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ORIGINAL RESEARCH ARTICLE

PHARYNGEAL AIRWAY SPACE IN DIFFERENT SKELETAL MALOCCLUSION AND FACIAL FORMS

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ABSTRACT

Background: Evaluation of the upper and lower airway space should be an integral part of diagnosis and treatment planning to achieve the functional balance and stability of the result after orthodontic or orthognathic treatment. This study aimed to analyze the pharyngeal airway space in different skeletal malocclusion and facial forms.

Methods: Study was carried out in lateral cephalometric radiographs of 210 patients. Data was collected from March 2021 to December 2021. Pharyngeal airway spaces were analyzed according to McNamara Analysis. Upper and lower pharyngeal airway in different skeletal malocclusion and facial form was determined. Data was analyzed in SPSS version 20. Independent samples-t test was applied for gender distribution and Pearson correlation test was applied for upper and lower pharyngeal space.

Results: The mean value of upper pharyngeal airway width in Class I, II and III were 12.07 mm, 11.57 mm and 12.34 mm respectively and for Mesofacial, Dolichofacial and Brachyfacial facial form were 12.35 mm, 11.83 mm and 11.81 mm respectively. Similarly, the mean value for lower pharyngeal airway width in Class I, II and III were 9.51 mm, 9.13 mm and 10.03 mm respectively and for Mesofacial, Dolichofacial and Brachyfacial facial form were 9.62 mm, 9.34 mm and 9.61mm respectively. Male had higher value of mean lower pharyngeal width than female.

Conclusions: There was no impact of sagittal skeletal malocclusion on the upper and lower airways width. Also, there was no impact of different vertical skeletal types or facial forms on the upper and lower airways width.

INTRODUCTION

Pharyngeal airway space (PAS) volume is mainly determined by the relative growth and the size of soft tissue surrounding the dentofacial skeleton and is altered in case of anatomical abnormalities of craniofacial skeleton and soft tissue.[1-3] Dentofacial deformity like retrusive maxilla or mandible or vertically excess maxilla can cause change (narrowing) in this volume of PAS.[4-6] If PAS is severely reduced it can cause breathing problem.[7]

Knowledge about various factors affecting PAS volume is of utmost importance and many studies have been used to access the anatomy of upper airway[8-11] like Computed Tomography, fluoroscopy, MRI, acoustic reflection, nasolaryngoscopy, these advanced techniques for assessing airway are expensive whereas cephalometry is more useful and less expensive method that enables the analysis of skeletal and dental abnormalities as well as the soft tissues including PAS.[12-14]

Normal airway space has an important role in the normal growth and development of the craniofacial structures. The evaluation of the upper and lower airway space should be an integral part of diagnosis and treatment planning to achieve the functional balance and the stability of the result after orthodontic or orthognathic treatment. Previous studies investigated the relation between the airway space and skeletal sagittal pattern[13,14], however, the relationship between pharyngeal airway dimension and both sagittal and vertical skeletal patterns was uncovered. This study aimed to analyze the pharyngeal airway space in different skeletal malocclusion and facial forms.

METHODS

This was prospective cross-sectional study conducted in the Department of Orthodontics, KIST Medical College and Teaching Hospital, Lalitpur, after ethical approval by the Institutional Review Committee of the same institution (KIST-IRC Ref. No. 077/078/41). The duration of study was from 1st March 2021 to 15th December 2021.

The sample size was calculated using following formula:

$n = Z^2 \sigma^2/E^2$

where;

z: Value on the z distribution

σ: Standard Deviation

MOE: Margin of error desired

σ = 3.65 (from previous study[14])

with margin of error 0.5mm and 95% confidence interval

n=204.71 n=210 approx.

Convenient sampling method was used and informed consent form was signed by each participant for this study. Study was carried out on a standard lateral cephalograms of patients visiting Department of Orthodontics, KIST Medical College and Teaching Hospital, Lalitpur. These lateral cephalometric radiographs were recorded using the standard techniques with the jaw in the centric relations and the teeth in occlusion, lips relaxed and head in natural head positions. X-ray were recorded with the same cephalometric machine (Carestream, USA – Model CS 8100 SC)

Patient with age greater than 16 years are included in this study as study shows not much changes occurs in the airway width after 16 years.[4] The exclusion criteria were: Presence of any pharyngeal pathology and the cephalometric radiograph with unclear soft tissue landmarks and magnification other than 100% scale.

