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Surgically assisted rapid maxillary expansion: long-term stability

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SUMMARY The purpose of this study was to evaluate treatment outcomes and long-term stability in patients treated by surgically assisted rapid maxillary expansion (SARME) and to compare the results with a matched, untreated control group. The sample comprised consecutive study models from 31 subjects (17 males and 14 females) with a mean pre-treatment age of 25.9 years [standard deviation (SD) 9.6]. The mean follow-up time was 6.4 years (SD 3.3). The transverse distances between the maxillary canines and maxillary first molars were measured with digital sliding callipers before treatment (T0), after treatment (T1), and at follow-up (T2). The data were analysed with a Mann–Whitney *U*, Spearman's rho, and Wilcoxon signed-rank tests.

At T1, all posterior crossbites were corrected and the expansions were statistically significant. At T2, despite some reduction in the transverse measurements, the posterior crossbites remained corrected. There were no statistically significant differences between the treatment and control groups at T2 regarding transverse measurements, except for the distance between the mesio-buccal cusp tips of the maxillary first molars. In the treatment group, there was no significant difference in terms of reductions in the transverse dimensions over the short- or long-term, no significant correlations between age or gender and the decrease in transverse dimensions or between the degree of anterior and posterior expansion. There were no significant correlations between the degree of expansion and subsequent post-treatment decrease.

The results indicate that SARME normalizes the transverse discrepancies and is stable a mean of 6 years post-treatment. The decreases in the transverse dimensions are most pronounced during the first 3 years post-treatment.

Introduction

Surgically assisted rapid maxillary expansion (SARME) has been an accepted modality in orthodontic therapy for many years. It is a well-known and widely used technique to expand the maxilla in skeletally mature and non-growing individuals.

In most cases, the indications are the same as for conventional expansion: posterior skeletal crossbite exceeding 5 mm, mild crowding, or to facilitate later treatment of anteroposterior discrepancies (Wertz, 1970; Haas, 1980; Bishara and Staley, 1987; Betts *et al.*, 1995).

The importance of nasal breathing to maintain favourable conditions for normal growth in the naso-maxillary complex has been emphasized (Linder-Aronson, 1979; McNamara, 1981). Hershey *et al.* (1976) and Warren *et al.* (1987) advocated RME to promote nasal breathing and to reduce nasal resistance, and Cistulli *et al.* (1998) in the treatment of sleep apnoea.

There is no consensus concerning the optimal technique for SARME or the minimal procedure required to achieve consistent and stable maxillary expansion. Proffit *et al.* (1996) stated that widening of the maxilla was not a stable surgical movement and recommended long-term retention. While several different surgical techniques are described in the literature, some more invasive than others, there is a tendency towards minimally invasive surgery to minimize complications (Anttila *et al.*, 2004).

The mid-palatal suture was earlier considered to be an area of major resistance (Melsen, 1975; Shetty *et al.*, 1994). Timms and Vero (1981) assumed that the mid-palatal suture was the target area and suggested mid-palatal osteotomy. However, Isaacson *et al.* (1964) and Isaacson and Ingram (1964) had previously shown this to be incorrect. Lines (1975) and Bell and Epker (1976) demonstrated that the areas of increased skeletal resistance were the zygomatico-temporal, -frontal, and -maxillary sutures. Resistance to maxillary transverse expansion was assumed to be the sum of all surrounding skeletal components (Bishara and Staley, 1987; Shetty *et al.*, 1994, Işeri *et al.*, 1998) and some authors recommended sectioning of almost all articulating maxillary structures (Bell and Epker, 1976; Kraut, 1984; Turvey, 1985).

