Original paper

Comparative study of changes in the airway dimensions following the treatment of Class II malocclusion patients with the twin-block and Seifi appliances

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D – writing the article; E – critical revision of the article; F – final approval of the article

Dental and Medical Problems, ISSN 1644-387X (print), ISSN 2300-9020 (online) *Dent Med Probl*. 2023;60(2):247–254

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Funding sources
None declared

Conflict of interest
None declared

Acknowledgements
None declared

Received on April 23, 2021
Reviewed on July 28, 2021
Accepted on September 15, 2021

Published online on June 29, 2023

Cite as
Tahmasbi S, Seifi M, Soleymani AA, Mohamadian F, Alam M. Comparative study of changes in the airway dimensions following the treatment of Class II malocclusion patients with the twin-block and Seifi appliances. *Dent Med Probl*. 2023;60(2):247–254. doi:10.17219/dmp/142292

DOI
10.17219/dmp/142292

Abstract

Background. Functional appliances are frequently used to stimulate mandibular growth in cases of Class II malocclusion with mandibular deficiency. Many studies have reported improved pharyngeal airway passage (PAP) dimensions following functional appliance therapy in children.

Objectives. The present study aimed to assess changes in the airway dimensions following the treatment of Class II malocclusion patients with the twin-block and Seifi appliances.

Material and methods. Lateral cephalograms of 37 patients with Class II malocclusion and mandibular deficiency treated with the twin-block appliance ($n = 20$) or the Seifi appliance ($n = 17$) were assessed in this before-and-after study. The preoperative and postoperative lateral cephalograms were compared to determine changes in the airway dimensions at the level of the palatal plane (PP), the occlusal plane (OP) and the 2nd–4th cervical vertebrae (C2–C4) in the 2 groups. The results were analyzed with the t test and the one-way analysis of covariance (ANCOVA).

Results. After treatment, significant changes occurred in the point A–nasion–point B (ANB) and sella–nasion–point B (SNB) skeletal cephalometric indices in the twin-block appliance group, and in ANB, SNB and incisor–mandibular plane angle (IMPA) in the Seifi appliance group. The airway dimensions at the level of PP, OP and the 3rd cervical vertebra (C3) significantly increased postoperatively as compared to the baseline in the twin-block appliance group ($p < 0.05$). The increases in the airway dimensions at the level of PP and C3 in the twin-block appliance group were significantly greater than in the Seifi appliance group ($p < 0.05$).

Conclusions. The treatment of Class II Division I malocclusion with the twin-block appliance significantly increased the airway dimensions at the level of PP, OP and C3, whereas the Seifi appliance did not cause any significant changes in the airway dimensions.

Keywords: malocclusion, airways, orthodontic appliances, Angle's Class II, functional

Introduction

The prevalence of dental and skeletal malocclusion is variable in different populations.[1] A meta-analysis conducted on the Iranian population reported a 24.7% prevalence of Class II malocclusion, ranking it second in terms of prevalence after Class I malocclusion.[2] Class II malocclusion is caused by mandibular deficiency in 65% of cases, and is due to maxillary prognathism in only a small percentage.[1,3] Mandibular deficiency can also occur due to the small size of the mandible or its retruded position relative to the maxilla.[4]

The growth and development of dentofacial structures and the pharyngeal airway dimensions have a mutual cause-and-effect relationship, i.e., the inhibited or limited growth of the craniofacial structures can lead to pharyngeal airway narrowing, and also a reduction in the nasopharyngeal airway dimensions due to anatomical obstruction can alter the craniofacial growth.[5,6] In Class II skeletal malocclusion caused by a retrognathic mandible, decreased space between the cervical vertebrae and the mandible body leads to airway narrowing, as well as a retrognathic position of the tongue and soft tissues,[7] which increases the risk of impairment in the respiratory function during the day and sleep-disordered breathing at night.[8] Decreased airway dimensions in childhood due to fat deposition in the posterior pharyngeal area increases the risk of sleep-disordered breathing in adulthood.[8,9]

