Original Article

Evaluation of Nose Morphology in Different Skeletal Patterns in Patients Reporting to A Tertiary Care Hospital Peshawar: A Cross-Sectional Study

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Abstract

Objective: To evaluate the relationship between nasal parameters and sagittal skeletal malocclusions while considering gender differences.

Methodology: A calculated sample size of 75 adult subjects was included in this cross-sectional study based on inclusion criteria of age between 16-30 years seeking orthodontic treatment. Nasal parameters were evaluated clinically using the nasal index, classifying noses into three shapes: Leptorhinne, Platyrhinne, and Mesorhinne. Skeletal malocclusions were categorized as Class I, Class II, or Class III based on the ANB angle on the lateral cephalogram. Statistical tests included chi-square tests and post-stratification chi-square tests to explore the correlation between nose morphology, gender, and skeletal malocclusions.

Result: The sample size comprises 56% females and 44% males. The chi square test value (3.402) and p value 0.182 shows no significant relationship between skeletal malocclusion and nose shape. One-way ANOVA indicated significant differences in Nose Depth (p value 0.031*) and Horizontal Distance between PRN and STPog parallel to HP (p value 0.000*) among skeletal malocclusion groups. Post hoc analysis confirmed significant variations in Nose Depth and Horizontal Distance between specific malocclusion groups. However, no significant differences were observed in Upper Nose Length, Nasal Height, or Lower Nose Length among these groups.

Conclusion: The nose shape has no relation to skeletal malocclusion and gender of subjects. Skeletal Class III has more deeper nose depth as compared to Class II malocclusion. Horizontal distance was greater in Skeletal Class II malocclusion in comparison to Class I and Class III malocclusion.

Keywords: Angle Class II; Angle Class III; Esthetics; Malocclusion; Maxilla; Nasal Cartilages

Introduction

Aesthetically face is considered attractive when it is well-proportioned and close to population average values[1] however the standard of beauty varies from region to region.[2] The current world pursues treatments in which their overall outlook and social standing could be improved therefore psychosocial considerations of aesthetically attractive faces cannot be denied.[1] The nose being in the centre is the most prominent part of the face and has great influence on face appearance and profile therefore nasal balance and harmony are extremely significant.[3]

Nasal bone growth is usually finished by the age of 10, while additional growth is reliant on nasal cartilage and soft tissues whereas the skeletal growth of maxilla is mostly completed by the age of 16.[4,5]

Noses are in various sizes and shapes. The concept of an ideal nose is diverse among races, and ethnic groups.[3] With aging nose tends to tip downward due to the resorption of bones.[6] Studies have shown the nose association with face profile. Patients with straight profiles tend to have straight noses, concave profiles go with a concave nose and, convex profiles were accompanied by a convex nose.[7]

Previous studies have shown that each race has diverse range of nose shapes. African Americans have a platyrrhine, while Caucasians usually have a leptorrhine. Asians have intermediate features somewhere among these two races and have mesorrhine nose shape.[8] Studies have shown that people living in cold and dry climate areas have thin noses and those living in warmer climate areas have broad and short noses.[9] The nasal index is one of the utmost suitable parameters and analytic factors for human ethnic origin. The nasal index, which is the ratio between nasal height and nasal width, multiplied by 100 is the most frequently used parameter in nasal anthropometry.[6,10]

The world of orthodontics is the world of aesthetics, patients pursue treatment primarily for aesthetic purposes, and the resultant soft tissue profile is one measure of aeshthetic success.[11] Assessing the soft tissue profile of the patient is one of the most important aspects of orthodontic diagnosis and treatment planning.[12] A soft tissue paradigm and its approach is to position the teeth and jaws in such a location that they principally encourage the soft tissues and improve an individual's aesthetics. The choice to treat orthodontic patients by extraction or non-extraction manner and skeletal aesthetic surgeries has an effect of either improving or deteriorating nasal profiles.[13]

The rationale of this study is to study various nose shapes in sagittal facial pattern which remains largely unexplored in our area. It will help the orthodontist in deciding a suitable treatment plan taking into consideration the soft tissue status and nose shape at the end of the treatment.

Objectives:

- To determine the difference of nasal height, nasal depth in various sagittal skeletal facial patterns and to investigate the correlation between nasal morphology and sagittal skeletal facial patterns and gender dimorphism.

