PHARYNGEAL AIRWAY SPACE IN CLASS I VS II WITH AVERAGE, HYPO & HYPERDIVERGENT PATTERN LATERAL CEPHALOGRAM

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ABSTRACT
The pharyngeal airway is closely related to craniofacial morphology and may vary with skeletal sagittal pattern and vertical growth pattern. Evaluation of airway dimensions is important in orthodontic diagnosis and treatment planning. Thus the aim of our study was to to assess the pharyngeal airway space in skeletal Class I and Class II individuals with average, hypodivergent, and hyperdivergent growth patterns using lateral cephalograms in total of 90 untreated subjects, divided into skeletal Class I and Class II groups, with each group further subdivided into average, hypodivergent, and hyperdivergent growth patterns based on mandibular plane angle. Upper and lower pharyngeal airway widths were measured on lateral cephalograms. We have found that, Upper pharyngeal airway width showed significant variation among the groups, with narrower dimensions observed in hyperdivergent subjects. Lower pharyngeal airway measurements did not show a consistent significant association with skeletal class or growth pattern. Thus, we have come to conclude that, Pharyngeal airway dimensions are influenced mainly by vertical growth pattern, particularly in the upper airway region. Lateral cephalometric evaluation may be useful in identifying skeletal and growth-related airway differences.

Keywords: Upper & Lower pharyngeal airway, Lateral cephalometric, Growth Pattern, Class I and Class II, Mandibular Plane Angle.
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INTRODUCTION

The pharyngeal airway is an important part of craniofacial assessment because its size may be influenced by both sagittal skeletal relationship and vertical growth pattern. Several studies have suggested that upper airway dimensions can vary in skeletal Class I and Class II individuals,[1,2] but the findings are not completely consistent, which makes our topic clinically relevant. Lateral cephalograms remain a practical and widely used method for

evaluating pharyngeal airway space in orthodontic and dentofacial research, especially when large samples need to be assessed efficiently.[3] In addition to above, vertical facial pattern appears to have a particularly strong relationship with airway size.[4] Previous reports have shown that subjects with hyperdivergent or long-face growth patterns often present with narrower upper pharyngeal airway dimensions than average- or hypodivergent individuals, and this tendency has been observed in both Class I and Class II malocclusions.[5,3,6] At the same time, some studies have reported that sagittal skeletal class alone may not significantly alter airway dimensions, indicating that craniofacial morphology is a multifactorial determinant rather than a single-variable effect.[1,2] This creates a clear need for the present study, which aims to evaluate pharyngeal airway space in skeletal Class I and Class II individuals with average, hypodivergent, and hyperdivergent growth patterns using lateral cephalograms. Understanding these relationships is clinically useful because airway narrowing may influence diagnosis, treatment planning, and long-term orthodontic outcomes. In particular, identifying whether vertical growth pattern contributes more strongly than skeletal class can help orthodontists recognize patients who may be predisposed to reduced pharyngeal airway space. Accordingly, the present study was designed to compare upper and lower pharyngeal airway dimensions across the different skeletal and growth-pattern groups. By doing so, it seeks to clarify whether Class I versus Class II morphology and average versus divergent growth patterns are associated with measurable differences in airway space, and to add further evidence to a literature that still shows mixed findings.

AIM

To evaluate the pharyngeal airway space in skeletal class I and class II individuals with average, hypodivergent and hyperdivergent growth patterns using lateral cephalograms.

MATERIALS AND METHOD

This retrospective study used archived pre-treatment lateral cephalograms from the Department of Orthodontics and Dentofacial Orthopaedics, Rajasthan Dental College and Hospital, Jaipur. 90 cephalograms of patients indicated for orthodontic treatment were selected, comprising 45 skeletal Class I and 45 skeletal Class II cases; each skeletal group was further subdivided by growth pattern (normal, horizontal, and vertical growers) according to mandibular plane angles. All radiographs had been acquired with a Cephalostat (Carestream 8200 3D Panoramic unit) under standardized positioning with the Frankfurt plane parallel to the floor as shown in figure 1.

