THE EFFECTS OF MAXILLARY EXPANSION ON THE SOFT TISSUE FACIAL PROFILE

Yüz Yumuşak Doku Profili Üzerine Üst Çene Genişletmesinin Etkileri

İşil ARAS 1, Sultan ÖLMEZ 2, Mehmet Cemal AKAY 3, Tayfun GÜNabay 3, Aynur ARAS 1

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ABSTRACT

Purpose: The aims of this retrospective study were to evaluate the possible changes in soft tissue facial profile induced by orthopedic rapid maxillary expansion (RME) and surgically assisted rapid maxillary expansion (SARME), and to correlate them with the underlying hard tissue alterations.

Materials and Methods: 16 patients who received bone borne SARME and 25 patients who were subjected to RME using metal cast splint hyrax appliance were analyzed retrospectively. This research was conducted on lateral cephalometric radiographs taken on 2 occasions: before expansion (T1) and at the beginning of any further orthodontic treatment (T2). Investigated lateral cephalometric parameters consisted of Holdaway soft tissue measurements with some supplementary soft tissue, skeletal and dental assessments.

Results: The acquisition of T2 cephalograms which conforms to the initiation of further orthodontic treatment corresponded to 83.25±3.51 days for SARME and 85.68±4.37 days for RME after the expansion was completed. The only significant change in soft tissue profile of the SARME group was a decrease in upper lip thickness (p<0.05), whereas in the RME group, decrease in soft tissue facial profile angle and increase in H angle were found to be statistically significant (p<0.05 for each). For the RME group, the changes in soft tissue facial profile angle and H angle correlated only with the changes in SNB angle (p<0.05).

Conclusion: While bone-borne SARME did not seem to possess the potential to alter soft tissue profile, tooth-borne RME caused a more convex soft tissue profile related to a reduction in SNB.

Keywords: Maxillary expansion; palatal expansion techniques; lateral cephalometry; soft tissue profile; orthognathic surgery

ÖZ

Amaç: Bu retrospektif çalışmanın amacı hızlı üst çene genişletmesi (RME) ve cerrahi destekli hızlı üst çene genişletmesi (SARME) ile meydana gelen yumusak doku değişiklikleri degerlendirmek ve altta yatan sert doku değişimleri ile korelasyonların araştırılması

Gereç ve Yöntem: Kemik destekli SARME ile tedavi gören 16 hasta ve döküm hyrax appareyi kullanılarak RME ile tedavi gören 25 hasta retrospektif olarak incelendi. Bu çalışma genişletmeden önce (T1) ve genişletmeden sonra sabit ortodontik tedavi başladıdan önce (T2) alınan sefalometrik filmler üzerinde yürüttüldü. Araştırılan lateral sefalometrik parametreler, Holdaway yumuşak doku ölçümleri ile birlikte destekleyici bazı yumuşak doku, iskeletsel ve dentoşek.Observerlerin lateral sefalometrik parametreler kullanılarak, Holdaway yumuşak doku ölçümleri ile birlikte destekleyici bazı yumuşak doku, iskeletsel ve dentoşek.

Bulgular: T2 rontgenleri, genişletmeden sonra sabit ortodontik tedavi başlamasından hemen önce olup SARME ve RME gruplarında sırası ile 83.2±3.51 ve 85.68±4.3 günlerde alındı. Yumuşak doku profilyile ilgili SARME grubundaki tek önemli değişiklik üst dudak kalınlığındaki azalma iken (p<0.05), RME grubundaki yüz profili açısındaki azalma ve H açısındaki artış istatistiksel olarak önemli bulundu (p<0.05). SARME grubunda, yumuşak doku yüz profili ve H açısındaki değişiklikler; SNB açısındaki değişşimler ile korelasyon gösterdi (p<0.05).

Sonuç: Kemik destekli SARME yumuşak doku profilli değişirecek potansiyele sahip gibi görünümese de, diş destekli RME, SNB açısındaki azalma ile ilişkili olarak daha konveks bir profile sebep oldu.

