Original Article

Effectiveness of twin-block and Mandibular Protraction Appliance-IV in the improvement of pharyngeal airway passage dimensions in Class II malocclusion subjects with a retrognathic mandible

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ABSTRACT

Objective: To test the hypothesis that twin-block and Mandibular Protraction Appliance-IV (MPA-IV) are not effective in improving the pharyngeal airway passage (PAP) dimensions among Class II malocclusion subjects with a retrognathic mandible.

Materials and Methods: Eighty-three subjects ranging in age from 8 to 14 years were divided into four groups. Group I included 30 Class I malocclusion subjects (healthy controls); group II consisted of 16 Class II malocclusion subjects (Class II controls); group III had 16 subjects in whom Class II malocclusion was treated by MPA-IV; and the remaining 21 subjects formed group IV, whose Class II malocclusions were corrected by twin-block appliance. Lateral cephalograms recorded at the beginning of orthodontic treatment in group I subjects and at the beginning and end of follow-up/treatment with functional appliance in group II, III, and IV subjects were analyzed to determine the PAP dimensions. Paired *t*-test, one-way analysis of variance, and Tukey tests were applied for statistical analysis, and a *P*-value .05 was considered statistically significant.

Results: Soft palate length was decreased significantly in group III ($P < .05$) and group IV ($P < .001$) subjects. Soft palate thickness in group IV subjects was increased significantly as compared to group II ($P < .05$) and group III ($P < .01$) subjects. The improvement in soft palate inclination in group III and group IV subjects was significant ($P < .01$). The oropharynx depth was increased significantly in group III ($P < .05$) and group IV ($P < .001$) subjects. The depth of the hypopharynx was increased significantly ($P < .01$) in group IV subjects.

Conclusions: The twin-block appliance was more efficient than the MPA-IV in the improvement of PAP dimensions among Class II malocclusion subjects with retrognathic mandible. (*Angle Orthod.* 2013;83:728–734.)

KEY WORDS: Functional appliance; Twin-block; Mandibular Protraction Appliance; Pharyngeal airway passage

INTRODUCTION

The incidence of sleep-disordered breathing (SDB) among school-aged children is approximately 2–10%,[1] and narrowing of the pharyngeal airway passage (PAP) is a common feature in these patients.[2] To date there is no consensus on whether the SDB in adolescents is an extension of a childhood disorder or simply a representation of early manifestation of the adult form of sleep apnea, for which mandibular retrognathism is considered one of the risk factors.[3] In children and adolescents with SDB the position of the mandible is more retrognathic in relation to the cranial base.[3] As a result the space between cervical column and the mandibular corpus decreases and leads to a posteriorly postured tongue and soft palate, increasing the chances of impaired respiratory function during the day and possibly causing nocturnal problems such as

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snoring, upper airway resistance syndrome, and obstructive sleep apnea (OSA) syndrome.[4,5] The literature[6,7] also supports the notion of narrow PAP and many anatomical adaptations in the PAP among subjects with retrognathic mandibles.

Robin[8] used an intraoral appliance to bring the lower jaw forward in newborns with mandibular deficiency, thereby preventing posterior relocation of the tongue during sleep and the occurrence of oropharyngeal collapse. Today this concept is widely used in dentofacial orthopedics. There are various removable and fixed functional appliances used routinely to stimulate mandibular growth in skeletal Class II growing patients. Similar oral appliances are also used in adult OSA patients to prevent upper airway collapse during sleep.[9,10] Although there are numerous studies those have evaluated the nature of Class II correction by various functional appliances in growing skeletal Class II children, there are only a few studies that mention the PAP dimension changes following functional appliance treatment. Studies have been conducted to evaluate the effect of the Harvold activator,[11] an activator with high-pull headgear,[12] cervical headgear,[6] the Farmand appliance,[13] the modified bionator,[14] the Klammt appliance,[15] the Herbst appliance,[16] and rapid maxillary expansion with Herbst appliance therapy[17] on the PAP in Class II patients. However, to our knowledge there is no study in the literature mentioning the effect of the most commonly used functional appliance, that is, the twin-block appliance, in the improvement of PAP dimension among subjects with Class II malocclusion. Thus, the present study was designed to evaluate the efficacy of the twin-block appliance in the improvement of PAP dimension in Class II malocclusion patients with retrognathic mandible and also to compare its effects with those of a fixed functional appliance, the Mandibular Protraction Appliance-IV (MPA-IV) for the correction of Class II malocclusion.

