Original Article

Semirapid Maxillary Expansion—A Study of Long-Term Transverse Effects in Older Adolescents and Adults

Haluk İşeri, DDS, PhD[a]; Serhat Özsoy, DDS, PhD[b]

Abstract: A new approach, namely, semirapid maxillary expansion (SRME) was introduced with the hypothesis that SRME may stimulate the adaptation process in the nasomaxillary complex and thus would result in reduction of relapse in the postretention period. The aim of this study was therefore to evaluate the short- and long-term effects of SRME on dentofacial structures in older adolescents and adults. The study sample consisted of 40 individuals, 20 orthodontic patients who required maxillary expansion and 20 control cases who received no orthodontic treatment. The mean ages were 14.57 and 13.83 years at the start of treatment and control periods, respectively, and ranged between MP3cap and Ru hand-and-wrist maturation stages. A rigid acrylic maxillary expander was used for SRME (RME of 5–7 days, followed by slow maxillary expansion). The mean expansion time was 0.34 years, and the mean follow-up period was 2.68 years after retention. PA cephalometric film measurements were performed, and the data were analyzed statistically by using paired and Student's *t*-tests.Lower nasal and maxillary base widths, and upper intermolar and incisor interapex widths were significantly increased compared with the control group ($P < .05$, $P < .001$) and remained unchanged during the retention and follow-up stages. Moreover, significant amount of increases occurred in zygomatic and lower nasal widths during the follow-up period. The findings of this study suggested that the dentoskeletal changes after the use of SRME were maintained satisfactorily in the long term in older adolescents and adults. (*Angle Orthod* 2004;74:71–78.)

Key Words: Maxillary expansion; Transverse dimension; Bonded RME appliance; Adult treatment

INTRODUCTION

Rapid maxillary expansion (RME) treatment has been used over the past century. Its first appearance dates back to 1860.[1] Through numerous research projects, RME became a routine procedure in orthodontic practice when the constricted maxilla and upper dental arch demand orthopedic widening.[2–5] RME has been shown to be a valuable aid in the orthodontic treatment of young patients exhibiting transverse maxillary deficiency, pseudo-Class III malocclusion, rhinologic and respiratory ailments,[4–8] and cleft lip and palate.[9]

Numerous RME appliances have been widely used by the clinicians such as Haas-, Hyrax-, and Minne-type banded appliances. However, long-term evaluation has shown a relapse tendency in cases who were treated by these conventional appliances of maxillary expansion.[6,10–13]

Age has also been discussed as a factor in the prognosis of RME, especially regarding long-term stability. Bishara and Staley[6] stated that the optimal age for expansion is before 13 to 15 years. The authors stated that although it may be possible to accomplish expansion in older patients, the results are neither as predictable nor as stable. Proffit[14] and McNamara and Brudon[15] supported this opinion by suggesting that the feasibility of palatal expansion in the late teens and early twenties is questionable. Surgically assisted RME combined with fixed orthodontic treatment has been suggested to overcome this problem.[16]

Conventional RME appliances widen the upper arch in the transversal dimension, mainly by the separation of the two maxillary halves. Bonded RME appliances with occlusal coverage have been reported to have certain advantages over conventional devices.[15, 17–23] Recent studies have stated that bonded RME appliances may expand the maxillary halves in a more bodily fashion and also reduce the risk of relapse.[24,25]

İşeri et al[26] evaluated the resistance of RME generated by the surrounding structures by using the finite element method as applied to the three-dimensional model of a human skull. The findings of this study indicated that high

[a] Professor, Department of Orthodontics, University of Ankara, Ankara, Turkey.

[b] Department of Orthodontics, SSK Hospital, Ankara, Turkey.

Corresponding author: Haluk İşeri, DDS, PhD, Ankara Üniversitesi, Diş Hekimliği Fakültesi, Ortodonti Anabilim Dalı, 06500 Beşevler, Ankara, Turkey
(e-mail: halukiseri@turk.net).