The early orthodontic treatment of skeletal and dental anomalies during the primary dentition and early mixed dentition period aims to prevent the development or aggravation of anomalies in the late mixed dentition and permanent dentition periods, and decrease or eliminate the need for future treatment.[10] Functional appliances are used to modify the process of development of Class II malocclusion, mainly during the growth period, by changing the pattern of the remaining facial growth or altering the position of the jaw. Functional appliances improve the sensory proprioceptive feedback mechanisms of various perioral muscles that control the position and function of the mandible, and transfer the loads to the basal bone and the teeth.[4]

The treatment of Class II malocclusion not only corrects the skeletal facial structure, but also affects the posterior airway dimensions and can aid in the treatment of obstructive sleep apnea. Although some previous studies reported significant effects of the twin-block appliance on the pharyngeal airway dimensions,[1,11] others refuted such effects.[12] Considering the existing controversy in the available literature on changes in the airway dimensions following the use of the twin-block appliance, and a lack of studies on the effects of the Seifi functional appliance on the airway dimensions, the present study aimed to assess changes in the airway dimensions following the treatment of Class II Division I malocclusion patients with the twin-block and Seifi appliances.

Material and methods

This experimental before-and-after study was conducted on 37 patients with Class II malocclusion and a retrognathic mandible reporting to the Department of Orthodontics at the School of Dentistry of Shahid Beheshti University of Medical Sciences and a private dental office in Tehran, Iran. The study protocol was approved by the ethics committee at Shahid Beheshti University of Medical Sciences (IR.SBMU.DRC.REC.1397.036). Informed written consent was obtained from all the participants.

The inclusion criteria were as follows: age between 8 and 14 years; having Class II Division I malocclusion with a retrognathic mandible (sella–nasion–point B angle (SNB) ≤76°); a normal position of the maxilla (sella–nasion–point A angle (SNA) of 79–84°); a bilateral Class II molar relationship; incisor–mandibular plane angle (IMPA) of more than 85° and less than 90°; an overjet of more than 4 mm and less than 10 mm; mild or no crowding; no excess space in the arch; profile improvement when the patient was asked to protrude the mandible with an edge-to-edge position of the teeth; and treatment with the twin-block appliance or the Seifi appliance (Fig. 1). Patients with a history of orthodontic treatment or upper airway surgical procedures, those with craniofacial syndromes, and patients with a history of systemic diseases affecting the skeletal growth or the response to orthodontic treatment were excluded.

The minimum sample size was calculated to be 17, according to a previous study,[13] assuming $\alpha = 0.05$, $\beta = 0.20$ and a study power of 80%. The patients were selected by convenience sampling.

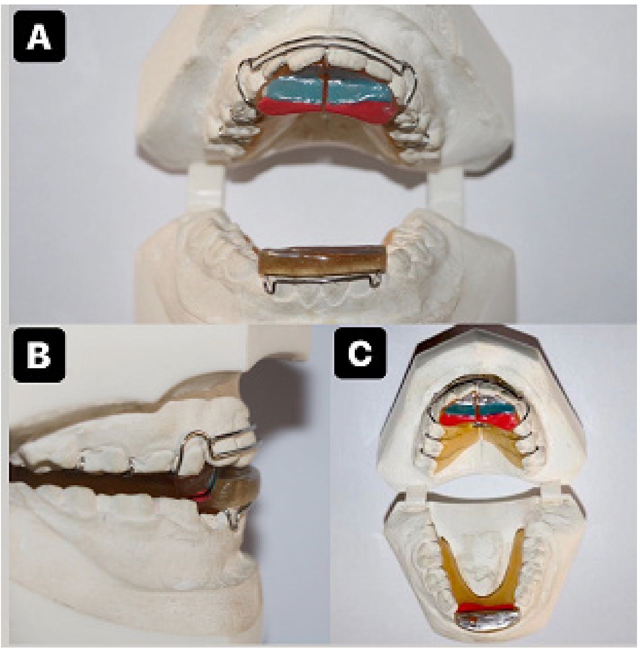

Fig. 1. Seifi appliance
A – frontal view; B – lateral view; C – occlusal view.

