RESEARCH

The Effect Of Rapid Maxillary Expansion On The Airway Dimension In Skeletal Class II Treatment

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ABSTRACT

The Effect Of Rapid Maxillary Expansion On The Airway Dimension In Skeletal Class II Treatment

Background: To examine the changes in pharyngeal airway dimension and hyoid bone position with the effect of rapid maxillary enlargement during the treatment of skeletal Class II malocclusion with functional appliances.

Methods: Patients with skeletal Class II malocclusion were divided into two groups; Group 1 consisted of 25 patients (8 males, 17 females) with a mean age of 11.41±1.13 who treated with twin-block appliance with rapid maxillary expansion appliance and Group 2 who only received twin-block therapy consisted of 25 patients (12 males, 13 females) with a mean age of 11.92±0.65. In this study, 11 angular and 3 linear measurements were used for skeletal evaluation of maxillary and mandibular on cephalometric X-rays of initial and intermediate records of 50 patients and 13 linear measurements were performed for pharyngeal airway evaluation. Intra-group comparisons were analyzed using the paired sample t-tests. Inter-group comparisons were analyzed using the independent t-test.

Results: According to the intra-group t test results, in skeletal evaluation of the maxillary and mandibular, 8 angular and 2 linear measurements for group 1, 9 angular and 2 linear measurements for group 2, in pharyngeal evaluation all measurements of group 1 and 11 linear measurements for group 2 were significant differences ($P<.05$). According to the intergroup t test results, there were significant differences in skeletal assessment and pharyngeal airway evaluation ($P<.05$).

Conclusion: A statistically significant difference was found in the upper and middle pharyngeal airway dimensions in the inter-group evaluation. While the contribution of rapid maxillary expansion to the increase of pharyngeal airway dimensions was shown, the effect of the functional appliances on this region is greater.

KEYWORDS

Maxillary-expansion; Pharyngeal-airway; Twin-block

ÖZ

İskeletsel Sınıf II Tedavisinde Hızlı Üst Çene Genişletmesinin Hava Yolu Boyutlarına Etkisi

Amaç: Bu çalışmanın amacı, iskeletsel Sınıf II maloklüzyona sahip hastaların tedavisinde kullanılan fonksiyonel apareyler sırasında hızlı üst çene genişletmesinin, farengeal hava yolu boyutlarına ve hyoid kemiğin pozisyonundaki değişimlere etkisinin değerlendirilmesidir.

Gereç ve Yöntemler: İskeletsel sınıf II maloklüzyona sahip hastalar iki gruba ayrıldı; Grup 1 hızlı üst çene genişletmesi ile birlikte twin blok tedavisi gören yaş ortalaması 11,41±1,13 olan 25 hastadan (8 erkek,17 kız) ve Grup 2 sadece twin blok tedavisi gören yaş ortalaması 11,92±0,65 olan 25 hastadan (12 erkek, 13 kız) oluşmaktadır. Çalışmamızda, 50 hastanın başlangıç ve ara kayıt sefalometrik röntgenleri üzerinde alt ve üst çeneye ait iskeletsel değerlendirme için 11 açısal 3 çizgisel ölçüm, farengeal havayolu değerlendirmesi için 13 çizgisel ölçüm gerçekleştirildi. İstatistiksel analiz için grup içi bağımlı örneklem t testi, gruplar arası bağımsız örneklem t testi kullanıldı.

Bulgular: Grup içi bağımlı örneklem t testi sonuçlarına göre alt ve üst çeneye ait iskeletsel değerlendirmede grup 1 için 8 açısal 2 çizgisel ölçümde, grup 2 için 9 açısal 2 çizgisel ölçümde, farengeal havayolu değerlendirmesinde grup 1 için kullanılan tüm çizgisel ölçümlerde, grup 2 için 11 çizgisel ölçümde anlamlı fark bulundu($p < 0,05$). Gruplar arası bağımsız örneklem t testi sonuçlarına göre iskeletsel değerlendirmede farengeal havayolu değerlendirmesinde anlamlı farklılıklar bulundu($p < 0,05$).