Anahtar kelimeler: Üst çene genişletmesi; palatal genişletme teknikleri; lateral sefalometri; yumuşak doku profilı; ortognatik cerrahi

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Effects of maxillary expansion on facial profile

Introduction

Various treatment protocols have been proposed for the correction of constricted maxillary arches depending on the severity of discrepancy and the age of the patient. While some techniques provide expansion of the dental arch, substantial enlargement of the maxillary apical base by opening the midpalatal suture is also possible with rapid maxillary expansion (RME) (1-3). RME via an orthodontic appliance with a midpalatal jackscrew that is attached to posterior teeth is the simplest and safe method utilized in the prepubertal or pubertal period. This sutural expansion, however, is usually futile in skeletally mature patients because of the increasing rigidity of the facial skeleton and the progressive fusion of the midpalatal suture with advancing age. Thus, surgically assisted rapid maxillary expansion (SARME) which incorporates various maxillary osteotomies to eliminate the bony resistance that restrain expansion would be necessary for adults (3-6). Recently, SARME through bone-borne devices, also named as transpalatal distraction, has been proposed as a valuable alternative to conventional SARME which offers the advantages of providing more skeletal expansion, avoiding dental tipping, root resorption, cortical fenestration and orthodontic relapse (3-14).

Since maxilla is the principal bone contributing to the configuration of the midface, considerable amount of physical changes are to be anticipated through RME and SARME considering the bony disintegration that will be taking place. Although the dental and skeletal effects of expansion using dental or skeletal anchorage are well documented, little information is available concerning the overlying soft tissue changes following these treatment modalities. The authors who have analyzed soft tissue changes associated with RME and SARME were more interested with naso-maxillary region (15-23). They reported modifications in cheek, upper lip and nasal morphology which were explained majorly by the transversal enlargement of the maxilla, except for few studies (19, 23) reporting that RME did not have significant clinical effects on the nose. Furthermore, it has been pointed out that the immediate maxillary advancement with downward and backward mandibular rotation during maxillary expansion could have an effect on the patients’ soft tissue profiles (24-30). While the influence of RME on overall facial profile has been discussed in a few studies with conflicting results (31-33), no attempt has been made to test the correlations between the soft tissue changes and the underlying dentoalveolar alterations. Although previous SARME studies correlated soft tissue changes with changes in the hard tissue, those studies included nasolabial area only (18, 22). Thus it becomes apparent that new studies involving more detailed assessment of the alterations in the overall soft tissue profile induced by RME and SARME as well as their correlations with the hard tissue changes are needed.

The aims of this retrospective study were to assess the possible changes in soft tissue facial profile caused by bone-borne SARME and RME using cast hyrax expander, and to determine whether there exists a correlation between the soft tissue alterations and the underlying hard tissue changes.

Materials and methods

Sample selection

This retrospective research was carried out on the lateral cephalometric radiographs of 41 patients who exhibited posterior crossbite and underwent either orthopedic RME or SARME between the years of 2000 and 2014. The radiographs were selected from the archives of Orthodontic Department of Faculty of Dentistry, Ege University, Izmir, Turkey. The study protocol was approved (no: 15-3.2/4) by the Ethics Committee of the School of Medicine, Ege University. The sample size for each group was based upon previous measures of projections to a vertical line of the soft tissue point A and upper lip (32), which indicated that a minimum of 15 subjects for each group was required to detect a 1.7 mm group difference with SD= 1.6 mm, α=0.05, 1-β=0.80.

Surgical techniques

SARME group included 16 patients (9 male, 7 female) with a mean pretreatment age of 27.4±4.6 years. Exclusion criteria were the presence of developmental deformities, syndromes and craniofacial anomalies. Also subjects were excluded from the study if they possessed a history of any soft tissue trauma or surgery. Cephalometric radiographs were not included if the lips were not in rest position during image acquisition. Maxillary expansion was obtained using a bone-anchored device (TransPalatal Distractor, “TPD”; SurgiTec® NV, Bruges, Belgium) with the same surgical procedure implemented for all cases. The horizontal osteotomies were made at
the anterolateral maxillary wall, from the piriform aperture to the pterygomaxillary suture. An additional vertical midline osteotomy between the upper central incisors extending from the anterior nasal spine to the alveolar crest was made. No pterygoid separation was performed. After a latency period of 7 days, the activation was started with a uniform rate of 1 mm per day and continued until the posterior crossbite was eliminated (7-10 days). Thus, the TPD device had a total activation of 8.06±0.93 mm. Further orthodontic treatment was initiated after an average of 83.25±3.51 days following the completion of the expansion while the TPD device was left in situ as a passive retainer. RME group consisted of 25 subjects (12 boys and 13 girls; mean age, 13.7±1.9 years) in the permanent dentition that included erupted second molars and had an initial treatment by cast splint Hyrax expander. The protocol used for activation of the appliance was a one-quarter turn (0.25 mm) twice a day until the posterior crossbite was overcorrected by approximately 2-3 mm. Hence an average activation of 7.58±0.64 mm was achieved in 15.16±1.28 days. After completion of the expansion, the appliance was kept in place as a retainer for 85.68±4.37 days and then it was replaced by a transpalatal arch for further multibracket appliance treatment. Figure 1 shows the appliances which were used for expansion in RME and SARME groups.

