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Bilaterally impacted maxillary canines and multiple missing teeth: a challenging adult case

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Structured Abstract

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Objectives – Orthodontic correction of bilateral maxillary canine impaction with agenesis of the lower second premolars and extraction of the lower first molars in an adult patient.

Methods – After surgical exposure, the canines were relocated in the arch by means of immediate orthodontic traction. Endosseous Brånemark system® implants were inserted in the lower jaw with a double purpose: stabilization of orthodontic anchorage and prosthetic tooth replacement.

Results – Closure of the edentulous space in the lower arch was accomplished by a multidisciplinary approach while orthodontic correction of the initial malocclusion was achieved.

Conclusion – Implants provided anchorage control for tooth movement and created the possibility of prosthetic rehabilitation through a multidisciplinary treatment approach.

Key words: clinical anchorage; impacted canine; implants; orthodontic correction; osseointegration; tooth replacement

Introduction

Impacted teeth are a common finding in patients consulting an orthodontic practice. After the third molars, maxillary canines are among the most frequently impacted teeth with an incidence ranging between 1 and 3% (1–5). Impaction is twice as common in females (1.17%) as in males (0.51%) (1, 2, 6). Of all individuals with impacted canines 8% seem to be bilateral (1, 5).

The maxillary canine not only has the longest period of development, it also has the longest and most tortuous path of eruption from its point of formation,

lateral to the piriform fossa, to its final destination in the dental arch (1, 2, 7, 8).

General causes resulting in retarded canine eruption include endocrine deficiencies, febrile diseases and irradiation. More specific the etiology of canine pathology comprises tooth size-arch length discrepancies, prolonged retention or early loss of deciduous canines, abnormal position of the tooth bud, ankylosis, cystic or neoplastic formation, root dilacerations, the presence of an alveolar cleft and other iatrogenic or traumatic factors (1, 2, 5).

In recent studies palatal impactions have also been associated with either the absence of roots or variations in the root size of the associated maxillary lateral incisor (1, 2, 5, 6, 9). The genetic origin for palatally impacted canines has also been proposed (2, 6).

Extraction, trauma or agenesis leads to the absence of teeth. In the literature the frequency of agenesis of the lower second premolars is reported to be 2.5–4% (10). Once agenesis of the lower second premolars is diagnosed, the appropriate treatment necessitates the formulation of a comprehensive treatment plan, which is dependent on a number of factors. These include the condition of the deciduous molars, dental and skeletal relationships, dental age of the patient, willingness of the patient to undergo extensive dental treatment and financial considerations (11).

The extraction of the first permanent molars accounts for a considerable proportion of cases treated within the United Kingdom's National Health Services (12). These extractions are mostly done because of caries (13) and result in the deepening of the overbite on average and changes in overjet, both related to lingual positioning and retroclination of the lower incisors (14).

Tooth movement in an adult mutilated dentition exacerbates the problem of anchorage control. Generally adults are reluctant to wear extra-oral force systems because of socio-psychological inconvenience. Moreover the few remaining teeth do not provide sufficient anchorage for orthodontic correction of the malocclusion without undesirable effects on the adjacent teeth (15). In such a case, implants, which are osseointegrated units that can only be moved by fracturing the interface (16), not only provide excellent anchorage control, but also create the possibility of prosthetic rehabilitation (17). The success of using implants lies in the multidisciplinary planning of the whole treatment (18).

This paper presents a case of bilateral maxillary canine impaction in an adult with agenesis of the lower second premolars and extraction of the lower first molars.

Case report

A 27-year-old patient was referred by the Department of Prosthodontics of the University Hospital of the KULeuven for the persistence of the deciduous maxillary canines in the upper arch and the deciduous second molars in the lower arch.

Clinical examination together with an orthopantomogram (Fig. 1), a lateral headplate (Fig. 2), intra and extra oral photographs (Figs 3–5) led to the following orthodontic diagnosis: a Class II division malocclusion with a straight profile tending towards a dished-in aspect, a neutral jaw relation, neutral occlusion, a full

Fig. 1. Pre-treatment panoramic radiograph showing agenesis of the lower second premolars, horizontal impaction of the maxillary canines and extraction of the lower first molars.

Fig. 2. Lateral headplate before treatment showing a neutral jaw relation and steeply inclined upper and lower incisors.