Methodology

This descriptive cross-sectional study was carried out at Peshawar Dental Hospital, Peshawar. We aimed to assess the correlation between nose morphology and different skeletal patterns among orthodontic patients. A consecutive non-probability sampling technique was used, sample size turned out to be 25 for each skeletal malocclusion group. Therefore 75 adult patients visiting the orthodontic department for treatment were selected. The inclusion criteria were healthy adult (16-30years) patients of both genders, normal swallowing patterns, and comfortable nose breathing. Those with syndromes, major illnesses, cleft patients, rhinoplasty, trauma, burns, scars, nutritional deficiencies, and craniofacial anomalies were excluded from the study. Ethical approval has been taken from the Institution Review Board (Prime/IRB/2021-380).

Data were collected by examining the patient for nasal index. The nasal index is defined as the ratio of nasal height to nasal width multiplied by 100, based on the nasal index, the nose is divided into three distinct shapes. Leptorhinne is a long narrow nose with having Nasal Index ≤69.90, Platyrhinne a flat nose having widely separated nostrils with having Nasal Index≥ 84.90 and Mesorhinne nose of moderate size, having Nasal Index of 70.0 ≤ NI ≤ 84.90. The nasal Index for nose shape was done by measuring the nasal height from soft tissue nasion to subnasale and nasal width by measuring the distance across the two most lateral points on the wings of nostrils.

For skeletal malocclusion tracing of each lateral cephalograph was done and ANB angle was measured. On lateral cephalographs, the ANB angle indicates how the maxilla and mandible are positioned in relation to one another as shown in figure 1. Skeletal malocclusion is classified in to three types on basis of ANB angle, Class I malocclusion (ANB 0°- 4°), Class II malocclusion (ANB ≥ 5°) and Class III malocclusion (ANB ≤ 0°).

The same skilled operator used the Rotograph Plus cephalostat machine (Model: BelmaX CM-C X168) to take all of the lateral cephalograms. The patient's head was in a natural position, and the exposure parameters were 90 kVp, 12 mA, and 12-secMAX. The angle was traced by a single operator with a 0.5mm lead pencil on an acetate paper sheet, to rule out inter-reliability error 20 cephalograms were randomly selected and evaluated by another postgraduate resident of same level.

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Data collected was analysed using SPSS software version 2514. The data was checked for normality of distribution. The following statistical tests and analyses were employed, Crosstabulation to explore relationships between categorical variables, Chi-Square tests to assess statistical significance in categorical variable associations, One-Way ANOVA to compare means among different groups for nasal measurements, and Post-Hoc Bonferroni comparisons to identify specific group differences when significant variations were detected.

Results

The data participants were evenly distributed among three categories of skeletal malocclusion, with each category comprising of 25 of the total sample size of 75 participants, including 56% female and 44% male.

The gender crosstabulation table presents the relationship between gender and the shape of the nose among the study participants as shown in Table 1. The distribution of nose shapes between males and females. For instance, more females have Leptorhinne noses compared to males, while males have more platyrhinne noses compared to females.

The skeletal crosstabulation table represents the relationship of the nose with skeletal malocclusion as shown in Table 2. The chi-square tests show no statistically significant relationship between skeletal malocclusion and the shape of the nose.

Table 3 shows descriptive statistics for different measurements Nose depth, upper nose length, Nasal Height, Horizontal distance through PRN and Soft tissue pogonion parallel to HP, and lower nose length across three different skeletal sagittal malocclusions. The one-way ANOVA indicates that there are significant differences between the skeletal malocclusion groups for Nose depth and Horizontal distance through PRN and Soft tissue pogonion parallel to HP (p-value <0.05), but there are no significant differences for Upper nose length, Nasal Height, and Lower nose length (p-value >0.05) as shown in table 3.

In Table 4 the Post Hoc Bonferroni comparisons indicate significant differences in Nose depth between Skeletal Class II and Skeletal Class III malocclusions (p = 0.031). Additionally, there are significant differences in Horizontal distance between PRN and Soft tissue pogonion parallel to HP between Skeletal Class I and Skeletal Class II malocclusions (p = 0.005), as well as between Skeletal Class II and Skeletal Class III malocclusions (p < 0.001). There are no significant differences in Upper nose length, Nasal Height, or Lower nose length between any of the skeletal malocclusion groups.

