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Research Article

Comparing The Effect of Maxillary Protraction with or without Expanion on The Airway Saggital Dimensions in Skeletal Class III Growing Patients

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ABSTRACT

Objective: Changes in craniofacial structures during different methods of treatment of class III malocclusion lead to some changes in airway dimensions. Precise clarification of these changes can be useful in selecting and designing orthodontic treatments for this type of malocclusion. The aim of this study was to study the effect of expansion treatment along with protraction in comparison to solely protraction therapy on airway sagittal dimensions.

Material and Methods: In this study, which was case-control, lateral cephalometric radiography was collected from 30 class III patients, which 15 of whom were solely treated with protraction (with mean age8.8) and 15 patients were treated with protraction along with expansion (with mean age 9.3). All of these patients had less than -2 vices and also end to end or anterior cross-bite and had no anomalies and congenital syndrome. Next all of the radiographs were analyzed via Orthosurger X software. The results were analyzed by paired T-test (for protraction and protraction along with only expansion) and independent t-test (for comparing both groups).

Results: For both groups, the variables of Wits, Overbite, SNA and ANB were significantly increased after the treatment. The difference between the variables related to the reference lines, was not significant in any of the groups. In addition, the variable related to nasopharynx and upper limit of bony nasopharynx in the protraction group, and also in comparing both groups to one another, with the mean of changes in the protraction group being larger, was significant. The changes in oropharynx and the lower limit of bony nasopharynx were significant only in the protraction group. Hypophyarynx changes, too, were not significant in any of the groups and were not significant in comparing both groups together.

Conclusion: In treating protraction only an increase in the size of nasopharynx, upper and lower border of bony nasopharynx and oropharynx was observed. Moreover, the use of expansion as well as protraction did not cause increase of airway and in none of the treatment methods no significant changes in hypo-pharynx was observed.

Keywords: malocclusion, Cl III, maxillary protraction, Sagittal

INTRODUCTION

Patients with Class III malocclusion are subject to excessive mandibular growth, mandibular prognathism, and maxillary retrognathism. In such cases, the mandibular teeth are malpositionedanteriorly compare to maxillary teeth that creating a concave facial profile (1). The patients are also subject to nasal passage (airway) disorders, such as velopharyngeal insufficiency, reduced nasal cavity dimensions, and nasal obstruction (2). Treatment for this type of malocclusion is widely considered as one of the most difficult and complex treatments in orthodontics, due to concave profiles and unpredictable mandibular growth (3).The treatment methods used in such cases include the use of growth modification appliances for patients who are still growing and orthopedic surgeries for adults. Since maxillary growth deficiency plays a more important role in the etiology of Class III malocclusion, treatments mostly focus on theapplication of protraction forces to maxilla and maxillary teeth at a young age (4). Given the airwaydimensions are directly and indirectly affected by the position of jaw and related soft tissues and the respiratory problems mentioned, it seems that changing the position of maxilla and mandible and,consequently, the position of the soft tissuesthrough growth modification may result in changedairwaydimensions in Class III patients (5).Many researchers emphasized on the importance of the interconnections between the airwayand respiratory state and the facial form and dental occlusion. Most importantly, respiratory needs are what determines the position of jaw and tongue in the first place and then the position of the head.The respiratory needs can change the way they are positioned and cause various forms in facial and dental form over time. On the other hand, malocclusionscause changes in the shape, volume, and dimensions of airway (6). In a study comparing the effect of protraction without and with expansion among Class III patients, it was found that the combination leads to more favorable results in treating Class III patients, especially due to maxillary retrognathism(7).Klonic et al., in their study on 18 patients with Class III skeletal malocclusion in treatment and control groups, concluded that lateral cephalometric comparison before and after treatment significantly increased the size of nasopharyngealand pharyngeal airway (5). Oktayobserved maxillary changes in addition an increase in the area and width of pharyngeal airway (8). On the other hand, Pamporakis et al. concluded that despite significant changes in the volume of maxillary sinus, no significant change was observed in the size of pharyngeal airway (9). However, there are few studies comparing the effect of these two treatment methods on airway (10).Considering the airway problems among patients with this type of malocclusion, such as velopharyngeal insufficiency, reduced nasal cavity dimensions, nasal obstruction or nostril stenosis and given the fact that craniofacial structure changes during Class III malocclusion treatments are expected to lead to different changes in airway dimensions, the precise clarification of such changes through various treatment methods can be useful for choosing and formulating orthodontic treatments for patients with this type of malocclusion. Therefore, the present study aimed to compare the changes of airway sagittal dimensions among ClassIIIgrowingpatients after maxillary protraction without/with expansion.