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TABLE 1. Mean Age Distribution of the SRME Group

	T1 (n = 20) Mean ± Sx	T2 (n = 20) Mean ± Sx	T3 (n = 20) Mean ± Sx	T4 (n = 16) Mean ± Sx
Age (y)	14.57 ± 0.38	14.91 ± 0.38	15.20 ± 0.37	18.00 ± 0.34
Duration of treatment (y)	—	0.34 ± 0.02	0.29 ± 0.01	2.68 ± 0.18

TABLE 2. Mean Age Distribution of the Control Group

	Start of Control (n = 20) Mean ± Sx	End of Control (n = 20) Mean ± Sx	Duration of Control (n = 20) Mean ± Sx
Age (y)	13.83 ± 0.29	14.91 ± 0.27	1.08 ± 0.01

TABLE 3. Survey of the Study Sample According to the Skeletal Maturation

	Treatment Group (n = 20)		Control Group (n = 20)	
Maturation Stage	Girls (n = 19)	Boys (n = 1)	Girls (n = 19)	Boys (n = 1)
MP_3cap	5	—	5	—
DP_3u	2	—	2	—
PP_3u	3	—	3	—
MP_3u	5	—	5	—
Ru	4	1	4	1

forces are generated by RME on various structures in the craniofacial complex and that these structures offer resistance of different degrees depending on their location and orientation relative to the center and direction of force. Rapid displacement or deformation of the facial bones would result in a marked amount of relapse in the long term, whereas relatively slower expansion of the maxilla would probably produce less tissue resistance in the nasomaxillary complex. Therefore, authors suggested RME followed by slow maxillary expansion, immediately after the separation of the midpalatal suture, namely, semirapid maxillary expansion (SRME). The schedule would be two turns each day for the first five to six days, and three turns each week for the remainder of the RME treatment. This would stimulate the adaptation process in the nasomaxillary complex and would result in reduction of relapse in the postretention period.

By taking the findings and suggestions of the above mentioned studies into consideration, we hypothesized that SRME treatment with the use of rigid acrylic bonded device may stimulate the adaptation process in the nasomaxillary complex and would result in reduction of relapse in the postretention period. Therefore, the aim of this study was to evaluate the short- and long-term effects of SRME on dentofacial structures, applied by a rigid acrylic bonded expansion device in older adolescents and adults.

MATERIALS AND METHODS

The study sample consisted of 40 individuals, 20 treated orthodontic patients who required maxillary expansion on the basis of their individual treatment plans and 20 control cases who received no orthodontic treatment. The mean ages were 14.57 and 13.83 years at the start of the treatment and control periods, respectively (Tables 1 and 2). Chronological ages of the study subjects ranged between 11.67 and 17.00 years. The skeletal maturity of treatment and control subjects ranged between MP3cap and Ru stages at the beginning of treatment and control periods[27] (Table 3). All patients had unilateral or bilateral crossbite due to the maxillary transversal insufficiency, and 13 cases were mouth breathers. None of the cases had craniofacial anomalies.

Design and use of the SRME device and fixed appliance orthodontic treatment

The design of the acrylic bonded device used in this study has been described by Memikoğlu and İşeri.[23] A maxiskeleton jackscrew was embedded in acrylic between the first premolars as close as possible to the palate, with the resin covering the occlusal and labial surfaces of the maxillary posterior permanent teeth (Figure 1). The resin was trimmed thin enough to preserve freeway space while allowing maximum occlusal contact bilaterally. After bonding of the RME appliance, the patient's parents were instructed to activate it by turning the screw one turn in the morning and another turn in the evening in the first 5–7 days. Each turn of the screw produced 0.2 mm of expansion. After it was determined that the suture was opened by the occlusal films, the appliance was debonded and used as a removable expansion device. The activation was continued three times a week. Duration of expansion depended on the amount of expansion needed with two mm of overexpansion, clinically determined in all study cases. The mean active expansion time was 4.08 months, and active treatment was followed by a mean retention period of 3.48 months with the same removable device. The appliance was worn full-time during the activation and retention phases. There was no problem regarding fitting or relapse because the patients wore the appliance throughout the day. The patients easily adopted the acrylic RME device, with no cooperation problem. At the end of the retention period, the treatment was continued with fixed appliance orthodontic therapy.