N=Nasion, STN=Soft tissue nasion, S=Sella, S=Sella, the pituitary fossa center. N=Nasion, the most anterior point of the nasofrontal suture in the midsagittal plane. Or=most inferior point on orbitale. Po=Superior border of Porion. ANS=Anterior nasal spine. A=deepest point on maxilla. B=deepest Point of mandible. ST-POg=Soft tissue pogonion, PRN=Pronasale. the most anterior point on the nose. Sn=Subnasale. the point at which the nasal septum merges with the upper cutaneous lip in the midsagittal plane. ANB angle formed from point A, Nasion and point B. 1) Horizontal Plane (HP): plane from Orbitale to Porion. 2) Vertical Plane (VP): Plane perpendicular to HP at Nasion. 3) Upper nose length: Horizontal distance from PRN to Nasion. 4) Lower nose length: Horizontal distance from PRN to ANS. 5) Nose depth: Horizontal distance from PRN to point A. 6) Nose height: Vertical distance from STN to Sn. 7) Nose length: distance from STN to PRN.

Table 1. Correlation of various nose shape with gender of subject

			shape of the nose			Total
			Platyrhinne	Messorhinne	Leptorhinne	
Gender	Male	Count	4	14	15	33
		Expected	2.2	13.2	17.6	33.0
	Female	Count	1	16	25	42
		Expected	2.8	16.8	22.4	42.0
Total		Count	5	30	40	75
		Expected	5.0	30.0	40.0	75.0

N = 75
Chi square value (3.402) and p value 0.182
Phi = 0.213
Cramer's V = 0.213
Level of significance 0.05

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Table 2. Correlation of Nose Shapes with Sagittal skeletal malocclusion

Skeletal Malocclusion		Platyrhinne	Messorhinne	Leptorhinne	Total
Skeletal class I malocclusion	Count	1	9	15	25
	Expected	1.7	10.0	13.3	25.0
Skeletal class II malocclusion	Count	1	10.0	14	25
	Expected	1.7	10.0	13.3	25.0
Skeletal Class III malocclusion	Count	3	11	11	25
	Expected	1.7	10.0	13.3	25.0
Total	Count	5	30	40	75
	Expected	5.0	30.0	40.0	75.0

N=75
Chi square test value (2.450) and p value 0.654
Phi = 0.181
Cramer's = V 0.128
Level of significance 0.05

Table 3. Difference of Various Nasal Dimension in Sagittal Skeletal Pattern

Variables	Class I n = 25	Class II n = 25	Class III n = 25	P value	F value
Nose depth	23.7 ±2.4	22.08 ± 3.12	24.68 ± 4.58	.034*	3.53
Upper nose length	23.96 ± 4.4	23.88 ± 4.30	22.64 ± 4.94	.521	0.658
Nasal height	48.68 ± 5.58	49.6 ± 4.28	51.0 ± 5.83	.300	1.224
Horizontal distance between PRN and soft tissue pogonion parallel to HP	25.92 ± 3.88	31.32 ± 6.79	23.08 ± 6.25	.000*	13.080
Lower nose length	30.84 ± 2.97	29.76 ± 3.45	30.88 ± 3.75	.894	0.894

N = 75
One Way ANOVA
Level of significance ≤ 0.05

Table 4. Angular and linear measurements of Nose in sagittal skeletal facial patterns

Dependent Variable	(I) Skeletal malocclusion	(J) Skeletal malocclusion	Std. Error	Sig.
Nose Depth	Skeletal Class II malocclusion	Skeletal class III malocclusion	.98901	.031
Horizontal distance between PRN and Soft tissue pogonion parallel to HP	Skeletal Class II malocclusion	Skeletal Class I malocclusion	1.63677	.005
		Skeletal class III malocclusion	1.63677	.000