METHODOLOGY

This case-control study included 30 patients with Class III malocculsion treated in the orthodontics department of the Faculty of Dentistry, Dental Clinic, and a number of private clinics in Hamedan. For data collection,lateral cephalograms were collected from each of the patientsbefore and after treatment, after which the patients exhibited positive overjet. Considering the study inclusion and exclusion criteria (patients with syndrome, patients with cleft lip and palate, and history of sleep apnea), the initial sample consisted of50 subjects, among which 20 patients were excluded and 30 patients were equally divided in two groups, i.e. control group (patients treated with protraction) and case group (patients treated with protraction and expansion).Screening was performed based on the first and second stage of skeletal growth. All the subjectshad exhibitedClass III molar relationships, width of -2 or smaller, anterior crossbite relationship,or end-to-end incisor relationshipbefore treatment. In addition, the medical records of all patients were checked for the history of diseases such as syndromes and cleft palate. In mostcases, the electronic file (CD)of radiographs, which had been provided for the patients, was used plus those available in their archives.After radiography

(using Microtech Scan Maker 48bit color.i800) for patients without radiographs (CD), the cephalograms were allresized at a certain dpi. The length of the ruler was considered to be the factor for resizing the scanned images. After collecting the electronic files of lateral cephalograms and the cephalometric scan for patients without the files, the images were analyzed using Orthosurger X. Then, the data were input to SPSS23. To determine the error of measurement, 10 radiographs were remeasured that showed all the results.

FINDINGS

The study sample consisted of 30 patients who were divided into two groups of 15. The control group consisted of 8 females (53.3%) and 7 males (46.7%), and the case group included 10 females (66.7%) and 5 males (33.3%).In total, the sample included 18 females (60%) women and 12 males (40%),indicating no significant difference between the two groups (p = 0.456)in terms of gender. The mean age was 8.8 in the control group and 9.3 in the case group, in terms of which there was no significant difference (p = 0.250). The sample mean age was 9.1. The duration of treatment was 10.2 months in the control group and 13.2 monthsin the case group. In this case, there was also no statistically significant difference between the two groups (p = 0.067).The mean was 11.7 months.

Considering the mean and standard deviations of dental-bone variables according to Table 1 and using statistical tests, therewere significant differencecfound except interms of SNB.

Table 1. Mean and standard deviations of dental-bone variables in both groups

		Mean (standard deviation) before intervention	Mean (standard deviation) after intervention	Significance
SNA	Case	(1.26) 79.25	(1.30) 80.84	0.004
	Control	(1.06) 88.02	(0.95) 75.37	0.008
Independent t-test result		Between the control and case groups		0.494
SNB	Case	(0.67) 81.37	(0.93) 80.35	0.114
	Control	(1.02) 79.46	(1.00) 78.64	0.31
Independent t-test result		Between the control and case groups		0.775
ANB	Case	(0.71) -1.12	(0.53) 0.49	0.012
	Control	(0.49) -1.43	(0.41) 0.71	0.003
Independent t-test result		Between the control and case groups		0.477

Considering the mean and standard deviation of variables related to the angle between two lines in accordance with Table 2 and using statistical tests, the mean was increased after treatment in terms of SN-MP in the case group, which was statistically significant. Themean in the case of L1-MP was also larger in the case group after treatment, which was again statistically significant.

Table 2. Mean and standard deviation of the angle between the two lines in both groups

		Mean (standard deviation) before intervention	Mean (standard deviation) after intervention	Significance

SN-MP, the angle between the two lines	Case	(0.99) 31.16	(1.17) 33.81	0.031
	Control	(1.86) 32.78	(1.68) 34.35	0.303
Mann-Whitney test result		Between the control and case groups		0.412
Angle between U1 and SN	Case	(2.60) 115.65	(1.71) 121.9	0.065
	Control	(1.70) 115.58	(1.25) 117.82	0.296
Mann-Whitney test result		Between the control and case groups		0.653
Angle between L1 and MP	Case	(2.20) 85.00	(4.22) 87.62	0.047
	Control	(1.98) 86.53	(1.86) 90.27	0.074
Mann-Whitney test result		Between the control and case groups		0.345

Regarding the mean and standard deviation of variables according to Table 3, the mean of overjet was larger after treatment in the control and case group, which was statistically significant. The mean of widthwas also increased after treatment in both groups, and this difference was also statistically significant.

Table 3. Mean and standard deviation in both groups

		Mean (standard deviation) before intervention	Mean (standard deviation) after intervention	Significance
Overjet	Case	(0.33) -1.77	(0.29) 2.46	0.000
	Control	(0.58) -3.52	(0.27) 2.72	0.000
Independent t-test result		Between the control and case groups		0.08
Overbite	Case	(0.18) 0.35	(0.22) 0.38	0.833
	Control	(0.24) 0.59	(0.18) 0.55	0.833
Independent t-test result		Between the control and case groups		0.935
Width	Case	(0.36) -4.07	(0.21) -1.90	0.000
	Control	(0.38) -4.70	(0.22) -1.80	0.001
Independent t-test result		Between the control and case groups		0.261

Considering the mean and standard deviation of variables According to Table 4, the mean length of the line between Pm and Aawas increased in the control group after treatment, which was statistically significant (p = 0.018). The mean length of the line between Pm and Ba was also increased after the treatment in the control group, which was statistically significant (p = 0.003). The mean difference between the length of the line between Pm and Ba between the control and case group was statistically significant, withlarger changes in the control group. The mean length of the line between Pm and UPW (sagittal pharyngeal length) was also increased after the treatment in the control group, which was statistically significant. The mean line changes between Pm and UPW was larger in the control group,in terms of which there was a significant difference between both groups (p = 0.037). The mean length of the line between U and MPW was also larger in the control group after treatment, which was found to be statistically significant.

