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Changes of Pharyngeal Airway Size and Hyoid Bone Position Following Orthodontic Treatment of Class II Open Bite Patient

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ABSTRACT

*The aim of this study was to investigate the changes of pharyngeal airway dimension and hyoid bone position after orthodontic treatment of class II open bite patients with extraction of two premolars in the upper arch Lateral cephalograms of 34 patients with class II open bite malocclusion in pre & post treatment used to assess the changes in hyoid position, and upper airway dimensions. All patients were treated with 0.022 * 0.028 inch preadjusted appliances after extraction of two first premolars. Anchorage was reinforced with maximum anchorage mechanics using headgears or mini-implants, depending upon the patients' compliance. Pretreatment and post treatment variables were compared using paired t-test. The mean SPAS (0.98 ± 2.73 mm, P < 0.05) had statistically significant decrease following orthodontic treatment. No significant change was found in any other parameter about airway and hyoid bone position. In dentoskeletal measurements mandibular plane angle did not show any significant change, whereas ANB degrees (1.29 +/- 0.93, P < 0.01) decreased significantly after treatment. This effect was associated with a significant decrease in SNA degrees (0.67 +/- 0.72, P < 0.01) and significant increase in SNB degrees (0.61 +/- 0.77, P< 0.01). Upper airway size and hyoid bone position have clinically insignificant changes after orthodontic treatment of class II open bite patient with extraction of two upper premolars.*

Keywords: Pharynx, Open bite, Airway Management, Malocclusion

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INTRODUCTION

Treatment of a skeletal Class II malocclusion with an open bite and vertical facial growth pattern is always challenging for the orthodontist [1, 2]. This clinical condition frequently results from excess vertical maxillary growth, either with or without lack of vertical growth in the mandibular ramus, leading to the downward and backward displacement of the entire maxillomandibular complex [1, 2]. This pattern in turn contributes to

convex soft tissue profile, microgenia, narrow and long symphysis, high and narrow palate and restricted pharyngeal space with the tongue forward position [3].

In this clinical scenario, orthognathic surgery is considered the first treatment option for an adult patient [4, 5]. However, what should be done when orthognathic surgery is not possible? Various possibilities are described in the literature for the nonsurgical treatment of Class II malocclusions, such as external appliances and dental projections with or without tooth extractions. The teeth routinely extracted are the premolars because their position is in the median region of the dental arch, and there are 2 in each hemi arch [6-9].

Previous studies have shown the influence of orthodontic treatment including extractions on the tongue and hyoid bone position that may cause an alteration in the upper airway anatomy. Existing evidence suggests that extraction treatment with maximum anchorage may lead to retracted position of tongue and narrowing of the upper airway however some studies have been shown extractions do not affect the oropharyngeal dimension [10-16]. The role of airway for open bite patient is critical and any intervention that influences this factor is important. The effects of orthodontic treatment, specifically the effects of extraction of two premolars on pharyngeal airway in the class II open bite patients, have never been discussed. so the aim of this study was to investigate changes of each section of pharyngeal airway dimension and hyoid bone position after treatment of these patients.

MATERIALS AND METHODS

Seventy-two patients who were clinically diagnosed with skeletal class II open bite were chosen from the files of patients previously treated at the Department of Orthodontics, Hamadan University School. From this patient sample, 34 patients (24 female and 10 male) who met the following selection criteria were included in this study:

- Minimum age 16 years
- Moderate Skeletal II pattern and a Class II, Division l dental malocclusion (ANB >= 4 overjet = 4-5 mm)
- Vertical growth pattern with steep mandibular plane angle. (SN-MPA > 35) and 3-5 mm open bite
- Moderate crowding in upper with no or minimal crowding in lower arch
- Orthodontic treatment consisting of extraction of two first premolars in upper arch with maximum or absolute anchorage
- No transverse problem
- No obvious hyperplasia of tonsils or adenoids on cephalograms
- Pre and post radiographs with good hard and soft tissue outlines and teeth in full occlusion, lips resting in natural position.

The patients with the medical history such as chronic mouth breathing, permanent snoring and tonsillectomy, or adenoidectomy were excluded to study. The mean preoperative age was 19.07 years with an overall range of 16-30 years.

