Original Article

Comparison of Uvulo-glossopharyngeal Dimensions between Hypo- and Hyper-divergent Growth Pattern of Skeletal Class II Malocclusion in Local Population: A Pilot Study

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Abstract

Aim: The aim of this study was to compare the uvuloglossopharyngeal dimensions between hypodivergent and hyperdivergent growth pattern of skeletal class II malocclusion. **Materials and Methods:** Lateral cephalograms of sixty skeletal class II malocclusion subjects were taken with SIRONA cephalostat. The cephalograms were divided into two groups as hypodivergent and hyperdivergent growth pattern with SN to Go-Gn plane for determining the various growth pattern. It was further subdivided into two groups and under each group (consisting of 15 male, 15 female subjects). Witt's appraisal and beta analysis was used to analyse the skeletal pattern. The airway space was divided as superior, middle and inferior airway space measuring from posterior pharyngeal wall. Statistical analysis used was done using SPSS software. Independent student t' test was used to compare the variables. The results obtained showed statistically significant dimensions of airway space in hyperdivergent females compared to hyperdivergent males. Hypodivergent females and males showed no significant changes in airway dimensions. **Conclusion:** Females of hyperdivergent growth pattern in skeletal class II malocclusion showed wider pharyngeal airway space than males.

Keywords: *Airway space, hyperdivergent, hypodivergent, skeletal Class II malocclusion*

Introduction

The pharynx is a tube-shaped structure that extends superoinferiorly from cranial base to the level of inferior surface of sixth cervical vertebrae. It can be separated into three parts – nasopharynx, oropharynx, and hypopharynx. The nasopharynx extends from nasal turbinate to hard palate, oropharynx into retroglossal and retropalatal area, and the hypopharynx from base of the epiglottis to larynx.[1]

The growth and function of nasal cavities, the nasopharynx and oro-pharynx, are closely associated with normal growth of the skull. Respiratory function is highly relevant to orthodontic diagnosis and treatment planning.

Respiration through upper airway is a vital functional process which has an impact on craniofacial development. Skeletal features such as retrusive maxilla, retrusive mandible, and vertical maxillary excess in hyperdivergent patients may lead to changes in anteroposterior dimensions of the airway.[2] Proper pharyngeal dimension is required for the vital function of respiration and for the normal development of maxilla and mandible. Pharyngeal space size is determined by relative growth and size of the soft tissues surrounding the dentofacial skeleton.

According to McNamara and Brudon,[3] upper pharyngeal wall is measured from a point on the posterior outline of soft palate to the closest point on posterior pharyngeal wall. Lower pharyngeal width is measured from intersection of the posterior border of the tongue and

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inferior border of the mandible to the closest point on posterior pharyngeal wall.

- Normal value: Upper airway: 15–20 mm (mean value: 17 mm)
- Lower airway: 11–14 mm.

Airway space maybe affected by conditions such as functional anterior shift in head posture, sagittal skeletal relation, and vertical growth pattern.

Younger patients of about 8–14 years treated with functional appliance for mandibular retrusion showed changes in pharyngeal airway passage and posterior pharyngeal wall. Significant changes were seen among different skeletal bases than facial pattern. Maxillary protraction devices during adolescence showed an increase in airway space as there is a forward movement of maxilla and its dentition with backward rotation of mandible.

Treatment of adult patients has become a reality in orthodontic practice for many years. For adult patients with mandibular deficiency, two treatment approaches are usually available. The first is compensatory, involving premolar extraction, allowing retraction of upper incisors and overjet correction, while the second is surgical repositioning of mandible anteriorly. Fixed functional appliances constitute as a third alternative to treat Class II malocclusion without a surgery or extraction. In adult patients, there were more of dentoalveolar changes than skeletal changes which will have an impact in increased airway space. Healthy controls with Class I skeletal malocclusion and vertical growth patterns have narrow airway passages than healthy controls with horizontal growth pattern.

Hence, this study was conducted to find which of the growth patterns in a skeletal Class II case showed narrow pharyngeal space so that it could be a diagnostic tool in the treatment planning of such patients.