Sonuç: Gruplar arası değerlendirmede üst ve orta farengeal hava yolu boyutlarında istatistiksel olarak fark saptandı. Hızlı üst çene genişletmesi uygulanmış fonsiyonel aparey tedavisi, farengeal hava yolu ve hyoid kemiğin pozisyonunu daha fazla etkilemektedir.

ANAHTAR KELİMELER

Üst Çene Genişletme, Faringeal Hava yolu, İkiz Blok Apareyi

Facial aesthetic has an important place in the beauty sense. This is also the key reason with skeletal Class II malocclusion to seek orthodontic treatment. This malocclusion is often the result of the mandibles being small and retruded. Several methods have been effective in Class II malocclusion treatment. Class II malocclusion with deficient mandible, if diagnosed at an early age, can be treated with functional appliances. Twin-block appliance is one of the most popular mandibular advancement device to correct skeletal Class II malocclusion. Narrowing of the pharyngeal airway passage is common among subjects with retrognathic mandible.[1,2] Mandibular deficiency can be accompanied by skeletal maxillary

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transverse discrepancies. Rapid maxillary expansion (RME) is an effective orthopedic technique to open the midpalatal suture that provides correcting stable maxillary width.[3] The RME appliances produce heavy forces of up to 10 kg so it can separate the midpalatal suture, providing orthopedic movement of the maxillary bones with minimal orthodontic tooth movement.[4] Although the potential effects of RME are orthopedic and dental, it has effects on the airway too.[5]

The pharyngeal airway space has an important role in breathing that it plays a role to regulate the establishment of mouth breathing or nasal breathing.[6] Furthermore, in growing patients the airway space affects dentoskeletal relationships and facial aesthetic patterns.[7] According to researches that retrognathia is associated with airway reduction that is because of the reduced space between the cervical column and the mandibular body.[8] It has been reported that a reduction in the superior airway area indicates a risk factor for obstructive sleep apnea syndrome, snoring and upper airway resistance syndrome.[9] By forcing the mandible, hyoid bone, soft palate and tongue forward and it causes an increase in oropharyngeal dimensions.[10]

Since the maxillary bones constitute a significant part of the structures of the nasal cavity, the lateral walls of the nasal cavity are also displaced when the middle palatal suture is open, and the volume increases and the upper airway resistance decreases with time.[11] Some studies have shown that suture opening with RME increases both the volumetric space of the nasal cavity and the transversal width of the maxilla. With this enlargement, the maxillary complex moves down and forward, resulting in an improvement in nasal airflow in the nasal canal.[12,13] Attention was paid to the absence of Adenotonsillar hypertrophy in the patient group included in these studies. According to another research, a slight increase of the nasopharyngeal airway space after rapid palatal expansion therapy.[8]

When the anatomy of the cervicofacial skeleton is examined in general, the hyoid bone tends to be obscured or not so much attention is paid.[14] However, the hyoid bone is associated with several important functions such as swallowing, phonation and respiration. For this reason, any change in position may adversely affect airway dimensions. Therefore, Class II functional treatment has the potential to affect the hyoid bone by changing the mandibular position.[15]

The purpose of this study was to evaluate the changes in pharyngeal airway dimensions and hyoid bone position with the effect of rapid maxillary expansion during functional appliances used in the treatment of patients with skeletal Class II malocclusion.

MATERIAL AND METHODS

This study was approved by the Selçuk University ethical committee. In sample size was calculation, based on significance level of 0.05 and a power of 90% to detect a clinically meaningful differences of 1.5 mm (±1.4 mm) for the upper pharyngeal dimension between the groups. The power analysis showed that 21 patients in each group were required. To increase the power of the study, the study sample included 25 patients for each group. Patients with skeletal class II malocclusion were divided into two groups; Group 1 who treated with twin-block appliance with rapid maxillary expansion appliance consisted of 25 patients (8 males and 17 females) with a mean age of 11.41 ± 1.13 and Group 2 who only received twin-block therapy consisted of 25 patients (12 males and 13 females) with a mean age of 11.92 ± 0.65. Patients in both groups had dental and skeletal class II malocclusion with mandibular retrognathia. In Group 1, patients also had transversal maxillary deficiency that they had bilateral posterior crossbite. In both groups patients had no systemic disease, temporomandibular joint disorders and congenital anomalies.

