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Evaluation of Nasal Proportions in Adults with Class I and Class II Skeletal Patterns: A Cephalometric Study

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Abstract:

AIM: The aim of this study was to evaluate sexual dimorphism in nasal proportions of Class I and Class II skeletal malocclusions in adults.

MATERIAL AND METHODS: The sample comprised 120 patients (females 18 years and above and males 21 years and above), with no history of previous orthodontic treatment or functional jaw orthopedic treatment. They were divided into different groups based on point A-Nasion-point B (ANB) angle and gender. Groups I and II included 30 males and 30 females with skeletal class I malocclusion (ANB 0–4 degrees). Groups III and IV included 30 males and 30 females with skeletal class II malocclusion, respectively (ANB above 4 degrees).

RESULTS: In regards to the comparison between males and females (Class I + Class II), nasal length ($P < 0.001$), nasal depth 1 ($P < 0.001$), nasal depth 2 ($P < 0.001$), nasobasal angle ($P < 0.001$), soft tissue convexity angle ($P < 0.001$), and nasal bone length ($P < 0.008$) were found to be statistically significant. Nasobasal angle was found to be significantly higher in females than in males (Class I) ($P < 0.001$). Nasolabial angle was prominent in class I males than in class I females ($P < 0.001$). Soft tissue convexity angle of Class I participants was significantly lower than that of Class II participants ($P < 0.001$), whereas nasobasal angle and nasomental angle of Class I participants were found to be significantly higher than that of Class II participants ($P < 0.001$).

CONCLUSION: Sexual dimorphism was found in various nasal parameters. Significant amount of differences was found in the nasal proportions of Class I and Class II (male and female) participants.

Keywords:

ANB angle, nasal proportions, soft tissue

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Introduction

One of the most important components of orthodontic diagnosis and treatment planning is the evaluation of the patients' soft tissue.[1] Subtelny,[2] Burstone,[3] and Bowker *et al*.[4] have recommended that the analysis of the soft tissue should be done carefully for the proper evaluation of an underlying skeletal discrepancy because of individual differences in soft tissue thickness. Facial harmony in orthodontics is determined by morphologic relationships and proportions of the nose, lips, and chin. The balance among these three anatomic structures can be altered by both growth and orthodontic treatment; thus, it is essential for the orthodontist to have an understanding not only of these changes incident on treatment but also of the amount and direction of growth expected in the facial structures. Several authors have indicated the importance of considering both growth and treatment in predicting post-orthodontic facial changes.[5]

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Hard tissue facial structure analysis, as seen in the lateral cephalogram, is relatively straightforward. Landmarks are identified to represent various skeletal and dental structures; distances, angles, and ratios are calculated according to the requirements of the specific cephalometric analysis selected by the clinician. To analyze the profile, however, curved surfaces of the soft tissue must be reduced to distances, angles, and ratios—which is much less precise than simply joining hard tissue landmarks.[6]

The nose plays a dominant role in facial aesthetics because of its location exactly in the middle of the face. Its importance is demonstrated by remarkable enhancement in facial aesthetics of a patient who has had minor rhinoplasty procedures. The ideal nasal proportion requires a straight nasal dorsum with the dorsal cartilage and nasal tip cartilage above the nasal tip, forming the supratip break. The alar rims 1-2 mm superior to the columella in the lateral view are required. The ideal nose is in harmony with other features of the face, and the nasal features vary from race-to-race along with other facial characteristics.[7]

In a comparative study of Japanese and European-American adults, Miyajima *et al*.[8] reported greater ethnic differences in soft tissue profiles than in skeletal and dental relationships. The issue of soft tissue profile, however, played a small part in the study mentioned above. Review of literature has not presented even a single variable regarding the soft tissue analysis, and substantial studies on this issue are lacking.[9-12] The aim of this study was to evaluate sexual dimorphism in nasal proportions of skeletal class I and class II malocclusion in adults.

Material and Methods

Pretreatment lateral cephalograms of 120 patients were chosen for this study. The study was approved by the Ethical Committee of the Institutional Review Board and the concerned University. Each participant met the following inclusion criteria:

- 18 years and above females
- 21 years and above males
- No history of previous orthodontic treatment or functional jaw orthopedic treatment
- No history of any surgery involving the jaws, cleft lip, palate, and any systemic disease affecting normal growth
- No previous history of trauma to the dentofacial structures.

