Article published online: 2022-06-14

Assessment of Dentofacial Characteristics in Individuals with Different Midfacial Skeletal Morphologies

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J Health Allied Sci[NU] 2023;13:126–133.

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Abstract

Introduction An orthodontist's primary objective is to diagnose and describe the characteristics of any particular malocclusion. It has been reported that when the anteroposterior dimension of the maxilla is either reduced or increased, the measured dentoalveolar and skeletal parameters gets affected in other dimensions also.

Aim This study aims to assess and compare the dentofacial characteristics in individuals with different skeletal morphology (normal, retrognathic, and prognathic maxilla).

Materials and Methods A total of 194 individuals in the age group of 18 to 32 years were grouped as group I (34 males, 33 females) with normal maxilla, group II (30 males, 32 females) with retrognathic maxilla, and group III (34 males, 31 females) with prognathic maxilla. The measurements of N-A and anterior nasal spine to posterior nasal spine were the basis for selecting the individuals. The dentoalveolar characteristics were assessed using 17 lateral cephalometric and 08 posteroanterior (P-A) cephalometric parameters.

Results The data of the study when analyzed statistically using sample "t" test ($p < 0.05$), revealed significant differences between the genders within the groups. All 08 characteristics measured in the P-A cephalogram showed had significant differences. Pairwise comparison between the groups was performed using the Tukey post hoc test ($p < 0.05$) and significant differences in various dentoalveolar characteristics were observed between the groups.

Conclusion Dentoalveolar and facial parameters showed a significant degree of sexual dimorphism associated with maxillary morphology in all three groups of individuals. The majority of the parameters showed male dominance, and the differences were statistically significant. Statistically significant differences were observed in dentofacial characteristics in individuals with different skeletal morphologies

Keywords
- dentofacial
- midfacial
- morphology
- prognathia
- retrognathia
- skeletal

article published online
June 14, 2022

DOI https://doi.org/10.1055/s-0042-1745731.
ISSN 2582-4287.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Introduction

Facial balance is of very much concern to health specialists. The introduction of cephalometrics has made it simple for quantitative assessment of the relationship between occlusion and skeletal balance of the face. It is reported that both the gender and the sagittal maxilla-mandibular relationship could affect the anteroposterior and vertical dimensions of the anterior alveolus and the interdependency in three dimensions of space of facial proportion.[1] The reduced maxillary dentoskeletal width was associated with an increased vertical height of the maxilla, thus showing the compensation in one dimension for a discrepancy in other dimensions to maintain the skeletal balance.[2]

Studies have compared the sexual dimorphism in different malocclusion, Giovanoli et al[3] and Farakas[4] reported the male dominance in all characters indicating significant differences between the genders. The cephalometric evaluation indicated that the length of the anterior cranial base was larger in males, but the cranial base angle was similar for both sexes at all age intervals studied. The effective lengths of the mandible and maxilla were comparable in both males and females up to 14 years of age. But the length remained relatively constant in females, while it increased in males. The direction of facial growth was similar for both genders. However, there was a tendency toward a more horizontal growth in females.[1]

An orthodontist's primary objective is to diagnose and describe the malocclusion. One should have a thorough knowledge of characteristics describing any particular malocclusion. It has been reported that when the anteroposterior dimension of the maxilla is either reduced or increased, the measured dentoalveolar and skeletal parameters gets affected in other dimensions also. A study by Franchi and Baccetti[5] reported significant differences in the transverse plane in craniofacial structures in individuals with the skeletal discrepancy in the sagittal plane. The cross-sectional and longitudinal studies have reported conflicting results on mandibular and maxillary dental and skeletal positions and vertical components of Class II patients. There is no common opinion regarding cranial base configurations. With these conflicting reports in the literature, the present study was designed and planned to assess and compare the dentofacial characteristics in individuals with normal, retrognathic, and prognathic maxilla through lateral cephalometric and frontal cephalometric analyses.

Materials and Methods

After obtaining clearance from the Institutional Central Ethics committee (Ref: NU / CEC/PhD-01–2010), a total of 194 (98 males and 96 females) individuals who were willing to take part in the study belonging to the age group of 18 to 32 years were grouped into three groups based on lateral cephalometric measurements of point A to N perpendicular (A-N⊥) and the length of maxillary base represented by posterior nasal spine to anterior nasal spine (PNS-ANS). All the subjects selected for the study belonged to the same ethnic group and geographical conditions. Informed written consent was obtained from each of the individuals taking part in the study. Individuals with a family history of either one of the siblings or one of the parents having a similar clinical condition were included in the study. Whereas individuals having cleft/other craniofacial defects, trauma either during or after birth, facial surgical treatment or orthodontic treatment, gross facial asymmetry, and multiple missing teeth were excluded from the study.