In Group 1 who treated with twin-block appliance with rapid maxillary expansion, the parents of the patients were informed to open the Hyrax screw (G&H Wire Company, Franklin, USA) twice per day for 1 week. Then, after the midpalatal suture opened, the activation protocol was modified of 1 activation of the jackscrew per day until resolution of the posterior crossbite. After 2 to 3 mm overexpansion (8,52±1,27 mm), the expansion process was terminated and the screw was ligated with stainless steel wire. In group 2 treated with only twin-block therapy. The total treatment duration of both groups was 12 ± 03 months. Following the removing of the appliance, all patients were applied to fixed treatment.

Lateral radiographs were taken just before the treatment (T1) and after the appliances were removed (T2) by an experienced radiology technician in standard positions (Planmeca Promax, Helsinki, Finland). In our study, 11 angular 3 linear measurements were made for skeletal evaluation of maxillary and mandibular on cephalometric X-rays of initial and intermediate records of 50 patients (Figure 1 and Table 1), and 13 linear measurements were performed for pharyngeal airway evaluation (Figure 2 and 3).

The measurements of both groups were made by an experienced orthodontist using cephalometric lateral films and Quick Ceph Studio Version 4.3.2. software (Quick Ceph Systems, San Diego, CA).

Table 1.

Pharyngeal airway dimensions and variables evaluating the position of the hyoid bone

Pharyngeal Airway Dimensions	
PNS-AD1, mm	The distance from posterior nasal spina (PNS) to posterior pharyngeal wall along the line from PNS to basion (Ba);
AD1-Ba, mm	The distance from Ba to adenoid (AD1) along the line from PNS to Ba;
PNS-AD2, mm	The distance from PNS to the adenoid tissue (AD2) along the line from PNS to Hormion (H, the point located at the intersection between the perpendicular line to Sella-Ba and the cranial base)
AD2-H, mm	The distance from AD2 to H
PNS-Ba, mm	The distance from PNS to Ba
Ptm-Ba, mm	The distance from pterygomaxillare (Ptm) to Ba
PNS-H, mm	The distance from PNS to H
Mc-upper, mm	McNamara's upper pharyngeal dimension, minimum distance from the soft palate to the nearest point of the posterior pharyngeal wall
Mc-lower, mm	McNamara's lower pharyngeal dimension, minimum distance from the point where the posterior tongue contour crosses the mandible to the nearest point on the pharyngeal wall
LPD, mm	Lower pharyngeal dimension, the distance between the anterior and posterior pharyngeal wall through the line between the Cv3ai and Cv3pi points
Variables Evaluating The Position Of The Hyoid Bone	
Hy-TW, mm	The distance from hyoid (hy) to the horizontal reference line (HRL, the line passing through the tuberculum sella [T] and wing [W] points)
Hy-VRL, mm	The distance from hy point to vertical reference line (VRL, perpendicular line passing through the T point)
Hy-Cv3, mm	The distance from hy to Cv3ai

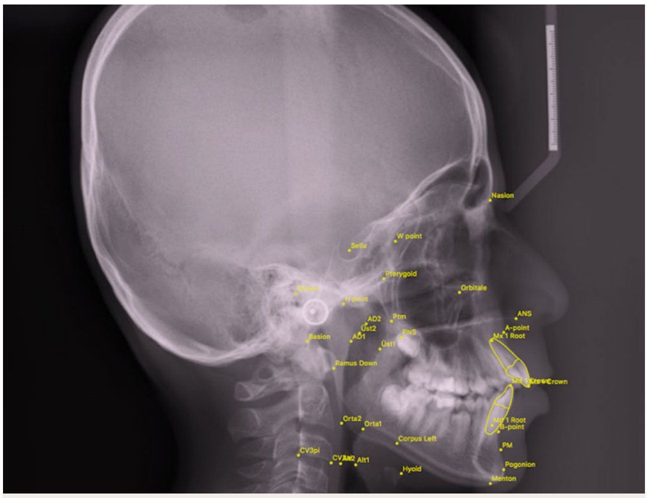

Figure 1

Cephalometric points.

