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A Comparative Evaluation Of Various Nasal And Pharyngeal Parameters In Different Growth Patterns In Angles Class I Malocclusion: A Cross sectional Study In Contemporary Indian Population.

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Abstract

Introduction: Beauty is the finest of human emotions. The nose which occupies a location in the middle of the face plays a dominant role in facial esthetics. A tube-shaped structure formed by muscles and membranes is the pharynx. Now because of significance in locations and functions; nasopharynx and the oropharynx form a part of the unit in which respiration and deglutition are carried out.

Materials and methods: The sample included 100 lateral cephalograms with Angle's class I malocclusion; ANB=2–4°, aged 18-30 years. The adults were categorized as average growers (GO-GN to SN = 28–34°), horizontal growers (GO-GN to SN = <28°) and vertical growers (GO-GN to SN = >34°). Four nasal (nasal length, nasal depth, nasolabial angle and lower nose to Frankfurt horizontal plane) and two pharyngeal (upper and lower airway according to McNamara airway analysis) measurements were assessed. One-way analysis of variance (ANOVA) was performed to determine whether there was a difference between the three groups for each of these variables, and it was followed by a post hoc test in which a p value < 0.05 was considered significant. **Results:** A comparative evaluation revealed significant difference among the three growers in Class I patients for upper pharynx parameter with greater mean values in horizontal growers when compared to others. A post hoc analysis revealed significant difference between only between the horizontal and vertical growers.

Conclusion: The present study revealed that the upper pharynx of vertical grower is narrower than horizontal grower; however growth pattern did not influence the lower pharyngeal airway width in Angles class I malocclusion.

Keywords: Growth patterns, malocclusion, nasal morphology, nasopharynx, oropharynx and pharyngeal airway space.

Introduction

Beauty is the finest of human emotions[1]. The nose which occupies a location in the middle of the face plays a dominant role in facial esthetics. It is also in close harmony with lips and chin further defining the characteristic facial appearance of an individual; which is a unique feature of every individual[2–5]. To achieve any desired treatment outcome, in- depth knowledge of the relationship between different facial structures and correlation between soft and hard tissue is very much essential[6-12.]

Nasal growth is relatively constant in adolescent and is almost completed by the age 16 in girls and 18 in boys[13-18.] however long term studies by Behrents[19] indicate a considerable amount of nasal growth during adulthood. Vertical growth of the facial skeleton, continues well after puberty both in both sexes, even after the cessation of growth in the sagittal and transverse dimensions[20-21]. It has been recognized and accepted that the underlying hard skeletal structure influences the facial form[22]

Scott[23] suggested that the cartilaginous nasal septum is a primary growth centre that pushes and thrusts the midface downwards and forward. Not accepting this hypothesis unanimously, various authors[24–27] noted genetic or traumatic etiology as prenatal and/or postnatal impaired growth of the nasal septum causes maxillary hypoplasia in the sagittal dimension. The relationship between nasal morphology and facial skeletal pattern has received attention in the orthodontic literature.[28–31].

Nasal length increases yearly by approximately 1.5 millimeters32 due to growth in downward and anterior direction which is in agreement by the studies done by Chaconas, Subtelny, Posen and Wisth. In a study conducted by Wisth, he reported the association between various malocclusion and nasal morphology and concluded that the nasal depth (N Dpt) was significantly different among groups. Nasal length and nasal inclination relative to sella-nasion (SN) line was similar in all sagittal malocclusions. One of earliest study by Robison30 on the relationship of nasal shape to skeletal pattern concluded that although the sagittal skeletal pattern was significantly correlated with nasal shape, vertical dimension was not significantly related to nasal morphology. Nasolabial angle has always remained the topic of interest by various researchers in the orthodontic literature as it depicts a close relationship between the lips and the nose[33-34]

A tube-shaped structure formed by muscles and membranes is the pharynx. Now because of significance in locations and functions; nasopharynx and the oropharynx form a part of the unit in which respiration and deglutition are carried out. Chronic mouth breathing, loud snoring, obstructive sleep apnea, excessive daytime sleepiness, and even cor pulmonale can be caused by nasal obstruction secondary to hypertrophied inferior turbinates, adenoidal pad hypertrophy, and hypertrophy of the faucial tonsils. This can lead to numerous postural changes such as open mandible posture, downward and forward positioning of the tongue, and extension of the head. Dentofacial disorders at different levels of severity can be seen, together with the inadequate lip structure, long face syndrome, and adenoidal facies, if these postural changes continue for a long period, especially during the active growth stage.