After obtaining the records of 37 eligible patients from the archives, they were assigned to the twin-block appliance treatment group (*n* = 20) or the Seifi appliance treatment group (*n* = 17). There were 9 females and 11 males aged 8–14 years in the twin-block appliance group, and 9 females and 8 males aged 9–12 years in the Seifi appliance group. Preoperative and postoperative patient records, including panoramic radiographs, lateral cephalograms, and intraoral and extraoral photographs, were retrieved from the archives.

This study adopted the airway analysis used by Kinzinger et al.,[14] with all the preoperative and postoperative lateral cephalograms of the patients in both groups analyzed by a third-year postgraduate student of pediatric dentistry after calibration with an orthodontist. The analysis of dental and skeletal features employed the Dolphin software, v. 10.1 (Dolphin Imaging & Management Solutions, Chatsworth, USA). Figure 2 shows the cephalometric landmarks used for this purpose. The airway dimensions were evaluated by hand tracing, and the related landmarks, reference planes and linear parameters are shown and described in Fig. 3 and 4 and Table 1. A cephalogram ruler was used to calibrate tracing in the Dolphin software and for manual tracing. Ten lateral cephalograms were randomly selected and traced twice by a third-year postgraduate student of pediatric dentistry, with a 2-week interval between the assessments. The intra-examiner reliability was assessed by calculating the intraclass correlation coefficient.

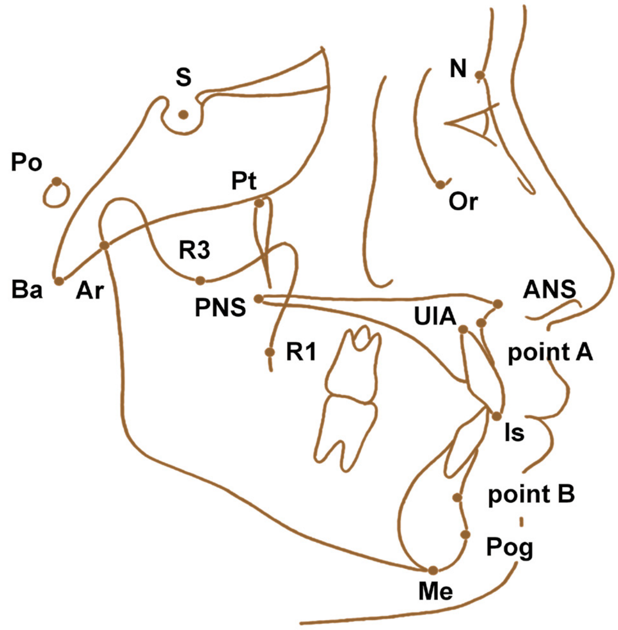

Fig. 2. Cephalometric landmarks

Ar – articulare; Ba – basion; Is – incision superius; Me – mention; N – nasion; S – sella; Or – orbitale; Po – porion; Pog – pogonion; Pt – pterygoid; R1 – ramus point 1; R3 – ramus point 3; UIA – upper incisor root apex.

Table 1. Cephalometric landmarks, reference planes and linear parameters used for the evaluation of changes in the airway dimensions

Indices		Definition
Landmark	P1	intersection of the palatal plane (PP) and the posterior pharyngeal wall
	P2	intersection of the occlusal plane (OP) and the posterior pharyngeal wall
	AP1	intersection of the occlusal plane and the uvula (the posterior border of the soft palate)
	AP2	intersection of the 2nd cervical vertebral plane and the dorsal surface of the tongue
	PP2	intersection of the 2nd cervical vertebral plane and the posterior pharyngeal wall
	AP3	intersection of the 3rd cervical vertebral plane and the base of the tongue
	PP3	intersection of the 3rd cervical vertebral plane and the posterior pharyngeal wall
	AP4	intersection of the 4th cervical vertebral plane and the anterior pharyngeal wall
	PP4	intersection of 4th cervical vertebral plane and the posterior pharyngeal wall
Reference plane	2nd cervical vertebral plane	line connecting AP2 and PP2
	3rd cervical vertebral plane	line connecting AP3 and PP3
	4th cervical vertebral plane	line connecting AP4 and PP4
Linear parameter	palatal plane (PP)	line connecting the anterior nasal spine (ANS) and the posterior nasal spine (PNS)
	occlusal plane (OP)	line connecting the center point of the orbit and the most distal contact point of posterior teeth
	AWPP	distance between PNS and P1
	AWOP	distance between AP1 and P2
	AWC2	distance between AP2 and PP2
	AWC3	distance between AP3 and PP3
	AWC4	distance between AP4 and PP4