MATERIALS AND METHODS

Eighty-three (male = 42; female = 41) consecutively treated subjects ranging in age from 8 to 14 years were selected. Among them, 30 (male = 13; female = 17) had a Class I malocclusion, and 53 had Class II, division 1 malocclusion. The Class I malocclusion subjects were considered as healthy controls (group I). Among 53 Class II, division 1 malocclusion subjects, 16 (male = 9; female = 7) were considered Class II control subjects (group II), 16 (male = 9; female = 7) were included in the fixed functional appliance group (group III), and the remaining 21 (male = 11; female = 10) were included in the removable functional appliance group (group IV). Each healthy control subject had an orthognathic and pleasing profile, Class I molar relationship bilaterally, FMA in the range of 20° to 25°, and mild to moderate crowding or spacing. Each Class II, division 1 malocclusion subject had normal maxilla and retrognathic mandible, bilateral Angle Class II molar relationship, FMA in the range of 20° to 25°, minimal or no crowding or spacing in either arch, and an overjet of 6–10 mm. Subjects with a history of orthodontic treatment, anterior open bite, severe proclination of the anterior teeth, or any systemic disease affecting bone and general growth were excluded from the study. A written consent was obtained from each subject, and the study was approved by the institutional review board.

All group I subjects were in the early permanent dentition stage and were treated by multibonded appliance. In group II subjects, a phase of prefunctional therapy, which included sectional fixed appliances for the correction of mild crowding and/or rotations, was carried out. All group III subjects were in the early permanent dentition stage and were treated with preadjusted edgewise appliances (Roth prescription, 0.018-inch slot). Both of the arches were leveled up to an 0.018 × 0.025–inch stainless-steel archwire, and then the MPA-IV[18] was ligated for mandibular advancement. The mandible was advanced to an edge-to-edge incisor position. All subjects were reviewed at 4-week intervals for a period of approximately 6 months, then the MPA-IV was removed and the occlusion finished with the same multibonded appliance. Group IV subjects were treated with a standard twin-block appliance. Single-step mandibular advancement was carried out during the wax bite registration. An edge-to-edge incisor relationship with a 2–3-mm bite opening between the central incisors was maintained for all of the subjects. The patients were instructed to wear the appliance 24 h/d, especially during mealtimes, and they were followed once every 4 weeks until the end of active appliance therapy. The interocclusal acrylic was trimmed in all of the subjects. Appliance use was discontinued when overjet and overbite were reduced to 1–2 mm.

In group I subjects, lateral cephalograms recorded at the beginning of orthodontic treatment were considered for analysis. In group II subjects, lateral cephalograms recorded at the beginning and end of the observation period were considered for analysis. In group III subjects, lateral cephalograms recorded before ligation of MPA-IV and immediately after removal of MPA-IV were considered for analysis. In group IV subjects, lateral cephalograms recorded before the start of treatment and at the end of active twin-block therapy were considered for analysis. While recording the lateral cephalograms, patients were placed in the standing position with the FH plane parallel to the floor and the teeth in centric occlusion. The head of the patient was erect. The cephalogram was exposed at the end-expiration phase of the respiration. Subjects were

