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Original Article

Lateral Cephalometric Analysis of Nasal Morphology in Patients Visiting Nishtar Institute of Dentistry

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ABSTRACT

Nasal morphology is the keystone of facial aesthetics. Being the most prominent part of the face, the shape and position of the nose greatly influence the facial profile and nasal soft tissue thickness also plays a vital role in orthodontic diagnosis and treatment planning. **Objective:** To evaluate the soft tissue nasal morphology in individuals presenting with different skeletal patterns such as skeletal class 1 and skeletal class 2 jaw relationship. **Methods:** It was Comparative Cross-sectional study conducted in Orthodontics Department of Nishtar Institute of Dentistry for the period of six months (5th Mar 2020 to 6th Jun 2021). Study sample consisted of Lateral cephalometric radiographs of 65 subjects. Age range of sampled subjects was 19-26 years (mean age 20.93). The sample was divided into two groups on basis of the Skeletal jaw relationship as class-1 and class-2. An Independent t-test was applied for evaluation of the difference in lateral nasal morphology between both groups. **Results:** Notable differences were found between skeletal class 1 and skeletal class 2 groups for the prominence of the mandible and Linear distance between soft tissue Pogonion and Pronasale. Considerable differences in measurements of nasal depth, nasofrontal angle, nasal tip projection angle, nasofacial angle and nasomental angle were found. **Conclusions:** It is concluded that nasal morphology was greatly influenced by not only the underlying skeletal jaw relationship yet other factors e.g., dentition along with soft tissue thickness were also responsible for nasal morphology differences among various skeletal patterns. Gender dimorphism also exists for various nasal features.

INTRODUCTION

Beauty is an entirely subjective perspective as it is commonly said Beauty lies in the eyes of the beholder. Individual facial proportions that are closer to specific norms of certain geographical areas, cultures, races and ethnicity are considered more esthetically pleasant. In the world of aesthetics and perfection, orthodontics is an important means of improving facial aesthetics and function. Orthodontic treatment can help provide an individual with an ideal smile and profile and has a positive psychological impact. Over the passage of years, there is an increasing demand for orthodontic therapy to obtain ideal facial proportions, as a result of which the quality of social life is enhanced. Not only corrected dentition but improvement in facial appearance is commonly the main concern for an individual seeking such a treatment. Therefore, soft tissue evaluation is the main part of orthodontic diagnosis and treatment planning [1, 2]. According to Edward Angle, optimum hard tissues and perfect occlusion are responsible for perfect soft tissue adaptation [3]. However, with the advent of the soft tissue paradigm, Hellman, on the contrary stated that variation in soft tissue morphology and adaptation can occur despite the normal underlying hard tissue morphology and normal dentition [4]. A harmonious and well-balanced face is crucial for esthetics and depends upon the proportionality among the three soft tissue structures i.e., chin, lips and nose. As the nose is positioned in the centre and is a prominent region of the face, it plays a key role in facial

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appearance [5]. Nasal growth is known to be terminated around the age of 16 and 18 years in girls and boys respectively [6]. It has a striking effect on the overall facial profile of any individual. Therefore, nasal morphology evaluation should be a part of patient assessment before procedures such as orthodontic treatment, orthognathic surgical procedures and nasal procedures such as rhinoplasty along with other facial structures [7]. Several methods are available for the evaluation of nasal morphology. Such as morphometry (clinical measurement of height, width, length and thickness), photogrammetry, radiographic methods, or other advanced 3D methods [8, 9]. Although these methods of evaluation are cost-effective, but cephalometry introduced by Broadbent in 1931 is more frequently and routinely used because of its prime advantage of providing soft tissue landmarks study and underlying skeleton simultaneously. The more advanced technology of CBCT (Cone beam computed tomography system) is also useful for more precise measurements but it has limited use because of its high cost [10]. Different landmarks and measurements have been used to describe nasal form on Lateral cephalometric radiographs as proposed by various studies. Such as Begg and Harkness evaluated the nasal form in Caucasian dental students by using a quantitative method in their study [11].
The purpose of the current study is evaluation of soft tissue morphology of the nose (Nasal tissue) in individuals with variable skeletal jaw relationships classified in sagittal dimension as skeletal class 1 and class 2 and to assess variations among males and females, using lateral cephalometric radiograph.