All patients were treated with 0.022 * 0.028 inch preadjusted appliances after extraction of two first premolars. anchorage was reinforced with maximum anchorage mechanics using headgears or mini-implants, depending upon the patients' compliance

All pretreatment and post treatment cephalograms were taken from the same machine by the same operator.

The cephalometric landmarks and lines used to assess the changes in hyoid position, and upper airway dimensions are shown in Table & Figure 1. All measurements were carried out by the same author

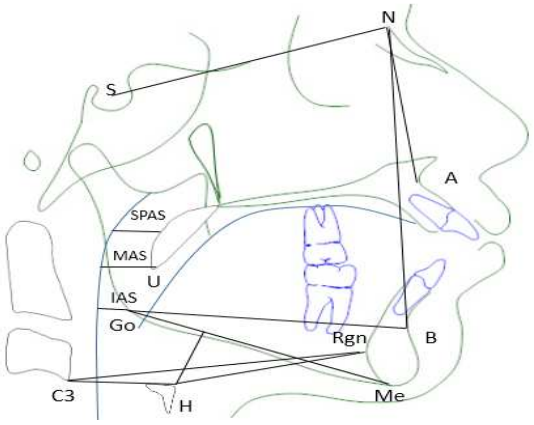

Figure 1: Cephalometric Landmarks and Measurements

Table 1: Cephalometric landmarks and measurements

Variable	Definition
Dentoskeletal measurements	
SNA degrees	Angle between point A or B and the SN plane
SNB degrees	
ANB degrees	Angle between point A and B at nasion
SN/MP degrees	Angle between the mandibular plane(Me-Go) and the SN plane
Hyoid position	Distance between H and RGN
H-RGN, mm	Distance between C3 and H
C3-H, mm	the perpendicular distance from H to the mandibular plane(Me-Go)
H–MP (mm)	
Upper airway dimensions	superior posterior airway space, width of the most constricted airway space behind the soft palate along a parallel line to the Gonion-Point B [Go-B] line
SPAS (mm)	
MAS (mm)	middle airway space, width of the airway along a parallel line to the Go-B line through the soft palate tip
IAS (mm)	inferior airway space, width of the airway space along the Go–B line)

Evaluation of Error at Measuring and Calculation

To assess measurement error, the records of 34 subjects were reevaluated 1 weeks later. The mean differences were less than 1 mm and 1 degree. Pearson correlation coefficients were calculated to evaluate the reliability of observations and showed a statistically significant range of 0.94 to 0.99.

Statistical Analysis

All statistical analyses were performed with software package SPSS (for Windows 7, version 19.0, SPSS, Chicago, Ill). Data were expressed as the mean and standard deviation (SD). Kolmogrov-smirnov test was applied to preoperative and postoperative measurements and showed a normally distributed population. Therefore, pretreatment vs post treatment values were analyzed with paired t-test.

RESULTS

Demographic data showed no significant difference between the male and female groups (Table 2). Table 3 shows the changes of dentoskeletal structures, pharyngeal airway and the hyoid bone position after the treatment. The mean SPAS (0.98 ± 2.73 mm, P < 0.05) had statistically significant decrease following orthodontic treatment. No significant change was found in any other parameter about airway and hyoid bone position. In dentoskeletal measurements mandibular plane angle did not show any significant change, whereas ANB degrees (1.29 +/- 0.93, P < 0.01) decreased significantly after treatment. This effect was associated with a significant decrease in SNA degrees (0.67 +/- 0.72, P < 0.01) and significant increase in SNB degrees (0.61 +/- 0.77, P< 0.01).

Table 2: Data between male and female groups

Variable	Male n = 10 Mean +/- SD	Female n = 24 Mean +/- SD	P
Age, y	17.90 +/- 1.663	20.25 +/- 4.286	0.105
ANB, degrees	5.60 +/- 1.174	5.88 +/- 1.393	0.588
SN-MP, degrees	40.70 +/- 3.529	41.33 +/- 3.964	0.665

** P < .05; ** P < .01*

Table 3: Changes of dentofacial structures, pharyngeal airway and the hyoid bone position after the treatment