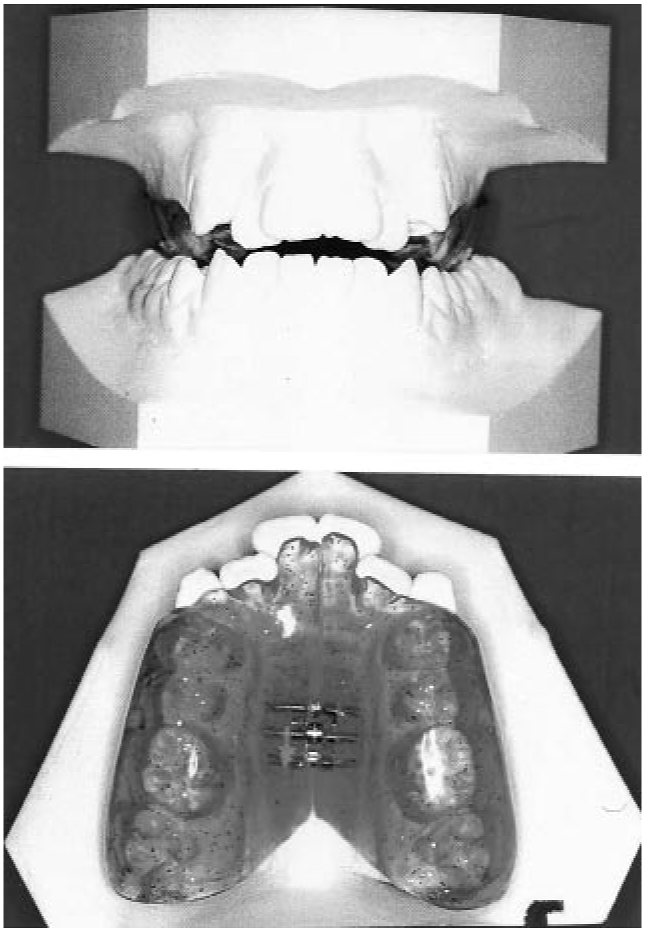

FIGURE 1. Rigid acrylic bonded semirapid maxillary expansion device.

Records

A set of records (lateral and PA cephalometric and occlusal films, dental casts, intraoral and extraoral photographs) was obtained for each patient, at the start (T1) and at the end of expansion (T2), as well as at the end of retention periods (T3). Hand-and-wrist films were obtained from all patients at the beginning of treatment. Radiographic records and photographs were also obtained 2.68 years after retention, on average, from patients whose fixed appliance therapy had been completed or was continuing (T4). At T4, five cases were out of retention, and nine cases were using retainers after fixed appliance treatment. Two cases were almost at the end of their fixed appliance therapy, and T4 records in these cases were made at least two years after SRME. The last four cases were not included in the study sample at T4. Lateral and PA cephalometric and hand-and-wrist films were obtained at the start (C1) and at the end of control (C2) periods from the control individuals who were subjected to no orthodontic treatment.

Measurements

A total of 11 PA measurements were assessed in this study. The reference points and lines used on PA cephalometric films have been previously described elsewhere[24,25] (Figure 2). Anatomic landmarks were identified, and digitization was performed to calculate the linear and angular measurements. Björk-type titanium metallic implants were placed bilaterally in the maxilla below the spina nasalis anterior and lower border of the zygomatic bones in 11 patients, and anterior (ia) and posterior (ip) maxillary implant points were marked on the cephalometric films as described by İşeri and Solow.[28] The PA cephalometric measurements were as follows:

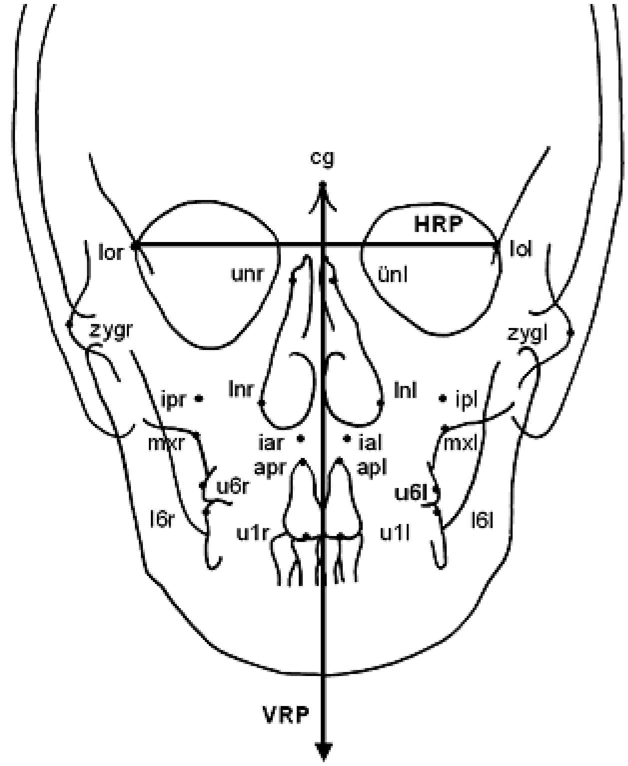

FIGURE 2. Reference points and planes used on PA films.

- Orbital width (lor-lol) (mm)—the horizontal distance between right and left orbital points.
- Upper nasal width (unr-unl) (mm)—the horizontal distance between right- and leftmost lateral aspects of the upper portion of the piriform aperture.
- Interzygomatic width (zygr-zygl) (mm)—the horizontal distance between right- and leftmost lateral borders of the zygomatic bone.
- Lower nasal width (lnr-lnl) (mm)—the horizontal distance between right- and leftmost lateral aspects of the lower portion of the piriform aperture.
- Maxillary width (mxr-mxl) (mm)—the horizontal distance between right and left intersections of the lateral contour of the maxillary alveolar process and the lower contour of the maxillozygomatic process of the maxilla.
- Upper intermolar width (u6r-u6l) (mm)—the horizontal distance between right- and leftmost prominent lateral

TABLE 4. Comparison of Initial PA Measurements Between Treatment and Control Groups

n = 20	SRME Group (Mean ± Sx)	Control Group (Mean ± Sx)	Test
Orbital width	93.28 ± 0.79	94.15 ± 0.76	
Upper nasal width	4.17 ± 0.32	4.66 ± 0.23	
Zygomatic width	130.54 ± 1.26	133.73 ± 1.34	
Lower nasal width	30.48 ± 0.61	31.13 ± 0.59	
Maxillary width	64.00 ± 0.71	71.38 ± 0.90	***
Upper intermolar width	51.93 ± 0.74	58.86 ± 0.91	***
Lower intermolar width	56.83 ± 0.69	58.19 ± 0.84	
Upper incisor interapex width	7.05 ± 0.37	8.59 ± 0.26	***
Upper incisor intercrown width	8.64 ± 0.16	8.85 ± 0.15	
Anterior implant distance (n = 11)	11.60 ± 1.40	—	
Posterior implant distance (n = 11)	60.12 ± 0.98	—	

* $P < .05$, ** $P < .01$, *** $P < .001$.

TABLE 5. Treatment Changes in SRME Group—T1 Start of SRME, T2 End of SRME, T3 End of Retention, and T4 Follow-up