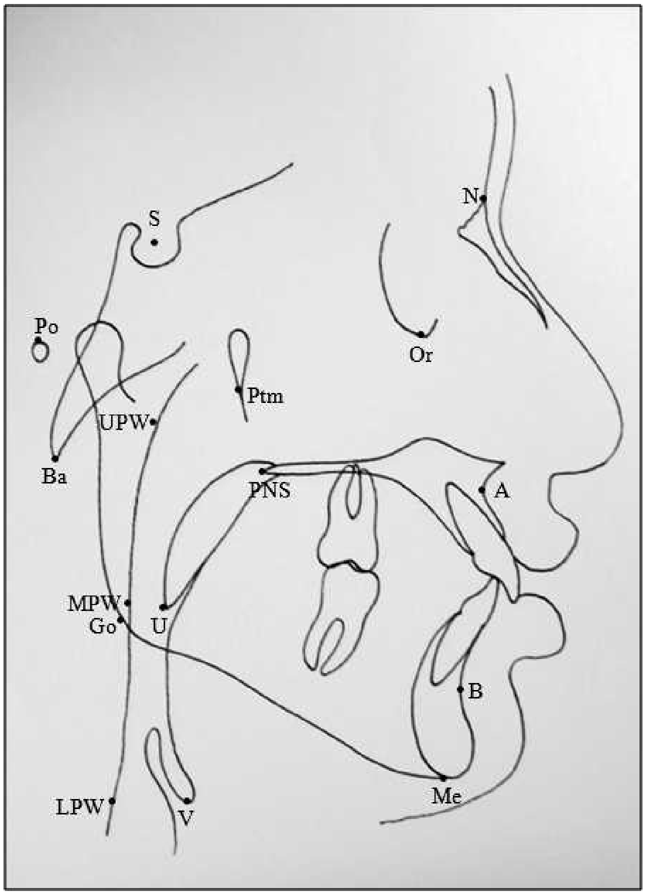

Figure 1. Various landmarks: S indicates sella; N, nasion; Po, porion; Or, orbitale; Go, gonion; A, Point A; B, Point B; Me, menton; PNS, posterior nasal spine; Ptm, pterygomaxillary fissure; Ba, basion; U, tip of the soft palate; UPW, upper pharyngeal wall, the intersection of line Ptm–Ba and posterior pharyngeal wall; MPW, middle pharyngeal wall, the intersection of perpendicular line on Ptm perpendicular from 'U' with posterior pharyngeal wall; V, vallecula; and LPW, lower pharyngeal wall, the intersection of perpendicular line on Ptm perpendicular from 'V' with posterior pharyngeal wall.

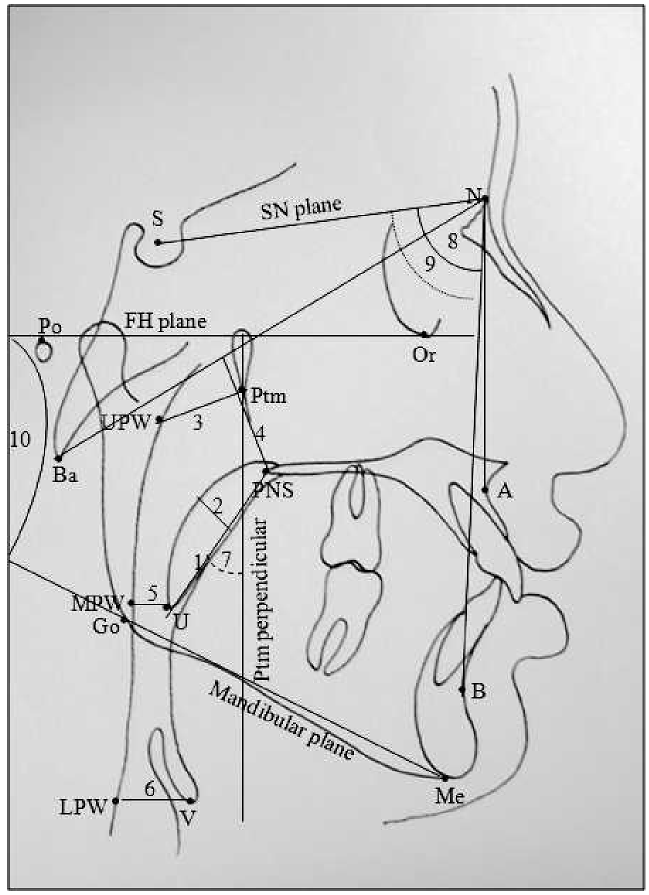

Figure 2. Various reference planes and linear and angular parameters. Reference planes: SN-plane indicates the line joining 'S' and 'N'; FH-plane, the line joining 'Po' and 'Or'; Ptm-perpendicular (Ptm per), perpendicular plane on FH plane through 'Ptm'; and Ba-N plane, line joining 'Ba' and 'N.' Linear parameters: (1) SPL (U-PNS) indicates linear distance between U and PNS; (2) SPT, maximum thickness of the soft palate; (3) DNP (Ptm-UPW), linear distance between 'Ptm' and 'UPW'; (4) HNP, shortest distance from PNS to Ba-N plane; (5) DOP (U-MPW), linear distance between 'U' and 'MPW'; and (6) DHP (V-LPW), linear distance from 'V' to 'LPW.' Angular parameters: (7) SPI (Ptm per $\times$ PNS-U), the angle between Ptm perpendicular and soft palate (PNS-U); (8) SNA, angle between 'S,' 'N,' and 'A'; it represents the antero-posterior position of the maxilla in relation to the anterior cranial base; (9) SNB, angle between 'S,' 'N,' and 'B'; it represents the antero-posterior position of the mandible in relation to the anterior cranial base; and (10) FMA, angle between FH-plane and mandibular plane (Go-Me).

instructed not to move their heads and tongues and not to swallow during cephalogram exposure. All of the cephalograms were recorded in the same machine with the same exposure parameters.

