Examination of the Soft Tissue Changes After Rapid Maxillary Expansion¶

RAPİD MAKSİLLER EKSPANSİYON SONRASI YUMUŞAK DOKU DEĞİŞİKLİKLERİNİN İNCELENMESİ

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Summary

Purpose: As a result of rapid maxillary expansion (RME) some changes appear in hard tissues as well as in soft tissues. The aim of this study was to examine the skeletal and dental changes together with soft tissue profile changes which occurred after RME.

Materials and Methods: Cephalometric films which taken before and after RME formed the study materials that was 10 male and 10 female totally 20 person, average age is 12.8±1.4 who have got transversal maxillary collaps. The expansion continued average 5.2 weeks by the activation of expansion screw at two times (2x¼ turn= 0.5 mm) a day. The changes in skeletal and soft tissue profile, incisor relations and lip structure were examined in sagittal and vertical directions on the cephalometric films. The measurements obtained from the lateral cephalometric films were evaluated by Paired t-test.

Results and Conclusion: Important changes were observed from the measurements of skeletal and soft tissue on sagittal and vertical directions. After RME, it was seen that while maxilla and upper incisors moved to anteriorly at sagittal direction, nose tip and soft tissue of A point followed hard tissue of A point. After expansion, central and inferior dimensions of face increased at vertical side.

Key Words: Rapid maxillary expansion, Soft tissue, Profile

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Özet

Amaç: Rapid maksiller ekspansiyonun (RME) sonucunda sert dokularla beraber yumuşak dokularda da değişiklikler meydana gelmektedir. Bu çalışmanın amacı RME sonrası meydana gelen iskeletsel ve dental değişikliklerle beraber yumuşak doku profil değişikliklerini incelemektir.

Materyal ve Metod: Çalışmanın materyalini yaş ortalaması 12,8±1,4 olan transversal yönde maksiller darlığa sahip 10 kız, 10 erkek toplam 20 bireyden RME öncesi ve sonrasında alınan sefalometrik radyografiler oluşturmaktadır. Ekspansiyon vidanın günde iki kez aktivasyonuyla (2x1/4 tur= 0,5 mm) ortalama 5,2 hafta devam etmiştir. Sefalometrik filmler üzerinde sagital ve vertikal yönlerde iskeletsel ve yumuşak doku profil değişiklikleri, kesici dişlerin ilişkileri ve dudak yapısındaki değişimler incelenmiştir. Elde edilen veriler eşleştirilmiş t-testi ile değerlendirilmiştir.

Bulgular ve Sonuç: RME sonrası sagital yönde maksilla ve üst kesici dişler öne hareket ederken burun ucu ve yumuşak doku A noktası sert doku A noktasını takip etmiştir. Vertikal yönde orta ve alt yüz boyutlarında artış görülmüştür.

Anahtar Kelimeler: Rapid maksiller ekspansiyon, Yumuşak doku, Profil

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Facial form was analysed by various orthodontic investigators in attempts to relate the soft tissue profile to the underlying dentition. Researches, who included Rickets (1), Steiner (2), Burstone (3) and Holdaway (4) soon recognised the need for, and therefore develop, cephalometric techniques to evaluate soft tissue that were separate from the es-

tablished skeletal and dental analyses. Other investigators (5-10) have clearly demonstrated that, although the overlying soft tissue does not always reflect the underlying dentoskeletal pattern, there were some associations between the amount of tooth movement and the resultant soft tissue changes.

Laufer et al (11), Kiyak et al (12) and Jacobson (13) determined that aesthetics was a basic pattern for the most of patients who search for orthodontic treatment.

A balanced soft tissue profile is one of the most important treatment object in orthodontic treatments. A lot of researchers emphasise that the alterations on harmony of face is a result of the inbalance of the lips and muscles that surrounds them (3,14,15). While the orthodontic treatments affect especially the lower face, orthopaedic and orthognatic surgical treatments changes the mid face area as well the lower face (16,17).

Maxillary expansion has long been used as a means of correcting a transverse discrepancy of the maxillary arch via orthopedic(skeletal), orthodontic(dental) or surgically assisted techniques, with the prime objective of coordinating the maxillary and mandibular denture bases (18-25).

Although there are many articles describing the general skeletal and dental changes of RME (18,19,24,26,27), there are limited articles examining the soft tissue changes (26-28).

Berger et al (26) examined the changes occurred soft tissue on the standard front photographs that obtained from 44 individuals be applied RME. They reported that skeletal changes that occurred on transversal and vertical direction affected the soft tissue profile too.