Lateral and posteroanterior (P-A) cephalograms were made under standardized conditions for each individual using Planmeca PM 2002 cc Proline Dental Panoramic X-Ray (Planmeca, Finland). Each of the cephalograms was traced by the investigator up to the accuracy of 0.5 mm and 0.5 degrees. The individuals were then grouped based on the maxillary morphology into the following groups.

Group IA had 34 males, and group IB had 33 females having normal maxillary morphology and is considered as the control group. The mean value for the measurement of point A to N perpendicular (A-N⊥) for males in this group was 0.044 mm (± 1.339). The mean value for the measurement of ANS-PNS was 54.058 mm (± 3.140). The females had a mean value of 0.287 mm (± 2.375) and for ANS-PNS the mean was 50.984 mm (± 3.525).

Group IIA had 30 males, and group IIB had 32 females having retrognathic maxilla. Here, the males had a mean value of –5.416 mm (± 1.889) for the cephalometric measurement of point A to N perpendicular (A-N). The mean value for the measurement of ANS-PNS was 51.65 mm (± 3.714). The females in this group had a mean value of 49.515 mm (± 4.180) for N-A (parallel to horizontal plane [IIHP]) and for ANS-PNS the mean was 49.515 mm (± 4.180).

Group IIIA had 34 males and group IIIB had 31 females having prognathic maxilla. The mean value for the measurement of point A to N perpendicular (A-N⊥) for males in this group was 6.602 mm (± 2.062). The mean value for the measurement of ANS-PNS was 61.632 mm (± 3.768). The females had a mean value of 6.656 mm (± 1.997) for point A to N perpendicular (A-N⊥) measurement, and for ANS-PNS the mean was 60.015 mm (± 3.968).

Evaluation of Dentoalveolar Characteristics

Lateral Cephalometric Analysis

The cephalometric analysis proposed by Burstone et al was used to analyze the facial skeletal pattern in anteroposterior and vertical dimensions. A total of 17 parameters was used in the present study (►**Fig. 1A**).

P-A Cephalometrics

The P-A cephalogram was used to measure the facial and dental arch characteristics in the transverse plane. Following 08 parameters were analyzed in the present study (►**Fig. 1B**).

Statistical Analysis

The collected radiographic data were subjected to statistical analysis using independent sample '*t*-test, analysis of variance (ANOVA), and Tukey's post hoc test, and the results are computed.