All lateral cephalograms were traced manually, and various landmarks were identified (Figure 1). Various reference planes, linear and angular parameters used for the evaluation of maxillary and mandibular position in relation to the anterior cranial base, vertical growth pattern of the mandible, and PAP dimensions are shown in Figure 2. All of the variables were measured three times, and the mean was considered for statistical analysis.

Statistical Analysis

The data were statistically analyzed on a computer with SPSS software (Version 16, Chicago, Ill). The data were subjected to descriptive analysis. The pre- and post–follow-up changes in group II subjects and the pre- and posttreatment changes in group III and IV subjects were compared by paired *t*-test. One-way analysis of variance was used for the comparison of various parameters within the groups, and post hoc test (Tukey test) was used for multiple comparisons. A probability (*P*-value) of .05 was considered statistically significant.

RESULTS

The mean age of the subjects at the beginning of study and the mean duration of follow-up and/or

Table 1. The Mean Ages and Duration of Study (±Standard Deviation) Among Various Study Group Subjects

Group	Age at the Start of Study, y	Duration of Study, mo (Mean ± SD)
I (n = 30)	12.38 ± 0.35	–
II (n = 16)	10.56 ± 0.91	9.86 ± 1.79
III (n = 16)	12.81 ± 0.85	6.18 ± 1.20
IV (n = 21)	11.38 ± 2.47	9.38 ± 1.68

treatment in group II, III, and IV subjects are described in Table 1. The mean duration of treatment among group III subjects was significantly less as compared to that of group IV ($P < .001$). The ideal measurements for various skeletal and PAP dimensions obtained from healthy controls (group I) and the change in various skeletal parameters and PAP dimensions during the study period among group II, III, and IV subjects are mentioned in Table 2.

The soft palate length (SPL) was decreased significantly in group III ($P < .05$) and group IV ($P < .001$) subjects. The difference in the change in SPL among the three groups was statistically significant ($P < .01$). The soft palate thickness (SPT) was increased significantly in group IV subjects ($P < .001$). The change in SPT in group IV subjects was significantly greater as compared to group II ($P < .05$) and group III ($P < .01$) subjects. There was significant improvement in the soft palate inclination (SPI) following Class II correction in group III and group IV subjects ($P < .01$). The changes in height of the nasopharynx and depth of the nasopharynx were minimal in group II, III, and IV subjects. The depth of the oropharynx (DOP) was increased significantly in group III ($P < .05$) and group IV ($P < .001$) subjects. The depth of the hypopharynx (DHP) was increased significantly ($P < .01$) in group IV subjects.

The comparison of post–follow-up and/or posttreatment measurements of various PAP dimensions in group II, III, and IV subjects to that of healthy controls is described in Table 3. The SPL, SPT, DNP, HNP, and DHP measurements at the end of study among group II, III, and IV subjects were comparable to those in healthy controls. The posttreatment measurement of SPI in group IV subjects was comparable with that of the healthy controls ($P = .891$), but in group II and III subjects these measurements were significantly greater ($P < .01$). The post–follow-up measurement of DOP was significantly less in group II subjects as compared DOP in healthy controls ($P < .05$). However, in group III and IV subjects, the posttreatment measurements of DOP were comparable with the DOP of healthy controls.

DISCUSSION

Small pharyngeal dimensions established early in life may predispose one to sleep-disordered breathing later when subsequent soft tissue changes[19] caused by age, obesity, or genetic background further reduce the available oropharyngeal airway. Therefore, it can only be regarded as beneficial if functional appliance treatment in children[11] or surgical mandibular advancement[20] results in permanent increase in PAP dimensions.