FIGURE 1: CEPHALOSTAT USED IN THE STUDY

Images were retrieved from the departmental archives and traced manually on 0.003-inch matte acetate sheets for subsequent analysis for following landmarks which includes basion(Ba), sella(S), nasion(N), .subspinale(Point A), supramental(Point B), Gonion (Go), gnathion (Gn), menton (Me), ANS, PNS and orbitale (O). In addition to this, angular measurements include SNA angle, SNB angle, ANB angle, saddle/sella angle, articular angle, gonial /jaw angle, mandibular plane angle, palatal mandibular angle (PP-GoGn), Y –axis, angle of convexity and FMA respectively as shown in figure 2.

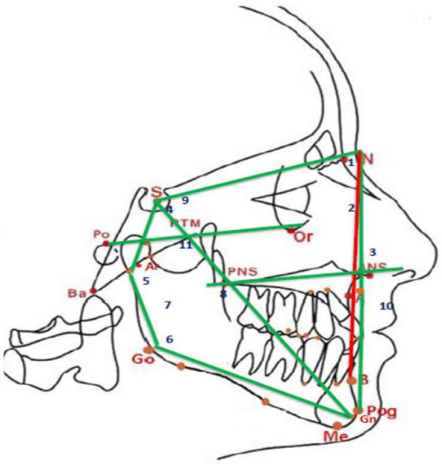

FIGURE 2: ANGULAR MEASUREMENTS

Linear measurements includes landmark like A point to Na perpendicular (A to N perp), Pogonion(Pog) to Na perp, ramus height (Ar-Go), mandibular body length (Go-Gn), Y-axis length (S-Gn), posterior facial height (S-Go), anterior facial height (Na-Me), jarabak ratio, overjet and overbite respectively as shown in figure 3.

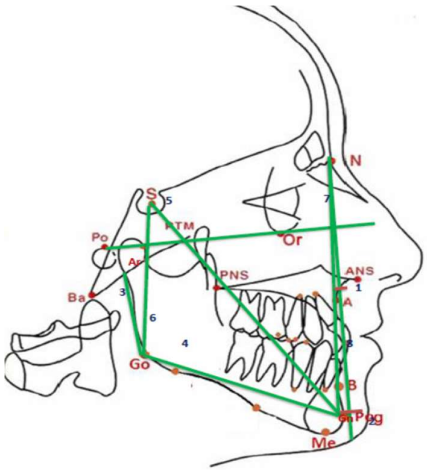

FIGURE 3 : LINEAR MEASUREMENTS

Airway space measurements includes nasophartngeal space, palatal tongue space, upper pharyngeal space, lower pharyngeal space as shown in figure 4.

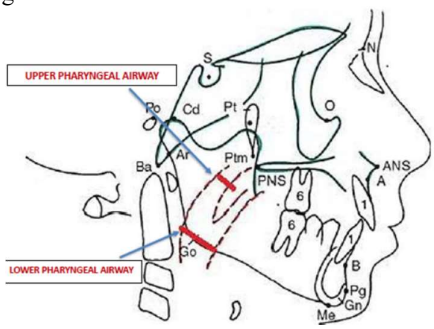

FIGURE 4 : PHARYNGEAL AIRWAY MEASUREMENTS

ARMAMENTARIUM

1. Cephalostat (Carestream 8200 3D Panoramic unit).
2. Lateral Cephalogram (8 X 10 inches).
3. View Box
4. Lead Acetate matte tracing papers (0.003 inches thick, 8 X 10 inches).
5. Rulers, set-squares, protractors, 0.3 mm lead pencil and eraser as shown in figure 5.

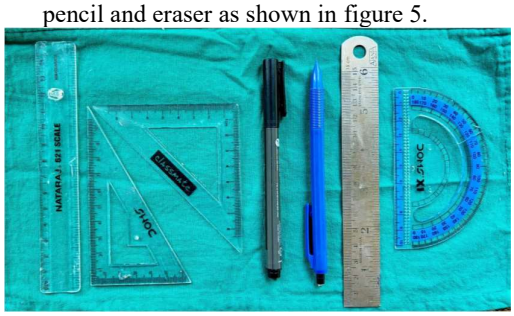

FIGURE 5 : MATERIAL USED IN OUR STUDY

Moreover, various subjects in the class I and the class II groups were later subdivided based on their growth pattern in this study as shown in figure 6-11.

Individuals with the same growth pattern were grouped together.