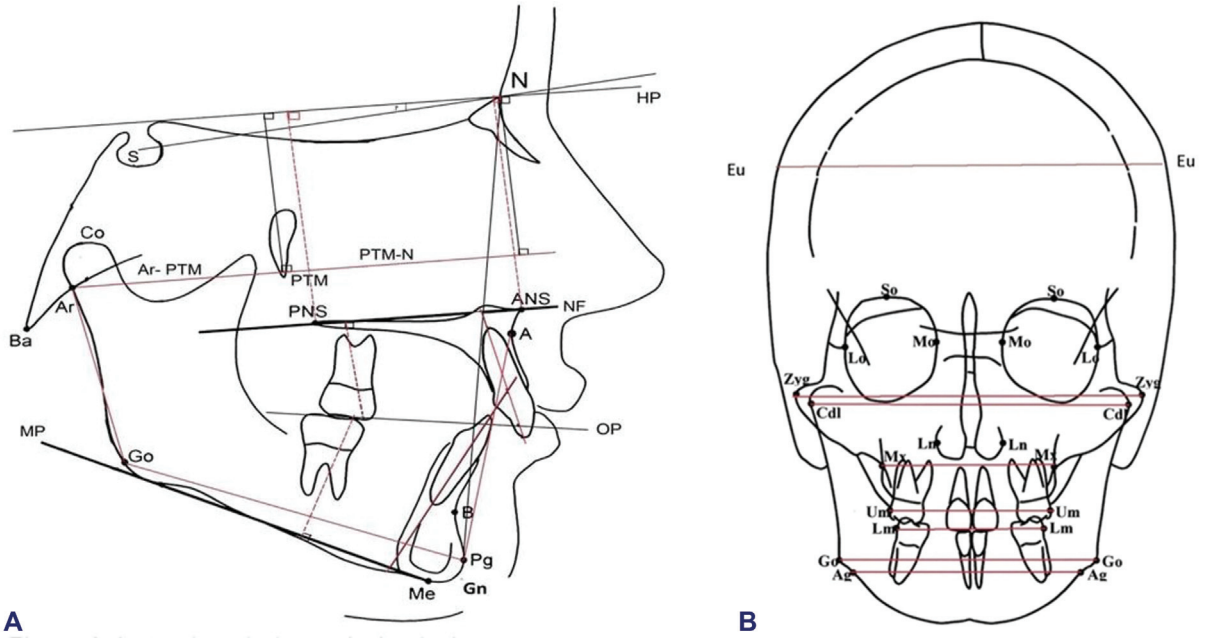

Fig. 1 (**A**) Lateral cephalometric measurements. (**B**) Posteroanterior (P-A) cephalometric measurements.

Results

The dentoalveolar characteristics were evaluated using 17 measurements in lateral cephalogram and 08 measurements in frontal cephalogram. When the values for various measurements were compared between the genders in group I using the independent sample '*t*-test ($p < 0.05$), the difference between the following characteristics as measured in lateral cephalogram were statistically significant in Ar-Ptm, N-A-Pg, N-ANS, N-PNS, ANS-Gn, lower 6-MP, Ar-Go, Go-Pg, and B-Pg. Whereas only the Mx–Mx was significantly different in frontal cephalogram.

Similarly, when the values for various measurements were compared between the genders in group II using the independent sample '*t*-test ($p < 0.05$), significant differences were observed in Ar-Ptm, Ptm-N, N-Pg, ANS-Gn, and Go-Pg values in lateral cephalogram measurements. The frontal cephalogram measurements showed significant differences in the values of Eu-Eu, Zyg-Zyg, Cdl-Cdl, Mx-M, Um-Um, Lm-Lm, Go-Go, and Ag-Ag.

When the values for various measurements were compared between the genders in group III using independent sample '*t*-test ($p < 0.05$), significant differences were observed in Ar-Ptm, MP-HP, upper 1-NF, upper 6-NF, Ar-Go, Go-Pg, B-Pg, and Ar-Go-Gn. Whereas the frontal cephalogram analysis showed a significant difference in the values of Eu-Eu, Um-Um, and Lm-Lm.

Gender-wise comparison between the groups was performed using ANOVA test and significant differences among male individuals were observed in the following lateral cephalometric values: Ptm-N, N-A-Pg, N-B, N-Pg, N-ANS, ANS-Gn, MP-HP, upper1-NF, lower 1-MP, upper 6-NF, Go-Pg, and B-Pg.

A pairwise comparison between the groups was performed using the Tukey post hoc test ($p < 0.05$). When the lateral cephalometric values for male individuals were compared between group I and group II, the following values showed significant differences, Ptm-N, N-A-Pg, upper 1-NF, lower 1-MP, upper 6–NF, and B-Pg. When the lateral cephalometric values for male individuals were compared between group I and group III, the following values showed significant differences, N-A-Pg, N-B, N-Pg, N-ANS, MP-HP, lower 1-MP, Go-Pg, and B-Pg. When the lateral cephalometric values for male individuals were compared between group II and group III, the following values showed significant differences, Ptm-N, N-A-Pg, N-B, N-Pg, ANS-Gn, MP-HP, upper1-NF, upper 6-NF, Go-Pg, and B-Pg (►**Table 1**).

ANOVA test showed all the characteristics measured in frontal cephalogram had significant differences. When the frontal cephalometric values for male individuals were compared between groups I and II and between groups II and III, the following values showed significant differences, Eu-Eu, Zyg-Zyg, Cdl-Cdl, Mx-Mx, Um-Um, Lm-L-Lm, Go-Go, and Ag-Ag. When the frontal cephalometric values for male individuals were compared between groups I and III, no significant differences were found in any of the values measured (►**Table 2**).

Significant differences among female individuals were observed when the ANOVA test was used in the following lateral cephalometric values N-A-Pg, N-B, N-Pg, N-ANS, N-PNS, MP-HP, upper 1-NF, lower 1-MP, upper 6-NF, B-Pg, and Ar-Go-Gn.