Several techniques comprise lateral maxillary corticotomies with an additional palatal osteotomy (Lines, 1975; Pogrel *et al.*, 1992; Betts *et al.*, 1995; Strömberg and Holm, 1995; Northway and Meade, 1997). It is claimed that this technique is necessary to achieve predictable and stable expansion (Pogrel *et al.*, 1992). Lehman *et al.* (1984), on the other hand, presented a simplified approach involving only maxillary lateral osteotomies and pterygomaxillary detachment. Glassman *et al.* (1984) demonstrated minimal morbidity and post-operative complications without pterygomaxillary detachment. In a randomized controlled study, do Egito Vasconcelos *et al.* (2006) found no significant difference in maxillary expansion with or without pterygoid plate separation. Anttila *et al.* (2004) concluded that minimally invasive SARME is feasible in non-growing individuals and results in long-term stability comparable with other, more invasive osteotomies. Furthermore, the technique is also applicable to patients over 30 years of age.

There are few studies of long-term stability after SARME; either the samples are too small or the follow-up periods too short (Lagravère *et al.*, 2006).

In a retrospective study of 20 patients, Strömberg and Holm (1995) reported stable and satisfactory outcomes for a mean follow-up period of 3.5 years. Bays and Greco (1992) found good and stable results for a minimal surgical approach 6 months to 2.4 years post-retention. In seven patients, Bierenbroodspot *et al.* (2002) found predictable, adequate expansion 1–1.5 years after SARME. Berger *et al.* (1998) compared conventional maxillary expansion in growing individuals with SARME with non-growing individuals and found no differences in the tendency to relapse 1 year post-treatment. Anttila *et al.* (2004) observed stable results in a long-term follow-up of 12 patients (mean follow-up 4.7 years, range 2.8–9.3 years).

Northway and Meade (1997) compared immediate treatment outcomes using three different expansion approaches in non-growing individuals: orthopaedic expansion and two techniques of SARME. The post-treatment results were stable for all three approaches. The periodontal impact was, however, more pronounced following orthopaedic expansion.

There is some debate over whether or not expansion occurs evenly throughout the maxilla. Some studies show more expansion anteriorly than posteriorly (Bays and Greco, 1992; Mossaz *et al.*, 1992; Pogrel *et al.*, 1992). On the contrary, Anttila *et al.* (2004) reported less expansion between the canines, which was attributed to a less invasive osteotomy and more skeletal resistance in the frontal area.

The purpose of the present study was to determine the degree of stability of the transverse dimensions of subjects who had undergone SARME similar to that described by Lehman *et al.* (1984), 6.4 years after retention, and to compare these patients with a matched control group of untreated subjects.

Materials and methods

The material consisted of study models from 31 consecutive patients (14 females and 17 males) treated with SARME at the Institute for Postgraduate Dental Education, Jönköping, Sweden, between 1991 and 2000. The mean age of the patients at the start of treatment was 25.9 years [standard deviation (SD) 9.6, range 15.7–48.9 years].

The indications for treatment were bi- or unilateral posterior crossbites with anterior crowding in 16 subjects. Eleven patients required maxillary expansion to facilitate later surgical mandibular advancement, and four to relieve anterior crowding.

In order to ensure a strict treatment protocol, all treatment plans were formulated and confirmed by an interdisciplinary team of orthodontists and oral and maxillofacial surgeons.

Orthodontically, maxillary expansion consisted of a tooth-anchored device activated by means of a conventional Hyrax expander (Hyrax II, Dentaurum, Ispringen, Germany) with a soldered framework and orthodontic bands on the first molars and first premolars (Figure 1). In subjects with missing first premolars, the second premolars, and the second molars were banded. In one patient with missing first premolars, the first molars and canines were banded. No acrylic pads were used. The appliance was scheduled for insertion as close as possible to the date of surgery.

Surgical treatment followed a technique similar to that described by Lehman *et al.* (1984) and was undertaken by three experienced senior oral and maxillofacial surgeons.

Incisions and bilateral osteotomies were performed on the maxillary lateral walls from the piriform aperture to the pterygoid fissure. The pterygoid fissures were separated on both sides with a curved osteotome and a minor vertical osteotomy at the anterior spine was carried out with an osteotome according to Cureton and Cuenin (1999). No palatal osteotomy was performed.