	T2-T1 (n = 20) Mean ± Sx	Test	T3-T2 (n = 20) Mean ± Sx	Test	T4-T3 (n = 16) Mean ± Sx	Test
Orbital width	0.22 ± 0.22		−0.11 ± 0.21		0.38 ± 0.20	
Upper nasal width	0.26 ± 0.16		0.19 ± 0.19		0.25 ± 0.13	
Zygomatic width	0.47 ± 0.16	**	0.07 ± 0.19		0.91 ± 0.23	**
Lower nasal width	1.28 ± 0.27	***	−0.16 ± 0.16		0.59 ± 0.31	*
Maxillary width	2.47 ± 0.35	***	0.25 ± 0.25		−0.15 ± 0.36	
Upper intermolar width	7.36 ± 0.51	***	0.04 ± 0.28		−0.14 ± 0.57	
Lower intermolar width	0.99 ± 0.34	**	0.31 ± 0.44		−0.24 ± 0.57	
Upper incisor interapex width	1.30 ± 0.26	***	−0.39 ± 0.17	*	0.05 ± 0.32	
Upper incisor intercrown width	0.80 ± 0.22	***	−0.23 ± 0.17		0.34 ± 0.15	
Anterior implant distance (n = 11)	1.27 ± 0.23	***	0.07 ± 0.10		−0.07 ± 0.12	
Posterior implant distance (n = 11)	1.02 ± 0.23	***	−0.11 ± 0.41		0.29 ± 0.17	

* $P < .05$, ** $P < .01$, *** $P < .001$.

points on the buccal surfaces of the first permanent maxillary molars.

- Lower intermolar width (l6r-l6l) (mm)—the horizontal distance between right- and leftmost prominent lateral points on the buccal surfaces of the first permanent mandibular molars.
- Upper incisor interapex width (apr-apl) (mm)—the horizontal distance between right and left apex points of the maxillary central incisors.
- Upper incisor intercrown width (u1r-u1l) (mm)—the horizontal distance between right and left incisal points of the maxillary central incisors.
- Anterior implant distance (iar-ial) (mm)—the distance between the right and left anterior implants.
- Posterior implant distance (ipr-ipl) (mm)—the distance between the right and left posterior implants.

Statistical methods

Initial descriptive statistics were calculated and compared by the Student's *t*-test in the treatment and control groups. The pretreatment and end of retention differences (T1-T3) and start and end of control changes (K2-K1) were compared by the Student's *t*-test. The changes obtained in the control group and in the different stages of treatment in the SRME group were evaluated statistically by using the paired *t*-test. The reliability of the measurements was examined for the records of all 40 subjects by repeating the point marking and digitizing procedures. The reliability of a single measurement was computed by using the formula described by Winner.[29] The reliability of measurements ranged between 0.95 and 0.99.

RESULTS

Initially, maxillary base, upper intermolar, and incisor interapex widths were significantly smaller in the SRME group, compared with the control group (Table 4).

Treatment changes (start of SRME, T1; end of SRME, T2; end of retention, T3; and follow-up, T4) are presented in Table 5. All the measurements except upper nasal width significantly increased during SRME (T2-T1) and remained unchanged (except interapex width, which significantly decreased, $P < .05$) during the retention and follow-up stages (T3-T2, T4-T3). Moreover, significant amount of increases occurred in zygomatic and lower nasal widths during the follow-up period (T4-T3).

Comparison of the changes obtained at the end of retention period in the SRME group (T3-T1) and at the end of observation period in the control group (C2-C1) are pre-

TABLE 6. Comparison of Treatment (T3-T1) and Control (C2-C1) Changes

n = 20	T3-T1 Mean ± Sx	C2-C1 Mean ± Sx	
Orbital width	0.11 ± 0.16	0.91 ± 0.29**	*
Upper nasal width	0.45 ± 0.18*	−0.15 ± 0.16	*
Zygomatic width	0.54 ± 0.20*	1.24 ± 0.33***	
Lower nasal width	1.12 ± 0.24***	0.27 ± 0.20	*
Maxillary width	2.72 ± 0.35***	1.03 ± 0.27**	***
Upper intermolar width	7.40 ± 0.60***	0.32 ± 0.20	***
Lower intermolar width	1.29 ± 0.31***	−0.09 ± 0.21	***
Upper incisor interapex width	0.91 ± 0.28***	−0.30 ± 0.18	***
Upper incisor intercrown width	0.57 ± 0.18***	−0.16 ± 0.17	
Anterior implant distance (n = 11)	1.33 ± 0.21***	—	
Posterior implant distance (n = 11)	0.90 ± 0.29**	—	

* $P < .05$, ** $P < .01$, *** $P < .001$.

sented in Table 6. Upper and lower nasal widths, maxillary base width, upper and lower intermolar widths, and incisor interapex width significantly increased in the SRME group, compared with the control group ($P < .05$, $P < .001$).