Ngan et al (28) examined the changes that RME and reverse headgear combination made on soft and hard tissues on 20 patients average 8 years old who have skeletal and dental Class III anomaly and found that, soft tissue followed hard tissues 50-79 % by the anterior movement of maxilla.

The aim of the this study was to examine the soft tissue profile changes with skeletal and dental changes that occurred after RME.

Material and Methods

The study was performed on 20 growing children (10 males and 10 females), presenting bilateral posterior crossbite and maxillary collapse. The age of the patients ranged from 10.1 to 14.8 years, with an average of 12.8 years (Table 1).

Modified acrylic bonded rapid maxillary expansion appliance were used for RME treatment in all patients.

Properties of the Appliance and Application

Appliance designed by us is a splint type with tooth-tissue borne. Acrylic part of the appliance extends to the occlusal and middle third of vestibular surfaces of all teeth. Acrylic thickness of occlusal surface was protected with in freeway space and contact to all lower teeth was provided. Holes were opened for drainage of extra cement during cementation process. Hyrax screw was used to increase the rigidity of the appliance (Figure 1).

Table 1. The distribution of average ages and expansion time of individuals

	n	Mean age (year)	Period of Expansion (week)
Male	10	12,1±0,7	5,2±0,3
Female	10	13,1±1,1	5,1±0,2
Total	20	12,8±1,4	5,2±0,3

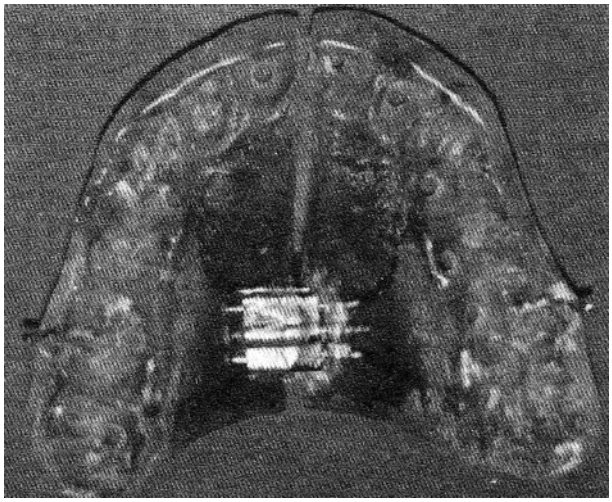

Figure 1. Modified acrylic bonded rapid maxillary expansion appliance.

Glass ionomer cemen was used in cementation.

Screw was activated twice (2x1/4 turns=0.5 mm) a day in the first week to overcome the resistance of the suture following the cementation and once (1x1/4 turns=0.25) a day after the suture opened.

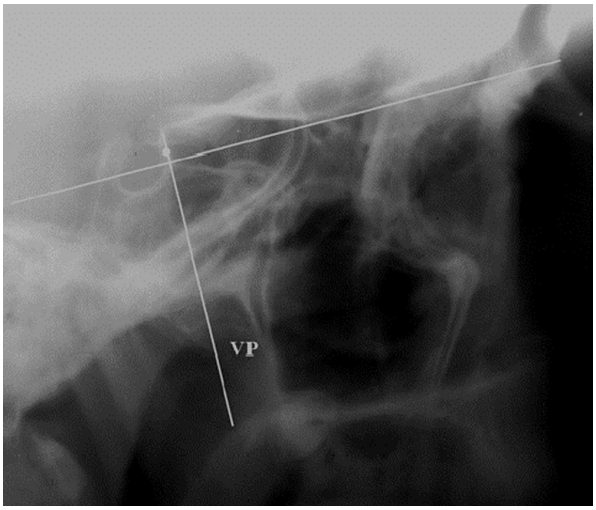

Figure 2. Vertical reference plane (VP).

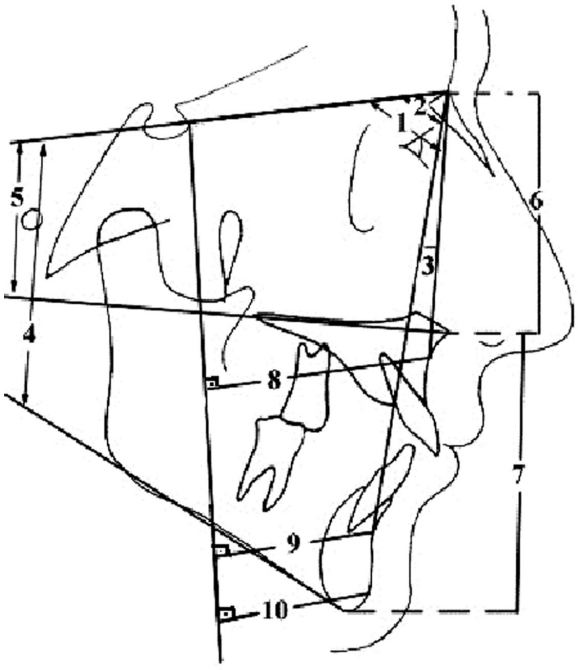

Figure 3. Skeletal cephalometric analysis; 1.SNA, 2.SNB, 3.ANB, 4.SN-MP, 5.SN-PP, 6.N-ANS, 7.ANS-Me, 8.VP-A, 9.VP-P, 10.VP-Po.