From the above literature it is evident that there is a close relationship between the pharynx and the dentofacial structures and thus a mutual interaction is expected to occur between them which signifies orthodontic interest. In many studies carried out on this subject, it has been demonstrated that there are statistically significant relationships between the pharyngeal structures and both dentofacial and craniofacial structures at varying degrees [35-43].

Nose is directly connected to the pharynx through nasopharynx and to the oral cavity through oropharynx as mentioned earlier, so a relationship between them exists. Many studies have been conducted but none of the studies have comparted nose and pharynx in class I malocclusion in different growth patterns. So the aim of our study is to compare nasal and pharyngeal parameters in class I malocclusion in different growth patterns.

Objectives:

1. To evaluate nasal and pharyngeal parameters in average growth patterns in Angles' class I malocclusion.

2. To evaluate nasal and pharyngeal parameters in a horizontal growth patterns in Angles' class I malocclusion.

3. To evaluate nasal and pharyngeal parameters in vertical growth patterns in Angles' class I malocclusion.

4. To compare nasal and pharyngeal parameters in average, horizontal and vertical growth patterns in Angles' class I malocclusion.

Materials and methodology

Pretreatment lateral cephalometric radiographs of 100 adult patients (45 males, 55 females) for this investigation were obtained from the records of patients that reported to MGV's KBH dental college and hospital in the department of orthodontics and dentofacial orthopaedics meeting the inclusion criteria of the study. A power analysis was established by G*Power, version 3.0.10 (Franz Faul Universita¨t, Kiel, Germany); based on a 1:1 ratio between groups, a sample size of 100 lateral cephalograms would yield more than 80% power to detect significant differences at (alpha) =0.05 significance level.

Inclusion criteria

1. Angle's Class I malocclusion with angle ANB 2-4 deg.
2. Age group 18-30 years; both males and females.
3. Intact permanent dentition with or without third molars.
4. No history of orthodontic treatment and/or maxillary functional orthopedic treatment.
5. Standardized lateral cephalogram with adequate sharpness and resolution.

Exclusion criteria

1. Angle Class II or III malocclusion.
2. Mixed/deciduous dentition.
3. Grossly decayed teeth or extensive carious lesion.
4. Previous history of nasal respiratory complex surgery.
5. Vestibular or equilibrium problems.
6. Radiographs of adults with developmental problems affecting growth and development, for example, craniofacial syndromes, endocrine disturbances.

All the lateral cephalograms were traced by the same operator on an acetate sheet of 0.5 mm thickness with a 0.50-mm mechanical pencil. All the landmarks were identified and marked (Table 1 and 2 and Figure 1). To determine the growth pattern of the adults, GO-GN to SN was used. All the 80 adults were grouped into three categories as average growers (GO-GN to SN = 28–34°), horizontal growers (GO-GN to SN = <28°) and vertical growers (GO-GN to SN = >34°)[44].

All these three groups were evaluated to study nasal and pharyngeal parameters.

Sella (S)	Midpoint of sella turcica.
Nasion (N)	Junction of the nasal and frontal bones at the naso-frontal suture.
Orbitale	Most inferior point on the infra-orbital margin
A-point	Point of deepest concavity of the anterior maxilla between the anterior nasal spine and the alveolar crest
B-point	Point of deepest concavity of the anterior mandible between the alveolar crest and pogonion
Pogonion (Pg)	Most anterior point on the anterior outline of the symphysis
Gnathion (Gn)	Midpoint along the contour of the anterior outline of the symphysis between pogonion and menton
Menton (Me)	Most inferior point on the inferior outline of the symphysis
Porion	Most superior point of external auditory meatus
Soft-tissue nasion (N')	The point of greatest concavity in the midline between the forehead and the nose.
Pronasale (Pr)	The most prominent or anterior point of the nose.
Posterior columella point (PCm)	The most posterior point of the lower border of the nose at which it begins to turn inferiorly to merge with the philtrum of the upper lip.
Subnasale (Sn)	The point at which the columella merges with the upper lip in the midsagittal plane.
Labrale superius (Ls)	The point indicating the mucocutaneous border of the upper lip.

Table 1: Definitions of skeletal landmarks identified on cephalograms.

Nasal length (N Lth)	The distance between Soft-tissue Nasion (N') and Pronasale (Pr)
Nasal depth (N Dpt)	The perpendicular distance between Pr and the line drawn through N' to Sn
Nasolabial angle (NLA)	The angle formed by columella tangent and upper lip tangent
Lower nose to Frankfort plane angle.	The anteroinferior angle formed by the PCm-Ls line extended superiorly to intersect the Frankfurt horizontal plane/inclination of the upper lip to Frankfurt horizontal plane
Upper pharynx:	According to McNamara's airway analysis the upper pharyngeal width is measured form a point on the posterior outline of the soft palate to the closest point on the pharyngeal wall.
Lower pharynx:	According to McNamara's airway analysis the lower pharynx is measured from the point of intersection of the posterior border of the tongue and the inferior border of the mandible to the closest point on the posterior pharyngeal wall.