Aim

This study aimed to compare the uvulo-glossopharyngeal dimensions in hypo- and hyper-divergent growth patterns of skeletal Class II malocclusions in local population.

Materials and Methods

Sixty digital lateral cephalograms were randomly selected from the outpatient records in the Department of Orthodontics and Dentofacial Orthopedics of KSR Institute of Dental Science and Research with patients' age ranging from 12 to 26 years. The growth patterns were categorized according to SN to Go-Gn plane (hypo <32°, hyper >32°). These were considered for the diagnosis of vertical growth pattern according to Isaccson *et al.*[2] All the digital cephalograms were taken using Sirona cephalostat machine. All patients were positioned in the cephalostat with Frankfort horizontal plane parallel to the floor, teeth in centric occlusion, and lips in relaxed position. Sixty cephalograms were divided into two groups as Group 1 and 2 comprising thirty cephalograms each which was based on their growth pattern. Groups 1 and 2 were further subdivided into subgroups A and B which comprised 15 lateral cephalograms in each subgroup (male – 15, female – 15). Acetate matte paper and sharp 3H drawing pencils were used to trace the cephalograms. Witt's appraisal and Beta analysis were used to analyze skeletal Class II patterns. All radiographs were traced manually, and linear and angular measurements were recorded by single author. Airway space was measured in which the upper airway space (superior posterior airway space [SPAS]) was measured to a line parallel to Go-B tangent, middle airway space (MAS) was measured from the tip of the soft palate (U) to the posterior pharyngeal wall, and inferior airway space (IAS) was measured along the line parallel to Go-B tangent line till the posterior pharyngeal wall [Figure 1].

Statistical analysis

IBM Statistical package for the social sciences statistics for windows, version 20.0 software (IBM Corp, Armonk, NY Inc) was used. ANOVA test and independent Student's *t*-test were used to analyze the measurements.

Student's *t*-test for two independent groups was used to compare the significance of difference between two groups at 5% level of significance.

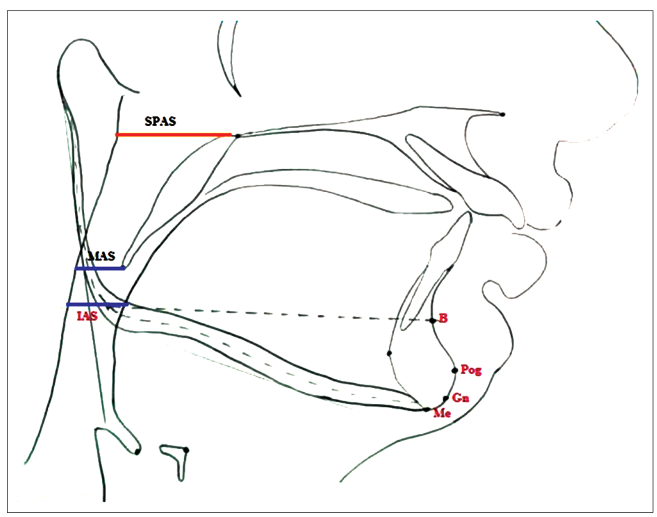

Figure 1: cephalometric points, lines and variables used for analysis. 1. SPAS, superior posterior airway space (width of airway space behind soft palate along line parallel to Go-B line); 2. MAS, middle airway space (width of airway space along line parallel to Go-B line through U); 3. IAS, Inferior airway Space (width of airway space along Go-B line); 4. B, point B; 5. Pog, Pogonion; 6. M, Menton; 7.Go, Gonion

Results

This study showed significant changes of hyperdivergent growth pattern in females than that in males. Females of hyperdivergent growth patterns showed narrower airway space than males [Tables 1 and 2].

