disk location (50%); disks reposition; muscle function normalisation (27.8%). The probability of occurrence of positive changes and their expressiveness in different groups varied and was defined by primary expressiveness of intraarticular changes.

**CONCLUSION:** After orthodontic treatment using the Herbst-modification appliance and elastopositioners at 91.1 per cent was clinically observed and show TMJ improvement which was expressed in reduction of painful sensations in joints, reduction of articulate noise and increase in amplitude and smoothness of movements of low jaw. MRT is informative method of diagnostics of TMJ dysfunction allowing to study as bone, and soft tissues joint elements.

#### 484 THREE-DIMENSIONAL INVESTIGATION OF MANDIBULAR DEVELOPMENT IN HEALTHY AND ARTHRITIC RABBITS

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**AIM:** The rabbit is a frequently used animal model for the investigation of craniofacial development. The aim of this study was to investigate three-dimensional (3D) mandibular development in growing animals with arthritis of the temporomandibular joint (TMJ) compared with healthy animals by means of 3D quantitative volumetry.

**MATERIALS AND METHOD:** Eight-week-old female New Zealand white rabbits ( $n = 12$ ) randomly divided into two equal groups. After sensitisation, bilateral arthritis was induced in the first group by repeated intraarticular injections of ovalbumin. The second group served as the control without any treatment. Thin sliced computerized tomographic (CT) full head scans were carried out every three weeks from 10 to 22 weeks of age and volumetric analyses of the mandible and its parts were performed. Intra- and intergroup growth variations were evaluated by comparison of the CT scans.

**RESULTS:** Mandibular development was not steady, but growth velocity declined from week 10 to 22 in both groups and showed its highest speed from week 10 to week 13. Growth was more accentuated in the sagittal and vertical dimensions; in contrast, there was a relatively smaller gain in mandibular breadth. Arthritis caused severe growth inhibition, especially in the condylar region, resulting in smaller mandibular condyles but a relatively normal development of the mandibular body compared with the group of healthy rabbits.

**CONCLUSION:** 3D quantitative volumetry provides important additional information about the development of the mandible in all three dimensions.

#### 485 MANDIBULAR SHAPE CHANGE IN ADULTS: A GEOMETRIC MORPHOMETRIC PILOT STUDY

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**AIM:** To retrospectively evaluate dental and skeletal changes of the anterior mandibular region in untreated adult subjects by means of geometric morphometrics.

**SUBJECTS AND METHOD:** Eighty subjects (7 females, 1 male, mean age: 22 years) who routinely underwent two low-dose mandibular computed tomographic (CT) scans with an interval of at least one year. The surface of these CT scans was reconstructed and a set of 172 anatomical landmarks and semi-landmarks was digitized on the anterior region of each mandible. Each subject was digitized twice in order to assess measurement error. Semi-landmarks were allowed to slide along the surface until they acquired geometric homology within the sample. The 32 configurations of landmarks and semi-landmarks were superimposed by generalized Procrustes analysis and the resulting shape coordinates were analyzed by principal component analysis.

**RESULTS:** Considerable mandibular shape differences between the consecutive scans were observed for all subjects. The position and orientation of the chin was most affected by these changes. The amount of change varied across the subjects and was less than that of sub-adult individuals. Measurement error was negligible relative to these changes and accounted for only 1.6 per cent of the total shape variation.

**CONCLUSIONS:** Geometric morphometrics, based on surface semi-landmarks, is a reliable method for analyzing and visualizing shape changes in consecutive CT scans. The findings demonstrate that the mandible in healthy adults is subject to continual shape change indicating that bone remodelling still occurs. The method can also be applied to other facial structures and can be utilized in orthodontic treatment planning.

#### 486 TOOTH SIZE DISCREPANCIES IN SUBJECTS WITH A CLEFT LIP AND PALATE

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**AIMS:** To investigate tooth size discrepancies in the permanent teeth of subjects with a unilateral cleft lip and palate (UCLP) and to compare them with dental anatomy templates.

**MATERIALS AND METHOD:** Orthodontic dental casts of patients successfully treated for rehabilitation of the cleft. Those with signs of enamel reduction or dental restorations were excluded. The sample comprised 21 males with a UCLP (16 left, 5 right). The mesiodistal diameters of all teeth present on the cast were measured by the same examiner using a digital calliper. Measurements were compared with dental anatomy templates with an unpaired *t*-test. A paired *t*-test was used for tooth size comparisons for the same patient

**RESULTS:** The error of the measurements was found to be non-significant. The mesiodistal dimensions of the maxillary (9.9 mm) and mandibular molars (10.7 mm) in the cleft subjects were significantly smaller than those in the templates. The four incisors of the cleft patients were significantly smaller than the templates ( $P < 0.001$ ). Both central and lateral incisors adjacent to the line of the cleft were significantly smaller than the contralateral side (central incisor  $P = 0.001$ , lateral  $P = 0.008$ ). No difference in mesiodistal dimensions was found in the lower arch.

**CONCLUSIONS:** Incisors close to the line of the cleft are smaller and the four incisors in the lower arch have smaller

mesiodistal dimensions than normal teeth. This might suggest that cleft lip and palate occurrence during embryogenesis affects the dental lamina at the initial stages of odontogenesis.

#### 487 IS OPTICAL COHERENCE TOMOGRAPHY ABLE TO AID IN PREDICTING GINGIVAL RECESSIONS IN ORTHODONTIC PATIENTS?

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AIM: The probability of developing gingival recession during comprehensive orthodontic treatment is related to the amount of the labial alveolar bone. Optical coherence tomography (OCT), which is routinely used in ophthalmology, is a non-invasive diagnostic imaging technique providing 'in vivo histological' images utilizing differences in reflection of light. Baek *et al.* (2009) introduced this technology in orthodontics by evaluating tooth movement in rats. The aim of this research was to verify the feasibility of OCT for locating soft- and hard-tissue boundaries of the periodontium *in vitro* in a human-like model.

MATERIALS AND METHOD: A prototype polarization-sensitive OCT system was used to scan the dentate parts of the lower jaw of a domestic pig. The light source was a Fourier-domain mode-locked (FDML) laser ( $\lambda_0 = 1310$  nm,  $\Delta\lambda = 140$  nm) with a power output of 5 mW. The system offers an axial resolution of 5  $\mu$ m.

RESULTS: The intensity images displayed a lingual-labial cross-section of a tooth with its covering periodontal tissues. The images clearly discerned the superficial tissues (enamel, gingival epithelium, bone). However, there was hardly any depiction of the subsurface structures, which makes sound diagnostic evaluation impossible.

CONCLUSIONS: Due to the higher resolution than conventional tomographs and the absence of radiation exposure, OCT would be an ideal diagnostic tool to detect fenestrations or dehiscences of the alveolar bone before orthodontic treatment. However, the effective penetrating depth of OCT was found not to be sufficient. According to this preliminary experiment with one of the most advanced OCT systems available, the instant performance of succeeding human studies is regarded to be unpromising.

#### 488 OVERALL AND ANTERIOR BOLTON RATIO IN DIFFERENT FACIAL BIOTYPES AND SKELETAL CLASSES

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AIMS: To compare overall and anterior Bolton ratios in different malocclusion groups (according to Ricketts' skeletal Class and Jarabak facial biotype) with Bolton's standards.

MATERIALS AND METHOD: Ninety-four orthodontic records (study casts, dental pantomograph lateral radiograph with Ricketts and Jarabak lateral analysis, medical history, intra- and extraoral photographs) of 28 brachy, 19 dolicho and 47 mesofacial patients. Twelve were Class III, 34 Class II and 48 Class I. The patients were of both genders and between 12 and 25 years of age. Ricketts skeletal Class was measured by hand tracing. All measurements were undertaken with sliding callipers accurate to the nearest 0.1 mm. The following were calculated for each pair of study casts: S 12mand — sum of the widths of the 12 mandibular teeth (mm); S 12max — sum of the widths of the 12 maxillary teeth (mm); S 6mand — sum of the widths of the 6 mandibular teeth (mm); S 6max — sum of the widths of the 6 maxillary teeth (mm); Overall and anterior Bolton ratios, OBR and ABR, were

calculated according to the following equations:  $OBR = S\ 12mand / S\ 12max$  and  $ABR = S\ 6mand / S\ 6max$ , respectively. A Student's *t*-test was performed to compare the groups.

RESULTS: The OBR of the sample was 78.56 per cent and ABR 91.72 per cent. No differences were observed between any of the groups either for skeletal Class or for facial biotype ( $P > 0.05$ ).

CONCLUSION: The anterior and overall Bolton ratio was not related to the skeletal Class or facial biotype in this sample.

#### 489 MAGNETIC RESONANCE IMAGING AND CLINICAL DIAGNOSIS OF THE TEMPOROMANDIBULAR JOINT IN JUVENILE IDIOPATHIC ARTHRITIS PATIENTS

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AIMS: Juvenile idiopathic arthritis (JIA) is the most frequent autoimmune disease in children and adolescents. In 87 per cent of these patients the temporomandibular joint (TMJ) is affected, but nearly 50 per cent proceed asymptotically. Magnetic resonance imaging (MRI) enhanced with gadolinium is currently the gold standard in detection of TMJ arthritis. The aim of this study was to analyze the correlation of pathological findings in MRI and the clinical examination results of patients with TMJ involvement in JIA.

MATERIALS AND METHOD: Data of 50 patients affected by JIA were retrospectively examined. The results of the TMJ clinical analysis were compared with the MRI results.

RESULTS: TMJ pain and decreased mouth opening capacity together with chin deviation were frequent findings in the clinical examination. MRI showed alteration in condyle and cases of acute inflammation. There was no statistically significant correlation between the results of the MRI and clinical symptoms of TMJ.

CONCLUSIONS: Fifty per cent of patients with JIAs and TMJ effects show no clinical symptoms. Long-term medication suppresses acute inflammation in the TMJ so that clinical examination without MRI is not diagnostically conclusive. To prevent long-term effects on condylar growth that result in an asymmetrical occlusion and chin deviation, early diagnosis and adequate treatment are essential.

#### 490 PERCEPTION OF FACIAL AESTHETICS: COMPARISON BETWEEN DENTISTS, PHYSICIANS AND LAY-PERSON IN ITALY

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AIM: To underscore the presence of universal aesthetic parameters in the evaluation facial aesthetics.

MATERIALS AND METHOD: Photographs of the profile (with and without a smile) and frontal photographs (with and without a smile) were obtained and modified using Adobe Photoshop for evaluation. A questionnaire was created to collect data concerning facial symmetry (question 2); the impact of the smile on the face (question 3); the impact of the eyes on the face (question 4); the divergence on the frontal plane with and without the variation of gonial angles (questions 5 and 6); the divergence on the frontal plane also including the inferior lip (question 7); the divergence on the sagittal plane in the photographs of the profile with a smile (question 8); the perception of anteroposterior relationship (question 9); the divergence on the sagittal plane in the photographs of the profile without smile (question 10). The questionnaire was submitted to two populations: 216 subjects with different professional categories (generic dentists, orthodontists, physicians) and 210 subjects with different ages and jobs. The data was then imported into the Statistical Package for Social Sciences, version 14, using a method of univariate statistical analysis.

RESULTS: For the total sample, profession influenced the answers to questions 4, 7, 9 and 10. In the comparison between generic dentists and orthodontists, age influenced the answers of questions 2 and 4. There were differences in answers for questions 4 and 10.

CONCLUSIONS: Dentists and laypersons have a different perception of the impact of the eyes on the face and of defects of proportions in the vertical and sagittal planes. Age influences the evaluation of symmetry and the impact of the eyes on the face. For questions 4 and 10, the majority of orthodontists chose the original photograph, unlike the generic dentists. Orthodontists are in agreement about their preferences.

#### 491 PEAK INSERTION TORQUE VALUES AT FRACTURE OF FIVE MINI-IMPLANT SYSTEMS UNDER DIFFERENT INSERTION PRESSURES

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AIMS: To investigate the effect of 1 and 3 kg of pressure during insertion of five different makes of mini-implants on peak insertion torque

MATERIALS AND METHOD: Five different mini-implants were used: Mini Spider Screw™ (1.5 × 8 mm), Health Development Company (Italy), Vector TAS™ (1.4 × 8 mm), Ormco (USA), OrthoEasy Pin System™ (1.7 × 8 mm), Forestadent (Germany), Dual Top™ (1.6 × 8 mm), Jeil Medical Corporation (Korea), and Infinitas™ (1.5 × 9 mm), DB Orthodontics (UK). The miniscrews were inserted into heat-cured acrylic blocks at 8 rpm utilizing a motorized torque measurement stand and peak insertion torque values were recorded at fracture under force loads of 1 and 3 kg (n = 20 for each group). Insertion pressure was measured with a calibrated scale.

RESULTS: Peak insertion torque values at fracture of Vector TAS™, Dual Top™ and OrthoEasy Pin System™ were nearly three times as high as the Infinitas™ and the Mini Spider Screw™ for 1 and 3 kg. The log rank test for each screw type

showed statistically significant differences for the two loads for the Vector TAS<sup>TM</sup>, OrthoEasy<sup>TM</sup> and the Mini Spider Screws<sup>TM</sup>; higher loads resulted in higher torque values. Mini Spider Screw<sup>TM</sup> had a tendency to bending rather than fracture (3 kg).

CONCLUSION: Peak insertion torque at fracture for different mini-implants were significantly different: Vector TAS<sup>TM</sup> (31.5/32.4) > OrthoEasy<sup>TM</sup> (29.2/30.7) > DualTop<sup>TM</sup> (28.9/30.2) > Infitas<sup>TM</sup> (10.5/9.79) > Mini Spider Screw<sup>TM</sup> (7.8/12.8) for 1 and 3 kg, respectively. Different pressures during insertion influenced the maximum torque value at insertion for Vector TAS<sup>TM</sup>, OrthoEasy<sup>TM</sup> and the Mini Spider Screws<sup>TM</sup>. The latter showed an occasional propensity to bending rather than fracture (3 kg). Pre-drilling should be considered before inserting some of the screws tested.

#### 492 EARLY ORTHODONTIC TREATMENT OF NEWBORNS WITH UNILATERAL CLEFT LIP AND PALATE

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A cleft lip and palate is characterised by a lack of continuity of various orofacial system structures: lips, alveolar horn, hard and soft palate. The lack of continuity can occur in different ways: from mild lip defects to a bilateral cleft lip, alveolar rib and palate and even asymmetric cleft faces. The aim of this research was to estimate the significance of the RB stimulator in the treatment of anatomical defects of the hard and soft palate in order to enable uninterrupted nourishment of the newborn with a unilateral cleft lip and palate (UCLP) and to facilitate subsequent intervention.

The study presents the procedure of palatal obturator production in a female newborn infant with a UCLP. The first palatal obturator was produced 24 hours after birth and then weekly in succession. Impressions for the casts is important in the production of the obturators and these are obtained without anaesthesia. The basic function of RB obturator (without extraoral fixation) is separation of the mouth cavity from the nasal cavity which enables formation of negative pressure in the mouth cavity such that a newly born child can be either breast or bottle fed.

The obturator results in shorter feeding times and a larger intake of food, which influence normal growth.

#### 493 DOES BOND STRENGTH CHANGE AFTER REPEATED REBONDINGS?

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AIM: Bracket rebonding is an undesirable encounter during treatment that requires an understanding of which variable most affects bond strength. The aim of this study was to evaluate the shear bond strength (SBS) of new brackets after repeated bonding.

MATERIALS AND METHOD: Twelve bovine incisors were moulded in acrylic with their facial surface perpendicular to the floor of a jig. The brackets were bonded using the conventional acid etch method. After immersion in water at 37°C for 48 hours, debonding and measurement of SBS values were carried out. New bracket rebonding was undertaken repeatedly after enamel re-preparation by means of a tungsten carbide bur and acid etching. The bonding-rebonding processes were repeated a total of four times.

RESULTS: Shear rebond strength mean values significantly increased from the first to the last sequence of bonding (repeated measures ANOVA test,  $P = 0.026$ ). Polynomial contrasts indicated, in support of this, there were significant linear trends ( $P = 0.041$ ). The adhesive remnant index scores for all bonding sequences were scored 1 or 2 as their most prevalent mode of bond failure.

CONCLUSION: In repeated rebondings, the bond strength of new brackets increases linearly up to fourth rebonding.

#### 494 THE FUTURE OF ORTHODONTIC INFORMATION SERVICES ON THE 'WORLD WIDE WEB'

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AIM: The Web is an enormous source of healthcare information and is being increasingly used by both the public and professionals. A thorough understanding of the current state and future prospect of orthodontic information services on the Web is required to make best use of this technology for the progress of our profession. The purpose of this study was to evaluate the current state and put forward a future foresight of orthodontic information on the Web.

MATERIALS AND METHOD: Google, Yahoo and Microsoft Network search engines were used to search the keyword 'orthodontics orthodontic'. The first 50 hits from each engine were visited. Pages that provided orthodontic information were evaluated and others were excluded. The quality assessment criteria included; type of target audience, availability of

authorship and last update time, listing of attributions and quality of the information provided. The results were compared with those of a previous survey conducted in 2006.

**RESULTS:** The engines provided an average of 1 575 000 results compared to 554 748 in 2006, an average increase of 184 per cent in 3 years. Fifty-two per cent of these pages were provided by doctors' practices (36 in 2006), 17 per cent by orthodontic organizations (11 in 2006), 7 per cent by vendors (19 in 2006), 5 per cent by non-commercial web site owners (19 in 2006) and 5 per cent by journals (4 in 2006). The ratio of pages made for the public was 82 per cent (64 in 2006). Attributions were not listed in 85 per cent (67 in 2006) and the information provided was considered correct in 97.3 per cent (97 in 2006).

**CONCLUSIONS:** The results indicated a variance of information. Despite being discredited in some of the quality assessment criteria most of the information seems to be correct. The amount of orthodontic information stored on the Web is constantly growing and being more accessible. Therefore, Web seems to be the 'number 1' source of orthodontic information in the future.

#### 495 PREVALENCE OF MALOCCLUSIONS IN PRESCHOOL CHILDREN

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**AIM:** To assess the incidence and types of malocclusion in preschool children, and to compare the results with those of other studies.

**SUBJECTS AND METHOD:** Fifty randomly selected preschool children (3-5 years) without a history of previous orthodontic treatment. Occlusal anteroposterior relationships were assessed based on Angle's classification. Other variables examined were: overjet, overbite, crowding, midline deviation and the presence of a diastema.

**RESULTS:** Eight per cent of the subjects were Class II and 6 per cent Class III. An open bite was observed in 6.0 per cent, premature contact with a mandibular shift in 8.0 per cent and an absence of a diastema in 22.0 per cent. A review of the literature showed that posterior crossbites and anterior open bites were the most frequently observed malocclusions in children.

**CONCLUSION:** The findings indicate a high prevalence of malocclusion in this group of preschool children, suggesting a need for early orthodontic treatment.

#### 496 BOND STRENGTH AND RESIDUAL ADHESIVE BETWEEN A RESIN-REINFORCED GLASS IONOMER CEMENT AND FIVE COMPOSITE ADHESIVES

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**AIM:** To compare the shear bond strength (SBS) and residual adhesive after orthodontic bracket debonding of resin-reinforced glass ionomer cement with five commonly used composite adhesive systems.

**MATERIALS AND METHOD:** Sixty freshly extracted bovine permanent mandibular incisors were randomly divided into six groups and self-ligating aesthetic Damon 3 brackets (Ormco, Orange, California, USA) were bonded according to the manufacturers' instructions. The groups were bonded with Fuji Ortho LC glass ionomer cement (GC America Inc., Alsip, Illinois, USA) and the composite light-cured adhesive systems Blugloo (Ormco), Enlight LV (Ormco), Kurasper F (Kuraray Medical Inc., New York, USA), Light Bond (Reliance Orthodontic Products, Itasca, Illinois, USA) and chemical-cured Quick Bond (Forestadent, Pforzheim, Germany). The brackets were debonded using a universal testing machine to evaluate SBS. After debonding the enamel surfaces of all incisors were examined to determine the amount of residual adhesive remaining on the teeth (adhesive remnant index scores).

**RESULTS:** SBS values ranged from 5.47 to 7.42 MPa. The SBS of Fuji Ortho LC was quite high, while Blugloo showed the highest SBS values and Quick Bond the lowest. The fracture modes differed between the adhesive groups.

**CONCLUSIONS:** All composite adhesives showed comparable SBS values with the resin-reinforced glass ionomer cement. Different fracture modes lead to variable clinical clean-up times and different risks of enamel damage. All achieved bond strength values were clinically satisfactory.

#### 497 TEMPOROMANDIBULAR DYSFUNCTION THERAPY WITH THE BALANCE SPLINT – A LONGITUDINAL STUDY

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AIM: To determine whether it is possible to treat temporomandibular joint dysfunctions (TMD) successfully up to 7 years after therapy.

SUBJECTS AND METHOD: In a longitudinal study, 38 previously treated patients [30 females, 8 males, aged 20-88 years (mean: 47.5 years)] with TMD were assessed at a recall visit. Bruxism, pain in the area of the chewing muscles and joint, and clicking were the main symptoms in all patients. Each patient was instructed to wear a balance splint at the beginning of therapy for 3 months for about 23 hours except during meals. When the patients were free of pain the splint was worn for 3 months for approximately 8 hours at night. In addition the patients were advised to breathe through the nose, keep their lips closed and chew on both sides. The presence of TMD symptoms was recorded before and after therapy, and at recall.

RESULTS: Therapy for correction of pain in the area of the temporomandibular joint was successful in 89 per cent of the patients, of click in 78 per cent, of bruxism in 76 per cent, of back problems in 59 per cent, and of headache in 74 per cent.

CONCLUSIONS: Correction of habits, i.e. chewing on one side, bruxism, allows for stable long-term success.

#### 498 GINGIVAL ENLARGEMENT DURING AND AFTER ORTHODONTIC TREATMENT WITH FIXED APPLIANCES

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AIM: Gingival enlargement commonly occurs in patients treated with fixed orthodontic appliances. The aim of this study was to evaluate the degree of gingival overgrowth during and after orthodontic treatment with fixed appliances and to determine whether gingival overgrowth is reversible on removal of the appliances.

SUBJECTS AND METHOD: Twenty-five patients were monitored during and after treatment with fixed orthodontic appliances. The extent of the enlargement of the gingiva was determined by means of intraoral photographs made shortly before the placement of the appliances, immediately after their removal and at 3 and 6 months after the appliances had been removed. The enlargement of the gingival was determined using a visual analogue scale.

RESULTS: During orthodontic treatment the average degree of gingival enlargement increased significantly. After removal of the appliances a significant decrease in the degree of gingival enlargement occurred. Within 3 months after debonding the gingival inflammation was at the same level as before the start of treatment.

CONCLUSION: The enlargement of the gingiva that takes place during treatment with fixed orthodontic appliances is reversible.

#### 499 THE HARMONY OF OCCLUSION OF THE PERMANENT DENTITION. A COMPUTERIZED ASSESSMENT

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AIM: To evaluate the harmony of occlusion permanent dentition using angular parameters: Po-N-I and Po-N-M (Persin, 2009), MNI, PoNA, PoNB. The angle Po-N-I characterizes the position of the interincisors (point I) with regard to the PoN reference line and angle Po-N-M the position of the contact point between the upper and lower first molars (M) with regard to the PoN reference line.

SUBJECTS AND METHOD: Seventy-five adults, aged 19 to 25 years, with ideal occlusion were clinically examined. Plaster casts of each adult were obtained and manually measured. Angular measurements were obtained from lateral cephalograms. Correlation and statistical analyses were undertaken.

RESULTS: The proposed angular parameters had average means of  $76.3 \pm 1.0$  degrees (PoNI),  $52.3 \pm 2.6$  degrees (PoNM),  $74.1 \pm 0.9$  degrees (PoN-A),  $72.2 \pm 0.9$  degrees (PoN-B) and  $19.8 \pm 0.9$  degrees (ML-NL) with good correlations. Based on these correlations a new method for assessment of harmony of occlusion of the permanent dentition was devised. A computerized version of the method was also developed.

CONCLUSIONS: Use of the parameters Po-N-I, Po-N-M MNI, PoNA, PoNB for assessment the harmony of occlusion of the permanent dentition is recommended.

#### 500 PREVALENCE RATE OF BUCCAL DISPLACEMENT OF THE MAXILLARY CANINES AND ASSOCIATED DENTOSKELETAL FEATURES

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AIM: To determine the prevalence and distribution of buccally displaced maxillary canines (BDC) in an orthodontic population and investigate the association between BDC, sagittal, vertical and transverse skeletal relationships and upper arch crowding.

SUBJECTS AND METHOD: An initial sample of 1975 subjects was evaluated. Application of exclusion criteria reduced the sample to 1852 subjects. The remaining sample was divided randomly into two groups. The first group of 252 subjects was used as the control. The remaining 1600 subjects comprised the experimental group. The following parameters were recorded for each subject: unilateral or bilateral maxillary BDC, evaluated on panoramic and periapical radiographs; craniofacial sagittal and vertical skeletal relationships, performed on the lateral cephalograms using the angular measurements, ANB and SN/GoGn; skeletal transverse maxillary relationship, calculated on dental casts by recording the intercanine and intermolar distances; tooth crowding within the upper arch, made on dental casts using the spaces analysis of Tweed. Chi-squared and *t*-test for independent sample were used for statistical comparisons.

RESULTS: The prevalence rate of BDC was 3.06 per cent. No significant association was found between BDC subjects and sagittal skeletal relationships. BDC subjects with high angle vertical relationships showed a significantly high prevalence rate; BDC was significantly associated with maxillary skeletal transverse discrepancy and with upper arch crowding.

CONCLUSION: BDC subjects exhibited a significant association with high angle vertical relationships, anterior maxillary transverse discrepancy and crowding in the upper arch. The presence of these characteristics can be considered as risk factors for developing a buccal displacement of the maxillary canine.

#### 501 METRIC REQUIREMENTS ON THE FIELD OF VIEW OF CONE-BEAM COMPUTED TOMOGRAPHIC SCANNERS FOR ORTHODONTIC TREATMENT PLANNING

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AIM: Cephalometric analysis is an integral part of orthodontic diagnosis. Cone-beam computed tomography (CBCT) offers the possibility of three-dimensional cephalometry at a low radiation dose. Given the wide range of available CBCT scanners in terms of their field of view (FOV) and the diversity in head size among humans, not every CBCT scanner may be appropriate for orthodontic treatment planning. The aim of this study was, therefore, to determine the size of the FOV required for cephalometric analysis based on a large number of orthodontic patients.

SUBJECTS AND METHOD: CBCT scans taken with the Mesantis line scanner of 764 adults (316 males, 448 females) and 517 adolescents (237 males, 280 females) orthodontic patients were metrically analyzed. After initial reorientation of the skull, specific peripheral cephalometric landmarks were located. Based on the spatial position of these landmarks, the corresponding minimum dimensions (i.e. height and diameter) of the FOV could be derived. For evaluation of the vertical dimension (height), the cephalometric points nasion and menton were used. For assessment of the horizontal dimension (diameter), the points, porion and pronasale were used.

RESULTS: The maximum vertical distances between nasion and menton in female and male adolescents were 13 and 15 cm, respectively, while the corresponding values in the adult group were 14 and 15 cm, respectively. For the horizontal dimension (pronasale-porion), female and male adolescents showed maximum values of 16 and 17 cm, respectively. In the adult group, horizontal distances of 17 and 18 cm were found.

CONCLUSION: The ideal FOV of CBCT scanners utilized for orthodontic treatment planning should be 15 cm in height and 18 cm in diameter in order to cover all relevant cephalometric landmarks. Scanners with a spherical FOV are less useful than those with a cylindrical FOV.

#### 502 FINITE ELEMENT ANALYSIS OF TOOTH MOVEMENT USING MAXILLARY MOLAR DISTALIZATION APPLIANCES

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AIM: Intraoral appliances such as repelling magnets, nickel titanium coil springs, distal jet, Keles slider, and pendulum have been used to distalize the maxillary molars in Class II cases have a number of problems. Temporary anchorage devices (TADs), which are one of skeletal anchorage, are recently receiving attention. The purpose of this study was to compare tooth movement according to maxillary molar distalization appliances using finite element analysis to help clinicians select the most suitable appliance in a clinical situation.

MATERIALS AND METHOD: A model of the teeth and periodontal tissue was made with reference to previous studies and three appliances were applied to this model. The first appliance had an open coil spring and indirect anchorage that connected

the anchorage teeth to a miniscrew with stainless steel wire. With the second appliance, the molars were distalized by an open coil springs when the retraction hook of anterior area is retracted to the miniscrew inserted in the posterior area close to the elastic chain. The third appliance was a miniplate in palatal area for the retraction force to pass through the centre of resistance.

**RESULTS:** In the first and second appliances, the posterior teeth were distally tipped and the anterior teeth protruded. With the third appliance the position of anterior teeth was maintained and the posterior teeth were translated and intruded, which is an ideal result for many clinical situations.

**CONCLUSION:** The miniplate appliance third appliance does not affect the position of the anterior teeth and translates and intrudes the posterior teeth because the force direction passes the centre of resistance. In many subjects who require molar distalization without distal tipping, the palatal miniplate would be a suitable appliance.

### 503 REDUCTION OF MICROORGANISMS DURING CRYOPRESERVATION PROCEDURES

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**AIMS:** Prior to cryopreservation, an extracted tooth has to be placed in transport medium and brought to the laboratory for an intermediate period of conservation. The absence of infection is one of the conditions for successful transplantation. The purpose of this study was to investigate contamination at the oral sites adjacent to the donor teeth and to verify if an antibiotic solution as transport medium should be able to reduce the microorganisms.

**MATERIALS AND METHOD:** Four oral sites originating from two patients were examined, chosen close to potential donor sites (the mucogingival junction in the region of 2.5 and the retromolar area). The initial contamination, the effect of the presence of antimicrobials in the transport medium and the effect of rinsing were evaluated. The samples were obtained by a sterilized cotton swab and preserved during 24 hours at 4°C in physiological saline (PS) or in Raid 10 per cent solution. The contamination of the physiologic saline was investigated immediately after sampling, after 24 hours of storage (without rinsing) and after rinsing following the preservation (in PS and Raid 10%). The amount of bacteria was evaluated using TSA and Schaedler agars. The presence of a purely commensal oral flora or possibly pathogenic colonies was assessed based on the visual inspection of bacterial growth. Wilcoxon ranks tests were performed to analyze the data with a level of significance of  $P \leq 0.05$ .

**RESULTS:** A reduction of microorganisms was found after preservation and rinsing, irrespective of the addition of antimicrobial substances in the medium ( $P \leq 0.008$ ). Only bacteria belonging to the commensal oral microflora, with a majority of coagulase negative staphylococci and  $\alpha$ -haemolytic streptococci, were cultured. Rinsing in sterile saline is effective in reducing microorganisms.

**CONCLUSION:** Rinsing is an important procedure to reduce contamination.

### 504 EFFECT OF TRANSPORT MEDIUM AND RINSING PROCEDURES ON REDUCTION OF CONTAMINATION DURING CRYOPRESERVATION OF TEETH

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**AIMS:** Prior to cryopreservation, an extracted tooth has to be placed in a transport medium and brought to the laboratory for an intermediate period of conservation. An absence of infection is one of the conditions for successful transplantation. The purpose of this study was to investigate if sterile pre-elevation is possible and to verify if an antibiotic solution will reduce or eliminate the microorganisms.

**MATERIALS AND METHOD:** Twenty-four impacted third molars originating from six patients were divided into four groups. The following were examined: the initial contamination, the effect of the presence of antimicrobials and the incubation period in the transport medium (with antimicrobials), the effect of rinsing the teeth. Preservation occurred at 4°C in physiological saline (24 hours in group 1) or in Raid 10 per cent solution (2 hours in group 2; 24 hours in groups 3 and 4). Except for group 4, the teeth were rinsed in physiologic saline immediately after extraction. The amount of bacteria was evaluated using Schaedler agars. The presence of a purely commensal flora or one with additional possibly pathogenic colonies was assessed based on the visual aspects of bacterial growth. Exact Wilcoxon signed rank tests were performed to analyze the data with the level of significance at  $P \leq 0.05$ .

**RESULTS:** The extraction and transport procedure are not devoid of contamination. A reduction was found after preservation in a medium, irrespective of the preservation time or addition of antimicrobials. Only bacteria belonging to the commensal

oral microflora, with a majority of coagulase negative staphylococci and  $\alpha$ -haemolytic streptococci, were cultured. Rinsing in sterile saline is effective in reducing micro-organisms ( $P \leq 0.004$ ).

CONCLUSION: Rinsing the teeth prior to cryopreservation is an important procedure to reduce contamination during the extraction and transport of teeth.

#### 505 SALIVARY pH CHANGE AS A PREDICTOR OF WHITE SPOT LESION DEVELOPMENT IN ORTHODONTIC PATIENTS

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AIM: To evaluate a test using the acid producing potential of bacteria in saliva as an indicator for the development of enamel demineralisation in an orthodontic patient wearing a fixed appliance.

SUBJECTS AND METHOD: Sixty patients who were about to start orthodontic banding. Unstimulated saliva samples were collected in sterile tubes before appliance placement and also at routine appointments during treatment. 0.5 ml of each sample was mixed with 0.5 ml of a 0.4 M potassium phosphate buffer solution containing sucrose (10% w/v), at pH 5.7, and the rate of pH change was measured over 30 minutes using a pH probe and meter. A control solution without sucrose was also used. Demineralisation development during treatment was determined from intraoral photographs. Change in salivary pH was then statistically compared with demineralisation development.

RESULTS: During the project, eight patients did not proceed with orthodontic treatment and were therefore excluded from the study. Of the remaining 52 participants, three developed demineralisation. Two were identified as high risk from their saliva test, one as low risk. This gave the test a sensitivity of 67 per cent, and specificity of 94 per cent. Inter-examiner reliability for identification of demineralisation tested using a Kappa statistic showed good correlation (0.73).

CONCLUSION: This technique has the potential to be developed into a commercial chair-side saliva test to help identify patients at increased risk of developing dental caries.

#### 506 SELLA TURCICA SHAPE AMONG ORTHODONTIC PATIENTS

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AIM: To assess the sella turcica shape in orthodontic patients.

MATERIALS AND METHOD: The orthodontic records of 346 patients ((152 males, 194 females) that attended the Odontology Department in the last 10 years were examined. One hundred and nineteen showed a hypodivergent growth, 85 a hyperdivergent pattern and 142 neutral growth. Sella turcica shape was registered according to Meyer-Marcotti. Growth pattern was assessed according to Jarabak. Sella turcica shape was assessed by two different operators. Statistical analysis was performed with the Social Package for Social Sciences, version 17.0 for Windows.

RESULTS: A circular sella turcica shape was observed in 47.11 per cent of the patients, an oval shape in 23.70 per cent and a flat shape in 29.19 per cent. In the hyperdivergent group, 22.35 per cent had an oval shape, 54.12 per cent a circular shape and 23.53 per cent a flat shape. In the hypodivergent group, 18.49 per cent had an oval turcica shape, 52.94 per cent a circular one and 28.57 per cent a flat one. In neutral pattern patients, 28.87 per cent had an oval sella turcica shape, 38.03 per cent a circular one and 33.10 per cent a flat one. There were no statistically significant differences between genders ( $P > 0.05$ ).

CONCLUSION: Circular is the most common and oval is the less common sella turcica shape, regardless of gender and Jarabak's divergence pattern.

#### 507 EFFECT OF A POSTERIOR GUMMY SMILE ON THE PERCEPTION OF SMILE AESTHETICS\*\*\*

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AIM: To evaluate the effect of excessive posterior gingival exposure on the varying perceptions of smile aesthetics amongst orthodontists, general dentists and laypersons.

MATERIALS AND METHOD: A frontal photograph of a smiling subject without posterior gum exposure (gummy smile) was selected. This was manipulated digitally using Adobe Photoshop C3 (Adobe systems Inc, San Jose, California, USA) in order to create three images of the smile with posterior gum exposure of 4, 6 and 8 mm. The four images were assessed by orthodontists (n = 40), general dentists (n = 40) and laypersons (n = 40). The average age of the three groups was 40-50

years. The ratio of male-female subjects was 20:20 in each group. Each photograph was awarded a mark: 1 if the subject considered it aesthetically acceptable; 2 if it was thought moderately acceptable and 3 if it was aesthetically unacceptable. Data were analysed using the Kruskal-Wallis ( $P < 0.05$ ) and Mann-Whitney tests, applying Bonferroni Correction ( $P < 0.0017$ ).

