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Evaluation and Comparison of Upper and Lower Pharyngeal Airway Space in Skeletal Class II Malocclusion with Different Growth Patterns Of South Rajasthan Population

Dr. T. K. Niharika[1], Dr. Namit Nagar[2], Dr. Vibhuti Mehta[3], Dr. Shreya Agarwal[4], Dr. Nishal Khattri[5], Dr. Joshi Niharika Manish[6]

[1,3,4,5,6]*(PG Student, Department of Orthodontics and dentofacial Orthopedics, Geetanjali Dental and Research Institute, Geetanjali University*

[2]*(Professor and Head of Department, Department of Orthodontics and Dentofacial Orthopedics, Geetanjali Dental and Research Institute, Geetanjali University)*

Abstract:

Background*: The normal airway is one of the important factors for the normal growth of the craniofacial structures. Significant relationships between the pharyngeal structures and both dentofacial and craniofacial structures have been reported. 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. The aim of the study is to evaluate and compare upper and lower pharyngeal airway space in skeletal Class II malocclusions with different growth patterns.*

Materials and Methods*: The study was conducted on 60 pre-treatment lateral cephalograms of skeletal Class II malocclusion patients with an age group of 12 to 30 years of South Rajasthan population. Based on Jarabak's ratio the subjects were divided into three groups of 20 each: Group I- Hypo divergent (Jarabak's value more than 62%), Group II- Normo divergent (Jarabak's value between 62-65%), Group III: Hyper divergent (Jarabak's value less than 65%). The assessment of upper and lower pharyngeal space was done by using McNamara analysis.*

Results: *The comparison of upper and lower pharyngeal airway space width was performed with one way analysis of variance (ANOVA), which suggested that the upper pharyngeal airway space is narrower in patients with hyperdivergent growth pattern with a mean value of 8.85mm when compared to normodivergent (mean=9.38) and hypodivergent (mean=11.10). A significant difference was seen in lower pharyngeal airway width when compared between normodivergent and hyperdivergent growth patterns*

Conclusion :*Patients with Skeletal Class II malocclusion with hyper divergent growth pattern have narrow upper pharyngeal airway width. No significant difference in upper pharyngeal airway space is seen between normodivergent and hypodivergent growth patterns but there is a significant difference in the lower pharyngeal airway space.*

Key Word: *Pharyngeal airway, growth patterns, cephalometry, McNamara airway analysis*

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I. Introduction

The pharyngeal airway is a multifunctional structure that is responsible for several different physiological functions including deglutition, vocalization and respiration.[1] The normal airway is one of the important factors for the normal growth of the craniofacial structures. Significant relationships between the pharyngeal structures and both dentofacial and craniofacial structures have been reported. Skeletal features like retrusive maxilla or mandible or vertical maxillary excess can cause change (narrowing) in the volume of Pharyngeal airway space (PAS). If PAS is severely reduced it can cause breathing problem. Variations in pharyngeal airway have also been described with some sleep disorders like obstructive sleep apnea (OSA).[2]

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. Some authors associated mouth breathing and Class II malocclusion and others reported associations of vertical growth pattern with obstruction of upper and lower pharyngeal airways with mouth breathing.[3]

The aim of this study is to evaluate and compare the upper and lower pharyngeal airway space in Skeletal Class II malocclusion with hypodivergent, hyperdivergent and normodivergent growth patterns.

II. Material And Methods

60 Pre- treatment lateral cephalograms of patients with age group between 12 and 30 years were taken to evaluate and compare the upper and lower pharyngeal width. The cephalometric tracings, landmark identifications, and measurements were performed manually on acetate paper.