1. Subjects with SN-MP angle of <26 were grouped under low angle.
2. Subjects with SN –MP angle of 26-38 were grouped under normal growth.
3. Subjects with SN –MP angle of >38 were grouped under high angle

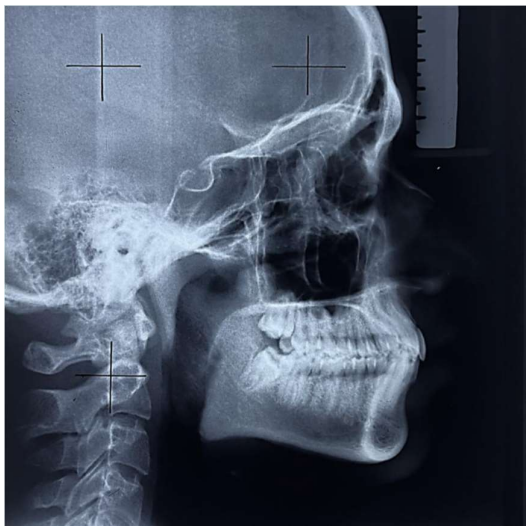

FIGURE 6 : CLASS I WITH HYPODIVERGENT GROWTH PATTERN

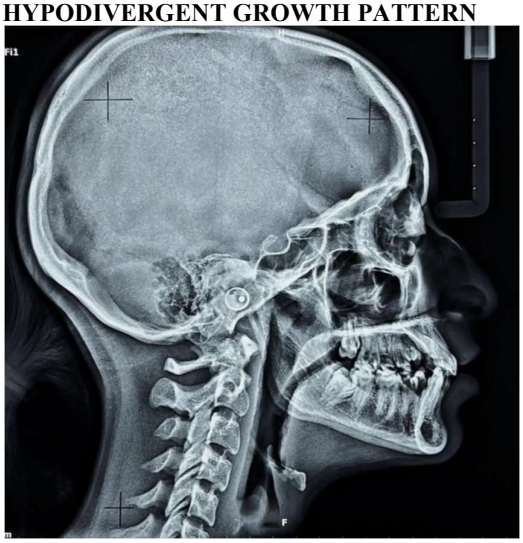

FIGURE 7 : CLASS I WITH AVERAGE GROWTH PATTERN

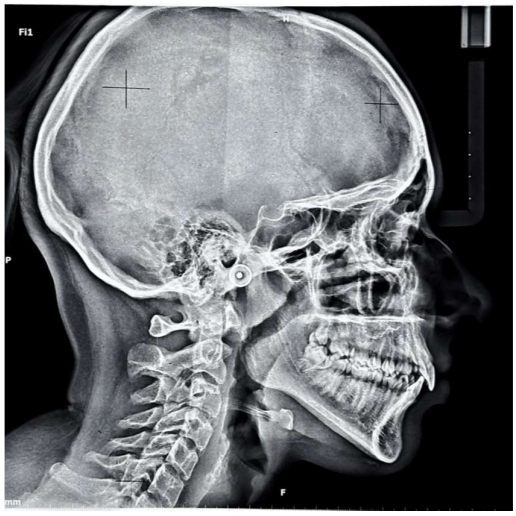

FIGURE 8 : CLASS I WITH HYPERDIVERGENT GROWTH PATTERN

FIGURE 9 : CLASS II WITH HYPODIVERGENT GROWTH PATTERN

FIGURE 10 : CLASS II WITH AVERAGE GROWTH PATTERN

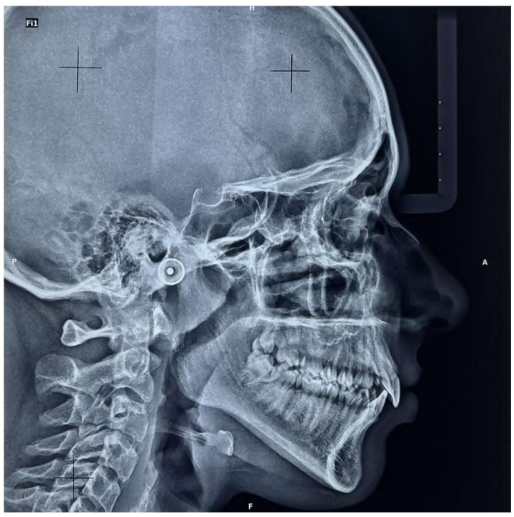

FIGURE 11 : CLASS II WITH HYPERDIVERGENT GROWTH PATTERN

INCLUSION CRITERIA

1. Those with different growth patterns.
2. no history of orthodontic treatment.
3. Above 18 years
4. Patient without any indication for orthognathic surgery