METHODS

A comparative cross-sectional study was conducted on subjects visiting the Orthodontics department of Nishtar Institute of Dentistry, Multan. The study duration was 6 months from 5th January 2021 to 6th June 2021. Study design approval was obtained from the ethics and review committee of the hospital before the initiation of research work. Lateral cephalometric radiographs of 65 subjects (15 males and 50 females) were selected for the concerned study. The age range of the sample was 19-26 (mean 20.09) years. To ensure the standardization and accuracy of point identification, all cephalometric images were acquired in natural head posture dictated by the head supporting device along with a pair of ear rods, with a cranex-D digital X-ray unit. Participants of the study were grouped into two on basis of ANB angle and were labelled as skeletal class 1 and skeletal class 2 (ANB 0-4° is the skeletal class I whereas ANB > 4° is skeletal class II jaw relationship). Inclusion criteria consisted of individuals with an age range of 19-26 years, well-proportioned facial profile, competent lips, no crowding, and no significant medical and dental history. Individuals with a history of orthodontic treatment, previous orthognathic and nasal surgical procedures, history of trauma, and craniofacial abnormalities were excluded from the study. Acetate tracing sheet of 0.003-inch thickness and lead pencil of 0.05mm pointer thickness were used for manual tracing of all the pre-treatment cephalometric radiographs. Reference points and planes as used in Begg and Harkness study are shown in Figure 1 and Table 1 is as follows [11].

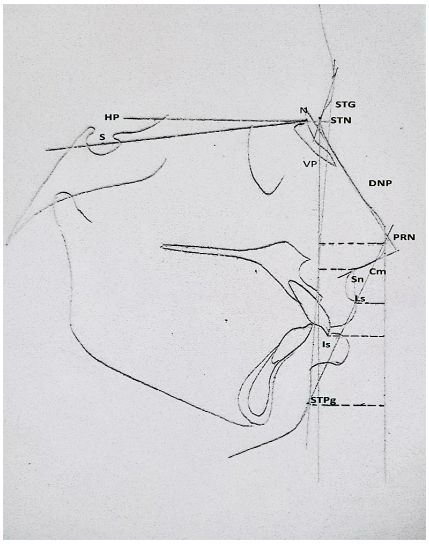

Figure 1: Reference points and planes

Reference Points and Planes: S: sella point, centre point of sella turcica [14] **N**: Nasion, the most prominent point of the Nasofrontal suture in the median plane [1] **VP:** Vertical plane, drawn at a right angle to the horizontal plane on soft tissue nasion [11] **HP:** Horizontal plane, a line traced through soft tissue nasion parallel to another line passing through nasion at an angular distance of 7° up from the Sella-nasion line [12] **STG:** Soft tissue glabella, the most prominent point in the median plane of the forehead [12] **STN:** Soft tissue Nasion, most concave point between glabella and pronasale [12] **DNP:** Dorsal nasal plane, a line on the upper part of the nose [7] **PRN:** Pronasale, the most anterior point on Nose [13] **Cm:** Columella, a prominent anterior point on nose columella [12] **Sn:** Subnasale, a point in the median plane where the nasal septum is connected to the upper cutaneous lip [12] **Ls:** Labrale superius, anterior most/ prominent point of upper lip [12] **Is:** Incision superius, point on incisal edge of most prominent maxillary central incisor [14] **S:** sella point, centre point of sella turcica [14].