Based on the ANB angle and gender, all the participants were divided into following four groups:

- Group I included 30 males with skeletal class I malocclusion (ANB: 0–4 degrees, mean value: 2 degrees, SD ± 1)
- Group II included 30 females with skeletal class I occlusion (ANB: 0–4 degrees, mean value: 1.5 degrees, SD ± 1)
- Group III included 30 males with skeletal class II malocclusion (ANB > 4 degrees, mean value: 5 degrees, SD ± 1)
- Group IV included 30 females with skeletal class II malocclusion (ANB > 4 degree, mean value: 5.5 degrees, SD ± 1).

The ANB angle was used to divide the groups as it gives an accurate relation of the maxilla with the mandible in the anterior posterior plane.[13] Other parameters such as Wits appraisal and facial angle are not as reliable. Lateral cephalograms were obtained in the standing position with the Frankfort Horizontal plane parallel to the floor. All the cephalograms were recorded with the same exposure parameters (KvP: 80, mA: 10, exposure time: 0.5 s) with the same magnification and the same machine (Kodak 8000C Digital and Panoramic System Cephalometer Rochester, NY, USA). The X-rays were printed using Fujifilm Medical Dry Imaging film (8 × 10 inches in size) and the Fujifilm Dry pix plus printer. All cephalograms were traced manually using lead acetate paper and 4B pencil tracings by the same operator.

The following lateral cephalometric landmarks were used to assess the nose [Figure 1].

1. Glabella (G′): The most prominent soft tissue point of the frontal bone
2. Soft-tissue nasion (N′): The point of greatest concavity in the midline between the forehead and the nose
3. Midnasale (Mn): The halfway point on nasal length (N′-Pr) that divides the dorsum into upper and lower dorsum
4. Supratip (St): The point constructed between mid-nasal and pronasal on the lower third of the nasal dorsum

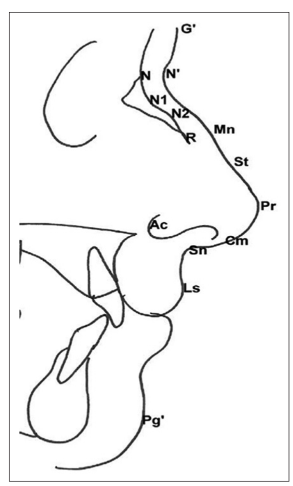

Figure 1: Soft tissue landmarks

5. Nasion (N): The intersection of the frontal and nasal bones
6. N1: The most concave point of the nasal bone
7. N2: The most convex point of the nasal bone
8. Rhinion (R): The most anterior and inferior point on the tip of the nasal bone
9. Pronasale (Pr): The tip of nose (nasal tip)
10. Columella (Cm): The most convex point on the columellar-lobular junction
11. Subnasale (Sn): The point at which the columella merges with the upper lip in the mid-sagittal plane
12. Alar curvature point (Ac): The most convex point on the nasal alar curvature
13. Labrale superior (Ls): The point indicating the mucocutaneous border of the upper lip
14. Soft-tissue pogonion (Pg′): The most anterior point on the chin in the mid-sagittal plane.

The following angles and measurements were used to assess the nose [Figure 2].

1. The axis of dorsum: The line constructed through the depth of the soft tissue nasion to the supratip point
2. Nasal length (N′-Pr): The distance between N′ and Pr
3. Nasal depth 1: The perpendicular distance between Pr and the line drawn through N′ to Sn
4. Nasal depth 2: The distance between points Ac and Pr
5. Hump: The perpendicular distance between the axis of the dorsum and the most superior point of the upper part of the nasal dorsum
6. Nasolabial angle (NLA): The angle formed by the intersection of the Cm tangent and the upper lip (Ls)
7. Nasal-base angle (NBA): The inclination of the nasal base (angle between the G′-Sn line and the long axis of the nostril)
8. Nasomental angle (NMA): The angle constructed by the axis of the dorsum and the Pr-to-Pg′ line
9. Soft-tissue facial convexity (SFC): The angle between the G′-Sn′ line and the Sn′-Pg′ line