RESULTS: No significant ( $P > 0.05$ ) differences were detected between the three groups of smile assessors in their responses to the non-gummy smile. Aesthetic perception of the 4 mm posterior gummy smile (median amongst orthodontists = 2, dentists = 1 and laypersons = 1), 6 mm (median amongst orthodontists = 2, dentists = 1 and laypersons = 1) and 8 mm (median amongst orthodontists = 3, dentists = 2 and laypersons = 2) showed significant difference between orthodontists and the other two groups ( $P < 0.0017$ ).

CONCLUSIONS: Posterior gummy smile aesthetics are perceived negatively to a greater degree by orthodontists than dentists and laypersons. General dentists and laypersons give similar aesthetic evaluations to differing degrees of a gummy smile.

#### 508 THERMOPLASTIC APPLIANCES - NOT FOR SIMPLE CASES ONLY

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AIM: To show that the Invisalign technique can be used as the treatment modality for difficult cases and can have the capacity for three-dimensional control.

MATERIALS AND METHOD: Approximately 10 subjects with different malocclusions (crowding, open bite, roots upright, implant site preparation and advanced periodontal cases).

RESULTS: The aesthetic and occlusal results were of a very high standard and can be compared to any bracket system, buccal or lingual. In most of the cases, treatment time was the same or shorter than treatment with braces, due to very accurate and careful planning.

CONCLUSION: When clinicians have to choose a treatment modality, they should be aware of all available options including clear aligners. The lingual technique has numerous advantages over Invisalign, but in most cases, both techniques can and should be considered.

#### 509 WNT SIGNALLING COMPONENTS AND THEIR ROLE IN MECHANOTRANSDUCTION OF PERIODONTAL LIGAMENT CELLS

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AIM: Wnt signalling is recognised to control bone formation in osteoblasts. However, the role of Wnt signalling in periodontal ligament (PDL) cells during orthodontic tooth movement is not well understood. The objective of this research was to determine what components of the Wnt signalling are expressed in PDL cells. Moreover, orthodontic tooth movement on PDL fibroblasts was simulated *in vitro* in order to observe a possible role of Wnt signalling in mechanotransduction in PDL cells.

MATERIALS AND METHOD: A non-carious and a periodontally healthy molar extracted for orthodontic reasons. Human PDL cells were scraped from the middle third of the tooth root and cultivated according to standard protocols. Total RNA was isolated from confluent grown cells and reverse transcribed into cDNA. Expression of Wnt signalling components was identified by polymerase chain reaction (PCR). An orthodontic force on PDL cells was simulated using a cell strain device. The change of gene expression was investigated by reverse transcription-real time PCR.

RESULTS: Different Wnt-ligands and pathway receptors, which are part of the canonical and non-canonical Wnt signalling were identified. Moreover, sFRP-2, SFRP-3 and DKK-1 expression was confirmed which are antagonists of the Wnt signalling, in PDL cells. The applied mechanical strain was able to induce Wnt signalling in PDL cells, which could be demonstrated by  $\beta$ -catenin accumulation.

CONCLUSION: The role of the Wnt signalling for mechanotransduction in PDL cells during simulated orthodontic tooth movement was demonstrated. The activation of Wnt signalling might be responsible for activation of osteogenic genes such as osteocalcin and alkaline phosphatase.

#### 510 THE SKELETAL REALITY OF CLASS III CASES IN BIMAXILLARY POSITION

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**AIM:** The prevalence of skeletal Class III malocclusions in Caucasians varies between 2-12 per cent and can be observed as different aetiological factors and intermaxillary combinations, which can influence the success of treatment and stability. The aim of this study was to determine the differences between skeletodental changes according to the source of the malocclusion and the distribution of intermaxillary combinations for appropriate and effective treatment.

**MATERIALS AND METHOD:** One hundred radiographs of subjects with untreated skeletal and dental Class III malocclusions. Thirty-seven dimensional, angular and proportional measurements were evaluated. The radiographs were analyzed as mandibular and maxillary retrusion, a normally mandible and maxilla, and mandibular and maxillary protrusion according to SNB and SNA angles. The skeletodental differences were statistically analysed.

**RESULTS:** Sixty-two per cent of the Class III cases had maxillary retrognathism 13 per cent had based on maxillary retrusion with bimaxillary retrusion and 38 per cent had a normally positioned mandible. Only 49 per cent had real mandibular prognathism. Fifty-eight per cent of these cases had a normal maxilla, 27 per cent retrusive and 14 per cent protrusive. The number of Class III subjects with mandibular protrusion, mandibular and maxillary effective lengths and mandibular corpus and ramus lengths were significantly increased when compared with the others.

**CONCLUSION:** In Class III subjects there is a predominance of bimaxillary retrusion, but increased mandibular dimensions because of the compensation mechanism. Thus during the treatment not only the maxilla but also mandible should be kept under control.

#### 511 DIGITAL ANALYSIS OF THE STAINING PROPERTIES OF CLEAR BRACKETS

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**AIM:** To analyze the staining properties of clear brackets using digital analysis.

**MATERIALS AND METHOD:** Four clear brackets from 10 popular brands (5 ceramic, 5 plastic). Cumulative discolouring effect of staining agents (tea, coffee, curry solution and red wine) was analyzed at different consumption levels; light to heavy. The estimated consumption period was based on 6 months of exposure at those levels. The study group brackets ( $n = 100$  per consumption level) were immersed in the agents consecutively at 37°C at each period. The control group ( $n = 100$ ) was only exposed to artificial saliva for an equivalent amount of time of the reciprocal consumption level. The samples were analyzed digitally to obtain the  $L^*$ ,  $a^*$ , and  $b^*$  (lightness, red-green, and yellow-blue) values of each specimen as the baseline colour readings. Using these values, total colour change ( $\Delta E^*$ ) at each level was also calculated. A general linear model (ANOVA) test was used for statistical comparisons.

**RESULTS:** Significant differences were observed in  $L^*$ , and  $b^*$  values of ceramic brackets between the staining agent and the control groups at all consumption levels ( $P < 0.001$ ). All consumption levels showed significant differences between the study and control groups of plastic brackets for  $L^*$ ,  $a^*$ , and  $b^*$  colour codes ( $P < 0.001$ ). According to  $\Delta E^*$  values, ceramic brackets better resisted staining at all levels. Total  $\Delta E^*$  values for the ceramic and plastic brackets were 11 and 36, respectively at the end of the entire experiment.

**CONCLUSIONS:** Both plastic and ceramic brackets showed changes in colour when exposed to heavy consumption of staining agents, with plastics being the most affected. Depending on the exposure level and material properties, colour parameters were affected in different patterns.

#### 512 EFFECTS PRODUCED BY THE FRÄNKEL-2 AND THE PRE-ORTHODONTIC TRAINER COMPARED WITH AN UNTREATED CLASS II DIVISION 1 SAMPLE

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**AIM:** To evaluate the effects of two different functional appliances on skeletal and dental structures and masticatory muscles.

**SUBJECTS AND METHOD:** Thirty-seven patients with a Class II division 1 malocclusion, 13 were treated with a Fränkel-2 and 13 with pre-orthodontic trainer appliances. Eleven patients served as the controls. Pre- and post-treatment cephalometric radiographs and electromyographic (EMG) signals of four masticatory muscles (masseter, temporalis anterior, sternocleidomastoid and suprahyoid) were analysed and compared before and after treatment. The EMG signals were recorded during resting, maximum clenching and swallowing. The significance of the mean differences between groups was evaluated using one-way ANOVA and the significance of the median differences between groups was evaluated with a Kruskal-Wallis test.

**RESULTS:** Both appliances increased sagittal growth of the mandible and proclination of the lower incisors and significantly decreased the inclination of the upper incisors and reduced the overjet and overbite. SNA, ANB and Wits appraisal were decreased and lower face height was increased with the Fränkel-2 appliance. No significant changes were observed in EMG activity of the masticatory muscles before or after treatment with either of the appliances.

**CONCLUSION:** Both appliances produced similar dental changes but the Fränkel-2 appliance treatment produced more skeletal changes than the pre-orthodontic trainer appliance. Both appliances had no significant effect on EMG activity of the masticatory muscles, which were similar in the both a groups. The pre-orthodontic trainer appliance can be a possible alternative for patients with increased face height and a Class II division 1 malocclusion due to mandibular deficiency.

#### 513 DIFFERENT BONE-REPLACEMENT MATERIALS IN CRITICAL-SIZE DEFECTS

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**AIM:** To analyze bone formation and biodegradation of different biomaterials in bony defects of minipigs.

**MATERIALS AND METHOD:** Critical-size bony defects in the mandibles of 18 adult Goettinger minipigs were created and filled with Bio-Oss®, NanoBone® and Ostim®. Macroscopic, histologic and morphometric analyses of the former defects were conducted 5 weeks (T1) and 8 months (T2) post-operatively.

**RESULTS:** Bone formation rates of Ostim®, Bio-Oss® and NanoBone® were 81.3, 68.3 and 60.8 per cent, respectively at T1. Incomplete bone formation with an increased rate of biodegradation was noted for Ostim® at T2. Significant differences in bone formation rates were found by using NanoBone® and Bio-Oss®.

**CONCLUSIONS:** All biomaterials presented good regeneration in former bony defects. NanoBone® and BioOss® are suitable for larger defects, while Ostim® should be used in smaller defects with reduced loading. Future studies are planned to analyze tooth movement in bony defects using beagle dogs.

#### 514 SHEAR BOND STRENGTH BETWEEN A CONVENTIONAL RESIN ADHESIVE AND A RESIN-MODIFIED GLASS-IONOMER CEMENT

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**AIM:** To compare the shear bond strength (SBS) between a conventional resin adhesive and a resin-modified glass-ionomer adhesive after tooth bleaching.

**MATERIALS AND METHOD:** A conventional composite resin adhesive (CRA) and a resin-modified glass-ionomer adhesive (RMGIA). Two bleaching protocols were used: 10 per cent carbamide peroxide and 38 per cent hydrogen peroxide. Sixty freshly extracted maxillary premolars were randomly divided into six equal groups. Orthodontic brackets were bonded to groups I, II and III with CRA and to groups IV, V and VI with RMGIA. In groups I and IV (controls), brackets were bonded to the enamel surface without bleaching. In groups II and V home bleaching of enamel was performed before bracket bonding to enamel surface. Office bleaching was performed in groups III and VI prior to bracket bonding. SBS of the brackets was measured in Megapascal. The collected data from all tested combinations were analyzed using ANOVA (one-way) and a Student *t*-test.

**RESULTS:** The SBS in group III had a significantly lower mean than that of groups I and II ( $2.16 \pm 1.69$ ,  $9.75 \pm 1.79$  and  $9.28 \pm 1.61$  MPa, respectively). The bond strengths of groups V and VI were not statistically significantly difference from group IV ( $7.72 \pm 2.41$ ,  $7.61 \pm 1.78$  and  $9.18 \pm 2.18$  MPa, respectively).

**CONCLUSIONS:** The in-office bleaching protocol showed a slight decrease in the SBS of the RMGIA but the values remained high enough to be clinically acceptable. On the contrary, the CRA was severely affected by the same protocol and the resultant SBS was too weak to withstand orthodontic and chewing forces.

#### 515 ACTIVE AND PASSIVE SELF-LIGATION BRACKETS PRESCRIPTIONS: EFFECTS ON LABIOLINGUAL TORQUE OF THE ANTERIOR TEETH

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**AIM:** To investigate the torque capabilities of two types of self-ligating brackets systems using three-dimensional (3D) imaging techniques [cone beam computed tomography (CBCT)].

**MATERIALS AND METHOD:** Two types of brackets systems were selected: passive self-ligating Damon 3MX® (Ormco, Glendora, California, USA), and active self-ligation, In-Ovation R® Roth (Dentstply, GAC International KIT89-055-54). All brackets had a  $0.022 \times 0.028$  slot size. The treatment protocol and wire sequences were as recommended by the manufacturers. Forty-nine patients (29 with Damon 3MX® and 20 with In-Ovation R® Roth) underwent pre- and post-treatment New Tom scanning. Mimics version 13.0 images were developed for use in 3D cephalometric analysis. All teeth from the mandibular right canine to the mandibular left canine were studied for root labiolingual orientation in relation to several planes. Each tooth 3D image was reduced into two dental planes (dental coordinate system) composed of the frontal dental plane extending mesiodistally and the midsagittal dental plane crossing the tooth labiolingually. The two dental planes meet each other perpendicularly at the tooth true long axis. The most coronal and apical points of the radiographic dental pulp images determined the long axis. Besides the dental coordinate planes, several structural planes were grouped together into two structural coordinate systems, which were the occlusal and mandibular coordinate systems. Each system comprised planes in a vertical relationship with each other. The angular relationship of the dental coordinate systems to the structural coordinate systems was studied.

**RESULTS:** Torque changes were different from the specific manufacturer bracket systems prescriptions. The angular changes of one brackets system did not differ significantly from those in the other system.

**CONCLUSIONS:** Bracket system design is of minor importance in the resultant torque expression. The interactive clip in the active self-ligation brackets system does not lead to the desired clinical third order corrections.

#### 516 EVALUATION OF THE RELATIONSHIP BETWEEN GROWTH PATTERN, DENTAL CHARACTERISTICS AND MALOCCLUSIONS

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**AIM:** To evaluate the relationship between growth pattern, dental characteristics (clinical crown length-mesiodistal crown width, intercanine and intermolar width) and malocclusions.

**SUBJECTS AND METHOD:** Two hundred subjects aged between 14-17 were divided as per dental malocclusions, Angle Class I-II-III, into three groups. To evaluate the growth pattern, SnGoGno, the sum of posterior angles and Jarabak ratio were measured. According to their vertical growth measurements the groups were classified as normo-, hypo- and hyperdivergent. Stone models scanned and the three-dimensional digital images were saved with Orthomodel digital dental model software. Clinical crown lengths, mesiodistal crown widths of 12 teeth and intercanine and intermolar widths were measured in the upper and lower jaws with the software program. Data were tested statistically.

**RESULTS:** Bolton overall and anterior ratio in the Class I normodivergent group was higher than in the other groups. Anterior ratio in the Class III normodivergent group was lower than in the other groups. Lower anterior and posterior arch widths were higher in the hypodivergent groups and all results were statistically significant ( $P < 0.05$ ). The clinical crown lengths of 13, 14, 23, 26, 41 and 42, the upper anteroposterior region and lower anterior region were statistically larger in hyper- than in the hypodivergent group ( $P < 0.05$ ). The clinical crown lengths in the hyperdivergent group tended to be higher than those in the other groups but did not reach statistical significance ( $P > 0.05$ ).

**CONCLUSION:** Bolton's analysis, intercanine-intermolar width measurements and clinical crown lengths are important factors that should be considered during treatment planning and prognosis.

#### 517 EVALUATION OF VERTICAL FACIAL CHANGES USING PANORAMIC RADIOGRAPHY

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**AIM:** To analyse vertical facial parameters using panoramic radiographs and to compare the results with lateral cephalometric radiographs; the radiation dose for a patient may be reduced by taking only a panoramic radiograph instead of a panoramic and lateral cephalometric radiographs.

**MATERIALS AND METHOD:** Randomly selected lateral cephalometric and panoramic radiographs of 300 skeletal Class I, skeletal Class II and skeletal Class III patients. All subjects had not undergone orthodontic treatment, had a full complement of anterior teeth, were non-syndromic and without asymmetry. Several reference points and lines were used in the analysis: anterior, posterior and antero-inferior face heights, and gonial, interjaw base and mandibular and maxillary plane angles. The results were analysed using Pearson's correlation coefficients.

**RESULT:** Comparison of vertical skeletal morphology between the lateral cephalometric radiographs and panoramic radiographs revealed a moderate to high correlation, all measurements were statistically significant. The highest correlations were found for gonial angle ( $r = 0.722^{***}$ ) and the lowest for mandibular base angle ( $r = 0.543^{***}$ ). Anterior face height

( $r = 0.658^{***}$ ), posterior face height ( $r = 0.659^{***}$ ), anterior inferior face height ( $r = 0.665^{***}$ ), interjaw base angle ( $r = 0.623^{***}$ ) and maxillary plane angle ( $r = 0.615^{***}$ ) were statistically significant parameters.

CONCLUSION: Even though panoramic radiographs provide information on the vertical dimensions of craniofacial structures, clinicians should be vigilant when predicting skeletal cephalometric parameters from panoramic radiographs.

#### 518 A SURVEY ON ORAL HYGIENE INSTRUCTION FOR ORTHODONTIC PATIENTS

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AIM: Oral hygiene instruction is essential for all orthodontic patients. Orthodontists are responsible for helping their patients to attain adequate oral hygiene. The aim of this survey was to determine the oral hygiene instructions presented to patients during fixed orthodontic treatment in Turkey.

SUBJECTS AND METHOD: A questionnaire, composed of 18 multiple choice questions, was sent to 300 orthodontists practicing at university hospitals. Two-hundred and ninety-five orthodontists responded to the questionnaire.

RESULTS: Following the bonding procedure 78.6 per cent of orthodontists used models to demonstrate correct brushing. Furthermore, 75.4 per cent of these orthodontists showed brushing in the patient's own mouth. Oral hygiene instruction performed on models and/or the patient's mouth was supported with written or audio-visual documents by 20.9 per cent of orthodontists. Disclosing tablets were applied by 35.6 per cent of orthodontists for oral hygiene motivation and 97 per cent recommended inter-proximal brushes to their patients. The use of mouthwashes was advised by 43.7 per cent of orthodontists and 72.9 per cent recommended a tooth-friendly diet. Patients were referred to periodontists in the presence of periodontal problems by 85.4 per cent of orthodontists. According to 88.6 per cent of orthodontist the most common sequela of fixed orthodontic treatment is white spot lesion development.

CONCLUSION: This questionnaire provides some insight into the oral hygiene instruction used in orthodontic practice in Turkey. The result of this survey shows that orthodontists carry out their responsibility for helping their patients to attain adequate oral hygiene.

#### 519 DENTOALVEOLAR EFFECTS OF A MINISCREW IMPLANT SUPPORTED DISTALIZATION SYSTEM

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AIM: To prospectively evaluate the treatment effects of the miniscrew implant supported distalization system (MISDS), which has been described as a bone anchored, non-compliance maxillary molar distalization appliance in patients with Class II malocclusion.

SUBJECTS AND METHOD: Ten patients with an Angle Class II molar relationship (mean age: 14.9 years). Two titanium intermaxillary fixation screws (length: 8 mm, diameter: 2 mm) were placed in the anterior paramedian region. After one week, the MISDS was connected to the screws, and the coil springs were activated for distalization, each applying a force of 200 g. The force was applied 4-5 mm gingival to the first molar crown and the vertical force vector passed approximately from the centre of resistance of the molars. Lateral cephalometric radiographs were obtained and measured before and after distalization, and the treatment changes were analyzed statistically with a paired *t*- or Wilcoxon test.

RESULTS: A Class I molar relationship was achieved, the overjet was decreased, and the facial profile was improved with the use of MISDS. The average treatment duration was 9.6 months. Distal molar movement of 2.45 mm was seen with slight distal tipping, specifically 3 degrees ( $P < 0.05$ ). The upper premolars (U4, U5) spontaneously distalized 1.6 and 2.3 mm, respectively, whereas, 3.3 and 2.3 degrees of tipping was accompanied by distalization. At the end of the distalization period, the increase in lower face height was only 0.45 degrees ( $P < 0.05$ ).

CONCLUSION: The MISDS is an efficient method for non-compliance maxillary molar distalization. Substantial premolar distalization that may help in reducing treatment duration was observed.

#### 520 EVALUATION OF FRICTIONAL RESISTANCE, SURFACE MORPHOLOGY AND SLOT SIZE OF SELF-LIGATING LINGUAL BRACKETS

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AIM: To evaluate the static and kinetic frictional resistance resulting from the combination of three types of self-ligating lingual brackets with stainless steel (SS) archwires at 0, 5 and 10 degrees of second order angulation and to compare their surface morphology, roughness and slot sizes.

MATERIALS AND METHOD: The frictional resistance between Adenta Evolution, GAC In-Ovation L and Gestenco Phantom right upper canine brackets (0.018 × 0.025 inch slot) and 0.016 inch and 0.016 × 0.022 inch SS archwires were evaluated with a universal testing machine (Zwick) in the dry state. The three-dimensional surface roughness (Ra) of the slot bases was evaluated using atomic force microscopy (AFM). Surface characteristics of the brackets were investigated with AFM and scanning electron microscopy. The actual slot heights of the brackets were measured using the optics of a Galvion microhardness tester.

RESULTS: The lowest static and kinetic friction was found with In-Ovation L brackets and 0.016 inch nickel titanium archwires at 0 degrees angulation and the highest friction with Evolution brackets and 0.016 × 0.022 inch SS archwires at 10 degrees angulation. At all angulations the frictional resistance of Evolution brackets was significantly higher than Phantom brackets. Phantom brackets were found to be oversized, while Evolution brackets were found to be undersized. There were no statistically significant differences between the Ra of the investigated brackets.

CONCLUSION: The size and material of orthodontic wires coupled with lingual brackets tested are effective on frictional force. According to AFM analysis there was no statistically significant difference between the Ra values of any of the brackets.

## 521 EVALUATION OF GROWTH PREDICTION WITH TWO DIFFERENT SOFTWARE PROGRAMS

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AIM: Growth prediction is an important process before treatment planning for growing patients. The aim of this study was to evaluate the growth prediction validity of Nemoceph NX and Vistadent OC software.

MATERIALS AND METHOD: Archived lateral cephalograms of 50 growing females and 50 growing males together with those obtained of the same patients after 3 years were selected from the initial orthodontic treatment records. Three groups were composed: girls, boys and both girls and boys. All first cephalograms were digitized using both software programs and growth prediction was performed for a 3 year period. Twenty-eight parameters related to the dental, skeletal and soft tissue profile were used to evaluate the growth prediction validity of the software. The growth prediction data were compared with the actual values obtained from the second cephalograms using the paired samples *t*-test.

RESULTS: Comparison of the predicted and actual values for girls showed that there was no difference in nine parameters of Vistadent OC and 16 parameters of Nemoceph NX. For boys 11 parameters of Vistadent OC and 12 parameters of Nemoceph NX were not statistically significant. Comparison of the predicted and actual values, female prediction values with Nemoceph NX and male prediction values with Vistadent OC were closer to the actual values. Comparison of predicted and actual values, in the general group showed that 6 parameters with Vistadent OC and 12 parameters with Nemoceph NX were not statistically significant. In the combined group, the prediction values obtained with Nemoceph NX were closer to the actual ones.

CONCLUSION: The growth prediction values of 28 parameters with Nemoceph NX were closer to the actual values. The prediction accuracy of both software programs was less than 50 per cent.

## 522 EFFECTS OF FACEMASK TREATMENT WITH OR WITHOUT RAPID MAXILLARY EXPANSION ON MAXILLARY AND MANDIBULAR STRUCTURES

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AIMS: To determine whether rapid maxillary expansion (RME) supports the treatment effects of facemask (FM) treatment.

MATERIALS AND METHOD: Lateral cephalometric radiographs of 32 patients divided into two groups. Each group included eight boys and eight girls. In the FM+RME group (mean age 10.84 years) a FM was applied simultaneously with RME, while in the FM group (mean age 10.93 years) a FM was used without RME. At the end of the 6 month treatment period, the treatment changes in each group, mean values at the end of treatment and the differences between the groups were compared using Wilcoxon, Mann Whitney *U* test and unpaired *t*-tests, respectively.

RESULTS: The amount of the forward movement of the maxilla was similar between the groups. No statistical differences were found in the degree of posterior rotation of the mandible. Dental and soft tissue changes were also not statistically significant between the groups.

CONCLUSION: Since both treatment modalities produced similar changes, the need for RME in patients without maxillary constriction seems controversial.

## 523 IS MAXILLARY PROTRACTION MORE EFFECTIVE WHEN INITIATED DURING OR AFTER RAPID MAXILLARY EXPANSION?

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AIM: To compare the effects of facemask (FM) treatment initiated during or after rapid maxillary expansion (RME).

MATERIALS AND METHOD: Sixty-four lateral cephalometric radiographs of 32 patients, taken before and after 6 months of treatment. All had a skeletal and dental Class III malocclusion. The patients were divided into two groups each including eight girls and eight boys. A FM was applied on the same day that the RME device was placed and activated (SimRME+FM group, mean age 10.84 years). In RME+FM group (mean age 10.95 years), a facemask was applied immediately after completion of RME. Descriptive statistics were calculated for all measurements. A Mann Whitney *U* test was used to compare the mean values of the treatment groups at T0 and T1. Treatment changes that occurred in both group were calculated by Wilcoxon matched pairs signed rank test. Changes during treatment (T1-T0) were compared using an unpaired *t*-test between the groups. All statistical analysis was performed using InStat (GraphPad Software Inc., San Diego, California, USA).

RESULTS: No pre-treatment cephalometric differences were statistically significant between the SimRME+FM and RME+FM groups. In both groups the maxilla moved forward and the mandible moved backward and downward. However, no statistically significant differences were found between the groups for any cephalometric change. Although not statistically significant, the maxilla moved forward more in the SimRME group.

CONCLUSION: Mostly similar changes were obtained by the two treatment protocols in skeletal, dental and soft tissue measurements.

## 524 COMPARISON OF THE EFFECTS OF CERVICAL HEADGEAR TREATMENT WITH OR WITHOUT RAPID MAXILLARY EXPANSION

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AIM: To determine whether rapid maxillary expansion (RME) application supports the efficiency of cervical headgear treatment in Class II patients

MATERIALS AND METHOD: Sixty-four lateral cephalometric radiographs of 32 patients with skeletal Class II, division 1 malocclusion, taken before and at the end of the treatment protocol. The patients were divided into two groups both including 8 girls and 8 boys. Cervical headgear was applied in combination with a maxillary appliance to the patients in the first group (mean age 12.29 years) while in the second group the patients (mean age 11.98 years) received RME treatment prior to cervical headgear application. At the end of treatment, the changes in each group, the mean values at the end and start of treatment and the differences between the groups were compared with Wilcoxon, Mann-Whitney *U*, and unpaired *t*-tests, respectively

RESULTS: There were similar maxillary and mandibular skeletal changes between the groups. Maxillary and mandibular dental and soft tissue changes also showed no statistically significant differences between the groups.

CONCLUSION: Although both treatment modalities produced similar skeletal and dental changes, clinical experience indicates that RME treatment reduces total treatment time.

## 525 MECHANICAL STRESS-INDUCED HYPERTROPHIC SCARRING AND HEME OXYGENASE: IMPLICATIONS FOR CLEFT PALATE PATIENTS

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AIM: A cleft lip and palate is a developmental disorder of the face that is characterized by a cleft in the upper lip, palate and alveolar bone. Affected patients require multiple surgery, which may result in excessive scarring, compromise normal growth of the maxilla and the development of the dentition. Unfortunately, the aetiology of hypertrophic scarring remains largely unknown. It has previously been shown that heme oxygenase-1 (HO-1) is involved in the inflammatory and contraction phases of wound healing. Therefore, the aim of this study was to determine the role of HO-1 during hypertrophic scarring.

MATERIALS AND METHOD: Hypertrophic scars were induced in C57Bl/6n mice by applying mechanical stress for 10 days to a healing incisional wound using an orthodontic expander (adapted from Aarabi *et al.*, 2007). HO-1 was induced by cobalt protoporphyrin (CoPP), whereas HO-activity was inhibited by tin mesoporphyrin (SnMP) via intraperitoneal injections on alternate days, which started prior to the incision and continued throughout the experiment.

**RESULTS:** Application of mechanical stress resulted in hypertrophic scars in all three experimental groups. Treatment with CoPP but not SnMP or vehicle led to a strong induction of HO-1, both systemically and locally in the skin. Expression of the myofibroblast-specific marker smooth muscle actin was only found in mechanically loaded scars, confirming development of scar hypertrophy. High levels of macrophages were present in mechanically-loaded scars, underscoring their importance during hypertrophic scarring. HO-1 positive cells were present in hypertrophic scars in all treatment groups, suggesting a role for HO-1 in this process. Quantitative polymerase chain reaction analysis revealed that treatment with CoPP, also induced expression in hypertrophic scars of other cytoprotective enzymes, including peroxiredoxin, superoxide dismutase, catalase, and ferritin, whereas inhibition of HO-activity attenuated this induction.

**CONCLUSIONS:** Although induction of HO-activity increases the expression of other cytoprotective genes in the skin, modulation of HO-activity did not affect the onset of mechanical-stress-induced hypertrophic scarring.

Aarabi S *et al.* 2007 Mechanical load initiates hypertrophic scar formation through decreased cellular apoptosis. *FASEB Journal* 21: 3250-3261

## 526 *IN VITRO* COLOUR FADING OF THE BLUE ALIGNER TEEN COMPLIANCE INDICATORS

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**AIM:** To evaluate colour fading of blue dot wear compliance indicators of the Invisalign® Teen system in the absence of oral fluid outside the oral cavity.

**MATERIALS AND METHOD:** The compliance indicators in the Invisalign® Teen aligners were determined in water, water + cleaning tablets, Coca Cola®, Schweppes® and lemon juice with no saliva involved.

**RESULTS:** Colour fading was observed as a function of time, pH, and temperature as compliance indicators were stored in water or sour soft drinks and in conjunction with the use of cleaning tablets and a dishwasher. These *in vitro* colour fadings were consistent with the colour changes observed when patients were wearing the aligners. Colour fading, notably as observed in connection with acidic soft drinks and oxidative cleaning techniques, introduced uncertainty into the assessment of actual patient compliance as reflected by the fading colours of compliance indicators.

**CONCLUSION:** Compliance indicators are not safe from simple intentionally or unintentionally manipulations. Therefore whilst at best they can show an estimation of wear-time, however they cannot be recommended as an objective wear-time indicator. The compliance Indicator of the Invisalign® Teen system changes colour not only by saliva but also in water and as a result of drinking and cleaning.

## 527 SELF-ESTEEM AND CURRENT WELL-BEING OF PATIENTS WITH CLASS II PROFILES

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**AIM:** The degree of satisfaction with one's facial or body image may depend on perceptual, developmental and socio-cultural influences as well as on self-esteem. This study investigated the influence of a Class II profile on a patient's facial or body image in a sample of randomly selected participants. The objective was to find out whether a Class II profile is associated with an increased likelihood of having a negative facial or body image, impaired well-being and social functioning and a higher willingness to undergo aesthetic surgery in comparison with subjects with a Class I or Class II profile.

**SUBJECTS AND METHOD:** Three hundred and twenty five subjects (162 females, 163 males, 18-30 years) were photographed, asked to complete an adjective mood scale, and to rate 46 statements regarding their own appearance and its impact on social functioning as well as their willingness to undergo aesthetic surgery on a visual analogue scale. The subjects were separated into three groups according to their profile types.

**RESULTS:** Average ratings of one's appearance were shown to be more positive in subjects with Class I profiles as compared with those with Class II profiles. Items regarding the impact of one's appearance on social functioning were answered more negatively in subjects with impaired well-being as compared with those with normal well-being, not depending on the type of profile. A Class II profile did not influence the well-being of the observed subjects. Subjects with a Class II profile did not show an increased willingness to undergo aesthetic surgery.

**CONCLUSIONS:** A Class II profile may cause an impaired facial image even if the well-being is normal. Willingness to undergo aesthetic surgery is equal in subjects with Class I, II or III profiles.

528 HERBST VERSUS MANDIBULAR ANTERIOR REPOSITIONING APPLIANCE TREATMENT AND THE IMPACT ON THE MASTICATORY MUSCLES

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AIM: Fixed functional treatment of Class II malocclusions is most effective in both early and late adulthood. The objective of this study was to compare the Herbst appliance and the mandibular anterior repositioning appliance (MARA) on their impact on the masticatory muscles.

SUBJECTS AND METHOD: Fourteen patients, aged 11 to 16 years, with Class II malocclusion in the permanent dentition were randomised for Herbst or MARA treatment. The monitored treatment consisted of fixed functional treatment only, which lasted for 9 month. The impact on the masticatory muscles was evaluated by palpation, electromyography and bite force measurement using a pressure-sensitive sheet.

RESULTS: Initially bite force and muscle activity declined with both the Herbst and MARA but returned to nearly pre-treatment measurements within 3 months of therapy. Post-treatment bite force and muscle activity considerably exceeded the initial measurements. The pressure-sensitive sheets showed an increase of occlusal contacts with progression of treatment, which was significantly accelerated with the MARA compared with the Herbst. During treatment, palpation showed no increase of tender areas in the masticatory muscles. Unstable anterior displacement of the mandible occurred faster in the MARA, than in the Herbst group.

CONCLUSIONS: During fixed functional anterior displacement of the mandible an initial reduction of muscular activity and bite force occurred. This might be due to re-adjustment of jaw position and change in vectorial muscle alignment with both appliances. Muscle adaptation was different in both treatment groups, with the MARA group showing an unstable anterior displacement of the mandible earlier than the Herbst group. The increase of occlusal contacts with the progression of treatment in the MARA group resulted in improved interdigitation on appliance removal.

529 CORRELATIONS BETWEEN BACK CONTOUR MORPHOLOGY AND CRANIOFACIAL FEATURES IN PRE-ADOLESCENTS

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AIM: The unexplored correlations between the back contour morphology and the features of the craniofacial region are one of the current popular research topics. The aim of this research was to determine which craniofacial indices have prognostic importance in terms of the development of the ultimate posture.

SUBJECT AND METHODS: Two hundred and seventy one children (mean age: 11 years 8 months; minimum: 7 years 2 months, maximum: 17 years; SD: 2 years). The four orthopaedic indices examined were provided by the rasterstereographic back contour analysis method working without radiation exposure. Routine orthodontic radiographs were processed and analyzed by the FRWin 5.0 (11 indices on the lateral cephalogram) and AsymmetrixX (36 indices on the dental pantomogram) analysing software. Data analysis was performed with the Statistical Package for Social Sciences, version 14.0.

RESULTS: Of the sagittal indices, in the case of the flèche cervicale the maxillary depth ( $P = 0.036$ ) and the mean of CH + RH ( $P < 0.0005$ ) proved to be the significant independent linear predictor, while the flèche lombaire showed close correlation ( $P = 0.011$ ) with the mean of RH. Of the frontal indices maximum lateral deviation showed close correlation with three variables: conical angle ( $P = 0.011$ ), mandibular base ( $P = 0.017$ ) and lower face height ( $P = 0.030$ ); in the case of lateral amplitude lower face height ( $P = 0.044$ ) proved to be the significant linear predictor.

CONCLUSION: The craniofacial parameters, whose common alterations as described, could be a disease-marker in terms of the examined postural and spinal deviations.

530 SEVERE EXTERNAL APICAL ROOT RESORPTION – DOES EPIDEMIOLOGY SUPPORT GENETIC PRE-DISPOSITION?

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AIM: Current information suggests that a large variation in orthodontic root resorption can be explained by differences in individual genetic predisposition. This would, however, imply a basically similar reaction of all teeth. The aim of this study was to determine the incidence and amount of severe external apical root resorption (SEARR) in maxillary incisors during multibracket (MB) appliance treatment.

MATERIALS AND METHOD: From patients having completed MB treatment (several MB systems, mainly Tip-Edge) between 1985-2010 (total = 5019), all subjects exhibiting severe root resorption of at least one maxillary incisor were selected. SEARR were defined according to Malmgren *et al.* (1982) (RR degree 4 = resorption >1/3 root length). Evaluation was performed using dental pantomograms from before and after MB treatment. For the assessment of the amount of SEARR, the root and crown lengths of the affected teeth were measured. Possible differences in projective magnification were considered by taking the pre-treatment crown length as the reference.

RESULTS: SEARR was detected in 16 patients. Thus, the incidence of SEARR on maxillary incisors during MB treatment was 0.3 per cent. The average amount of SEARR of the affected incisors was  $42.1 \pm 9.4$  per cent of the initial root length (minimum = 31.8%, maximum = 61.0%). Most subjects exhibited only single affected teeth. Only two subjects (0.04%) presented three or four maxillary incisors with SEARR.

CONCLUSIONS: The incidence of SEARR on maxillary incisors during MB treatment (0.3%) was very low compared with the literature. With only 0.04 per cent of the patients presenting three or four affected teeth, local rather than systemic/genetic factors seem to have predisposed the present subjects to SEARR.

#### 531 DENTAL ARCH DIMENSIONS OF DEEP BITE CASES TREATED WITH A CONNECTICUT INTRUSION ARCH AND MINI-IMPLANT SYSTEMS

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AIM: To comparatively evaluate the treatment effects of two intrusion systems established by Connecticut intrusion arch (CTA) and mini-implants on maxillary dental casts of young adult cases with deep overbite.