Variable	Pre (Mean +/- SD)	Post (Mean +/- SD)	Difference (post–pre; Mean +/- SD)	P
SNA degrees	81.55 +/- 1.23	80.88 +/- 0.94	0.67 +/- 0.72	.000**
SNB degrees	75.73 +/- 1.28	76.35 +/- 1.01	0.61 +/- 0.77	.000**
ANB degrees	5.79 +/- 1.32	4.50 +/- 0.50	1.29 +/- 0.93	.000 **
SN/MP degrees	41.15 +/- 3.79	41.00 +/- 3.26	0.14 +/- 0.98	.377
H-RGN, mm	34.94 +/- 5.41	33.21 +/- 4.38	1.73 +/- 5/35	.067
C3-H, mm	32.97 +/- 4.35	32.88 +/- 3.64	0.88 +/- 3.21	.874
H–MP (mm)	13.62 +/- 3.87	13.37 +/- 3.45	0.25 +/- 2.18	.509
SPAS (mm)	12.32 +/- 3.49	11.34 +/- 3.88	0.98 +/- 2.73	.043 *
MAS(mm)	8.93 +/- 2.66	8.82 +/- 2.23	0.10 +/- 1.99	.765
IAS (mm)	10.19 +/- 2.85	9.35 +/- 2.25	0.83 +/- 2.42	.502

** P < .05; ** P < .01*

DISCUSSION

In the present study, the dimension of the pharyngeal airway (except SPAS) and hyoid bone position were not changed after maximal retraction of anterior teeth with extraction of two premolars in class II open bite patients. The mean SPAS, MAS and IAS dimensions decreased less than 1 mm so that this result may be show clinically insignificant changes in airway dimension. Similar to the findings by Valiathan *et al*., [12], who demonstrated oropharyngeal volumes did not show significant change after orthodontic treatment with extraction of four premolars in adolescents. He found that when the anterior teeth are retracted to a new position, predicting how the minimum axial cross-sectional area will respond to this movement and how respiratory function will be affected is impossible.Stefanovic and associates [13] who analyzed the pharyngeal airway also concluded that extraction of four premolars does not affect the pharyngeal airway volume or the minimum axial cross-sectional area.

Existing evidence suggests that extraction treatment with maximum anchorage mechanics may cause the tongue's length and height to decrease slightly and move to a more retracted position against the soft palate [10, 11]. This movement results in an adaptation and may lead to the narrowing of the UA. However, because one study was a 2D study [10] and the other lacked a control group [11], reaching definitive judgments is difficult.

In our study all 34 patients were over 16 years of age, there is no growth potential in this population. In addition, all subjects suffered from class II open bite malocclusion have the strategy of maximum anchorage, which inevitably improved the homogeneity of subjects. Dentoskeletal (SNA, SNB & ANB degree) outcomes exhibited statistically significant changes after orthodontic treatment however mandibular plane angle did not show any significant change. Indeed, maximal retraction of upper anterior teeth and proclination of lower anterior segment maybe caused posterior movement of point A and anterior movement point B

Another possible explanation for UA reduction after incisor retraction is the movement of the hyoid bone in a posterior and inferior direction [14]. Wang and colleagues reported that this change in hyoid bone position was an adaptation that prevents an encroachment of the tongue into the pharyngeal airway. Shannon, in contrast, evaluated the 3D changes in the hyoid position in extraction and non-extraction subjects and concluded that the hyoid position had no significant change attributable to extractions [15] . Our study indicated that the pharyngeal hyoid bone position, vertically or horizontally did not changed after retraction of upper anterior teeth. Therefore, the impact of extraction of premolars and retraction of anterior teeth on hyoid bone position remains controversial.

Since patients with class II open bite malocclusion generally have convex soft tissue profile, microgenia, narrow and long symphysis, high and narrow palate and restricted pharyngeal space with the tongue forward position [3], the role of airway for open bite patient is critical and any intervention that influence this factor is important

Our findings confirmed that extraction of two premolars and maximum retraction of anterior teeth in class II open bite patient did not changed UA dimension and hyoid position

CONCLUSION

Upper airway size and hyoid bone position have clinically insignificant changes after orthodontic treatment of class II open bite patient with extraction of two upper premolars. to be more specific, actual functional assessment of breathing patterns must be evaluated in further studies, and higher quality trials are necessary to verify reliability.

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