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Comparison Of Pharyngeal Space Width In Hyperdivergent Patients With And Without Mouth Breathing - A Cephalometric Study

Research Article

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Abstract

Background: The importance of respiratory function in orthodontic diagnosis and treatment planning cannot be overstated. The growth and function of the nasal cavities, nasopharynx, and oropharynx are all associated to appropriate skull growth. The aim of this study was to compare the pharyngeal space width in hyperdivergent patients with and without mouth breathing.

Materials and Methods: Lateral cephalograms of 30 patients with hyperdivergent facial patterns who reported for orthodontic treatment were obtained and allotted to 2 groups based on the clinical history recorded with respect to nasal/mouth breathing and cephalometric findings. The upper and lower pharyngeal airway widths were measured manually on the cephalograms using the Mc Namara airway analysis.

Results: The upper airway width in hyperdivergent subjects with mouth breathing was greater compared to subjects who had nasal breathing. However there was no statistically significant differences in lower pharyngeal widths in the two groups ($p<0.0625$) .

Conclusion: The upper airway width in hyperdivergent subjects with and without mouth breathing varied significantly ($p<0.047$). Subjects with hyperdivergent growth patterns show a narrow upper pharyngeal airway space.

Keywords: Hyperdivergent; Mouth Breathing; Pharyngeal Space.

Abbreviations: UPA: Upper Pharyngeal Airway; LPA: Lower Pharyngeal Airway.

Background

Respiration is a metabolic process in which an organism's living cells obtain energy (in the form of ATP) by inhaling oxygen and exhaling carbon dioxide produced by the oxidation of complex organic molecules [1]. The upper and lower respiratory airways are structurally separated in the respiratory system [2]. Both the nasopharynx and the oropharynx are parts of the unit that carries out respiration [3].

A normal airway is crucial for the normal development of the craniofacial tissues. Breathing through the nose acts as a filter of the inspired air by extracting contaminants such as dust and bacteria prior to air passing into the remaining respiratory system [2]. However, a large percentage of indivituals in the general population have mouth breathing due to various etiologies including enlarged tonsils, deviated nasal septum. On evaluation, these patients have been found to have reduced airway volume.

Maintaining an oral airway is required to breathe through the mouth, which is achieved by shifting the mandible and tongue downward and backward, as well as tilting the head backward.

Obstruction of upper airway alters breathing, which can have a substantial impact on craniofacial development, resulting in defects in transverse maxillary growth, as well as cause downward and backward growth of the mandible [4].

According to Harvold EP et al, increased convexity of face, increased lower face height, narrow maxillary arch shape, deep pala-

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tal contour, gummy smile, Class II and Class III malocclusion are all characteristic features that occur due to changes in the pattern of craniofacial growth caused by upper airway obstruction, resulting in mouth breathing [5].

Skeletal features such as retroposition of the upper and lower jaws and vertical maxillary excess in hyperdivergent patients may lead to narrow anteroposterior dimensions of the airway [6].

However, according to Tourne LP et al, variables that influence dentofacial development and the onset of a malocclusion condition include genetic, developmental, and environmental factors [7].

McNamara airway analysis is a cephalometric analysis used to examine the possibility of an airway impairment by measuring the upper and lower pharyngeal width [8].

Adults of both sexes have an average upper airway measurement of 15-20 millimeter. With age, this measure increases [8].

The average width of the lower pharyngeal space is 11 to 14 mm and does not alter much with age [8].

An understanding of upper and lower pharyngeal airway is great value and helps the clinician in diagnosis and planning of orthodontic treatment objectives. This study aimed to compare the pharyngeal space width in hyperdivergent patients with and without mouth breathing.

Methods

Lateral cephalograms of 30 patients of age group 12 -35 years who had reported to the Amrita School of Dentistry for orthodontic treatment were obtained for each subject and allotted to 2 groups based on the clinical history recorded with respect to nasal/mouth breathing and cephalometric findings.

The subjects were assigned into 2 groups

Group A- 15 patients with Mouth Breathing and Increased facial height.
Group B- 15 patients without Mouth breathing and Increased facial height.

The upper and lower pharyngeal width in these patients were measured on the cephalogram. The soft palate, the posterior border of tongue, and the wall of posterior pharynx were all defined (Fig 1)

To measure the upper pharyngeal width, the distance from posterior nasal spine to the tip of the soft palate was bisected. The distance between the soft palate's anterior region and the posterior pharyngeal wall was measured. Measurements of less than 5 mm is an indicator of possible airway impairment [8].

To measure the lower pharyngeal width, the point of intersection between the tongue's posterior outline and the mandible's inferior border (at the gonial angle) was identified. The distance between this point and the posterior pharyngeal wall was calculated [8]. A lower pharyngeal width of more than 15 mm indicates that the tongue is positioned anteriorly, either as a result of habitual posture or due to an enlarged tonsil [9].

SN-GoGn angle was used to identify the facial patterns3. An angle of greater than 32 degrees was classified into hyperdivergent facial pattern.

Statistical Details

To test the statistical significant difference in the mean pharyngeal space width between hyperdivergent patients with and without mouth breathing, independent sample t test, was applied.

Results and Discussion

Normal respiration relies heavily on adequate anatomical dimensions of the airway. According to Linder Aronson S et al, the development of the face and occlusion could be influenced by respiratory function[10]. In recent years, studies have focused on the variations in skeletal pattern that can predispose to airway obstruction [3]. This study aimed to compare the width of the upper and lower pharyngeal space in hyperdivergent patients with and without mouth breathing.