Table 2: Evaluation of cephalometric landmarks

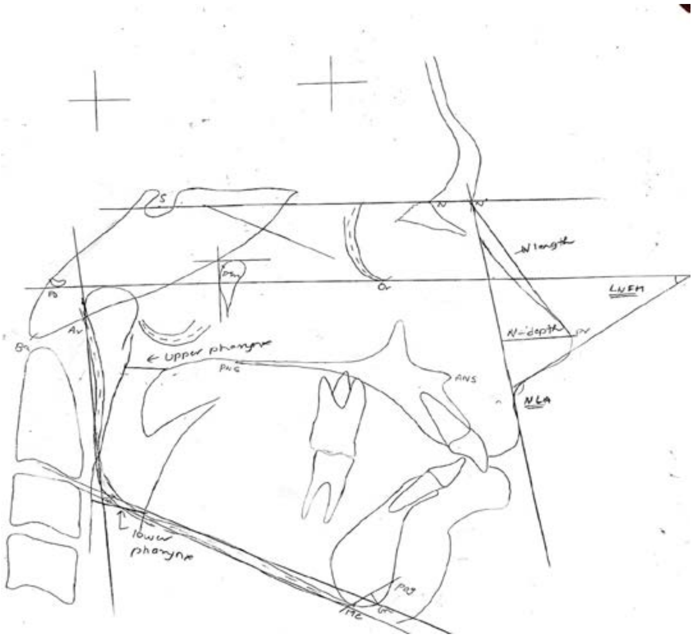

Figure 1: Nasal and pharyngeal parameters

Statistical analysis

The database was formulated in MS-Excel sheet, and SPSS version 22 (IBM, Armonk, New York, United States) Software was used for the data analysis. Mean and standard deviation were calculated, and confidence interval was set as 95%. One-way analysis of variance (ANOVA) was performed to determine whether there was a difference between the three groups for each of these variables, and it was followed by a post hoc test in which a *p* value < 0.05 was considered significant.

Results

The lateral cephalograms of total 100 patients that are divided into three groups were studied and analyzed. The descriptive statistics which is the mean, standard deviation, and the errors of the difference between mean and levels of significance of all the 6 variables were studied for the three groups (average, horizontal and vertical growers) are summarized in Table 3. The one-way ANOVA results applied to the study groups and the post hoc multiple comparisons are shown in Table 4. A comparative evaluation revealed significant difference among the three growers and Class I patients for upper pharynx parameter with greater mean values in vertical growers when compared to others in table 5. A post hoc analysis revealed significant difference between only between the horizontal and vertical growers.

Parameter	Average Growers (N=41) Mean± S.D.	Horizontal Growers (N=41) Mean± S.D.	Vertical Growers (N=18) Mean± S.D.	p value
Nasal Length	48.17± 4.48	46.70±4.15	48.33±3.62	.213
Nasal Depth	18.12+15.09	15.34± 1.89	15.16± 1.82	.367
Nasolabial Angle	87.80± 17.08	89.95±12.77	92.33±10.94	.525
Lower Nose to FH	19.39±11.19	18.70±8.93	22.55±8.41	.377
Upper pharynx	16.02±3.47	17.43± 3.00	14.72±4.83	.023 *(S)
Lower Pharynx	9.51±2.71	11.09±4.40	10.05±3.17	.134

Statistical test employed: Analysis of Variance (S) = Significant (p ≤ 0.05).

Table 3: Evaluation of parameters among average, horizontal and vertically growing Class I patients.

	Average Growers	Horizontal Growers	Vertical Growers
Average Growers	-	.07	.20
Horizontal Growers	.07	-	.008*
Vertical Growers	.20	.008*	-

Table 4: Post hoc analysis.