The surgery was carried out under general and local anaesthesia in 26 subjects and under sedation and local anaesthesia on an outpatient basis in the remaining five patients. The hyrax expander was activated up to 12 turns (3 mm) during surgery to verify the success of the osteotomy, and then deactivated by the same amount.

Depending on the type of anaesthesia, the patients were discharged from the hospital on the same day or the day after surgery.

The degree of expansion was calculated for each individual, including a general overexpansion of a half cusp

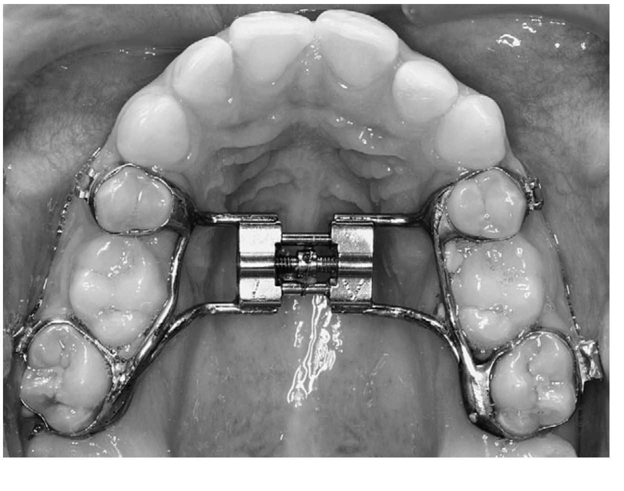

Figure 1 Tooth-anchored device activated by means of a conventional Hyrax II expander with a soldered framework and orthodontic bands.

width bilaterally. The patients were instructed to start activating the appliance with one turn twice a day (0.5 mm) on the first day after surgery. Post-operative control was scheduled 1 week post-surgery and included an occlusal radiograph to ensure clinically symmetrical opening of the mid-palatal suture and a medial diastema. In all 31 patients, opening of the mid-palatal suture was established and confirmed by post-expansion occlusal radiographs.

After the active expansion period (mean 15 days, range 14–22 days), with overexpansion and buccal tipping, the appliance was left *in situ* as passive retainer for 90 days. At that time, the hyrax expander was replaced by a modified transpalatal arch (Figure 2) and fixed appliance treatment was commenced. On completion of the active treatment phase, the transpalatal arch was removed and the fixed appliance treatment continued with stiff rectangular archwires, in order to adjust the transverse width and to control and correct the buccal root torque of the molars. All posterior crossbites were corrected by the end of treatment. A Hawley plate was used for retention: full time for 6 months and then at night for the following 6 months. Treatment was then concluded.

Study models were obtained before treatment (T0), after completed orthodontic treatment and retention (T1), and at follow-up T2. Direct measurements on the study models were made to the nearest 0.01 mm with a digital sliding calliper (model Mitutoyo 500-171, Kanagawa, Japan). As shown in Figure 3, anterior intermaxillary measurements were taken at two reference points on the canines, and posterior measurements at two reference points on the first molars. Two measurements were made on each tooth to assess dental tipping. In order to evaluate whether treatment had normalized the transverse discrepancies, the results were compared with an untreated control group, matched for age, gender, and follow-up time. All measurements were performed by one author (AM).

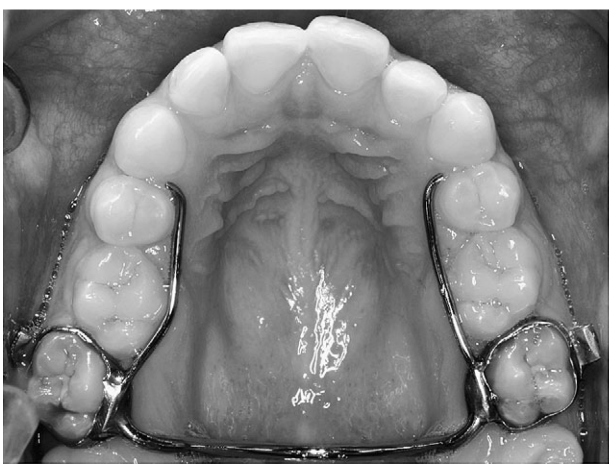

Figure 2 The appliances were left *in situ* as passive retainers for 90 days. At this time, the Hyrax expander was replaced by a modified transpalatal arch.