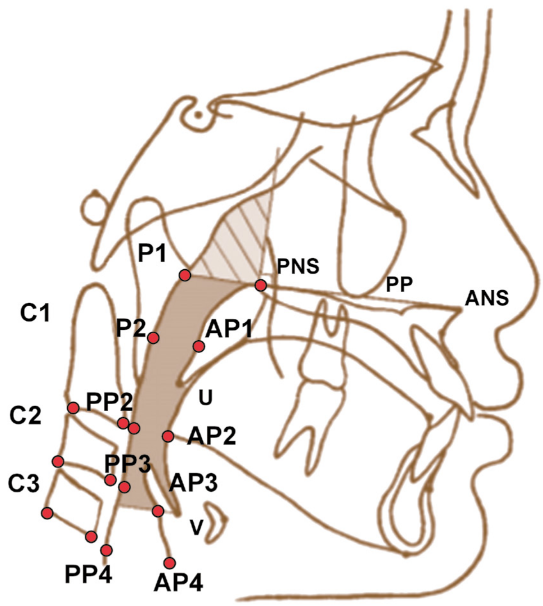

Fig. 3. Cephalometric landmarks used for the evaluation of changes in the airway dimensions

C1 – 1st cervical vertebra; C2 – 2nd cervical vertebra; C3 – 3rd cervical vertebra; U – tip of the soft palate; V –vallecular.

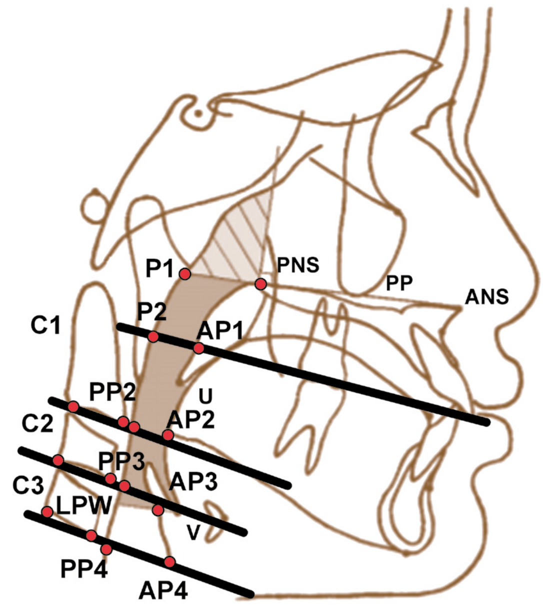

Fig. 4. Airway width at different levels according to the study by Kinzinger et al.[14]

LPW – lower pharyngeal wall.

Statistical analysis

All cephalometric indices were measured on preoperative and postoperative lateral cephalograms, and compared within each group with the use of the paired *t* test, while the independent *t* test and the analysis of covariance (ANCOVA) were used to compare differences between the groups. All statistical analyses employed IBM SPSS Statistics for Windows, v. 21.0 (IBM Corp., Armonk, USA), with a significance level at $p < 0.05$.

Results

Out of the 37 Class II Division I patients evaluated in this study, 20 were treated with the twin-block appliance and 17 with the Seifi appliance. The χ^2 test revealed no significant difference in gender distribution between the 2 groups ($p > 0.05$) and the independent *t* test showed no significant difference in the mean age between the 2 groups ($p > 0.05$). The duration of treatment was 6–36 months with the twin-block appliance and 12–36 months with the Seifi appliance, though the difference in this respect between the 2 groups was not significant ($p > 0.05$).