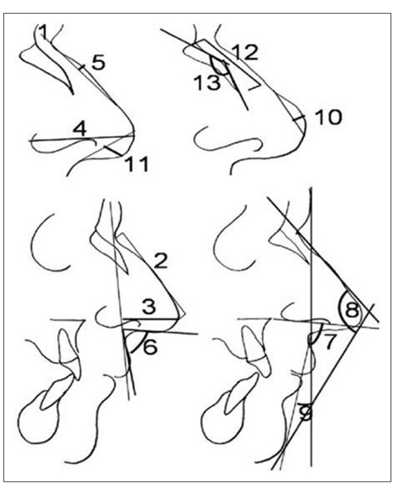

Figure 2: Linear and angular measurements

10. Lower dorsum convexity (Dconv): The perpendicular distance from the most convex point of the lower nasal dorsum to the Mn-Pr line
11. Columella convexity (Cconv): The perpendicular distance from the most convex point of columella to the line drawn from Pr to Sn
12. Nasal-bone length (NboneL): The distance from N to R
13. Nasal-bone angle (NboneA): The posterior angle formed between the N1-N2 line and the N2-R line.

Statistical analysis

A master file was created, and the data was statistically analyzed on a computer using the Statistical Package for Social Sciences (SPSS) software (version 13) (SPSS Inc. Released 2008. Chicago, US). A data file was created under dBase and converted into a micro stat file. The data was subjected to descriptive analysis for mean, standard deviation, range, and 95% confidence interval. Group differences were analyzed with one-way analysis of variance (ANOVA). For multiple comparisons, a *post hoc* Tukey's honestly significant difference (HSD) test was used. To identify errors associated with radiographic measurements, 25 radiographs were selected randomly. Their tracings and measurements were repeated 6 weeks after the first measurements were taken. The Dahlberg Test was applied to the first and second measurements, and the differences between measurements showed no statistical significance.

Results

For class I malocclusion nasal length, nasal depth 1, nasal depth 2, nasal bone length, nasolabial angle, and soft tissue convexity angle of males was found to be higher than that of females; this difference was found to be statistically significant ($P < 0.001$) [Table 1]. In class II malocclusion, nasal length, nasal depth 1, nasal depth 2, and nasal bone length of males were higher in males than females; these differences were found to be statistically significant ($P < 0.001$), except for nasal bone length [Table 2]. Nasal length, nasal depth 1, nasal depth 2, and nasal bone length of males of Class I and Class II malocclusion class were found to be significantly higher than that of females ($P < 0.05$). Soft tissue convexity angle of males was found to be significantly higher for males as compared to females ($P < 0.001$). Lower dorsum convexity and columella convexity of males was found to be higher than that of females, however, these differences were not found to be statistically significant [Table 3].

Discussion

Producing a change in the soft tissue profile through treatment often is one of the primary concerns of the orthodontic patient. The perception of beauty varies

Table 1: Descriptive statistics of males and females and comparison of sex differences in malocclusion group (Class I)

Variable	Male (*n*=30)				Female (*n*=30)				*t*	*P*
	Mean	SD	Min	Max	Mean	SD	Min	Max		
Nasal length (mm)	44.13	4.42	35	51	38.17	3.30	30	45	5.920	<0.001
Nasal depth 1 (mm)	16.47	2.64	11	24	13.80	2.34	7	17	4.144	<0.001
Nasal depth 2 (mm)	26.85	3.60	21	34	22.20	2.06	18	26	6.138	<0.001
Nasolabial angle	95.93	16.11	63	119	92.07	12.42	72	120	1.041	0.302
Nasobasal angle	78.87	7.68	67	91	90.97	7.26	74	102	−6.272	<0.001
Nasomental angle	127.77	8.25	120	157	124.93	5.97	107	135	1.524	0.133
Soft tissue convexity angle	21.37	7.21	7	33	15.57	7.45	6	46	3.063	0.003
Lower dorsum convexity (mm)	0.75	0.57	0	2	0.70	0.47	0	1	0.372	0.711
Columella convexity (mm)	4.98	1.44	3	9	3.83	0.87	2	5	3.748	<0.001
Nasal bone length (mm)	22.60	2.70	16	27	20.67	3.00	15	30	2.625	0.011
Nasal bone angle	154.83	9.92	138	180	158.50	13.47	138	180	−1.200	0.235