In order to evaluate post-treatment changes over time, the treatment group was divided into two groups: those who were followed for less than 5 years and those followed for more than 5 years (15 subjects, mean 3.7 years and 16 patients, mean 9.3 years, respectively).

Measurement error study

Ten study models from the treatment group were randomly selected and remeasured by the same observer after an interval of 4 weeks. The measurement error was calculated by intraclass correlation coefficients (ICCs) for single measurements, which is an expression of intraobserver reliability. The ICCs were between 0.995 and 0.999. An ICC above 0.75 indicates excellent reliability.

Statistical analysis

Statistical analyses were undertaken using the Statistical Package for the Social Sciences version 13.0 (SPSS Inc., Chicago, Illinois, USA). As the data were not normally distributed non-parametric tests, Mann–Whitney *U*, Spearman's rho, and Wilcoxon signed-rank tests, were used.

Results

Pre-treatment T0

At T0, as shown in Table 1, there were significant differences in the transverse dimensions between the treatment and control groups for all four measured distances, *CI*, *CII*, *MI*, and *MII*.

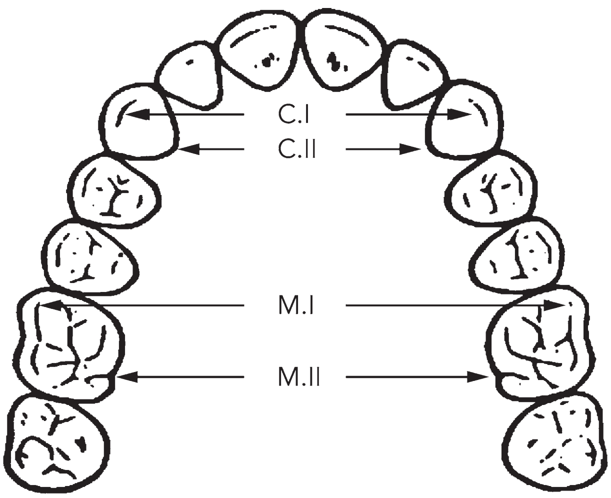

Figure 3 Direct measurements on the study models were made to the nearest 0.01 mm with a digital sliding calliper. Anterior intermaxillary measurements were taken at two reference points on the canines and posterior measurements at two reference points on the first molars. *CI* denotes the distance between the cusp tips of the canines and *CII* the distance between the most prominent cervical point of the palatal ridge on the canines. For the maxillary first molars, the distances measured were between the mesiobuccal cusp tips (*MI*) and between the most cervical point of the palatal fissure (*MII*).

Post-treatment T1

Depending on the clinical need for expansion, there was a major interindividual variance in the degree of expansion.

At T1, a mean of 2.8 years after the start of treatment, the average value for *CI* was 33.69 mm (SD 2.83), an average increase of 3.24 mm (SD 2.13). *CII* showed a mean value of 24.93 mm (SD 2.18), an average increase of 3.89 mm (SD 1.77). The changes were statistically significant (Table 2). Statistically significant ICC was found between *CI* and *CII*.

The mean value for *MI* at T1 was 49.82 mm (SD 3.60), an average increase of 5.80 mm (SD 2.50) and for *MII* 35.03 mm (SD 3.23), an average increase of 4.55 mm (SD 1.91). The changes were statistically significant (Table 2). Thus, the greatest expansion was recorded for *MI*, the distance between the tips of the buccal cusps of the maxillary first molars. There was, however, a statistically significant ICC between *MI* and *MII*.