MATERIALS AND METHOD: Seventy-six 76 pre- (T1) and post- (T2) treatment maxillary dental casts of 38 young adults (19 females, 19 males) with a deep overbite, divided into two groups regarding treatment protocol. The CTA group consisted of 17 subjects (8 males, 9 females) and mini-implant group 21 subjects (11 males, 10 females). The mean ages of the CTA and mini-implant groups were  $19.73 \pm 3.42$  and  $19.22 \pm 3.11$  years, respectively. During the six-month treatment period (T1-T2), only the maxillary incisors were intruded in each group. The transverse dimensions of the dental arches in the canine, first and second premolar, and molar regions, arch perimeters between the mesial aspect of the canines and between the mesial aspect of first molars, and the perpendicular distance from mid-point of the central incisors to a line between the central fossae of the right and first molars of both groups were measured on dental casts at T1 and T2. Paired *t*-test and one-way analysis of variance (ANOVA) were performed to statistically analyze intra- and intergroup differences.

RESULTS: Maxillary intercanine width ( $P \leq 0.05$ ), maxillary inter-first premolar width ( $P \leq 0.001$ ) and maxillary inter-second premolar width ( $P \leq 0.01$ ) increased significantly in the CTA group, while only inter-first premolar width ( $P \leq 0.05$ ) increased significantly in mini-implant group. No statistically significant difference was observed between the two different treatment modalities ( $P > 5$ ).

CONCLUSIONS: The two different intrusion systems revealed similar treatment effects on the transverse dimensions of the dental arches and arch perimeter. Increases in maxillary intercanine and interpremolar dimensions with CTA and inter-first premolar dimension were obtained with mini-implants.

#### 532 COMPARISON OF NASO- AND OROPHARYNGEAL AIRWAY DIMENSIONS IN UNILATERAL CLEFT LIP AND PALATE AND SKELETAL CLASS III PATIENTS

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AIM: To compare dimensional differences of the upper airways in adult unilateral cleft lip palate (UCLP) and skeletal Class III patients on lateral cephalometric radiographs.

MATERIALS AND METHOD: Pre-treatment lateral cephalograms of 31 adult UCLP (22 males, 9 females) and 31 skeletal Class III (22 males, 9 females) patients were evaluated. The mean ages of the UCLP and Class III groups were  $21.4 \pm 2.4$  and  $23.7 \pm 4.8$  years, respectively. Naso- and oropharyngeal airway areas, SNA, SNB, ANB, Wits, ArGoMe, SGoMe, GnGnSN measurements were evaluated in both groups. After tracing on acetate paper, tracings were scanned, and naso- and

oropharyngeal airway areas were analyzed using Netcad (5.0) software program. A Student's *t*-test was used to investigate any significant morphological differences between the UCLP and skeletal Class III patients.

RESULTS: SNA ( $P < 0.001$ ), SNB ( $P < 0.001$ ), Wits ( $P < 0.001$ ) and SGoMe ( $P < 0.001$ ) measurements showed statistically significant differences between the groups. However, Go-GnSN and Ar-Go-Me angles were found to be similar in both groups. A bimaxillary retrognathic pattern was observed in the UCLP group. Naso- ( $P \leq 0.01$ ) and oropharyngeal ( $P \leq 0.05$ ) airway areas were found to be significantly narrower in the UCLP group than in the Class III group.

CONCLUSION: The airway areas were narrower in the UCLP patients, although the vertical plane angles were similar in both groups. Maxillary surgery may be preferred in adult UCLP patients instead of double jaw surgery to avoid any restriction of the airways.

### 533 PREVALENCE OF DIFFERENT MALOCCLUSION TYPES IN ESTONIAN CHILDREN

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AIM: To determine the prevalence of different types of malocclusion in Estonian children in order to estimate the need for orthodontic treatment and to obtain data for evidence based oral health care planning.

SUBJECTS AND METHOD: Total 1200 children, 400 in each of three age groups (4–5 years, 8–9 years, 17–19 years) were examined in Tallinn, Tartu and Pärnu. Children with clefts, syndromes, systemic health diseases and any who had undergone orthodontic treatment were excluded. The method used to register the malocclusion was modified from that of Björk *et al* (1964). Examination included morphological and functional assessment of extra- and intraoral soft tissue structures, dentition and dentoalveolar features. Upper and lower alginate impressions with an occlusal wax index for plaster casts were taken of each subject.

RESULTS: Eighty-six per cent of the subjects had some type of malocclusion. An increased overjet and overbite (more than 3.5 mm) was observed in 24 and 30.6 per cent, respectively of 4–5-year-old children, and a posterior crossbite in 5 per cent. An increased overjet (more than 3.5 mm) was observed in 41 per cent, overbite in 74 per cent, AII in 47 per cent, AIII in 8 per cent and a posterior crossbite in 6 per cent of 8–9-year-old children. An increased overjet (more than 3.5 mm) was observed in 41 per cent, overbite in 70 per cent, AII in 25 per cent, AIII in 5 per cent and a posterior crossbite in 6 per cent of 17–19-year-old children.

CONCLUSION: The prevalence of different types of malocclusion and orthodontic treatment need are high in Estonian children. The obtained data will serve as a basis for planning of efficient orthodontic services as part of the oral health care system in Estonia. It will also increase public knowledge about the problems related to malocclusions.

### 534 INTERACTIONS BETWEEN GAS1, CDO AND BOC DURING EARLY DEVELOPMENT OF THE CRANIO-FACIAL MIDLINE AND DENTITION

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AIM: Gas1, Cdo and Boc are membrane proteins able to bind to the signalling protein sonic hedgehog (Shh) and regulate its activity. Disruptions within the SHH pathway are the most common cause for holoprosencephaly (HPE), a congenital disorder of forebrain patterning that affects 1:8000 live births. HPE is also associated with varying degrees of facial midline anomalies, including cleft palate and fused maxillary incisors. The aim of this study was to investigate interactions between Gas1, Cdo and Boc during the development of the craniofacial midline and dentition.

MATERIALS AND METHOD: Normal expression of Gas1, Cdo and Boc was studied with radioactive *in situ* hybridization and Gas1/Cdo and Gas1/Boc compound mutant mice were used for phenotypic analysis.

RESULTS: Gas1, Cdo and Boc are predominantly expressed in overlapping domains during palatal and dental development. However, even Gas1<sup>+/-</sup> and Cdo<sup>+/-</sup> mice develop normally, Gas1<sup>+/-</sup>Cdo<sup>+/-</sup> mice display a spectrum of midline phenotypes in the most severe form, resulting in incisor agenesis and cleft palate. Complete loss of Gas1 and Cdo activity in Gas1<sup>-/-</sup>Cdo<sup>-/-</sup> mice results in a severely dysmorphic craniofacial midline, with many structures either fused or absent. The findings provide evidence that Gas1 and Cdo function co-operatively during craniofacial midline development. In contrast, loss of Boc does not affect gross craniofacial development in combination with Gas1. However, Gas1<sup>-/-</sup>Boc<sup>-/-</sup> mice display supernumerary maxillary incisors and therefore Boc may have a role in incisor formation. Whereas, Gas1<sup>-/-</sup> mice display supernumerary premolar teeth, the number of molars in both Cdo<sup>-/-</sup> and Boc<sup>-/-</sup> mice is normal.

**CONCLUSIONS:** This phenotypic analysis has demonstrated strong genetic interaction between *Gas1* and *Cdo* that influences *Shh* signalling activity during early craniofacial midline development. However, these requirements appear to vary between different regions of the craniofacial complex during development.

**535 MASTICATORY CYCLE MORPHOLOGY IN CHILDREN WITH UNILATERAL POSTERIOR CROSSBITE AND NORMAL OCCLUSION\*\*\***

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**AIMS:** To investigate the characteristics of chewing cycles in the primary dentition in children with unilateral posterior crossbites (UPXBs), when chewing gum on the UPXB side and on the non-UPXB side, and to compare the average chewing pattern with a group of children with a normal occlusion.

**SUBJECTS AND METHOD:** Twenty children in the primary dentition with a UPXB (6 boys, mean age  $5.3 \pm 1.2$  years, and 14 girls,  $4.8 \pm 1.3$  years of age; nine with a left and 11 with a right UPXB) and 10 children with a normal occlusion. Chewing movements were recorded with the Sirognathograph computer analysing system (COSIG II). All children were asked to chew gum on both sides. The chewing patterns were averaged and analysed in two projection planes and compared using a Student's *t*-test with respect to the relationship between chewing pattern and occlusion. Significance was set at  $P < 0.05$ .

**RESULTS:** Children with a UPXB showed a difference between the chewing pattern on the UPXB and non-UPXB sides. Greater lateral deviation in the chewing cycle was observed on the working side when chewing on the non-UPXB side. The closing angle was found to be more pronounced towards the non-working side when chewing on the UPXB side and the time spent in maximal intercuspation showed reduced values when chewing on the same side. Children with a UPXB opened their mouths wider and showed greater chewing cycles in the sagittal and horizontal projection planes while chewing on the UPXB side and also in the frontal projection while chewing on both the UPXB and the non-UPXB sides in comparison with the control group,  $P < 0.05$ . Children with a UPXB produced chewing cycles with a shorter rest position and more frequently in a reverse direction when chewing on the UPXB side.

**536 MOTIVATION FOR ORTHODONTIC TREATMENT: PARENTS' PERCEPTIONS**

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**AIMS:** Parents have been shown to be a powerful factor in child patient's motivation for treatment. This study aimed to use Q-methodology (a mixed methods analysis utilising quantitative and qualitative methods) to determine why parents want their children to undergo orthodontic treatment.

**SUBJECTS AND METHOD:** Thirteen parents of adolescent orthodontic patients were interviewed in order to generate reasons why they wanted treatment for their child and a Q-methodology grid was designed to accommodate the statements generated. Sixty parents then rank ordered the statements on the grid from the most, to the least, important reason. The results were subjected to factor analysis, which categorised parents' views into groups of shared opinions and beliefs.

**RESULTS:** The interviews generated 35 items to place in the Q-methodology grid. Factor analysis identified four factors which parents mapped to: timing of intervention was considered important in all four. The majority of the parents placed a high importance on timing, wanting treatment to prevent future problems for their child and ensuring that the growth of their child was utilised during treatment. Mothers and fathers showed very similar motivations for seeking orthodontic treatment for their child. It also appears that there may be gender differences, with parents placing a higher importance on dental aesthetics in girls than in boys; parents of boys also noted a higher negative social impact as a result of malocclusion than parents of girls.

**CONCLUSIONS:** Four groups with different motivations for seeking treatment were identified, however further research is required to investigate if an improvement in cooperation can be achieved through tailoring management based on these groups.

**537 INTERMAXILLARY COMBINATIONS IN EVALUATING EMERGENCE OF CLASS II DIVISION 1 MALOCCLUSIONS**

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**AIMS:** Class II division 1 malocclusions (prevalence of 20%) are types of anomalies, seen with aesthetic, phonetic and functional problems. It is known that these malocclusions can lead to maxillary protrusion, mandibular retrusion or a

combination of both. Therefore, clinicians primarily should know the origin of the anomaly and the effective factors on the emergence of the malocclusion. The aim of this study was to determine the intermaxillary combination seen with skeletal and dental Class II division 1 malocclusions, and reveal the skeletal and dental differences in these combinations.

**MATERIALS AND METHOD:** Two thousand files were scanned and 105 patients (65 females, 40 males) with a skeletal and dental Class II division 1 malocclusion selected. Thirty-eight measurements were assessed on the lateral cephalograms. All subjects were categorized individually according to SNA and SNB angles and divided into groups as: maxillary-mandibular retrusion, normal maxilla-mandible and maxillary-mandibular protrusion. The distribution of the groups and the differences between the groups were statistically tested.

**RESULTS:** According to the maxillary measurements, the maxilla was in a normal position in 48.5 per cent, retruded in 37.14 per cent and protruded in 14.28 per cent. Mandibular retrusion was found in 88.57 per cent, while 11.42 per cent had a normal mandibular position. All subjects with maxillary retrusion also had mandibular retrusion. There was no difference in overjet between the groups. Increased maxillary and mandibular effective lengths showed positive correlations with maxillary protrusion.

**CONCLUSION:** Although, 88.5 per cent of the cases had mandibular retrusion, evaluating the cases according to the intermaxillary combination, almost half (42%) had bimaxillary retrusion and increased mandibular posterior rotation.

### 538 THE EFFECTS OF MAXILLARY INCISOR INTRUSION ON DENTOFACIAL STRUCTURES AND MASTICATORY MUSCLES IN DEEP BITE CASES

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**AIM:** To determine the effects of maxillary incisor intrusion achieved by fixed mechanics, with or without mini-implant anchorage, on the dentofacial structures and masticatory muscles in young adults with morphological deep bite.

**SUBJECTS AND METHOD:** The first group included 14 patients with a mean chronological age of 18.78 years and the second group 2 patients with a mean chronological age of 18.65 years. TMA utility intrusion arches were used in both groups. In the second group, two mini-implants were inserted in the right and left maxillary posterior regions as anchorage. Lateral cephalometric, panoramic and hand and wrist radiographs, dental models, and photographs were taken before and after intrusion. Electromyographic recordings were obtained with the BioPak system from the temporalis anterior, masseter, sternocleidomastoid and anterior digastric muscles to evaluate electromyographic activity during rest and clenching. The mean treatment time was  $11.68 \pm 3.37$  months for the first group and  $10.5 \pm 3$  months for the second group.

**RESULTS:** In both groups, intrusion of the upper incisors and the decrease in overbite were similar and statistically significant. The axial inclination of the upper incisors increased in both groups but was more significant in the first group. Increases in overjet and maxillary molar vertical position in the first group were also statistically significant. The decrease in the electrical activity of the right anterior digastric muscle during rest in the first group was statistically significant. In the first group, positive correlations were found between the change in electrical activity of the right masseter muscle and the change in distance between the upper first molar and CT plane.

**CONCLUSIONS:** Using a utility arch with or without posterior mini-implant anchorage causes dentofacial changes but has minimal effects on the masticatory muscles.

### 539 AN ALTERNATIVE METHOD OF ASSESSING MOLAR MOVEMENT WITH THREE-DIMENSIONAL IMAGING

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**AIM:** To establish an accurate and reproducible method of three-dimensional (3D) measurement of tooth movement and inclination on models.

**MATERIALS AND METHOD:** A study model was digitised ( $N = 5$ ) and images superimposed on the medial and lateral palatal rugae to assess reproducibility using a dental surface scanner. A digital calliper was used to measure intermolar width on a dental model. An upper molar, embedded in wax, was moved 2 mm buccally and the changed position was compared using callipers and 3D analysis software. The inclination of the upper first molar was assessed on a model with dimples made on the tooth surface to determine if molar inclination was measured reproducibly. Statistical analysis at the 95 per cent confidence level was carried out.

**RESULTS:** Superimposition variations were not significant using the Wilcoxon signed ranks test with a range of 0.11 to 1.00 ( $P < 0.05$ ). The 'original' intermolar width measured with the calliper [95% confidence interval (CI) = 51.66-52.15] and the 3D analysis software (CI = 51.84-52.17) showed a mean difference of 0.098 mm. The mean difference between the changed intermolar width measurements taken with the calliper (CI = 53.96-54.09) and the 3D analysis software



(CI = 53.63-58.80) was 0.31 mm; 2.12 mm with the calliper and 1.71 mm with the 3D analysis software. Molar inclination with added dimples had a CI of 39.40-44.50 degrees. Molar inclination of the patient's pre-treatment model had a CI of 38.20-40.80 degrees, and post-treatment 41.90-46.80 degrees.

CONCLUSIONS: An accurate and reproducible technique was developed for measuring tooth movement on models with 3D imaging. An alternative method was established for measuring changes in molar inclination with 3D imaging. Additional dimples on the tooth surface increased the accuracy of measuring molar inclination.

#### 540 AIRWAY DIMENSIONS AND VERTICAL FACE HEIGHT – A MAGNETIC RESONANCE IMAGING STUDY†

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AIM: To explore the relationship between volume and area of the airway and anterior face height using magnetic resonance imaging (MRI).

MATERIALS AND METHOD: MRIs of 40 (13 females, 27 males, age range: 20-38) healthy subjects. Computer algorithms for accurate automated image segmentation were used to create patient-specific airway models. The volume and maximum and minimum cross-sectional area of the airway were calculated. Linear measurements of soft tissue anterior face height and anterior lower face height were also measured. The relationship between the maximum and minimum cross-sectional area and volume of the airway and anterior face height and lower face height was analyzed using Spearman's rank correlation coefficient. All measurements for the first 20 subjects were repeated and intra-examiner reliability was determined using Bland Altman's plot.

RESULTS: No statistically significant correlation was found between the upper airway dimensions and vertical face measurements. Bland Altman's plot showed good intra-examiner reliability.

CONCLUSION: The findings of this study contradict the classic airway studies by Linder-Aronson *et al.* Airway obstruction alone does not result in a change in vertical facial height. Other factors such as mode of breathing may play a part in vertical facial height development.

†Winner of an EOS poster award.

#### 541 SCANNING ELECTRON MICROSCOPY OF THE SURFACE TOPOGRAPHY OF DIFFERENT ORTHODONTIC ARCHWIRES

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AIM: The surface roughness of different orthodontic archwires such as nickel-titanium (NiTi) and stainless steel (SS) is an essential factor because of its influence on corrosion, friction, tooth movement, biocompatibility, aesthetics and hygiene. The purpose of this cross-sectional study was to evaluate the surface roughness of seven groups of orthodontic archwires from different manufacturers.

MATERIALS AND METHOD: Seven orthodontic wires (four NiTi wires manufactured by American Orthodontics, Orthotechnology, Allstar and Smart and three SS archwires manufactured by American Orthodontics, Orthotechnology and Allstar). An energy-dispersive X-ray spectroscopy study was done on each sample of every wire to determine the composition of the wires and then the surface roughness of each wire was determined by scanning electron microscopy (SEM)

RESULTS: In the images taken by SEM more defects and cracks were seen on two wires (SS made by American Orthodontics and NiTi made by All Star) than the others. There were also more defects and porosities on NiTi wires than on SS wires.

CONCLUSIONS: The NiTi wire manufactured by Allstar and the SS wire made by American Orthodontics were the roughest wires and since surface roughness can cause corrosion, ion release, allergic reactions and also can have influence on aesthetics, friction, tooth movement and oral hygiene, it is recommended to use archwires with the least surface roughness. Manufacturers should pay more attention on the quality of their products in order to produce archwires with better mechanical properties.

#### 542 NICKEL LEVELS IN THE URINE OF PATIENTS WITH FIXED ORTHODONTIC APPLIANCES

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AIM: Nickel (Ni), as the primary component of orthodontic appliances, causes more allergic reaction than all other metals combined and can initiate a wide range of hypersensitivity reaction in susceptible subjects. However it is not known whether release of this ion from dental alloys is high enough to be clinically significant. The aim of this study was to compare the level of nickel ion in the urine of two groups of subjects, with a without an orthodontic appliances.

MATERIALS AND METHOD: Urine samples from 30 orthodontic subjects (20 females, 10 males) one year after placement of an orthodontic appliance and 30 specimens from their same gender sister or brother without any orthodontic appliances (controls) were collected. Urine Ni ion analysis was carried out with atomic absorption spectrophotometer and statistically analysed using a *t*-test and ANOVA.

RESULTS: Urinary Ni levels in the subjects with an orthodontic appliance were 9.81 ug/litre compared with 7.83 ug/litre in the controls. However this difference was not statistically significant.

CONCLUSION: Although urine Ni ions level were increased in patients with an orthodontic appliances compared with those without an appliance, it was not sufficient to cause concern. Follow-up is needed to determine the patterns and long-term significance of Ni content.

#### 543 DETERMINING THE RELATIONSHIP BETWEEN THE USE OF FIXED APPLIANCES AND PERIODONTAL CONDITIONS

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AIMS: To determine, using a historical cohort design, the relationship between the use of fixed appliances and periodontal conditions during orthodontic treatment.

SUBJECTS AND METHOD: Thirty patients (all female) undergoing fixed appliance orthodontic treatment and 30 control patients. Neither group had a background of trauma and the control group had no previous orthodontic treatment. The periodontal condition of both groups was evaluated and recorded according to the bleeding index and periodontal enlargement as grades 0, I, II, III, and classified into two groups. The findings were statistically evaluated using Fisher's exact test.

RESULTS: The mean age for treatment group was  $15.1 \pm 1.5$  years and for the control group  $14.7 \pm 2.4$  years. Gingival bleeding was 50 and 76.7 per cent, while gingival recession was 3.3 and 0 per cent in the control and case groups ( $P > 0.3$ ;  $P < 0.9$ ), respectively. Gingival enlargement grade II and above was 13.3 and 46.4 per cent in the control and case groups ( $P < 0.005$ ), respectively.

CONCLUSIONS: Fixed appliance orthodontic treatment increases the incidence of gingival bleeding and periodontal enlargement. It is recommended that patients undergoing orthodontic treatment with fixed appliances should take all the necessary preventive measures in order to have a good orthodontic outcome.

#### 544 COMPARISON OF THE EFFECTS OF BIOBLOC STAGE 3, TWIN-BLOCK AND BITE JUMPING APPLIANCES\*\*\*

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AIMS: Functional appliances, which cause skeletal and dentoalveolar changes, correct Class II malocclusions. The Biobloc Stage 3 appliance restricts dentoalveolar change and causes maximum skeletal effect. The appliance does not open the bite, so lower face height does not increase. The mandible grows forward and upward. The purpose of this study was to evaluate the differences in Biobloc Stage 3, Twin-Block (TB) and bite jumping appliances, both from a skeletal and dentoalveolar perspective.

SUBJECTS AND METHOD: Biobloc Stage 3 group (2 boys, 11 girls; average age 9 years 5 months; average treatment time 24 months); TB group (4 boys, 9 girls; average age 9 years 5 months; average treatment time 13 months); bite jumping group (2 boys, 11 girls; average age 9 years 5 months; average treatment time 18 months); All patients had an Angle Class II division 1 malocclusion with maxillary protrusion. Lateral cephalograms taken at the beginning (T1) and end (T2) of treatment were analysed to determine skeletal and dentoalveolar effects.

RESULTS: The TB and Bite Jumping appliance groups showed statistically significant forward movement of the lower incisors compared with the Biobloc group. The bite jumping group demonstrated significant reductions in the inclination of upper incisors compared with the Biobloc group. The TB and bite jumping groups showed significantly greater reduction of overjet than the Biobloc group. Treatment time in the Biobloc group was significantly longer than in the TB and bite jumping groups. The Biobloc group showed significant reduction in SN.Mand.pl.angle compared with the bite jumping group.

CONCLUSIONS: The dentoalveolar effects with the Biobloc stage 3 appliance were smaller than with the TB and the bite jumping appliances.

#### 545 CHANGES IN LIP-LINE IN ASYMMETRIC CASES TREATED WITH ONE-JAW SURGERY

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AIMS: Facial symmetry can be achieved by orthognathic surgery. However, it is unclear how much one-jaw surgery improves the canted lip-line. The aim of this study was to clarify the change in lip-line in asymmetrical cases treated with one-jaw surgery to the mandible.

SUBJECTS AND METHOD: Thirty patients who complained of lip-line inclination. They underwent one-jaw surgery, or mandibular osteotomy. Frontal cephalograms and facial photographs, taken pre- and post-treatment, were used to measure the inclination of lip-line, the cant of the occlusal plane, and the lateral deviation of menton (Me) on the bone and soft tissues.

RESULTS: Inclination of the transverse occlusal plane exhibited no significant changes before or after active treatment. On the other hand, the inclination of lip-line after treatment was significantly improved as compared with that before treatment. Me on the hard and soft tissues also experienced a significant improvement after treatment compared with that pre-treatment. A positive correlation was observed between the amount of improvement of Me and Me on the hard and soft tissues. Moreover, a positive correlation was also observed between the movement of Me on the mandible and the inclination of the lip-line. However, there was no correlation between mandibular movement and the amount of molar change and midline deviations.

CONCLUSIONS: One-jaw surgery or mandibular osteotomy has the possibility to improve the inclination of lip-line even with an occlusal cant. The inclination of the lip-line would be corrected by sufficient lateral movements of Me on the mandible.

#### 456 INSUFFICIENT JAW SIZE REVEALED BY COMPUTER TOMOGRAPHY IN PATIENTS WITH CROWDING AND A CLASS I MALOCCLUSION

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AIM: To reveal the mismatch of the size of the teeth and jaws by computer tomograms (CT) in patients with crowding and an Angle Class I malocclusion.

MATERIALS AND METHOD: Fifty CT of patients with crowding and an Angle Class I were studied using the Vitrea 2 program. Half of the patients had their orthodontic treatment undertaken without extraction of the permanent teeth (group 1) while treatment for the other 50 per cent (group 2) included the extraction of four permanent teeth. After visual analysis nine symptoms of an insufficient size of the jaws were found on CT. Each symptom was estimated separately for the maxilla and mandible. When the symptom was present on the both sides its intensity was scored as 1 and when only on one side as 0.5. If no symptoms were observed it was scored as 0. Statistical comparison between the groups was carried out.

RESULTS: In group 2 three symptoms were found more often than in group 1: lingual position of the roots of the lateral incisors, the vestibular position of the canine; insufficiency of the alveolar bone of the lateral incisors ( $t$ -test: 0.0006; 0.006; 0.009, respectively). Also in this group in the mandible two symptoms were found much more often: a dense arrangement of the roots of the incisors and vestibular inclination of the incisors ( $t$ -test:  $1.47 \times 10^{-6}$ ; 0.0027).

CONCLUSION: These symptoms observed reflect an extreme degree of compensation of the insufficient size of the jaws, and suggest an extraction treatment strategy. Blocking of the second premolar and the lack of alveolar bone are rare. Reflecting the lack of size of the jaws, they do not reflect the extent of compensatory changes.

#### 457 FACTORS INFLUENCING THE DURATION OF ORTHODONTIC TREATMENT IN PATIENTS WITH EC-TOPIC CANINES

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AIM: To investigate the influence of radiographic position of palatally impacted canines on panoramic radiographs and initial diagnosis deriving from cephalometric analysis on the length of orthodontic treatment.

**MATERIALS AND METHOD:** The records of 45 successfully treated patients with ectopic palatal canines from two private practices, treated by surgical exposure and orthodontic traction. Both orthodontists had the same orthodontic education background and experience. Complete patient files, initial lateral cephalograms and initial panoramic radiographs were used. The duration of treatment after surgical exposure of the canine was correlated with the radiographic parameters taken from the panoramic radiography: angulation of the canine axis relative to the maxillary midline and canine mesiodistal overlap relative to the root of the adjacent lateral.

**RESULTS:** The average age at the beginning of treatment was 12.2 years. Total treatment duration was greater in the hyperdivergent patients than in the rest of the sample. There was a statistically significant correlation for treatment duration after canine exposure with the horizontal position of the canine crown relative to the maxillary dental midline ( $P = 0.007$ ) and the overlap of the root of the adjacent lateral ( $P = 0.010$ ), but no correlation with the vertical dimension. Both total treatment duration and duration after surgical exposure seem to be influenced more by the initial sagittal relationship than the vertical dimension of the patient.

**CONCLUSIONS:** The mesiodistal position and canine crown overlap assessed on panoramic radiographs remains the most useful predictor of treatment duration. An increased vertical dimension does not seem to affect the biomechanics used by the practitioner during canine traction.

#### 458 EARLY ORTHODONTIC TREATMENT WITH A PREFABRICATED FUNCTIONAL APPLIANCE

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**AIMS:** To determine the effect of a pre-fabricated functional appliance (T4K, Myofunctional Research Co), on transverse dimensions and the anterior height of the dental arches.

**MATERIALS AND METHODS:** A retrospective study was performed on 60 pre-adolescent children treated with the T4K over  $1.3 \pm 0.5$  years, without any other treatment. Four measurements, pre- and post-treatment, were performed on the upper and lower cast models: intercanine (IC), inter-premolar (IP) and intermolar (IM) distances, and anterior arch height (AAH). A control group was built from normative data (Moorrees, Harvard University Press, Cambridge, Massachusetts, USA) in order to determine the effects produced by the appliance regardless of natural growth. Statistical differences were determined by a non-parametric statistical test. The direct effect of the appliance on the results (clinical significance) was determined by subtracting natural growth from the treatment effect, and then contrasted with twice the error of the method.

**RESULTS:** Patients treated with the T4K showed a significant increase in IP and IM distances at the end of the observation period in both the maxillary (IP = 1.7 mm, IM = 1.4 mm) and mandibular (IP=1.8 mm, IM = 1.0 mm) dental arches. A significant increase was also observed in the maxillary arch for IC distance (1.2 mm), but not in the mandibular arch. To differentiate the effect of treatment with the T4K over natural growth, the clinical significance was determined. Clinical significance for T4K treatment was observed in IP and IM distances for both dental arches, but not for IC distance. T4K caused a clinically significant increase in the AAH in the maxillary but not in the mandibular arch.

**CONCLUSIONS:** The T4K, a prefabricated functional appliance, is a valid alternative to treat malocclusions at an early age, as it clinically significantly stimulates transverse development of the dental arches.

#### 549 COMPARATIVE ASSESSMENT OF THE LABIOPALATAL FORCES AND MOMENTS GENERATED BY LINGUAL AND CONVENTIONAL APPLIANCES

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**AIM:** To assess the effect of bracket type on labiopalatal forces and moments generated in the sagittal plane.

**MATERIALS AND METHOD:** Incognito lingual brackets (3M Unitek), Stb lingual brackets (Light Lingual System, Ormco) and conventional 0.018 inch slot brackets (Gemini, 3M Unitek) were bonded on three identical maxillary Frasaco models, with a palatally displaced right lateral incisor. The transfer trays for indirect bonding of the lingual brackets were constructed in certified laboratories (AOA Orthodontic Laboratory, Sturtevant Wisconsin, USA and Incognito Laboratory, Bad Essen, Germany). Each model was mounted on the Orthodontic Measurement and Simulation System and 10 specimens of 0.013 CuNiTi (Stb Social 6 Optimal Force, Ormco) were used for each bracket type. The wire was ligated with elastomeric ligatures and each measurement was repeated once after re-ligation. The labiopalatal forces and the moments in the sagittal plane were recorded on the right lateral incisor. One-way ANOVA and linear regression was used to assess the effect on bracket type on the generated forces and moments.



RESULTS: The mean (standard deviations) generated forces were 1.62 (0.07) N, 1.27 (0.05) N and 1.81 (0.06) N, and the mean generated moments 2.01 (0.19) Nmm, 1.45 (0.42) Nmm and 2.19 (0.43) Nmm for Stb, conventional and Incognito brackets, respectively. Bracket type was a significant predictor of the generated forces [ $F(2,27) = 212.67$ ,  $P < 0.001$ , adjusted  $R^2 = 0.94$ ] and moments [ $F(2,27) = 11.2$ ,  $P < 0.001$ , adjusted  $R^2 = 0.41$ ].

CONCLUSIONS: The forces produced were different among all three bracket types, whereas the generated moments differed between conventional and lingual brackets but not between lingual brackets.

#### 550 A COMPARATIVE *IN VITRO* ASSESSMENT OF DIFFERENT BUCCAL TUBE BONDING ADHESIVES

P Simon, P Römer, P Proff, C Reicheneder, Department of Orthodontics, Regensburg University Medical Center, Germany

AIM: To investigate the *in vitro* bonding properties of five different bonding systems to verify the achievements of clinical claims considering shear bond strength (SBS) and the adhesive remnant index (ARI) when used for bonding orthodontic buccal tubes.

MATERIALS AND METHOD: One hundred and fifty human molars were randomly divided into 10 groups of 15 specimens each. The buccal tubes were bonded with the five different adhesive bonding systems (3M Transbond XT, 3M Transbond XT MIP, 3M Unite, Reliance Light Bond, Sure Light Bond) and two different pre-treatments of the tube base. The SBS of each specimen was examined with a universal testing machine (Instron 5965) and the modified ARI score was used to evaluate remnant adhesive at the enamel surface. The SBS values were compared by univariate analysis of variance and a *post-hoc* Tukey test. The ARI values were analyzed with chi-square, Kruskal-Wallis and Mann-Whitney *U* tests.

RESULTS: All specimens showed clinically sufficient SBS values (mean  $15.5 \pm 5.11$  MPa). The adhesive systems and the pre-treatments showed significant influence on the SBS value ( $P = 0.001$ ). Tukey's test showed significant differences between the groups. The ARI score values demonstrated significant differences according to the chi-square and Kruskal-Wallis tests (both  $P < 0.001$ ). The *U*-test showed significant differences between the groups. ARI score evaluation showed enamel tears in 30.6 per cent of all specimens. The group bonded with 3M Unite and primer pre-treated tube base showed the highest SBS values (mean  $20.4 \pm 6.4$  MPa) and most enamel tears (64.3% of the group).

CONCLUSIONS: The tested adhesive systems showed high SBS values; precoating the tube base with primer led to a higher SBS at all adhesives, but also displaced the fatigue surface in the direction of the enamel. Further investigations are necessary to review the findings *in vivo*.

#### 551 EFFECTS OF DIFFERENT MOUTHRINSES ON THE SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS

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AIMS: To investigate the *in vitro* bonding properties of two different bonding systems (3M Transbond XT, Ormco Grenglo) with the influence of pre-treatment with three different mouthrinses (McNeill-PPC Lysterine, Gaba Meridol, GlaxoSmithKline Chlorhexamed) to verify the achievements of clinical claims considering shear bond strength (SBS) and the adhesive remnant index (ARI) when used for bonding orthodontic brackets.

MATERIALS AND METHOD: One hundred and twenty bovine teeth were randomly divided into eight groups of 15 specimens each. The groups were stored in mouthrinse for 30 minutes, washed, dried and etched. The brackets were bonded with the different adhesive bonding systems according to the manufacturers' instructions. The SBS of each specimen was examined with a universal testing machine (Instron 5965) and the modified ARI was used to evaluate remnant adhesive at the enamel surface. The SBS values were compared by univariate analysis of variance.

RESULTS: The adhesive systems and the mouthwash pre-treatments did not show significant influence on the SBS value but there was a trend ( $P = 0.057$ ). The group bonded with Grenglo and Chlorhexamed pre-treatment showed the highest SBS values (mean  $12.8 \pm 1.4$  MPa), which equates to a 20.7 per cent higher SBS value than the control group. All other mouthrinses led to a decrease in SBS. The groups bonded with Transbond XT showed a decrease in SBS when pretreated with mouthrinse – the control group stored in water showed a SBS value of  $10.5 \pm 1.4$  MPa.

CONCLUSIONS: The tested adhesive systems showed clinically sufficient SBS values, although treatment with Meridol and Listerine mouthrinse lowered the SBS values of all tested adhesives. The Chlorhexamed pre-treatment showed different effects, depending on the used adhesive system. Further investigations are necessary to clarify this influence *in vivo*.

## 552 A COMPARATIVE *IN VITRO* ASSESSMENT OF DIFFERENT BUCCAL TUBE BONDING ADHESIVES

P Simon, P Römer, P Proff, C Reicheneder, A Faltermeier, Department of Orthodontics, Regensburg University Medical Center, Germany

**AIM:** To investigate the *in vitro* bonding properties of five different bonding systems to verify the achievements of clinical claims considering shear bond strength (SBS) and remnant adhesive when used for bonding orthodontic buccal tubes.

**MATERIALS AND METHOD:** One hundred and fifty human molars were randomly divided into ten groups of fifteen specimens each. The buccal tubes were bonded with the five different adhesive bonding systems (3M Transbond XT, 3M Transbond XT MIP, 3M Unite, Reliance Light Bond, Sure Light Bond) and two different pre-treatments of the tube base. The SBS of each specimen was examined with a universal testing machine (Instron 5965) and the modified ARI score was used to evaluate remnant adhesive at the enamel surface. The SBS values were compared by univariate analysis of variance and a post-hoc Tukey test. The ARI values were analyzed with chi-square, Kruskal-Wallis, and Mann-Whitney *U* tests.

**RESULTS:** All specimens showed clinical sufficient SBS values (mean  $15.5 \pm 5.11$  MPa). The adhesive systems and the pre-treatments show significant influence on the SBS value ( $P = 0.001$ ). The Tukey test showed significant differences between the groups. The ARI score values showed significant differences according to the chi-square test and the Kruskal-Wallis test (both  $P < 0.001$ ). The *U*-test showed significant differences between the groups. The ARI score evaluation showed enamel tears at 30.6 per cent of all specimens. The group bonded with 3M Unite and primer pre-treated tube base showed the highest SBS values (mean  $20.4 \pm 6.4$  MPa) and most enamel tears (64.3% of the group).