When the lateral cephalometric values for female individuals were compared between groups I and II, the following values showed significant differences, N-A-Pg, N-Pg, N-ANS, N-PNS, MP-HP, upper 1-NF, upper 6-NF, B-Pg, and Ar-Arr. When the lateral cephalometric values for female individuals were compared between groups I and III, the following values showed significant differences, N-A-Pg, N-B, N-Pg, N-ANS, N-PNS, lower 1-MP, and Ar-Ar. When the lateral cephalometric values for female individuals were compared

Table 1 Pairwise comparison between groups (lateral cephalometrics)—male

Dependent variable	(I) Group	(J) Group	Mean difference (I – J)	Standard error	*p*-Value	95% Confidence interval	
						Lower bound	Upper bound
PTM-N (II HP)	I	II	–4.16	1.12	0.001*	–6.83	–1.49
		III	–0.65	1.09	0.82 (NS)	–3.23	1.94
	II	III	3.51	1.12	0.006*	0.84	6.18
N-A-Pg (angle)	I	II	11.69	1.17	< 0.001*	8.90	14.47
		III	–3.62	1.13	0.005*	–6.31	–0.92
	II	III	–15.30	1.17	< 0.001*	–18.09	–12.52
N-B (II HP)	I	II	0.60	1.22	0.88 (NS)	–2.31	3.51
		III	–9.06	1.18	< 0.001*	–11.88	–6.24
	II	III	–9.65	1.22	< 0.001*	–12.56	–6.75
N-Pg (II HP)	I	II	–0.03	1.20	1.00 (NS)	–2.89	2.83
		III	–11.85	1.16	< 0.001*	–14.62	–9.08
	II	III	–11.82	1.20	< 0.001*	–14.68	–8.96
N-ANS (I HP)	I	II	1.97	1.22	0.24 (NS)	–0.93	4.87
		III	3.00	1.18	0.03*	0.20	5.80
	II	III	1.03	1.22	0.68 (NS)	–1.87	3.93
ANS-Gn (I HP)	I	II	–3.09	1.51	0.11 (NS)	–6.67	0.50
		III	2.90	1.46	0.12 (NS)	–0.57	6.37
	II	III	5.98	1.51	< 0.001*	2.40	9.57
MP-HP (angle)	I	II	–2.91	1.53	0.14 (NS)	–6.55	0.73
		III	6.35	1.48	< 0.001*	2.83	9.88
	II	III	9.26	1.53	< 0.001*	5.62	12.90
1-NF (I NF)	I	II	–5.91	0.84	< 0.001*	–7.91	–3.92
		III	1.09	0.81	0.38 (NS)	–0.84	3.02
	II	III	7.00	0.84	< 0.001*	5.00	8.99
1-MP (I MP)	I	II	–4.81	1.66	0.01*	–8.77	–0.85
		III	–6.50	1.61	< 0.001*	–10.34	–2.66
	II	III	–1.69	1.66	0.57 (NS)	–5.65	2.27
6-NF (I NF)	I	II	–4.46	1.08	< 0.001*	–7.04	–1.89
		III	1.74	1.05	0.23 (NS)	–0.76	4.23
	II	III	6.20	1.08	< 0.001*	3.62	8.77
Go-Pg (linear)	I	II	–0.46	1.41	0.94 (NS)	–3.81	2.88
		III	–4.29	1.36	0.006*	–7.54	–1.05
	II	III	–3.83	1.41	0.02*	–7.18	–0.49
B-Pg (II MP)	I	II	2.95	0.57	< 0.001*	1.60	4.31
		III	4.56	0.55	< 0.001*	3.25	5.87
	II	III	1.61	0.57	0.02*	0.25	2.96

Abbreviation: NS, nonsignificant.*significant; p<0.05/fn-group>

between group II and group III, the following values showed significant differences, N-A-Pg, N-B, N-Pg, N-ANS, N-PNS, and lower 1-MP (►**Table 3**).

When the frontal cephalometric values for female individuals were compared, significant differences were observed between the groups in the following values, Zyg-Zyg, Cdl-Cdl, Um-Um, Lm-L, and Ag-Ag.