SD – Standard deviation; *t* – Degree of variation; *P*=0.05 Value of significance

Table 2: Descriptive statistics of males and females and comparison of sex differences in malocclusion group (Class II)

Variable	Male (*n*=30)				Female (*n*=30)				*t*	*P*
	Mean	SD	Min	Max	Mean	SD	Min	Max		
Nasal length (mm)	45.93	4.03	39	57	39.17	3.90	33	48	6.609	<0.001
Nasal depth 1 (mm)	16.53	2.39	11	21	14.70	2.38	11	23	2.980	0.004
Nasal depth 2 (mm)	26.45	3.32	20	34	23.00	2.86	18	30	4.307	<0.001
Nasolabial angle	99.17	13.40	70	124	99.23	11.18	74	115	−0.021	0.983
Nasobasal angle	75.00	10.51	56	102	79.23	8.59	66	98	−1.708	0.093
Nasomental angle	123.27	7.67	115	155	121.97	4.25	114	129	0.812	0.420
Soft tissue convexity angle	32.67	8.82	22	59	27.37	5.01	16	39	2.863	0.006
Lower dorsum convexity (mm)	1.60	0.74	0	3	1.18	0.71	0	2.5	2.227	0.030
Columella convexity (mm)	3.37	1.47	1	7	4.13	0.83	2.5	6	−2.491	0.016
Nasal bone length (mm)	22.10	3.41	13	27	20.88	3.65	12	28	1.334	0.188
Nasal bone angle	158.83	11.30	143	180	149.50	12.17	122	180	3.079	0.003

SD – Standard deviation; *t* – Degree of variation; *P*=0.05, Value of significance

Table 3: Descriptive statistics of males and females and comparison of sex differences (Class I + Class II)

Variable	Male (*n*=60)				Female (*n*=60)				*t*	*P*
	Mean	SD	Min	Max	Mean	SD	Min	Max		
Nasal length (mm)	45.03	4.29	35	57	38.67	3.62	30	48	8.785	<0.001
Nasal depth 1 (mm)	16.50	2.49	11	24	14.25	2.38	7	23	5.054	<0.001
Nasal depth 2 (mm)	26.65	3.44	20	34	22.60	2.51	18	30	7.368	<0.001
Nasolabial angle	97.55	14.78	63	124	95.65	12.26	72	120	0.766	0.445
Nasobasal angle	76.93	9.33	56	102	85.10	9.86	66	102	−4.660	<0.001
Nasomental angle	125.52	8.22	115	157	123.45	5.35	107	135	1.632	0.105
Soft tissue convexity angle	27.02	9.81	7	59	21.47	8.66	6	46	3.285	0.001
Lower dorsum convexity (mm)	1.18	0.78	0	3	0.94	0.65	0	2.5	1.785	0.077
Columella convexity (mm)	4.18	1.65	1	9	3.98	0.86	2	6	0.797	0.427
Nasal bone length (mm)	22.35	3.06	13	27	20.78	3.32	12	30	2.705	0.008
Nasal bone angle	156.83	10.73	138	180	154.00	13.51	122	180	1.272	0.206

SD – Standard deviation; *t* – Degree of variation; *P* = 0.05, Value of significance

widely among individuals and among racial and ethnic groups; many investigators[14-16] have tried to quantify objectively their clinical experiences of the soft tissue profile. Yet, the quantification of the soft tissue profile is not simple because the profile, as seen in the lateral head film, consists of many curved lines. Skeletal Class III samples were not included in the study due to a large variance in relation to the maxilla and mandible. The skeletal Class III samples had high variability among themselves, and adding them to the study would not have given us accurate results. Because of these factors, skeletal Class III samples were not included in this study.