**CONCLUSIONS:** The tested adhesive systems showed high SBS values, precoating the tube base with primer led to a higher SBS at all adhesives, but also displaced the fatigue surface in direction of the enamel. Further investigations are necessary to review the findings *in vivo*.

## 553 ADVANTAGES OF CONE BEAM COMPUTED TOMOGRAPHY WHEN PLANNING TREATMENT IN PATIENTS WITH SUPERNUMERARY TEETH

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The aim of this presentation is to illustrate the improved diagnostic yield using cone beam computed tomography (CBCT) over conventional radiography, thus facilitating appropriate treatment planning.

Supernumerary teeth are those present in addition to the normal complement within the dentition. The prevalence reported in the literature varies between 0.1 and 3.8 per cent in the Caucasian population (Brook, 1974; Celikoglu *et al.*, 2010). Their aetiology involves both genetic and environmental factors. A series of five case reports will be presented that cover supernumeraries related to syndromes, a patient who presented with multiple supernumeraries, an odontoma in the anterior maxilla, and cases that highlight the different types and positions of supernumeraries within both the maxilla and mandible. CBCT is a useful tool when diagnosing and treatment planning patients with single and multiple supernumeraries. However orthodontic clinicians have a responsibility to their patients to ensure that they request radiographic images that maximise diagnostic yield. This is particularly true when the information will be used to plan surgical and orthodontic intervention. CBCT allows the clinician to have an accurate three-dimensional position of the teeth/areas of interest, which is particularly useful for surgical planning and can be involved in the informed consent process.

## 554 INCISOR ALIGNMENT AND ARCH DIMENSIONAL CHANGES AFTER EXTRACTION OF PRIMARY CANINES - A 2.5 YEAR FOLLOW-UP†

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**AIMS:** To investigate changes in incisor alignment and dental arch dimensions after extraction of the primary canines.

**SUBJECTS AND METHOD:** Seventy-one children, with anterior crowding in the early mixed dentition, were randomized into extraction ( $n = 32$ ) and control ( $n = 38$ ) groups. Dental casts from baseline (T0), and follow-ups after 1 (T1) and 2.5 years (T2), were used for measurements. Changes over time and between groups were investigated for incisor irregularity and rotation, arch dimensions (width, length, circumference), overjet and overbite.

**RESULTS:** Mandibular incisor irregularity decreased significantly in both groups ( $P < 0.05$ ), although showing different

patterns with median values at T0, T1 and T2 of 4.2, 2.3 and 3.0 mm in the extraction group versus 3.6, 2.9 and 2.7 mm in the control group. Maxillary incisor irregularity showed an increase from T1 to T2 in the extraction group (2.6 to 3.0 mm;  $P < 0.05$ ) in contrast to a decrease in the control group (4.5 to 3.3 mm;  $P < 0.05$ ). Irregularity showed no significant differences between groups at baseline or endpoint. Changes in rotation over time (T0-T2) did not differ significantly between groups. Mandibular and maxillary arch circumference and maxillary arch length decreased significantly in the extraction group from T0 to T2 ( $P < 0.001$ ,  $P < 0.001$  and  $P < 0.05$ ). Mandibular arch length decreased in the control group ( $P < 0.05$ ), while mandibular and maxillary arch width remained unchanged in both groups from T0 to T2. No significant differences in arch dimensions were observed between groups at baseline or endpoint except for a significantly larger maxillary arch circumference in the control group at T2 ( $P < 0.05$ ). Overjet remained unchanged, while overbite increased significantly in both groups ( $P < 0.001$ ).

CONCLUSIONS: Extraction of the primary canines has no significant effect on spontaneous alignment of the incisors. Neither did these extractions have any significant impact on arch dimensions, overjet or overbite.

†Winner of an EOS poster award.

## 555 ORTHODONTIC TREATMENT OF PATIENTS WITH FUNCTIONAL DISORDERS OF THE MAXILLO-FACIAL REGION

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AIM: To improve the results of orthodontic treatment of patients with functional disorders of the maxillofacial region by improvement, optimization and individualization of the preparatory treatment stage.

SUBJECTS AND METHOD: One hundred and forty eight patients between the age of 18 and 65 years (108 females, 40 males) with functional disorders of the maxillofacial region. Optimum jaw relationship was determined using functional and physiological algorithm according to a reported technique of centric jaw relationship registration by occlusal splints and temporary ceramic occlusal plates located in certain regions of the tooth arch. Radiographic control of the condition of the temporomandibular joints (TMJ) was performed at the stage of centric jaw relationship registration (computed tomography of two joints in three planes using this measurement technique and a coordinate system in order to compare the spatial relationship of joint structures at the initial jaw relationship in habitual occlusion and as determined and fixed with occlusal splints).

RESULTS: Nine-eight patients with functional disorders of the maxillofacial region using the suggested algorithm and preparatory stage showed significantly better results concerning improvement of the relationship between TMJ structures (based on radiographic examination), functional activity of muscles (based on electromyography control) and relief of dysfunction symptoms compared with the 50 subjects without morphologic-functional and functional-physiological preparation prior orthodontic therapy.

CONCLUSION: Use of silicone rims for jaw relationship registration is inaccurate, unreasonable, causes diagnostic mistakes and prevents orthodontic treatment success.

## 556 DENTAL ARCH FORM AND TOOTH-SIZE DISCREPANCY IN CLASS I AND II MALOCCLUSIONS USING THREE-DIMENSIONAL VIRTUAL MODELS

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AIM: To analyze whether dental arch form can be used in the prediction of tooth-size discrepancies in Class I and II malocclusion subjects.

MATERIALS AND METHOD: Randomly selected plaster dental casts of 85 patients [41 Class I mean age  $14.4 \pm 0.3$  years (18 males, 23 females) and 44 Class II mean age  $14.5 \pm 0.4$  years (19 males, 25 females)]. The models were scanned and digitized using ATOS II SO ('small objects') scanning technology (GoM mbH, Braunschweig, Germany), and three-dimensional virtual objects were created. Twelve points were digitally marked on each model (representing the midpoint of the facial axis of the clinical crown), using ATOS viewer, version 6.A.2 software. The following measurements were calculated for the upper and lower dental arches: anterior Bolton ratio, overall Bolton ratio, width/depth ratio, molar width/depth ratio, canine/molar depth ratio, canine/molar width ratio. Data were analyzed using the Statistical Package for Social Sciences, version 10.0. Multiple regression was used for analysis; a level of  $P < 0.05$  was considered statistically significant.

RESULTS: Maxillary molar width/depth ratio ( $P = 0.036$ ) and mandibular canine/molar depth ratio ( $P = 0.012$ ) could be

used in the prediction of anterior Bolton ratio in Class I malocclusions, but the regression model accounted for only 37 per cent of the variance in anterior Bolton ratio ( $P = 0.041$ ). While controlling for all other variables in the regression model, the independent contribution of maxillary molar width/depth ratio to the prediction of anterior Bolton ratio was 9.4 per cent ( $r = 0.307$ ), and mandibular canine/molar depth 13.9 per cent ( $r = -0.373$ ). In Class II malocclusions archform cannot be used in the prediction of Bolton ratio.

CONCLUSION: Dental arch forms are poor predictors of tooth size discrepancies.

#### 557 COMPARISON OF TRADITIONAL AND MEMORY TYPE ELASTOMERIC CHAINS WITH RESPECT TO THEIR FORCE-EXTENSION CHARACTERISTICS\*\*\*

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AIMS: An ideal space-closure system from mechanical standpoint is a system that elicits a continuous light force. Among all systems, elastomeric chains are widely used due to their simplicity and low cost. In an effort to improve the characteristics of these chains, 'memory types', have recently been introduced. However, information about their mechanical properties is limited. Thus the aim of this *in vitro study* was to compare traditional and memory type elastomeric chains with regard to their force-extension characteristics.

MATERIALS AND METHOD: Elastomeric chains were divided into six groups according to their types and manufacturer: 1) traditional American Orthodontics, 2) traditional GAC, 3) traditional Orthoorganizer, 4) memory American Orthodontics, 5) memory GAC and 6) memory Orthoorganizer. Each of 12 mm chain was stretched to twice its original length and kept constant for 1 month at 37°C in distilled water. Force-extension diagrams were drawn by means of an Instron universal testing machine at 0, 1, 8, 24, 72 hours and 1, 2 and 4 weeks. The mean and standard deviation of force at 25 mm extension, force at 100 and 200 per cent elongation in addition to the amount of elongation required to deliver a force of 200 g were calculated for each chain group at each time interval. To compare the results, analysis of variance and Tukey test were performed.

RESULTS: The force decay rate was significantly different between traditional and memory elastomeric chains. However the curves were similar for the specimen within each group. For traditional chain, there was a substantial decay in force in the first hour and 30-40 per cent of the force was retained at 4 weeks. The memory chains demonstrated more constant force and retained 60 per cent of their initial force at 4 weeks.

CONCLUSION: Memory chains exhibited superior mechanical properties compared with traditional elastomeric chains ( $P < 0.05$ ). Memory chains from GAC and American Orthodontics showed better characteristics among all studied chains.

#### 558 COMPARISON OF ARCH FORM BETWEEN ETHNIC MALAYS AND MALAYSIAN ABORIGINES IN PENINSULAR MALAYSIA

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AIM: To determine and compare the frequency distribution of various arch shapes in ethnic Malays and Malaysian Aborigines in Peninsular Malaysia and to investigate the morphological differences of arch form between these two ethnic groups.

MATERIALS AND METHOD: One hundred and twenty study models (60 maxillary, 60 mandibular) from 60 ethnic Malays (30 males, 30 females) and 129 study models (66 maxillary, 63 mandibular) from 129 Malaysian Aborigines (35 males, 94 females) that fulfilled the inclusion and exclusion criteria. Eighteen buccal cusp tips and incisor line angles were marked on each model, and the occlusal surfaces of the models were scanned and then digitised using Engauge version 4.1 computer software. The dental arches were classified into square, ovoid and tapered shapes by superimposing the printed scanned images and Orthoform™ arch form templates. Intercanine width (ICW) and intermolar width (IMW) measurements were taken, followed by ICW/IMW ratio calculation.

RESULTS: Using chi-square test, a significant difference was only noted for mandibular arch shape distribution ( $P = 0.040$ ) between the two groups. However, for mean values of maxillary and mandibular arch widths, independent *t*-tests showed that there was no significant difference. There was no difference in arch shape distribution between genders for both ethnic groups. It was also found that arch shape was not specific to ethnicity for either gender. Ovoid shape was the most common maxillary arch shape in both genders and the most common mandibular arch shape in females, whereas a square arch shape was the rarest in both ethnic groups.

CONCLUSIONS: Ethnic Malays and Malaysian Aborigines have similar dental arch dimensions and shapes. Hence, archwire selection for orthodontic treatment may not differ between these two groups for post-treatment aesthetics and

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occlusal stability.

559 COMPARISON OF AN INTRAOSSEOUS MINISCREW SUPPORTED MODIFIED JONES JIG AND MODIFIED FIRST CLASS DISTALIZATION APPLIANCE

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AIM: To correct Class II malocclusions using a modified Jones jig and modified first class intraoral distalization appliances with intraosseous miniscrew anchorage placed in the incisive palatal region, and investigation of the dentoalveolar effects. SUBJECTS AND METHOD: Twenty-one patients (11 females, 10 males) average age 12.56 years, who were skeletal Class I or Class II with a dental Class II Angle half-unit relationship. Upper molar distalization of the same patient was undertaken using a Jones Jig on the left side and a first class appliance (FCA) on the right side supported by miniscrew anchorage. Model and cephalometric analysis were carried out to evaluate the dental and skeletal changes.

RESULTS: Molar distalization of 3.16 and 3.00 mm was obtained with modified FCA and modified Jones Jig, respectively. Incisor protrusion of 0.90 degrees and an increase in overjet of 0.41 mm were observed. Parallel molar distalization was successful with both distalization systems. Model analysis showed molar distalization of 3.34 and 3.24 mm with the modified FCA and modified Jones Jig respectively. Central incisor protrusion of 0.29 mm and second premolar anchorage loss of 1.45 mm was observed in the segment where the FCA was used, and 0.35 mm protrusion of the central incisor and 1.55 mm second premolar anchorage loss in the segment where the Jones jig was used. Distalization time was  $2.95 \pm 0.13$  months with the FCA and  $5.53 \pm 0.17$  months with the Jones Jig.

CONCLUSION: The molars were effectively distalized in both groups, but the time was shorter to achieve a Class I molar relationship with the FCA system. Both systems can be an alternative to headgear, especially in non-cooperative patients.

560 TEMPOROMANDIBULAR JOINT LESIONS IN CHILDREN WITH JUVENILE RHEUMATOID ARTHRITIS

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AIM: To increase the effectiveness of rehabilitation of children with juvenile rheumatoid arthritis (JRA) by early diagnosis of destructive changes in the mandibular condyle.

SUBJECTS AND METHOD: Fifty-eight children (26 males, 32 females) aged 6 to 16 years (mean: 11 years) with JRA. All patients had undergone complex assessment that included personal data, medical history, facial examination, dysfunctional index of Helmiko (1976) and identification of the mandibular condyle stage of destruction (Billiau *et al.*, 2009). Statistical evaluation was performed by means of comparative analysis (Student's *t*-test) and Spearman rank correlation coefficient.

RESULTS: Clinical signs of TMJ dysfunction were identified in 28 per cent of children, of which 22 per cent had a minimal degree of dysfunction and 6 per cent a medium degree. When the dental pantomograms (DPTs; OrthoZone) were analysed pathological changes were found in 33 per cent. In general, the effects of the TMJ articular head manifested as erosion and cortical plate thinning and were registered in 21 and 19 per cent of children, respectively. Comparing clinical and radiological changes the following resulted were obtained: 72 per cent of patients had no clinical signs of TMJ dysfunction, while 55 per cent of cases demonstrated destructive changes (I-II severity level) on the DPTs, mainly unilateral condyle lesion. Light TMJ dysfunction was found in 21 per cent of the children, although all had affected condyles (II-III severity level) manifested in bilateral lesions. Patients with a medium degree of dysfunction showed bilateral condyle destruction (III-IV severity level).

CONCLUSION: When examining children with JRA it is necessary to conduct early radiological examination of the TMJs because significant destructive changes often occur without clinical symptoms.

561 THE EFFECT OF RAPID MAXILLARY EXPANSION ON CARDIAC PREDICTORS\*\*\*

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AIM: It has been shown that upper airway obstruction has some adverse cardiac effect. Rapid maxillary expansion (RME) is a routine procedure used in orthodontics and has positive effects on nasal airway. This study aimed to assess the affect of RME on cardiac autonomic function and/or to quantify risk of ventricular arrhythmias in orthodontic cases.

SUBJECTS AND METHOD: Twelve children with a bilateral crossbite (4 females, 8 males, mean age  $11.09 \pm 2.02$  years). All children were assessed pre- and 6 month post-treatment with 24 hour Holter monitoring and electrocardiomyographic

analysis. The prevalence analysis of arrhythmias, totally VPC (ventricular extrasystol) and APC atrial extrasystol number and mean heart rate (HR) and heart rate turbulence analysis was assessed.

RESULTS: APC and VPC count per day and mean HR, detected by the 24 hour ambulatory electrocardiography were compared. A statistical difference was present pre- and post-treatment ( $42 \pm 18.7 \pm 4$ ,  $P < 0.05$ ;  $54 \pm 69.6 \pm 5$ ,  $P < 0.05$ ;  $97.42 \pm 4.28$ ,  $74.17 \pm 6.58$ ,  $P < 0.00$ , respectively)

CONCLUSIONS: APC, VPC and mean HR are independent predictors for sudden cardiac death and cardiac arrhythmias. These parameters decreased significantly in post-treatment period.

## 562 ERUPTION DISTURBANCES OF THE MANDIBULAR FIRST MOLARS: CHARACTERISTICS, CLASSIFICATION, AND TREATMENT PROGNOSIS

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AIM: To test the hypotheses that eruption disturbances of the mandibular first molar (M1mn) could be classified as impaction or retention according to its characteristics and that the respective prognoses, on those bases, can be predicted.

SUBJECTS AND METHOD: Thirty-eight subjects presenting with M1mn eruption disturbances were tentatively classified into three categories: impaction due to the ectopic position of the tooth germ, impaction due to obstruction of the eruption path, and retention due to defects in the follicle or periodontal ligament. The characteristics and treatment outcomes of the subjects were assessed by cast and panoramic radiographic examination. The chi-square test was used to analyze the differences in the prevalence of M1mn eruption disturbance by gender and site distribution. The groups' aetiologic factor values were compared statistically by means of analysis of variance (ANOVA) with Bonferroni *post-hoc* tests.

RESULTS: The prevalence of M1mn eruption disturbance was 0.27 per cent. Impacted M1mn due to an ectopic eruption path were inclined mesially. Impacted M1mn due to obstruction showed specificities including dentigerous cyst, odontoma, ameloblastoma, and abnormally positioned adjacent tooth germ. The retained M1mn exhibited infraocclusion, and the adjacent teeth had erupted and drifted into the space. They showed significantly more dental anomalies of agenesis, impaction and underdevelopment, especially in P2mn and M2mn.

CONCLUSIONS: The results of impacted M1mn treatment by orthodontic traction were excellent, but those for retained M1mn were disappointing. However, traction failed to induce eruption in some of the impacted M1mn, but some spontaneous reeruption of a secondary retained molar occurred. In any case, after ruling out other causes, orthodontic traction or periodic observation will be required.

## 563 DETERMINATION OF THE IDEAL LOCATION OF PALATAL MINISCREWS

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AIM: Palatal miniscrews are commonly preferred as an anchorage device in orthodontics because, the force vector is favourable and the bone structure is sufficient for screw resistance and maintenance. The depth of the palatal wall, thickness of soft and hard tissues, angulations of incisive teeth may change the insertion vector for every single patient. In order to avoid complications and to achieve optimum bone contact for the miniscrew, an ideal insertion point and drilling angle should be determined pre-operatively on models. The aim of this study was to determine the ideal points of insertion for palatal miniscrews on cadaver maxillae.

MATERIALS AND METHOD: Twelve adult human hemimaxillae. All miniscrews (diameter, 1.6 mm, length 7-10 mm) were inserted 3 mm away from the palatal midline. All models were fixed with simulating 45 mm mouth opening. The drilling angulations were evaluated in two dimensions. The distance between the second incisor root, nasal floor and miniscrew were evaluated separately with a millimetric sensitive calliper. The thickness of the cortical bone, trabecular bone and attached gingivae were also recorded for all models. The ideal placement angle, safety distance from the incisive papilla and reliable screw length were determined. The results were statistically analyzed with one-way ANOVA.

RESULTS: The ideal insertion point for palatal miniscrews was 11 mm from the gingival margin of the second incisor, 3 mm away from the midline with the angle between the second incisor axis and the drill not less than 50 degrees (between 400-500) ( $P > 0.05$ ).

CONCLUSIONS: Ideal palatal miniscrew location can be determined by calculating the ideal drilling angle and considering the measurements from the noted anatomical landmarks.

#### 564 DOES PERCEPTION OF MALE FACIAL PROFILES RELATE TO FEMALE SEX HORMONES?

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**AIM:** To examine whether female perception of male facial profiles relates to the change of oestrogen and progesterone levels depending of menstrual cycle phase.

**SUBJECTS AND METHOD:** Seventy-eight female dental students (48 in secretory and 42 in proliferative phase). Hormonal status was examined by estimating the hormonally conditioned change of salt quantity in saliva utilising the Maybe Baby mini microscope (OPTIX, Offenbach, Germany). Photographs representing 14 distortions of one Caucasian male facial profile, with different skeletal and dental relationships were used. Each profile was estimated separately from two perspectives – social (colleague) and emotional (romantic partner) utilising a 10-point numerical rating scale. ANOVA and cluster analysis were used for statistical analysis.

**RESULTS:** The flat profile with a mild bialveolar retrusion was evaluated as the most beautiful. Females in the secretory phase evaluated this profile in their emotional estimation as beautiful more often than the females in the proliferative phase ( $P = 0.035$ ). In the proliferative phase it was evaluated as more beautiful than the flat profile ( $P = 0.037$ ) and the mild bialveolar protrusion ( $P = 0.005$ ), while there were no differences regarding the secretory phase and social estimation. In the proliferative phase, they grouped profiles at emotional estimation differently than at social estimation. At emotional estimation, females in the proliferative phase clearly distinguished a group of flat profiles with mild bialveolar protrusion or retrusion and slightly pointed chins, while there was little difference between intense dentoalveolar and skeletal profile alterations. For social estimation, they differentiated skeletal deviations from slight and intense dentoalveolar deviations. In the secretory phase, they grouped profiles in emotional and in social estimation equally.

**CONCLUSION:** Profile estimation varies depending on female sex hormone levels.

#### 565 CAN SIGNS AND SYMPTOMS OF TEMPOROMANDIBULAR DYSFUNCTION BE USED TO PREDICT ORTHODONTIC TREATMENT NEED?

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**AIM:** To explore whether sign and symptoms of temporomandibular dysfunction (TMD) can be used to predict orthodontic treatment need in children and adolescents.

**SUBJECTS AND METHOD:** One thousand five hundred and ninety-seven subjects aged 11-19 years, without a previous orthodontic history, from 16 randomly selected public schools in Zagreb, Croatia. Orthodontic treatment need was assessed using the Dental Aesthetic Index (DAI) and Index of Complexity, Outcome and Need (ICON). Data on TMD signs/symptoms and parafunctional behaviour were obtained by means of a questionnaire and clinical examination, respectively. Multiple linear regression was used for analysis.

**RESULTS:** Twenty-two per cent of children and young adolescents had one or more TMD signs/symptoms, ranging from 17 per cent at 11 years of age up to 24 per cent at 19 years of age. There was significant but weak correlation between TMD signs/symptoms and orthodontic treatment need, and regression models accounted for less than 6 per cent of variability ( $P < 0.001$ ). When controlling for age and gender, only altered joint function and tooth wear showed a significant but weak positive correlation with orthodontic treatment need assessed by DAI ( $P < 0.05$ ). In the ICON model, when controlling for age and gender, maximal mouth opening, deviation on opening and tooth wear correlated with orthodontic treatment need ( $P < 0.05$ ).

**CONCLUSION:** TMD signs and symptoms are poor predictors of orthodontic treatment need in children and adolescents.

#### 566 EVALUATION OF FACIAL PROFILE AESTHETICS

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**AIM:** To determine the existence and the level of self-awareness and perception of the individual's own profile and appearance of teeth among different groups.

**SUBJECTS AND METHOD:** Residents and specialists in orthodontics, dental medicine students, patients in orthodontic treatment and patients without orthodontic treatment ( $n = 100$ ) were divided into four groups. The participants answered a

questionnaire on issues related to self-awareness, satisfaction with their facial profile, the appearance of their teeth, avoidance of laughter and a desire to change the appearance of their teeth and facial profile. Among four offered silhouettes the participants chose the one that most closely resembled their facial profile. The selected profiles were then compared with the photograph of the subject's profile. Agreement between the examiner and examinees was evaluated using the kappa statistics. Differences in responses concerning the appearance of the facial profile and teeth were compared using *t*-tests.

**RESULTS:** Agreement between the evaluated and selected profiles between the examiner and examinees was 58 per cent ( $\kappa = 0.308$ ). The best assessment of their profile was by residents and specialists (66.67%), followed by students (64%), then patients with (54%) and without (45%) orthodontic treatment. Self-awareness and perception of their own profile in the group of patients with no orthodontic treatment was statistically significant than in the other groups ( $P < 0.05$ ). Participants who chose silhouettes of Class II and III were less satisfied with their profile appearance than others ( $P < 0.05$ ).

**CONCLUSION:** Fifty per cent of the studied population cannot recognize their own profile. The possibility of perception and self-awareness of their own profile and dental appearance depends on their education and profession. Dissatisfaction with appearance and readiness for a change was associated with perception of their own profile being different than average.

#### 567 TALIN, VINCULIN AND NESTIN EXPRESSION IN THE OROFACIAL MUSCLES OF DYSTROPHIN DEFICIENT MDX MICE

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**AIM:** The activity of cytoskeletal proteins such as talin, vinculin, and nestin increase in muscle that regenerates. Little is known about their role, or at least their expression, in the process of regeneration in masticatory muscles of mdx mice, a model of Duchenne muscular dystrophy.

**MATERIALS AND METHOD:** To determine a potential role of cytoskeletal proteins in the regeneration process of mdx masticatory muscles the expression of talin 1, talin 2, vinculin and nestin was examined in 100 day-old control and mdx mice using quantitative RT-polymerase chain reaction, Western blot analyses and histochemistry.

**RESULTS:** The protein expression of talin 1 and vinculin was increased in mdx tongue (20%), whereas talin 2 was diminished in mdx masseter and temporal muscles (17 and 26%, respectively). The protein expression of nestin was increased in mdx temporal and masseter muscles (59 and 37%, respectively). In mdx mice a significantly lower percentage of transcripts coding for nestin, talin 1, talin 2 and vinculin in masseter ( $P < 0.05$ ) and temporal ( $P < 0.001$ ) muscles was found. In contrast, the mRNA expression of nestin was increased in mdx tongue. Activated satellite cells, myoblasts and immature regenerated muscle fibres in mdx masseter and temporal muscles revealed positive staining for nestin.

**CONCLUSIONS:** Dystrophin-lack associated changes in the expression of cytoskeletal proteins in mdx masticatory muscles could be compensatory for dystrophin absence. The expression of nestin may serve as an indicator for regeneration in the orofacial muscles.

#### 568 TENSILE BOND STRENGTH OF THREE DIFFERENT BRACKET TYPES USING TWO ADHESIVES RESINS

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**AIM:** The different mechanical properties of brackets may affect the bonding characteristics of these brackets. The aim of this *in vitro* study was to compare the tensile bond strength (TBS) and de-bonding characteristics [adhesive remnant index (ARI) scores] of metal, ceramic, and polycarbonate brackets with comparable geometric properties.

**MATERIALS AND METHOD:** Ninety freshly extracted bovine teeth, divided into six groups ( $n = 15$ ), were ground flat (grit 600) and used as substrate for bracket bonding. Mini Twin metal brackets (Ormco), Allure ceramic brackets (Dentsply GAC), and Elegance polycarbonate brackets (Dentaurum) were bonded according to the manufacturer's instructions. After 30 seconds etching with 37 per cent phosphoric acid, the enamel was washed for 20 seconds and dried for 10 seconds. Brackets were bonded with Padlock (Reliance) or Transbond XT (3M) bonding system and light cured for 10 seconds with a visible curing unit (Satelec). After 1 hour the specimens were debonded in a tensile mode using a universal testing machine (Instron) with a crosshead speed of 1 mm/minute. ARI scores were assessed after debonding with a  $\times 25$  magnifying microscope.



RESULTS: Regarding Padlock, significant differences between the TBS were found between metal (4.8 MPa), ceramic (9.2 MPa) and polycarbonate (3.6 MPa) brackets ( $P < 0.01$ ). For Transbond XT, significant differences were found between the metal (4.3 MPa), ceramic (6.9 MPa) and polycarbonate (5.2 MPa) brackets ( $P < 0.01$ ). Significant differences between ARI scores were found between the different bracket types ( $P < 0.05$ ).

CONCLUSION: Higher forces are needed for debonding ceramic brackets. Bracket material and geometry appear to play a significant role in debonding characteristics. Changing these properties may improve bonding properties.

#### 569 AN INVESTIGATION OF EAR, NOSE AND THROAT RESPIRATION INHIBITION AFFECTING MAXILLARY GROWTH REDUCTION

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AIM: To investigate whether pharyngeal airway restriction affects growth of the maxilla, to study which findings can be ascertained, and to determine whether there is a relationship between the extent of obstruction and developmental disorders of the maxilla.

MATERIALS AND METHOD: The narrowest transverse area of the pharynx was measured on transverse magnetic resonance images. The results were compared with the transverse width of the maxilla and its pathological findings.

RESULTS: Analysis of 18 patients with maxillary deficiencies computed an area of 19 to 70 mm<sup>2</sup> for females and 25.5 to 49.5 mm<sup>2</sup> for males. The reference control group with regular developed maxilla and no ear, nose and throat findings or anamnesis had distinctly better pharyngeal areas with measured values from 195 to 225 mm<sup>2</sup>.

CONCLUSION: Pharyngeal obstruction affects maxillary development disorders, which result in a lateral or anterior crossbite or a shortage of space for the canines. Every patient with a verified pharyngeal obstruction had one of these pathological findings. Even though it could not be proven that there a close coherence will exist between the transverse width and pharyngeal narrowness, the findings verify the association between respiratory obstruction and maxillary growth inhibition.

#### 570 PRE-SURGICAL ORTHOPAEDICS IN CHILDREN WITH NON-SYNDROMIC UNILATERAL CLEFT LIP AND PALATE

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AIM: To analyze the long-term treatment outcome of different treatment protocols in children with non-syndromic unilateral cleft lip and palate (UCLP). The question if pre-surgical orthopaedics has a long-term benefit for UCLP patients should be answered.

MATERIALS AND METHOD: A prospective controlled clinical interdisciplinary study was conducted among three certified cleft palate centres (A, B, C). Time points of surgical interventions for lip, soft and hard palate closure differed between the three centres. Pre-surgical orthopaedics is carried out in newborns in centre B and C for 6 months, while centre A does not undertake that type of treatment. Impressions of the upper jaw as well as intra and extraoral photographs were taken immediately after birth (T1), before surgical lip closure (T2), before surgical closure of the soft palate (T3), before surgical closure of the hard palate (T4) and at the age of 5 years when the full primary dentition was present. Model analysis was done at T1, T2 and T3. Upper arch length and arch width, as well as deviation of the premaxilla towards the non-cleft side, was measured.

RESULTS: Pre-surgical orthopaedics enhances uprighting of the premaxilla and favours reduction of cleft width by mesial shifting of the smaller maxillary segment. Maxillary dimensions are greater in children with no pre-surgical orthopaedics and simultaneous closure of the soft and hard palate at an early age (18 months). Unfavourable intermaxillary relationships (Class III) were found mainly in UCLP patients who had not undergone pre-surgical orthopaedics and a one-phase procedure of hard and soft palate closure.

CONCLUSIONS: Differences in orthodontic and surgical treatment protocols are reflected by asymmetry of the premaxilla and differences in intermaxillary relationships. While early closure of the soft and hard palate does not seem to have an impact on upper arch dimensions in the primary dentition, early signs of midfacial deficiency can be seen in those UCLP patients who did not receive pre-surgical orthopaedics.

## 571 TOMOGRAPHIC EVALUATION OF MANDIBULAR ASYMMETRY IN OCULO-AURICULO-VERTEBRAL AND HEMIMANDIBULAR ELONGATION

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**AIM:** The degree of mandibular asymmetry is one of the important parameters in orthodontic diagnosis and treatment of facial deviations. The aim of this study was to prove the reliability of cephalometric measurements of mandibular deviation using multi-slice computed tomography (MSCT).

**SUBJECTS AND METHOD:** Forty-five patients (19 with oculo-auriculo-vertebral syndrome, six with hemimandibular elongation and 20 with lateral deviations of unknown aetiology). Clinical assessment showed mandibular deviation to the left in 25 cases and to the right in 20. Low dose MSCT was performed for general diagnostic purpose and surgical treatment planning. The index of facial asymmetry (Katsumata *et al.*, 2005) was applied using the software, VoXim® (IVS Solutions AG, Chemnitz). Allocation of different facial regions (Maeda *et al.*, 2006) was performed for the maxilla, mandibular body and mandibular ramus.

**RESULTS:** Classification of the direction of mandibular asymmetry failed in six cases (13.3%). Twenty-five cases (55.6%) showed deviations in all three regions, one in the maxilla, nine in the mandibular body and mandibular ramus and seven in the mandibular corpus. In addition to the originally defined five categories, three further categories were detected: one case showed only asymmetry of the mandibular ramus, one of the maxilla and mandibular ramus and one of the maxilla and mandibular corpus.

**CONCLUSIONS:** The definition of Katsumata's reference system using nasion, sella and dens axis as landmarks for the median sagittal plane was not reliable regarding the direction of mandibular deviation. Additional classification categories for skeletal location of asymmetry need to be added to in a future index. Further research is necessary for improvement of the reference system.

## 572 SKELETAL EFFECTS OF SANDER'S BITE JUMPING APPLIANCE IN SUBJECTS WITH DIFFERENT AUXOLOGIC CATEGORIES

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**AIM:** To evaluate the functional treatment response of subjects with an Angle Class II malocclusion and mandibular retrusion with different auxologic categories and to determine whether the auxologic category might be a useful prognostic factor during treatment with Sander's bite jumping (BJ) functional appliance.

**SUBJECTS AND METHOD:** Thirty subjects (16 males 14 females; mean age  $10.3 \pm 1.2$  years) with an Angle II Class malocclusion. For each subject a cephalometric tracing using Hasund's criteria was realized. The normal associations of cephalometric variables according to Hasund and Boë were utilized to classify subjects into growth categories according to Lavergne and Gasson's criteria. The subjects were then divided into six groups according to Petrovic's auxologic categories. The subjects were close to mandibular growth peak (CVMS stages 2 and 3). Sander's BJ appliance was used in all patients. Cephalometric tracings before (T0) and after (T1) treatment were compared to determine mandibular changes in the six categories with using the method of Pancherz. T1-T0 differences were calculated for OLP-Co and OLP-Pg. One-way analysis of variance was used to test differences between Petrovic's auxologic categories, each rotational group, and each sub-class of maxillary-mandibular differential growth.

**RESULTS:** Mandibular length (OLP-Pg + OLP-Co) was  $5.83 \pm 3.82$  mm in group 1,  $2.31 \pm 0.81$  mm in group 2,  $3.36 \pm 2.27$  mm in group 3,  $2.16 \pm 1.12$  mm in group 4 and  $2.55 \pm 1.80$  mm in group 5. Analysis of variance did not show significant differences between the groups.

**CONCLUSIONS:** No between group significant differences in mandibular length changes were found. Auxologic category is not a prognostic aid for evaluating response to treatment with Sander's BJ functional appliance.

## 573 FACIAL ASYMMETRY OF SKELETAL ORIGIN – CORRELATION OF SOME MANDIBULAR PARAMETERS AND DEVIATIONS

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**AIM:** To identify if deviation of mandible on left or right side is in correlation with the length of the mandibular corpus and ramus and also the size of gonial angle in subjects with facial asymmetry of skeletal origin.

**MATERIALS AND METHOD:** Thirty-one frontal cephalograms of subjects with face asymmetry of skeletal origin. The following parameters were analyzed: length of the mandibular corpus and ramus and also the size of gonial angle on the left and the right side and the degree of mandibular deviation (angle ANS-Me). Spearman test of correlation and multivariate regression analysis were used for statistical processing of the data.

**RESULTS:** There was a significant positive correlation of ANS-Me and gonial angle on the right side ( $\alpha = 0.56$ ,  $P < 0.05$ ) when deviation to the right side was present. The mandibular corpus on the left side and gonial angle on the right side also significantly affected the degree of deviation when a deviation to the right side was present ( $P < 0.05$ ). There was a positive correlation of the mandibular corpus on the right side and angle ANS-Me when deviation was to the left side ( $P < 0.01$ ). Multivariate regression analysis showed that a 61.7 per cent variation of ANS-Me was caused by other parameters that were not included in this multivariate regression model.

**CONCLUSION:** The length of the mandibular corpus and ramus and size of the gonial angle have a significant role, but there are other parameters that can influence the degree and side of mandibular deviation in subjects with facial asymmetry of skeletal origin.

#### 574 ERRORS IN DIGITIZING AND PROCESSING OF CEPHALOGRAMS

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**AIM:** To measure the 'real' amount of error in everyday cephalometrics and to discriminate between values that are more erroneous from those that are not. An additional aim was to compare data between digital versus classic radiography and different methods of processing.

**MATERIAL AND METHOD:** Thirty classic (film-based) and 30 digital cephalograms randomly selected. The Croatian analysis, Zagreb 82 MOD, was used together with values from most used international analyses such as Steiner, Downs and Björk). All data was processed by one analyzer in five non-consecutive repetitions and by five independent analyzers without repetitions. The error was measured as variability among examiners and repeated measurements in the case of one examiner. For computer processing Dolphin 10.5 was used.

**RESULTS:** Higher error levels than expected were found for all measured or calculated values. Digital radiographs demonstrated significantly lower value variability in repetitions than classic images. The highest variability was calculated (ratio) for interincisal angle (15.31° interexaminer, 8.77° intraexaminer), and the lowest in the distance from the lower incisive tip to the N-B line (2.52° interexaminer, 2.02° intraexaminer). Manual measuring showed no significant difference for most variables compared with computerized measurements.