Anatomic tracing of these radiographs was done using graphite pencil by the single investigator. ANB angle and Tweed FMA angle were measured manually in the cephalometric tracings of each radiograph. Radiographs were divided into Skeletal Class I, Class II, Class III groups using the ANB angle. ANB angle 2-4° as Class I, ANB angle > 4° as Class II, ANB angle < 2° as Class III. Tweed FMA angle was used to select the facial form. The FMA measurement corresponded to the angle between the Frankfort plane (Po-Or), mandibular plane (Go-Me) and its reference value is 25°. Values above 30° were considered a vertical growth trend (dolichofacial); below 20° as horizontal trend (brachyfacial) and between 25° to 30° as Normal growth trend (Mesiofacial). Pharyngeal airway spaces were analyzed according to McNamara Analysis. Upper and lower pharyngeal airway width were measured manually on a tracing of the cephalometric x-ray (Figure 1).

The mean value of the pharyngeal airway dimension was recorded. Data was analyzed in SPSS version 20. ANOVA test was applied for facial forms and skeletal types, Independent Samples-t test was applied for gender distribution and Pearson correlation test was applied for upper and lower pharyngeal space. p-value of < 0.05 was considered statistically significant.

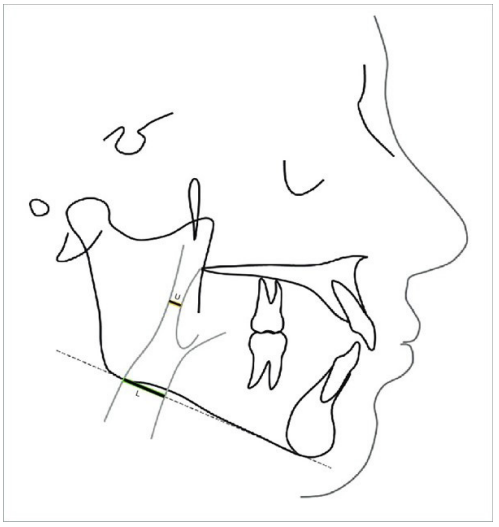

Figure 1: Upper pharyngeal airway width (U); Lower pharyngeal airway width (L)

RESULTS

Among 210 study participants, 139 were (66.2%) females and 71 were (33.8%) males. The age ranged from 16 to 48 years with mean age 21.06±5.56 years. Among the 210 participants, according to sagittal skeletal types 87(41.4%) were Skeletal class I, 65(31%) were Skeletal class II and 58(27.6%) were skeletal class III. According to facial forms, 68 (32.4%) had Normal growth trend- Mesiofacial, 59(28.1%) had Vertical growth trend- Dolichofacial and 83(39.5%) had Horizontal growth trend- Brachyfacial. The mean upper pharyngeal airway width was 11.99 mm ± 3.066 (min. 3 to max. 22) and lower pharyngeal airway width was 9.54mm ± 3.072. (min. 4 to max. 20)

The difference in mean upper pharyngeal width was not found to be statistically significant between male and female. Male had higher value of mean lower pharyngeal width than female and this difference was found to be statistically significant with p-value of 0.04 (Table 1).

No statistically significant difference was found in mean difference in mean pharyngeal width among the three skeletal malocclusion types both in case of upper pharyngeal airway (p-value 0.36) and lower pharyngeal airway with p-value of 0.27(Table 2).

No statistically significant difference was found in mean difference in mean pharyngeal width among the three facial types both in case of upper pharyngeal airway (p-value 0.50) and lower pharyngeal airway with p-value of 0.85(Table 3).

Table 1: Comparison of mean pharyngeal width between male and female

Airway space	Width in Male Mean±SD	Width in Female Mean±SD	t value	95% Confidence Interval		p-value
				Lower Bound	Upper Bound	
Upper Pharyngeal Airway	11.9±2.89	12.04±3.16	-0.308	-1.022	0.745	0.76
Lower Pharyngeal Airway	10.20±3.57	9.20±2.74	2.069	0.042	1.956	0.04*

p-value < 0.05 statistically significant*

Table 2: Comparison of mean pharyngeal width among different skeletal malocclusion types

Airway space	Class I Mean±SD	Class II Mean±SD	Class III Mean±SD	F value	95% Confidence Interval		p value
					Lower Bound	Upper Bound	
Upper Pharyngeal Airway	12.07±2.93	11.57±3.06	12.34±3.27	1.034	11.58	12.41	0.36
Lower Pharyngeal Airway	9.51±3.27	9.13±2.95	10.03±2.87	1.337	9.12	9.95	0.27

p-value < 0.05 statistically significant*

Table 3: Comparison of mean pharyngeal width among different facial forms

Airway space	Mesiofacial Mean±SD	Dolicofacial Mean±SD	Brachyfacial Mean±SD	F value	95% Confidence Interval		p value
					Lower Bound	Upper Bound	
Upper Pharyngeal Airway	12.35±3.08	11.83±3.01	11.81±3.11	0.692	11.58	12.41	0.50
Lower Pharyngeal Airway	9.62±2.91	9.34±3.09	9.61±3.22	0.167	9.12	9.95	0.85