N = 75
Post Hoc Bonferroni
Significance values 0.05

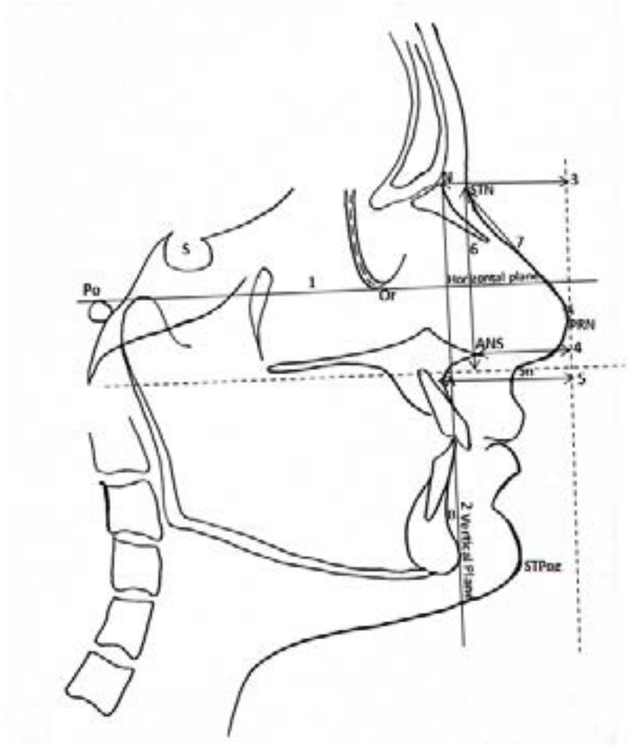

Figure 1: Linear and Angular measurements of Nose

Discussion

In orthodontics, patients often seek treatment for aesthetic reasons, and the soft tissue profile plays a crucial role in determining the success of orthodontic treatments.[12] Treatment decisions, such as extraction versus non-extraction, can impact the soft tissue profile and nasal appearance.[15] A study shows importance of the soft tissue paradigm in orthodontics, emphasizing its role in improving nasal profiles and aesthetics through appropriate positioning of teeth and jaws[13] The results of our study contribute to this evolving field by investigating the relationship between nose shape, skeletal malocclusion, and various nasal measurements. Understanding these connections enhances orthodontists' ability to tailor treatment plans to individual patient needs and aesthetic goals.

Various studies show ethnic and gender variation in nose shape.[16-18] Studies in Indian and Iranian populations found a high prevalence of leptorrhine noses.[10,19] In one study Males tend to have increased Nasal Length, Depth, and Height.[20] Our study shows gender-based variations in nose shape. Leptorhinne noses were found to be more common in females, while males exhibited a higher prevalence of Platyrhinne noses. The findings highlight the complexity of nose shape variations among different populations and suggest that factors such as ethnicity, geography, and climate may influence nasal morphology. Orthodontists should consider the unique preferences and aesthetic goals of each patient, recognizing that facial aesthetics are not one-size-fits-all.

The various nose shapes with sagittal facial patterns have been relatively unexplored. Orthodontic treatment can indirectly influence nose shape through changes in jaw and soft tissue positioning. A study shows that the nose is seen to be convex in class I malocclusion and straight in class II malocclusion. It is also more convex in class II vertical malocclusion as compared to class II horizontal malocclusion.[19] Another study shows that Class I skeletal patterns were found with a proportioned nose while Class II skeletal patterns were linked to a more prominent nose whereas Class III malocclusions are associated with an elevated Nasomental angle, indicating an impact on nasal shape due to a prominent lower jaw.[2] Our study shows gender dimorphism but our study did not reveal a statisti-

cally significant correlation between skeletal malocclusion (Class I, Class II, and Class III) and nose shape. This result may be surprising, as one might anticipate that the underlying skeletal structure would influence certain aspects of nose shape.

We utilized various measurements to comprehensively evaluate nasal characteristics, including nose depth, upper nose length, nasal height, horizontal distance, and lower nose length. Our study shows significant differences in nose depth and horizontal distance among different skeletal malocclusions. Specifically, Class III malocclusion demonstrated deeper nose depth compared to Class II malocclusion. Additionally, the horizontal distance through PRN (Pronasale) and Soft tissue pogonion parallel to HP (Horizontal Plane) was more significant in Class II malocclusion compared to Class I, with Class III exhibiting the most significant horizontal distance.

This study underscores the significance of considering nose shape and soft tissue profile in orthodontic treatments, particularly for achieving facial aesthetics. It highlights the diversity in nose shapes among different groups and the potential impact of orthodontic interventions on nasal morphology. Orthodontists must adopt a patient-centered approach, recognizing that individualized treatment plans should balance functional improvements with aesthetic outcomes for overall patient satisfaction. Further research can refine orthodontic protocols in light of these findings

The study's limitations include not considering additional variables that could influence nose shape, such as genetic factors or environmental conditions. These limitations suggest the need for larger, more diverse samples and prospective longitudinal studies to enhance the robustness and applicability of the findings.

Conclusion:

Leptorhinne noses were found common in females, while males had more Platyrhinne noses. There was no correlation between nose shape and skeletal malocclusions. Skeletal Class III has more deeper nose depth as compared to Class II malocclusion. Horizontal distance between PRN and STPog was greater in Skeletal Class II malocclusion in comparison to Class I and Class III malocclusion, (further it was higher in Class III as compared to Class I).

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