**CONCLUSION:** Digital radiographs cause significant lower variability in repeated measuring than film-based. Because there is no difference between manual and computer measuring, the error is due to identifying points and anatomical structures. Cephalometry is a reliable diagnostic method, but it cannot be the only one.

#### 575 THREE-DIMENSIONAL MODELLING OF OXYTALAN FIBRES IN THE RAT PERIODONTIUM

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**AIM:** The cause of orthodontic relapse is still largely unknown. Oxytalan fibres have been proposed to induce relapse after tooth movement. In the present study the distribution of oxytalan fibres was examined using a three-dimensional (3D) model of the rat periodontium.

**MATERIALS AND METHOD:** Serial sagittal sections of the mandibular molars, from adult Wistar rats, were stained using Gomori's aldehyde fuchsin following oxidation. Stained serial sections were photographed and the digital images were stacked to construct a 3D model of the periodontium using Amira software.

**RESULTS:** Oxytalan fibres form a continuous 3D network surrounding the roots of the molars stretching from the apex to the gingiva. At low magnification the large fibres mainly have an occluso-apical orientation. At higher magnification a more random network of fine interconnecting branches can be identified. In the supracrestal part of the periodontium, thin fibres emerge from the acellular cementum, perpendicular to the root surface, and extend across the transseptal region to the adjacent tooth with varying orientation. Some fibres are embedded in the alveolar crest and run parallel to the alveologingival collagen fibres. In the periodontal ligament (PDL), fine fibres emerge from the acellular cementum and join an extensive network of thicker fibres. The thicker fibres have an occluso-apical orientation and a wavy appearance. Many fibres are observed in close proximity to the blood vessels, but no fibres are observed embedded in the alveolar bone. In the apical area

the oxytalan network is similar to that seen in the rest of the PDL with the exception of the orientation, which is random for the apical fibres.

**CONCLUSIONS:** Relapse after orthodontic tooth movement is still an unknown process and will remain so as long as we do not recognize and understand all the constituents of the PDL. Although individual oxytalan fibres are relatively small in dimension, together they form an extensive fibre system, which might play an important role in relapse after orthodontic tooth movement.

#### 576 RELIABLE JUDGEMENT OF FACIAL AESTHETICS OF CLASS III PATIENTS: ESTABLISHING THE OPTIMAL PANEL SIZE

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**AIM:** To determine the required panel size of judges formed by laypeople, orthodontists and maxillofacial surgeons, respectively, ensuring a reliable judgement on facial aesthetics of Class III patients.

**MATERIALS AND METHOD:** Standardized profile photographs of 18 Caucasian adults (10 males, 8 females; mean age 24.5 years) with skeletal Class III malocclusions were evaluated for attractiveness by three panels, consisting of 23 maxillofacial surgeons, 56 orthodontists and 61 laypersons. A 10-graded visual analogue scale was used and the ratings were recorded as profile assessment score. Intraclass correlation coefficient (ICC) was calculated, relating the variability between the patients to the total variability. The optimal panel size was obtained through the Spearman-Brown prophecy formula. The optimal panel would be the one for which the smallest number of randomly selected judges (N) yields an ICC(N) equal or larger than 0.8.

**RESULTS:** ICC (single measures) for laypeople, orthodontists and maxillofacial surgeons were 0.126, 0.217 and 0.129 respectively. ICC (average measures) were 0.898, 0.939 and 0.773 for the same groups. Reliable judgement on facial aesthetics of Class III patients is possible when the panel consists of at least 27 randomly selected laypeople, 14 orthodontists and 27 maxillofacial surgeons (ICC (N) = 0.8)

**CONCLUSION:** The highest ICC (single measures) for orthodontists is possibly due to the fact that most of them were trained at the same institute. Lower ICC (single measures) for maxillofacial surgeons, similar to that of laypeople, shows a larger diversity of opinions, possibly reflecting a different training background. A thorough calibration procedure should be undertaken to keep a good level of heterogeneity. Keeping the panel size to a minimum avoids unnecessary effort and expense in future studies involving aesthetic evaluation of Class III malocclusion patients when evaluated by these three types of judges.

#### 577 EVALUATION OF CONDYLAR AND RAMAL ASYMMETRY IN PATIENTS WITH ECTODERMAL DYSPLASIA

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**AIM:** To compare the condylar, ramal, condylar-plus-ramal mandibular asymmetry of patients with ectodermal dysplasia and healthy patients using cone beam computerized tomography (CBCT).

**MATERIALS AND METHOD:** CBCTs of nine patients (4 girls, 5 boys) with ectodermal dysplasia and 10 healthy patients (5 girls, 5 boys) with normal occlusion. Mandibular asymmetry index measurements (condylar, ramal, and condylar-plus-ramal) were made on the CBCT. A paired samples *t*-test was used to establish statistically significant differences between the sides for all three measurements. An independent *t*-test was used to determine possible statistically significant differences between the groups.

**RESULTS:** There was no statistically significant difference between the right and left sides for condylar, ramal, and condylar-plus-ramal height measurements of the patients with ectodermal dysplasia and the normal occlusion sample. There was also no statistically significant difference between the groups in asymmetry index measurements.

**CONCLUSION:** Patients with ectodermal dysplasia show similar condylar, ramal, condylar-plus-ramal measurements as healthy patients.

#### 578 HYPODONTIA – DIFFERENCES BETWEEN SAMPLES FROM THE GENERAL POPULATION AND UNIVERSITY CLINIC PATIENTS

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AIM: This research is part of a hypodontia heredity project, which has been ongoing in Prague from the mid-1970s. Cohorts of hypodontia probands and their families were collected from the general population and partially from university clinic patients.

SUBJECTS AND METHOD: Three hundred and sixty two probands (135 boys, 227 girls) with hypodontia of any teeth except third molars were selected from Prague schoolchildren and 182 (58 boys, 124 girls) from the orthodontic and endodontic departments at a university stomatology clinic. Profanes and first-degree relatives were examined; hypodontia was diagnosed and recorded from radiographic evidence.

RESULTS: 1. More girls than boys were seen in both hypodontia samples. The proportion of girls over boys in the clinical sample was significantly higher. 2. Differences were noted in the morphological types of missing teeth. Hypodontia of lateral incisors was more frequent in the clinical profanes, and hypodontia of premolars had a greater occurrence in the general population sample. 3. Differences between the two samples in terms of the frequency of hypodontia among relatives of probands were not significant.

CONCLUSIONS: The minor differences found between the two samples should not limit further genetic analysis. Thus, the combined group of 564 probands and their relatives could be evaluated as a whole in future studies.

#### 579 TOOTH-SIZE DISCREPANCY AND BOLTON'S RATIOS USING PLASTER, DIGITAL THREE-DIMENSIONAL AND DIGITAL THREE-DIMENSIONAL MODELS WITH REVERSE NORMALS

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AIM: To determine and compare the accuracy of performing Bolton's tooth-size analysis using digital three-dimensional (3D) dental models and digital 3D dental models with reverse normals.

MATERIALS AND METHOD: Pre-treatment study models of 32 randomly selected patients. Two examiners performed all the measurements after initial training. A hand held digital calliper (measurement resolution of 0.01 mm) was used to manually measure the plaster models. A digital analogue of the dental model was produced by Elinvision Ltd. Data were transferred to RapidForm 2006 software (Inus Technology Inc., Seoul, Korea) and points pertinent for mesiodistal dental measurements were ticked using reference geometry functions. The measurement points ticked again on the 3D dental model having reversed surface normals. Linear distances between landmarks were calculated to five decimal places. Generalised Linear Model repeated measurements (ANOVA) test was performed for statistical analysis.

RESULTS: Tooth width measurements using different techniques are different. Comparison of measurement data between examiners showed the highest correlation ( $r = 0.986$ ) of manual tooth width measurements on the lower dental arch ( $P = 0.365$ ). There were small or no systematic errors within or between Bolton tooth-size discrepancies and ratio measurements on 3D dental models (model with conventional normals direction and with reverse normals direction).

CONCLUSIONS: 3D dental models with reverse normals can be used for performing Bolton's tooth-size analysis. This enables convenient ticking of the points on mesiodistal dental surfaces with small errors. Single estimations of tooth-size discrepancies should be treated with caution and replicate measurements are advised in a clinical setting.

#### 580 CEPHALOMETRIC ANALYSIS OF SWEDISH ADULTS WITH TURNER SYNDROME

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AIM: Turner syndrome (TS) is a genetic disorder caused by numerical and/or structural aberration of the X-chromosome. TS affects females with a prevalence of 1/2500 live female births. The aim of this study was to compare cephalometric variables from adult females diagnosed with TS to a standardized reference group of healthy 30-year old females, and to evaluate the possible effects of growth hormone therapy on the subjects with TS.

SUBJECTS AND METHOD: Registered TS patients in the southeast region of Sweden were invited to participate. Twenty-two females aged  $36.8 \pm 13$  (17-63) years responded and cephalometric radiographs were obtained between September 2003 and June 2008. The radiographs were analyzed using standard cephalometric methods (Hasund analysis) and with the commercially available software program, FACAD®. Comparisons were made with roentgencephalometric standards from nineteen 30-year old Swedish females.

RESULTS: The TS patients showed a slightly more retrognathic maxilla (SNA  $80.5 \pm 5.4$ ) and mandible (SNB  $77.2 \pm 5.2$ ) and a small posterior inclination of the maxilla (SN/NL  $8.5 \pm 3.6$ ), as compared with the standard values (SNA  $84.2 \pm 3.0$ , SNB  $81.5 \pm 2.3$ , and SN/NL  $5.2 \pm 2.7$ , respectively). There were no significant differences regarding sagittal or vertical jaw

relations, mandibular inclination or cranial base angle between the TS-group and standard values. There were also no significant differences regarding cephalometric values when comparing TS patients with and without previous growth hormone administration.

CONCLUSION: The TS patients showed a slightly more retrognathic maxilla and mandible, and a small posterior inclination of the maxilla, as compared with standard values.

#### 581 EVALUATION OF COMBINED SURGICAL-ORTHODONTIC TREATMENT

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AIM: To perform an objective estimation of treatment results, some indices are needed. Nevertheless, it is important to draw attention to the fact that subjective evaluation of the treatment made by the patients themselves is also essential. The aim of the study was to compare combined surgical- orthodontic treatment results both from the clinician's and patient's perspectives. SUBJECTS AND METHOD: Analysis was performed in 30 patients with a skeletal Class III malocclusion before treatment and 12 months after surgery. The patient's facial appearance (lower part) as well as occlusal relationship before (T1) and after (T2) combined surgical-orthodontic treatment, was evaluated by the patient and clinician. In a parallel evaluation, a four-grade scale was used: very good = 4 points, good = 3 points, satisfactory = 2 points, not satisfactory = 1 point. The estimation was made at the same time, independently by both the clinician and patient. The results were statistically analyzed using the Wilcoxon's test with the level of significance set at  $P < 0.05$ . A ratio of R, Spearman's rank correlation was used to compare the treatment results of the clinician and patient.

RESULTS: Both the clinician and patient's evaluation was statistically significantly higher after combined surgical-orthodontic treatment as far as facial appearance and occlusal relationship were concerned ( $P = 0.000$ ). There was a correlation between the clinician's and patient's evaluation regarding appearance before treatment (correlation ratio  $q = 0.0730$ ;  $P = 0.000$ ) and the occlusal relationship after treatment (correlation ratio  $q = 0.548$ ;  $P = 0.0017$ ). There was no correlation in the simultaneous estimation regarding facial appearance after treatment and the occlusal relationship before.

#### 582 CLINICAL ASSESSMENT OF ORTHODONTIC TREATMENT BY POSTGRADUATE STUDENTS\*\*\*

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AIM: To quantitatively evaluate orthodontic outcome of treatment by 10 residents on the 2010 postgraduate course at the Department of Orthodontics, Tokyo Dental College.

MATERIALS AND METHOD: Forty pre- and post-treatment study models were assessed according to the peer assessment rating (PAR) index. The PAR index was divided into seven components: tooth alignment (maxillary and mandibular), right and left buccal segment occlusion, overjet, overbite and midline. Evaluation was carried out based on the pre- and post-treatment PAR index and reduction rate.

RESULTS: Treatment was carried out on 30 females and 10 males and included 22 Class I cases (10 non-extraction, 12 extraction), 14 Class II cases (5 non-extraction, 9 extraction), and four Class III cases (2 non-extraction, 2 extraction). Six surgery cases (3 non-extraction, 3 extraction) were included. The average active treatment period was 2.1 years (1.4 to 3.9 years). The pre- and post-treatment scores were  $2.23 \pm 2.20$  and  $0 \pm 0$  for maxillary segment alignment;  $1.78 \pm 1.98$  and  $0 \pm 0$  for mandibular segment alignment;  $1.43 \pm 1.45$  and  $0.10 \pm 0.38$  for right buccal segment occlusion;  $1.35 \pm 1.27$  and  $0.03 \pm 0.16$  for left buccal segment occlusion;  $1.55 \pm 1.48$  and  $0.05 \pm 0.22$  for overjet;  $0.88 \pm 0.99$  and  $0 \pm 0$  for overbite; and  $0.40 \pm 0.63$  and  $0 \pm 0$  for the midline. The average PAR index reduction was  $9.58 \pm 4.87$ , and the average PAR index reduction rate (%) was  $97.67 \pm 6.68$ .

CONCLUSIONS: Both post-treatment PAR index reduction and PAR index reduction rate were excellent. These results indicate that the postgraduate course at Tokyo Dental College provides postgraduate residents with a high level of orthodontic knowledge and skill.

#### 583 SHEAR BOND STRENGTH AND FAILURE SITES OF DIFFERENT AESTHETIC BRACKETS BONDED TO ENAMEL ETCHED WITH PHOSPHORIC ACID AND ER:YAG LASER

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AIM: To evaluate shear bond strength (SBS) of Radiance, Inspire Ice, Clarity, Luxi II and Sierra Classic brackets bonded to enamel etched with phosphoric acid or Er:YAG lasers and to assess the tooth surfaces in terms of enamel fracture.

MATERIALS AND METHOD: Enamel surfaces of 150 premolars were etched with phosphoric acid, 80 mJ, 30 Hz and 120 mJ, 20 Hz Er:YAG laser. The brackets were bonded using light cured adhesive and debonded with Universal testing machine. Debonding characteristics were assessed using the modified adhesive remnant index (ARI) by stereomicroscope. Enamel surfaces of 10 teeth from each group were evaluated with scanning electron microscopy (SEM) to detect probable enamel fractures. SBS data displaying normal distribution (parametric) was analyzed using one-way analysis of variance (ANOVA) and *post hoc* Tukey HSD was used to determine whether significant differences existed between the various groups. To determine statistical differences of ARI scores, Kruskal-Wallis and Mann-Whitney *U* tests were used.

RESULTS: The most retentive bracket in all three etching groups was Inspire Ice; followed by Clarity, Radiance, Luxi II and Sierra Classic. In the phosphoric acid group, failure mode was generally at the bracket/adhesive interface and in the laser groups at the enamel/adhesive interface for all bracket groups. SEM evaluation revealed no enamel fracture. With stereomicroscopic evaluation, five enamel fractures were seen in the phosphoric acid group and one in the Er:YAG (80 mJ, 30 Hz) laser group.

CONCLUSION: The effect of acid and Er:YAG laser etching (80 mJ, 30 Hz and 120 mJ, 20 Hz) on SBS of Radiance, Inspire Ice, Clarity, Luxi II and Sierra Classic brackets were found to be insignificant. Failure sites in the different etching groups were significantly different. Er:YAG laser provides sufficient bond strength and can be considered as a safe alternative for the prevention of enamel fractures.

#### 584 THE MANDIBULAR HINGE AXIS IN SKELETAL CLASS III POSTERIOR UNILATERAL CROSSBITE PATIENTS\*\*\*

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AIMS: A posterior unilateral crossbite (PUXB) may induce skeletal remodelling of the temporomandibular joint (TMJ), which in turn could lead to permanent mandibular asymmetry. Analysis of mandibular motion found that the centre of rotation was located in the condylar head of the mandible (Lemoine *et al.*, 2005). However, few previous studies have evaluated the change in the axis of mandibular hinge movement associated with skeletal asymmetry. Therefore, the purpose of this study was to evaluate the hypothesis that mandibular asymmetry is associated with a change in the mandibular hinge axis in adults with PUXB.

SUBJECTS AND METHOD: Thirty adult subjects with a skeletal Class III malocclusion divided into PUXB ( $n = 15$ ) and non-PUXB ( $n = 15$ ) groups. The bilateral centres of rotation of mandibular motion (CoRs) were measured by computerized axiography (Cadix®) and duplicated on posteroanterior (PA) and submentovertex (SMV) cephalometric radiographs. The mandibular hinge axis was defined as the line that connected the bilateral CoRs. Morphological asymmetry was evaluated for both skeletal and dental components and positional deviation of the mandible by the PA and SMV cephalometric analysis. A Mann-Whitney *U*-test was used for statistical evaluation ( $P < 0.05$ ).

RESULTS: Significant differences in both skeletal and dental components were found between the PUXB and non-PUXB groups. These differences included a more posterobuccal position of the mandibular first molar on the shifted side in the PUXB group compared with the non-PUXB group. The inclination of the mandibular hinge axis toward the mandibular shifted side was greater in the PUXB group than in the non-PUXB group.

CONCLUSIONS: The present findings support the hypothesis and suggest that PUXB may cause morphological asymmetry of the mandible and an altered mandibular hinge axis.

#### 585 ASSESSMENT OF THE CERVICAL VERTEBRAL POSITION IN CHILDREN WITH ENLARGED ADENOIDS

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AIM: To describe the relationship of cervical vertebra position and adenoid hypertrophy in children.

SUBJECTS AND METHOD: Sixty-eight subjects (37 females, 31 males), age 8–14 years, without previous orthodontic treatment. The material comprised the lateral cephalometric radiographs of 33 adenoid hypertrophic patients and of 35 patients with Class I occlusion and physiological nasal breathing. Standardized lateral cephalograms were taken in the natural head position, centric relation, and with a relaxed lip posture. Group differences were statistically evaluated by Student's *t*-test at  $P < 0.05$  level.

**RESULTS:** There was a decrease in VER/NSL and VER/NL angles; and an increase in CVT/NSL, OPT/NSL, CVT/HOR, OPT/HOR, CVT/NL and OPT/NL angles in the adenoid hypertrophic patients in comparison with the nasal breathing patients with a Class I occlusion.

**CONCLUSIONS:** Adenoid hypertrophic patients show greater head extension related to the cervical spine, and more skeletal divergence, compared with nasal breathing patients with a Class I occlusion. In addition the palatal plane showed anticlockwise rotation in adenoid hypertrophic group.

#### 586 GENDER RELATED CRANIOFACIAL VARIATIONS BETWEEN CLASS I AND CLASS II ADOLESCENTS

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**AIM:** To evaluate the craniofacial variations between sexes in randomly selected Turkish adolescents with skeletal Class I and Class III relationships.

**SUBJECTS AND METHOD:** Eighty randomly selected untreated subjects (40 males, 40 females). The age range was between 10-11.5 years. All had an optimal SN/GoGn angle ( $32 \pm 6^\circ$ ). Four groups were constructed and matched: group 1; male subjects with a skeletal Class I (ANB:  $2 \pm 2^\circ$ ) relationship; group 2; female, skeletal Class I; group 3; male, skeletal Class II (ANB:  $>4^\circ$ ); group 4; female, skeletal Class II. A coordinate system (R1 and R2) was constructed and four angular and 32 linear measurements were used to evaluate the lateral cephalometric radiographs. Variance analysis (ANOVA) and Duncan test were used for statistical evaluation.

**RESULTS:** Significant differences were found in ANB between the Class I and Class II groups, but not between males and females. Maxillary length and depth ( $R2 \perp A$ ,  $R2 \perp ANS$ , Co-A) were found to be significantly different between Class I females and Class II males. Significant differences were also found in  $R2 \perp ANS$  and Co-ANS between Class I males and females and in  $R2 \perp Me$  and  $R2 \perp Ant.$  notch between Class II males and females. Mandibular length and depth (Co-Gn, Co-B,  $R2 \perp Me$ ,  $R2 \perp B$ ,  $R2 \perp Pg$ ,  $R2 \perp Go$ ,  $R2 \perp Gn$ ,  $R2 \perp Ant.$  notch) were found to be significantly different between Class I males and Class II females.  $R1 \perp Co$  showed significant differences between Class I and Class II males ( $P < 0.05$ ).

**CONCLUSIONS:** Maxillary length and depth, indicating the sagittal position of the maxilla, differ in gender in Class I subjects, and mandibular depth, indicating the sagittal position of the mandible, in genders in Class II subjects. Mandibular length is different between Class I males and Class II females.

#### 587 THE LEVEL OF INTERLEUKIN-6 AND -10 IN GINGIVAL CREVICULAR FLUID DURING ORTHODONTIC TOOTH MOVEMENT

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**AIM:** To evaluate the level of interleukin-6 (IL-6) and interleukin-10 (IL-10) in gingival crevicular fluid (GCF) during orthodontic treatment with extractions and to investigate the relationship between these cytokines.

**SUBJECTS AND METHOD:** Twelve adolescents (mean age 15.5 years, 5 males, 7 females) treated by fixed orthodontic appliances and premolar extractions. For space closure NiTi ( $0.010 \times 0.036$  inch springs, 9 mm with eyelet) closed coils were used after levelling. The initial force range on the distal side was 100-120 g. All subjects received professional prophylaxis and oral hygiene (OH) instruction prior to study baseline. Clinical parameters were recorded as plaque index (PI), gingival index (GI), probing depth (PD), clinical attachment level (CAL), bleeding on probing (BOP). GCF samples were collected from the test and control sides for each subject at baseline and after force application at 7 and 28 days. The levels of IL-6 and IL-10 concentration in GCF were measured by enzyme-linked immunosorbent assay. Repeated ANOVA, Mann-Whitney *U* test and Spearman rank correlation analysis were used.

**RESULTS:** Following orthodontic activation, the GCF level of IL-6 was significantly higher at the test side ( $P < 0.05$ ). A decrease in the level of GCF was observed both on days 7 and 28. The levels of IL-10 concentration were decreased in a time-dependent manner during the experimental period. A negative correlation was observed between the level of IL-6 and the level of IL-10 in GCF.

**CONCLUSIONS:** Orthodontic forces play a significant role on levels of IL-6 and IL-10 during the early stages of tooth movement. The levels of IL-6 in GCF may be key mediators of bone resorption during orthodontic tooth movement.



588 THREE-DIMENSIONAL ANALYSIS OF CHEEK MORPHOLOGY AT REST AND DURING SMILING IN SKELETAL CLASS III ORTHOGNATHIC PATIENTS

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AIM: To examine three-dimensionally soft-tissue cheek morphology at rest and the peak of posed smile in skeletal Class III orthognathic patients.

SUBJECTS AND METHOD: The sample comprised two groups: an experimental Group (n = 15, mean age = 23.9 years, skeletal Class III orthognathic female patients) and a control group (n = 20; mean age = 25.3 years). Three-dimensional (3D) images of the face at rest and peak of posed smile were recorded for each subject by means of a 3D surface-imaging device (3dMDcranial™ System). Based on lines of intersection that extended from the eyes to lip corners, four variables that describe the features of each participants' cheek surface configuration (i.e., the eye-lip base length, cheek prominence, eye-cheek base length, and cheek prominent area; Tanikawa, 2010) were extracted from each image. In addition, to assess cheek configuration changes during smiling, the absolute differences between the values at rest and at peak smiling were examined. A Mann-Whitney test was used to test for significant differences in the variables between groups ( $P < 0.01$ ).

RESULTS: Cheek prominence and the cheek prominent area were significantly smaller in the experimental than in the control group during both facial postures. Further, the absolute difference between the values for cheek prominence and cheek prominent area at rest and at the peak of smiling were significantly smaller in the experimental than in the control group.

CONCLUSION: 3D examination of soft tissue cheek morphology showed that skeletal Class III orthognathic patients had less prominent cheeks at rest and at the peak of posed smiling.

589 CRYOPRESERVATION TECHNIQUE FOR 'TOOTH BANKS' AVAILABLE FOR FUTURE TOOTH TRANSPLANTATION

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AIM: Missing teeth are a major problem in dentistry and clinical orthodontics. The purpose of this study was to develop a new cryopreservation technique for teeth, which will be used for future transplantation in subjects with tooth defects.

MATERIALS and METHODS: A program freezer available for applying a magnetic field with varying intensities was used. Under optimal magnetic intensity, hold-time and plunging temperature, defined in a preliminary study, the cell survival and proliferating rates were examined for periodontal ligament (PDL) cells. An *in vivo* experiment was then carried out to examine transplantation of the cryopreserved tooth. The upper incisors of 8-week-old Wistar rats were extracted and the teeth in the first group were replanted immediately after extraction, serving as the controls. The teeth in the second group were cryopreserved and replanted after three-day cryopreservation. Ninety days the reimplantation, histochemical examinations were executed for the periodontium and the number of clast cells.

RESULTS: The cell survival rate increased dose-dependently, and reached the maximum with use of trehalose as a cryoprotectant at a dose of 20 or 30 per cent. These values were significantly greater than the 44.1 per cent with conventional freezing. The number of proliferated cells also increased dose-dependently and reached the maximum with 20 per cent trehalose. The experimental group showed periodontal tissue regeneration similar to that of the controls without root-bone ankylosis and progressive root resorption. The number of odontoclasts was almost similar to that in the controls.

CONCLUSIONS: Cryopreservation using a program freezer produces no damage of the PDL. It is expected that a new era of tooth transplantation will be opened up by such a highly advanced teeth cryopreservation technique.

590 BONE REGENERATION IN THE TREATMENT OF BONE DEFECT IN CLEFT LIP AND PALATE PATIENTS WITH MESENCHYMAL STEM CELLS

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AIM: In dentistry, tissue defects are currently treated by replacement with living tissues or biomaterials. The purpose of this study was to examine a possibility of bone regeneration using bone marrow-derived mesenchymal stem cells (MSCs) in simulated bone defects in dogs.

**MATERIALS AND METHOD:** Three beagle dogs, three-months-old, were used. In each dog, a bone defect of  $10 \times 5$  mm was created bilaterally in the upper third incisor region, simulating a jaw cleft in a cleft lip and palate (CLP) patient, under general anaesthesia. MSCs, derived from iliac bone and cultured, were transplanted with carbonated hydroxyapatite (CAP) as a scaffold into the bone defect area on the left, whereas only CAP was transplanted on the right side. Bone regeneration was evaluated by means of radiographs and computed tomographic images. The structure of regenerated bone was examined histologically. In addition, movement of the second incisor into the regenerated bone area was examined histomorphometrically. **RESULTS:** Four months after the transplantation, the jaw cleft was closed completely without any infection or inflammation, indicating that MSCs were differentiated to osteoblasts and induced new bone formation. The internal structure of the new bone was equivalent to the original bone architecture, whereas bony tissues were induced with a considerable amount of CAP. Furthermore, the second incisor was moved more efficiently on the experimental side than on the control right side. **CONCLUSIONS:** Bone regeneration can be achieved with MSCs and the appropriate scaffold. Orthodontic tooth movement into the bone regeneration area is achieved successfully. MSC transplantation therapy could be a useful tool for the treatment of CLP patients with bone defects.

#### 591 A THERAPEUTIC APPROACH TO CLASS III MALOCCLUSIONS IN THE MIXED DENTITION

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**AIM:** A lack of interceptive therapy in the temporary dentition and orthodontic therapy in the mixed dentition leads to the progression of the anomaly with augmentation of the intermaxillary gap and changes in the function of the dentomaxillary complex. The aim of the study was to evaluate the skeletal changes (SNA, SNB, ANB, AoBo) depending on the type of appliance used.

**SUBJECTS AND METHOD:** Thirty patients, between 6 to 12 years of age. Diagnosis was based on clinical and paraclinical investigations. The first group was treated with a maxillary removable appliance for expansion and a chin cap, and the second with a maxillary removable appliance for expansion or palatal expansion with a Delaire facemask. The data were analyzed using Statistica 7.0.

**RESULTS:** For the first group treated the following results were achieved: SNA  $-1.2$  degrees, SNB  $-0.4$  degrees, ANB  $-13$  degrees, AoBo  $-1.1$  mm and in the second group: SNA  $-2.2$  degrees, SNB  $-0.3$  degrees, ANB  $-1.9$  degrees, AoBo  $-2.1$  mm. **CONCLUSION:** The changes were more significant in the second group.

#### 592 RELATIONSHIP BETWEEN DENTAL ARCH DIMENSIONS FOR EGYPTIAN PATIENTS WITH CLASS II AND III MALOCCLUSIONS\*\*\*

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**AIM:** To investigate the relationships between dental arch width, depth, perimeter and length

**MATERIALS AND METHOD:** Maxillary and mandibular dental casts of 90 patients with a mean age of 16 years. The test sample was divided into three equal groups (Class II division 1, Class II division 2 and Class III). The control group consisted of 30 dental casts of individuals with a normal occlusion. The coefficient of correlation between dental arch dimensions was statistically analyzed using the Statistical Package for Social sciences, version 6.

**RESULTS:** There was no correlation between palatal depth and the other dimensions for both the control and test groups, while a significant correlation was found between arch width for both arches in the Class II patients. Arch length and arch perimeter correlations were not significantly correlated with the other dimensions for either arch in the test groups while it was highly significant for the control group.

#### 593 THE MODIFIED HUDDART/BODENHAM AND GOSLON YARDSTICK METHODS FOR ASSESSING DENTAL OCCLUSIONS

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**AIM:** To test the measurement of agreement between the modified Huddart/Bodenham scoring system and the Goslon Yardstick for assessing the dental occlusions of patients with a unilateral complete cleft lip and palate (UCLP).

**MATERIALS AND METHOD:** Sixty sets of study models of 8-10-year-old UCLP patients. All subjects had undergone cleft

lip and palate repair, but no alveolar bone grafts or orthodontic treatment had been carried out. The judgments of two trained examiners were used to classify the modified Huddart/Bodenham scores for the models into five categories and with the Goslon ratings in order to test for agreement between the two methods. The strength of agreement of ratings was analyzed by weighted kappa statistics. A paired *t*-test was carried out to compare the time taken in assessment with each index.

RESULTS: There was good agreement between the two methods, with a kappa value of 0.73. The Goslon assessment took significantly less time than the modified Huddart/Bodenham.

CONCLUSION: The modified Huddart/Bodenham scoring system can be used as an alternative to the Goslon Yardstick for diagnostic purposes. Although the numerical scoring system takes more time, it provides more information about the sites of occlusal discrepancy than the Goslon Yardstick.

#### 594 CORRELATION OF MEASUREMENTS BETWEEN TRUE, DIGITAL AND PRINTED MODELS OF THE FACE AND SKULL

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AIM: To measure the correlation of particular distances between digital cone beam computed tomographs and face stereo scans (measured on a personal computer) and measurements of their three-dimensional (3D) printed models both compared to actual *in vivo* measurements.

MATERIALS AND METHOD: i-CAT CBCT head scan with a maximum field of view was processed in Medical Design Studio - Invivo5 from Anatomage and exported to STL. The facial 3D scan produced by a stereo scanner (3DMD) were saved as OBJ processed in Photoshop CS extended and imported into Medical Design Studio - Invivo5 from Anatomage. The face scan and skull were printed by 3d printer Spectrum Z510 in 450 × 450 × 280 dpi (0.089 mm layer thickness). The skull dimensions measured were: widths and lengths of the first molars and widths of first the incisors to be comparable with the *in vivo* situation. Some extra linear dimensions were compared between the digital and printed models of the skull. For comparison of linear measurements more than 10 different distances were compared between the soft tissue surface from CBCT, soft tissue surface from 3DMD scan and original image.

RESULTS: The accuracy of the printed 3D models and digital virtual models was, after calibration of the digital models, over 99 per cent for all parameters.

CONCLUSION: Current 3D technology is sufficiently accurate to be used clinically – it is the CBCT resolution that is limiting. The accuracy of facial scanning is sufficient and suitable for research.

#### 595 CORRELATION BETWEEN SKELETAL BONE AGE AND CHRONOLOGICAL AGE OF BOSNIAN ADOLESCENTS

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AIM: To investigate whether bone age [determined by cervical vertebral maturation (CVM) method] matched with the chronological age of Bosnian adolescents.

SUBJECTS AND METHOD: Forty subjects (20 males, 20 females) aged 9-16 years. All were of Bosnian origin, with known history of orthodontic treatment. The maturity stage (1-5) was determined on lateral cephalograms of cervical the vertebrae using the method of Baccetti *et al.* (2002). The obtained data were compared with known chronological age.

RESULTS: For 49 per cent of male subjects aged 10-16 years and 58 per cent of female subjects aged 9-15 years, the maturity stage of the cervical vertebrae coincided with chronological age.

CONCLUSION: Chronological age is not an accurate indicator of developmental status of Bosnian adolescents. Determination of CVM provides reliable data of the actual biological age of Bosnian adolescents.

#### 596 SHORT-TERM SAGITTAL AND VERTICAL DENTOFACIAL CHANGES WITH THE HERBST APPLIANCE

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AIM: The Herbst functional appliance is a fixed bite-jumping device for treatment of skeletal Class II malocclusions. A bilateral telescopic mechanism keeps the mandible in an anterior-forced position during mandibular functions. The aim of

this appliance is to increase lower jaw length by stimulating mandibular growth. In this study the aim was to evaluate the short-term treatment changes with the Herbst appliance.

**SUBJECTS AND METHOD:** Nine patients with a Class II division I malocclusion and an average pre-treatment age of 12.8 years. All were in the peak phase of the pubertal growth spurt. A Herbst type IV appliance was cemented to all maxillary and mandibular first premolars and molars by means of double bands. The average treatment duration was six months. Changes in the sagittal and vertical planes were assessed by occlusal analysis.

**RESULTS:** Overjet reduction was accomplished as 68 per cent skeletal and 32 per cent dental changes. The improved molar relationship was accomplished by 53 per cent skeletal and 47 per cent dental change. Vertical linear measurements were on average as a result of 0.22 mm intrusion of the upper first molars, 0.88 mm extrusion of upper incisors, 1.11 mm extrusion of lower first molars, 0.22 mm intrusion of the lower incisors. The mean vertical angular effects of Herbst treatment were 0 degrees rotation of the nasal line, 1.77 degrees clockwise rotation of the maxillary occlusal line, 3.11 degrees clockwise rotation of the mandibular occlusal line and 0.22 degrees clockwise rotation of the mandibular line.

**CONCLUSION:** Bite jumping using the Herbst appliance improved the basal skeletal relationship and normalised the occlusion efficiently in Class II growing patients

#### 597 THERMOPLASTIC APPLIANCES IN MULTIDISCIPLINARY PRE-PROSTHETIC TREATMENT

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**AIM:** To describe the efficacy of the Invisalign technique in multidisciplinary pre-prosthetic treatment of adult patients.

**SUBJECTS AND METHODS:** Nine adult patients (mean age 43 years) with one or two missing teeth in the mandibular arch. All patients had a Class I malocclusion with no or mild crowding, a diastema near the edentulous area, a normal skeletal pattern and periodontal disease (gingival inflammation), midlines deviation. After radiographic evaluation (dental pantomogram and lateral cephalogram) and clinical and functional analysis, a multidisciplinary approach was used that included aerodontics, orthodontics and prosthodontics (rehabilitation with implants).

**RESULTS:** All patients were successfully treated using the Envisaging technique in a mean time of 21 months. Sufficient Interco Ronal and interradiolar space for implant placement were achieved, preserving periodontal health. The treatment time and final results varied considerably according to the degree of patient compliance.

**CONCLUSIONS:** The key to the success of the Invisalign technique for pre-prosthetic treatment (opening space and rehabilitation with implants of missing teeth) is radiographic analysis of root inclination of the teeth adjacent to the edentulous area and the absence of extruded teeth in the opposite/antagonist quadrant. The Invisalign technique does not control root movements but an excellent result can be accomplished if the roots of the teeth adjacent to the edentulous area are divergent.

#### 598 COORDINATION OF MANDIBULAR MOVEMENT AND MUSCLE ACTIVITY IN PATIENTS WITH SKELETAL MANDIBULAR PROTRUSION

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**AIM:** Subjects with mandibular protrusion and deviation show not only craniofacial asymmetry but also functional asymmetry such as jaw movement and occlusal force. The present study simultaneously recorded incisal paths as well as masseter and anterior temporal muscle activity during masticatory movement in patients with skeletal mandibular protrusion with (MWD) and without (MWOD) mandibular deviation. A six-degrees-of-freedom measurement system was combined with electromyography to investigate the relationship between mandibular movement and muscle activity.

