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Craniofacial characteristics of different growth patterns of Malwa population

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ABSTRACT

Introduction: Variations in craniofacial characteristics occur in different races and different face types. Due to such inherent variations, different standards must be used for different population and gender as reference lines. These norms also vary in different types of growth patterns. No previous study has been reported which compared the craniofacial characteristics cephalometric norms in different growth patterns. So the aim of the present study was to describe the dentofacial characteristics in different growth patterns and also to find out gender differences if any in Class I normal subjects of Malwa population of Madhya Pradesh in India and to compare the craniofacial morphology with Caucasians.

Material and methods: Study sample (labeled as Malwa sample II) comprised of 89 normal adult subjects (43 females and 46 males) of different growth patterns which were divided on the basis of cephalometric norms taken from earlier study conducted on adults of Malwa population (Malwa sample I). The lateral cephalograms were analyzed and the mean values of all parameters were compared with Caucasians. Each parameter was analyzed to find out any differences among growth patterns and to find out gender differences.

Results: Statistically significant differences were found between Malwa population and Caucasians. Some of the parameters showed statistically significant difference between males and females and between horizontal and vertical growers.

Conclusion: Compared to Caucasians, Malwa subjects showed more protusive jaws and proclined incisors along with decreased gonial and nasolabial angle. Males showed more maxillary base length while females showed more nasolabial angle. Horizontal growers showed more protrusive bases while vertical growers had more dental and lip protusion with increased saddle angle and gonial angle.

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1. Introduction

Evaluation of face is carried out through diverse angles by different specialists of different fields. Orthodontists employing cephalometric technique have investigated the relationship between dental occlusion and skeletal balance of the face.

The description of relationship of various craniofacial components among individuals with normal and abnormal facial morphology is one of the most frequently addressed subject in orthodontics literature.

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The differences in facial type and body type must be taken into account when facial proportions are addressed. The skeletal anteroposterior relationship is affected by vertical jaw relationship, i.e. degree of anteroposterior relationship can vary in response to vertical change of dimension.[1] The relationship of facial components varies broadly depending on the face type – whether the face is concave, convex or straight.

In order to treat the full spectrum of malocclusion effectively, it is necessary to understand developing skeletal patterns which effect the maxillary and/or mandibular basal arch relations. Orthodontist should also recognize developing skeletal patterns, their shape and size leading to dentoalveolar compensation.

There exist faces of different vertical face heights. Schudy[2] recognized three different growth patterns, i.e. vertical, average and horizontal. Different vertical facial heights lead to anteroposterior dispositioning of jaws with obvious dentoalveolar compensations. Hence the key to orthodontic diagnosis is to recognize skeletal problem, the location of disharmony and degree of dysplasia.

The main purpose of any classification is to provide a frame of reference for both the normal and abnormal. Angle was first to identify the relation between normal occlusion and facial esthetics. Angle concluded that if the teeth are in a good occlusion, the face should be harmonious. The wide range of normal individual variations is such that there is no practical classification which can encompass every individual. It is thought that dividing the wide normal range into three clinically pertinent facial growth patterns might offer a practical guide for an orthodontist.

Thus, the present study was planned to study the relation of various craniofacial and dental components in different facial growth patterns of male and female adults (18–27 years of age) in Malwa region of Madhya Pradesh and to determine any difference in these cephalometric norms from Caucasians and establish the cephalometric norms for different facial growth patterns of adults of Malwa region of Madhya Pradesh.

2. Materials and method

This study was approved by the Ethical committee of Government College of Dentistry, Indore (M.P). Consent was obtained by asking subjects to sign a form that explained the nature and purpose of the radiographic examination.

2.1. *Sample collection*

1500 Sample were examined who came to Department of Orthodontics, Government college of Dentistry, Indore, M.P. 100 cases met the inclusion criteria. Out of selected 100 cases, 11 cases were rejected because Sella-Nasion plane and Frankfurt horizontal plane were deviated significantly from constructed Horizontal plane. Remaining 89 cases which consisted of 46 males and 43 females were divided in to average growth pattern (12 cases), vertical growth pattern (41 cases), horizontal growth pattern (36 cases) on the basis of SN plane to Go-Gn plane and Jarabak ratio.

Subjects, age range from 18 to 27 years (43 females and 46 males) of different growth patterns were selected on the basis of following criteria.

2.2. *Inclusion criteria*

1. Esthetically acceptable face with no apparent facial deformity.
2. Angle's class-I molar relation and class-I canine relation with normal overjet and overbite with no abnormal spacing, crowding and rotation of teeth.
3. No history of previous orthodontic treatment.

The standard cephalograms were taken in 10 in. × 12 in. (245 mm × 294 mm) radiographic screen (Kiran high speed intensifying screen). Kodak film was used. The subject was placed in the cephalostat with the Frankfurt horizontal plane parallel to the floor and looking straight. The subjects were asked to occlude the teeth with lips in an unstrained position. Tracing was done by 3H lead pencil on Acetate Matte Tracing Paper (0.003 in. thick GATEWAY) 9.5 in. × 11 in. Millimeter scale and protector graduated up to 0.5 mm and 0.5° respectively were used for linear and angular measurements respectively. To eliminate intra-observer error each cephalogram was traced twice by the same operator to evaluate the reliability and reproducibility of landmarks and measurements. Minimal errors indicate that the measurements were reliable.