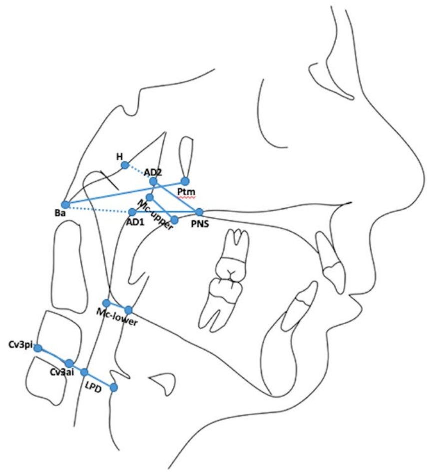

Figure 2

Pharyngeal airway dimensions.

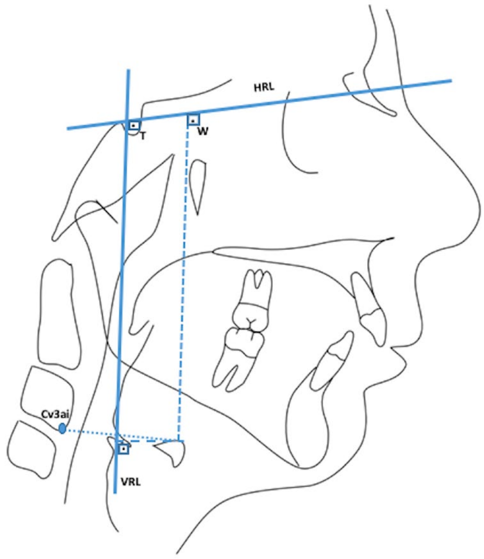

Figure 3

Variables evaluating position of the hyoid bone.

STATISTICAL ANALYSIS

All measurements were repeated by the same orthodontist to ensure the reliability of the measurements. The differences between the two readings were between 0.1° and 0.5° for the angular measurements and 0.1 and 0.4 mm for linear measurements. To improve accuracy, all measurements were repeated 3 times and the means were used for the comparisons. Statistical analysis was performed using the SPSS 21.0 (Statistical Package for Social Sciences, IBM, Armonk, NY, USA). In each group, cephalometric and pharyngeal airway values and mean changes were evaluated using t-test. Intragroup paired sample t-test and intergroup independent sample t-test were used for statistical analysis. The significance levels were set at P ≤ .05, P ≤ .01, P ≤ .001 for all statistical tests.

RESULTS

According to the intra-group paired sample t-test results, in skeletal evaluation of the maxillary and mandibular, in both groups, SNB significantly increased, ANB decreased so in both groups, the skeletal class II relationships were improved (Table 2).

Table 2.