**RESULTS:** During habitual masticatory movement, the incisal path in MWD in the late opening and closing phases in the horizontal direction (axis), as well as in early to late opening phase and in the early to middle and late closing phases in the vertical direction (axis) were significantly more unstable than those of MWOD. In non-habitual masticatory movement, the incisal path of the MWD in the late closing phase in the horizontal direction (axis), and also in the early to late opening phase and in the early to middle closing phase in the vertical direction (axis) were significantly more unstable than those of MWOD. The onset of masseter and temporal muscle activity during both habitual and non-habitual masticatory movements was significantly earlier in MWOD than in MWD.

**CONCLUSION:** The incisal path during masticatory movement is more unstable in MWOD than in the MWO, and the onset of masseter and temporalis masticatory movement are earlier in MWOD than in the MWO. It is therefore speculated that the masseter and temporal muscles might compensate for the disharmony of masticatory movement due to frontal craniofacial asymmetry and occlusal deviation in mandibular protrusion with mandibular deviation.



## 599 EVALUATION OF PERIODONTAL STATUS DURING TREATMENT WITH SELF-LIGATING LINGUAL AND LABIAL APPLIANCES

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**AIMS:** Demand for orthodontic treatment with lingual brackets has increased as aesthetics and appearance affect the quality of life. The aim of this study was to evaluate and compare oral hygiene in patients treated with labial and lingual orthodontic appliance.

**SUBJECTS AND METHOD:** Fifteen female and five male patients (mean age:  $17.4 \pm 3$  years). Formal oral hygiene instruction was given to each patient before placement of the brackets. Probing pocket depths, the modified plaque index and bleeding index data of the sample group were recorded before placement of the appliances. The same measurements were repeated by the same operator in the third month of fixed lingual appliance therapy. Mann Whitney and Wilcoxon tests were used to evaluate the obtained data.

**RESULTS:** Modified plaque index and probing pocket depth measurements of labial brackets were significantly higher ( $P < 0.05$ ) while bleeding on probing values showed no difference between the bracket types ( $P = 0.146$ ).

**CONCLUSION:** Lingual appliances may be a good alternative for aesthetic treatment demands. Long-term studies should be undertaken to compare labial and lingual brackets regarding periodontal health status.

## 600 THE EFFECTS OF SCREW CONFIGURATION ON THE STABILITY OF MINISCREWS

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**AIMS:** To analyze the effects of configuration (length, diameter and thread forms) of titanium alloy miniscrews on the stability of screws using the removal torque test (RTT), scanning electron microscopy (SEM), and histomorphometric analyses.

**MATERIAL AND METHODS:** Ten male 6-month-old New Zealand white rabbits, weighing 3.0 to 3.5 kg. A total of 80 commercially available, produced by four different manufacturers, cylindrical, self-drilling,  $T_6Al_4V$  alloy orthodontic miniscrews with different diameters (1.5, 1.6, 1.7, 1.8 mm) and lengths (4.4, 4.7, 5.5, 5.6 mm) were used. The experiment group comprised the right fibulae of 10 rabbits into which four miniscrews were placed and a force of 115 g was applied with a nickel-titanium closed-coil spring. The control group comprised the left fibula of the same rabbits with four unloaded miniscrews. After two months of healing, osseointegration between the miniscrews and surrounding bone was evaluated by histomorphometric analyses, SEM, and the RTT.

**RESULTS:** The values for RTT for the unloaded mini-implants were lower than those of the loaded groups. While the length of miniscrews did not result in any significant difference between the groups ( $P > 0.05$ ), differences in diameters caused significant differences between the groups ( $P < 0.05$ ). Morphometric findings indicated that osseointegration on the loaded implants was slightly greater than those of the controls. SEM revealed that, there were no morphological differences between the groups.

**CONCLUSION:** Immediate loading of the miniscrews did not result in any negative effect on clinical stability or osseointegration, while immediately loaded screws showed greater stability unloaded screws. The diameter of miniscrews has a positive effect while the length of miniscrews does not have a significant effect on stability.

## 601 PERCEPTION OF IRANIAN ORTHODONTISTS REGARDING INFECTION CONTROL BETWEEN PATIENTS

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**AIM:** In view of the difficulty in identifying infected persons, current recommendations for infection control are to treat all patients as if they are infected with blood-borne pathogens such as human immunodeficiency (HIV) and hepatitis viruses. The aim of this study was to investigate the infection control measures each orthodontist feels obliged to consider in private practice.

**MATERIALS AND METHOD:** A questionnaire covering different aspects of infection control was sent to 200 Iranian orthodontists actively practicing orthodontics. Sixty-five answered and returned the questionnaire. The distribution of demographic factors (age and gender) in the responding group and those who did not respond was the same.

**RESULTS:** Disinfection of pliers between patients was considered by 88.4 per cent of orthodontists to be sufficient while only 3 per cent considered sterilization as the method of choice to decontaminate the pliers. The disinfection material mostly utilized by orthodontists was solar-sept (Deconex), as 75 per cent reported using it, while micro10 was used by 38 per cent. Two per cent believed that alcohol and water can sufficiently disinfect pliers to allow their use in the next patient.

**CONCLUSION:** Most Iranian orthodontists believe in disinfection rather than sterilization for decontamination of pliers between patients in daily practice among which solar-sept is the most widely used material.

#### 602 ASSESSMENT OF GONIAL ANGLE ON PANORAMIC RADIOGRAPHS AND LATERAL CEPHALOGRAMS OF CLASS I MALOCCLUSION SUBJECTS

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**AIM:** To assess and compare the measurements of gonial angle on panoramic radiographs and lateral cephalograms in patients with a Class I malocclusion.

**MATERIALS AND METHOD:** Lateral cephalograms and dental pantomograms (DPTs) of 70 patients with Angle Class I, aged 15-30 years. To confirm that all patients had a Class I malocclusion, the following cephalometric parameters were measured: SNA, SNB, ANB, FMA, facial angle and Wits analysis. On the lateral cephalograms mandibular and ramal planes were drawn and based on these planes, gonial angle was determined.

On the DPTs gonial angle was determined from two tangents that were drawn from the inferior border of the mandible and posterior border and ramus on both sides. The data were statistically evaluated by *t*-test and regression analysis.

**RESULTS:** The mean value of gonial angle on the lateral cephalograms was 124.00, and on the DPTs 123.16. The mean values of the right and left gonial angles on the DPTs were 122.93 and 123.39, respectively. There were no significant differences between the values of the gonial angles determined by lateral cephalogram and panoramic radiography ( $P = 0.406$ ). Also in panoramic radiography there were no significant differences between the right and left gonial angles ( $P = 0.670$ ). Linear regression analysis showed a significant correlation between the means of gonial angle in panoramic radiographs and lateral cephalometry ( $r = 0.562$ ,  $P < 0.05$ ).

**CONCLUSION:** Panoramic radiography can be used to determine the gonial angle as accurately as a lateral cephalogram. In panoramic radiography the right and left gonial angles can be measured easily without superimposition of anatomic landmarks, which occurs frequently in a lateral cephalogram.

#### 603 TOOTH SIZE AND ARCH DIMENSION IN UNCROWDED VERSUS CROWDED CLASS I MALOCCLUSIONS

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**AIM:** To examine the extent to which tooth size or arch dimension contributes to dental crowding.

**MATERIALS AND METHOD:** Two groups of dental casts: each containing of 30 pairs of dental casts of an equal number of males and females. The first group had Class I malocclusions without crowding or spacing and the second group Class I malocclusions with severe dental crowding ( $>5$  mm space deficiency). The following parameters were measured and used to compare the two groups: individual and collective mesiodistal tooth diameters, arch dimensions (buccal and lingual arch widths in the canine and molar regions), dental arch length, arch perimeter and anterior and overall Bolton's ratios. To compare the groups a Student's *t*-test with a 95 per cent confidence interval was used.

**RESULTS:** There were statistically significant differences in both tooth sizes and transverse arch dimensions between the groups. Tooth diameters were significantly greater in the crowded group than in the normal group. Arch dimensions (maxilla) were greater in the uncrowded group compared with the crowded group. There were no significant differences in either arch length or arch perimeter in the two groups in either the maxilla or the mandible. Bolton's ratio showed no significant difference in the crowded and uncrowded groups.

**CONCLUSIONS:** Tooth size has a greater contribution to the development of dental crowding, under equal conditions (a Class I skeletal relationship of the jaws).

604 REAL-TIME CELL ANALYSIS OF THE CYTOTOXICITY OF ORTHODONTIC BRACKETS ON GINGIVAL FIBROBLASTS\*\*\*

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AIM: To evaluate the cytotoxicity of six different orthodontic bracket materials on human gingival fibroblasts.

MATERIALS AND METHOD: Gold alloy (Apollo, G&H), Titanium (Rematitan, Dentaureum), Locit (Ice, Ormco), Ceramic (Clarity, 3M Unitek), chrome cobalt (Equilibrium, Dentaureum) and composites (Orthoflex, Ortho Tech) were used. Gingival fibroblasts were isolated from human gingival connective tissue of systemically healthy individuals. The materials were incubated in Dulbecco modified Eagle medium (DMEM) culture medium for 72 hours according to ISO 10993-5 standards (surface area-to volume ratio of the specimen to cell-culture medium; 3 cm<sup>2</sup>/ml). Gingival fibroblasts were maintained with DMEM containing 10 per cent foetal bovine serum. A real-time cell analyzer (xcelligence) was used to evaluate cell survival. After seeding 200 µL of the cell suspensions into the wells (20 000 cells/well) of the E-plate 96, gingival fibroblasts were treated with bioactive components released by the bracket materials (1/1 and 1/2 dilutions) and were monitored every 15 minutes. The data was analyzed by one-way analysis of variance and Tukey-Kramer multiple comparison tests.

RESULTS: Gingival fibroblastic viability was significantly reduced in the gold alloy group ( $P < 0.001$ ) at 29 and 65 hours. There were no significant differences between the other groups and the control group ( $P > 0.05$ )

CONCLUSION: The tested bracket materials are suitable for clinical application, but further studies using different test methods are needed for gold alloy.

605 PREVALENCE OF HABITUAL SNORING AND SYMPTOMS OF SLEEP-DISORDERED BREATHING IN TURKISH CHILDREN

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AIM: Paediatric obstructive sleep apnoea (POSA) is a disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal sleep patterns. POSA affects 0.69-3 per cent of children and snoring is the most important symptom. The aim of this study was to determine the prevalence of snoring in primary school children in Ankara, and to evaluate the symptoms and conditions that may be associated with sleep problems in these children.

SUBJECTS AND METHOD: Eight primary schools from four educational regions were randomly selected and a parental questionnaire was given to all 1st, 3rd, and 5th class students. A 43-item, multiple-choice questionnaire was formulated according to the guidelines of Brouillette *et al.* Questions concerning mouthbreathing and its negative effects on the development of jaws were included in the questionnaire.

RESULTS: Out of the 2245 given questionnaire 1522 (67.8%) were completed and returned. Seven hundred and fifty four (49.5%) of the students were boys, and 768 (50.5%) were girls. The prevalence of habitual snoring was 14.37 per cent. The percentage of parents who did not have any idea about the negative effects of mouthbreathing on the development of jaws in children was 55.6.

CONCLUSION: Habitual snoring is a significant problem in children and may be associated with diurnal symptoms. The findings also revealed a low awareness of the impact of sleep disorders on jaw development amongst parents.

606 EFFECT OF NEWLY DESIGNED MINI-IMPLANT RING APPARATUS ON THE RESISTANCE TO MIGRATION OF MINISCREWS UNDER ORTHODONTIC FORCE

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AIM: To assess, *in vitro*, the effect of a mini-implant ring (MIR) on force anchorage resistance to migration of miniscrews.

MATERIALS AND METHOD: Forty-eight TM miniscrews (Trimed, Ankara Turkey) were used. The MIR was applied in the study group and the other group was assigned as the control. Miniscrews were inserted into bone from the ilium of bovine. A force of 200 g was applied to the miniscrews with an Instron machine and migration of the miniscrew heads was recorded. Bone samples were sectioned and bone thickness was measured.

**RESULTS:** The MIR group had statistically high force anchorage resistance than the control group. The miniscrew heads in the MIR group migrated significantly less than in the control group. The mean cortical bone thickness of the samples was 1.25 mm.

**CONCLUSION:** The MIR, which increases the stability and force anchorage resistance of miniscrews, is a good option especially in subjects where the cortical bone is thin.

#### 607 THE MINI-IMPLANT RING: AN APPLIANCE TO INCREASE THE STABILITY OF SMALL DIAMETER MINISCREW IMPLANTS

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**AIM:** To compare, *in vitro*, the force resistance of larger diameter miniscrew implants (MI) to a newly designed mini-implant ring (MIR) applied small diameter miniscrew implants.

**MATERIALS AND METHOD:** Thirty-six TM mini-implants (MIs) (Trimed, Ankara Turkey) were used. MIs with a diameter of 1.4 mm (control group) were compared with a 2.0 mm diameter and MIR applied 1.4 mm diameter MIs (MIR group). MIs were inserted in to bone from bovine ilium. A force of 200 g was applied to the MIs with an Instron test machine and migration of the miniscrew heads was recorded. Bone samples were sectioned and bone thickness was measured.

**RESULTS:** Both the MIR and 2.00 mm group had statistically high force anchorage resistance than the control group. The implants in the MIR group migrated less than in the 2.0 mm group but the difference was not significant. The mean cortical thickness of the bone samples was 1.15 mm. MIR enhanced miniscrew stability and anchorage force resistance without increasing the miniscrew diameter. Results exhibited that MIR increased the stability and the anchorage force resistance of miniscrews and miniscrew heads with MIR migrated significantly less than the same diameter miniscrews.

#### 608 EFFECTS OF A NEWLY DESIGNED MINI-IMPLANT RING FOR ORTHODONTIC SKELETAL ANCHORAGE

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**AIM:** To compare, *in vitro*, the force resistance of conventional miniscrews to newly designed mini implant ring (MIR) applied miniscrews.

**MATERIALS AND METHOD:** TM miniscrews (Trimed, Ankara Turkey) and MIR were used. Maximum insertion torque was measured. All specimens were subjected to tangential force loading perpendicular to the miniscrew through a lateral displacement of 0.6 mm with the use of an Instron machine and force anchorage resistance values were recorded. Maximum removal torque was measured. Bone samples were sectioned from the screw holes and bone thickness at the screw sites were measured.

**RESULTS:** The MIR group had statistically higher force anchorage resistance than the control group. The maximum insertion torques of the MIR group were significantly higher than in the control group. The results were more significant where the cortical bone was thin. No statistically significant difference for maximum removal torque or the number of mobile screws was observed between the groups. The results were more significant in samples in which the cortical bone was thin. A non-significant increase was observed for the removal torques.

**CONCLUSION:** MIR is a good option, increasing the primary stability and the force anchorage resistance especially in patients where the cortical bone is thin.

#### 609 PREVALENCE OF DIFFERENT TYPES OF CLEFT LIP AND PALATE PATIENTS REFERRED TO AN ORTHODONTIC CLINIC

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**AIM:** To estimate the incidence of different types of cleft lip and palate patients referred to an orthodontic clinic.

**SUBJECTS AND METHOD:** One hundred and eighty five babies, 14 adolescent, and 36 adult patients were examined. The subjects were classified according to gender and type of the cleft. Cleft type was determined by Veau classification.

**RESULTS:** Of the 235 patients, 79 (33.6%) had an isolated cleft palate. Thirty-nine (49%) were female and 40 (51%). Sixteen (6.8%) had a unilateral incomplete cleft lip and palate with an equal percentage of males and females. Two (0.85%) of the total number patients had a facial cleft, both of whom were male. Ninety-five (40%) had a unilateral complete cleft lip



and palate; this group included 57(60%) males and 38 (40.4%) females. Forty-one (17.4%) had a complete bilateral cleft (17 females, 24 males). One had a bilateral incomplete cleft lip and palate and another a bilateral lip and alveolar cleft; both males.

CONCLUSION: These findings suggest that the highest incidence belongs to unilateral complete lip and palate patients followed by isolated cleft palate, with most of these patients being male (56.5%).

#### 610 TOOTH ABNORMALITIES OF THE PERMANENT DENTITION IN PATIENTS WITH A CLEFT LIP AND/OR PALATE

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AIM: To review the literature concerning differences in size, number and crown morphology of permanent teeth between individuals with a cleft lip and/or palate and control groups representing the general population.

MATERIALS AND METHOD: PubMed and Cochrane Collaboration databases were searched using the following key words: cleft lip, cleft palate, dental/tooth abnormalities, tooth size, crown morphologic abnormalities. Articles that fulfilled the criteria were chosen based on the objectives of the study. Data from each individual article were extracted and pooled.

RESULTS: Twenty-one articles were selected for inclusion in the study, the dates of publication ranging from 1982 to 2010. Tooth agenesis in cleft patients ranged from 12 to 91 per cent. The percentage of anomalies in crown morphology in cleft patients ranged from about 6 to 29 and the percentage of microdontia from 29.5 to 60, with tooth dimensions being smaller in general in cleft than non-cleft subjects. The most affected teeth were the lateral incisors and the most affected jaw was the maxilla.

CONCLUSIONS: Tooth dimensions in patients with a cleft lip and/or palate were, in general, smaller than those of a general population. Cleft groups also presented higher percentages of tooth agenesis and hypodontia than the control groups. Regarding crown morphology, cleft subjects demonstrated abnormalities more frequently than control subjects, namely various shape anomalies and hypoplasia.

#### 611 FAILURE OF ERUPTION OF THE MAXILLARY SECOND MOLAR: AETIOLOGY AND TREATMENT PLANNING

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AIMS: To conduct a review of the literature, based on the aetiology and treatment planning of eruption failures of maxillary posterior teeth, and to present a case with an ankylosed permanent second molar of the upper arch.

MATERIALS AND METHODS: PubMed and Cochrane Libraries were searched using a combination of the words: 'eruption', 'failure', 'submerge', 'ankylosis', 'maxillary', 'molars'. The presented case is of a 32-year-old female with the chief complaint of infraocclusion of her maxillary right second molar and symptoms of acute periodontal inflammation (pain, swelling). There was no history of trauma in the region. Clinical and radiographic evaluation revealed a severely submerged maxillary second molar with evident clinical signs of ankylosis.

RESULTS: The origin of interruption of the eruptive process is obscure, especially in cases without extrinsic factors identified. The genetic factor should be evaluated. There is limited and conflicting evidence in the literature on how to treat permanent teeth that have failed to erupt. Consecutive surgical loosening of the alveolus of the second maxillary molar (luxation) was performed, together with the application of direct orthodontic force, with the aid of skeletal anchorage.

CONCLUSIONS: Differential diagnosis includes primary failure of eruption or secondary retention. Such cases should be managed with caution. Regular monitoring of stability and periodontal health is strongly recommended.

#### 612 CONDYLAR ASYMMETRY IN A SAMPLE OF HEALTHY INDIVIDUALS

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AIM: To assess condylar asymmetry in healthy individuals.

MATERIALS AND METHOD: The panoramic radiographs of 500 individuals (257 males, 243 females) obtained retrospectively were divided into three groups. Group I consisted of 41 subjects aged from 8 to 18 years, group II 134 individuals aged from 19 to 30 years and group III of 325 individuals aged from 31 to 60 years. On digitized dental

pantomograms, condylar height and width on both sides of the mandibular arch were measured using a digital analysis program (Enil Packs, Eskişehir, Turkey). Paired *t*-tests were used to determine the significance of the differences between the sides. ANOVA were used to test the significance of the change in asymmetry between the age groups and an independent samples *t*-test for between gender differences.

RESULTS: There was a statistically significant difference between the right and left sides in condylar width in the 18-30 and 30-60 year age groups. There were no significant differences in condylar height in any age group. No relationship was found between gender and differences in left and right condylar dimensions.

CONCLUSIONS: Healthy adult subjects generally have a statistically significant condylar width asymmetry, which, however, is not clinically significant.

#### 613 TREATMENT EFFECTS OF MAXILLARY PROTRACTION ASSESSED WITH COUNTERPART ANALYSIS

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AIM: To evaluate the effects of maxillary protraction on the middle cranial base and maxillomandibular complexes, and to compare the responses with untreated Class III subjects by counterpart analysis.

SUBJECTS AND METHOD: Twenty skeletal Class III children exhibiting maxillary retrognathism (14 girls, 6 boys; mean chronological age 11 years 3 months) treated with reverse headgear assisted by rapid maxillary expansion. The mean treatment period was 9.6 months. The control group included 22 Class III subjects (9 girls, 13 boys; mean chronological 10 years) with a mean observation period of 9.5 months. The cephalometric measurements were performed by counterpart analysis. Paired *t*-tests for intragroup comparisons, and independent *t*-tests for intergroup comparisons were used.

RESULTS: The treatment group revealed significant increases for SNA, ANB, SN-GoGn, Co-A and Co-Gn, while a significant decrease was found for SNB. In relation to growth, significant increases in SNA, Co-A and Co-Gn were found. Although there were no significant changes in middle cranial base and maxillomandibular dimensions in the control group, the treatment group showed increases in the effective dimension of the middle cranial base, maxilla, and nasomaxillary complex, and a decrease in the effective dimension of corpus. Intergroup comparisons showed that maxillary advancement was more pronounced and the mandible was more posteriorly rotated in the treatment group. While the effective dimensions of the middle cranial base did not change in the control group, the treatment group showed a significant increase. The effective dimension of the mandibular corpus decreased with treatment, although there was no change in the control group.

CONCLUSION: Increases in the effective dimension of the middle cranial base and decreases in the effective dimension of the corpus results in a favourable treatment response in Class III subjects.

#### 614 THREE-DIMENSIONAL MEASUREMENTS OF CANINE DRIFT INTO EXTRACTION SPACE\*\*\*

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AIM: To present a method for three-dimensional (3D) measurements of tooth movement and to measure canine drift into the extraction space.

MATERIALS AND METHOD: One hundred and ten models of 55 orthodontic patients in whom upper and/or lower first premolar teeth were extracted as part of their orthodontic treatment. Canine drift into the extraction space was evaluated for 3 months via models taken before and after this period. These models were obtained from a prospective clinical trial evaluating root resorption repair. Three points were selected on the medial or lateral end points of prominent rugae on both sides. These points were marked with burs (height 1 mm, diameter 1 mm). After marking of these points, the models were transformed into digital format by a 3D scanner (3Shape R700 3D Scanner, 3Shape A/S, Copenhagen, Denmark). The models, taken before and after the observation period, were superimposed on these three points. After superimposition, canine movement was measured in three planes of space, i.e. sagittal, transverse, and vertical. The patients were divided into two subgroups according to canine position, i.e. displaced canine and canine within the arch. Four weeks after the first superimposition, models of 10 cases were re-scanned and re-superimposed for accuracy and reliability. Intraclass correlation coefficients were 0.85 for transverse, 0.98 for distal and 0.99 for vertical measurements.

RESULTS: Distal, vertical and transverse canine drifts were 1.79 mm, 1.06 mm and 0.31 mm, respectively. When canine drift was evaluated according to the canine position, distal (2.44 mm) and vertical (1.79 mm) movements of the displaced canines were greater than distal (1.36 mm) and vertical (0.57 mm) movements of canines within the arch ( $P < 0.001$ ). No

significant difference was observed between transverse drift was 1.79, 1.06 and 0.31 mm, respectively. When canine drift was evaluated according to canine position, distal (2.44 mm) and vertical (1.79 mm) movements of the displaced canines were greater than distal (1.36 mm) and vertical (0.57 mm) movements of the canines within the arch ( $P < 0.001$ ). No significant difference was observed between transversal drifts.

#### 615 MINISCREW ANCHORAGE FOR UPPER MOLAR DISTALIZATION

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AIM: To evaluate the dentoalveolar effects of miniscrew anchorage on upper molar distalization.

SUBJECTS AND METHOD: Twenty-six patients were included. The Fast-Back appliance (Leone S.p.A., Firenze, Italy) was used in all cases. In 13 subjects (mean age:  $11.7 \pm 1.5$  years) the first premolars and a palatal acrylic button were used for anchorage as recommended by the manufacturer (group FB). In the remaining 13 patients (mean age:  $13.4 \pm 1.9$  years) a miniscrew instead of a palatal acrylic button, inserted into the hard palate, was used for anchorage (group MS-FB). In both groups Memoria coil springs (Leone S.p.A.) generating a force of 200 g were used. Dentoalveolar changes were measured on pre- and post-distalization lateral cephalograms. Comparison of pre- and post-distalization values were made with the Wilcoxon test and comparisons of the changes between the groups with the Mann-Whitney *U* test.

RESULTS: In the FB group, anterior movement and anterior tipping of the upper incisors (1.85 mm,  $3.06^\circ$ ), anterior movement of first premolars (2.65 mm) and distal movement first molars (3.23 mm) were significant ( $P < 0.01$ ) during the observation period ( $0.74 \pm 0.37$  years). Furthermore, extrusion of the first premolars (1.38 mm) was significant ( $P < 0.05$ ). In the MS-FB group, anterior movement of the upper incisors (0.88 mm), anterior movement of first premolars (1.42 mm) and distal movement of first molars (5.29 mm) were significant ( $P < 0.01$ ) during the observation period ( $0.68 \pm 0.14$  years). Distal movement of the first molars ( $P < 0.01$ ) and anterior movement of the first premolars and incisors ( $P < 0.05$ ) showed statistically significant differences between the groups.

CONCLUSION: In the MS-FB group there was more pronounced molar distalization with less pronounced anchorage loss.

#### 616 THE EFFECT OF DRILL-FREE AND DRILLING METHODS ON THE STABILITY OF MINI-IMPLANTS UNDER EARLY ORTHODONTIC LOADING

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AIMS: To compare the stability of mini-implants using drill-free and drilling methods both before and after early force loading.

SUBJECTS AND METHOD: Sixty-two adolescent patients (24 males, 38 females, mean age  $15.7 \pm 4.2$  years) were randomly assigned to three groups and 112 titanium mini-implants were placed between the upper first molars and second premolars to achieve molar distalization. Groups I ( $n = 22$ ) and II ( $n = 20$ ) received pilot drilling with diameters of 1.1 and 0.9 mm, respectively, while the drill-free method was used in group III ( $n = 20$ ). Distalization forces were applied up to 200 g. With open Ni-Ti coil springs. The *Z*-test was used for statistical analyses to compare the success rates of the groups with each other.

RESULTS: The overall success rate was 77.7. There was no significant difference between groups I and II either before or after force loading. Significant differences were found between groups I and III ( $P = 0.0002$ ), and between groups II and III ( $P = 0.045$ ) both before and after force loading. Mini-implants using the drill free method provided the highest success rate before orthodontic force application and also maintained their stability after early loading for one month during orthodontic treatment.

CONCLUSION: Smaller drill diameters can contribute to the clinical stability of mini-implants in the short term, however long-term evaluations are needed to clarify the stability of temporary skeletal anchorage devices throughout orthodontic loading.

#### 617 BOND STRENGTH TO LINGUAL SURFACE ENAMEL IN MANDIBULAR INCISORS WITH DIFFERENT BONDING SYSTEMS

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AIM: To determine whether different types of adhesive systems and enamel-protective agents will affect the tensile bond strength of lingual brackets.

MATERIALS AND METHOD: A total of 75 extracted mandibular incisors were randomly divided into five groups and lingual brackets were bonded. Group 1 specimens received Transbond XT, group 2 required the application of a fluoride-releasing resin (Ortho-coat) with Transbond XT and group 3 specimens received a chlorhexidine varnish (Cervitec Plus) with Transbond XT. In Group 4, a light-cured orthodontic adhesive (Aegis Ortho) was applied and in group 5, an antimicrobial self-etching primer (Clearfil Protect Bond) was used.

RESULTS: There were no significant differences in bond strength whether fluoride-releasing resin or chlorhexidine varnish were used or not. Group 5 had significantly higher bond strength and adhesive remnant index (ARI) values than other groups ( $P < 0.001$ ).

CONCLUSION: The application of enamel-protective products did not have an adverse affect on the bond strength of lingual brackets. These products might provide benefits both for the patient and clinician, by supporting oral hygiene during lingual orthodontic treatment. The higher ARI score may be beneficial for Clearfil Protect Bond but its excessive bond strength should be considered in clinical practice, especially where the enamel is thin.

#### 618 EFFECTS OF DIFFERENT ENAMEL CONDITIONING TECHNIQUES FOR ORTHODONTIC BONDING

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AIMS: To compare the effects of different enamel conditioning techniques for bracket bonding, as there are no studies evaluating all known enamel conditioning systems together.

MATERIALS AND METHOD: Ninety-one human premolars randomly divided into six groups of 15 specimens each. The enamel surfaces of the teeth were etched with 35 per cent orthophosphoric acid in group 1, with a self-etching primer in group 2, sandblasted in group 3, sandblasted and etched with 35 per cent orthophosphoric acid in group 4, conditioned by Er:YAG laser in group 5 and conditioned by Er:YAG laser and etched with 35 per cent phosphoric acid gel respectively in group 6. After enamel conditioning, the brackets were bonded and shear bond testing was performed. After debonding, ARI scores were calculated for all groups. One tooth from each group and an unconditioned tooth that served as the control group were inspected by scanning electron microscopy (SEM) to evaluate the enamel surface characteristics.

RESULTS: Group 5 showed the highest mean shear bond strength (SBS) value ( $13.61 \pm 1.14$  MPa) while group 3 the lowest value ( $3.12 \pm 0.61$  MPa). ARI scores were higher in groups 1, 5 and 6. A rough and irregular ablated enamel surface with microcracks and deep craters could be seen in SEM photographs of groups 5 and 6, however no craters and cracks were visible in the other groups.

CONCLUSION: Although the SBS values were higher, the teeth in the laser conditioned groups were highly damaged. Therefore, acid etching and self-etching techniques were found to be safer for orthodontic bracket bonding. The sandblasting method was found to generate inadequate bonding strength, so this technique must be accompanied by acid etching in order to achieve better results.

#### 619 COMPARISON OF OROFACIAL AIRWAY DIMENSIONS IN SUBJECTS WITH DIFFERENT BREATHING PATTERNS

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AIM: To test the null hypothesis that there is no significant difference in craniofacial morphology and orofacial airway dimensions between mouth breathing (MB) and nasal breathing (NB) subjects.

MATERIALS AND METHOD: Lateral cephalometric radiographs of 34 MB (mean age:  $12.8 \pm 1.5$  years; range: 12.0–15.2 years) and 33 NB (mean  $13.9 \pm 1.3$  years; age range: 12.2–15.8 years) subjects with a Class I occlusion. Thirty-four measurements (27 craniofacial and 7 orofacial airway) were evaluated. Group differences were statistically evaluated using a Student's *t*-test at the  $P < 0.05$  level.

RESULTS: Statistical comparisons showed that SNA ( $P < 0.01$ ), ANB ( $P < 0.01$ ), A to N perp ( $P < 0.05$ ), convexity ( $P < 0.05$ ), IMPA ( $P < 0.05$ ) and overbite ( $P < 0.05$ ) measurements were lower in the MB group when compared with the NB group. However, SN-MP ( $P < 0.01$ ) and PP-GoGn ( $P < 0.01$ ) angular measurements; and S-N ( $P < 0.05$ ) and anterior face height ( $P < 0.05$ ) from linear measurements were significantly higher in the MB subjects. Among the orofacial airway measurements, only upper posterior airway space was higher in the MB than in the NB subjects and this was statistically significant ( $P < 0.001$ ).

CONCLUSION: The null hypothesis was rejected. Mouth breathing affects craniofacial morphology and orofacial airway dimensions.



## 620 TONGUE VOLUME, LOWER INCISOR CROWDING AND LOWER INCISOR POSITION. IS THERE A RELATIONSHIP?

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**AIM:** To evaluate the relationship between tongue volume and lower incisor crowding/position, and to identify possible gender differences.

**SUBJECTS AND METHOD:** Twenty-two males and 23 females divided into three groups. Group I (mild: crowding up to 4 mm) comprised nine males and six females (mean age:  $15.1 \pm 1.1$  years), group 2 (moderate: crowding between 4 and 8 mm) six males and nine females (mean age:  $14.8 \pm 1.3$  years) and group 3 (severe: crowding of more than 8 mm) seven males and eight females (mean age:  $14.6 \pm 0.9$  years). To evaluate gender differences in tongue measurements, an independent samples *t*-test was used. Statistical comparisons of tongue dimensions in subjects with different levels of crowding (mild, moderate, severe) were undertaken using one-way analysis of variance (ANOVA). To evaluate the correlation between tongue volume and lower incisor crowding/position; Pearson correlation coefficients (*r*) were estimated.

**RESULTS:** In the male group, significant correlations were determined between incisor crowding and L1-NB (mm) ( $r = -0.590$ ;  $P = 0.004$ ), L1-NB ( $^{\circ}$ ) ( $r = -0.638$ ;  $P = 0.001$ ) and L1-mandibular plane ( $^{\circ}$ ) ( $r = -0.505$ ;  $P = 0.017$ ). In the female group, significant correlations were found between tongue volume and L1-NB (mm) ( $r = 0.457$ ;  $P = 0.029$ ) and L1-NB ( $^{\circ}$ ) ( $r = -0.447$ ;  $P = 0.032$ ). Tongue volume measurements were greater in males than in females. All other measurements showed no statistically significant gender differences. According to ANOVA, there was no statistically significant difference for the measurements among subjects with different levels of crowding.

**CONCLUSION:** A statistically significant inverse correlation was found between the irregularity index and mandibular incisor position in males and a statistically significant correlation between tongue volume and mandibular incisors position for both males and females. No statistically significant difference was found for tongue measurements among subjects with different levels of crowding.

## 621 THE EFFECT OF ISOFLAVONES ON EARLY BONE FORMATION OF ORTHOPAEDICALLY EXPANDED SUTURE IN RATS

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**AIM:** To histomorphometrically evaluate the effects of isoflavones (IF) on early bone formation in response to expansion of the interpremaxillary suture in male rats.

**MATERIALS AND METHOD:** Twenty 50–60 day old male Wistar rats divided into two equal groups (control and experimental). Both groups were subjected to expansion for 5 days, and 50 cN of force was applied to the maxillary incisors with a helical spring. After the expansion period, the springs were removed and replaced with short lengths of rectangular retaining wire for a retention period of 10 days. IF, dietary supplement, concentrated of genistatin and daidzain (Solgar, USA) were used. In the experimental group, 10  $\mu$ g/g IF were administered orally during the expansion and retention periods. Bone formation in the sutural area was histomorphometrically evaluated including the amount of new bone formation ( $\mu$ m<sup>2</sup>), number of osteoblasts, number of osteoclasts, and number of vessels. A Mann–Whitney *U*-test was used for statistical evaluation at the  $P < 0.05$  level.

**RESULTS:** New bone formation area ( $P = 0.003$ ; 2.26-fold) and number of osteoclasts ( $P = 0.001$ ; 1.87-fold) showed statistically significantly lower values in the experimental than in the control group. No significant differences were found in number of osteoblast and vessel values between the groups.

**CONCLUSION:** IF negatively affected bone formation in the orthopaedically expanded interpremaxillary suture. The main effect of IF was on osteoclasts in bone metabolism.

## 622 OROFACIAL AIRWAY DIMENSIONS IN SUBJECTS WITH A CLASS I MALOCCLUSION AND DIFFERENT GROWTH PATTERNS\*\*\*

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AIM: To test the null hypotheses that there are no significant differences in the craniofacial structures and orofacial airway dimensions in subjects with a Class I malocclusion and different growth patterns.

MATERIALS AND METHOD: Lateral cephalometric radiographs of 31 low angle (mean age:  $14.0 \pm 2.0$  years; range: 10.3  $\pm$  16.5 years), 40 high angle (mean age:  $12.7 \pm 1.6$  years; range: 10.1–16.2 years) and 33 normal growth (mean age:  $13.9 \pm 1.3$  years; range: 11.2–16.8 years) subjects with a Class I malocclusion. Thirty-four measurements (27 craniofacial, 7 orofacial airway) were evaluated. Group differences were analyzed with analysis of variance (ANOVA) and Tukey test, at the  $P < 0.05$  level.

RESULTS: According to ANOVA, only five of the 27 craniofacial measurements showed no statistically significant difference among the different growth patterns. For orofacial airway measurements, statistically significant differences were found for nasopharyngeal airway space ( $P < 0.01$ ), palatal tongue space ( $P < 0.05$ ), upper posterior airway space (PAS) ( $P < 0.05$ ) and tongue gap ( $P < 0.001$ ). No statistically significant orofacial airway differences were determined between the low angle and normal growth patients. High angle patients had a larger tongue gap than the normal and low angle cases ( $P < 0.01$ ). Additionally, nasopharyngeal airway space ( $P < 0.01$ ) and upper PAS ( $P < 0.05$ ) measurements were larger, and palatal tongue space ( $P < 0.05$ ) was narrower in the low angle than the high angle subjects.