DISCUSSION

One of the most challenging issues in patients treated with RME has been the prevention of relapse in the long term. A number of researchers have studied the stability of RME, and factors such as age of patient,[8,9,30] rate of expansion,[6,31] design of the device,[15,24] length of the retention period,[13] cooperation during the retention period,[32] severity of the maxillary collapse, response of the midpalatal suture and surrounding structures of the maxilla,[6,26,33] and adaptation of the soft tissues to the new positions[34] have been discussed in detail.

Long-term evaluation has shown a relapse tendency in cases who were treated by the conventional appliances of maxillary expansion.[31,35] Conventional RME devices widen the upper arch in transversal direction mainly by the separation of the two maxillary halves by tipping and extrusion of maxillary posterior teeth.[8,24,36–38] However, bonded RME appliances with occlusal coverage have been reported to have certain advantages over conventional devices. Memikoğlu and İşeri[25] demonstrated that bonded RME therapy could be maintained during orthodontic treatment in terms of dentoskeletal expansion. The overall findings might be related to the rigid design of the device and might also be promising for RME concerning prevention of the relapse tendency.

The literature agrees that RME dramatically affects the surrounding skeletal structures. Therefore, another important issue is how one could decrease tissue resistance and stimulate the adaptation process of the surrounding structures during RME procedure to achieve stable long-term results. Bishara and Staley[6] suggested that the main resistance to midpalatal suture opening is probably not in the suture itself but in the surrounding structures such as sphenoid and zygomatic bones. İşeri et al[26] evaluated the resistance of RME generated by the surrounding structures by the finite element method as applied to the three-dimensional model of a human skull. The findings of this study indicated that various structures in the craniofacial complex offer resistance of different degrees, depending on their location. In fact, the highest stress levels were observed at the sphenoid and zygomatic bones, particularly at the superior parts of the pterygoid plates of the sphenoid bone and anterior part of the zygomatic bone. These findings indicated clearly that RME not only produces an expansion at the intermaxillary suture but also generates high forces on various structures in the craniofacial complex. Therefore, to produce less tissue resistance and stable long-term results, the authors suggested SRME in growing and adult subjects.

It is well-known that age and maturation stage of the patient are important factors when considering the effects of RME on craniofacial structures. Many investigators agree that RME treatment is more stable in growing subjects than in young adults and adults. With advancing maturity, the rigidity of the craniofacial skeleton limits the long-term stability.[5,9,31] On the other hand, the treatment group of our study mainly consisted of postadolescent patients with a mean chronological age of 14.57 years at the start of SRME treatment (Tables 1 and 2), and the maturation stage ranged between MP3cap and Ru (Table 3). Only five cases were in the MP3cap stage. Ten cases were in the MP3u and Ru stages, which represent the termination of growth in height (Helm et al).[27] Five cases were in the DP3u and PP3u stages. Therefore, the sample of this study mainly consisted of patients in early adulthood at the beginning of treatment. All patients had unilateral or bilateral crossbite due to the maxillary transversal deficiency. A control group was also used in this study to find out the long-term treatment effects of SRME, by eliminating spontaneous growth of the dentofacial structures. The control group material was a part of a University project started in 1978, and derived from the archives of the Department of Orthodontics, University of Ankara. Individuals who are most similar to the patients of the treatment group with regard to parameters such as sex, skeletal maturity, and intermaxillary relationship were selected as control subjects. None of the control individuals had unilateral or bilateral crossbite. Because of ethical reasons, no attempt was made to set up a control group that consisted of subjects with constricted maxilla and posterior crossbite. Thus, there were significant differences between treatment and control groups initially regarding the dental and skeletal maxillary transversal measurements (Table 4).

Efficiency and stability of SRME treatment

Significant amounts of linear and angular transverse changes were observed in the zygomatic bone, lower nasal cavity, maxillary base, and maxillary dentoalveolar structures. At the end of the retention period, all the changes except the upper incisor interapex width were maintained (Table 5) and found to be statistically significant compared with the changes observed in the control group (Table 6).