Image acquisition and study variables

The lateral cephalograms were acquired on 2 occasions: before expansion (T1) and at the beginning of any further orthodontic treatment (T2). In selection of the material, special attention was also paid that the films were obtained with lips at the rest position and with the hyrax expander being removed. Measurements were carried out by same investigator using Dolphin Image Software, Version 11.0 (Dolphin Imaging and Management Solutions, Los Angeles, CA, USA). Besides soft tissue analysis of Holdaway (34), some supplementary soft tissue (basic upper lip to VerP and upper lip to VerP), skeletal and dental measurements were made (Figure 2).

Statistical analysis

For assessment of the method error, 10 randomly selected cephalograms were retraced and remeasured. Systematic errors were estimated using a two-tailed paired t-test and no significant differences were found. Dahlberg formula (35) was used for the calculation of combined method errors in locating and measuring the changes of the different landmarks \( \sqrt{\sum d^2} \), where \( d \) is the difference between two measurements of a pair and \( n \) is the number of double measurements. The method error did no exceed 0.73 mm and 0.67 degrees for any of the variables investigated. All statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) version 13.0 for windows (SPSS Inc., Chicago, IL, USA). Firstly, the normality test of Shapiro-Wilks and the Levene variance homogeneity test were applied to the data. The data were normally distributed, and there was homogeneity of variance among the groups. Thus, the statistical evaluation was performed by using parametric tests. Paired t-test was used to determine the changes in cephalometric measurements from T1 to T2 within each group. The homogeneity of the groups regarding duration of the observation period and amount of screw activation were tested with the independent t-test. To evaluate the relationship between soft tissue changes and hard tissue alterations, Pearson’s correlation coefficients were calculated. The statistical significance was determined at \( p<0.05 \) level.

Results

The acquisition of T2 cephalograms which conforms to the initiation of further orthodontic treatment corresponded to 83.25±3.51 days for SARME and 85.68±4.37 days for RME after the expansion was completed. The means and standard deviations of hard and soft tissue variables at T1 and T2 stages for both groups are shown in Table 1. The dento-skeletal and soft tissue profile changes with their significance in each group in Table 2. No significant difference was detected between groups concerning both the mean of screw activation amount and the mean of observation period (from T1 to T2).

In the SARME group, only significant change in the soft tissue profile was a decrease in upper lip thickness, while maxilla moved forward (SNA increased), clockwise rotation and backward displacement of the mandible was observed (SNGoGn increased, SNB decreased) with a consequent increase in the ANB and ANPg measurements \( (p<0.05) \). There was no correlation between the hard tissue changes and upper lip thickness.
Effects of maxillary expansion on facial profile

Figure 1. (A) Transpalatal distractor used in SARME group and (B) Cast splint Hyrax expander used in RME group.

Figure 2. Hard tissue cephalometric measurements: 1, SNA; 2, SNB; 3, ANB; 4, skeletal profile convexity; 5, SNGoGn; 6, U1-SN; 7, L1-MP Soft tissue cephalometric measurements: 8, soft tissue facial angle; 9, nose prominence; 10, superior sulcus depth; 11, soft tissue subnasale to H line; 12, basic upper lip thickness; 13, upper lip thickness; 14, H angle; 15, lower lip to H line; 16, Inferior sulcus to H line; 17, soft tissue chin thickness; 18, basic upper lip to Ver P; 19 upper lip to Ver P; (12-13) upper lip strain measurement

In the RME group, decrease in soft tissue facial profile and increase in H angle were found to be statistically significant \( (p<0.05) \), while hard tissue variables revealed similar alterations with those of the SARME group, which are as follows; maxilla was positioned anteriorly, mandible displaced backward with a concomitant increase in the ANB, ANPg and SNGoGn measurements \( (p<0.05) \). A significant correlation was evident between soft tissue facial profile angle and SNB angle \( (r=0.49, p=0.014) \). Also H angle had a significant negative linear correlation with SNB changes \( (r=-0.42, p=0.037) \).