p-value < 0.05 statistically significant*

The mean value for upper airway width in Class I, II and III were 12.07 mm, 11.57 mm and 12.34 mm respectively. The mean value for upper airway width in Mesofacial (normal growers), Dolichofacial (vertical growers) and Brachyfacial (Horizontal growers) were 12.35 mm, 11.83 mm and 11.81mm respectively. Similarly, the mean value for lower airway width in Class I, II and III were 9.51 mm, 9.13 mm and 10.03 mm respectively. The mean value for lower airway width in Mesofacial, Dolichofacial and Brachyfacial were 9.62 mm, 9.34 mm and 9.61mm respectively.

DISCUSSION

Evaluation of the upper and lower airway space is important for diagnosis and treatment planning and to achieve the functional balance and the stability of the result after orthodontic or orthognathic treatment.[15-17]

According to McNamara and Brudon, width of upper pharyngeal area is determined from posterior outline of the soft palate to the nearest point on the wall of posterior pharynx and the width of the lower pharyngeal area is measured from juncture of the posterior limit of tongue and the lower boundary of the mandible to the nearest area on the wall of posterior pharynx.[18] It has been reported that normal upper pharyngeal airway width is 15-20 mm whereas lower pharyngeal airway width is 11-14mm.[19,20]

In various skeletal types, there can be a narrowing of antero-posterior dimension of the airway. Other predisposing factors may be allergy, environmental irritation, infection which can cause narrowing of the airway.[21]

In the present study, the difference in mean upper pharyngeal width was not found to be statistically significant between male and female. Male had higher value of mean lower pharyngeal width than female and this difference was found to be statistically significant (p-value 0.04).

The finding of this study revealed, no statistically significant difference in mean pharyngeal width among the three skeletal malocclusion types (Skeletal class I,II & III) both in case of upper pharyngeal airway (p-value 0.36) and lower pharyngeal airway (p-value 0.27). This finding is similar to the study done by Omair Mojeed et. al.[22] where no statistically significant difference in both the upper and lower airway structure in both class I and II malocclusion in a group of Pakistani patient. Similar results were observed in the study by Soheilifar et al[9], who showed that airway dimensions were not significantly different between patients with skeletal Class I and Class II and that the ANB difference did not have a direct influence on airway dimensions and the dimensions of soft palate.[23]

Comparing the airway widths with the growth trend types, no statistically significant difference was found in mean pharyngeal width among the three facial types (Vertical growers – Dolicofacial types, Normal growers – Mesofacial types & Horizontal growers – Brachyfacial types) both in case of upper pharyngeal airway (p-value 0.50) and lower pharyngeal airway (p-value 0.85).

Memon et. al[24] in their study also showed that there was no difference in upper and lower airway in normodivergent and hypodivergent facial patterns and concluded that sagittal malocclusion has no influence on upper pharyngeal width but hyperdivergent facial patterns were an exception.

A study by Lacerda RH et al.[25] in 2015 on the assessment of upper airway measurements in patients with mandibular skeletal class II malocclusion found that in class II individuals, the sizes of the oropharynx and nasopharynx as well as the mandibular position and length were found to be reduced. Iqbal reported no statistically significant difference in upper airway width between hypodivergent and normodivergent facial pattern of skeletal Class I and II subjects in a group of Pakistani population.[26]

In our study, the mean value of upper pharyngeal airway width in Class I, II and III were 12.07 mm, 11.57 mm and 12.34 mm respectively and for Mesofacial, Dolichofacial and Brachyfacial facial form were 12.35 mm, 11.83 mm and 11.81 mm respectively. Zhong et al.27 in their study also have

compared the upper airway dimensions among Chinese non-snoring children of different sagittal and vertical skeletal facial morphologies (class I, II, III) where the upper airway dimension among class I subjects in their study was 11.2 mm whereas lower pharyngeal airway was 17.3 mm.

The limitation of this study is that the study was done in a single tertiary center and may not represent the general population of the society.

CONCLUSION

There was no impact of sagittal skeletal malocclusion (Class I, II & III) on the upper and lower airways width. Also, there was no impact of different Vertical skeletal types or facial forms (Normal growers- Mesofacial, Vertical growers- Dolichofacial & Horizontal growers- Brachyfacial) on the upper and lower airways width. Concerning gender, male had higher value of mean lower pharyngeal width than female and this difference was found to be statistically significant.

It is suggested that even more accurate conclusions can be derived if an adequate subject number; bigger samples as well as factors like divergence of the face are also taken into consideration for the study and the study is conducted throughout the country.

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