Follow-up T2

At T2, an average of 6.4 years (SD 3.3, range 3.1–13.9 years) post-treatment (T1), the mean value for *CI* was 32.85 mm (SD 3.08), a mean decrease of 0.84 mm (SD 1.27) from T1. *CII* showed a mean value of 24.03 mm (SD 2.32), representing a mean decrease of 0.90 mm (SD 1.01) from T1. The maxillary intercanine reduction from T1 to T2 was statistically significant at both *CI* and *CII*. However, no statistically significant differences were found between the treatment and control groups for *CI* and *CII* (Table 3).

The mean value for *MI* at T2 was 48.28 mm (SD 3.67), a mean decrease of 1.54 mm (SD 1.66) from T1. *MII* showed a mean value of 34.33 mm (SD 3.39), a mean decrease of 0.69 mm (SD 1.08) from T1. The maxillary intermolar reduction from T1 to T2 was statistically significant for *MI* and *MII*. There were no statistically significant differences between the treatment and control groups, except for *MII* (Table 3).

Table 1 Comparison between maxillary intercanine and intermolar distances for the treatment and the control groups at T0, before treatment/start of observation.

Tooth		*n*	Treatment (mean, mm)	SD	*n*	Control (mean, mm)	SD	*P*
Canine cusp tip	*CI*	31	30.45	3.11	31	34.32	2.28	***
Canine gingival	*CII*	31	21.04	2.53	31	24.56	2.22	***
First molar cusp tip	*MI*	31	44.02	3.87	31	52.26	3.34	***
First molar gingival	*MII*	31	30.48	3.44	31	36.43	3.08	***

Table 2 Comparison between maxillary intercanine and intermolar distances for the treated subjects before (T0) and after completed treatment and retention (T1).

Tooth		*n*	T0 (mean, mm)	SD	*n*	T1 (mean, mm)	SD	*P*
Canine cusp tip	*CI*	31	30.45	3.11	31	33.69	2.83	***
Canine gingival	*CII*	31	21.04	2.53	31	24.93	2.18	***
First molar cusp tip	*MI*	31	44.02	3.87	31	49.82	3.60	***
First molar gingival	*MII*	31	30.48	3.44	31	35.03	3.23	***

Table 3 Comparison between intercanine and intermolar distances at follow-up (T2) for the treatment group and the last registration for the control group.

Tooth		*n*	Treatment (mean, mm)	SD	*n*	Control (mean, mm)	SD	Significance
Canine cusp tip	*CI*	31	32.85	3.08	31	33.95	2.45	n.s.
Canine gingival	*CII*	31	24.03	2.32	31	24.56	2.24	n.s.
First molar cusp tip	*MI*	31	48.28	3.67	31	52.43	3.45	*
First molar gingival	*MII*	31	34.33	3.39	31	36.30	3.12	n.s.

*$P < 0.05$; ***$P < 0.0001$; n.s., not significant.

No statistically significant differences were found between the two groups, those with less than a 5 year follow-up and those with more, with respect to T1 changes (Figure 4, Table 4).

No significant correlation was found between the age of the patient and the reduction in transverse dimensions or between intercanine and intermolar expansion. Furthermore, no significant correlation was found between the initial expansion achieved and the severity of the transverse decrease post-treatment. No statistically significant differences were found between gender with respect to the severity of the T1 changes.

Discussion

Although SARME is an accepted treatment modality in modern orthodontics, there is, however, no consensus in the literature with respect to long-term stability and relapse associated with the procedure (Koudstaal *et al.*, 2005). Lagravère *et al.* (2006) found, in a systematic-review, only six long-term studies with a follow-up of more than 1 year. Swennen *et al.* (2001) concluded that there is a lack of appropriate data on long-term follow-up and relapse and more studies are necessary to determine the long-term treatment effects.