Many limitations of lateral cephalogram have been discussed,[21] particularly inadequate description of airway in a two-dimensional radiograph. However, the use of lateral cephalograms for the airway analysis

Table 2. The Ideal Measurements for All Parameters Among Group I Subjects and Treatment Changes for All Parameters Among Group II, III, and IV Subjects[a]

	Groups							
	Group I (Class I Control Subjects) (n = 30)	Group II (Class II Control Subjects) (n = 16)			Group III (MPA-IV Subjects) (n = 16)			Group IV (Twin-Block Subjects) (n = 21)
Variables	Ideal Value, Mean ± SD	Pre–Follow-Up, Mean ± SD	Post–Follow-Up, Mean ± SD	*P*-Value	Pretreatment, Mean ± SD	Posttreatment, Mean ± SD	*P*-Value	Pretreatment, Mean ± SD
SNA, °	81.98 ± 1.67	81.97 ± 1.73	82.31 ± 1.75	.036*	82.75 ± 1.74	81.78 ± 1.31	.008**	82.60 ± 1.26
SNB, °	79.50 ± 1.17	73.72 ± 2.58	74.00 ± 2.76	.293^{NS}	75.06 ± 2.89	76.50 ± 3.06	.000***	72.78 ± 2.82
FMA, °	25.61 ± 2.70	24.50 ± 3.83	24.56 ± 3.74	.882^{NS}	23.50 ± 2.76	23.28 ± 2.31	.343^{NS}	24.95 ± 2.76
SPL, mm	29.98 ± 3.20	30.92 ± 1.90	30.93 ± 1.74	.958^{NS}	31.76 ± 2.55	30.72 ± 2.57	.031*	31.60 ± 2.85
SPT, mm	8.12 ± 1.02	7.47 ± 0.97	7.65 ± 0.70	.338^{NS}	7.84 ± 0.92	7.74 ± 1.08	.576^{NS}	7.22 ± 1.21
SPI, °	39.68 ± 4.13	45.75 ± 4.88	45.16 ± 4.33	.604^{NS}	46.75 ± 5.38	44.25 ± 4.52	.008**	44.83 ± 4.79
DNP, mm	14.85 ± 4.06	14.78 ± 4.68	15.42 ± 4.46	.362^{NS}	15.18 ± 5.22	14.69 ± 6.16	.507^{NS}	14.54 ± 5.06
HNP, mm	22.14 ± 2.69	20.99 ± 1.31	20.96 ± 1.51	.913^{NS}	21.33 ± 3.53	21.31 ± 3.74	.969^{NS}	20.00 ± 3.80
DOP, mm	9.29 ± 1.64	7.36 ± 1.64	7.37 ± 1.60	.972^{NS}	7.76 ± 3.64	8.61 ± 3.77	.048*	7.29 ± 2.04
DHP, mm	14.46 ± 2.42	12.20 ± 2.13	12.85 ± 1.77	.140^{NS}	15.23 ± 2.72	15.79 ± 3.45	.244^{NS}	12.93 ± 2.00

[a] SNA indicates angle between 'S,' 'N,' and 'A'; it represents the antero-posterior position of the maxilla in relation to the anterior cranial base; SNB, angle between 'S,' 'N,' and 'B'; it represents the antero-posterior position of the mandible in relation to the anterior cranial base; FMA, Frankfort mandibular plane angle; SPL, soft palate length; SPT, soft palate thickness; SPI, soft palate inclination; DNP, depth of the nasopharynx; HNP, height of the nasopharynx; DOP, depth of the oropharynx; DHP, depth of the hypopharynx; SD, standard deviation; and NS, nonsignificant. * $P < .05$; ** $P < .01$; *** $P < .001$.

is an established tool.[22] Reproducibility of airway dimensions on lateral cephalograms was found to be highly accurate.[23] Although three-dimensional imaging would be the appropriate method for the evaluation of PAP dimension, the technique is not available in all centers and results in a relatively high radiation dose. Therefore, the conventional lateral cephalogram remains a valuable and reliable diagnostic tool in numerous airway studies.