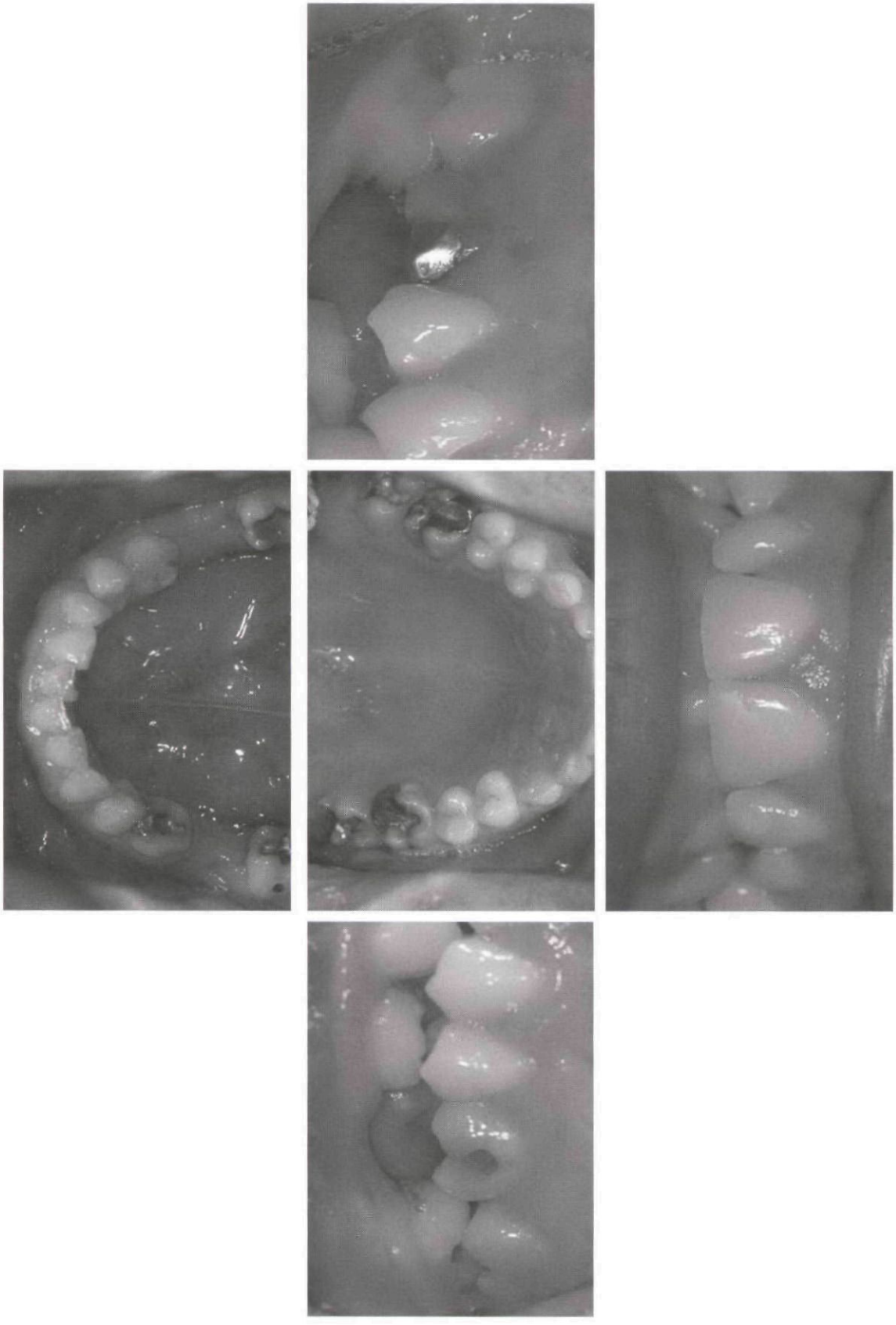

Fig. 3. Pre-treatment intraoral photographs demonstrating a full covered bite.

