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ORIGINAL ARTICLE

Cephalometric Assessment of Pharyngeal Airway Dimensions in Sagittal and Vertical Growth Patterns

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ABSTRACT

Setting: Determination of patency of airway in sagittal and vertical growth patterns in patients visiting LUMHS Institute of Dentistry, Jamshoro.
Methods: This cross-sectional study took place in the Orthodontic Department, Institute of Dentistry, LUMHS Jamshoro. Patients in the age group of 12 to 28 years were included. All subjects were categorized into two groups: Group 1 consists of patients with vertical growth, and Group 2 consists of patients with horizontal growth. Measurements were done by McNamara analysis; the skeletal type was analyzed using ANB, FMA, and SN-GOGN measurements were plotted on the Y-axis, measuring the angle between the S-N plane and sella-gnathion.
Results: A total of 62 patients were studied; their mean age was 20.74+3.36 years. The majority were females 77.4% and males 22.6%. two groups were made according to growth patterns, group 1 consisted of vertical growers and group 2 was of horizontal grower patients. 37.1% of patients were found to have an obstructive lower pharyngeal airway. Mean ANB, FMA, Y-Axis, SN-GOGN, upper pharyngeal airway, and lower pharyngeal airway was 5.42±3.52 degree, 27.90±7.93 degree, 66.31±6.56 degree, 34.24±7.95 degree, 14.5±2.24 mm and 9.2±2.04mm respectively. The results show a positive and negligible correlation between ANB and pharyngeal airways.
Conclusion: There was a positive and negligible correlation between sagittal growth patterns and pharyngeal airway, with class II cases having obstructive pharyngeal airway and class III cases having patent pharyngeal airway.
Keywords: Patency of Airway, Sagittal, Skeletal Discrepancies, Vertical

INTRODUCTION

For decades, it has been studied that respiration and respiratory patency have a direct effect on craniofacial growth and clinicians have now realized the importance of respiratory function in the diagnosis and treatment planning in cases requiring orthodontic intervention[1].

The parameters of the upper airway space (UAS) play a key part in the improvement of the craniofacial complex and, consequently, should be considered when determining orthodontic treatment[2]. It is believed that the etiology of malocclusions is multifactorial. To associate malocclusions only with breathing mode could be considered erroneous. Different studies tried to correlate patients having normal nasorespiratory functions with different airway dimensions and malocclusions, assuming the airway plays a role in dentofacial development. Vertical and mandibular retrognathic maxilla growth patterns are the skeletal features that may lead to the narrowing of the airway[3]. The base tongue position is affected by the sagittal position of the mandible[4]. Depending on the severity and skeletal age of the patient, Class II skeletal malocclusion can be corrected through growth modification, orthognathic surgery, or dental camouflage[5].

Adenoid, allergies, tonsillar hypertrophy, nasal deformities, infections, and polyps are some of the predisposing factors that lead to upper airway obstruction[1]. By restoring airway patency, early adenoidectomy normalizes the hyper-divergent growth pattern[6-8]. In a study, excessive vertical growth of the maxilla or hyper divergent growth of the facial cranium can result in head posture extension[2]. The airway passages of healthy subjects with vertical growth patterns and skeletal malocclusions of Class I might be narrower than healthy subjects with horizontal growth patterns of Class I.

In different subjects, malocclusion and narrow pharyngeal airway space correspond to different diameters of posterior airway space (PAS), leading to a partial or complete cessation of breathing. Modern-day assessment of the upper airway is being carried out with fibre optic pharyngoscopy, computed tomography, magnetic resonance imaging, acoustic reflection, and fluoroscopy. However, cephalometric is more useful and less expensive. But its proper analysis relies on the location of anatomical, accurate identification and constructed landmarks on human cephalograms. So far, the data available on the obstruction of the airway in skeletal class II or III in Jamshoro Sindh, the population of Pakistan, is unavailable. For appropriate filtration of patients and planning of orthodontic services, it is important to have information about the need for treatment in a population to render services to high treatment needs.

Relieving the obstruction of the airway can be an important objective for the orthodontic treatment needed in the population of Pakistan.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at the Orthodontic Department, Liaquat University. Institute of Dentistry of Medical and Health Sciences for a period of 6 months from April 2018 to October 2018. Total sample size was 62

Sampling technique: OpenEpi sample size calculator version 3 (http://www.openepi.com/samplesize/SSCC.htm)

Inclusion criteria
- Subjects with skeletal class III and class II.
- Subjects with vertical and horizontal growth patterns.
- Male and female, age range 12-28 years.
- Except for third molars, subjects with full dentition.