From the present study it was observed that the sagittal jaw relationship was improved significantly among the subjects of treatment groups. The contribution of forward mandibular advancement for the correction of Class II sagittal relationship by MPA-IV was significantly less as compared to the contribution offered by the twin-block appliance. This observation was similar to the results of a previous study.[24] The anterior displacement of the mandible by the functional appliances influences the position of hyoid bone and, consequently, the position of the tongue and thus improves the morphology of the upper airways.[20]

In Class II controls, the PAP dimensions did not change significantly during the follow-up period. Hänggi et al.[12] also did not find any change in PAP dimensions during adolescence. In our Class II subjects, the soft palate was thinner, longer, and more inclined compared to that of Class I subjects. The backward position of the tongue among subjects with mandibular retrognathism pressed the soft palate and resulted in decreased thickness and increased its length and inclination.[7] However, we observed significant improvement in the soft palate length, thickness, and inclination in these subjects following functional appliance treatment, as compared to subjects who did not receive any treatment. These changes were more noticeable among subjects in whom Class II correction was accomplished by twin-block appliance and were probably due to the more anterior displacement of the mandible, which caused more anterior traction of the tongue away from the soft palate and changed the soft palate dimensions and inclination. Although the dimensions and inclination of the soft palate improved among subjects in whom the Class II was corrected by MPA-IV, these measurements were not comparable with those in healthy controls. However, in subjects in whom the Class II was corrected by the twin-block appliance, the measurements were comparable with the measurements of healthy controls.

During the study period we observed no significant change in the dimensions of the nasopharynx among all Class II malocclusion subjects, and these dimensions were also comparable to those observed in Class I subjects. However, in contrast to our observation, Restrepo et al.[15] reported a significant increase in the nasopharyngeal airway dimensions among Class II subjects treated by Klammt or bionator appliance.

The most prominent finding of the present study was improvement in the DOP among treatment subjects. This improvement among subjects treated by twin-block appliance was greater than that in subjects treated by MPA-IV. Mandibular advancement by the functional appliances caused forward relocation of the tongue and increased the DOP. Many investigators[11,13,25,26] have also reported a similar observation following various functional appliance therapy. We found only 0.85 ±

Table 2. Extended

Groups: Group IV (Twin-Block Subjects) (n = 21)		Mean Difference Within the Group				Comparison of Mean Differences Among the Groups, *P*-Value		
Posttreatment, Mean ± SD	*P*-Value	Group II (n = 16), Mean ± SD	Group III (n = 16), Mean ± SD	Group IV (n = 21), Mean ± SD	*P*-Value	II/III	II/IV	III/IV
82.80 ± 1.21	.383NS	0.33 ± 0.60	−0.87 ± 1.15	0.21 ± 1.10	.001**	.003**	.919NS	.005**
76.06 ± 2.52	.000***	0.28 ± 1.03	1.44 ± 0.73	3.28 ± 1.15	.000***	.006**	.000***	.000***
27.09 ± 2.87	.000***	0.66 ± 1.66	−0.22 ± 0.90	2.14 ± 1.23	.000***	.813NS	.000***	.000***
29.95 ± 2.58	.000***	0.02 ± 1.33	−1.04 ± 1.74	−1.65 ± 1.45	.007**	.100NS	.005**	.454NS
8.22 ± 0.98	.000***	0.18 ± 0.71	−0.09 ± 0.65	1.00 ± 1.03	.001**	.636NS	.013*	.001**
40.57 ± 4.60	.001**	−0.59 ± 4.47	−2.50 ± 3.26	−4.26 ± 4.97	.049*	.439NS	.038*	.450NS
15.18 ± 5.13	.352NS	0.63 ± 2.70	−0.49 ± 2.89	0.63 ± 3.03	.437NS	.519NS	1.000NS	.477NS
20.94 ± 2.80	.059NS	−0.03 ± 1.14	−0.01 ± 1.43	0.92 ± 2.12	.141NS	1.000NS	.206NS	.218NS
9.41 ± 2.71	.000***	0.01 ± 1.48	0.85 ± 1.56	2.12 ± 1.81	.001**	.333NS	.001**	.058NS
14.12 ± 2.30	.004**	0.65 ± 1.66	0.55 ± 1.83	1.19 ± 1.70	.479NS	.987NS	.615NS	.513NS

Table 3. Comparison of Posttreatment Measurements of Various Parameters Representing Pharyngeal Airway Pressure (PAP) Dimensions Among Group II, III, and IV Subjects With That of Ideal Measurements of Group I Subjects[a]