Table 1: Mean, Standard Deviation, and *P*-Value for hyperdivergent males and females between the airway space

	Hyperdivergent				*P*
	Mean		SD		
	Males	Females	Males	Females	
SPAS	11.9	14.2	2.4	3.1	0.033
MAS	10.3	14.8	2.6	3.5	0.001
IAS	9.8	12.6	1.8	2.7	0.015

Level of significance: 5%. $P<0.05$. SD=Standard deviation, SPAS=Superior posterior airway space, MAS=Middle airway space, IAS=Inferior airway space

Table 2: Mean, Standard Deviation, and *P*-Value for hyperdivergent males and females between the airway space

	Hypodivergent				*P*
	Mean		SD		
	Males	Females	Males	Females	
SPAS	14.5	14.1	3.9	3.4	0.751
MAS	11.3	12.5	4.7	3.6	0.442
IAS	10.9	9.8	4.2	2.5	0.369

Level of significance: 5%. $P<0.05$. SD=Standard deviation, SPAS=Superior posterior airway space, MAS=Middle airway space, IAS=Inferior airway space

Discussion

The upper airway is a structure which is responsible for major function - breathing. Abnormal development of airway is related to airway constriction/expansion, which can affect respiratory function and thereby craniofacial growth indirectly which has to be considered by orthodontists before treatment planning. This study was performed with two-dimensional cephalometric films to evaluate pharyngeal airway width.

The main aim of this study was to establish the relationship of airway space with hypo- and hyper-divergent skeletal Class II malocclusion and to determine whether it was reliable for orthodontists to diagnose treatment plan using pretreatment orthodontic records. This study has shown significant airway dimensions (SPAS, MAS, and IAS) in females of hyperdivergent growth pattern ($P \leq 0.001$) of skeletal Class II lateral cephalogram than males, and there were no significant changes between hypodivergent growth pattern in males and females.

De Freitas *et al*.[4] used McNamara analysis to compare upper and lower pharyngeal airway dimensions in untreated individuals of Class I and Class II malocclusion with normal and vertical growth pattern. They reported that individuals with vertical growth pattern in Class I and II malocclusion showed significant narrower airway passage than those with the normal growth pattern. Ucar and Uysal[5] reported that nasopharyngeal airway space and upper pharyngeal airway space in Class I individuals were larger in low-angle individuals than in high-angle individuals. In the present study, females with hyperdivergent growth pattern showed larger airway space than males with hyperdivergent growth pattern.

Batool *et al*. (2010)[6] reported that individuals with Class II malocclusion and vertical growth patterns have significant narrower lower pharyngeal airway than those with Class II malocclusion and horizontal growth pattern. Joseph *et al*.[7] reported that nasopharyngeal airway in hyperdivergent growth pattern was significantly narrower than normal divergent pattern. The lack of deficiency in high-angle individuals maybe because of reduced SNA, SNB, and posterior facial height. It may be caused by a decrease in the dimensions of upper airway in high-angle individuals.

According to Memon *et al*.,[8] hyperdivergent facial patterns belonging to skeletal Class I and skeletal Class II malocclusion show narrow upper pharyngeal airway width as compared to normo- and hypo-divergent facial patterns. This study shows increased pharyngeal space in Class II hyperdivergent when compared to hypodivergent growth patterns.

Oh *et al*.[9] reported that children with Class II malocclusions have more backward orientation and smaller volume of pharyngeal airway width. Inclination of the oropharyngeal airway might be the key in determining the form of the entire pharyngeal airway and is related to head posture.

Kirjavainen and Kirjavainen[10] reported that Class II division 1 malocclusion is associated with narrow upper airway structure even without retrognathia. Treatment with headgear increases the retropalatal airway space, but has no effect on oro- and hypo-pharyngeal space.

Abu Allhaija and Al-Khateeb[11] studied uvulo-glossopharyngeal dimensions in different anteroposterior jaw relationships and found a weak correlation with inferior airway space and showed variations in hyoid bone position.

El and Palomo[12] evaluated the nasal passage and oropharyngeal volumes and found that oropharyngeal volume of Class II malocclusion patients is smaller than Class I and Class III malocclusion groups. Nasopharyngeal volume was also smaller in Class II malocclusion group.