In the present study, nasal length was found to be greater in males than that in females [Tables 1 and 3]. The men have been found to have longer nasal length than females. Enlow and Hans[17] reported that the male nose was proportionately longer than the female nose. Nasal depth 1 was found to be prominent in males than that in females in the present study. Similarly, the male nose was proportionately larger than the female nose and usually more protrusive and longer, with a more pointed tip and a tendency to be turned in the downward direction with more flaring nostrils.[17]

In the present study, nasal depth 2 was found to be greater in males than in females. Similarly, Enlow *et al*.[17] concluded that male nose usually ranges from straight to convex, whereas female nose tends to range from straight to concave, with a tendency to tip up. These findings should also be kept in mind when planning rhinoplasty in men because the final result will be different for men and women.[5] Nasolabial angle (Cm–Sn–Ls) depends on inclination of upper anteriors. The relationship between nasal base (columella) and upper lip is one of the facial profile parameters with greater clinical uncertainty. Present study showed that nasolabial angle in Class I males was prominent than that in Class I females [Table 1]. Burstone *et al*.,[18] in 1967, reported nasolabial angle of 74° ±8° degrees in a Caucasian adolescent sample with normal facial appearance. Similarly, McNamara *et al*.[19] in 1992 reported an angle of 102.2° ±8° in males and 102.4° ±8° in females. Yuen and Hiranaka[20] in 1989 reported an angle of 102.7° ±11° for males and 101.6° ±11° for females in Asian adolescents on standardized photographic records, which is almost similar to the present finding. Genecov *et al*.,[21] in 1989, found that the angular parameters of nasal complex between the age of 7 and 17 years remained relatively constant. Despite few findings of differences in growth of the nasal complex, the whole nasal contour increased by an average of 3° to 4°. Farnandez-Riveiro *et al*.,[22] in 2003, reported wide sexual dimorphism for nasolabial angle. Basciftci *et al*.,[23] in 2004, reported significant racial and sex difference in soft tissue measurements.

In the present study, nasomental angle in males was greater than females although the reading were found to be statistically nonsignificant. Similarly, Basciftci *et al*.,[23] in 2004, reported significant racial and sex difference in soft tissue measurements. Gulsen *et al*.[5] concluded that nasomental angle is related to mandibular position; in this respect, narrow nasomental angle can be expected in Class II patients.

In the present study, it has been found that the nasobasal angle of males was significantly lower than that of females. Gulsen *et al*.[5] found that the increase in lower dorsum convexity was related to the decrease of nasal-base inclination. This means that, as the nose moves downward, its tip tends to move downward and increases its total size, or vice versa. This implies that when the anterior part of the maxilla moves upward, nasal-base inclination increases, and the nasal tip moves upward.

Soft tissue convexity angle which was measured as the angle between the G′-Sn′ line, and the Sn′-Pg′ line was found to be greater in males than in females. A soft tissue convexity angle is related to the position of mandible. Retrusive position of mandible is associated with increased soft tissue convexity angle. Similarly, Gulsen *et al*.[5] concluded that larger convexity angle might be expected in a Class II patient. In the present study, lower dorsum convexity which was measured as the perpendicular distance from the most convex point of the lower nasal dorsum to the Mn-Pr line was found to be significantly prominent in males than in females. Columella convexity was found to be prominent in Class I males than in Class I females [Table 1] and vice versa in case of Class II males and Class II females [Table 2].

Nasal bone length was found to be prominent in males than in females. The nasal length was significantly greater in both Class I and Class II males than in Class I and Class II females. Nasal length correlates with nasal bone length, and prominent nasal length in males than females have already been discussed by Enlow and Hans.[17] The limitations of the study include the reliability of the cephalometric tracings, ethnicity of the population in the study, and absence of skeletal Class III group. These normal data should not be used as a template. Orthodontic and orthognathic treatment should always be planned according to each patient's specific needs and desires.

Conclusion

- Nasal length was greater in both Class I and Class II males than that in Class I and Class II females
- Nasal depth 1 was greater in both Class I and Class II males than that in Class I and Class II females
- Nasal depth 2 was greater in both Class I and Class II males than that in Class I and Class II females
- Nasolabial angle in Class I males was greater than that in Class I females
- Soft tissue convexity angle was greater in males than that in females
- Nasal bone length was greater in males than that in females
- Nasal bone angle was greater in males than that in females.

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Conflicts of interest

There are no conflicts of interest.

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