The intraclass correlation coefficient was 0.9 for the analysis of skeletal and dental cephalometric landmarks, and the airway dimensions, which was favorable.

Table 2 shows the preoperative and postoperative cephalometric indices for the 2 groups. The within-group comparisons with the use of the paired *t* test showed a significant increase in SNB and a significant decrease in ANB after treatment with the twin block appliance as compared to the baseline ($p < 0.05$). No other significant change was noted in this group ($p > 0.05$). In the Seifi appliance group, the paired *t* test showed that SNB and IMPA significantly increased, while ANB significantly decreased after treatment as compared to the baseline ($p < 0.05$). Other indices did not show a significant change in this group ($p > 0.05$).

Table 3 shows the comparisons of the mean changes in the skeletal cephalometric indices between the 2 groups. As shown, the maxillary incisor to sella–nasion angle (U1–SN) significantly decreased in the Seifi appliance

Table 2. Preoperative and postoperative cephalometric indices for the 2 groups

Appliance	Index	Before treatment	After treatment	*p*-value
Twin-block appliance	ANB [°]	6.2 ±2.8	3.7 ±1.7	<0.001*
	SNB [°]	75.9 ±4.5	77.6 ±4.4	0.010*
	SNA [°]	81.9 ±5.1	81.3 ±6.0	0.540
	IMPA [°]	99.5 ±8.0	101.2 ±5.9	0.210
	Jarabak index	69.2 ±12.1	65.9 ±5.3	0.230
	MP–SN [°]	32.5 ±5.3	31.5 ±6.5	0.320
	U1–SN [°]	106.2 ±7.6	107.1 ±6.4	0.240
Seifi appliance	ANB [°]	6.9 ±2.7	5.2 ±1.9	<0.001*
	SNB [°]	75.4 ±3.3	76.7 ±2.4	0.020*
	SNA [°]	82.3 ±4.5	82.2 ±3.0	0.900
	IMPA [°]	95.6 ±2.7	98.6 ±4.6	0.001*
	Jarabak index	62.4 ±3.7	62.9 ±2.9	0.400
	MP–SN [°]	37.2 ±4.4	37.2 ±4.6	0.900
	U1–SN [°]	100.2 ±8.2	96.1 ±11.2	0.070

Data presented as mean ± standard deviation (*M* ±*SD*). ANB – point A–nasion–point B angle; SNB – sella–nasion–point B angle; SNA – sella–nasion–point A angle; IMPA – incisor–mandibular plane angle; MP–SN – mandibular plane to sella–nasion angle; U1–SN – upper incisor to sella–nasion angle; * statistically significant.

Table 3. Comparisons of the mean changes in the skeletal cephalometric indices between the 2 groups

Index	Twin-block appliance	Seifi appliance	p-value†	p-value‡
ANB [°]	−2.5 ±2.4	−1.7 ±1.5	0.270	0.015*
SNB [°]	1.7 ±2.6	1.3 ±2.2	0.730	0.560
SNA [°]	−0.6 ±4.4	−0.1 ±3.0	0.660	0.580
IMPA [°]	1.7 ±6.2	3.0 ±2.9	0.420	0.030*
Jarabak index	−3.3 ±11.7	0.5 ±3.0	0.210	0.210
MP–SN [°]	−1.0 ±4.5	0.0 ±3.2	0.430	0.260
U1–SN [°]	0.9 ±5.8	−4.1 ±8.5	0.040*	0.010*

Data presented as *M* ±*SD*. * statistically significant; † independent *t* test; ‡ ANCOVA for the comparison of the postoperative values between the 2 groups after controlling for the effects of the preoperative values.

group, while it slightly increased in the twin-block appliance group. According to the independent *t* test, the change in this index was significant only in the Seifi appliance group ($p < 0.05$). The changes in other indices were not significant ($p > 0.05$).