Exclusion criteria
- History of previous orthodontic treatment.
- Patients with pharyngeal pathology or allergies.
- The patient has undergone adenoidectomy
- The patient has undergone nasopharyngeal surgery
- Patients with generalized growth disorders

Data collection procedure: This cross-sectional study was conducted in the Orthodontic Department, Institute of Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro, after ethical approval by the Ethical Committee of the hospital. The study duration was six months from April 2018 to October 2018.

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Completely informed written consent of the patients was received. For this study, a structured performa was used to keep a record of the findings, including patient demographic data like age and gender. The lateral cephalogram tracing technique was used to measure the lower and upper pharyngeal space. The patients were divided into two groups based on their growth patterns: group 1 was vertical grower patients, and group 2 was horizontal grower patients. Each radiograph was taken for tracing with a lead pencil of 0.5mm tip diameter on a standard translucent acetate sheet 8×10 inch which was placed in a standard illuminated view box. All measurements to assess the upper and lower pharyngeal airway were according to McNamara analysis; skeletal type was analyzed using ANB (subject to 4 degrees). Plots of FMA (subject to 22 degrees) and SN-GOGN (subject to 32 degrees) measurements were plotted. Y-axis (subject to 66 degrees) and measured the angle between the S-N plane and sella-gnathion. Assessments of the pharyngeal airway upper (UAS subject to 15mm) and lower airway space (LAS subject to 10mm) were made.

RESULTS

A total of 62 male & female patients with age 12 to 28 years meeting the inclusion criteria of the study were evaluated to determine patency of airway in sagittal and vertical skeletal discrepancies. The results showed male and female patients as presented in Table 1.

Table 1: Descriptive distribution of gender (n=62)

Gender	Frequency(%)
Male	14(22.6%)
Female	48(77.4%)
Total	62

The overall mean age was 20.74±3.36 years. Most of the patients were found to the obstructive lower pharyngeal airway. positive and significant correlation between a sagittal measurement with lower and upper pharyngeal airway for class II and III, Most class II cases show obstructive lower pharyngeal airway while class III cases show patent upper and lower pharyngeal airway.

Table 2: Correlation of skeletal sagittal measurements with lower pharyngeal airway and upper pharyngeal airway (Skeletal Class II and Skeletal class III) (n=62)

Pharyngeal airway	Class	R	P-Value
Upper Pharyngeal airway	Class-II	-0.214	0.048*
	Class-III	-0.396	0.050*
Lower Pharyngeal airway	Class-II	-0.281	0.018*
	Class-III	-0.339	0.046*

In our study, the mean ANB, FMA, Y-Axis, SN-GOGN, upper pharyngeal airway and lower pharyngeal airway was 5.42±3.52 degree, 27.90±7.93 degree, 66.31±6.56 degree, 34.24±7.95 degree, 14.57±2.24 degree, and 9.26±2.04 degree respectively. Pearson's correlation was applied to see the linear relationship. P-value ≤0.05 was taken as significant. The results show a positive and significant correlation between ANB and upper-pharyngeal airway and lower-pharyngeal airway shown in table-3, positive and significant correlation between a sagittal measurement with lower and upper pharyngeal airway for class II and class III, Most of class II cases shows obstructive lower pharyngeal airway while class III cases show patent upper and lower pharyngeal airway.

Table 3: Correlation of skeletal sagittal measurements (ANB) with upper-pharyngeal airway and lower-pharyngeal airway (n=62)

ANB Pharyngeal airway	R	P-Value
ANB Upper Pharyngeal airway	-0.269	0.035*
ANB Lower Pharyngeal airway	-0.353	0.005*

While the negative and insignificant correlation was found for vertical measurement (FMA) with upper and lower pharyngeal airway for low and high angles, an insignificant Correlation between vertical measurement (Y-axis) with upper and lower pharyngeal airway for high and low angle cases and negative and Insignificant correlation of vertical measurement (SN-GOGN) with upper and lower pharyngeal airway for low and high angle case shown in table-4 respectively, Insignificant relation of vertical measurement with upper and lower pharyngeal airway.

Table 4: Correlation of vertical measurements FMA, Y-Axis, and SN-GoGn with upper and lower pharyngeal airway(n=62)

Correlation	Pharyngeal airway	Angle	R	P-Value
FMA degree	Upper Pharyngeal airway	Low Angle	0.008	0.979**
		High Angle	0.288	0.093**
	Lower Pharyngeal airway	Low Angle	0.433	0.122**
		High Angle	0.196	0.260**
y-axis	Upper Pharyngeal airway	Low Angle	-0.403	0.154**
		High Angle	-0.398	0.018*
	Lower Pharyngeal airway	Low Angle	0.387	0.191**
		High Angle	-0.162	0.353**
SN-GoGn	Upper Pharyngeal airway	Low Angle	0.339	0.236**
		High Angle	0.067	0.703**
	Lower Pharyngeal airway	Low Angle	0.313	0.276**
		High Angle	0.176	0.312**