Previous studies suggested that there was significant amount of increase in the zygomatic width,[24,25] and this finding is supported by the finding of the present study. Anatomically, there is an increase in the width of the nasal cavity immediately after expansion, particularly at the floor of the nose adjacent to the midpalatal suture.[3–5] As the two maxillae separate, the outer walls of the nasal cavity move laterally, whereas the more superior areas might move medially.[26,39] In the present study, the changes obtained in the lower nasal cavity supported the above findings and were similar to the changes presented in the studies of Wertz[8] and Memikoğlu and İşeri.[25] The mean increase in the lower nasal width was 1.3 mm using SRME, whereas it was about 1.5 mm using RME in the above-mentioned studies. Therefore, the increase in the lower nasal width at the level of the inferior turbinates would probably result in an increase in the intranasal capacity if the obstruction were in the lower anterior portion of the nasal cavity.[8]

The findings also indicated that significant amount of widening was obtained in the maxillary base with SRME treatment, and this widening was maintained at the end of retention period (2.7 mm). The greatest widening effect of the SRME treatment was found in the region of dentoalveolar structures (7.4 mm). Therefore, the mean increase in maxillary base width was less than one-half the amount of dentoalveolar widening (about 40%) and supported the finding of another study. Krebs[40] found that the amount of sutural opening was equal to or less than one-half the amount of dental arch expansion. On the other hand, the findings of a previously published study indicated that the mean increase in maxillary base width was more than one-half the amount of intermolar expansion by the rigid acrylic RME device.[25] Similar findings were also obtained in RME and SME cases by Mossaz-Joelson and Mossaz.[41]

Björk-type metallic implants were used to find out the real skeletal widening effect of the SRME in the present study. The mean increases in the anterior and posterior implant distances were 1.27 and 1.02 mm, respectively (Table 5). The upper incisor interapex width also increased by 1.3 mm and supported the increase in the anterior implant distance. There are few studies in which the metallic implant technique was used to analyze the effects of maxillary expansion. Krebs[40,42,43] studied maxillary expansion with metallic implants. He placed implants in the alveolar process lingual to the upper canines and along the infrazygomatic ridge, buccal to the upper first molars, and demonstrated that the sutural opening was more than twice as large between the incisors than it was between the molars. Isaacson and Murphy[9] evaluated the effects of rapid midpalatal expansion in cleft lip and palate patients by using silver implants. One of the cases was a 22-year-old male, and no skeletal widening was observed. Four cases were 12-year-old boys, and the individual increases in the interimplant distances (implants placed in the inferior surface of the zygomatic process) ranged between one and 3.5 mm in these four growing cases, and this was about one-third the widening of the maxillary first molars measured at the occlusal level. Sarnas et al[35] found that the distance between the bilateral implants was increased by about two mm, whereas 7.2 mm widening was achieved between the upper molars by RME in a 12-year-old girl. Mossaz-Joelson and Mossaz[41] suggested a 4.4 and 3.9 mm increase in the implant distance by RME and SME, respectively, and there was a relapse of 0.4 and 0.7 mm during the retention and follow-up periods. Thus, the total amount of change in the implant distance was 2.8 mm. As seen from the results of previously published implant studies, the amount of increase in the implant distance varied from two to 4.4 mm with RME in growing subjects. Therefore, the finding of the present study demonstrates that the smallest separation effect generated on the intermaxillary suture was found with the use of SRME in this sample of early adulthood cases, and this pure skeletal widening effect was stable in the long-term observation. The above findings also indicated that the widening of the maxilla was mainly achieved with the expansion of the maxillary dentoalveolar structures by using SRME.