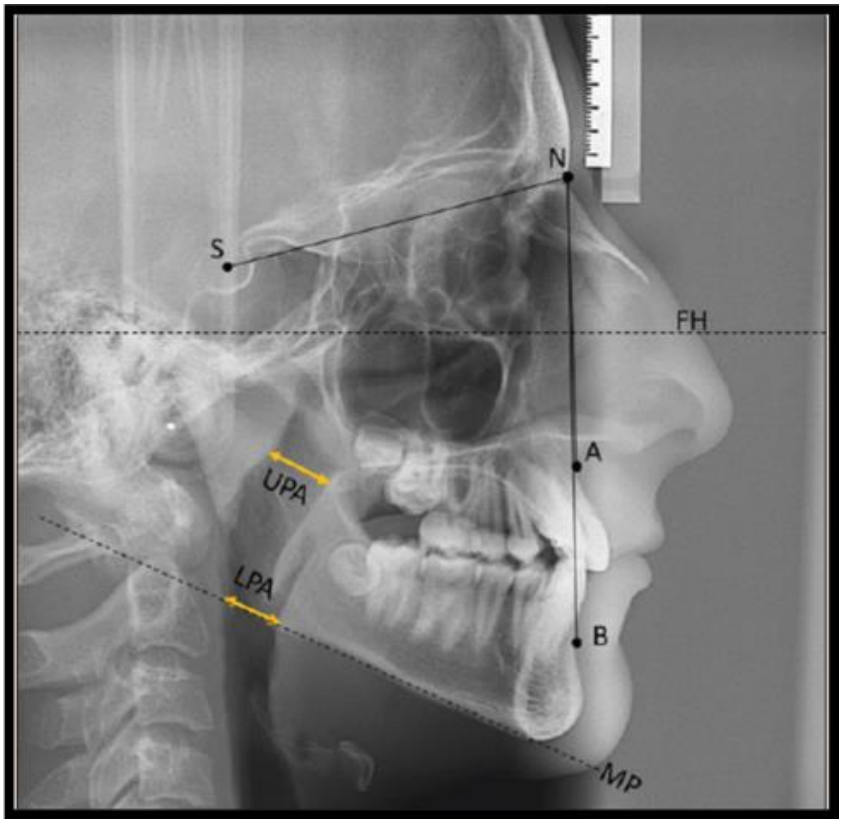
Inclusion criteria

-Pre-treatment lateral cephalograms of patients with age groups between 12-30 years recorded in natural head position.
-No history of orthodontic treatment.
-Absence of any pharyngeal pathology and nasal obstruction.

Exclusion criteria

-Patients with craniofacial syndromes.
-The cephalometric radiograph with unclear soft tissue landmarks.

The subjects are of skeletal Class II malocclusion based on their ANB value more than 4°. Based on Jarabak's ratio the subjects were divided into three groups of 20 each: Group I- Hypo divergent (Jarabak's value more than 62%), Group II- Normo divergent (Jarabak's value between 62-65%), Group III: Hyper divergent (Jarabak's value less than 65%). McNamara airway analysis was used to measure the upper and lower pharyngeal airway in all the groups mentioned above.



Upper and lower airway pharyngeal space using McNamara analysis

SR. NO	GROUP I Hypodivergent	Upper airway space	Lower airway space	Group II Normodivergent	Upper airway space	Lower airway space	Group III Hyperdivergent	Upper airway space	Lower airway space
1		18mm	10mm		13mm	16mm		5mm	6mm
2		9mm	11mm		10mm	10mm		10mm	5mm
3		12mm	10mm		11mm	5mm		11mm	8mm
4		11mm	8mm		12mm	8mm		9mm	7mm
5		11mm	7mm		9mm	5mm		9mm	7mm
6		7mm	3mm		8mm	12mm		8mm	12mm
7		14mm	12mm		10mm	6mm		10mm	10mm
8		14mm	12mm		5mm	5mm		7mm	10mm
9		4mm	6mm		8mm	6mm		11mm	9mm
10		11mm	10mm		7mm	5mm		7mm	6mm
11		10mm	10mm		12mm	13mm		4mm	7mm
12		12mm	11mm		10mm	7mm		10mm	6mm
13		9mm	4mm		11mm	7mm		9mm	4mm
14		13mm	9mm		7mm	9mm		9mm	6mm
15		15mm	4mm		10mm	7mm		12mm	6mm
16		8mm	12mm		14mm	10mm		9mm	6mm
17		11mm	14mm		8mm	6mm		10mm	6mm
18		10mm	7mm		7mm	8mm		9mm	7mm
19		12mm	7mm		7mm	10mm		11mm	8mm
20		11mm	9mm		7mm	9mm		7mm	6mm

Table 1- Values obtained from the subjects.

III. Result

One way analysis of variance(ANOVA) is used to perform intergroup comparison between upper and lower pharyngeal space. Mean and standard deviations of upper pharyngeal airway space and lower pharyngeal airway space in different growth patterns individually i.e., hypodivergent, normodivergent and hyperdivergent are obtained at a level off significance $p< 0.05$ as shown in Table 2 and 3 respectively.

Table 2: Mean value and standard deviations of upper pharyngeal airway space in different growth patterns

	Mean	**S.D**	**p value**
Hypo-divergent	11.10	3.02	0.015
Normodivergent	9.30	2.39	
Hyper-divergent	8.85	2.03	

Graph 1: Graphical representation of the mean values of upper pharyngeal space in different growth patterns.