DISCUSSION

Several subjects in both groups can be criticized; the compatibility for sex and age was great (Tables I & II). Due to the retrospective design of the study, it was not possible to directly assess the nasorespiratory pattern of each patient. This reason resulted in selection criteria which were based upon information from the clinical chart at their initial visits about complaints of nasal obstruction, pharyngeal pathology, clinical symptoms, and signs. Enlarged tonsils or adenoids could have been related to any of these factors. [(8)] Patients who did not have any of these factors were considered to have healthy pharyngeal functions.

Subjects having Class I and vertical growth patterns and malocclusions had considerably narrower upper pharyngeal airways than subjects of Class I and II with normal growth patterns, which is a confirmation of the results in the literature[9-12]. According to the analysis of these results, it can be inferred that the craniofacial growth pattern influences upper airway width, as suggested earlier[(4,7,13]. However, a few studies have discovered weak associations between nasopharyngeal airway growth pattern and facial morphology[(2,14]. This may be due to those studies which evaluated the influence of nasopharyngeal airway on occlusion and facial form; there was a conflicting current study.

2D head films for evaluation of only pharyngeal airway widths, and not airway-flow capacities that may need a more complex dynamic and 3D evaluation[8,15]. So, it is not suggested by these results that patients with a vertical growth pattern have been found to have lower airway flow capacity than those with a normal growth pattern. Normal growers may be smaller transversely than vertical growers; this needs to be investigated further.

According to the results found by Oh et al. in their study, no significant differences in sex, age, or pharyngeal airway were detected. [(12)] Meanwhile, in a study by Daniel et al. and a study by Chaturvedi et al., differences between sexes and pharyngeal airway dimensions were found[16,17]. An airflow test, nasoendoscope examination, nasal resistance measurements, lateral cephalometric examination, magnetic resonance, and three-dimensional cone beam computed tomography can be used for the evaluation of pharyngeal airway dimensions and capacity. Precise measurements in a sagittal plane can be taken using cephalometric analysis of airways at anatomically well-defined homologous locations[18,19].

It is stated by Kim et al. that retrognathic patients tend to have a smaller airway volume in comparison with patients having a normal anteroposterior skeletal relationship[1]. It is also found that a more retruded mandibular position has a negative influence on airway space. However, in some studies, the relationship between the decrease in the width of the upper airway and the retrognathic position of the mandible was not detected[20]. These results can be explained because of large inter-individual variation[21].

Literature indicates a relationship between a high vertical facial pattern and a narrow pharyngeal airway. In a study, a negative correlation between an increased SN-MP angle and narrowed nasopharyngeal and oropharyngeal airway width was found. [22] Studies performed by Alves et al, Ansar et al and by Wang et al., who used 3D measurements, also stated that there is a correlation between airway width and vertical skeletal angle[2,23,24]. However, in Memon et al. study, no association between the lower pharyngeal airway and different vertical growth patterns was detected[25]. In some studies, it was found that high-angle Class II patients had significantly narrower upper airways than neutral-angle or low-angle Class II patients[13] and it was stated that pharyngeal airway space is affected by vertical growth pattern. Narrow pharyngeal airway space is one of the predisposing factors for obstructive sleep apnea and mouth breathing[15].

This study demonstrated that in patients without overt pharyngeal lesions, skeletal Class II malocclusions have obstructive pharyngeal airways. Though the prevalence of pharyngeal obstruction in different malocclusions and growth patterns was not addressed, it should be taken into consideration in future studies.

CONCLUSION

Patients with skeletal class II cases were found to have an obstructive pharyngeal airway, while skeletal class III cases have a patent pharyngeal airway and a significant correlation with skeletal class II cases**.** Negative and negligible correlations were found for vertical growth patterns and pharyngeal airway width. However, vertically high and low-angle cases do not influence malocclusion and pharyngeal airway width, and in sagittal pattern classes II and III, lower pharyngeal airway width influences.