Since differences in some indices (the Jarabak index (the ratio of the posterior facial height, measured as the distance between S and gonion (Go), to the anterior facial height, measured as the distance between N and menton (Me)), U1–SN and the mandible plane to sella–nasion angle (MP–SN)) were significant between the 2 groups at the baseline, ANCOVA was applied to control for the effects of such confounding variables. ANCOVA showed that, after eliminating the effects of the confounding variables, there were significant differences between the 2 groups with regard to the changes in ANB, IMPA and U1–SN ($p < 0.05$). No other significant differences were noted ($p > 0.05$).

Table 4 shows the within-group comparisons of the airway cephalometric indices before and after treatment in the 2 groups. As indicated, the paired *t* test demonstrated no significant change in any index after treatment with the Seifi appliance ($p > 0.05$). However, all indices significantly changed after treatment with the twin-block appliance ($p < 0.05$), except for AWC2 and AWC4, which increased insignificantly ($p > 0.05$).

Table 5 compares the mean changes in the airway cephalometric indices between the 2 groups. The independent *t* test revealed greater increases in all indices in the twin-block appliance group as compared to the Seifi appliance group after treatment, except for AWC2. However, these differences were significant only for AWPP and AWC3 ($p < 0.05$).

Since differences in some indices were significant between the 2 groups also before treatment, ANCOVA was applied to control for the effects of such confounding variables. Accordingly, the results showed significant differences in AWPP and AWC3 between the 2 groups ($p < 0.05$). No other significant differences were noted ($p > 0.05$).

Table 4. Airway cephalometric indices before and after treatment in the 2 groups

Appliance	Index	Before treatment	After treatment	p-value
Twin-block appliance	AWPP [mm]	14.7 ±5.5	18.3 ±4.5	0.005*
	AWOP [mm]	10.4 ±3.3	12.7 ±2.4	0.010*
	AWC2 [mm]	11.1 ±2.9	12.0 ±4.1	0.400
	AWC3 [mm]	10.4 ±3.9	14.3 ±5.4	0.010*
	AWC4 [mm]	13.3 ±4.3	14.4 ±4.7	0.190
Seifi appliance	AWPP [mm]	16.0 ±6.7	15.9 ±4.4	0.940
	AWOP [mm]	12.1 ±4.6	12.5 ±4.6	0.690
	AWC2 [mm]	10.7 ±2.6	12.2 ±3.3	0.160
	AWC3 [mm]	12.1 ±4.1	11.6 ±3.4	0.610
	AWC4 [mm]	12.8 ±2.9	13.0 ±2.9	0.700

Data presented as *M* ±*SD*. * statistically significant.

Table 5. Comparisons of the mean changes in the airway cephalometric indices between the 2 groups

Index	Twin-block appliance	Seifi appliance	p-value†	p-value‡
AWPP [mm]	3.6 ±5.0	−0.1 ±6.0	0.050*	0.040*
AWOP [mm]	2.3 ±3.6	0.4 ±4.7	0.200	0.550
AWC2 [mm]	0.9 ±4.4	1.5 ±4.3	0.640	0.770
AWC3 [mm]	3.9 ±5.9	−0.5 ±4.2	0.010*	0.040*
AWC4 [mm]	1.1 ±3.8	0.2 ±3.2	0.230	0.150

Data presented as *M* ±*SD*. * statistically significant; † independent *t* test; ‡ ANCOVA for the comparison of the postoperative values between the 2 groups after controlling for the effects of the preoperative values.

Discussion

This study compared changes in the airway dimensions following the treatment of Class II Division I malocclusion patients with the twin-block and Seifi appliances. The results showed significant increases in the airway dimensions at the level of the palatal plane (PP), the occlusal plane (OP) and the 3rd cervical vertebra (C3) following the use of the twin-block appliance, while the Seifi appliance caused insignificant increases in the airway dimensions at the level of OP, the 2nd cervical vertebra (C2) and the 4th cervical vertebra (C4). Such greater changes in the airway dimensions following the use of the twin-block appliance as compared to the Seifi appliance were mainly due to skeletal changes and can be attributed to a better correction of the retrognathic position of the mandible in Class II patients, which is reflected in a greater change in ANB. The retrognathic position of the tongue in patients with a retrognathic mandible pushes soft tissues backward and decreases the airway dimensions.[15] The forward repositioning of the mandible by functional appliances corrects the position of the hyoid bone and the tongue, and affects airway morphology.[16]