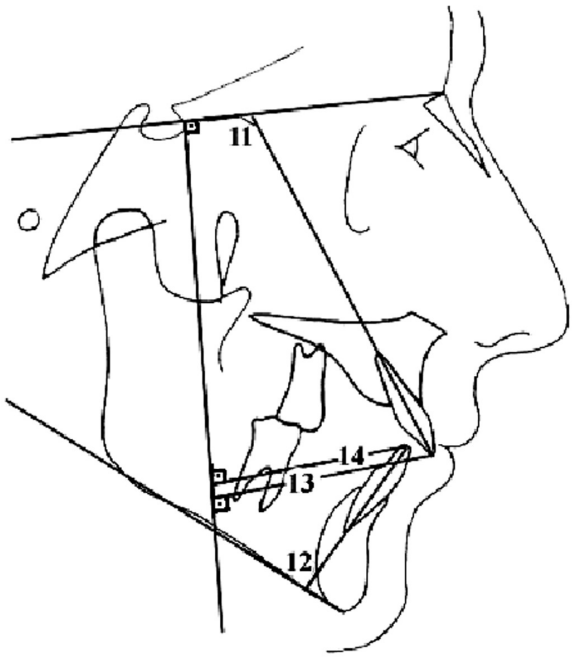

Figure 4. Dental cephalometric analysis; 11.U1-SN, 12.L1-MP, 13.VP-U1, 14.VP-L1.

Expansion process was completed after crossbite was corrected and over expansion of 2-3 mm was obtained. Appliance used in active treatment was removed and cleaned the appliance was used again as a removable appliance in retention period.

Lateral cephalometric films were taken before RME treatment and after RME treatment. All radiographs were taken in centric relation with lips in repose. Lateral cephalometric films were recorded in Planmeca PM 2002 CC. The profile radiographs were recorded with fixed focus to mid-sagittal plane and mid-saggital plane to film distances of 150 and 13 cm respectively.

In order to form vertical reference plane on the, a perpendicular line was drawed toward the SN plane from the intersection of cella tursica's anterior walls and anterior clinoid processus (29) (Figure 2).

The measurements that have been done on the lateral cephalometric films are shown in the Figure 2, 3, 4 and 5.

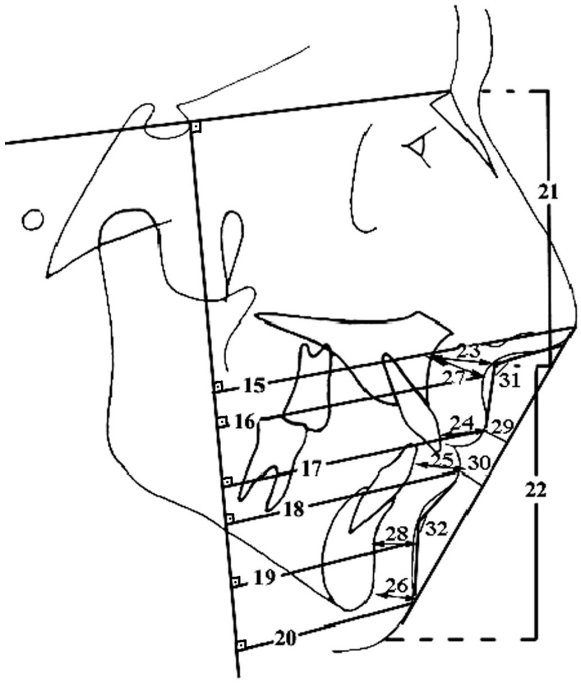

Figure 5. Soft tissue cephalometric analysis; 15. VP-Pn, 16.VP-As, 17.VP-Ls, 18.VP-Li, 19.VP-Bs, 20.VP-Pos, 21.Ns-Sn, 22.Sn-Ms,23.Sn-A, 24.Ls-U1, 25.Li-L1, 26.Pos-Pog, 27.Sls-A, 28.Ils-B, 29.Ls-E plane, 30.Li-Eplane, 31.Nasolabial angle, 32.Mentolabial angle.