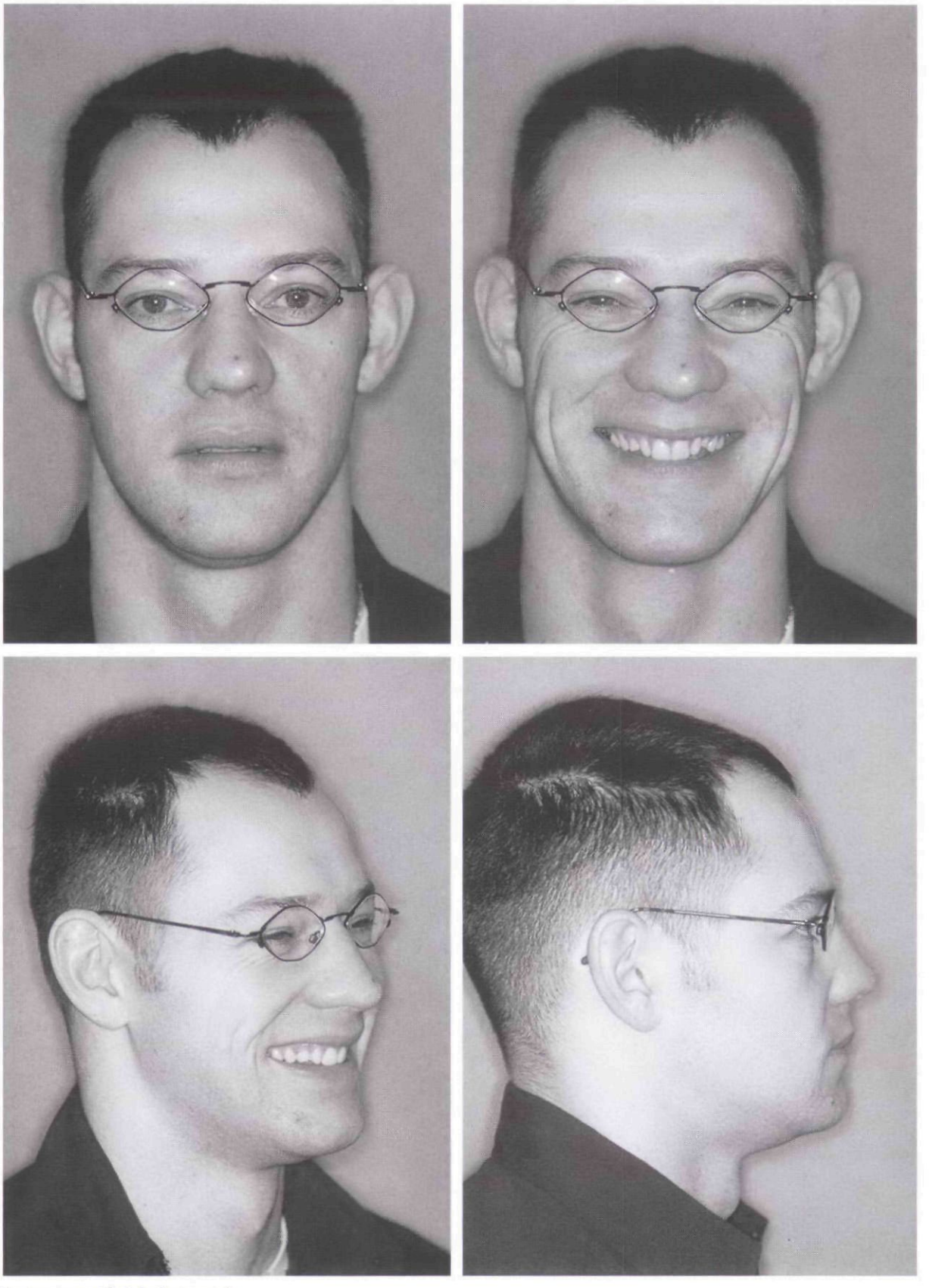

Fig. 4. Pre-treatment facial photographs.