Another reason for increased airway dimensions following the treatment with functional appliances is a reduced thickness of the posterior pharyngeal wall.[17] However, other studies showed the inefficacy of functional appliances, and some even demonstrated an increased posterior pharyngeal wall thickness following treatment with such appliances.[18] Zhang et al. reported that treatment with functional appliances preserved the thickness of the posterior pharyngeal wall in the nasopharynx, oropharynx and hypopharynx, while the thickness decreased in most control patients.[19] These observations revealed that a reduction in the posterior pharyngeal wall thickness in the upper airways is a compensatory mechanism in patients with a retrognathic mandible who received no treatment to maintain an open airway. The present study also showed insignificant reductions in the airway dimensions at the level of PP and C3 following the use of the Seifi appliance, which may be due to an increased thickness of the posterior pharyngeal wall.

The comparison of changes in the airway dimensions between the 2 groups revealed significant increases in the airway dimensions at the level of PP, OP and C3 in the twin-block appliance group. Although some studies reported increased airway dimensions following the treatment of Class II malocclusion with functional appliances, this effect was transient; in contrast, some other studies demonstrated that this increase was significant in the long term.[11,20]

The patients evaluated in the present study were in their growth period. Thus, natural patient growth and the use of orthodontic appliances influenced the linear and angular changes. Assessing the pure effect of treatment alone requires a control group. However, the ethical legitimacy of having a control group in such studies is questionable, since depriving Class II malocclusion patients of treatment would be unethical. Although Buschang et al.[21] and Bishara et al.[22] found insignificant differences in the growth patterns of normal-occlusion and Class II malocclusion patients, Björk and Skieller found some significant differences in this respect between normal-occlusion and Class II malocclusion patients.[23] To decrease the effect of inter-individual differences in growth patterns on the results, the 2 groups were standardized for age and gender in the present study.

Lateral cephalograms are commonly used to assess the airway dimensions, as the skull is in a fixed position, and the patient is conscious and can maintain a natural head position. Thus, lateral cephalograms can be used reliably for assessing changes in skeletal and soft tissue structures.[12,24] However, lateral cephalometry provides two-dimensional (2D) images of three-dimensional (3D) structures.[20] The images are sharp in the midsagittal plane; nonetheless, transverse plane distances cannot be accurately measured. Thus, lateral cephalometry cannot provide precise information on the airway width. Also, lateral cephalometry has limitations with regard to measuring the posterior airway space. To overcome such limitations, cone-beam computed tomography (CBCT) or magnetic resonance imaging (MRI) can be used.[14] However, such imaging modalities should only be requested by physicians when medically indicated. Considering the retrospective design of this study, the available lateral cephalograms of the patients were retrieved from the archives and evaluated, as they are still commonly used for linear airway measurements.[14] The technique described by Kinzinger et al.[14] was adopted for the measurements in this study. Also, as the posterior border of the tongue cannot be easily detected on lateral cephalograms. The index described by Rose et al.[25] was used for assessing the airways at the level of OP.

The present study showed that the horizontal intermaxillary relationship significantly improved in both groups due to significant changes in ANB and SNB. Changes in IMPA and U1–SN demonstrate the effects of upper and lower teeth on overjet reduction, but in the twin-block appliance group, such changes. However, IMPA significantly increased after treatment with the Seifi appliance, and although the U1–SN reduction was not significant in this group, the p-value was close to the significance level ($p = 0.070$). Considering the greater skeletal changes in the sagittal plane following treatment with the twin-block and Seifi appliances, it appears that the efficacy of these appliances for overjet improvement is mainly due to skeletal changes. The comparison of the effects of the 2 appliances by means of the independent t test and ANCOVA revealed a significant reduction in U1–SN in the Seifi appliance group as compared to the twin-block appliance group. Moreover, ANCOVA showed a greater increase in IMPA following treatment with the Seifi appliance and a greater reduction in ANB in the twin-block appliance group, which were both significant. According to the results, skeletal changes in the sagittal plane were greater when using the twin-block appliance. In the vertical dimension, changes in the Jarabak index and MP–SN were not significant in any group. The Jarabak index decreased in the twin-block appliance group, but not significantly.