Table 4. Mean and standard deviation of baseline variables

		Mean (standard deviation) before intervention	Mean (standard deviation) after intervention	Significance
Distance between Pm and UPW (sagittal nasopharyngeal length)	Case	(0.99) 11.82	(1.17) 13.13	0.672
	Control	(1.16) 12.95	(0.91) 13.43	0.322
Independent t-test result		Between the control and case groups		0.623
The length of the line between Pm and Aa (superior nasopharyngeal region)	Case	(1.93) 38.73	(1.30) 39.60	0.348
	Control	(0.83) 35.69	(1.03) 38.38	0.018
Independent t-test result		Between the control and case groups		0.185

The length of the line between Pm and Ba (inferior nasopharyngeal region)	Case	(1.71) 37.45	(0.75) 39.86	0.003
	Control	(1.13) 34.14	(0.99) 38.87	0.125
Independent t-test result		Between the control and case groups		0.045
The length of the line between Pm and UPW (sagittal nasopharyngeal length)	Case	(1.69) 14.67	(1.03) 14.95	0.363
	Control	(0.79) 12.06	(0.94) 16.22	0.000
Mann-Whitney test result		Between the control and case groups		0.037
The length of the line between U and MPW (sagittal oropharyngeal length)	Case	(1.03) 8.93	(0.72) 9.21	0.615
	Control	(0.60) 8.62	(0.71) 10.12	0.039
Independent t-test result		Between the control and case groups		0.172

DISCUSSION

Considering the disordersaffecting the airways and respiratory tract among Class III patients such as velopharyngeal insufficiency, reduced nasal cavity dimensions, and nasal obstruction or nostril stenosis andgiven the fact that the airway dimensions are directly and indirectly affected by the position of jaw and related soft tissues and the respiratory problems mentioned, it seems that changing the position of maxilla and mandible and, consequently, the position of the soft tissues through growth modification may result in changed airway dimensions in Class III patients. There is limited evidence that airway dimensions are increased with expansion treatments (11). Therefore, if the expansion treatmentis combined with protraction with the aim of improving respiratory state and airway dimensions, this combination will be more useful for providing appropriate treatment plans, especially for patients with respiratory disorders (12, 13).Therefore, the present study aimed to examine the effect of expansion with protraction on airway dimensions among Class III patients by comparing the dimension changes after maxillary protraction without/with expansion using lateral cephalograms before and after treatment.Bronoosh et al. concluded that there is a strong relationship between the information obtained from two types of radiography (14). Vizzotto et al. compared lateral cephalometry and CBCT for superior airway and concluded that there isa positive relationshipbetween linear measurements in both methods of imaging, which indicates that the two methods are reliable and there is no significant difference in the use of CBCT and lateral cephalometryin terms of airway sagittal dimensions.This finding is consistent with the present study (15).According to Mucedero that did not considered dentofacial variables, there was no available information on dental or skeletal changes, which may indicate that the treatment method employed in this study is more dental in nature (10). According to Oktay and Klinicthat considered the mentioned dentofacial variables, SNA, ANB, overjet, and width were significantly changed, indicating skeletal changes due to treatment. In the present study, the mean change of these variables was not found to be significant by comparing the two groups,indicating that the protraction was almost the same in both groups (5, 8). Changes in the sagittal length were significantin the protraction-only groupof the present study, which is consistent with Pamporakis and Oktay (8, 9).Mucedero was the only research study focusing on the effect of protraction with/without expansion on the inferior nasopharyngeal region (10), results of which are consistent with those of the present study in this regard. In terms of sagittal oropharyngeal length, changes in the protraction-only group were significant and are similar to the results of Tuncer and Sayinsu et al. (16, 17). Moreover, Pavoni that investigated the effect of face masks on airway achieved similar results to those of the present study (with a meantreatment duration of 11.7 months) (18). No studies were reported to have focused on superior nasopharyngeal changes in the nasopharynx, while there werefew studies on the effect of treatment on hypopharynx, among which Chen et al. reported similar results to those of the present study after treatment with expansion (19).

CONCLUSION

In the present study, there were increased nasopharynxsize, larger inferior and superior nasopharyngeal and oropharyngeal regions observed after the protraction treatment without expansion. It shouldalso be noted that protraction with expansion did not result in increased airway dimensions in any part of the pharynx, and no significant changes were also observed in the hypopharynxdue to the treatment methods.

RECOMMENDATIONS

Considering that the present study examined the effect of protraction and expansion treatments on airway in the short term, it is firstrecommended investigating the long-term effects of these treatment methods. Given the limited statistical population of this study, it is also recommended studying on a larger sample in a prospective manner, using the scans of patients who have been undergone CBCT for other reasons in order to study the volume and form of airway in addition to sagittal dimension.

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