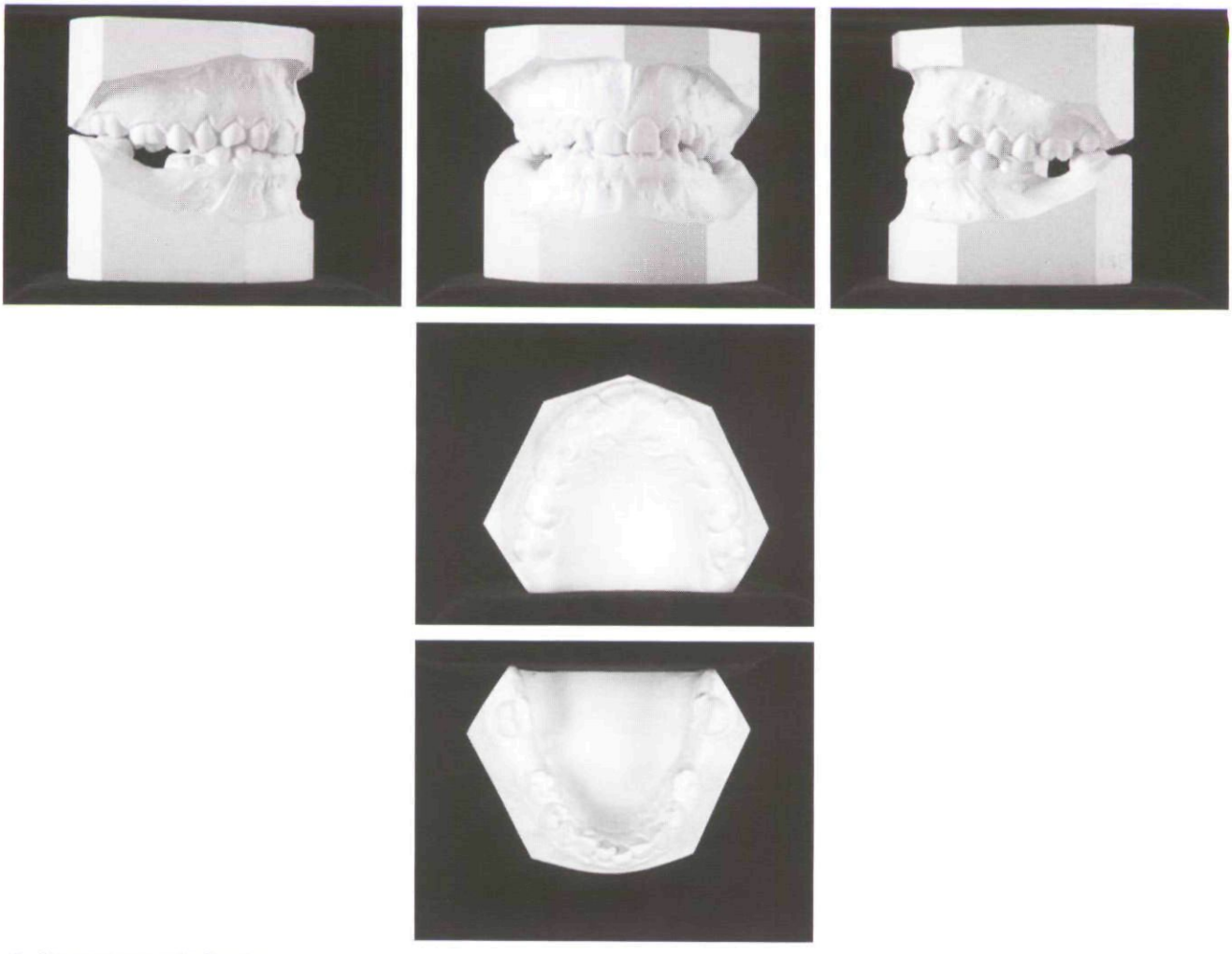

Fig. 5. Pre-treatment study casts.

covered bite, persisting deciduous upper canines and lower second deciduous molars, extraction of the lower first molars and retroclined upper and lower incisors. The panoramic radiograph (Fig. 1) revealed agenesis of the lower second premolars. The clinical mobility and the mild infra-occlusion of both the deciduous second molars led to the decision that they were unsuited for lifelong preservation. Both maxillary canines were impacted horizontally with the crowns positioned medially towards the roots of the central incisors. Further detailed radiographic investigation by means of apical radiographs and computer tomography disclosed no significant resorption of the roots of both central and lateral maxillary incisors. The canines were located palatally after clinical palpation and application of the buccal object rule for radiographic evaluation.

Periodontal probing before orthodontic treatment did not show any attachment loss.

Treatment approach

The following treatment plan was conceived:

1. full mouth prophylaxis and conservative treatment of the present caries.
2. placement of two implants bilaterally in the lower jaw.
3. surgical exposure of the upper maxillary canines and start of the closed eruption technique (19–21). Orthodontic extrusion using a removable appliance.
4. standard fixed edgewise appliances (0.018″ slot size) in upper and lower jaw.
5. retention with a fixed lingual retainer in the lower jaw and a Hawly-retainer in the upper jaw.
6. the manufacturing of the permanent prosthetic restorations on the implants.

The patient was willing to undergo a combined surgical–prosthetic–orthodontic treatment after having

been informed about the length of the treatment and the possible related risks such as root resorption, anesthesia of the nervus alveoalaris inferior, failure of the osseointegration of the implants.

Treatment began with the extraction of the lower deciduous molars. The exact location and orientation of the implants were determined according to a method described by Willems et al. (15) (Fig. 6). First an orthodontic diagnostic setup was made with the teeth in the desired future position. Subsequently, the missing teeth were waxed up on both sides in order to obtain a proper occlusion with the upper dentition. After transfer of the replacement teeth from the setup cast to the original cast by means of a putty overlay matrix, their contour and the existing occlusion determined the center of the implants. Succeedingly an implant placement guide was fabricated in the laboratory and implants were inserted in the lower jaw 3 weeks after the extraction (Fig. 7). During the surgical placement of the implants, close attention was paid to