Table 1: Reference points and planes

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Angular and Linear Cephalometric Measurement	
Nasal size	
STN-Sn	Nasal Height [linear distance between soft tissue nasion and subnasale in vertical dimension]
STN-PRN	Nasal Length [distance on the line drawn b/w soft tissue nasion and pronasale]
PRN-VP	Nasal depth [horizontal distance b/w Pronasale and Vertical plane]
Nasal size	
STN-STG-DNP	Naso frontal angle [angular measurement b/w a line from glabella through nasion and dorsal nose plane]
Cm-Sn-Ls	Nasolabial angle [angle b/w columella of nose to subnasale to labrale superius]
Nasal tissue Position relative to other craniofacial structures (Angles)	
HP-DNP	Nasal tip Projection angle [angle b/w horizontal plane and the dorsal nasal plane]
STG-STPg-DNP	Naso-facial Angle [angle b/w glabella-soft tissue pogonion line and Dorsal nasal plane]
DNP-PRN-SPg	Nasomental angle [angle b/w Dorsal nasal Plane and line from pronasale to soft tissue pogonion]
Horizontal linear measurement	
PRN-Ls	Distance between Pronasale (PRN) and Ls parallel to HP
PRN-Is	Distance between Pronasale (PRN) and Is parallel to HP
PRN-STPg	Distance between Pronasale (PRN) and soft tissue pogonion parallel to HP
Vertical linear measurements	
PRN-Ls	Distance between Pronasale (PRN)and Ls parallel to VP
PRN-Is	Distance between Pronasale (PRN) and IS parallel to VP
PRN-STPg	Distance between Pronasale (PRN) and STPg parallel to VP
Relative Prominence	
Maxilla	Maxillary prominence (distance b/w Sn and VP, parallel to Horizontal plane)
Mandible	Mandibular prominence (linear distance b/w STPg and VP, parallel to HP)

Obtained data were statistically analyzed in the SPSS version-20.0 for windows. Frequencies of two skeletal groups were generated in the software. An Independent t-test was applied for the comparison of nasal morphological features of two sagittal skeletal classes categorized as skeletal class 1 and skeletal class 2 with a value of $p<0.05$ considered as statistically significant.

RESULTS

The study sample consisted of 65 subjects including 12 males and 53 females, with an age range of 19-26 (mean 20.93) years. According to statistical analysis, the mean age of Skeletal class-1 subjects was 20.96 ± 1.92 and that of Skeletal class 2 was 20.91 ± 2.05 (Table.2). Mean age was calculated to be 20.00 ± 1.12 and 21.15 ± 1.12 for males and females respectively. Cephalometric measurements of nasal morphology were made for Skeletal class 1 and Skeletal class-2 groups. An independent t-test was then applied to compare the mean of these measurements to find differences in nasal morphology among the two skeletal groups.

Table 2: Mean and Standard Deviation of age in skeletal classes

SK. Class		Mean ± SD
Age	Sk. I	20.9677 ± 1.92
	Sk. II	20.9118 ± 2.05

Table 3 depicts the mean cephalometric measurements being compared between skeletal class 1 and skeletal class 2. Statistically, significant differences were found for the prominence of the mandible and a horizontal distance b/w pronasale and soft tissue pogonion among the two skeletal groups indicating a more projected nose in the skeletal class II group. Upon comparing the nasal morphology among male and female subjects, a considerable difference was found for various measurements such as Nasal depth; the males had a more projected nose and Nasofrontal angle. Concerning the nasal position in relation to the other craniofacial structures, significant differences were found for the Nasal tip projection angle, Nasofacial angle, and Nasomental angle. In addition to this, statistically significant differences between both genders were found for the horizontal distance between the pronasale and incisor superius depicting the nose being eminently projected from the incisal edge of the maxillary central incisor in males.

Table 3: Independent t-test for comparison of cephalometric measurements between skeletal class 1 and skeletal class 2