**Discussion**

The present study primarily sought to determine the possible changes in overall soft tissue profile induced by two different maxillary expansion techniques for correction of posterior crossbite and correlate these soft tissue changes with the underlying hard tissue alterations. Thus, we would be able to carry out a clearer and more detailed discussion of the changes in facial soft tissues from sagittal perspective after RME using cast hyrax appliance and bone-borne SARME, unlike previous studies (32, 33).

In their RME study, Kılıç et al. (33) took into consideration of the soft tissue profile changes only, while Karaman et al. (32) studied the dentoskeletal effects as well. However, a statistical assessment of whether or not there existed a consistent relationship between soft tissue changes with the underlying hard tissue alterations was not performed in those studies (32, 33). Although detailed evaluation of soft tissue changes and their correlation with the underlying dento-alveolar changes have been described in previous SARME studies (18, 22), the soft tissue regions evaluated in three-dimensional study of Nada et al. (22) were limited to the upper lip and cheek region adjacent to the angle of the mouth, while Filho et al.’s (18) cephalometric study provided limited information associated with naso-labial area only. Considering that the residual loads at the termination of the appliance activation dissipated within 6 weeks, the retention phase of the current study via the expansion appliance can be deemed sufficient (36).
**Table 1.** Means and standard deviations for the cephalometric measurements (SD: standard deviation, SARME: surgically assisted rapid maxillary expansion, RME: rapid maxillary expansion).

| Variables                      | SARME |          | SARME |          | RME |          |
|--------------------------------|-------|----------|-------|----------|-----|----------|
| Hard tissue variables          | Before| After    | Before| After    |     |          |
| SNA                            | 77.11 | 4.42     | 77.74 | 4.66     | 78.19 | 4.35     |
| SNB                            | 78.57 | 4.36     | 77.93 | 4.06     | 75.57 | 5.95     |
| ANB                            | -1.46 | 3.02     | -0.19 | 3.36     | 0.62 | 3.85     |
| ANPq                           | -2.85 | 3.88     | -1.79 | 3.95     | 0.50 | 3.89     |
| SNGoGn                         | 36.15 | 7.48     | 37.00 | 6.91     | 38.81 | 6.36     |
| U1-SN                          | 103.61| 6.43     | 102.77| 6.17     | 101.78| 6.63     |
| L1-MP                          | 82.91 | 6.25     | 82.77 | 6.23     | 87.22 | 6.95     |
| Soft tissue variables          | Before| After    | Before| After    |     |          |
| Soft tissue facial angle       | 90.26 | 8.02     | 89.64 | 7.49     | 85.09 | 5.41     |
| Nose prominence                | 16.77 | 4.12     | 16.54 | 3.66     | 15.41 | 3.25     |
| Superior sulcus depth          | 2.16  | 1.51     | 2.03  | 1.41     | 0.97  | 1.20     |
| Soft tissue subnasale to H line| 2.41  | 3.08     | 2.70  | 2.84     | 3.14  | 2.81     |
| Basic upper lip thickness      | 16.57 | 2.50     | 15.96 | 2.34     | 15.39 | 1.92     |
| Upper lip thickness            | 13.30 | 3.07     | 12.75 | 2.27     | 12.26 | 2.39     |
| H angle                        | 7.94  | 5.67     | 8.38  | 5.29     | 12.27 | 3.55     |
| Lower lip to H line            | 1.46  | 1.35     | 1.59  | 1.69     | 1.16  | 1.48     |
| Inferior sulcus to H line      | 3.43  | 2.05     | 3.66  | 1.89     | 3.57  | 1.65     |
| Soft tissue chin thickness     | 12.35 | 1.85     | 12.61 | 1.78     | 11.71 | 2.42     |
| Upper lip strain measurement   | 3.27  | 2.31     | 3.21  | 2.22     | 3.13  | 1.97     |
| Basic upper lip to Ver P       | 76.22 | 7.72     | 76.03 | 6.98     | 75.33 | 6.41     |
| Upper lip to Ver P             | 78.81 | 8.57     | 78.37 | 8.01     | 76.54 | 6.61     |

Aras I et al.
Table 2. Changes in each group and intergroup differences for the cephalometric measurements (SD: standard deviation, SARME: surgically assisted rapid maxillary expansion, RME: rapid maxillary expansion).