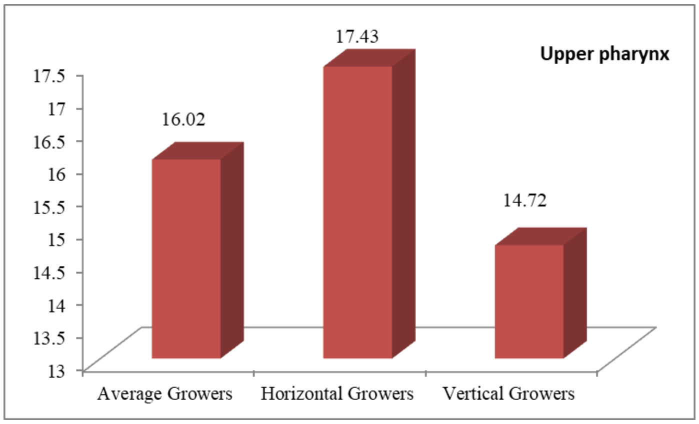

Table 5: Comparision among average, horizontal and vertical growers in upper pharynx parameter.

Discussion

The present retrospective, cross- sectional study was carried out on lateral cephalograms of 100 adults on various nasal and pharyngeal parameters in different growth patterns in Angle's class I malocclusion. The rationale behind using lateral cephalograms in the present study was it being an essential diagnostic aid and routinely advised in all patients planned for orthodontic treatment. Second, the radiation exposure and cost are less as compared to other diagnostic methods, i.e., cone beam computed tomography, etc. The age group of the patients selected for this study was between 18 and 30 years as most of the growth would have been completed by that time; further growth pattern does not change much with age once established. Although studies have been reported in the literature[13, 31,32,45] about the association between different malocclusion or skeletal growth pattern with nasal characteristics independently, none of the studies have reported an association between growth pattern with various nasal parameters and pharyngeal parameters.

Enlow and Hans[20] reported that the nose of the leptoprosopic facial-dolichocephalic skull was quite protrusive, with a convex contour and a tipped-down point. While in the brachycephalic skull-euryprosopic facial type, a less protrusive nose tended to be straighter and frequently tipped up. In our study too nasal characteristics were related to facial characteristics. However, nasal length and nasal depth did not show any statistically significant difference among average, horizontal and vertical growers which is in agreement with the study done by Bhardwaj A et al[44]

NLA has been extensively studied in the orthodontic literature[46-51], and it is an important parameter while deciding the treatment plan. Fitzgerald et al.[46] divided the NLA into the inclination of the upper lip and inclination of the lower nose and investigated their relation with sagittal and vertical facial parameters. The present study found that NLA and LNFH angle was higher in adults with vertical growth pattern as compared to average and horizontal growers; although statistically insignificant. This is in accordance with Bhardwaj A et al[44] and Robison et al[30] who stated that the sagittal skeletal pattern was highly significantly correlated with general nasal shape; however nasal shape was not significantly related to the vertical dimension. This may be attributed to a significant difference in methodology and study sample in their study design.

Subjects with Class I malocclusions and vertical growth patterns had significantly narrower upper pharyngeal airways which may be attributed to clockwise rotation of the mandible, confirming previous results in the literature[35, 52, 53]. Analyzing these results, we can infer that upper airway width is influenced by the craniofacial growth pattern, as previously suggested[52, 54, 55, 56, 57]. However, some studies found weak relationships between growth pattern, facial morphology, and nasopharyngeal airway[38,58]. This may be attributed to the influence of the nasopharyngeal airway on facial form and occlusion evaluated by those studies.

There is no association of lower pharyngeal airway space with craniofacial growth pattern and malocclusion type when evaluated statistically by this study. This corroborates previous studies[58,59,60.] However, additional studies are necessary to clarify this issue because Linder-Aronson and Leighton[61] and Linder-Aronson and Backstrom[57] suggested that oropharyngeal space appears to be larger than normal when the nasopharyngeal airway is smaller, although they did not evaluate this correlation directly.

Adequate knowledge of the form and growth of the human face helps in diagnosis and treatment of malocclusion. One of the prime requisites of satisfactory orthodontic therapy is the improvement of facial form. The “ideal” nose is one that is in harmony with the other favorable features of an individual’s face as nasal characteristics are related to the person’s race, sex, and other facial features. Further, there is a long standing association in orthodontics between mode of breathing and craniofacial growth. Narrower upper airway in some cases may increase the air flow resistance which may also increase the risk of snoring. In severe cases it may lead to obstructive sleep apnea.

Conclusion

1. The upper pharyngeal airway is narrower in vertical growers in Angles class I malocclusion.
2. The upper pharynx of vertical grower is narrower than horizontal grower; however growth pattern did not influence the lower pharyngeal airway width in Angles class I malocclusion.
3. There is no association between average growth pattern with various nasal and pharyngeal parameters in Angles class I malocclusion.
4. There is no association between horizontal growth pattern with various nasal and pharyngeal parameters in Angles class I malocclusion.

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