Sarwat Memon *et al*. (2012)[8] compared different craniofacial patterns with pharyngeal widths in 360 orthodontic patients. They reported that sagittal malocclusion type does not influence upper pharyngeal width, but hyperdivergent individuals have shown statistically significant narrower upper pharyngeal width than the other two growth patterns. A study by Atia Abd *et al*.[13] also showed narrow pharyngeal airway dimensions in Class II division 1 malocclusion patients when compared with Class I malocclusion and Class III malocclusion, where Class III malocclusion had wider lower pharyngeal airway dimensions because of prognathic mandible, and males showed wider pharyngeal airway dimensions than females. This study showed significant changes between hypo- and hyper-divergent males and females. The comparison between hypo and hyperdivergent groups showed narrower pharyngeal space in males than in females who showed larger airway space in hyperdivergent growth pattern.

Cone beam computed tomography is the simple and effective method to accurately analyze the airway, and the volume of airway space seems to be greater than two-dimensional cephalometric tracing.

When diagnosing and treating patients with malocclusion, orthodontists should recognize pharyngeal airway morphologies that might be a predisposing factor of undesirable craniofacial development.

Conclusion

1. Females of hyperdivergent growth pattern in skeletal Class II malocclusion showed wider pharyngeal airway space than that of males
2. Hyperdivergent group showed significant changes when compared with hypodivergent growth pattern.

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Conflicts of interest

There are no conflicts of interest.

References

1. Sheng CM, Lin LH, Su Y, Tsai HH. Developmental changes in pharyngeal airway depth and hyoid bone position from childhood to young adulthood. Angle Orthod 2009;79:484-90.
2. Isaacson JR, Isaacson RJ, Speidel TM, Norms FN. Extreme variations in vertical facial growth and associated variation in skeletal and dental relation. Angle Orthod 1971;41:219-29.
3. McNamara JA, Brudon WL. Orthodontic and Orthopedic Treatment in Mixed Dentition. Ann Arbor: Needham Press Inc, 1993, 367.
4. de Freitas MR, Alcazar NM, Janson G, de Freitas KM, Henriques JF. Upper and lower pharyngeal airways in subjects with Class I and Class II malocclusions and different growth patterns. Am J Orthod Dentofacial Orthop 2006;130:742-5.
5. Ucar FI, Uysal T. Orofacial airway dimensions in subjects with Class I malocclusion and different growth patterns. Angle Orthod 2011;81:460-8.
6. Batool I, Shaheed M, Ali Rizvi AS, Abbas A. Comparison of upper and lower pharyngeal airway space in class II high and low angle cases. Pak Oral Dent J 2010; 30:81-4.
7. Joseph AA, Elbaum J, Cisneros GJ, Eisig SB. A cephalometric comparative study of the soft tissue airway dimensions in persons with hyperdivergent and normodivergent facial pattern. J Oral Maxillofacial Surg.1998;56:135-9.
8. Memon S, Fida M, Shaikh A. Comparison of different craniofacial patterns with pharyngeal widths. Journal of College of Physicians and Surgeons Pakistan 2012;22:302-6.
9. Oh KM, Hong JS, Kim YJ, Cevidanes LS, Park YH. Three-dimensional analysis of pharyngeal airway form in children with anteroposterior facial patterns. Angle Orthod 2011;81:1075-82.
10. Kirjavainen M, Kirjavainen T. Upper airway dimensions in Class II malocclusion. effects of headgear treatment. Angle Orthod 2007;77:1046-53.
11. Abu Allhaija ES, Al-Khateeb SN. Uvulo-glosso-pharyngeal dimensions in different anteroposterior skeletal patterns. Angle Orthod 2005;75:1012-8.
12. El H, Palomo JM. Airway volume for different dentofacial skeletal patterns. Am J Orthod Dentofacial Orthop 2011;139:e511-21.
13. Elrazik Yousif AA. Evaluation of upper and lower pharyngeal airway in hypo and hyperdivergent Class I, II and III malocclusions in a group of Egyptian patients. Tanta Dental Journal 2015;12:265e76.