| Variables                          | SARME       | Paired-t test | RME         | Paired t-test |
|------------------------------------|-------------|---------------|-------------|--------------|
|                                    | Mean change | SD            | p           | Mean change  | SD            | p         |
| Hard tissue variables              |             |               |             |              |               |           |
| SNA                                | 0.63        | 1.06          | 0.031*      | 0.77         | 1.30          | 0.007*    |
| SNB                                | -0.64       | 0.92          | 0.014*      | 1.65         | 0.74          | 0.000*    |
| ANB                                | 1.27        | 1.51          | 0.004*      | 2.42         | 1.34          | 0.000*    |
| ANPg                               | 1.07        | 0.98          | 0.001*      | 2.32         | 1.84          | 0.000*    |
| SNGoGn                             | 0.85        | 1.30          | 0.019*      | 1.42         | 1.28          | 0.000*    |
| U1-SN                              | -0.84       | 1.80          | 0.081       | -0.53        | 1.32          | 0.138     |
| L1-MP                              | -0.13       | 0.47          | 0.286       | 0.28         | 1.85          | 0.456     |
| Soft tissue variables              |             |               |             |              |               |           |
| Soft tissue facial angle           | -0.62       | 1.46          | 0.111       | -1.50        | 1.49          | 0.001*    |
| Nose prominence                    | -0.24       | 0.92          | 0.320       | 0.30         | 1.49          | 0.330     |
| Superior sulcus depth              | -0.13       | 0.77          | 0.505       | 0.03         | 0.66          | 0.810     |
| Soft tissue subnasale to H line    | 0.29        | 0.98          | 0.258       | 0.42         | 1.63          | 0.209     |
| Basic upper lip thickness          | -0.61       | 1.10          | 0.043*      | -0.33        | 1.13          | 0.153     |
| Upper lip thickness                | -0.55       | 1.26          | 0.102       | 0.13         | 1.29          | 0.613     |
| H angle                            | 0.45        | 1.11          | 0.133       | 2.04         | 1.79          | 0.000*    |
| Lower lip to H line                | 0.14        | 1.27          | 0.672       | -0.35        | 1.15          | 0.145     |
| Inferior sulcus to H line          | 0.23        | 0.87          | 0.305       | 0.32         | 0.87          | 0.076     |
| Soft tissue chin thickness         | 0.26        | 1.59          | 0.519       | 0.12         | 1.03          | 0.554     |
| Upper lip strain measurement       | -0.06       | 1.13          | 0.836       | -0.46        | 1.49          | 0.133     |
| Basic upper lip to Ver P           | -0.18       | 1.23          | 0.564       | -0.13        | 1.30          | 0.542     |
| Upper lip to Ver P                 | -0.44       | 0.98          | 0.094       | -0.22        | 0.75          | 0.166     |

Karaman et al.’s (32) study investigating changes in soft tissue profile following RME through cephalometry reported concomitant lip adaptations to forward movement of maxilla, such as anterior positioning of the soft tissue A point and upper lip tip in relation to the referenced vertical plane. However, our findings were not in agreement with their data, as we found non-significant changes in above-mentioned soft tissue measurements despite the forward movement of maxilla which can be explained with the rotational movement of the maxillary halves in RME and SARME in which the pterygomaxillary disjunction was avoided, as previously theorized (9, 37). This finding held true for both groups in present study. On the other hand, Ramieri et al. (38) showed that bone-anchored distraction including pterygomaxillary disjunction had no influence on jaw positions and lips, while Nada et al. (22) using
the same surgical procedure, detected posterior displacement of anterior maxillary region and slight retro-positioning of the central part of the upper lip that correlated with remodeling in the anterior alveolar region to close the created midline diastema following tooth-borne and bone-borne SARME (22, 38). However, post-SARME records included in those studies were acquired at the end of fixed appliance therapy or during fixed orthodontics following SARME. Therefore, authors pointed out that the findings associated with lip position may have been influenced by the dental movement resulting from active orthodontics (22, 38). In the cephalometric study investigating the effects of different suturing techniques on the upper lip of patients undergoing SARME, Filho et al. (18) reported that a tendency for retro-positioning of the upper lip following SARME with conventional suturings when compared with SARME using simple V-Y suture. The dissimilar findings described in preceding studies might also be attributable to multifactorial consequences of different elements, such as the surgical technique (localization and extent of maxillary osteotomies), complex anatomy and dynamics of the upper lip, amount of the soft tissues, facial type and measuring methods applied in the studies (21, 39, 40).