Conflict of interest: Nil

REFERENCES

1. Kim Y-J, Hong J-S, Hwang Y-I, Park Y-HJAJoO, Orthopedics D. Three-dimensional analysis of pharyngeal airway in preadolescent children with different anteroposterior skeletal patterns. 2010;137(3):306. e1-. e11.
2. Ansar J, Maheshwari S, Verma SK, Singh RK, Agarwal DK, Bhattacharya PJTAo. Soft tissue airway dimensions and craniocervical posture in subjects with different growth patterns. 2015;85(4):604-10.
3. Daraze A, Delatte M, Liistro G, Majzoub ZJIjod. Cephalometrics of pharyngeal airway space in Lebanese adults. 2017;2017.
4. Shaikh SY, Malik AM, Khalid O, Mahnoor MJPOJ. Comparison of upper pharyngeal airway space in Class II and Class III malocclusion cases. 2014;6(1):2-6.
5. Uslu-Akcam OJIsid. Pharyngeal airway dimensions in skeletal class II: A cephalometric growth study. 2017;47(1):1-9.
6. Martin O, Muelas L, Viñas MJJAjoo, orthopedics d. Nasopharyngeal cephalometric study of ideal occlusions. 2006;130(4):436. e1-. e9.
7. Gupta RK, Chandra A, Verm A, Kumar SJTJotAoPoI. Obstructive sleep apnoea: a clinical review. 2010;58:438-41.
8. de Freitas MR, Alcazar NMPV, Janson G, de Freitas KMS, Henriques JFCJAjoo, orthopedics d. Upper and lower pharyngeal airways in subjects with Class I and Class II malocclusions and different growth patterns. 2006;130(6):742-5.
9. Joseph AA, Elbaum J, Cisneros GJ, Eisig SBJJoo, surgery m. A cephalometric comparative study of the soft tissue airway dimensions in persons with hyperdivergent and normodivergent facial patterns. 1998;56(2):135-9.
10. Ucar FI, Uysal TJTao. Orofacial airway dimensions in subjects with Class I malocclusion and different growth patterns. 2011;81(3):460-8.
11. Ellis H, Feldman S, Harrop-Griffiths W. Anatomy for anaesthetists: John Wiley & Sons; 2008.
12. Oh K-M, Hong J-S, Kim Y-J, Cevidanes LS, Park Y-HJTAO. Three-dimensional analysis of pharyngeal airway form in children with anteroposterior facial patterns. 2011;81(6):1075-82.
13. Oz U, Orhan K, Rubenduz M. Two-dimensional lateral cephalometric evaluation of varying types of Class II subgroups on posterior airway space in postadolescent girls: a pilot study. Springer; 2013.
14. Claudino LV, Mattos CT, de Oliveira Ruellas AC, Sant'Anna EFJAJoO, Orthopedics D. Pharyngeal airway characterization in adolescents related to facial skeletal pattern: a preliminary study. 2013;143(6):799-809.
15. Batool I, Shaheed M, Rizvi SAA, Assad AJPO, Journal D. Comparison of upper and lower pharyngeal airway space in class II high and low angle cases. 2010;30(1).
16. Daniel MM, Lorenzi MC, da Costa Leite C, Lorenzi-Filho GJC. Pharyngeal dimensions in healthy men and women. 2007;62(1):5-10.
17. Chaturvedi S, Agarwal A, Chaturvedi Y, Goyal A, Agarwal VJJoIOS. Comparative study of the nasopharyngeal airway dimensions in class II individuals using cone-beam computed tomography. 2014;48(4):256-61.
18. Grauer D, Cevidanes LS, Styner MA, Ackerman JL, Proffit WRJAjoo, orthopedics d. Pharyngeal airway volume and shape from cone-beam computed tomography: relationship to facial morphology. 2009;136(6):805-14.
19. Celikoglu M, Bayram M, Sekerci AE, Buyuk SK, Toy EJTAO. Comparison of pharyngeal airway volume among different vertical skeletal patterns: a cone-beam computed tomography study. 2014;84(5):782-7.
20. Mehta S, Lodha S, Valiathan A, Urala AJATiO. Mandibular morphology and pharyngeal airway space: A cephalometric study. 2015;5(1):22-.
21. Bollhalder J, Hänggi MP, Schätzle M, Markic G, Roos M, Peltomäki TAJTEJoO. Dentofacial and upper airway characteristics of mild and severe class II division 1 subjects. 2013;35(4):447-53.
22. Lopatienė K, Dabkutė A, Juškevičiūtė VJS. Vertical and sagittal morphology of the facial skeleton and the pharyngeal airway. 2016;18(1):21-5.
23. Alves Jr M, Franzotti E, Baratieri C, Nunes L, Nojima L, Ruellas AJIjoo, et al. Evaluation of pharyngeal airway space amongst different skeletal patterns. 2012;41(7):814-9.
24. Wang T, Yang Z, Yang F, Zhang M, Zhao J, Chen J, et al. A three dimensional study of upper airway in adult skeletal Class II patients with different vertical growth patterns. 2014;9(4):e95544.
25. Memon S, Fida M, Shaikh AJJotCoP, Pakistan S. Comparison of different craniofacial patterns with pharyngeal widths. 2012;22(5):302.