EXCLUSION CRITERIA

1. Patient who has undergone orthognathic surgery.
2. Subjects who had already undergone orthodontic treatment or undergoing current orthodontic treatment.
3. Patients with less than 28 permanent teeth.
4. Non-availability of good quality of pre-treatment cephalometric radiographs.
5. Patients suffering from craniofacial anomalies or systemic muscle or joint disorders.

STATISTICAL ANALYSIS

The data were summarized as mean ± standard deviation for continuous variables and as number and percentage for categorical variables. Normality of continuous data was assessed using the Shapiro–Wilk test, while proportions were compared using the Chi-square test. One-way analysis of variance (ANOVA) was used to compare group means for continuous variables, and when the F value was significant, Tukey's post hoc test was applied to identify which groups differed significantly; if the ANOVA was not significant, post hoc testing was not performed. A p value of less than 0.05 was accepted as indicating statistical significance, and data analysis was carried out using the Statistical

Package for Social Science (SPSS ver. 10.5) package.

RESULT

	Angle	N	Mean	SD	'F' value	'p' value	Low vs Normal	Low vs High	High vs Normal
SNA	Low	15	84.56	6.064	1.670	0.196	0.550	0.202	0.598
	Normal	15	82.85	3.608					
	High	15	81.42	2.906					
SNB	Low	15	84.00	7.382	9.647	<0.001*	0.025	<0.001*	0.016
	Normal	15	79.98	3.512					
	High	15	76.17	2.443					
ANB	Low	15	1.44	2.698	6.611	0.002	0.325	0.003	0.014
	Normal	15	2.87	2.613					
	High	15	5.25	1.765					
NSAr	Low	15	123.778	4.79000	0.955	0.390	0.546	0.472	0.962
	Normal	15	125.902	5.04166					
	High	15	126.583	3.82488					
SArGo	Low	15	137.67	6.325	1.689	0.193	0.658	0.207	0.488
	Normal	15	139.80	5.336					
	High	15	142.17	6.206					
ArGoMe	Low	15	124.00	8.689					
	Normal	15	126.63	33	6.566	0.003	0.461	0.004	0.010
	High	15	132.00	5.560					
PP-GoGn	Low	15	19.89	9.427	9.194	<0.001*	0.693	0.001*	0.001*
	Normal	15	21.87	4.564					
	High	15	28.83	5.006					
SN-MP	Low	15	21.778	4.8161	85.162	<0.001*	<0.001*	<0.001*	<0.001*
	Normal	15	31.957	2.9455					
	High	15	40.000	2.4495					
YAXIS NSGn	Low	15	64.78	3.898	19.606	<0.001*	0.272	<0.001*	<0.001*
	Normal	15	66.50	2.714					
	High	15	71.67	2.348					
GoGn-SN	Low	15	22.778	8.40800	31.341	**<0.001***	**0.001***	**<0.001***	**<0.001***
	Normal	15	28.837	3.3334					
	High	15	37.083	2.6097					
NaPog	Low	15	1.89	6.412	4.062	**0.022**	0.151	**0.018**	0.275
	Normal	15	6.48	6.726					
	High	15	9.92	4.738					
GoMe	Low	15	20.556	7.90755	21	**<0.**	**0.**	**<**	**<**
	No	1	24.	3.4					

-FH	rmal	5	728	636	.921	**001***	**025**	**0.001***	**0.001***
	High	15	32.167	3.0101					

TABLE 1 : COMPARISON OF MEAN ANGULAR CRANIOFACIAL MEASUREMENTS WITHIN CLASS I DIFFERENT GROWTH PATTERNS

Table 1 showed that there was no statistically significant difference among the groups for SNA, NSAr, and SArGo. However, SNB, ANB, ArGoMe, PP-GoGn, SN-MP, Y-axis NS-Gn, GoGn-SN, NaPog, and GoMe-FH showed significant intergroup differences. Post hoc analysis revealed significant pairwise differences in several variables, with SN-MP and GoGn-SN demonstrating highly significant differences across all three groups. These findings indicate that the groups differed mainly in sagittal and vertical skeletal parameters, with the High group showing greater angular values than the Low group in most measurement.