Decrease of the thickness of upper lip that had been observed immediately after RME (20) was not seen in present RME group. This was probably related to the fact that radiographs acquired in the current study was 85 days after the expansion whereas Kim et al. (20) carried out their measurements right after full activation of the appliance. Small but significant changes were found concerning the thickness of upper lip at the vermilion border in the present SARME group only. It is assumed that the decrease of thickness of upper lip at the vermilion border is a result of possible stretching of lip caused by greater skeletal expansion of the maxillary segment through bone-borne SARME compared to tooth-borne RME and SARME. However we are unable to test the correlation between the upper lip thickness and the amount of transversal skeletal expansion, as only lateral cephalograms were used. On the other hand, it should also be noted also that the decrease of thickness of upper lip cannot be regarded as clinically significant. While mandible was positioned backwards in both groups, soft tissue chin became less prominent in RME patients as indicated by a significant decrease in the soft tissue facial angle. The other significant soft tissue change in RME group was a significant increase in H angle, meaning that upper lip became more prominent in relation to the overall soft tissue profile, compatible with the more convex skeletal profile as determined by increases in the ANB and ANPg measurements. These findings partially agree with those reported by Kılıç et al. (33) who recorded similar results to the present study in terms of H angle, but found non-significant changes in soft tissue angle at the end of a retention period of meanly 5.95 months.

The authors who analyzed the soft tissue changes associated with RME and SARME reported contradicting results regarding sagittal changes to external shape and form of the nose. While Altorkat et al. (15) acknowledged retraction and flattening of the nasal tip, Karaman et al. (32) noted forward movement of the nose tip (a mean of 2.53 mm) following RME. Also, employing a similar surgical technique with present study, Magnusson et al. (21) found minor but statistically significant changes demonstrating anterior movement of the nose following tooth-borne SARME, with no evident modification of subnasale. In the present study, there was no effect of RME on nose prominence, similar to the results reported by Kılıç et al. (33) and da Silva Filho et al. (23) suggesting that RME does not alter nasal morphology which also held true for the SARME group. The patients in the current study were not specified according to a certain growth pattern and no initial sagittal and vertical differentiations were made similar to other studies in this field. Also, it must be considered that the major difference between the groups were in their patient’s age. Furthermore, differences in expender type and sample size related to RME and SARME groups were other limitations. Due to the lack of intergroup homogeneity, an analysis of significance comparing the RME and SARME groups was not carried out. The results of this study suggested that RME with cast Hyrax device has the potential to affect facial soft tissue profile, unlike the bone-borne SARME. A likely explanation is the multiple cuspal interferences possibly occurring as a result of buccal tipping of the posterior maxillary teeth related to the expansion method using tooth-borne appliances together with the overcorrection, which both have been held responsible for clockwise rotation of mandible resulting in a concomitant increase in soft tissue convexity. This hypothesis is supported by the RME study of Santos et al. (31) using modified acrylic hyrax device, which caused no significant alterations in the soft tissue profile at the end of the retention
Effects of maxillary expansion on facial profile

period, because of the presence of the thicker acrylic occlusal surface and palatal tissue support, both of which prevent buccal tipping of the anchored teeth when compared with the occlusal surface coverage only of the cast hyrax appliance. Also the findings in RME group demonstrated that the changes in the soft tissue facial angle and H angle followed the changes in SNB angle in a consistent manner. Although we found statistically significant correlations between these soft and hard tissues, the correlation coefficients were relatively weak hence it will not be possible to make precise predictions of soft tissue changes following RME.

Conclusion

In RME group, soft tissue chin prominence decreased and upper lip became more prominent in relation to overall soft tissue profile, meaning that the convexity of the soft tissue profile has increased. In the SARME group, the only significant change in soft tissue profile was characterized by a decrease in thickness of the upper lip at the vermilion border that was not significant clinically. Tooth-borne RME appeared to have a potential to alter the soft tissue profile, but not the bone-born SARME. In RME group, the changes in soft tissue facial angle and H angle showed a weak association with the changes in SNB angle. Prospective studies conducted on patients classified according to sagittal and vertical growth pattern, using 3-dimensional methods are needed.

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None declared.

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**Corresponding Author:**
İşil ARAS  
Department of Orthodontics  
Faculty of Dentistry Ege University  
35080 Bornova-Izmir / Turkey  
Phone: +90 0232 388 03 26  
e-mail: isilaras@gmail.com