Statistical Method

The measurements on lateral cephalometric films which was taken before and after RME were evaluated by means of SPSS statistic pocket program, the statistic importance before and after expansion, values were evaluated statistically by "Paired t-test" (30).

Reliability of measurements

The reliability of the cephalometric measurements was examined on lateral cephalometric films of 20 randomly selected subjects, by repeating the tracing and measuring procedures. The reliability of a single measurement was calculated by using Dalhberg formula. The reliability of measurements ranged between 0.158 to 0.930 in lateral cephalometric variables (31).

Results

For the 20 individuals be applied RME along average 5.2 weeks averages, treatment differences and standard deviations relating to before and after expansion are given in Table 2.

With the expansion in VP-U1, Ns-Sn and Li-L1 measurements ($p<0.05$), SNA, N-ANS, ANS-Me, SN-MP, VP-Ls and Sn-Ms measurements ($p<0.01$), ANB VP-A and VP-Pn measurements ($p<0.001$) an increasing was determined. However in SNB ($p<0.05$) VP-B and VP-B ($p<0.001$) measurements a decrease was found.

Discussion

The proportion of skeletal orthodontic and orthopaedic movement is dependent on the rate of expansion, the age of the patient and appliance type (32,33).

Many investigators suggest that RME should be done in prepubertal period or during puberty. Skeletal and dental effects are obtained more easily and relapse is rare (19-21,23,25). In our study age means was 10.1 years to 14.8 years and average age was 12.8 years respectively.

Molar tipping and extrusion have been shown to be the cause of the bite opening and increasing of the vertical dimensions after conventional RME treatment. Several authors have pointed out that, increasing rigidity of an appliance reduces the rotational component of the forces along the long axis of teeth (1,29,34). Therefore, to avoid the tipping of the upper molars and to control of the vertical facial dimension, a more rigid type of RME device, namely, modified acrylic bonded rapid maxillary expansion appliance was used in the present study. Mild inflammation of the alveolar and palatal mucosa was observed after appliance removal and no reported notable pain or discomfort during RME treatment.

There are limited study about the soft tissue change formed by RME in the literature (26-28). In our study, skeletal, dental and soft tissue profile changes which was formed with acrylic bonded RME was evaluated on lateral cephalometric films.

Many investigators reported that maxilla moves forward and downward by the use of RME appliance (19-22,24,25,33,35). But there are many investigators reporting opposite findings (25,36-39).

Table 2. Values for various profile cephalometric parameters before and after expansion

			Before		After				
			Mean	Sd	Mean	Sd	Difference	Sd	P
SKELETAL	1	SNA (deg)	78,88	3,70	80,03	3,24	1,15	1,47	0,0043**
	2	SNB (deg)	76,55	2,54	75,70	2,61	-0,85	1,59	0,0294*
	3	ANB (deg)	2,33	2,57	4,27	2,29	1,95	1,27	0,0002***
	4	SN-MP (deg)	38,63	6,48	40,42	6,72	1,80	2,17	0,0023**
	5	SN-PP (deg)	9,15	3,02	9,22	2,94	0,07	2,53	0,6726
	6	N-ANS (mm)	54,35	3,24	56,22	3,64	1,88	2,49	0,0046**
	7	ANS-Me (mm)	68,80	5,40	71,40	5,80	2,60	2,96	0,0011**
	8	VP-A (mm)	51,70	5,95	52,79	6,47	1,09	1,15	0,0007***
	9	VP-B (mm)	38,28	8,51	36,53	9,00	-1,75	1,35	0,0003***
	10	VP-Po (mm)	39,37	11,54	37,49	12,03	-1,89	1,50	0,0003***
DENTAL	11	U1-SN (deg)	104,20	6,69	103,69	6,79	-0,52	4,31	0,5713
	12	L1-MP (deg)	90,38	5,65	90,32	5,29	-0,06	3,58	0,8129
	13	VP-U1 (mm)	52,41	7,12	53,52	7,09	1,11	1,73	0,0174*
	14	VP-L1 (mm)	48,68	6,71	48,28	7,40	-0,40	2,16	0,3259
SOFT TISSUE	15	VP-Pn (mm)	83,90	7,36	86,43	5,84	2,53	6,90	0,0007***
	16	VP-As (mm)	66,03	6,44	67,32	6,67	1,30	1,59	0,0015**
	17	VP-Ls (mm)	67,83	6,85	69,00	6,93	1,17	1,77	0,0069**
	18	VP-Li (mm)	61,95	7,31	61,90	7,85	-0,05	2,37	0,4566
	19	VP-Bs (mm)	50,49	8,47	49,65	8,91	-0,84	2,79	0,1978
	20	VP-Pos (mm)	49,62	8,56	49,20	9,51	-0,42	2,99	0,2862
	21	Ns-Sn (mm)	57,85	3,66	58,78	3,58	0,93	1,38	0,0125*
	22	Sn-Ms (mm)	75,10	6,08	77,20	5,94	2,10	2,86	0,0052**
	23	Sn-A (mm)	16,00	2,12	16,27	1,96	0,27	1,47	0,4603
	24	Ls-U1 (mm)	12,60	1,91	12,75	1,55	0,15	1,22	0,8424
	25	Li-L1 (mm)	14,75	1,68	15,43	1,81	0,68	1,12	0,0144*
	26	Pos-Pog (mm)	11,61	1,53	11,60	1,87	-0,09	1,31	0,9001
	27	Sls-A (mm)	14,76	2,02	15,03	1,68	0,27	1,57	0,3438
	28	Ils-B (mm)	11,50	1,31	11,89	2,06	0,39	1,46	0,2868
	29	Ls-E plane (mm)	-2,79	1,97	-2,54	2,29	0,25	1,18	0,4102
	30	Li-E plane (mm)	-0,59	2,96	-0,10	2,81	0,49	1,08	0,0800
	31	Nasolabial angle	91,11	31,36	96,55	11,44	5,44	29,52	0,5014
	32	Mentolabial angle	118,90	16,68	116,25	18,66	-2,65	11,63	0,4115