Pairwise comparison between groups I and II showed significant differences in Um-Um, Lm-L-Lm, Gn-Gn, and Ag-Ag. When the frontal cephalometric values for female

Table 2 Pairwise comparison between the groups (posteroanterior [P-A] cephalometrics)—male

Dependent variable	(I) Group	(J) Group	Mean difference (I – J)	Standard error	*p*-Value	95% Confidence interval	
						Lower bound	Upper bound
Eu-Eu	I	II	−9.09	1.43	< 0.001[a]	−12.50	−5.68
		III	−2.79	1.39	0.11 (NS)	−6.10	0.51
	II	III	6.29	1.43	< 0.001[a]	2.88	9.70
Zyg-Zyg	I	II	−8.60	1.27	< 0.001[a]	−11.62	−5.57
		III	2.10	1.23	0.21 (NS)	−0.83	5.03
	II	III	10.70	1.27	< 0.001[a]	7.68	13.72
Cdl-Cdl	I	II	−8.85	1.70	< 0.001[a]	−12.89	−4.80
		III	3.01	1.64	0.16 (NS)	−0.90	6.93
	II	III	11.86	1.70	< 0.001[a]	7.82	15.90
Mx-Mx	I	II	−4.48	0.94	< 0.001[a]	−6.72	−2.25
		III	−0.01	0.91	1.00 (NS)	−2.18	2.15
	II	III	4.47	0.94	< 0.001[a]	2.23	6.70
Um-Um	I	II	−7.00	0.82	< 0.001[a]	−8.96	−5.04
		III	−1.38	0.80	0.19 (NS)	−3.28	0.52
	II	III	5.62	0.82	< 0.001[a]	3.66	7.58
Lm-Lm	I	II	−5.23	0.85	< 0.001[a]	−7.25	−3.22
		III	−1.26	0.82	0.28 (NS)	−3.22	0.69
	II	III	3.97	0.85	< 0.001[a]	1.95	5.99
Go-Go	I	II	−7.06	1.61	< 0.001[a]	−10.90	−3.22
		III	−0.62	1.56	0.92 (NS)	−4.34	3.10
	II	III	6.44	1.61	< 0.001[a]	2.60	10.28
Ag-Ag	I	II	−11.28	1.25	< 0.001[a]	−14.26	−8.30
		III	−2.31	1.21	0.14 (NS)	−5.19	0.58
	II	III	8.97	1.25	< 0.001[a]	5.99	11.95

Abbreviation: NS, nonsignificant.
Note: Tukey post hoc test, [a]$p < 0.05$ statistically significant, $p > 0.05$ NS.

individuals were compared between group I and group III, Cdl-Cdl showed a significant difference. Between groups II and III, the following values had significant differences, Zyg-zyg, Cdl-Cdl, Um-Um, and Lm-Lm (►**Table 4**).

Discussion

The evaluation of dentoalveolar characteristics using commonly used methods of lateral cephalogram and frontal cephalograms revealed significant differences between the individuals having retrognathic maxilla and prognathic maxilla when compared with that of the individuals having normal maxilla.

In a longitudinal study of normal subjects, Sinclair and Little[6] reported a high degree of sexual dimorphism. The male subjects showed larger dimensions, more postpubertal growth, and greater late dental and skeletal alterations. Ursi et al,[1] in their cephalometric study, indicated that the anterior cranial base was longer in males, but the cranial base angle was comparable for both genders at all age intervals studied. The effective lengths of the mandible and maxilla were comparable in both males and females up to 14 years of age. But the length remained relatively constant in females, while it increased in males. The direction of facial growth was similar for both genders. However, there was a tendency toward a more horizontal growth in females.[7]

Other studies compared sexual dimorphism in different malocclusion, in studies like Giovanoli et al[3] and Farakas,[4] they reported the significant differences between the genders with the male dominance in all characters, whereas in this study, significant differences among male individuals were observed in the following lateral cephalometric values, Ptm-N, N-A-Pg, N-B, N-Pg, N-ANS, ANS-Gn, MP-HP, Upper 1-NF, Lower 1-MP, Upper 6-NF, Go-Pg, and B-Pg.