Descriptive statistics and intra-group comparison of groups

	Group 1					Group 2				
	T1		T2			T1		T2		
	Mean	SD	Mean	SD	P value	Mean	SD	Mean	SD	P value
SNA, °	79.11	3.94	78.78	3.9	0.171	79.31	4.36	78.85	4.37	0.008**
SNB, °	73.38	3.75	74.89	3.5	0.001***	74.92	3.49	76.63	3.42	0.001***
ANB, °	5.72	1.66	3.88	1.83	0.001***	4.38	1.76	2.86	1.78	0.001***
Mx1-NA, mm	5.6	2.97	5.81	2.58	0.611	5.5	2.22	5.48	2.79	0.882
Mx1-NA,°	26.26	8.81	27.79	7.83	0.676	21.87	5.47	21.84	7.57	0.983
Mn1-NB, mm	5.63	2.02	7.62	1.7	0.001***	5.75	1.9	7.44	1.94	0.001***
Mn1-NB,°	28	5.91	34.38	4.87	0.001***	28.12	6.45	36.68	5.46	0.001***
Pg-NB, mm	1.56	1.77	1.06	1.82	0.006**	1.49	2.22	0.88	2.29	0.037*
GoGn-SN,°	38.42	7.79	39.48	7.78	0.001***	33.97	4.5	35.48	4.57	0.003**
Intincisor, °	120.05	10.77	115.96	8.76	0.001***	125.73	8.29	118.5	7.71	0.001***
FMA, °	27.24	7.75	28.59	7.78	0.001***	23.71	4.88	26.28	4.95	0.001***
FMIA, °	56.54	6.17	51.39	5.18	0.001***	56.81	6.17	48.97	6.62	0.001***
IMPA, °	96.21	8.19	100.02	8.29	0.001***	99.46	7.16	104.76	6.52	0.001***
Hy-TW, mm	-93.04	6.17	-95.23	6.39	0.003**	96.32	7.34	96.14	8.87	0.896
Hy-VRL, mm	-13.73	7.23	-16.25	7.81	0.001***	-22.32	10.1	-27.83	11.63	0.001***
Hy-Cv3, mm	30.24	3.48	32.21	3.91	0.001***	31.19	3.47	33.26	3.07	0.001***
PNS-AD1, mm	22.26	4.12	24.22	3.6	0.001***	26.08	3.25	29.15	2.71	0.001***
AD1-Ba, mm	21.14	3.74	21.9	3.44	0.012*	17.53	2.36	19.33	2.37	0.001***
PNS-AD2, mm	23.89	6.17	25.82	6.59	0.001***	19.7	3.94	22.42	3.11	0.001***
AD2-H, mm	12.51	2.55	13.19	2.72	0.001***	10.5	1.95	11.32	1.97	0.053
PNS-Ba, mm	43.33	3.16	45.81	3.09	0.001***	42.62	3.03	47.16	4.08	0.001***
Ptm-Ba, mm	50.7	9.65	52.86	10.44	0.001***	41.48	9.52	44.91	9.62	0.032*
PNS-H, mm	29.7	2.5	31.8	2.44	0.001***	30.04	2.86	32.53	2.66	0.001***
Mc-upper, mm	9.46	3.63	11.32	3.71	0.001***	11.06	2.74	12.58	2.97	0.001***
Mc-lower, mm	8.84	2.77	10.69	2.6	0.001***	8.4	2.34	9.74	3.02	0.001***
LPD, mm	8.86	2.87	10.51	2.96	0.001***	9.99	2.74	11.84	2.82	0.026*

* : P ≤ .05, ** : P ≤ .01, *** : P ≤ .001

Mn1-NB mm, Mn1-NB der, FMA, IMPA increased, FMIA decreased respectively P ≤ .001. Also, in group 1, Pg-NB decreased respectively P ≤ .01, in group 2 SNA decreased and GoGn-SN increased respectively P ≤ .01 and Po-NB decreased respectively P ≤ .05.

Intra-group paired sample t-test results in pharyngeal evaluation, in both groups, Hy-VRL decreased, Hy-Cv3, PNS-AD1, PNS-AD2, PNS-Ba, PNS-H, Mc-upper, Mc-lower increased respectively P ≤ .001 from T1 to T2. After the treatment, upper airway dimensions were significantly increased in both groups from T1 to T2 (P ≤ .001). In group 1, Hy-TW and Ptm-Ba decreased, LPD increased respectively P ≤ .01. AD1-Ba increased respectively P ≤ .05. In group 2, Ptm-Ba and LPD increased respectively P ≤ .05 from T1 to T2 (Table 2).

According to the inter-group independent sample t-test results, there were significant differences in skeletal evaluation. FMIA showed a statistically significant difference in group 2 compared to group 1 (P ≤ .05). In pharyngeal airway evaluation, Hy-VRL decreased significantly group 2 compared group 1 (P ≤ .05), AD1-Ba increased significantly group 2 compared to group 1 (P ≤ .05), Mc-upper and Mc-lower increased significantly group 1 compared to group 2 (P ≤ .05). PNS-Ba and PNS-H increased significantly in group 2 compared group 1 (P ≤ .01). Mc Namara's upper and lower pharyngeal dimensions (Mc-upper, Mc-lower) were significantly increased in both groups (P ≤ .05), whereas lower pharyngeal dimension (LPD) was found to be statistically insignificant (P ≥ .05). Also, the horizontal position (Hy-VRL) of the hyoid bone was significantly affected (P ≤ .05; Table 3).