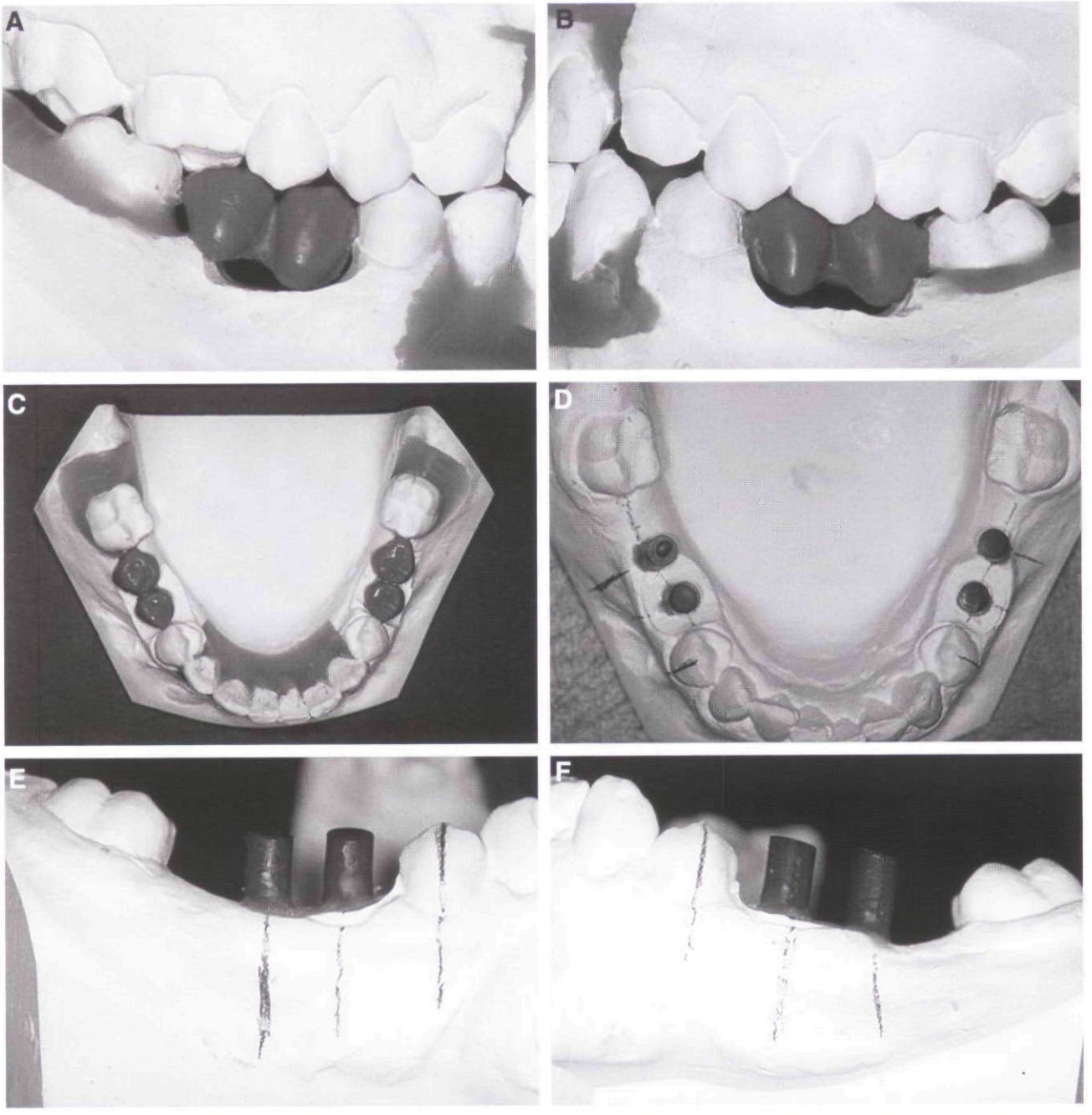

Fig. 6. Determination of the location and orientation of the implants according to the method described by Willems et al. (15). A–C: Orthodontic diagnostic setup with waxed up missing teeth. D–F: Location and orientation of the implants on the original cast.

Fig. 7. Implant placement guide.

trauma-free surgery by first raising a mucogingival flap. In addition to a sterile surgical operatory along with sterile instruments, an appropriate sterile irrigant was mandatory. Overheating osseous structures during implant drilling will almost always cause failure of the osseointegration and a fibrous encapsulation will ensue.

During the low speed drilling process (<800 rpm), with constant cooling through sterile irrigation and with the use of sharp drills, the appropriate osteotomy site for the implant placement was attained by a stepwise increase to final site diameter. Four Bränemark system® implants with a length of 10 mm and a diameter of 4 mm were inserted and covered with a tension-free sutured flap, with close tissue adaptation to the implant surfaces. The implants were left unloaded during a four-month healing and osseointegration period (22).

Meanwhile the palatally impacted canines were exposed: incisions were made from the distal of the premolar to the mesial of the central incisor and full thickness flaps were reflected. As the impactions were located high in the roof of the mouth, special attention was paid to the neurovascular bundle of the incisal canal. The bone covering the crowns was removed and cleats with a wire ligature were bonded on the cusps. The impacted teeth were gently luxated with an elevator to rule out possible ankylosis. After having tested the bond strength, by pulling on the traction ligature, the flaps were sutured over the attachments, leaving a window allowing the ligating wires to run outside of the flaps (5, 19–21) (Fig. 8). A removable appliance was used to transfer anchorage demands to the maxillary teeth, the palatal vault and the alveolar ridge. This Hawley-type appliance was designed with multiple clasps for adequate retention, an anterior bite plane and two heart-shaped metal devices to allow vertical elastic traction on the impacted canines. The gross displacement of the canines was accomplished by means of elastic traction within a period of about 1 year (Fig. 9).

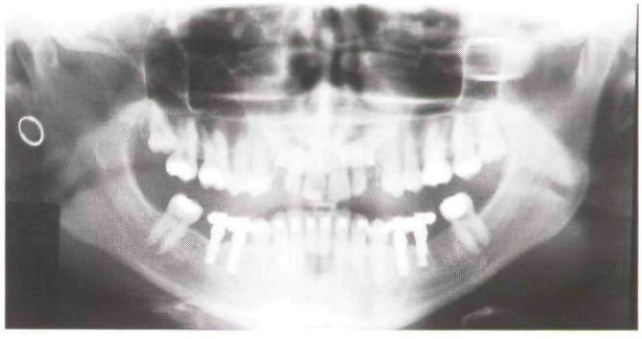

Fig. 8. Panoramic radiograph after surgical exposure of the impacted maxillary canines and osseointegration of the lower implants.