	Angle	**N**	**Mean**	**SD**	**'F' value**	**'p' value**	**Low vs Normal**	**Low vs High**	**High vs Normal**
SNA	Low	15	82.587	2.696	1.341	0.271	0.792	0.289	0.631
	Normal	15	81.562	4.144					
	High	15	79.582	7.494					
SNB	Low	15	78.547	2.669	1.057	0.355	0.559	0.463	0.964
	Normal	15	76.538	3.406					
	High	15	75.555	10.737					
ANB	Low	15	4.353	1.952	0	0.	0.	1.	0.6
	Normal	15	2.2	2.3					
	High	15	1	66	.789	460	665	000	92
	Low	15	14.257	3.952					
NSAr	Low	15	125.000	5.5806	2.863	0.066	0.075	0.892	0.458
	Normal	15	129.172	5.23099					
	High	15	126.455	7.03037					
SArGo	Low	15	138.73	7.176	3.391	0.041	0.996	0.118	0.042
	Normal	15	138.24	7.347					
	High	15	144.91	7.981					
ArGoMe	Low	15	119.20	4.873	10.914	<0.001*	0.013	<0.001*	0.044
	Normal	15	125	4.38					
	High	15	129.27	5.676					
PP-GoGn	Low	15	14.80	2.336	26.227	<0.001*	<0.001*	<0.001*	<0.0001*
	Normal	15	20.55	4.205					
	High	15	26.73	5.746					
SN-MP	Low	15	22.4677	2.26336	175.77	<0.001*	<0.001*	<0.001	<0.0

	Normal	15	30.8288	2.46500	7			*	01*
	High	15	40.2277	2.35997					
YAXISNSGn	Low	15	64.13	2.4616	18.7763	<0.0011*	0.002	<0.01*	0.003
	Normal	15	68.03	2.921					
	High	15	72.18	5.036					
GoGn-SN	Low	15	20.667	2.69004	69.9946	<0.0011*	<0.001*	<0.01*	<0.0001*
	Normal	15	27.4488	3.25778					
	High	15	36.2734	4.19744					
NaPog	Low	15	4.13	6.479	6.1511	0.0004	0.005	0.025	0.999
	Normal	15	9.79	4.776					
	High	15	10.000	5.3110					
GoMe-FH	Low	15	17.00	3.7003	5	<0	<0.	<0	<
			00	3	2.041	.0011*	001*	.001*	0.0001*
	Normal	15	22.3452	3.72522					
	High	15	31.5458	3.07788					

TABLE 2 : COMPARISON OF MEAN ANGULAR CRANIOFACIAL MEASUREMENTS AMONG CLASS II DIFFERENT GROWTH PATTERNS

Table 2 showed that SNA, SNB, and ANB were not statistically significant among the Low, Normal, and High groups, indicating that the sagittal maxillary and mandibular relationships were broadly similar across the groups. NSAr also did not show a significant difference, although it approached significance. In contrast, SArGo was significantly different overall, with the High group showing a higher mean value than the Low and Normal groups, suggesting a difference in gonial morphology. More importantly, ArGoMe, PP-GoGn, SN-MP, Y-axis NSGn, GoGn-SN, NaPog, and GoMe-FH showed highly significant intergroup differences, indicating that the groups differed mainly in vertical skeletal pattern and mandibular plane inclination. The post hoc results show that SN-MP, GoGn-SN, and GoMe-FH differed significantly across all pairwise comparisons, while ArGoMe, PP-GoGn, and Y-axis NSGn also showed significant group separation, with the High group generally demonstrating larger angular values than the Low group. Overall, this suggests that the chief distinction among the three groups lies in vertical growth pattern rather than sagittal jaw relationship.