CONCLUSIONS: The null hypotheses were rejected. Significant differences were found in craniofacial morphology and orofacial airway dimensions of Class I subjects with different growth patterns.

#### 623 MEDIUM-TERM INDIRECT EFFECTS OF RAPID MAXILLARY EXPANSION THERAPY ON THE MANDIBULAR ARCH: A CONTROLLED CLINICAL STUDY

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AIM: To retrospectively investigate medium-term indirect effects of rapid maxillary expansion (RME) therapy on mandibular arch dimensions and characteristics.

SUBJECTS AND METHOD: Thirty-three patients in the mixed dentition (mean age 8.8 years) showing maxillary deficiency and a unilateral crossbite were treated with a RME appliance (Haas type) on first permanent molars. The treatment protocol consisted of two turns per day until slight overcorrection of the molar transverse relationship occurred. Study models were taken before (T1) and after expansion (T2) with 15 months interval on average. A control group of 15 untreated subjects with a unilateral crossbite (mean age 8.3 years) were also registered at 12 months interval. Stone cast were digitized with a three-dimensional scanner (3Shape, Denmark). A customized set of landmarks was digitized on each digital model. All the considered variables were normally distributed. Descriptive statistics were calculated and a *t*-test was applied to check differences between the two groups.

RESULTS At T1, no differences between the treated and untreated subjects were found. At T2, in the treated subjects, mandibular intermolar distance significantly increased 1.9 mm on the vestibular side and 0.7 mm on the lingual side. Mandibular molar torque increased 9 degrees. There was a significant but minimal effect on intercanine distance (+1.0 mm) but not on canine torque. The controls showed a tendency towards contraction of the transverse dimension and a decrease in molar and canine torque values.

CONCLUSIONS RME has medium-term widening indirect effects on the mandibular first molars.

#### 624 THREE DIMENSIONS OF THE MAXILLA IN PALATAL VERSUS LABIAL CANINE IMPACTIONS

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AIM: Impacted canines pose a challenge for orthodontists to treat due to the prolonged treatment time and involvement in interdisciplinary dental care. Although palatally impacted canines (PIC) in the maxilla have been widely studied, labially impacted canines (LIC) have to date has not attracted a similar level of interest. The objective of this study was to compare the sagittal and vertical positional variation, and arch width of the maxilla in a PIC versus LIC groups of patients.

SUBJECTS AND METHOD: The subjects were selected on the basis of the following criteria: minimum age 12.5 years, unerupted maxillary canines, no previous orthodontic treatment, and no systemic condition. The mean ages for the PIC (37) and LIC (38) groups were 16.4 years (12.5–26.8) and 14.0 years (12.5–19.2), respectively. A Class I, non-impacted, comparison group (COMP,  $n = 83$ ) with a mean age of 14.9 years (12.5–21.2) was also established. Digital lateral cephalometric evaluation included measurements in the sagittal and vertical dimensions; interarch width was measured on initial digital models. Statistical analysis consisted of a two-sample *t*-test.

**RESULTS:** When assessed in the transverse dimension, both the LIC and PIC groups showed statistically significant differences in interpremolar width compared with the COMP group. The sagittal position of the maxilla was similar among the PIC, LIC, and COMP groups. Statistically significant differences were found in vertical dimension parameters (SN-GoGn and PP-GoGn), suggesting hypodivergent vertical pattern for the PIC group and a hyperdivergent vertical pattern for LIC group.

**CONCLUSIONS:** Expansion type intervention seems to remain a modality to gain space and improve the maxillary arch shape of patients with both palatal and labial canine impactions. For these patients, extraoral appliances should be carefully applied and limited to maxillary prognathism and/or Class II dental malocclusions. In addition, the prevailing association of hypodivergent vertical pattern with PIC and hyperdivergent vertical pattern with LIC should carefully be factored into the treatment planning.

## 625 INTERCANINE WIDTH CHANGES WITH THERMOPLASTIC APPLIANCE TREATMENT

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**AIM:** Invisalign®, a series of clear, removable aligners, is currently used widely by both orthodontists and general practitioners to straighten teeth without brackets and metal wires. Because maintaining the mandibular intercanine width has long been suggested as a pillar of stability in orthodontic treatment, this study investigated changes in mandibular intercanine distance following Invisalign® treatment.

**SUBJECTS AND METHOD:** Thirty-one subjects, treated for an average of 21.9 months, with an average age of 37.0 years (14.0-65.0) were evaluated. Intercanine width was measured with an electronic digital calliper on images of dental casts, and the mean changes in mandibular intercanine distance values were calculated pre- and post-treatment. The patients were characterized by the severity of their malocclusions utilizing discrepancy indices (DI) as outlined by the American Board of Orthodontics. Specifically, subjects were categorized into three groups according to case difficulty: DI <9, DI 10-19, and DI >20. The mean changes in mandibular intercanine distance values were analyzed by ANOVA for each DI category.

**RESULTS:** The DI >20 group showed greater mean amounts of intercanine distance increase. Some of the outlying values were as high as 2.84 mm.

**CONCLUSIONS:** Mandibular intercanine width increased with Invisalign® treatment in difficult cases; this requires careful monitoring during treatment planning and throughout the course of treatment. Clinicians should judiciously implement the grid tool of the software as one of the ClinCheck® tasks.

## 626 LIP POSITION AND FACIAL ATTRACTIVENESS: HOW DOES INCISOR MOVEMENT INFLUENCE ADULT PROFILES AND THEIR AESTHETIC PERCEPTION?

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**AIMS:** Evaluation of soft tissue profile is important in determining orthodontic treatment options and outcomes. Balancing the position of the lips in relation to the nose and chin has a direct relationship with patient aesthetics, in particular when a retruded profile is present. Many studies have investigated the relationship between incisor retraction and backward lip movement, after extraction space closure, while limited data are available about lip response to incisor proclination. The aim of this study was to assess changes in lip profile after incisor buccal movement, simulated by resin covers, in dentoalveolar retruded adults and to score profile attractiveness by a panel of orthodontic postgraduate students.

**SUBJECTS AND METHOD:** Five dental students were selected. All met the following inclusion criteria: complete permanent dentition (excluding third molars), dentoalveolar retrusion and lower crowding <3 mm. Three acrylic resin covers were made for each subject, with a thickness of 2 × 4 × 6 mm, covering the upper and lower incisors. Data were analyzed with the Kruskal-Wallis test ( $P < 0.05$ ). Photographs were then shown to a panel of 15 orthodontic postgraduate students and they were lip asked to order them according to profile attractiveness.

**RESULTS:** All covers increased lip protrusion. An average ratio of 0.46:1 between cover thickness and changes in upper lip position was found. The aesthetic evaluation showed that, most cases, protruded profiles were preferred.

**CONCLUSIONS:** Incisor proclination increases lip protrusion even if many factors can influence this response. A more anterior incisor position is desirable in subject with dentoalveolar retrusion, since protruded profiles are preferred nowadays.

627 EFFICIENCY OF AMORPHOUS CALCIUM PHOSPHATE-CONTAINING ORTHODONTIC COMPOSITE AND RESIN MODIFIED GLASS IONOMER ON DEMINERALIZATION

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AIM: To compare, *in vitro*, the efficacy of amorphous calcium phosphate (ACP)-containing orthodontic composite and resin-modified glass ionomer cement (RMGIC) on enamel demineralization adjacent to orthodontic brackets evaluated by a new laser fluorescence device.

MATERIALS AND METHOD: Sixty extracted maxillary premolars. Twenty orthodontic brackets were bonded with ACP-containing orthodontic adhesive (Aegis-Ortho), 20 with RMGIC (Fuji Ortho LC) and 20 with Transbond XT composite as the control. All samples were then cycled for 21 days through a daily procedure of demineralization for 6 hours and remineralization for 17 hours. Demineralization evaluations were then undertaken with a pen-type laser fluorescence device (Diagno-dent pen, KaVo). Analysis of variance (ANOVA) and Tukey test was used for statistical evaluation, at the level of  $P < 0.05$ .

RESULTS: Significant demineralization variations ( $\Delta D$ ) were determined among the groups ( $F = 6.650$ ;  $P < 0.01$ ). The ACP-containing composite showed the lowest (mean:  $8.98 \pm 2.38$ ) and the control composite the highest (mean:  $12.15 \pm 3.83$ )  $\Delta D$ , during the 21 day demineralization process ( $P < 0.01$ ). A significant difference was also observed between the  $\Delta D$  scores of the RMGIC (mean:  $9.24 \pm 2.73$ ) and control ( $P < 0.05$ ) groups. No significant difference was found in the preventive effects of ACP-containing composite and RMGIC ( $P > 0.05$ ) against demineralization.

CONCLUSION: The use of both ACP-containing orthodontic composite and RMGIC should be recommended for any at-risk orthodontic patient to provide preventive actions and potentially remineralize subclinical enamel demineralization.

628 RESONANCE FREQUENCY ANALYSIS OF ORTHODONTIC MINISCREWS SUBJECTED TO LIGHT EMITTING DIODE PHOTOBIOMODULATION THERAPY

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AIM: To prospectively evaluate the effect of light emitting diode (LED) photobiomodulation therapy (LPT) on the stability of immediately-loaded miniscrews under different force levels; as assessed by resonance-frequency analysis (RFA).

MATERIALS AND METHOD: Sixty, titanium orthodontic miniscrews (length 8 mm, diameter 1.4 mm) were implanted into cortical bone by closed-flap technique in each proximal tibia of 15 New Zealand white adult male rabbits ( $n = 30$ ). The animals were randomly divided into irradiated and control groups under different force levels (0, 150 and 300 cN). An OsseoPulse® LED-device (Biolum Research Ltd.), 618 nm wavelengths and 20 mW/cm<sup>2</sup> output power irradiation (20 minutes/day) was applied to the miniscrews, for 10 days. The RFA records were performed at miniscrew insertion and 21 days after surgery. Wilcoxon and Mann-Whitney *U*-tests were used for statistical evaluation at the  $P < 0.005$  level.

RESULTS: The initial primary stability of all miniscrews was similar in all groups at the start of the experiment. Statistically significant differences were found for changes in implant stability quotient (ISQ) values between the LED photobiomodulated group and the control (0 cN,  $P = 0.001$ ; 150 cN,  $P < 0.001$ ; 300 cN,  $P < 0.001$ ). A significant increase was found in ISQ values of LPT applied miniscrews under 0 cN (+11.63 ISQ), 150 cN (+10.50 ISQ) and 300 cN (+7.00 ISQ) force, during the observation period.

CONCLUSION: Due to the increase in force levels ISQ values decreased in the non-irradiated control miniscrews. Within the limits of this *in vivo* study, the RFA findings suggest that LPT might have a favourable effect on healing and attachment of titanium orthodontic miniscrews.

629 TOOTH COLOUR ASSESSMENT AFTER LINGUAL RETAINER APPLICATION: A PROSPECTIVE CLINICAL TRIAL

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AIM: To test the null hypothesis that there is no statistical significant difference in the colour parameters, L\*, a\*, and b\* (lightness, red/green, and blue/yellow) of the Commission Internationale de l'Eclairage (CIE) for lower anterior teeth after orthodontic treatment and a 6-month follow-up period.



**MATERIALS AND METHOD:** Fifteen patients treated with fixed appliances. At the end of active treatment all brackets were debonded and cleaning procedures were performed. The intraoral spectrophotometer (Vita Easyshade® Compact) was used to objectively assess the colour alterations of the lower anterior teeth before (T1) and after (T2) lingual retainer application. Lingual retainers were bonded with Transbond LR (3M Unitek, Monrovia, California, USA) adhesive system on the lingual surfaces of the lower anterior teeth. Final records for colour assessment were taken at the end of a 6-month follow-up period. Colour quantification was based on the CIE L\*, a\* and b\* colour system and the corresponding colour differences ( $\Delta E$ ) were calculated. Paired t-test was used for statistical evaluation of these parameters at  $P < 0.05$  level.

**RESULTS:** Lingual retainer application was associated with changes in colour parameters. Although the L\*, a\* and b\* values were not different significantly; all measured types of teeth demonstrated significant colour changes ( $\Delta E$ ) ( $P < 0.05$ ) after lingual retainer application (T2-T1). T3 records demonstrated that only the a\* value was different from the T2 records and this was statistically significant ( $P < 0.05$ ).  $\Delta E$ , L\* and b\* were not changed to baseline values (T3-T2) after the 6 six month observation period.

**CONCLUSIONS:** The null hypothesis was partially rejected. The colour of lower anterior teeth is changed in various ways after lingual retainer application. At the end of the 6-month follow-up period, the colour of the lower anterior teeth with lingual retainer was not changed to baseline values.

### 630 ALVEOLAR BONE GRAFTING PERFORMED BEFORE AND AFTER MAXILLARY EXPANSION IN TWO ADULTS WITH A CLEFT LIP AND PALATE

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**AIM:** To show the one year follow-up outcomes of secondary alveolar bone grafting (SABG) performed before and after slow maxillary expansion in two adult patients with A unilateral cleft lip and palate (UCLP).

**MATERIALS AND METHOD:** Cone beam computed tomography (CBCT) scans of two adult patients with a UCLP. In patient 1 slow maxillary expansion with a quadhelix appliance was performed before SABG and in patient 2 slow expansion was started six weeks after grafting. Autogenous grafts were taken from the iliac crests of the patients. CBCT scans were taken one week after surgery and 1 year post-operatively with a slice thickness of 0.3 mm. To analyze the DICOM data of the scans, Mimics 13.1 software was used. The bone graft area was outlined and erased from each slice in the axial, coronal and sagittal planes. Three-dimensional construction of the bony graft was achieved using the Boolean operation of the software system. Volume and density (Hounsfield units) were calculated for the bony graft immediately and for one year post-operatively.

**RESULTS:** For patient 1, the decrease of bone volume in one year was 17.7 per cent and bone density was increased at the rate of 0.6 per cent. In patient 2, the decrease of bone volume in one year was 48.8 per cent, whereas the bone density was increased at the rate of 67.4 per cent.

**CONCLUSIONS:** It was found that although there was more bone volume loss, the increase of the bone density was greater when grafting was performed before maxillary expansion. It was also seen that maxillary expansion could be achieved after alveolar grafting.

### 631 TEMPOROMANDIBULAR JOINT DYSFUNCTION IN PATIENTS WITH MARFAN SYNDROME

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**AIM:** Marfan syndrome (MFS) represents a connective tissue disorder with dominant autosomal inheritance that affects *inter alia* the musculoskeletal apparatus. Though joint hypermobility is a common finding, only scant attention has been paid to temporomandibular joint dysfunction (TMD). Therefore, the aim of the present study was to examine the prevalence of subjective TMD in patients with MFS.

**SUBJECTS AND METHOD:** Fifty-eight adult patients (33 males, 25 females) with MFS aged between 18 and 58 years underwent a clinical examination. Sixty-three healthy adults (33 males, 30 females) aged between 25 and 53 years served as the control group. Evaluation included the mandibular range of motion, temporomandibular (TMJ) palpation and registration of TMJ pain during mandibular opening and muscle palpation. Possible intergroup differences were determined using the independent t-test.

**RESULTS:** No statistically significant differences were found for mandibular opening between the two groups. Patients with MFS did not show reduced mouth opening in comparison with the controls. The differences in pain during mouth opening were highly statistically significant. Patients with MFS frequently reported pain during mandibular opening in comparison

with the control (MFS 17 patients, control 6 patients). The differences in subjective TMJ sounds showed statistically significant differences between the two groups (MFS 38 patients, control 23 patients).

CONCLUSION: MFS did not affect mandibular opening but signs and symptoms of TMD increased. Connective tissue disorders should be seen as an aetiological factor in the emergence of TMD.

#### 632 HYGIENE STATUS AT THE END OF ORTHODONTIC TREATMENT

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AIM: During the last decades, an increasing number of cases are retained with bonded lingual retainers. Studies have indicated acceptable compatibility of metal-bonded retainers with periodontal health. The current study was performed to evaluate whether significant differences in gingival conditions exist between patients in need of fixed retainers at the end of orthodontic treatment. Differences in build-up of plaque and calculus were also investigated.

MATERIALS AND METHOD: Mandibular lingual measurements were taken just before debonding from canine to canine of 30 patients with conventional appliances (group I) and of 30 patients with self-ligating appliances (group II). Ninety untreated subjects were recruited at a high school and served as control (group III). The gingival condition was scored according to four parameters: visual plaque index, modified gingival index (MGI), bleeding on probing, and gingival crevicular fluid flow. After staining with erythroline 0.8 per cent, the plaque index was registered. Additionally bleeding was scored after enamel preparation. The amount of calculus was measured with a calibrated periodontal probe.

RESULTS: With a mean MGI level of 0.023 the subjects in group III showed significantly less gingival inflammation in comparison with patients at the end of orthodontic treatment ( $P < 0.001$ ). Comparable limited gingival inflammation was found in groups I and II. Slightly more plaque and calculus were present on the lingual surfaces in group I. Significantly ( $P < 0.01$ ) more bleeding was observed in group I after the etching procedure.

CONCLUSION: Orthodontic treatment increased periodontal indices compared with an untreated group. Within the limits of this study less gingival inflammation was scored at the end of orthodontic treatment with self-ligating systems.

#### 633 A SURVEY OF RETENTION PROCEDURES AMONG NORWEGIAN ORTHODONTISTS

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AIMS: To survey and identify retention protocols among orthodontists practicing in Norway, and to examine the need for practical guidelines related to retention type and duration.

MATERIALS AND METHOD: A questionnaire was sent to all registered members of the Norwegian Orthodontic Society. The survey form included background information about the orthodontist and questions concerning the most commonly used types of upper and lower retainers; length of retention; reasons for choosing a certain retention protocol; information provided to patients and the orthodontists' need for common guidelines related to retention type and duration. A chi-square test was used to analyze the data.

RESULTS: The response rate was 77.72 per cent, of which 69.7 per cent were male and 30.3 per cent were female. The most commonly used retainer in the upper jaw was a combined fixed and a clear thermoplastic retainer (39.3%), followed by a clear thermoplastic retainer only (32.0%) and a Hawley (18.0%). In the lower jaw, a fixed retainer bonded on all anterior teeth was most common (64.7). Orthodontists working for >20 years tended to use more removable than fixed retainers in both jaws, in contrast to the those having <20 years experience that opted for more fixed retention procedures. The duration of retention in the upper jaw lasted 2-3 years (34%), or 3-5 years (23.3%). In the lower jaw, 40.7 per cent of the orthodontists kept the retainer >5 years and 18 per cent kept it permanently. The main reason for choosing a certain retention protocol was clinical experience (53.3%). Only 8 per cent of the orthodontists based their protocols on information from the literature and courses. Half of the orthodontists express a need for common retention guidelines, females being significantly predominant (65.9%).

CONCLUSIONS: Bonded retainers alone or in combination with a clear thermoplastic retainer seem to be the most commonly used retention appliances.

#### 634 GLENOID FOSSA POSITION IN CLASS II AND CLASS III MALOCCLUSION SUBJECTS: A CONTROLLED STUDY

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AIM: To investigate the position of the glenoid fossa in subjects with Class II and Class III malocclusions to clarify the role of this craniofacial component in sagittal skeletal disharmonies.

SUBJECTS AND METHOD: Thirty subjects with dentoskeletal Class III malocclusions associated with mandibular protrusion, and 30 subjects with dentoskeletal Class II malocclusions associated with mandibular retrusion, both aged 8 years  $\pm$  6 months, with normal skeletal vertical relationships, and normal mandibular dimensions, were compared with a control group of 33 subjects with dentoskeletal Class I relationships. The comparisons between the Class II and Class III groups and the control group on the cephalometric measurements for the assessment of glenoid fossa position were performed with a Mann-Whitney *U* test,  $P < 0.05$ . The power of the study exceeded 0.90.

RESULTS: Subjects with a Class III malocclusion presented with a significantly more mesial position of the glenoid fossa, while those with a Class II disharmony showed a significantly more distal position of the glenoid fossa when compared with the control group as measured by means of three parameters (GF-S on FH, GF-Ptm on FH, and GF-FMN).

CONCLUSIONS: An anomalous sagittal position of the glenoid fossa is a possible diagnostic anatomical feature of Class II and III malocclusions associated with mandibular retrusion and protrusion, respectively. An effective measurement to evaluate glenoid fossa position within the craniofacial relationships is the cephalometric distance from the glenoid fossa to the fronto-maxillo-nasal suture (GF-FMN), which also showed the least measurement error.

### 635 OCCLUSAL CONTACTS AND MAXIMUM VOLUNTARY BITE FORCE IN SUBJECTS WITH ESSIX AND WRAPAROUND RETAINERS

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AIMS: To determine the differences in occlusal contact (OC) and maximum voluntary bite force (MVBF) changes in subjects with Essix and wraparound retainers.

SUBJECTS AND METHOD: Sixty subjects aged 14-20 years wearing Essix (13 males, 17 females; mean age  $16.3 \pm 1.9$  years), and wraparound (11 males, 19 females; mean age  $16.0 \pm 1.7$  years) retainers. Measurements were undertaken after fixed appliance removal (T1) and after 6 (T2), and 10 (T3) weeks of retention. MVBF was determined with the occlusal force meter GM10 (Nagano, Keiki, Japan). The subjects bit on the instrument four times on each side and repeated the procedure in reverse order. OC was determined using Hawe Transparent Strips No 690 (Kerrhawe SA, Bioggio, Switzerland). The strip was placed between the lower teeth, and OC was recorded when it could not be pulled out from between the antagonists. Statistical analyses were performed with mixed types of multifactorial variance analysis (ANOVA) and Bonferroni *post hoc* tests.

RESULTS: There was statistically significant increase ( $P < 0.001$ ) in MVBF in the wraparound group during all readings. In the Essix group the increase was more pronounced between T1 and T2 ( $P = 0.002$ ) than between T2 and T3 ( $P = 0.039$ ). OC did not differ between readings when the Essix appliance was used, but in the wraparound group there was a significant increase between T1 and T2 ( $P = 0.003$ ). When the measurements were compared, no statistically significant differences were found with regard to OC or MVBF.

CONCLUSIONS: There was more increase in MVBF and OC during the 10 week retention period with wraparound retainers, but no significant difference between the appliances at each reading. Thus both wraparound and Essix retainers can be successfully used for retention.

### 636 ORTHODONTIC FORCES AND THEIR EFFECTS ON OSTEOBLASTS

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AIM: To test the influence of mechanical stress on the viability and function (production of osteocalcin and alkaline phosphatase activity) of osteoblasts cultivated *in vitro*.

MATERIALS AND METHOD: Cell culture: Human osteoblast-like cell line SaOS-2, from an osteosarcome (ATCC85-HTB) after decongelation. The cells were seeded onto glass coverslips at a density of  $1 \times 10^5$  cells/cover glass. The cover glasses were then incubated with 2 mL of culture media in six-well culture plates. The cells were grown to confluence in a humidified 5 per cent CO<sub>2</sub> incubator at 37°C. Pressure force simulation: *in vitro* application compressive force. Pressure was achieved through centrifugation according to Redlich *et al.* using the following pulse- chase protocol. Cell cultures grown under identical conditions were used as negative controls and remained unloaded. Immediately before (pre-load time period) and at defined points in time after centrifugation cell viability was measured from the experimental and control cells.

RESULTS: Compression delivered an immediate and proportional deformation of the cells. After 10-15 minutes the morphology of cells readapted to the new mechanical environment, causing a loss of biological activation. The cells became irregularly aligned, and cell viability decreased, indicating that compressive force caused cell death.

**CONCLUSIONS:** The loss of biological activation suggests that a new mechanical stimulus is necessary to induce a new biological reaction. The number of apoptotic cells increased significantly in a time and force-dependent manner. The *in vitro* application of compressive force can induce apoptosis.

**637 EVALUATION OF SYMPHYSIS MORPHOLOGY IN PATIENTS WITH DIFFERENT SAGITTAL SKELETAL PATTERNS USING CONE BEAM COMPUTED TOMOGRAPHY**

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**AIM:** Anatomic structures may vary among subjects. The aim of this study was to evaluate three-dimensional (3D) symphysis morphology in patients with different sagittal skeletal patterns.

**MATERIALS AND METHOD:** Cone beam computed tomography (CBCT) records of 90 subjects divided into three subgroups according to their ANB angle as Class I, II and III. The vertical skeletal patterns of all patients were within normal values. Six parameters (height, depth, anterior distance, posterior distance, height/depth ratio and surface area) were measured. Analysis of variance was used for inter-group comparison. Evaluation of the differences between the groups was then undertaken using Tukey's test.

**RESULTS:** Depth, height, posterior distance and height/depth ratio showed statistically significant differences in some groups. The depth of symphysis in Class II patients was higher than in Class III patients ( $P < 0.05$ ). The height of symphysis in Class II patients was also found to be greater than in Class I patients. Posterior distance and height/depth ratio showed statistically significant differences in both Class I and II patients relative to Class III patients.

**CONCLUSION:** Symphysis morphology can be affected by the sagittal skeletal pattern.

**638 INCREASED RECRUITMENT OF BONE MARROW-DERIVED CELLS TO PALATAL WOUNDS BUT NOT TO SKIN WOUNDS**

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**AIM:** To investigate the contribution of bone marrow-derived cells to palatal and skin wounds. Bone marrow-derived cells contribute to wound healing, and are able to differentiate into tissue-specific cell types. As wound healing in oral mucosa generally proceeds faster and with less scarring than in skin, the bone marrow contribution to these two tissues was compared.

**MATERIALS AND METHOD:** Bone marrow cells from green fluorescent protein (GFP)-transgenic rats were transplanted to 20 irradiated wild-type rats. After recovery, 4 mm wounds were made in the palate (10) or the skin (10). Two weeks later, wound tissue with adjacent normal tissue was stained for GFP-positive cells, myofibroblasts ( $\alpha$ -smooth muscle actin), activated fibroblasts (HSP47), and myeloid cells (CD68).

**RESULTS:** The fraction of GFP-positive cells in unwounded skin (19%) was larger than in unwounded palatal mucosa (0.7%). On wounding, the fraction of GFP-positive cells in the palate increased (8.1%), while it was unchanged in skin. About 7 per cent of the myofibroblasts in both wound types were GFP-positive, 10 per cent of the activated fibroblasts, and 25 per cent of the myeloid cells.

**CONCLUSION:** Recruitment of bone marrow-derived cells is enhanced by wounding in oral mucosa, but not in skin. This might be related to the larger healing potential of oral mucosa.

**639 EARLY TREATMENT WITH FRÄNKEL'S FUNCTION REGULATOR TYPE III – EVALUATION OF SWALLOWING AND TONGUE POSTURE**

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**AIMS:** To assess the swallowing pattern and tongue posture in children with a Class III malocclusion (CIII) before and after orthodontic treatment with Fränkel's function regulator type III (FRIII) and in children with normal dentition (ND) using two and three-dimensional (3D) ultrasonography.

**SUBJECTS AND METHOD:** The swallowing cycles of 12 patients with CIII (mean  $6.8 \pm 0.9$  years) and 12 children with a ND (mean  $7.1 \pm 0.3$  years) were recorded using B- and M-mode ultrasound (Toshiba SSA-770A with a 3.5 MHz convex e256



transducer). The scan line was set through the tongue tip and swallowing pattern was assessed. Voluson730 Expert with a 3D convex transducer RAB 2-5 MHz, G E Healthcare, was used to obtain 3D ultrasound images of the tongues in both groups. 3D reconstructions were made using the program, 4DView. Referential 3D ultrasound reconstructions were used for assessment of tongue posture. The CIII children were treated using a FRIII for 10–12 months and both groups were ultrasonographically examined after one year.

RESULTS: Seventy five per cent of CIII children and 50 per cent ND children had a visceral type of swallowing before treatment (Fisher's exact test,  $P = 0.4$ ). After one year there were no statistically significant changes either within or between the groups. Ninety-two per cent of CIII children and 25 per cent of ND children demonstrated tongue posture on the mouth floor according to the 3D ultrasound ( $P < 0.001$ ). After one year 75 per cent of the treated children and 25 per cent of the ND children were found to have a tongue posture on the mouth floor. However, the difference was still statistically significant ( $P < 0.01$ ).

CONCLUSIONS: There were no statistically significant differences in swallowing pattern between CIII and ND children. The tongue of the CIII children was initially and after treatment with the FRIII to a much greater extent postured on the mouth floor compared with ND children. Early orthodontic intervention improved the tongue posture in the CIII children, but not significantly.

#### 640 BODY MASS INDEX AND PATIENT COOPERATION - IS THERE A CORRELATION?

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AIM: To answer the question: Is there a correlation between body mass index (BMI) and patient cooperation during multibracket (MB) appliance therapy?

MATERIALS AND METHOD: All adolescent MB patients started and finished between 2007 and 2010 were analyzed. The pre-treatment BMI was calculated and negative file entries such as poor oral hygiene, missed appointments, appliance breakage etc. were recorded. According to the number of entries, cooperation was classified as good, bad or poor.

RESULTS: Of the 78 subjects, 62 had a normal BMI (79.5%) and 16 were considered overweight (20.5%). Whereas 51.6% ( $n = 32$ ) of the normal weight children had a good cooperation, only 25 per cent ( $n = 4$ ) of the overweight patients cooperated sufficiently. Consequently, the amount of patients exhibiting a bad or poor cooperation was higher in the overweight group (37.5%, bad, 37.5% poor) than in the normal weight group (30.6% bad, 17.7% poor).

CONCLUSION: Children with an increased BMI did not cooperate as well during MB therapy as their normal weight peers.

#### 641 COMPARISON OF THE MEASUREMENT OF ROOT LENGTH ON CONE BEAM COMPUTERISED TOMOGRAPHY

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AIM: Apical root resorption is a major complication during orthodontic treatment. Although root form is commonly used to predict apical root resorption, qualitative assessment inherently contains examiner-related variability. Conversely, even though quantitative assessment has an advantage, the measurement of actual root length is difficult on two-dimensional radiographs because of the inclination of the tooth. The aim of this study was to investigate an objective method to measure root length on three-dimensional images using cone beam computerised tomography (CBCT).

MATERIALS AND METHOD: CBCT and dental panoramic tomography (DPT) images taken before orthodontic treatment were used to compare the root length of the central incisors ( $n = 7$  each). On the DPT radiograph, as in the previous studies (Sherrard, 2010), root length was defined as the distance from the root apex and the midpoint of the highest points on the cemento-enamel junction (CEJ). When analysing the CBCT images, the root axis was first defined as a line through the root apex and the centre of gravity of the CEJ calculated from all the CEJ points seen on each slice. To mirror the definition in DPT, root length in CBCT was defined as the distance from the root apex to the midpoint of the highest points on the CEJ projected to the root axis.

RESULTS: The root length in CBCT was significantly longer than that in DPT ( $16.6 \pm 1.96$  versus  $14.0 \pm 2.47$  mm;  $P < 0.001$ ). A possible explanation of the ratio of both lengths was compared with the incisor inclination to the Frankfort horizontal plane obtained from lateral cephalograms. The correlation was neither significant nor strong ( $P = 0.39$ ;  $r^2 = 0.15$ ), indicating that other factors such as focal troughs and head positioning also affect the root length on DPTs.

CONCLUSION: Root length is underestimated on DPTs. This three-dimensional method will be useful to develop quantitative analysis to predict apical root resorption.

642 ANALYSIS OF VERTICAL SMILE FEATURES IN ORTHODONTICALLY TREATED AND UNTREATED INDIVIDUALS

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AIM: To assess the vertical characteristics of posed smiles among patients after fixed appliance therapy when compared with untreated subjects with initially a normal occlusion.

MATERIALS AND METHOD: Full-smile photographs of 50 young adults with an age range of 21 to 25 years. The material consisted of two groups with an equal number of subjects of a similar age. The study group consisted of 25 individuals after orthodontic treatment with fixed appliance and with initially different types of malocclusion, while the control group consisted of 25 individuals with a normal occlusion, orthodontically untreated. The exclusion criteria were: excessive facial disharmony, significant asymmetry, missing or poorly shaped teeth, prosthetically restored anterior teeth and visible periodontal disease. Each subject was photographed twice and only individuals with identical characteristics were included. The smile line (high, medium high, low), the smile arc (parallel, straight, reverse), relationship between maxillary anterior teeth and lower lip (slightly covered, touching, not touching) and upper lip curvature (upward, straight, downward) were assessed. The results were statistically analyzed using Statistica 8.0. Pearson chi-square significance test, contingency coefficient and coefficient of relevance (*P*).

RESULTS: No statistically significant differences were found. In both groups the medium high smile dominated – in 76 per cent of treated and 68 per cent of untreated subjects. A consonant smile arc was observed in 44 and 52 per cent, respectively. The lower lip did not touch the upper teeth in 56 per cent of the cases in both groups. In the treated group an upward and straight upper lip curvature was most prevalent (40%), while in the untreated group an upward curve dominated (48%).

CONCLUSIONS: All analyzed smile characteristics were similar in the treated subjects and individuals with normal occlusion. A high smile line was correlated with a downward upper lip curvature.

643 DEVELOPMENT OF AN *EX VIVO* MODEL TO INVESTIGATE THE EFFECT OF ORTHODONTIC FORCES ON ROOT RESORPTION

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AIM: To develop a laboratory-based *ex vivo* model to investigate cellular and molecular responses associated with root resorption following application of mechanical stimuli.

MATERIALS AND METHOD: Tooth slices sectioned from 28-day-old male Wistar rat hemi-mandibles and subjected to compressive forces at 100 g, 50 g, or no forces were maintained in Trowel-typed cultures at 37°C in 5 per cent CO<sub>2</sub> in air for 7 days. Tissue maintenance and viability were assessed histologically and by cell quantification. Osteoclasts and odontoclasts were identified by tartrate resistant acid phosphatase (TRAP) assay, quantified and analyzed using Kruskal-Wallis test. Dentine sialoprotein (DSP), a non-collagenous protein abundantly found in dentine and a root resorption marker, was localized by immunohistochemistry and assessed qualitatively.

RESULTS: The periodontal ligament (PDL) structure and viability were maintained. Multinucleated TRAP positive cells increased significantly in the 100 g (median = 6.33; 95% CI = 5.01 - 7.79; *P* < 0.05) and 50 g (median = 8.42; 95% CI = 7.42 - 9.66; *P* < 0.001) groups compared with the control (median = 2.00; 95% CI = 1.66 - 2.80). Most cells were located closer to the bone. There was a small increase in odontoclasts in the 100 g (median = 0.33; 95% CI = 0.15 - 0.40) and a statistically significant increase in the 50 g (median = 0.58; 95% CI = 0.34 - 1.73; *P* < 0.01) groups compared with the control (median = 0.17; 95% CI = 0.04 - 0.25). DSP expression increased in numbers and intensities within the PDL cells and extracellular matrices of both test groups and was more prominent in the 50 g group compared with the 100 group.

CONCLUSIONS: Orthodontic forces stimulated osteoclast and odontoclast formation in the *ex vivo* tooth slice model. There is a potential to use this model for further investigations on orthodontically induced root resorption.

644 EFFECT OF PRE-TREATMENT PARAMETERS ON THREE-DIMENSIONAL DENTAL CHANGES WITH PREMOLAR EXTRACTIONS

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AIMS: To investigate the effect pre-treatment parameters have on changes to the positions of the maxillary and mandibular molars, canines and incisors, as well as the intermolar and intercanine widths.

SUBJECTS AND METHOD: Sixty patients who had finished fixed appliance orthodontic treatment were randomly selected from completed premolar extraction cases. Pre- and post-treatment study models were digitally occluded and superimposed onto the pre- and post-treatment lateral cephalographs, which were then superimposed onto each other using cephalographic stable reference structures. Multivariate linear regression was performed to determine the adjusted effect of pre-treatment parameters (i.e. overjet, age, upper and lower dental arch crowding, maxillary and mandibular incisor angulation, ANB angle, maxillomandibular plane angle) on the observed dental changes.

RESULTS: Certain pre-treatment factors affected different directions and types of tooth movements to statistically significant degrees (i.e.  $P < 0.05$ ): upper incisor angulation significantly affected movement of the maxillary first molars and incisors, and mandibular canines; lower incisor angulation significantly affected movement of the maxillary and mandibular first molars; upper arch crowding significantly affected movement of the maxillary and mandibular incisors; lower arch crowding significantly affected movement of the maxillary incisors and first molars and mandibular first molars and canines; age significantly affected movement of the maxillary and mandibular first molars and canines, and mandibular incisors; patient gender significantly affected movement of the maxillary first molars and mandibular incisors; pre-treatment overjet significantly affected movement of the maxillary first molars, mandibular first molars and mandibular canines and incisors.