	Groups				Comparison, *P*-Value		
Variables	Group I (Class I Control Subjects), Mean ± SD	Group II (Class II Control Subjects), Mean ± SD	Group III (MPA-IV Subjects), Mean ± SD	Group IV (Twin-Block Subjects), Mean ± SD	I vs II	I vs III	I vs IV
SPL, mm	29.98 ± 3.20	30.93 ± 1.74	30.72 ± 2.57	29.95 ± 2.58	1.000[NS]	.989[NS]	.541[NS]
SPT, mm	8.12 ± 1.02	7.65 ± 0.70	7.74 ± 1.08	8.22 ± 0.98	.403[NS]	.595[NS]	.984[NS]
SPI, °	39.68 ± 4.13	45.16 ± 4.33	44.25 ± 4.52	40.57 ± 4.60	.001**	.006**	.891[NS]
DNP, mm	14.85 ± 4.06	15.42 ± 4.46	14.69 ± 6.16	15.18 ± 5.13	.982[NS]	1.000[NS]	.995[NS]
HNP, mm	22.14 ± 2.69	20.96 ± 1.51	21.31 ± 3.74	20.94 ± 2.80	.524[NS]	.773[NS]	.432[NS]
DOP, mm	9.29 ± 1.64	7.37 ± 1.60	8.61 ± 3.77	9.41 ± 2.71	.017*	.063[NS]	.319[NS]
DHP, mm	14.46 ± 2.42	12.85 ± 1.77	15.79 ± 3.45	14.12 ± 2.30	.176[NS]	.328[NS]	.965[NS]

[a] MPA-IV indicates Mandibular Protraction Appliance-IV; SPL, soft palate length; SPT, soft palate thickness; SPI, soft palate inclination; DNP, depth of the nasopharynx; HNP, height of the nasopharynx; DOP, depth of the oropharynx; DHP, depth of the hypopharynx; SD, standard deviation; and NS, nonsignificant. * $P < .05$; ** $P < .01$.

1.56 mm of improvement in the oropharynx depth by MPA-IV, whereas this improvement measured 2.12 ± 1.81 mm in those treated by twin-block. The greater improvement in the DOP among twin-block subjects could be due to more forward movement of the mandible. Similar to our observation, Ozbek et al.[11] also noted a 2.08 ± 0.59 mm increase in the DOP following Class II treatment with the Harvold activator. Schutz et al.,[17] however, reported 3.2 mm improvement of the posterior airway space following maxillary expansion and Herbst therapy in Class II subjects. They explained that Herbst appliance therapy displaced the mandible and hyoid bone forward and caused anterior traction of the tongue and increased the posterior airway space.[17] However, Kinzinger et al.[16] recommended that treatment of Class II malocclusion by functional mandibular advancer and Herbst appliance was ineffective in preventing breathing problems in patients who were at risk.

The DHP was marginally improved in our untreated Class II subjects and in those subjects in whom the Class II malocclusion was corrected by MPA-IV, but it was significantly improved in twin-block subjects. Significant forward movement of the mandible could be responsible for such a change. Similarly, Schutz et al.[17] also found a volume increase at the hypopharynx region following Class II treatment by Herbst appliance, and they explained that this improvement was due to mandibular repositioning.

Thus, the present study confirmed that there is a positive impact of functional appliance therapy on the PAP dimension. The positive impact of functional appliance therapy on the airway dimension cannot be explained simply by the established skeletal change; the difference in the posture of the tongue caused by increased genioglossus muscle tonus or soft tissue changes may play an important role and is probably induced by forward positioning of the mandible during the treatment.[12] Another possible explanation for the improvement could be "catch-up growth,' whereby children with small oropharyngeal dimensions would have a greater intrinsic stimulus to increase their capacity for respiratory function.[11]

The literature[12,27] also supports the fact that the changes in the PAP following functional appliance therapy are maintained in the long term. Thus, Class II correction by twin-block appliance during childhood might help to eliminate the predisposing factors to OSA and may serve to decrease the risk of OSA development in adulthood.

CONCLUSIONS

- There were improvements in the adaptations of the soft palate following treatment of Class II malocclusion by functional appliances.
- The growth of the nasopharynx occurred independent of functional appliance treatment.
- Both twin-block and MPA-IV were effective in improving the DOP among subjects with retrognathic mandibles, but the improvement was significantly greater with use of the twin-block appliance.
- Twin-block treatment was effective in the improvement of the hypopharyngeal airway passage dimension.

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