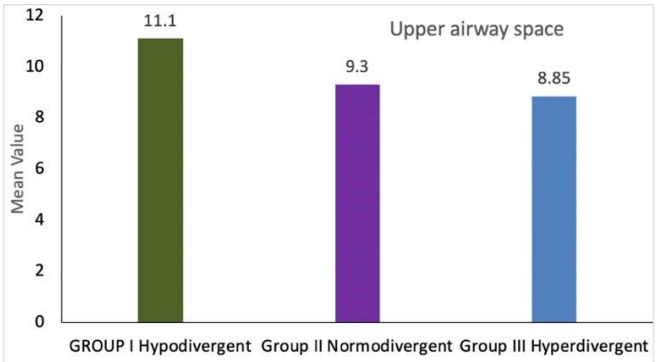


Table 3: Mean and standard deviations of lower pharyngeal airway space in different growth patterns

	Mean	**S.D**	**p value**
Hypo-divergent	8.80	3.00	0.136
Normodivergent	8.20	2.98	
Hyper-divergent	7.10	1.92	

Graph 2: Graphical representation of the mean values of lower pharyngeal space in different growth patterns.

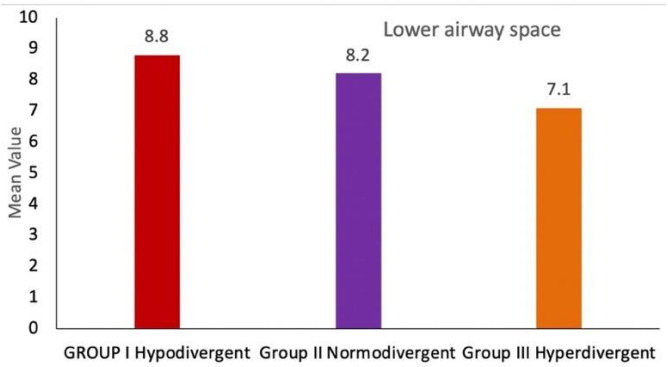


Table 4: Comparison of upper pharyngeal airway space amongst hypodivergent, normodivergent and hyperdivergent growth patterns.

		Mean difference	S.D error	p value
Hypodivergent Normodivergent	**vs**	1.8	0.8	0.04
Normodivergent Hyperdivergent	**vs**	0.45	0.7	0.52
Hypodivergent Hyperdivergent	**vs**	2.25	0.8	0.01

Table 5- Comparison of lower pharyngeal airway width amongst hypodivergent, normodivergent and hyperdivergent growth patterns.

		Mean difference	S.D error	p value
Hypodivergent Normodivergent	**vs**	0.6	0.9	0.53
Normodivergent Hyperdivergent	**vs**	1.1	0.7	0.04
Hypodivergent Hyperdivergent	**vs**	1.7	0.7	0.17

Graph 3- Graphical representation of the comparison of upper and lower pharyngeal space in different growth patterns.

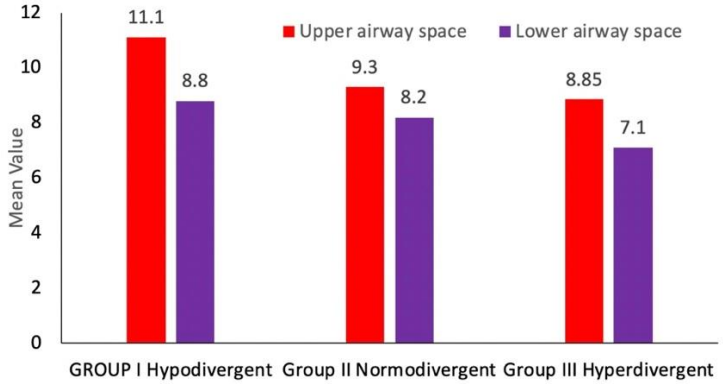


Table 6- Comparison between upper and lower pharyngeal airway width.

ANOVA	p value
Upper pharyngeal airway space	0.015
Lower pharyngeal airway space	0.136

The values obtained from this study has shown that patients with hyperdivergent growth pattern have narrow upper pharyngeal airway space when compared to normodivergent and hypodivergent growth patterns and the differences were statistically significant. Significant difference was found in upper pharyngeal airway space between hyperdivergent and normodivergent but no significant difference in the lower pharyngeal airway space. No significant difference in upper pharyngeal airway space is seen between normodivergent and hypodivergent growth patterns but there is a significant difference in the lower pharyngeal airway space.