Four months after the placement the implant cover screws were removed and replaced by abutments. Temporary crowns with mounted brackets were installed and provided excellent anchorage for the desired tooth movement. An anterior bite plane enabled bracket placement in the lower jaw. Alignment was accomplished through a series of increasingly stiff wires. The lower incisors were intruded following the segmented arch approach described by Burstone. Hereby the overbite was diminished without reducing the lip to tooth relationship. Therefore three separate 0.016×0.022 inch segmented stabilizing arch wires were inserted: one anterior and posterior on each side in connection with the implants to provide maximal anchorage control. A 0.016×0.022 inch stainless steel intrusion wire with a helix of 1 1/2 turns was inserted into the right and left molar auxiliary tubes and was tied to the anterior segment as a point contact. The anterior teeth could then maintain their positions relative to each other as they were intruded (23).

Once brought into the dental arch, the upper canines were uprighted with 0.017×0.025 inch sectional springs; further second order corrections and

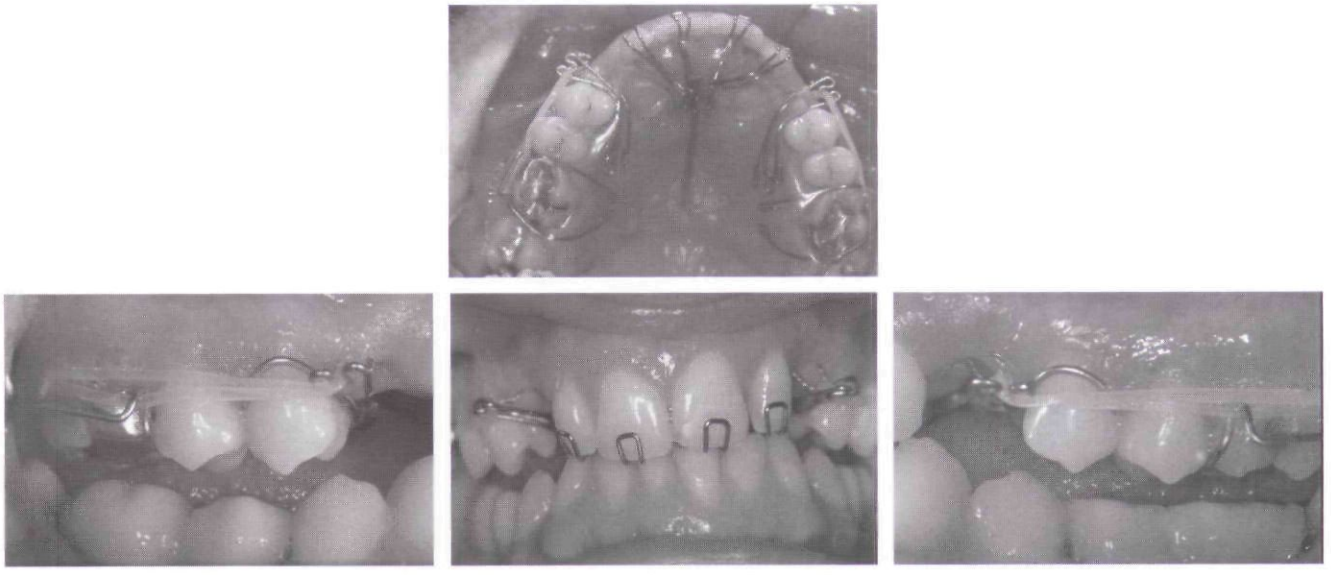

Fig. 9. Displacement of the impacted maxillary canines by means of a removable appliance.

root-torquing were accomplished with an 0.016 × 0.022 inch-arch wire.

The canines had to be mesialized to close the remaining diastemas because of a tooth-size discrepancy.

The orthodontic treatment with removable and fixed appliances was completed in approximately 40 months.

When an acceptable occlusion with adequate root dispersion had been achieved, the appliance was