Variables	Skeletal Class-1	Skeletal Class-2	t-test value
Nasal Height	52.7258 ± 3.54	51.5294 ± 3.59	.182
Nasal Length	48.0645 ± 3.41	46.4412 ± 3.73	.073
Nasal Depth	22.5968 ± 4.21	21.0882 ± 4.63	.177
Nasofrontal angle	133.0323 ± 7.61	136.1618 ± 8.91	.135
Nasolabial angle	98.3548 ± 12.05	99.4118 ± 19.21	.794
N tip projection Angle	125.0968 ± 5.02	123.4118 ± 5.53	.205
Nasofacial Angle	37.0000 ± 3.78	37.5588 ± 4.08	.570
Nasomental Angle	122.9677 ± 5.72	121.0147 ± 4.72	.137
Horizontal Distance btw PRN and Ls	12.8548 ± 3.02	12.5441 ± 3.26	.693
Horizontal Distance btw PRN and Is	22.4355 ± 4.15	22.7206 ± 6.56	.837
Horizontal Distance btw PRN and STPG	23.6290 ± 5.13	28.4853 ± 6.91	.002
Vertical Distance btw PRN and Ls	20.5806 ± 5.08	18.9559 ± 4.56	.180
Vertical Distance btw PRN and Is	31.1935 ± 4.39	30.8676 ± 3.68	.746
Vertical Distance btw PRN and STPG	57.2742 ± 7.02	55.3235 ± 8.53	.321
Prominence of Maxilla	8.2742 ± 3.42	7.0735 ± 3.68	.179
Prominence of Mandible	5.0484 ± 4.36	7.4853 ± 4.78	.036

Moreover, the significant differences in the vertical distance between the pronasale (tip of the nose) to incisor superius (incisal edge of most prominent upper central incisor), the vertical distance between pronasale and labrale superius (upper lip) and the prominence of the maxilla showed a significantly projected nose tip in males as compared to females (Table 4.)

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Table 4: Comparison of cephalometric measurements among males

Variables	Male	Female	p- value
Nasal Height	52.7917 ± 2.36	51.9434 ± 3.82	.465
Nasal Length	48.3333 ± 4.11	46.9623 ± 3.52	.243
Nasal Depth	25.7083 ± 4.58	20.9245 ± 3.98	.001
Nasofrontal Angle	129.8333 ± 8.13	135.7642 ± 8.14	.026
Nasolabial Angle	103.2500 ± 10.30	97.9245 ± 17.048	.304
Nasal Tip Projection Angle	130.3333 ± 4.86	122.8302 ± 4.39	.000
Nasofacial Angle	40.3333 ± 2.74	36.6038 ± 3.83	.002
Nasomental Angle	118.8333 ± 3.99	122.6509 ± 5.30	.022
Horizontal Distance btw PRN and Ls	13.7083 ± 4.18	12.4623 ± 2.84	.216
Horizontal Distance btw PRN and Is	25.9583 ± 5.69	21.8208 ± 5.22	.018
Horizontal Distance btw PRN and STPG	27.5417 ± 10.97	25.8585 ± 5.18	.426
Vertical Distance btw PRN and Ls	22.5000 ± 5.35	19.1038 ± 4.55	.027
Vertical Distance btw PRN and Is	33.5000 ± 4.07	30.4623 ± 3.81	.017
Vertical Distance btw PRN and STPG	58.9583 ± 12.20	55.6415 ± 6.50	.189
Prominence of Maxilla	9.9583 ± 4.61449	7.1226 ± 3.13	.012
Prominence of Mandible	5.5833 ± 4.37	6.4906 ± 4.81	.551