p<0,05*, p<0,01**, p<0,001*** Significant p values are shown.

In this study, the determination of important increasing in SNA angle and VP-A measurement showed that maxilla moved anteriorly after RME treatment. Also this important increase was determined on soft tissue (VP-As) measurement. The forward movement maxilla was accompanied by corresponding increase (18%). Soft tissue followed the skeletal structures at 18% rate. Ngan et al (28) determined that with RME and reverse headgear combination maxilla moved anteriorly and connected to this the soft tissues moved forwardly at 50-79%. Our findings agreed with Ngan et al (28) studies. In addition, it was determined that in our study nose tip moved forwardly at an important amount We can say that this movement has been depending upon the maxilla's anterior part which is much more free than its posterior part because of the anatomic structures.

Several authors reported that the mandible moves downwards and backwards as result of downward and forward movement of maxilla and buccally tipping and extrusion of upper first molars by RME. This results in a decrease at the angle of SNB and increase in lower face dimensions (19-21,33,37,39,40).

In this study, at SNB angle, VP-B and VP-Po measurements were found important decreasing.

This findings showed that mandibula moved the downward and backward direction. However we found that the decreasing at the soft tissue VP-Bs and VP-Pos measurements were not important statistically. Ngan et al (28) determined that in patients treated by RME and reverse headgear combination, mandibula moved the backward and downward direction and soft tissues followed the skeletal structures 71 to 81%.

We found that as a result of maxilla's forward movement and mandibla's downward and backward movement, ANB angle statistically increased at an important degree. This finding is consistent with findings of most researchers who inform about relation between RME and ANB angle angle (19,25,35,36).

Depending upon the downward and backward movement of the mandible, SN-MP angle, N-ANS and ANS-Me distances were statistically significant increased. This findings are agree with Asanza et al (39), Ngan et al (28), Sarver and Johnston's (37) findings. Depending upon this findings in soft tissue at N'-SN and Sn-Me distances were determined important increasing. The soft tissues followed the skeletal structures at 49 and 80 % respectively. This situation showed that mandible moved downward and backward after RME treatment. This findings are in agreement with the findings at Ngan et al (28) studies.

Berger et al (33) reported that the soft tissue upper and lower face height increased after RME treatment on the standard frontal photographs.

We determined that the upper central teeth moved anteriorlly without lingual tipping. The anterior movement of the upper central teeth was accompanied by corresponding increase %100 in the soft tissues, probably due to the design of the acrylic bonded RME appliance, which was extended to the occlusal and third middle of vestibular surfaces of all teeth.

Conclusion

Posterior crossbites of all patients were corrected. Statistically significant changes was obtained both skeletal and soft tissues measurements on sagittal and vertical directions.

In sagittal direction, when maxilla and upper central teeth moved anteriorly, nose tip, soft tissue A point and upper lip tip moved anteriorly.

In vertical direction, central and lower face dimensions increased both skeletal and soft tissue measurements.

In summary this study showed that significant dentoskeletal changes and improvements in the dentofacial profile could result from one mounts of RME treatment. Certain hard and soft tissue variables were valuable as elements of prediction in preorthopedic treatment planning.

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