IV. Discussion

60 Pre-treatment lateral cephalograms of skeletal Class II malocclusion based on ANB value more than 4° recorded in Natural head position of patients with age group between 12 and 30 years of South Rajasthan population were taken to evaluate and compare the upper and lower pharyngeal airway width. The cephalometric tracings and measurements were performed manually on acetate paper. Based on Jarabak's ratio the subjects were divided into three groups of 20 each: Group I- Hypo divergent (Jarabak's value more than 62%), Group II- Normo divergent (Jarabak's value between 62-65%), Group III: Hyper divergent (Jarabak's value less than 65%). McNamara airway analysis was used to measure the upper and lower pharyngeal airway in all the groups mentioned above. In each group, mean and standard deviations were determined individually. One way analysis of variance(ANOVA) was used to find the significance of the study parameters between three groups.

Upper Pharyngeal Airway Width with different growth patterns-

The present study suggested that the upper pharyngeal airway space is narrower in patients with hyperdivergent growth pattern with a mean value of 8.85mm when compared to normodivergent (mean=9.38) and hypodivergent (mean=11.10). The results were similar to the findings of the study conducted by **Mani P, Muthukumar K, Krishnan P, Senthil Kumar KP (2015)[2],** which stated that patients with Class II malocclusions and hyperdivergent growth patterns have significantly narrow upper pharyngeal airway space than normodivergent and hypodivergent growth patterns, indicating that growth pattern affect the upper airway space.

This is also similar to the study conducted by **Lakshmi K B, Yelchuru SH, Chandrika V, Lakshmikar O G, Sagar V L, Reddy G V (2018)[7],** in which the growth patterns and pharyngeal widths in different skeletal malocclusion was compared and concluded that skeletal malocclusions with vertical growers showed a significant decrease in the upper pharyngeal width than the horizontal and normal growers.

A comparative study was conducted by **de Freitas MR, Alcazar NM, Janson G, de Freitas KM, Henriques JF (2006)[4]** on upper and lower pharyngeal airways in Class I and Class II malocclusion with different growth patterns, stated that patients with Class I and Class II malocclusions and vertical growth patterns have significantly narrower upper pharyngeal airways than those with normal growth patterns. They also concluded that malocclusion type and growth pattern does not influence upper pharyngeal airway width and lower pharyngeal airway width.

Lower pharyngeal Airway Width with different growth patterns-

A significant difference is seen in lower pharyngeal airway width when compared between normodivergent and hyperdivergent growth patterns, which is similar to the study conducted by **Jain S, Raghav P, Misra V, Reddy CM, Singh S, Aggarwal S (2014)[5],** who stated that that the lower pharyngeal airway width is significantly narrower in Skeletal Class II patients.

The results of the present study is contradicting from the results of the study conducted by **Mani P, Muthukumar K, Krishnan P, Senthil Kumar KP (2015)[1],** who concluded that there was no significant difference seen in all three vertical patterns. Similarly, a study conducted by **Kapoor S, Pallav P, Moirangthem R, Varshney SR, Jain AK (2014)[8],** concluded that there is no significance in the lower pharyngeal airway space in all the three growth patterns which is in contradiction to the results of the present study. These contrasting results might be caused because of the differences in sample selection. As, this study included patients from South Rajasthan population only, whereas the above studies used samples from West Tamil Nadu population.

The results of present study revealed that upper pharyngeal airway width is narrower in hyperdivergent growth pattern when compared to normodivergent and hypodivergent growth patterns. A significant difference is seen lower pharyngeal airway width between normodivergent and hypodivergent growth patterns.

It can be seen that there is a close association between skeletal Class II malocclusion and vertical growth pattern with obstruction of the upper and lower pharyngeal airways and mouth breathing.

V. Conclusion

From the results of the study, the following conclusions can be drawn-

- Patients with Skeletal Class II malocclusion with hyper divergent growth pattern have narrow upper pharyngeal airway width.

- No significant difference in upper pharyngeal airway space is seen between normodivergent and hypodivergent growth patterns but there is a significant difference in the lower pharyngeal airway space.
- Significant difference is seen in upper pharyngeal airway space between hyperdivergent and normodivergent but no significant difference in the lower pharyngeal airway space.
- Significant difference is seen in upper pharyngeal space between hypodivergent and hyperdivergent growth patterns but no significance is seen in the lower pharyngeal airway space.

This study was performed with two-dimensional cephalometric films to evaluate only pharyngeal airway width not airway flow capacity. In order to obtain the capacity of airway flow, a three-dimensional cone beam computed tomography (CBCT) will be required. This holds the future scope for the present study.

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