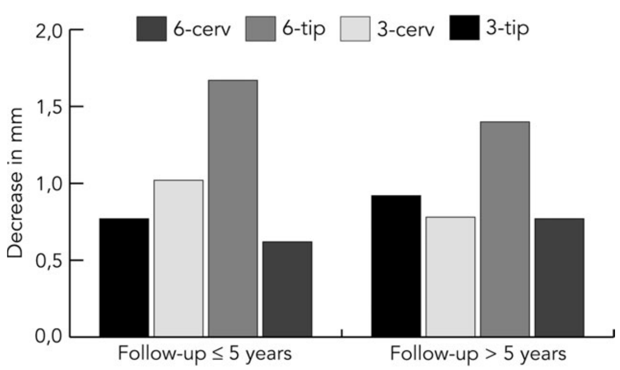

Figure 4 In order to evaluate post-treatment changes over time, the treatment group was divided into two groups: those with less than five years follow-up and those with more (15 subjects, mean 3.7 years, and 16 subjects, mean 9.3 years respectively). No statistically significant differences were found between these two groups with respect to post-treatment changes.

The surgical procedure used in this study was in accordance with the technique of Lehman *et al.* (1984). The procedure comprised osteotomies of the maxillary lateral walls with supplementary osteotomies of the pterygoid fissure and an additional minor vertical osteotomy at the anterior spine. This method is assumed to reduce biomechanical resistance at the pterygoid plates and results in more parallel anteroposterior expansion. In agreement with Northway and Meade (1997), the reduced posterior resistance would also diminish the risk of periodontal injury, dental tipping, and relapse (Glassman *et al.*, 1984; Bays and Greco, 1992). The procedure did not include palatal osteotomy, which may exacerbate operative bleeding and post-operative complications.

It should be noted that the measurements in this research were made on study models at three time points, using a digital calliper. As no posteroanterior headfilms were available, the findings recorded in this study are consequently the transverse dental changes.

Because SARME is not a standardized procedure, it is difficult to compare treatment outcomes achieved by the different technique variations. Early techniques involved more invasive surgical procedures intended to reduce the total surrounding skeletal resistance and minimize post-treatment relapse and decrease in the transverse dimensions (Lines, 1975; Bell and Epker, 1976; Turvey, 1985; Epker and Fish, 1986; Pogrel *et al.*, 1992; Betts *et al.*, 1995; Northway and Meade, 1997; Berger *et al.*, 1998).

Glassman *et al.* (1984) presented a minimized treatment modality which did not involve a palatal or pterygoid approach. The surgery comprised only osteotomies of the maxillary lateral walls to diminish the risks of peri- and post-operative complications. Schimming *et al.* (2000) stated that while the Glassman technique was suitable for patients up to the age of 30 years, older patients required additional surgical separations. Anttila *et al.* (2004) found stable long-term results post-treatment (average 4.7 years) in a sample of 12 patients treated according to the Glassman technique. More than 50 per cent of the patients in the study by Anttila *et al.* (2004) were over 30 years of age. In agreement with Timms and Vero (1981) and Schimming *et al.* (2000), it was concluded that age might influence treatment outcome and that additional osteotomies can facilitate expansion. On the other hand, Handelman *et al.* (2000) reported stable and

Table 4 Comparison between post-treatment changes over time. Follow-up ≤5 years compared with follow-up >5 years.

Tooth		*n*	<5 years, (mm)	SD	*n*	>5 years (mm)	SD	Significance
Canine cusp tip	*CI*	15	0.77	0.94	16	0.92	1.02	n.s.
Canine gingival	*CII*	15	1.02	0.59	16	0.78	0.97	n.s.
First molar cusp tip	*MI*	15	1.67	1.10	16	1.40	1.92	n.s.
First molar gingival	*MII*	15	0.62	1.04	16	0.77	1.02	n.s.

n.s., not significant.