According to Preston CB at al, in children of all ages, lateral skull radiographs provide a good view of the nasopharyngeal airway [11]. The measurements of the upper and lower pharyngeal widths in our study was carried out on lateral cephalograms using the Mc Namara airway analysis. This was similar to a study by Joseph at al who also used lateral cepahlometric records to compare the nasopharyngeal, oropharyngeal, and hypopharyngeal dimensions of people with hyperdivergent and normodivergent facial types [12]. This was also similar to a study carried out by Mirja et al who used lateral cephalograms to study the upper airway structure in Class II malocclusion children who underwent treatment

Figure 1. Upper and Lower pharyngeal airway space analysis.

with cervical headgear [13].

Linder Aronson also observed a strong link between posterior rhinoscopy results and radiographic cephalometrics [10]. However, according to Malkoc et al, because lateral cephalometric radiographs only provide two-dimensional representation of the nasopharynx, which is made up of complex three-dimensional anatomic features, their relevance in evaluating the upper airway is restricted [14]. In this study, we have evaluated only the pharyngeal airway width and not airway volume.

The results of this study showed that the median upper pharyngeal airway (UPA) of the patients those who had mouth breathing was 12 mm, (11 mm and 14 mm as the first and third quartile respectively). The median upper pharyngeal airway (UPA) of the patients without mouth breathing was 11 mm, (10 mm and 13 mm as the first and third quartile respectively). There was a statistically significant difference in the median UPA of patients with and without mouth breathing ($p<0.047$) (Table 1).

The upper pharyngeal airway in subjects with mouth breathing was greater compared to subjects without mouth breathing which may be attributed to the varying age groups of subjects included in the study. However, these hyperdivergent subjects showed a small upper airway space. This is consistent with the findings of Mani et al, who observed a small width of the upper pharyngeal airway in hyperdivergent facial pattern patients which was statistically significant.[3]

Box plot graphs showing the comparison of UPA between groups with respect to mouth breathing showed a positively skewed distribution.(Graph 1). Lines in the boxes denote the median value with the lower whisker demonstrating the first quartile and the upper whisker demonstrating the third quartile.

The median lower pharyngeal airway (LPA) of the patients those who had mouth breathing was 9 mm, (7 mm and 11 mm as the first and third quartile respectively). The median lower pharyngeal airway (LPA) of the patients without mouth breathing was 9 mm, (7 mm and 10 mm as the first and third quartile respectively). The comparison of the median LPA in patients between the two groups was found to be not statistically significant ($p<0.625$) (Table 2).

When compared to other facial types, hyperdivergent facial types have a small maxillary area.

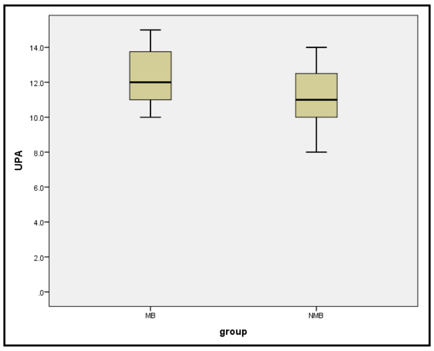
Table 1. Comparison of UPA between groups w.r.t mouth breathing.

Groups	n	Mean ± SD	Median (Q1,Q3)	p value
MB	15	12.36 ± 1.56	12(11,14)	0.047
NMB	15	11.13 ± 1.76	11(10,13)	

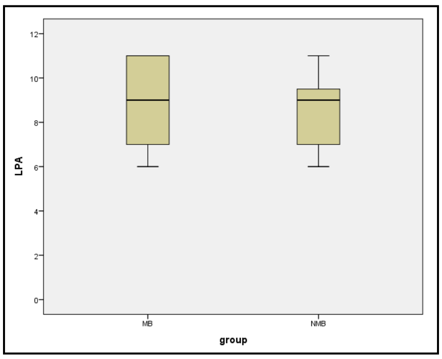
Table 2. Comparison of LPA between groups w.r.t mouth breathing.

Groups	n	Mean ± SD	Median (Q1,Q3)	p value
MB	15	8.93 ± 2.08	9.00 (7,11)	0.625
NMB	15	8.60 ± 1.63	9.0 (7,10)	

Graph 1. Box plot showing the comparison of UPA between groups w.r.t mouth breathing.



Graph 2. Box plot showing the comparison of LPA between groups w.r.t mouth breathing.



On the contrary, de Freitas et al mentioned that upper pharyngeal airway width is not influenced by malocclusion type, and lower pharyngeal airway width is unaffected by malocclusion type and growth pattern [15].

Orthodontists should evaluate pharyngeal airway morphologies while evaluating and treating preadolescent children with malocclusion because they may be a risk factor for undesired craniofacial development. This can help provide better stability of treatment results. Future studies should include a long term examination of craniofacial morphology with a larger sample size and patients with sagittal Class I, Class II, and Class III and vertical facial growth patterns must be examined.

Conclusion

➢ The upper airway width in hyperdivergent subjects with and without mouth breathing varied significantly .
➢ Subjects with hyperdivergent growth patterns show a narrow upper pharyngeal airway space.
➢ There was no statistically significant differences in lower pharyngeal width in hyperdivergent subjects in the two groups.

Authors' contributions: The work presented here was carried out in collaboration with all the authors. Anu Rose James carried out the analysis, performed the literature review, interpreted the results, and wrote the manuscript. Ajith V.V was the chief supervisor of the study and provided guidance in every phase of the study and the writing of the manuscript. Sapna Varma N.K: provided approval of final study design and critical review of the article.All authors read and approved the final manuscript.

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Ethics approval and consent to participate

This study was approved by the Institutional Review Board of the Amrita Institute of Medical Sciences, Kochi (IRB No: 2019/147).

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