About 3.5 years after the initiation of SRME treatment, all the transversal skeletal and dental changes were stable (Table 5). The changes obtained in some of the structures were not only maintained but also increased significantly in the follow-up period (zygomatic and lower nasal widths). Sarnas et al[35] published long-term effects of RME in a 12-year-old girl, studied with the aid of metallic implants and roentgen stereometry. The distance between the bilateral implants increased during RME by 2.3 mm at anterior and 2.2 mm at posterior levels. However, roughly one-third of the expansion of the maxilla relapsed. The total increase in width was one mm anteriorly and 1.3 mm posteriorly at the end of 10 years of follow-up. Further relapse took place in the intermolar region. During the RME treatment, the transverse distance between the upper molars increased by 7.2

mm. Marked amount of relapse took place during the retention and follow-up periods and resulted in a net increase by 1.2 mm at the end of the 10-year observation period. Despite the discouraging finding of Sarnas et al,[35] no relapse tendency was found in our sample. The mean total increase in implant distance was 1.27 and 1.2 mm anteriorly and posteriorly at the end of 3.5 years of follow-up. The 2.47 mm maxillary and 7.36 mm upper intermolar width increase was maintained as 2.57 and 7.26 mm during the same period. Memikoğlu and İşeri[25] suggested that the dentoskeletal changes in the transverse dimension after the use of an acrylic bonded RME are maintained satisfactorily, three years after the initiation of treatment. The authors also suggested that the rigid design of the expansion device and the contribution of the patient's maturation level (all patients were in the pubertal growth phase at the start of treatment) may be the factors causing stability. Spillane and McNamara[44] presented the findings of patients who underwent RME during the early mixed dentition by evaluating the maxillary changes through the analysis of serial dental casts. During the postexpansion period, most of the arch width increases were maintained. For example, 90.5% of the original expansion at the first permanent molars remained after the first year, with slightly less overall expansion (80.4%) evident at the end of the observation period (2.4 years after expansion). However, the study group of this paper remarkably differs from the group of our study with regard to chronological age and skeletal maturity. Handelman et al[45] also reported encouraging results regarding the long-term effects of RME using a Haas expander in 47 adults and 47 children. In adults, about five mm mean transarch expansion and the correction of the posterior crossbites were stable after discontinuance of retainers, which was 5.9 years on average. The adults achieved 18% of their transmolar expansion at the height of the palate and the remainder with buccal displacement of the alveolus. The children achieved 56% of their expansion by an increase at the height of the palate with the remainder due to displacement of the alveolus. Therefore, we suggested that nonsurgical RME in adults is a clinically successful and safe method for correcting transverse maxillary arch deficiency.

On the other hand, besides Sarnas et al,[35] discouraging long-term results were also presented in many previously published studies. Krebs[42] found that after fixed retention was discontinued, there was a substantial reduction in dental arch width. This tendency continued for up to five years. Linder-Aronson and Lindgren[46] recorded the results of RME five years after retention and found that 45% of the initially achieved expansion was maintained. The above findings were in agreement with the findings of Stockfish,[47] who found 50% relapse within three to five years after retention. Mossaz-Joelson and Mossaz,[41] also found an average of 30% relapse, although the correction of crossbite was maintained in all subjects.

In the present study, although all the patients were older adolescents and adults, the findings regarding the long-term stability were promising with the use of SRME treatment. The hypothesis that RME followed by slow expansion reduces tissue resistance and relapse would probably be true with respect to the magnitude of load present. One might suggest that slower expansion takes longer to occur and just extends the repair process over a longer period. Therefore, rapid expansion followed by slower rates of expansion would allow for physiologic adjustment at the maxillary articulations and surrounding skeletal structures and would prevent the accumulation of large residual loads within the maxillary complex.[49] This would help to minimize relapse in the long term. Nevertheless, further long-term studies at least five years out of retention are still necessary.

CONCLUSIONS

The results indicate that the dental and skeletal changes achieved with SRME in the transversal dimension were stable at the end of three years of retention and follow-up in older adolescents and adults. Thus, this finding supported the hypothesis of the present study that SRME (RME followed by slow maxillary expansion, immediately after the separation of the midpalatal suture) would produce less tissue resistance and stimulate the adaptation process in the circummaxillary structures. These factors would minimize relapse in the long term even in young adult and adult patients, treated nonsurgically by SRME.

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