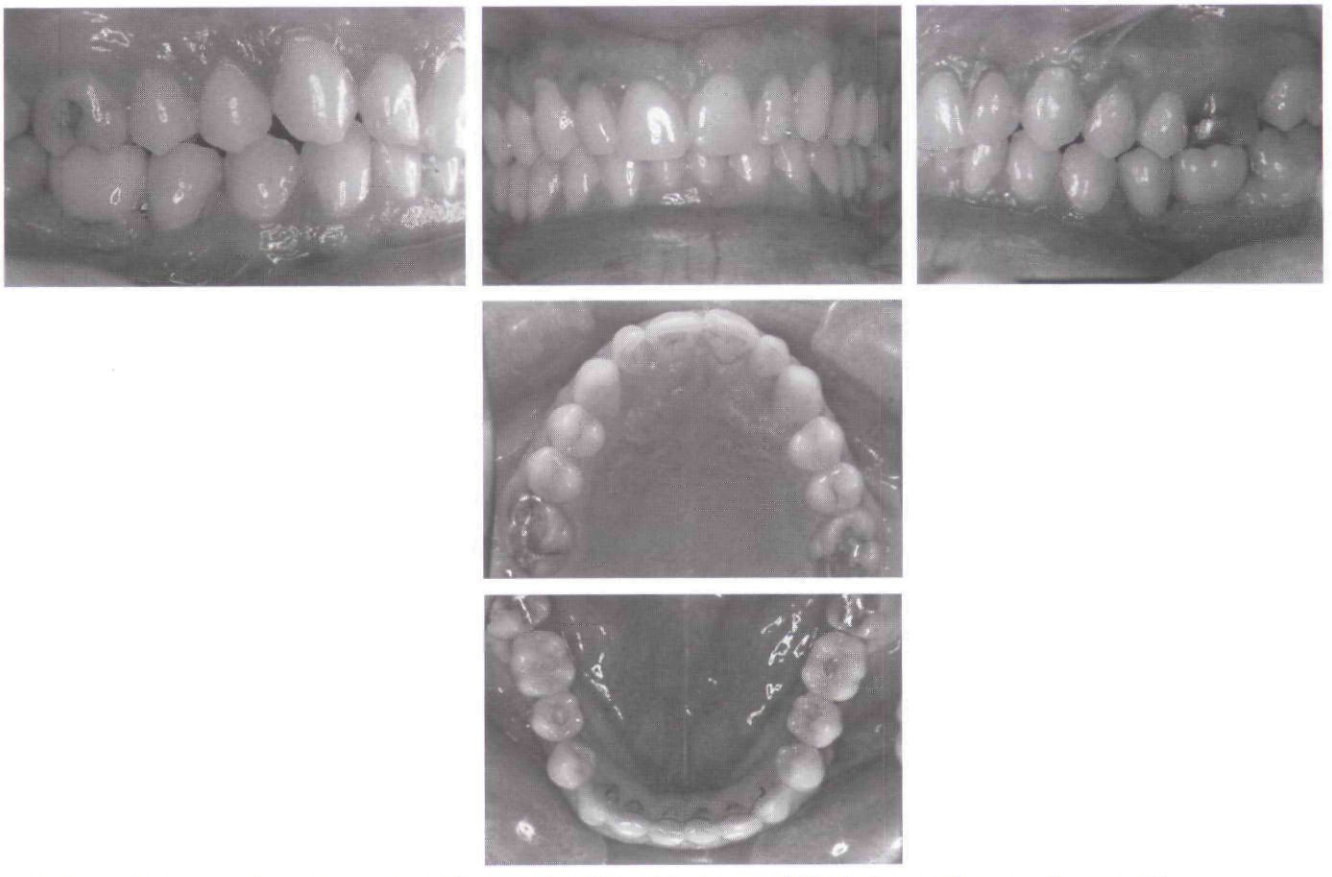

Fig. 10. Intraoral photographs post-treatment. The central and lateral incisors could be built up with composite material.

Fig. 11. Post-treatment facial photographs.

removed and a 0.0175 inch-twisted wire was bonded to the lingual of the mandibular anterior teeth as a retainer. In the upper jaw a removable Hawly-retainer was used (Fig. 10).

Treatment results

The two impacted canines were positioned into proper alignment with the remaining permanent teeth, resulting in a complete anterior dentition and a pleasant smile (Figs 10–13).

During the 3 years of treatment and thereafter no sign of root resorption, vitality impairment or other damage to the lateral incisors or canines was observed. Radiographically, the canines displayed proper root inclination (Fig. 12).

The replacement of the agenetic lower second premolars and of the extracted lower first molars by means of four implants and their use for anchorage control

Fig. 12. Panoramic radiograph post-treatment.

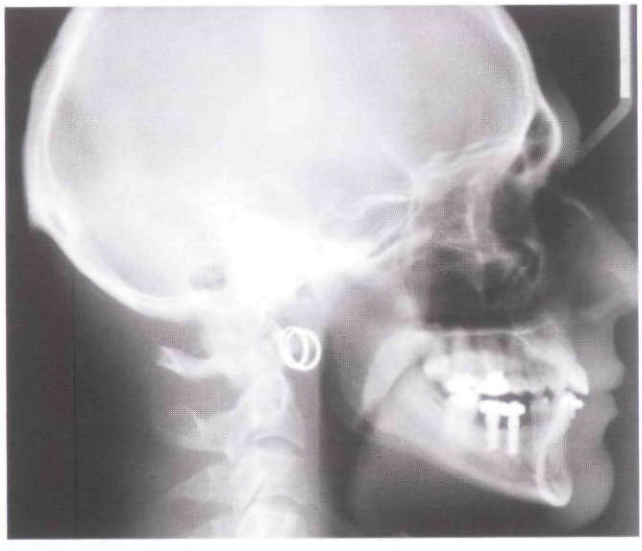

Fig. 13. Lateral headplate post-treatment.