	Angle	**N**	**Mean**	**SD**	**'F' value**	**'p' value**	**Low vs Normal**	**Low vs High**	**High vs Normal**
Np	Low	15	10.778	2.86266	0.5	0.5	1.000	0.854	0.638
	Norm	1	0.9	4.3					

er-A	al	5	02	762	83	61			
	High	15	-0.542	3.98555					
Nper-Pog	Low	15	-3.000	8.24622	5.054	0.009	0.896	0.027	0.013
	Normal	15	-4.587	6.68944					
	High	15	-11.1675	6.60335					
Ar-Go	Low	15	51.333	8.62005	2.8306	0.006	0.096	0.092	0.933
	Normal	15	46.717	5.42188					
	High	15	45.708	4.70223					
Go-Gn	Low	15	77.222	5.06900	2.016	0.142	0.991	0.294	0.172
	Normal	15	76.685	5.65592					
	High	15	73.292	5.06533					
S-Go	Low	15	84.500	9.47336	6.016	0.004	0.051	0.003	0.152
	Normal	15	78.793	5.76066					
	High	15	74.708	6.12177					
N-Me	Low	15	117.722	7.65331	1.586	0.213	0.924	0.301	0.328
	Normal	15	119.315	7.99688					
	High	15	123.250	6.99551					
JARABAKRATIO	Low	15	69.7568	5.698	19.056	<0.001*	0.011	<0.001*	<0.001*
	Normal	15	65.9099	3.0500					
	High	15	60.5172	3.1422					
OVERJET	Low	15	1.7778	1.09299	3.327	0.042	0.162	0.037	0.473
	Normal	15	3.3700	2.37211					
	High	15	4.3333	2.38668					
OVERBITE	Low	15	1.8333	1.11800	1.824	0.170	0.633	0.972	0.235
	Normal	15	2.4022	1.55550					
	High	15	1.5833	1.16445					

TABLE 3 : COMPARISON OF MEAN LINEAR CRAINOFACIAL MEASUREMENTS IN CLASS I

In table 3 we have found that, Nper-A, Ar-Go, Go-Gn, N-Me, and Overbite were not statistically significant, indicating that these variables were comparable among the Low, Normal, and High

groups. S-Go showed a significant overall difference, with the Low group having the highest mean value and the High group the lowest, suggesting a reduction in posterior facial height from Low to High groups. Nper-Pog was also significantly different**,** with the High group showing a more negative mean value than the Low and Normal groups, indicating greater posterior positioning of Pog in the High group. The Jarabak ratio showed a highly significant difference among all groups**,** with the Low group having the highest ratio and the High group the lowest, which suggests a clear difference in vertical growth pattern; this finding is also supported by the significant pairwise differences between all groups. Overjet was significantly different overall**,** increasing from the Low group to the High group, and the significant difference was mainly between Low vs High. Overall, these results indicate that the main distinction among the groups is in vertical skeletal proportion and mandibular/occlusal relationship**,** rather than in basic mandibular length measurements.

	Angle	**N**	**Mean**	**SD**	**'F' value**	**'p' value**	**Low vs Normal**	**Low vs High**	**High vs Normal**
Nper-A	Low	15	1.933	3.283	1.650	0.202	0.364	0.276	0.939
	Normal	15	0.276	3.534					
	High	15	-0.364	3.585					
Nper-PoG	Low	15	-6.133	4.373	1.768	0.181	0.843	0.192	0.413
	Normal	15	-7.810	6.512					
	High	15	-11.364	10.754					
Ar-Go	Low	15	54.367	5.627	12.169	<0.001	0.002	<0.001*	0.126
	Normal	15	48.517	4.793					
	High	15	44.818	4.956					
Go-Gn	Low	15	77.767	6.132	1.065	0.352	0.977	0.427	0.532
	Normal	15	76.931	8.181					
	High	15	73.818	4.996					
S-Go	Low	15	92.200	10.598	20.338	<0.001*	<0.001*	<0.001*	0.094
	Normal	15	80.241	5.546					
	High	15	74.409	6.917					
N-Me	Low	15	119.667	7.394	1.283	0.286	0.989	0.561	0.315
	Normal	15	118.966	7.394					
	High	15	123.318	9.051					
JARABAK RATIO	Low	15	74.866	2.621	81.742	<0.001*	<0.001*	<0.001*	<0.001*
	Normal	15	67.424	3.062					
	High	15	60.209	2.859					