Table 3.

Variables evaluating position of the hyoid bone

	Group 1		Group 2		
	Mean	SD	Mean	SD	P value
SNA, °	-0.32	1.15	-0.56	0.66	0.378
SNB, °	1.51	1.37	1.68	1.41	0.67
ANB, °	-1.83	0.84	-1.51	1.03	0.233
Mx1-NA, mm	0.21	2.02	0	2.26	0.733
Mx1-NA,°	-0.47	5.53	-0.03	6.63	0.8
Mn1-NB, mm	2	1.38	1.68	1.37	0.426
Mn1-NB,°	6.38	4.1	8.56	5.31	0.11
Pg-NB, mm	-0.5	0.84	-0.61	1.37	0.739
GoGn-SN,°	1.06	1.16	1.51	2.29	0.378
Intincisor, °	-4.08	5.35	-7.24	7.33	0.089
FMA, °	1.35	1.36	2.57	2.73	0.051
FMIA, °	-5.15	3.97	-7.84	4.98	0.040*
IMPA, °	3.8	4.14	5.3	5.55	0.284
Hy-TW, mm	-2.19	3.31	-0.18	6.82	0.191
Hy-VRL, mm	-2.52	2.71	-5.5	5.35	0.016*
Hy-Cv3, mm	1.97	2.18	2.06	2.53	0.891
PNS-AD1, mm	1.96	2.38	3.06	2.85	0.145
AD1-Ba, mm	0.76	1.39	1.8	1.96	0.034*
PNS-AD2, mm	1.93	1.53	2.71	2.28	0.162
AD2-H, mm	0.68	0.68	0.82	2.01	0.736
PNS-Ba, mm	2.48	2.33	4.54	3.03	0.010**
Ptm-Ba, mm	2.16	1.92	3.43	7.54	0.417
PNS-H, mm	2.1	1.5	3.53	2.04	0.007**
Mc-upper, mm	1.86	1.99	1.52	1.44	0.040*
Mc-lower, mm	1.84	1.78	1.34	1.39	0.048*
LPD, mm	1.64	1.75	2.1	1.94	0.383

*: P ≤ .05, ** : P ≤ .01, *** : P ≤ .001

DISCUSSION

The effects of twin-block appliance and rapid maxillary expansion appliance have been widely studied in the literature.[3-6] But in this study assessed changes in the pharyngeal airway dimensions according to pre- and post treatment of the patients who using the twin-block appliance used with RME and only the twin-block appliance.

The presence of a small pharyngeal airway size and anatomic adaptation of the soft palate in those with a retrognathic mandible are common features of these patients.[16] Kikuchi observed that air volume was directly related to the position of the mandible. Furthermore, Graber et al., added that the use of functional appliances expanded the shape and size of the nasopharyngeal space, which automatically contributed to the better respiration.[17-18]

However, contrary to these studies, Vig et al.[19] and Horowitz et al.[20] have not been proven the relationship between mandibular position and airway dimension in their studies. In addition, O'Brien et al. argued that the twin-block appliance did not significantly alter mandibular growth and that it was only a dental change.[21] As a result, they reported that pharyngeal dimension modification with functional treatments did not occur and that the progression of the mandibular position could not cause a change in the airway.

In this current study twin-block appliance used in two groups and it was observed that the anteroposterior relationship of the mandible with the cranial base was significantly improved with twin-block treatment. With a significant increase in the SNB angle in both groups, these findings suggest that sagittal deviation of the jaws is mostly corrected by anterior mandibular repositioning. The analysis results showed that statistically significant increase was recorded in the airway in two groups. It was also concluded that there was a significant enlargement of the pharyngeal upper airway in patients using a twin-block appliance with the RME device. Kannan et al.[22] had come to similar conclusion in their study that there was a significant increase in oropharynx and hypopharynx in the group using the twin-block appliance. There was no significant increase in nasopharynx.