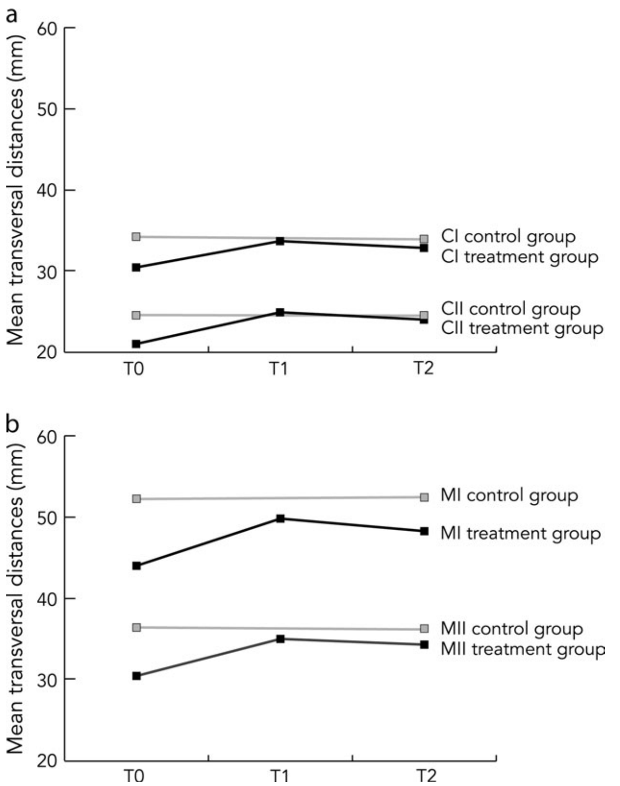

Figure 5 Mean transversal distances (black) in the treatment group at the maxillary canines (a) and maxillary first molars (b) before treatment (T0), after completed treatment (T1), and at follow-up (T2), and at the first and last registration (grey) for the control group.

clinically successful expansion of up to 5 mm, without any surgical intervention, in a sample of 47 skeletally mature patients.

Due to the pronounced differences in the techniques described, it is difficult to determine which surgical method provides the best long-term results. Pogrel *et al.* (1992) stated that the extent of the osteotomy, the risk of surgical complications, and long-term stability were unresolved issues.

The findings of the present study confirmed that less dental tipping and correct alignment post-treatment result in a more predictable and stable long-term outcome. Most patients exhibited pre-treatment dental crowding with buccal malposition and/or tipping of the canines. After surgical expansion of the maxilla and alignment by fixed appliance therapy, the buccal tipping of the canines was reduced and within the normal range. At T1, 22 subjects were more expanded at the gingival margin. The ratio between the expansion at the cusp tips and the gingival margin of the canines was thus negative because of the initial buccal tipping and should consequently be interpreted as a positive criterion for normalization.

Relative to the first registration in the control group, the canines in the treatment group exhibited almost the same or some increased intercanine distances (Figure 5a). There were no statistically significant differences between the treatment group at T1 and the control at the first registration and thus the outcome in the treatment group could be considered normalized.

However, at T1 for the molars the pattern was the opposite. There was buccal tipping and after completion of treatment, the molars exhibited, on average, 25 per cent more expansion at the mesiobuccal cusp tips. Jafari *et al.* (2003) and Holberg and Rudzki-Janson (2006) evaluated areas of increased biomechanical resistance in the maxilla. After RME, the highest stress concentration was found at the pterygoid plates close to the cranial base. The question arises as to whether posterior osteotomies at the pterygoid plates are adequate if other posterior structures still offer resistance, which results in tipping.

Haas (1961) reported a wedge-shaped separation of the two freed maxillary halves after conventional RME. This separation also affects the angulations of the molars, which may explain molar tipping. There is also a need to upright the posterior segments, which are often tipped lingually. In consideration of this uprighting, more expansion should be expected between the molar cusp tips. Statistical analysis, however, showed no significant differences between expansion measured at *MI* and *MII*.

Despite the considerable age range in the sample, 16–48 years pre-treatment, no correlation was found between age and dental tipping at T1. The assumption for the necessity of pterygomaxillary disjunction to achieve parallel expansions (Matteini and Mommaerts, 2001; Jafari *et al.*, 2003) would justify the more comprehensive surgical approach adopted during surgery.