CONCLUSION: Certain pre-treatment parameters, such as crowding, incisor angulation, age, gender and overjet, may influence the type, direction and magnitude of dental changes.

#### 645 A COMPARATIVE *IN VITRO* STUDY OF THE BOND STRENGTH OF ADHESIVE PRECOATED AND UNPRECOATED BRACKETS

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AIM: To compare the bond strength of adhesive precoated brackets with brackets without adhesive coating using the conventional bonding method.

MATERIALS AND METHOD: Shear testing was performed with a universal mechanical testing machine at a feed rate of 0.5 mm/minute and the adhesive remnant index scores were determined by stereomicroscope ( $\times 10$ -66 magnification). Statistical analysis was carried out using the SPSS program. For group comparison, the single factor variance analysis (ANOVA) and the *post hoc* test (Tukey-HSD) were used. The level of significance was established at  $P < 0.05$ . A *t*-test for independent random samples was employed when comparing two mean values.

RESULTS: A minimum bond strength of 5-8 MPa was found with only a significant difference between the lower incisor groups. ARI: In 18 of 25 cases in the bracket group without adhesive coating, >90 per cent of the composite remained on the enamel. The APC Plus system also showed this fracture mode but a smaller tendency towards bracket-adhesion failure was recognizable.

#### 646 ARE MINERALIZATION DEGREE AND BONE-TISSUE STIFFNESS CORRELATED IN THE PORCINE MANDIBULAR CONDYLE?

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AIMS: The mineralization degree of bone from the porcine mandibular condyle is known to increase during development, but the effect of this age-related change on the micromechanical properties is unknown. The aim of this study was to correlate the local mineralization degree with bone-tissue stiffness.

MATERIALS AND METHOD: Cancellous and cortical bone samples were obtained from 10 mandibular condyles taken from five young and five adult female pigs. Bone-tissue stiffness was assessed in three directions using nanoindentation. At each of the three tested sides (superior, anterior, and lateral) five indents were made over the width of five single trabeculae, resulting in 1500 indents. Microcomputed tomography with a resolution of 10  $\mu\text{m}$  was used to determine the local mineralization degree at the indented sites. Pearson correlation coefficients and coefficients of determination were used to statistically test the correlation between the mineralization degree and bone-tissue stiffness.

RESULTS: Bone from the adult pigs had approximately a 50 per cent higher mineralization degree than bone from young pigs ( $P < 0.01$ ), whereas no statistically significant difference was observed between cancellous and cortical

bone. Bone tissue stiffness was highest in bone from the adult animals ( $P < 0.01$ ) and did not differ between cancellous and cortical bone. Local bone-tissue stiffness at the indented sites showed a significant but low coefficient of determination with the local mineralization degree ( $R^2 = 0.26$ ,  $P < 0.001$ ). The mean mineralization degree, ignoring the local mineral distribution, appeared to have a higher coefficient of determination with the mean bone-tissue stiffness ( $R^2 = 0.55$ ,  $P < 0.05$ ).

CONCLUSIONS: Local mineralization degree is a minor determinant of local bone tissue stiffness. The correlation between these parameters should be analyzed very locally in order to avoid overestimation of the correlation.

#### 647 TREATMENT OPTIONS OF SAGITTAL AND TRANSVERSE ASYMMETRIES BY MEANS OF SKELETAL ANCHORAGE

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AIM: The correction of sagittal, vertical and transverse asymmetries is associated with a major challenge concerning the establishment of an appropriate anchorage unit. In these cases mini-implants have widened the anchorage options. However, failure rates still seem to be unsatisfactory. The aim of this prospective clinical trial was to determine the efficiency of mini-implant anchored appliances for the correction of sagittal and transverse asymmetries.

MATERIALS AND METHOD: Fifty-seven patients (36 females, 21 males, aged 10 to 33 years) in whom two mini-implants were inserted in the anterior palate.

RESULTS: The overall failure rate was 3.5 per cent (4 of 114). The design of the appliance had a major impact on the success rate. In the cases with stable mechanics (55 of 57) the midline could be corrected and spaces could be closed even with asymmetrically missing teeth.

CONCLUSIONS: The employment of skeletal anchorage is a suitable method for the correction of dentoalveolar asymmetries. Since tooth movement is not impaired due to a contact mini-implant/root and success rates are very high, the anterior palate seems to be a favourable insertion site for mini-implants in the maxilla.

#### 648 THE EFFECT OF MONASCUS PURPUREUS EXTRACT ON BONE FORMATION

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AIM: To compare *in vitro* the extent of new bone formation by *Monascus purpureus* extract to that produced by collagen matrix alone.

MATERIALS AND METHOD: Bone defects,  $5 \times 10$  mm, were created in the parietal bones of six New Zealand White rabbits. A group of six defects were grafted with *Monascus purpureus* extract mixed with collagen matrix. Another group of six defects were grafted with collagen matrix alone (control, data previously published). After two weeks, the animals were sacrificed and bone defects were dissected and prepared for histological assessment. Quantitative analysis of new bone formation was performed on 100 sections (50 sections for each group) using Image Analysis.

RESULTS: Defects grafted with *Monascus purpureus* extract mixed with collagen matrix displayed an increase in bone formation (717 %) compared with those grafted with collagen matrix alone.

CONCLUSION: *Monascus purpureus* extract stimulates new bone formation *in vivo*, and potentially could be used as a bone graft material.

#### 649 MULTIBRACKET APPLIANCES: IMPRESSION DEFAULTS AND THEIR REDUCTION BY BLOCKING-OUT

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AIM: To evaluate how the precision of dental impressions are influenced by different ligature materials, removal of the archwire, or covering of brackets.

MATERIALS AND METHOD: The maxilla of a phantom head was provided with brackets on teeth 16 to 26. Three examiners took three impressions of each of these variants: brackets only, archwire fixed by elastics, ligatures or Kobayashi-hooks, brackets and archwire completely covered by impression wax or just covered on the gingival side. Casts made from alginate impression material were scanned using the advice Activity102®. The scanned virtual models were compared with the scan of the original model (without brackets) using the program, Comparison®. Differences were measured at the top of the cusps and the incisal edges and then analyzed using the *t*- and Mann-Whitney tests.



**RESULTS:** While the pyramidal reference blocks had a mean difference of  $0.02 \pm 0.008$  mm to the original model, the second molars without attachments showed a mean difference of  $0.09 \pm 0.027$  mm ( $P < 0.001$ ) and teeth 16 to 26 with brackets showed a mean difference of  $0.17 \pm 0.042$  mm ( $P < 0.001$ ). The smallest mean and the least spreading of the differences were found when using protection wax only on the gingival bracket side ( $0.15 \pm 0.008$  mm). Complete coverage of the brackets showed the highest mean differences with more spreading ( $0.18 \pm 0.047$  and  $0.17 \pm 0.053$  mm) ( $P < 0.05$ ). High differences were also found using uncovered ligatures ( $0.19 \pm 0.058$  mm) and elastics ( $0.17 \pm 0.046$  mm). For single teeth the incisors deviated the most (tooth 21:  $0.27 \pm 0.127$  mm).

**CONCLUSIONS:** Covering the fixed appliance with protection wax only on the gingival side of the brackets is a good practicable procedure and shows the highest precision. In contrast even the removal of the archwire leads to a higher deviation in comparison to the original model.

## 650 ARE ODONTOCLASTS IDENTICAL TO OSTEOCLASTS OR A SEPARATE CELL TYPE? A SYSTEMATIC LITERATURE REVIEW

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**AIM:** There is an ongoing debate on the aetiology of root resorption as a negative side effect of orthodontic tooth movement. This systematic literature review was performed to answer the question whether orthodontic root resorption is caused by odontoclasts, as a unique cell type, or by osteoclasts, the ubiquitous bone resorbing cells.

**MATERIALS AND METHOD:** The literature was searched with PubMed (1950-May 2010) and subsequent hand search to perform a systematic review of the characteristics of osteoclasts and odontoclasts, cementoclasts, or dentinoclasts, in relation to root resorption. The search yielded 369 publications.

**RESULTS:** Odontoclasts, defined as the cells responsible for root resorption, show many common features with osteoclasts, but differences have also been described. (1) Morphology. Odontoclasts are smaller and have less nuclei and tartrate resistant acid phosphatase-positive regions than osteoclasts. (2) Differentiation and function. If orthodontic forces are applied in osteopontin-deficient mice, the number and the activity of odontoclasts decrease, while the number and activity of osteoclasts increase. (3) Transcription factors. The activity of the two cell types is differently influenced by activation of the protein kinases PKA and PKC. This is probably related to differences in the expression of the calcitonin receptors CTR-1 and CTR-2. (4) Enzymes. No differences in the expression of cathepsins and matrix metalloproteinases (MMPs) have been described except for MMP9, a gelatinase, which is probably not expressed by osteoclasts. (5) Growth factors and their receptors. Although odontoclasts and osteoclasts both synthesize the insulin-like growth factors IGF-1 and IGF2, they show differences in the expression of IGF-1 receptor and several IGF-binding proteins.

**CONCLUSIONS:** Odontoclasts are different from osteoclasts in several aspects. However, to date it is unclear whether they can be considered as a separate cell type or as the result of phenotypic adaptation of osteoclasts to local circumstances.

## 651 MANDIBULAR ANTERIOR BONY SUPPORT AND LOWER INCISOR CROWDING. IS THERE A RELATIONSHIP?

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**AIM:** To evaluate the relationship between mandibular anterior bony support and lower incisor crowding, and to identify the possible gender differences.

**MATERIALS AND METHOD:** From a sample of 1100 digital volumetric tomographs, 125 were selected from Class I malocclusion subjects, aged from 16 to 36 years. Tomography was carried out using iCAT® (Imaging Sciences International, Hatfield, Pennsylvania, USA). The following parameters were measured on the sections corresponding to the four mandibular incisors: height, thickness and area of the entire symphysis; height, thickness, and area of the cancellous bone of the symphysis; distance of the vestibular and lingual cortices. Lower incisor crowding was measured with Little's irregularity index. For statistical evaluation, independent samples *t*-tests, analysis of variance and Tukey HSD tests were used at the  $P < 0.05$  level. Pearson correlation coefficient and simple linear-regression was calculated to determine the relationship between mandibular anterior bony support and incisor crowding.

**RESULTS:** Statistically significant gender differences were found almost in all mandibular anterior bone measurements. Mild-crowding subjects showed higher values for cancellous bone height and the vestibular part of the cancellous bone thickness than the severe-crowding group. Additionally significant correlations were determined between incisor crowding

and the thickness of the mandibular symphysis, cancellous bone thickness and vestibular part of cancellous bone thickness, in females.

**CONCLUSION:** Significant relationships were found between measurements of mandibular incisor crowding and basal bone dimensions in female subjects. Except for the vestibular part of cancellous bone thickness, all mandibular incisor bone measurements were greater in males than in females.

#### 652 EFFECT OF RAPID MAXILLARY EXPANSION ON DYNAMIC MEASUREMENT OF NATURAL HEAD POSITION

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**AIM:** To prospectively identify the effect of rapid maxillary expansion (RME) on dynamic measurement of natural head position (NHP).

**SUBJECTS AND METHOD:** The treatment group comprised 23 patients (12 girls, 11 boys, mean age:  $10.1 \pm 1.1$  years) and the control group 15 subjects (8 girls, 7 boys, mean age:  $9.7 \pm 1.4$  years). The test subjects underwent RME using a full cap acrylic device; the mean amount of expansion was 5.48 mm. An inclinometer and a portable data logger were used to collect NHP data. Intragroup changes were evaluated using the non-parametric Wilcoxon test and intergroup changes were analyzed with the Mann-Whitney *U* test. *P* values less than 0.05 were considered statistically significant.

**RESULTS:** The mean difference between the initial and final NHP was 0.31 degrees, which was not statistically significant. There were also no statistically significant differences between the RME and control groups before and after treatment.

**CONCLUSION:** Treatment with RME does not have a significant effect on the dynamic measurement of NHP, when compared with the initial values or an untreated control group.

#### 653 RELIABILITY OF DENTAL MEASUREMENTS ON RAT DIGITAL MODELS

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**AIM:** Digital models are an accurate, efficient, and easy-to-use alternative to plaster models. They allow precise measurements and visualization of proposed treatment outcomes. The aim of this study was to determine the reliability of measurements made on rat digital models of scanned impressions.

**MATERIALS AND METHOD:** Forty-nine 12-week-old young male adult Wistar rats. Dental impressions were taken twice, under anaesthesia, with vinyl polysiloxane impression material. While one of the impressions was poured using a die stone, the other was digitized by orthomodel. A hand held digital calliper was used to manually measure the plaster models. The distance between the most mesial point of the maxillary molar unit and the enamel-cementum border of the ipsilateral maxillary incisor at the gingival level was measured (I-M distance) for the right and left sides. The distance between the most mesial point of the left and right maxillary molar unit was also measured. All measurements were repeated one week later to determine the measurement error, which was 0.900 or above for all parameters. All statistics were performed using the Statistical Package for Social Sciences, version 16.0.0. Descriptive statistics, including the mean, standard deviation, standard error, minimum and maximum values were calculated for each of the groups tested. An Independent sample *t*-test was used to compare the groups.

**RESULTS:** The average I-M distance on the right side was  $12.36 \pm 0.51$  and  $12.39 \pm 0.46$  for the digital and plaster models, respectively. The average I-M distance on the left side was  $12.21 \pm 0.53$  and  $12.21 \pm 0.57$  for the digital and plaster models, respectively. The average right and left molar distance was  $6.51 \pm 0.26$  and  $6.75 \pm 0.25$  for the digital and plaster models, respectively. There were significant differences between the right and left molar distance ( $P < 0.01$ ).

**CONCLUSIONS:** Digital rat models can be used efficiently, except to measure molar-molar distances.

#### 654 THE PREVALENCE OF DENTAL ABNORMALITIES IN A KOREAN POPULATION

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**AIM:** To investigate the prevalence of dental abnormalities in outpatients of Sacred Heart Hospital, Hallym University and to determine the rate of these patients visit the orthodontic department compared with non-orthodontic departments.

**SUBJECTS AND METHOD:** Three thousand two hundred and forty eight patients (age range; 14–35 years) who visited the clinic between January, 2009 and June, 2010. A review of the medical records and panoramic films of the patients and detection of supernumerary, missing, dislocated, impacted teeth and peg-shaped laterals was carried out. The results were analyzed according to age, number of visits and the department attended.

**RESULTS:** The number of the patients with dental abnormalities was 374, with the prevalence rate of 11.55 per cent. Congenitally missing teeth (5.57%) were ranked first in the categories and impacted teeth accounted for 2.22 per cent. The percentage of patients with supernumerary or dislocated teeth was 1.79 and 0.92, respectively.

**CONCLUSION:** Congenitally missing was the most common dental abnormality in the Korean population, followed by supernumerary teeth.

#### 655 CHANGES IN OCCLUSAL FORCE AND OCCLUSAL CONTACT AREA AFTER ORTHODONTIC TREATMENT

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**AIM:** To evaluate functional changes of occlusion after orthodontic treatment by measuring the occlusal force (OcFr) and occlusal contact area (OcAr), and to compare OcFr and OcAr change according to premolar extractions.

**MATERIALS AND METHOD:** Data were obtained from 74 patients aged between 18 and 40 years who had finished orthodontic treatment using fixed appliance. The subjects were divided into groups who had four premolars extraction or non-young extraction (male extraction-16, male non-extraction-18, female extraction-19, female non-extraction-21). All subjects were asked to bite pressure-sensitive sheets into maximum intercuspation with maximum bite force, and OcFr and OcAr were evaluated by measuring the sheet with a CCD camera. Records were taken right after debonding and 1 week, 1 month, 3 months, 6 months and 1 year after debonding.

**RESULTS:** OcFr and OcAr increased gradually in all groups during the 1 year retention period ( $P < 0.05$ ). The male groups showed higher OcFr and OcAr than the female groups throughout the retention periods ( $P < 0.05$ ). There were no statistically significant differences in OcFr and OcAr between both the male and female extraction and non-extraction groups ( $P > 0.05$ ).

**CONCLUSIONS:** Occlusion was improved functionally throughout the 1 year retention. Premolar extractions did not induce a decline in the functional aspect of occlusion.

#### 656 A RANDOMISED CLINICAL TRIAL OF TWO MODIFICATIONS OF CLARK'S TWIN BLOCK APPLIANCE\*\*\*

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**AIM:** To determine, in a randomized clinical trial, whether there is any significant difference in skeletal and dentoalveolar changes between two different designs of the Clark's Twin Block (CTB); one with a maxillary labial bow, the other without.

**SUBJECTS AND METHOD:** Sixty-four participants, divided into age and gender matched pairs, and randomly allocated to treatment with either appliance design. The patients underwent treatment for 12 months when further data was collected.

**RESULTS:** Sixty participants completed the study. Both groups experienced a reduction in overjet as a result of anterior repositioning of pogonion, proclination of the mandibular incisors and retroclination of the maxillary incisors. There was no statistical difference between the groups for any of the skeletal or dental variables measured. The upper incisors retroclined 10.1 (SD 5.99) in the labial group and 7.730 (SD 6.12) in the non-labial bow group ( $P = 0.94$ ). This was paralleled in the skeletal changes, including anterior position of pogonion ( $P = 0.93$ ) and increase in lower face height ( $P = 0.41$ ) with the inclusion of a labial not resulting in greater rotation effects during treatment.

**CONCLUSIONS:** The addition of a maxillary labial bow to the CTB had no effect on either skeletal or dentoalveolar changes related to appliance therapy, and did not result in greater skeletal rotation or less anteroposterior change.

#### 657 JERK-OPTIMIZATION OF GUM-CHEWING KINEMATICS AFTER CORRECTION OF INCISOR CROSSBITE

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AIM: Human jaw movement during gum chewing is normally performed in an optimally smooth (jerk-optimal) way. The purpose of present study was to examine whether the correction of an incisor crossbite results in significant improvement in the smoothness of the chewing cycle.

SUBJECTS AND METHOD: Eleven children with incisor a crossbite (5 boys, 6 girls, mean age, 10 years 8 months; S.D. 11 months: pre-treatment stage). The lower incisor-point movements during chewing of standardized gum were monitored using a three-dimensional tracking device. For each child, the smoothness (jerk-optimality) of masticatory jaw closing movement trajectories were statistically compared between those measured before and after correction of the crossbite. In addition, the velocity profile of jaw closing movement for each chewing cycle was predicted by minimum-jerk cost (maximum smoothness) model. The prediction errors were statistically compared between chewing cycles recorded before and after correction of the incisor crossbite.

RESULTS: After treatment, the smoothness of the jaw closing movements increased significantly ( $P < 0.05$ ) and the velocity profile was characterized as significantly closer to that predicted by the minimum-jerk (maximum smoothness) kinematic model ( $P < 0.05$ ).

CONCLUSIONS: Correction of an anterior crossbite allows the patient to perform smoother jaw closing movements during chewing. These findings for achievement of smooth and economical jaw closing movements during chewing demonstrate necessity of orthodontic treatment of an incisor cross bite to improve jaw motor function.

#### 658 TOOTH PERIODONTAL DAMPING CHARACTERISTICS DURING RETENTION OF PATIENTS WITH CROWDING

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AIM: To investigate tooth mobility after active orthodontic treatment using a device, the Periotest.

SUBJECTS AND METHOD: Seventy patients with pre-treatment crowding. A positioner or perfector was used as the retention device. For each patient, tooth mobility in both arches was measured immediately after orthodontic treatment (T0) and then 1 (T1), 3 (T3), 6 (T6), and 12 (T12) months post-debond using a Periotest, according to the manufacturer's instruction.

RESULTS: No significant differences were found for any measurements between the left and right sides or between the positioner and perfector groups. At T1 and T3, the Periotest values for all the teeth (especially in the posterior group) increased in comparison with those at T0, due to the retention devices allow settling mostly of the posterior teeth. Tooth mobility significantly decreased at T6 and T12 compared with the values at T0. Negative correlations were found between the Periotest value and age. Significant differences were found between males and females at T0, but there was no influence of gender at T12. Comparing the extraction (26) and non-extraction (44) cases, the Periotest values for the anterior teeth were large in the extraction group at T3 but at T12 tooth mobility was almost the same.

CONCLUSION: The Periotest method is a simple and accurate method to measure tooth mobility, which is supposed to be one of the useful indicators to determine the cases period of retention. The necessary period for retention cannot be less than one year.

#### 659 CHANGES IN OCCLUSAL CONTACTS DURING RETENTION

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AIM: To characterize post-orthodontic settling of occlusion and to investigate how the retention device used after active orthodontic treatment affects occlusion.

SUBJECTS AND METHOD: Seventeen patients wearing a positioner and 13 a perfector retainer following orthodontic treatment to alleviate crowding, were compared to determine changes in number and the area of contacts. A-Silicon impression material (O-bite DMG) was used to record changes in occlusal contacts at four time periods during retention period: at the end of treatment (T0) and 1 (T1), 3 (T3) and 6 (T6) months post-debond. Bite registrations were examined on a light box. Occlusal photographs were then taken and analyzed using AutoCad09 software to assess number and the area of contacts.

RESULTS: No significant differences were found between the positioner and perfector groups at T6. A 50 per cent increased was recorded in the number and a 58 per cent increase in areas of contacts at T6. In both groups the most significant increases were found during T1-T3 (47 and 44%, respectively).



CONCLUSION: Positioner and perfector retention devices allow settling and an increase number and area of occlusal contacts, improving the occlusion of the teeth during three months of retention.

#### 660 RELIABILITY OF LINEAR CEPHALOMETRIC MEASUREMENTS ON THREE-DIMENSIONAL CRANIO-FACIAL IMAGES

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AIM: To evaluate the reliability of landmark identification and to explore the effects of differences in landmark identification on linear cephalometric measurements applied on three-dimensional (3D) craniofacial images.

MATERIALS AND METHOD: Pre-treatment axial computed tomographic images of 18 orthognathic surgery patients (9 males, mean age 21.7 years and 9 females, mean age 21 years). 3D images were reconstructed and measured with Mimics 12.01 image processing software. The identification of 16 landmarks, independently repeated by three investigators, and 14 linear measurements were calculated. The precision of the intra- and interexaminer measurements was assessed both in terms of millimetres and percentages and tested for statistical significance. Systematic errors for intra- and interexaminer analysis were assessed by Wilcoxon and the Mann-Whitney *U* tests, respectively.

RESULTS: There was no statistically significant difference between intra- and interexaminer analysis ( $P > 0.05$ ). The greatest difference was found in Co-Gn linear measurement (1.45% for intraexaminer results and 1.88% for interexaminer results).

CONCLUSION: 3D landmark identification and linear cephalometric measurements using 3D volume rendering by computed tomographic images can offer consistent and reproducible data for orthodontic applications.

#### 661 COMPARISON OF DENTOFACIAL EFFECTS OF TWO DIFFERENT INTRAORAL DISTALIZATION APPLIANCES

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AIM: To compare the dentofacial effects of two different intraoral appliances.

SUBJECTS AND METHOD: Twenty patients with a dental Class II malocclusion divided into two groups. In both groups bilateral molar distalization was performed for three months. In group I, 10 patients (7 females, 3 males; mean age:  $11.8 \pm 0.92$  years) were treated with a Molar Mover, and group II was composed of 10 patients (7 females, 3 males; mean age: of  $12.0 \pm 1.05$  years) treated with a Drive Tube. Dental models, photographs, cephalometric and basilar radiographs were taken before treatment and at the end of three months of distalization. Wilcoxon analysis was used to evaluate in-group differences and the Mann Whitney *U* test for between-group differences.

RESULTS: Molar distalization was attained in all patients. Distal molar tipping and distopalatal rotation were found in both groups. In group I, more distopalatal rotation was observed and this rotation caused an increase in intermolar distance. Extrusion, mesialization and mesial tipping of second premolars were also found in group I, while extrusion, distalization and distal tipping of second premolars were observed in group II. Vertical anterior face height increased in both groups due to tipping of the first molars and extrusion of the second premolars. The maxillary incisors were protruded due to the anchorage loss and this protrusion caused protrusion of the upper lip and reduction of the nasolabial angle.

CONCLUSION: Molar Mover and Drive Tube are both effective in molar distalization and these appliances can be used in the treatment of dentoalveolar Class II malocclusions without pain, irritation of the soft tissues, or hygiene problems.

#### 662 ANXIETY AND PATIENT CONCERNS BEFORE AND AFTER THE SURGERY WITH SKELETAL ANCHORAGE

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AIM: Skeletal anchorage has recently become popular in the early treatment of Class III malocclusion characterized by maxillary retrognathism. Rapid maxillary protraction with skeletal anchorage following surgical disarticulation of the maxilla is one of the treatment procedures. This treatment protocol performed under general anaesthesia may be considered invasive in a young age group. The aim of this study was to determine patients' perceptions and anxiety before and their concerns after surgery.

**SUBJECTS AND METHOD:** Twenty patients (age range 11 to 15 years). The Amsterdam Preoperative Anxiety and Information Scale and Spielberger's State Trait Anxiety Inventory were used to evaluate anxiety. Questionnaires were given to the patients one hour before the surgery. Post-operative discomfort, pain and swelling were assessed following the surgery. **RESULTS:** The findings showed that patients who wanted a lot of information were more anxious. Most of them reported that the surgical experience was better than they expected; they had little or no pain. The most frequent problem was post-surgical swelling, which, on average, lasted 5 days.

**CONCLUSIONS:** The operation is well accepted by patients. The personal approach of the clinician in informing patients seems to be the key factor affecting patients' perceptions and pre-operative attitude before surgery.

#### 663 BONE-ANCHORED MAXILLARY EXPANSION VERSUS BONDED MAXILLARY EXPANSION

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**AIM:** Along with the desired orthopaedic effect of conventional tooth-borne rapid maxillary (RME) appliances, tipping/extrusion of posterior teeth, bite opening, posterior rotation of the mandible are inevitable. Bonded expansion appliances with occlusal coverage reduce the undesired effects, but still lead to significant dental tipping. This study evaluated the effects of a new mini-implant supported maxillary expansion appliance (MISME) applying forces directly to the maxilla in comparison with bonded maxillary expansion.

**MATERIALS AND METHOD:** The records of 20 patients requiring maxillary expansion due to posterior crossbite were used. In the first group (N = 10, mean age: 11.15 years), maxillary expansion was achieved with a McNamara type bonded expansion appliance, whereas MISME was used in the second group (N = 10, mean age: 13.1 years). MISME is an acrylic expansion device that is bonded on four palatal miniscrews (diameter 1.6 mm, length 7 mm). Both appliances were activated with a semi-rapid protocol (RME of 5-7 days, followed by slow maxillary expansion twice a week) until the desired expansion was achieved. The average treatment duration was 57.9 and 96.7 days, respectively. Measurements from cephalometric, posteroanterior radiographs and dental models obtained before and after treatment were statistically evaluated. **RESULTS:** Nasal width and maxillary skeletal and dental widths increased significantly in both groups. Maxillary molar tipping was significant only in the first group, and the intergroup difference was significant ( $P < 0.001$ ) indicating a parallel expansion with MISME. Forward movement of the maxilla was significant with MISME ( $P < 0.01$ ). FMA changes differed between the groups ( $P < 0.01$ ), showing vertical control with the MISME.

**CONCLUSION:** MISME therapy resulted in parallel expansion of the maxilla. It is an easy applicable and hygienic method for RME in growing patients. MISME is recommended for patients with missing posterior teeth and high-angle cases with decreased overbite.

#### 664 ASSESSMENT OF DENTAL PLAQUE ACCUMULATION IN SUBJECTS UNDERGOING TREATMENT WITH CONVENTIONAL AND SELF-LIGATING BRACKETS

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**AIM:** To investigate the effects of two different types of brackets on oral hygiene. This study was performed by determining the microbial dental plaque area measurement present on the dental surface based on clinical index parameters obtained at different time intervals and photographic images taken at the same periods from individuals with mild crowding.

**SUBJECTS AND METHOD:** Twenty males between the ages of 12 and 15 years. In group 1 (10 patients) 0.018 inch slot self-ligating metal brackets (Quick-Forestadent) were used and in group 2 (10 patients) 0.018 inch slot conventional metal pretorqued brackets (Gemini-3M Unitek) with metal ligatures. In total six teeth, including the bilateral central, canine and first premolars in the upper jaw were involved. The plaque index, sulcus bleeding index, probing depth and percentage plaque area measurements of these teeth were repeated in on five different occasions as follows: baseline (T0), 2 weeks after oral hygiene education (T1), 1 week after bonding (T2), 1 month after bonding (T3) and 3 months after bonding (T4). After the teeth were disclosed by applying Mira-2-ton for better visualization of the microbial dental plaque area, the images of the disclosed plaque were taken from a standard distance using a digital camera. Six images per patient at each time point T0, were obtained. The photographs were loaded into a computer program that allowed screening of the microbial dental plaque area of the teeth using image-processing techniques. The percentage of plaque area was measured by calculating the differences between the pixel densities. The data were statistically analyzed.

**RESULTS:** No significant difference was found between two groups. However, oral hygiene was better with the Quick brackets.

665 PREVALENCE OF TAURODONTISM AMONG HYPO- AND OLIGODONTIC PATIENTS IN BULGARIA

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**AIM:** Taurodontism is an aberration of teeth resulting in constriction at the level of the cemento-enamel junction characterized by elongated pulp chambers, apical displacement of the bifurcation or trifurcation and shortened roots. Although taurodontism has been reported in the literature to be common in the hypodontia, no previous investigations exist for Bulgarian patients. The aim of this research was to investigate the occurrence of taurodontism among non-syndromic patients with hypo- and oligodontia.

**MATERIALS AND METHOD:** The prevalence of taurodontism was retrospectively studied from dental pantomograms of 40 patients aged 7 to 37 year patients with hypo- and oligodontia. Determination of taurodontism was made only on teeth with at least half of the root developed using the method of Shifman and Chanannel.

**RESULTS:** Single or multiple teeth with taurodontism, both unilaterally or bilaterally were present in 37.5 per cent of the patients. All three types of taurodontism were found mainly in the upper or lower permanent molars. The results indicate that the orthodontists should diagnose very carefully patients with hypo- and oligodontia.

**CONCLUSIONS:** High prevalence of taurodontism among hypo- and oligodontic patients is a clinical problem both for general dental practitioners and orthodontists. Successful outcomes in conventional orthodontic space closure in patients with hypo- and oligodontia also depend on careful diagnosis of taurodontism.

666 THREE-DIMENSIONAL COMPUTED TOMOGRAPHIC ANALYSIS OF MANDIBULAR MORPHOLOGY IN PATIENTS WITH FACIAL ASYMMETRY AND MANDIBULAR PROGNATHISM

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**AIM:** To investigate the dimensional changes at each skeletal component in the mandibles of patients with facial asymmetry and mandibular prognathism.

**SUBJECTS AND METHOD:** Fifty adult patients with mandibular prognathism, divided into a symmetry group (n = 20) and an asymmetry group (n = 30) according to the degree of menton deviation (MD). Three-dimensional (3D) computed tomographic (CT) scans were obtained using a spiral CT scanner. Landmarks were designated on the reconstructed 3D surface model. Lines to represent the condylar, coronoid, angular, body, and chin units were used. Ramal and body volumes were measured in the hemi-mandibles.

**RESULTS:** In the asymmetry group, condylar and body lengths were significantly longer, and coronoid length was significantly shorter on the non-deviated side than on the deviated side ( $P < 0.01$ ). Angular and chin lengths were not significantly different between the two sides ( $P > 0.05$ ). Ramal volume was significantly greater on the non-deviated side ( $P < 0.01$ ), but body volume was not significantly different between the two sides ( $P > 0.05$ ).

**CONCLUSIONS:** Both condylar and body components appear to contribute to mandibular asymmetry, with a more central role of the condyle.

667 EFFECTS OF HAN APPLIANCE TREATMENT ON LOWER AIRWAY SPACE IN PSEUDO-CLASS III CASES

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**AIM:** During the early mixed dentition period the prognosis of pseudo-Class III malocclusions is reported to be good. Holding the mandible in a posterior position and guiding the maxillary incisors into a correct relationship provides the opportunity for normal dental base development along with favourable skeletal growth during early treatment. The aim of this study was to evaluate lower airway space dimensions following the treatment of pseudo-Class III malocclusions with the Han appliance.

**SUBJECTS AND METHOD:** Nineteen subjects (10 females, 9 males, mean age: 10 years 5 months) with a pseudo-Class III malocclusion were treated with the Han appliance (mean treatment time: 4 months 18 days). Lateral cephalograms taken before and after treatment were used to evaluate the changes of the craniofacial structures and lower airway space dimensions. The effect of the Han appliance on the craniofacial structures and lower airway space was evaluated with the paired *t*-test. A correlation analysis was applied to determine the relationship between craniofacial structures and lower airway changes.

**RESULTS:** A significant decrease in SNB angle and a significant increase in ANB angle occurred during Han appliance treatment. Sn/GoGn angle increased significantly showing a clockwise rotation of the mandible. No significant changes

were found for the oropharyngeal dimensions during the treatment period. No correlation was found between the oropharyngeal measurements and craniofacial variables.

CONCLUSIONS: Functional treatment of a pseudo-Class III malocclusion with the Han appliance did not change the lower airway space dimensions.

#### 668 AVERAGING OF THREE-DIMENSIONAL FACIAL IMAGES – ADVANCED APPROACH

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AIM: To develop advanced techniques for averaging three-dimensional (3D) facial images that would provide an improved accuracy of 0.5 mm or better.

MATERIALS AND METHOD: The techniques apply to studying any cohort of population, including an arbitrary number of subjects. Surface data are acquired with laser or optical scanners (e.g., Konica Minolta or 3dMD) and processed to obtain 3D facial shells accurate to within 0.5–1 mm. The averaging is performed as follows: (i) the facial shells are landmarked and fitted into a common reference frame with mid-endocanthion taken as the origin, (ii) each shell is scaled to a common mean size, (iii) an average face is computed using the template-averaging algorithm with a sphere taken as the template, (iv) the facial shells are realigned on the resulting average face using a best-fit algorithm with scaling, (v) a new average face is computed using the previous average face as the template and (vi) the last two steps are repeated until a desired accuracy is attained. All algorithms are implemented as in-house subroutines for Rapidform software.

RESULTS: The procedure converges in three or four iterations and results in an average face accurate to 0.5 mm or better. The inclusion of new steps, (ii) and (iv), as compared with the existing method allowed an overall increase in the accuracy across the average face and especially in the nose, lips and chin areas; the effect is particularly pronounced for small samples.

CONCLUSIONS: Average shells are important in studying facial anomalies versus normal facial morphology, evaluating facial asymmetries and average facial growth, comparing facial morphologies for different ages, gender and ethnicity etc. They are useful as templates for aligning other faces to quantify differences and, particularly, to study individual facial growth. The techniques suggested enable these studies to be performed with improved accuracy.

#### 669 SURVEY OF ORTHODONTIC RADIOLOGICAL PRACTICE AND LATERAL CEPHALOMETRY TRACING ACCURACY IN SWITZERLAND

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AIM: To evaluate Swiss orthodontists' knowledge of their radiographic equipment and their radiographic habits, as well as to assess the reproducibility of landmark identification and tracing habits on lateral cephalograms.

SUBJECTS AND METHOD: A questionnaire, plus a standard lateral cephalogram, was sent to 163 Swiss orthodontic specialists. Prior to the start of the study the participants were randomly assigned to either a non-instructed or an instructed group. These groups were advised to trace the 26 cephalometric landmarks according to their routine or to specific written guidelines for landmark identification. To determine the significance of differences between two independent groups Mann-Whitney-*U* test was applied.

RESULTS: Eighty-five of the original 163 questionnaires were returned including a cephalometric tracing. All responders had a cephalometric radiographic unit in their office and 67 per cent of them used it on all their patients. The main landmarks of interest were sella, points A and B, nasion, and anterior and posterior nasal spine. The angles with the least difference between the two groups were: ANB and nasion-sella-articulare. Clear written guidelines did not have any significant impact on the accuracy of tracings and on measurement of angles or distances.

CONCLUSION: Two-thirds of the responding orthodontist, irrespective of their postgraduate education, routinely obtain lateral cephalograms on all their patients for assessment of the skeletal pattern and for treatment planning. Interexaminer reliability for tracing of a standard lateral cephalogram was high for most landmarks, and precise written guidelines did not cause a significant reduction in the standard deviations for measurements assessed.



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