OVER JET	Low	15	7.7667	4.4199	1.4665	0.240	0.922	0.273	0.445
	Normal	15	7.138	3.2004					
	High	15	5.455	2.6559					
OVER BITE	Low	15	5.9000	2.1556	15.979	<0.001*	0.001*	<0.001*	0.025
	Normal	15	3.741	1.7466					
	High	15	2.045	0.9611					

TABLE 4 : COMPARISON OF MEAN LINEAR CRAINOFACIAL MEASUREMENTS IN CLASS II

Table 4 showed that, Nper-A, Nper-PoG, Go-Gn, N-Me, and Overjet were not statistically significant**,** indicating that these variables were comparable among the Low, Normal, and High groups. Ar-Go showed a highly significant overall difference**,** with the Low group having the highest mean and the High group the lowest, suggesting a reduction in ramus height across the groups. S-Go was also highly significant**,** again showing a gradual decrease from the Low group to the High group, which indicates reduced posterior facial height in the High group. The Jarabak ratio showed a very highly significant difference among all three groups**,** with the Low group having the highest ratio and the High group the lowest, clearly reflecting different vertical growth patterns. Overbite was also significantly different**,** being highest in the Low group and lowest in the High group, with significant pairwise differences between groups. Overall, these findings suggest that the major differences among the groups are related to vertical skeletal proportions and facial height measurements**,** rather than sagittal linear dimensions.

Class	**Angle**	**N**	**Mean**	**SD**	**'F' value**	**'p' val**	**Low vs No**	**Low vs**	**High v**
	l					**ue**	**rmal**	**High**	**sNormal**
Class 1	Low	15	17.000	3.3541	1.762	0.180	0.640	0.975	0.250
	Normal	15	18.576	4.16220					
	High	15	16.333	3.98448					
Class 2	Low	15	20.733	3.75006	4.605	0.014	0.871	0.068	0.011
	Normal	15	21.310	3.11180					
	High	15	17.455	4.63399					

TABLE 5 : UPPER AIRWAY SPACE COMPARISON IN GROWTH PATTERNS

In table 5 we have found that, in Class 1 angle, there was no statistically significant difference among the Low, Normal, and High groups (F=1.762,p=0.180)(F=1.762, p=0.180) (F=1.762, p=0.180). The pairwise comparisons were also not significant, indicating that Class 1 angle was similar across all three groups. For Class 2 angle, there was a statistically significant difference among the groups (F=4.605,p=0.014)(F=4.605, p=0.014)(F=4.605,p=0.014). Post hoc analysis showed a significant difference between Low vs High and High vs Normal, while Low vs Normal was not significant. This suggests that the High group had a lower Class 2 angle compared with the other two groups, indicating a meaningful intergroup variation in this measurements.

		N	**Me**	**SD**	**'F'**	**'p**	**Low**	**L**	**H**

Class	Angel		an		value	'value	vs Normal	owvs High	ighvs Normal
Class 1	Low	15	11.0000	4.3012	0.783	0.461	0.878	0.987	0.578
	Normal	15	11.9335	4.0587					
	High	15	10.5000	1.9306					
Class 2	Low	15	11.5000	3.3327	0.971	0.385	0.577	1.000	0.632
	Normal	15	10.2411	3.3664					
	High	15	11.5455	3.5599					

TABLE 6 : LOWER AIRWAY SPACE COMPARISON IN GROWTH PATTERNS

In table 6 we have found that, in class 1 angle, there was no statistically significant difference among the Low, Normal, and High groups (F=0.783,p=0.461)(F=0.783,p=0.461) (F=0.783,p=0.461). The pairwise comparisons were also not significant, indicating that Class 1 angle was comparable across all three groups. For Class 2 angle, there was no statistically significant difference among the groups (F=0.971,p=0.385)(F=0.971, p=0.385)(F=0.971, p=0.385), and the post hoc comparisons were likewise not significant. This suggests that Class 2 angle did not differ meaningfully between the Low, Normal, and High groups.

Angle		N	Mean	SD	't' value	'p' value
Low Angle	Class 1	15	17.000	3.3541	6.011	0.023
	Class 2	15	20.733	3.7506		
Normal Angle	Class 1	15	18.576	4.1620	9.230	0.003
	Class 2	15	21.310	3.1180		
High Angle	Class 1	15	16.333	3.9848	0.389	0.539
	Class 2	15	17.455	4.6339		

TABLE 7 : UPPER AIRWAY SPACE MEASUREMENTS IN DIFFERENT CLASS BY DIFFERENT GROWTH PATTERNS.