In sagittal maxillary hypoplasia, the individual presents with a concave facial profile, involving the zygoma, an acute nasolabial angle, a paranasal deficiency associated with

Table 3 Pairwise comparison between the groups (lateral cephalometrics)—female

Dependent variable	(I) Group	(J) Group	Mean difference (I – J)	Standard error	*p*-Value	95% Confidence interval	
						Lower bound	Upper bound
N-A-Pg (angle)	I	II	9.05	1.09	< 0.001[a]	6.46	11.64
		III	–6.00	1.10	< 0.001[a]	–8.62	–3.39
	II	III	–15.06	1.10	< 0.001[a]	–17.69	–12.43
N-B (II HP)	I	II	–1.45	1.29	0.50 (NS)	–4.51	1.62
		III	–7.57	1.30	< 0.001[a]	–10.66	–4.48
	II	III	–6.12	1.31	< 0.001[a]	–9.23	–3.01
N-Pg (II HP)	I	II	–3.63	1.11	0.004[a]	–6.28	–0.98
		III	–9.02	1.12	< 0.001[a]	–11.69	–6.35
	II	III	–5.39	1.13	< 0.001[a]	–8.08	–2.69
N-ANS (I HP)	I	II	–4.55	1.17	0.001[a]	–7.33	–1.76
		III	–2.85	1.18	0.04[a]	–5.66	–0.04
	II	III	1.69	1.19	0.33 (NS)	–1.14	4.53
PNS-N (I HP)	I	II	–4.30	1.03	< 0.001[a]	–6.76	–1.83
		III	–3.47	1.04	0.004[a]	–5.95	–0.98
	II	III	0.83	1.05	0.71 (NS)	–1.67	3.33
MP-HP (angle)	I	II	–3.15	1.16	0.02[a]	–5.92	–0.38
		III	2.14	1.17	0.17 (NS)	–0.66	4.93
	II	III	5.29	1.18	< 0.001[a]	2.48	8.10
1-NF (I NF)	I	II	–5.48	1.04	< 0.001[a]	–7.95	–3.01
		III	–2.07	1.04	0.12 (NS)	–4.56	0.42
	II	III	3.41	1.05	0.005[a]	0.90	5.91
1-MP (I MP)	I	II	–2.03	1.19	0.21 (NS)	–4.87	0.81
		III	–3.85	1.20	0.005[a]	–6.71	–0.98
	II	III	–1.82	1.21	0.29 (NS)	–4.70	1.07
6-NF (I NF)	I	II	–4.06	1.06	0.001[a]	–6.59	–1.52
		III	–1.81	1.07	0.21 (NS)	–4.37	0.74
	II	III	2.24	1.08	0.10 (NS)	–0.33	4.82
B-Pg (II MP)	I	II	2.69	0.81	0.004[a]	0.76	4.62
		III	1.71	0.82	0.09 (NS)	–0.23	3.65
	II	III	–0.98	0.82	0.46 (NS)	–2.93	0.98
Ar-Go-Gn (angle)	I	II	–2.54	1.24	0.11 (NS)	–5.49	0.42
		III	–3.24	1.25	0.03[a]	–6.22	–0.26
	II	III	–0.70	1.26	0.84 (NS)	–3.70	2.30

Abbreviation: NS, nonsignificant.
Note: Tukey post hoc test, [a]$p < 0.05$ statistically significant, $p > 0.05$ NS.

accentuated nasolabial fold, and short and retrusive upper lip with a thin vermilion. Lack of dental display (vertical deficiency) may also be present. The mandible appears prognathic, which becomes more prominent when there is a vertical maxillary deficiency which results in a further counterclockwise rotation of the mandible.[8]

A study by Alarashi et al[2] has reported that individuals with Class II malocclusion showed significant variations in shapes in craniofacial structures in the frontal plane when compared with individuals with normal occlusion. The narrowing of the base of the nose and contraction of the maxilla were the main components. The reduced maxillary width was coupled with an increase in the vertical height, indicating the compensation for the discrepancy in other dimensions to maintain the balance between skeletal structures.[9] Whereas study by Vásquez et al[10] reported that during the

Table 4 Pairwise comparison between the groups (posteroanterior [P-A] cephalometrics)—female

Dependent variable	(I) Group	(J) Group	Mean difference (I-J)	Standard error	*p*-Value	95% Confidence interval	
						Lower bound	Upper bound
Zyg-Zyg	I	II	−1.29	1.11	0.48 (NS)	−3.94	1.35
		III	2.31	1.12	0.10 (NS)	−0.35	4.98
	II	III	3.61	1.13	0.005[a]	0.92	6.29
Cdl-Cdl	I	II	−0.99	1.18	0.68 (NS)	−3.80	1.83
		III	3.79	1.19	0.006[a]	0.95	6.62
	II	III	4.77	1.20	< 0.001[a]	1.92	7.63
Um-Um	I	II	−2.65	0.73	0.001[a]	−4.39	−0.92
		III	1.75	0.73	0.05 (NS)	0.00	3.49
	II	III	4.40	0.74	< 0.001[a]	2.64	6.16
Lm-Lm	I	II	−2.23	0.78	0.01[a]	−4.09	−0.37
		III	1.38	0.79	0.19 (NS)	−0.49	3.26
	II	III	3.61	0.79	< 0.001[a]	1.73	5.50
Ag-Ag	I	II	−2.67	1.06	0.04[a]	−5.20	−0.14
		III	−1.50	1.07	0.34 (NS)	−4.05	1.05
	II	III	1.16	1.08	0.53 (NS)	−1.41	3.73