Pirelli et al.[12] evaluated the effect of rapid maxillary expansion on children with nasal breathing and obstructive sleep apnea syndrome. They reported an impact on the nasal cavities, with a mean increase of the nasal pyriform opening of 1.3 ± 0.3 mm with RME. Erdur et al.[23] reported that pharyngeal airway and maxillary sinus volume increased with RME treatment. Chang et al.[24] used cone-beam computed tomography to evaluate the dimensional changes of the upper airway in orthodontic patients with maxillary narrowing treated with rapid maxillary expansion in a prospective study. They studied retropalatal and retroglossal airway changes in their study of 40 orthodontic patients. According to the results of the study, it was found that the cross-sectional area of the upper airway at the posterior nasal spine to basion level increased moderately after RME. The present study results confirm the findings of this previous study that the posterior nasal spine to basion (PNS-Ba) level significantly increased ($P \leq .001$) in group 1.

When the airway was analyzed, it was found that the Mc-upper and Mc-lower parameters increased slightly in the upper pharyngeal airway parameters according to group 2 in group 1. This may be related to the rapid maxillary expansion in group 1. In addition, the increase in nasopharyngeal dimension after rapid palatal expansion observed in this study is similar to the findings of Linder-Aronson and Leighton's study.[25]

In an ideal study designed to assess airway size after orthodontic treatment, an untreated control group should be established to monitor for pure growth changes. However, lateral cephalograms of patients not treated for ethical reasons are not included in this study. Mislik et al.[26] measured the pharyngeal area and physiological changes in the lateral cephalograms of untreated, early childhood patients. A mild increase of only 1 mm was detected between 6 and 17 years. Therefore, in this study it was assumed that changes in airway size were associated with growth and were limited depending on the lenght of short treatment.

In addition to a small number of patients, a limitation of the current study is lateral cephalometric analysis, which allows two-dimensional assessment of the respiratory tract. This method can not be used to determine the thickness and the volume of the airway area.[27] Today, the cone-bean computerized tomography (CBCT) method provides accurate three-dimensional analysis of the airways, but not all patients due to legal or ethical reasons. Lateral cephalogram is a legal and ethical method and is routinely used in all orthodontic patients. Also, the reproducibility of measurements of airway dimensions in lateral cephalograms was also fairly accurate.[28]

Normal position of the hyoid bone is occupies a constant position opposite the third and fourth cervical vertebrae.[15] Hyoid bone is fairly displaced superiorly and posteriorly in Class I and especially Class II malocclusions. Twin-block is the appliance that introduced by William Clark, is the most common functional appliance for treatment of Angle's Class II division 1 subjects. As the hyoid bone is held in the mandible by the muscle, the change in the position of the mandible also changes the position of the hyoid bone.

In this study, anteroposterior movement of the hyoid bone with respect to the line passing thorough the tuberculum sella was represented by Hy-VRL. Also, Hy-Cv3 was used as a point. Increased value of Hy-VRL mean the hyoid bone was moving anteriorly from the vertical reference line (VRL). Hy-VRL and Hy-Cv3 were significantly increased in both groups ($P \leq .001$) because of the anterior movement of mandible, hyoid bone was also anteriorly moved respect to the pharyngeal airways. This signified anterior movement of hyoid bone to increase in airway. Significantly difference was found at only Hy-VRL measurement in the comparison between groups. This was supported by Galvao et al. study was in horizontal, normal and vertical growth patterns and they found moderately significant the forward movement of hyoid bone in horizontal and normal growth directions.[29] Also, vertical growth direction was highly significant. Moreover, in this study, hyoid bone's vertical position (Hy-HRL) was significantly increased only group 1 ($P \leq .01$). There was no significant increase between group 1 and group 2.

CONCLUSION

There were statistically significant differences in upper and lower pharyngeal airway dimensions between the groups. While the contribution of RME to the increase of pharyngeal airway dimensions was shown, the effect of the functional appliances on this region is greater.

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