The decrease in ANB and the increase in SNB following treatment with the twin-block appliance are in agreement with the results of Ahmadian-Babaki et al.[15] and Toth and McNamara.[16] Parkin et al. also reported an increase in SNB, but it was not statistically significant.[17] However, LaHaye et al. reported no SNB change following treatment with the Herbst appliance.[18] In the present study, the change in U1–SN was not significant in the twin-block appliance group, while Ajami et al. reported a significant reduction of this index.[26] An increase in IMPA after treatment was reported in studies by de Almeida-Pedrin et al.,[27] O'Brien et al.,[13] Seifi et al.,[28] and Jamilian et al.[29] Ahmadian-Babaki et al. reported an insignificant reduction in the Jarabak index in the twin-block appliance group.[15]

The current study also showed a significant increase in the upper and middle airway dimensions in the twin-block appliance group, which is in line with the results of Vinoth et al.,[24] while Ali et al.[1] and Jena et al.[30] only reported an increase in the upper airway dimensions.

The twin-block appliance repositions the mandible forward, and thus affects the position of the hyoid bone and the tongue. Such a change can affect the soft palate and subsequently improve the upper airway dimensions. The improvement in the upper airway dimensions with the twin-block appliance in the present study is in agreement with the results of Jena et al.;[30] however, Fastuca et al. reported no change in the airway dimensions after mandibular repositioning and maxillary expansion following treatment with the twin-block appliance.[31]

Ghodke et al. reported a significant increase in SNB of 1.8°, and increases in the depth of the nasopharynx (1.54 mm) and hypopharynx (1.77 mm).[32] Thapa et al. reported a significant increase of 1.97 mm in the depth of the oropharynx.[33] In the present study, the twin-block appliance treatment caused a significant increase of 1.7° in SNB, and nasopharynx and oropharynx depth increases of 3.6 mm and 2.3 mm, respectively. Kinzinger et al. showed insignificant reductions in the airway dimensions at the level of PP and C3 after treatment with the functional mandibular advancer,[14] which is in agreement with the results obtained in the present study for the Seifi appliance group. Yassaei et al. demonstrated significant increases in the airway dimensions and the changed position of the tongue and the hyoid bone after treatment with the Farmand appliance.[34]

Although functional appliances cause various skeletal and dental changes, they have limited effects on the airway dimensions. Kinzinger et al. compared the Herbst appliance and the functional mandibular advancer,[14] Godt et al. compared the Harvold activator and the bite-jumping appliance,[35] and Gu et al. compared the Herbst appliance and the twin-block applaince in terms of airway changes,[20] and none of them found significant differences between the appliances. However, the present study revealed significantly greater increases in the airway dimensions at the level of PP and C3 when using the twin-block appliance as compared to the Seifi appliance. Jena et al. compared the twin-block appliance and the mandibular protraction appliance-IV, and reported an increase in the airway depth in the hypopharynx in the twin-block appliance group, with the mandibular protraction appliance causing greater dental rather than skeletal changes, and having no significant effect on the airway dimensions.[30]

It is noteworthy that statistically significant changes as a result of using functional devices may not be clinically significant in some cases.[13]

Future studies with larger sample sizes are required to compare the effects of the Seifi appliance with other treatment modalities on the airway dimensions in Class II malocclusion patients. Also, future studies may use more advanced 3D imaging modalities, such as CBCT, for this purpose.

Conclusions

The twin-block appliance caused greater increases in the airway dimensions than the Seifi appliance. These results may help orthodontists to select an appliance that is functionally and structurally suitable (the mandibular growth being the primary aim) based on the effects it has on the structures supporting the upper airways.

Ethics approval and consent to participate

The study protocol was approved by the ethics committee at Shahid Beheshti University of Medical Sciences (IR.SBMU.DRC.REC.1397.036). Informed written consent was obtained from all the participants.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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