Abbreviation: NS, nonsignificant.
Note: Tukey post hoc test, [a]$p < 0.05$ statistically significant, $p > 0.05$ NS.

circumpubertal period, there is no significant deficiency in transverse dentoskeletal relationships. Hence, studies have demonstrated that variations in facial skeletal characteristics do occur in different facial morphology and growth pattern in all three planes of space.

The study by Burke et al[11] showed that condylar head inclination and superior joint space were highly correlated to facial morphology. While the individuals with vertical facial morphology had condyles and posteriorly angled and decreased superior joint spaces, the individuals with horizontal facial morphology had anteriorly angled condyles and increased superior joint spaces.

A study by Alhadlaq[12] showed significant differences in the anterior alveolar dimensions between males and females with different skeletal maxilla-mandibular classifications. This finding is in accordance with the findings of the present study.

The lateral cephalometric analysis described by Burstone et al[13] was used to assess the facial and dental characteristics. Dentoalveolar and facial parameters showed a significant degree of sexual dimorphism associated with maxillary morphology in all three groups of individuals. The majority of the parameters showed male dominance, and the differences were statistically significant. Similar results were also reported by Giovanoli et al[3] and Farakas.[4] Significant differences were observed in several characteristics between the groups in the present study. Significant differences were noted in the skeletal vertical dimension represented by measurements such as N-ANS, ANS-Gn, and MP-HP and the dentoalveolar characteristics like upper 1–NF, lower 1 MP, and upper 6-NF. In the transverse plane also the measured parameters for craniofacial and dental arch widths as measured by the frontal cephalometric analyses showed significant differences between the individuals, suggesting that when the anteroposterior dimension of the maxilla is either reduced or increased, the measured dentoalveolar and skeletal parameters get affected in other dimensions also. A study on skeletal Class III malocclusion[14,15] reported that cases with maxillary retrognathism demonstrate a tendency toward vertical growth pattern as a possible compensation mechanism.

The study by Franchi and Baccetti[5] also reported significant differences in the transverse plane in craniofacial structures in individuals having a skeletal discrepancy in the sagittal plane.

The finding of the present study emphasizes the fact that the facial structures do not behave in isolation and that the diagnosis and treatment planning in orthodontics should always consider the dentofacial characteristics in all three dimensions.

The present study also reinforced the view that not all individuals with maxillary retrognathism or prognathism show all the characteristic features, but rather, they exhibited different combinations of skeletal variations. With this knowledge of individual variations in all three dimensions in dentoskeletal characteristics, orthodontic/orthognathic surgical procedures should be planned such that the outcome of these interventions is harmonious and structurally balanced, keeping in mind of the facial aesthetics.

One of the limitations of the present study could be that the findings reflect the radiological characteristics. The variations in soft tissue thickness may influence the facial dimensions which are important to be considered during clinical evaluations. The dentofacial characteristics also need to be studied in different age groups as well as in different racial groups.

Conclusion

- Dentoalveolar and facial parameters showed a significant degree of sexual dimorphism associated with maxillary morphology in all three groups of individuals. The majority of the parameters showed male dominance, and the differences were statistically significant.
- The facial structures do not behave in isolation and that these differences in facial characteristics should be taken into consideration in all three dimensions during the orthodontic and orthognathic surgical treatment planning.
- Not all individuals with maxillary retrognathism or prognathism show all the characteristic features, but rather, they exhibited different combinations of skeletal variations.

Presentation at a Meeting
None.

Funding
None.

Conflict of Interest
None declared.

Acknowledgments
The authors acknowledge the help of Dean, A B Shetty Memorial Institute of Dental Sciences, Nitte (Deemed to be) University. The study is approved by the central Ethics Committee of the Institution: NU/CEC/PHD/01-10. The study is conducted by the methodology conforming to the Declaration of Helsinki.

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