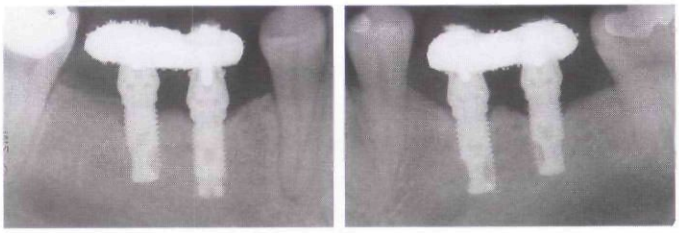

Fig. 14. Radiographs of the implants after their use as anchorage units in orthodontic treatment.

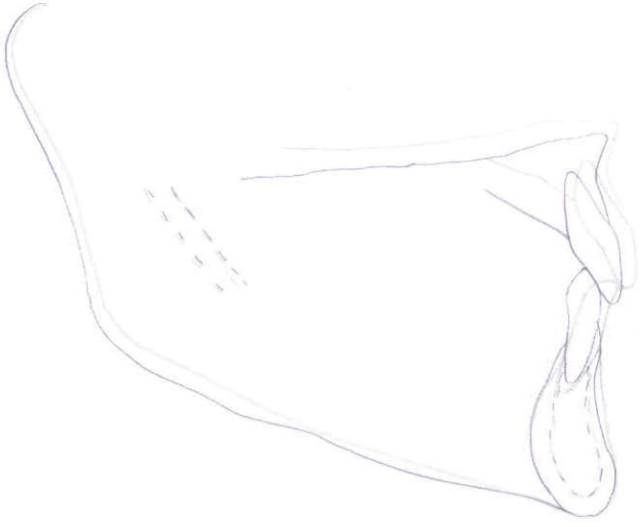

Fig. 15. Superimposition of the lateral headplates pre- and post-treatment using Bjork's stable anatomical structures shows intrusion of the lower incisors.

was a success. Also after 2 years follow-up there was still a good osseointegration and stability (Fig. 14).

Leveling of the deep bite occurred mainly by intrusion of the lower incisors as seen on the superimposition of the lateral headplates pre- and post-treatment (Fig. 15).

The patient had provisional implant restorations for 1 year to ensure the stability of the occlusion and the remodeling of the bone around the implants. Thereafter the temporary restorations were replaced by permanent screw retained restorations.

As a result of inadequate patient compliance some objectives were not completely met: the final occlusion was not fully Class I at the canines mainly because they had to be moved mesially. The patient did refuse to have them reshaped with composite material to compensate for tooth size discrepancy (Fig. 10).

Discussion

Treatment of this case, with bilateral maxillary impacted canines, agenesis of the lower second premolars

and extraction of the lower first molars, had a strong multi-disciplinary character, which necessitates a full cooperation between the concerned disciplines (18). The implants were inserted with the view of providing anchorage control for the orthodontic treatment and of making prosthetic rehabilitation possible. Notwithstanding the fact that the implants, after respecting a healing period of 4 months, were used as an anchorage device for tooth movement, their osseointegration remained stable. This is analogous to the results of a recent study in which the periodontal outcome of implants used in orthodontics was evaluated. The success rate of the implants at surgery and during/after orthodontic treatment was high. After therapy the implants were still surrounded by an acceptable marginal bone level and the clinical periodontal parameters were favorable (24). After orthodontic treatment a mean probing depth around the implants ranged from 2.8 to 3.7 mm and no significant bone loss was observed. In a previously published study by Roberts (25) the implants also remained osseointegrated after having been used as a rigid anchorage device for the translation of molars.

Several studies have documented the use of implants for orthopedic anchorage. However, only a few reports have reported the use of osseointegrated oral implants to anchor tooth movement (25–27).

The prognosis for orthodontic eruption and repositioning of the impacted canines within the dental arch depends on the position and angulation of the impacted teeth, the patient's age, the available space and the presence of keratinized gingival tissue (5).

An adult case with bilaterally impacted canines, lying in a completely horizontal position, is at the very least challenging. Immediate orthodontic traction after surgical exposure during the entire treatment was mandatory as the canines could then immediately be guided into their correct position (Fig. 8).

The choice for a removable appliance to extrude the impacted canines was twofold. First, this type of appliance transfers a large portion of the anchorage demands to the palatal vault and alveolar ridge, whereas with the use of fixed appliances the anchorage is entirely supported by the teeth themselves. Secondly, during the osseointegration period of the implants, the removable appliance was used as a first phase in orthodontic treatment and eventually functioned as an anterior bite plane, hence reducing the length of time that fixed appliances had to be worn in the upper jaw, with all associated benefits and the possibility of avoiding some gingival and/or carious problems. But on the contrary, a removable appliance necessitates a good cooperation from the patient.

An alternative treatment could have been the extraction of the impaired deciduous canines, the surgical removal of the impacted permanent cuspids and their replacement by implants. However, most clinicians agree that permanent canines are almost indispensable for an attractive smile and for functional occlusion (1).

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