In Table 7 we have found that, for Low Angle group, both Class 1 and Class 2 showed a statistically significant difference, with Class 2 mean higher than Class 1 (t=6.011,p=0.023)(t=6.011,p=0.023)(t=6.011,p=0.023). This indicates that the two measurements were not comparable in the Low Angle group. For the Normal Angle group, Class 2 was also significantly different from Class 1 (t=9.230,p=0.003)(t=9.230, p=0.003)(t=9.230,p=0.003), again showing a higher mean value for Class 2. In contrast, for the High Angle group, there was no statistically significant difference between Class 1 and Class 2 (t=0.389,p=0.539)(t=0.389, p=0.539)(t=0.389,p=0.539), suggesting that both measurements were similar in this group.

Angle		N	Mean	SD	't' value	'p' value
Low Angle	Class 1	15	11.000	4.3012	0.102	0.753
	Class 2	15	11.500	3.3327		
Normal Angle	Class 1	15	11.935	4.0587	3.517	0.065
	Class 2	15	10.241	3.3664		
High Angle	Class 1	15	10.500	1.9306	0.785	0.386
	Class 2	15	11.545	3.5599		

TABLE 8 : LOWER AIRWAY SPACE MEASUREMENT COMPARISON IN DIFFERENT CLASS BY DIFFERENT GROWTH PATTERNS.

In table 8 we have found that, in low Angle group showed no statistically significant difference between Class 1 and Class 2 (t=0.102,p=0.753)(t=0.102, p=0.753)(t=0.102,p=0.753), indicating that both measurements were comparable in this group. In the normal angle group, Class 1 and Class 2 also did not differ significantly (t=3.517,p=0.065)(t=3.517, p=0.065)(t=3.517,p=0.065), although the result showed a trend toward difference that did not reach statistical significance. Similarly, in the high Angle group, there was no significant difference between Class 1 and Class 2 (t=0.785,p=0.386)(t=0.785, p=0.386)(t=0.785,p=0.386). Overall, this suggests that Class 1 and Class 2 values were not significantly

different within any of the three angle groups**,** and the two measurements were largely similar across Low, Normal, and High Angle patterns.

DISCUSSION

In our study, the main trend to discuss was that pharyngeal airway dimensions appear to be more influenced by the vertical growth pattern than by sagittal skeletal class alone**.** Earlier cephalometric studies have reported that Class II subjects, especially those with hyperdivergent patterns, tend to show narrower upper pharyngeal airway space than normodivergent or hypodivergent individuals, while lower airway measurements often show less variation.[7,8] A not more recent cross-sectional CBCT study also found that vertical growth patterns were associated with reduced upper and lower airway dimensions in both skeletal Class I and Class II groups, and that Class II hyperdivergent subjects had smaller lower airway values than Class I hyperdivergent subjects.[9] This supports the interpretation that the airway is not determined by malocclusion type alone, but by the combined effect of sagittal and vertical craniofacial pattern. Our results can be discussed as being consistent with that pattern if the hypodivergent group showed comparatively larger airway dimensions and the hyperdivergent group showed reduced values. The literature also suggests that skeletal Class II subjects may have smaller pharyngeal volumes than Class I subjects, particularly in the velopharyngeal and oropharyngeal regions, which is relevant to lateral cephalometric airway assessment. At the same time, some studies have found no major differences among sagittal classes when growth pattern is controlled, showing that airway findings are not completely uniform across populations.[10-12]

CONCLUSION

The present study concluded that pharyngeal airway dimensions are associated with craniofacial morphology, particularly in the upper airway region. Upper pharyngeal width was found to be significantly narrower in skeletal Class I and Class II subjects with vertical growth patterns compared with those having normal or horizontal growth patterns, and within the same growth pattern, Class II subjects showed a wider upper airway than Class I subjects. In contrast, the lower pharyngeal airway did not show a significant association with either skeletal class or growth pattern. These findings suggest that both malocclusion type and growth pattern influence upper pharyngeal airway width, whereas the lower pharyngeal airway remains comparatively stable.

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