As shown in Figure 5b, the mean values of the distances between the molars, *MI* and *MII*, at T1 were somewhat less in the treatment group than at T0 in the control group. There were, however, no statistically significant differences between the treatment group at T1 and the control group at T0. This finding should thus be interpreted as normalization of the transverse discrepancy.

The total degree of molar and canine expansion post-treatment corresponds well with previous findings (Bays and Greco, 1992; Pogrel *et al.*, 1992; Northway and Meade, 1997; Berger *et al.*, 1998).

At T2, a mean of 6.4 years post-treatment, all transverse dimensions had decreased. The reduction was most evident between the molar cusp tips, and the changes were statistically significant. Although the mean values in the treatment group showed minor discrepancies compared with those in the control group, statistical analysis demonstrated no significant differences except for *MI* at T2. This decrease in intermolar cusp width was, however, not obvious clinically and not more pronounced compared with the other distances measured. The mean values for total reduction in transverse dimension ranged from 15 to 25 per cent.

Bondevik (1998) found, in an untreated sample with a mean age of 23 years to a mean age of 34 years, a significant increase in maxillary intermolar width but no difference in intermaxillary canine width. The significant increase in maxillary intermolar width observed by Bondevik (1998) would highlight a more pronounced difference between the treatment and control groups at the maxillary molars in the present study but no such findings were observed in the matched control group.

On average, expansion was greater in the molar than in the canine region. This finding is in agreement with Anttila *et al.* (2004) and Handelman *et al.* (2000), but other studies report greater anterior expansion (Bays and Greco, 1992; Mossaz *et al.*, 1992; Pogrel *et al.*, 1992; Strömberg and Holm, 1995; Northway and Meade, 1997; Berger *et al.*, 1998). There are some possible explanations for this discrepancy. The true skeletal expansion in the canine area may be larger, but is obscured by treatment with fixed appliances, which normalizes the initial buccal tipping of the canines (Figure 5a). The osteotomies at the pterygoid plates in the present study may also explain in part the greater expansion in the molar area (Figure 5b).

The indication for SARME is considered to be maxillo-mandibular transverse discrepancy exceeding 5 mm (Betts *et al.*, 1995; Handelman *et al.*, 2000). In present study, the mean expansion between the canines and molars was less, except for the mesio-buccal cusp tips of the molars. There was, however, a great variance in minimum and maximum values. Analysis of individual cases shows different expansion needs. To achieve a correct transverse relationship, the expansion was adapted to meet requirements of the treatment which was to follow the maxillary expansion. The need for transverse expansion in the canine area was more pronounced in patients with a skeletal open bite. In contrast, subjects with a skeletal Class II relationship and planned subsequent mandibular surgical advancement required more posterior expansion.

The concept of initial overexpansion by a half cusp width was related to the findings of Wertz (1970) who reported buccal tipping of anchor teeth. The overexpansion would make it possible to upright the anchor teeth post-surgery with fixed appliances. In the present study, there was an initial overexpansion of approximately 2 mm on each side after the active expansion period. At T1, this overexpansion was normalized, but some molar tipping persisted. Thus, overexpansion does not guarantee that post-treatment tipping will not occur.

The follow-up range in the sample made it possible to study two groups: those with a follow-up of less than 5 years (mean 3.7 years) or more than 5 years (mean 9.3 years), with 15 cases in the first group and 16 cases in the second. There were no significant differences between these two groups with respect to the degree of expansion, T1 tipping, or retention time. It was of interest to note that there were no significant differences in the decrease in transverse dimensions between these two groups, indicating that transverse decrease is most pronounced during the first 3 years.

Conclusion

Treatment with SARME and orthodontic fixed appliance normalizes the transverse discrepancy and is stable a mean of 6 years post-treatment.

Pterygoid detachment does not entirely eliminate posterior resistance, and buccal tipping of the maxillary molars may still occur. Relapse is time related and is most pronounced during the first 3 years after treatment. Retention should be considered for this period.

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