DISCUSSION

Soft tissue evaluation is an essential part of diagnosis and helps in treatment planning in orthodontics. With the recent shift of orthodontic focus towards the soft tissue paradigm, concern has deviated towards the improvement of facial and nasal profile and not just the dentition. For esthetic concerns, nasal morphology assessment is important before various procedures such as extractions for orthodontic treatment, nasal procedures such as rhinoplasty etc. Nasal profile varies greatly among individuals of different races and ethnicity [15]. Since nasal profile analysis has great importance, therefore the current study was conducted, on basis of measurements used by Begg and Harness, to evaluate nasal morphology in various skeletal patterns. Study results showed that two groups labelled as Skeletal class 1 and skeletal class 2 differ significantly for the prominence of the mandible and horizontal distance between pronasale and soft tissue pogonion. Comparison between males and females showed a significant difference in Nasal depth, Nasofrontal angle, Nasal tip projection angle, Nasofacial angle, and Nasomental angle, for linear measurements there was a difference in vertical distance between pronasasle and labrale superius, the horizontal distance between pronasale and incisor superius, the vertical distance between pronasale and incisor superius, prominence of the maxilla. Only a few studies have been conducted for the evaluation of nasal profile and morphology. One such study by Anić-Milošević *et.al.*, for nasal profile comparison among adult males and females of Croatia showed that males display appreciably increased nasal prominence in comparison with their female counterparts [16]. Results of the current study are in accordance with these results, showing a significant difference in nasal prominence among males and females. According to a study by Genecov *et al.*, there is no notable association between skeletal class and the amount of nasal development in an individual [17]. It was observed that nasal growth is not dependent upon skeletal hard tissue. A study conducted by Bharadwaj *et al.*, stated no remarkable difference between skeletal class 1 and class 2 malocclusion for nasal depth, nasolabial angle and the nasal tip projection angle [18]. Results of the present study also exhibited no prominent difference between the two skeletal groups for values of above-mentioned nasal features. In a study for nasal profile analysis, Gulsen *et al.*, found a correlation between the Nasolabial angle and Sagittal skeletal pattern [19]. It was established that the nasolabial angle was higher in individuals with skeletal class 2 patterns as compared to skeletal class 1. However, the outcomes of the current study showed no considerable difference in nasolabial angle measurements between skeletal patterns. The nasolabial angle plays a vital role in diagnosis and treatment planning in the field of orthodontics. It is considered to be a decision-making factor in planning orthodontic extractions according to an individual's Nasal and facial profile. Arshad *et al.*, found a difference in nasal profile between male and female individuals because of significant differences in nasal length, nasal depth and profile convexity [1]. present study exhibited a notable difference for nasal depth only whereas an insignificant difference was concluded for nasal length between the two groups. Enlow and Hans also stated nasal depth and nasal length are considerably greater in male subjects when compared to females [20]. This explains the more prominently structured nose in men. A study by Jafarpour *et al.*, outlined higher values of angular measurements of nasal morphology for skeletal class 2 pattern but no considerable variations were found between different sagittal skeletal groups for linear measurements [21]. For the present study, results were not statistically significant for angular measurements among skeletal groups. Basciftci *et al.*, stated that soft tissue measurements differ significantly in individuals based on different races and ethnicity [22]. Differences also exist on basis of gender dimorphism. Nasal morphology analysis plays a pivotal role in the diagnosis as well as treatment planning of orthodontic and orthognathic cases. It has been inferred from various studies and discussions that soft tissue measurements are not completely dependent upon underlying skeletal structures. Soft tissue thickness is an important factor to consider during orthodontic extractions to avoid over-retracted facial appearance.

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During treatment planning, orthodontists should also consider ethnic and racial differences for nasal features to achieve more esthetic results. A study by Fernandes concluded that Japanese-Brazilian females showed thinner nasal soft tissues and smaller noses in comparison to Caucasians [23]. Also, the males, belonging to Japanese-Brazilians had thinner tissues in the nasion region and thick lower lips when compared to the Caucasian sample. Hence, it is crucial to keep in view these soft tissue thickness differences while devising an orthodontic treatment plan. Nasal size and profile are also important for Surgeon during surgical procedures such as maxillary advancement and setback, and rhinoplasty for therapeutic or cosmetic purposes. This improved post-treatment results. Further study should be considered with larger samples of both genders.

CONCLUSIONS

Nasal morphology differs in skeletal class 1 and skeletal class 2 due to the prominence of the mandible and horizontal distance between pronasale and soft tissue pogonion. Males and females show a significant difference in nasal profile due to differences in Nasal depth, Nasofrontal angle, Nasal tip projection angle, Nasofacial angle and Nasomental angle. Gender dimorphism in nasal profile also exists due to differences in horizontal and vertical distances between the prominence of the nose and labrale superius, incisal edge and Prominence of the maxilla.

Authors Contribution

Conceptualization: SJ
Methodology: SJ
Formal analysis: ZHA
Writing-review and editing: ZA, ZHA, SJ

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest

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