Following skeletal, dental and soft tissue landmarks were used in the study (Fig. 1). 17 variables were divided into skeletal, dental and soft tissue measurements.

All the subjects were screened cephalometrically on the basis of cephalometric measurements. Mean value were taken from cephalometric norms for Adults of Malwa region published in earlier study[3] which was labeled as Malwa sample I to divide subjects into 3 different growth patterns, i.e. horizontal, average, vertical on the basis of SN plane to Go-Gn plane of 27.64° ± 5° and Jarabak ratio of 69.17 ± 5. The sample of the present study was labeled as Malwa sample II.

3. Statistical analysis

The basic descriptive statistics, including mean standard deviation, standard error of mean and minimum and maximum values were calculated (not shown) for each variable, using SPSS 8.0 Statistical Software Program. *z*-Test was used to determine the differences between different groups. *p*-Value of <0.05 was considered as significant.

4. Results

Table 1 represents the division of growth patterns and number of males and females in each group for all the 89 subjects.

Table 2 represents the statistical comparison of all the parameters for Male and Female subjects of the Malwa sample II.

Table 3 represents the statistical comparison of all the parameters for the Malwa Sample II and Caucasian Sample.

Table 1 – Sample size, growth patterns and number of males and females in each group.

Growth pattern ($n = 89$)	Females ($n = 43$)	Males ($n = 46$)
Average (12)	5	7
Horizontal (36)	17	19
Vertical (41)	21	20

Table 4 represents the mean and standard deviation of all the parameters in cases of average, vertical and horizontal growth pattern of Malwa sample II and the statistical comparison amongst them.

5. Discussion

Cephalometric standards used in orthodontic diagnosis act as reference lines by which person is compared. Standards that are unique for age, sex, and face type attempt to bring that reference line closer to the individual patients. Therefore, we must use standards for each patients with regard to age, sex, race, and face type.

There exists different facial, skeletal and dental morphology in different individuals. Only a few individuals are near to ideal. Thus, if treatment objectives are set on one type or near to ideal individual, it becomes unrealistic approach toward treatment.

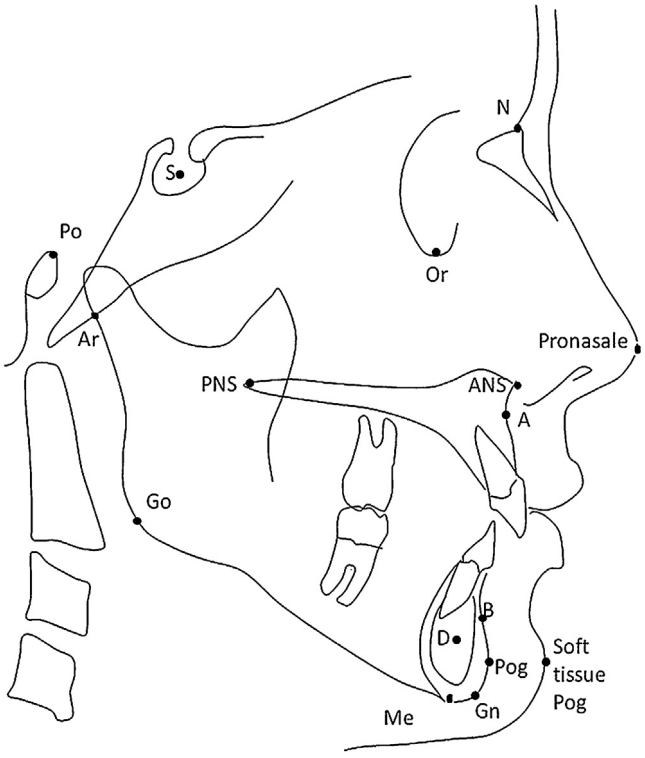


Fig. 1 – Landmarks used in the study.

Table 2 – Statistical comparison of all the parameters for male and female subjects of the Malwa sample II.

S. no.	Parameter	Females ($n = 43$) Mean ± SD	Male ($n = 46$) Mean ± SD	z-Test	*p*-Value
Maxillary skeletal					
1.	SNA (°)	82.7 ± 3.7	82.4 ± 3.4	0.3617	>0.020
2.	Angle of facial convexity (°)	168.4 ± 3.9	168.4 ± 3.9	0.0885	≫0.020
3.	Maxillary base length (mm)	49.8 ± 2.3	52.5 ± 2.8	4.8375	**<0.0005****
Maxillary dental					
4.	1 to SN (°)	109.1 ± 5.1	108 ± 5.4	1.0228	>0.05
5.	1 to NA (°)	26 ± 4.5	25.6 ± 5.1	0.3640	≫0.20
6.	1 to NA (°)	7.1 ± 1.8	6.7 ± 1.7	0.9660	>0.20
Mandibular skeletal					
7.	SNB (°)	80.7 ± 3.7	80.25 ± 3.4	0.6767	>0.20
8.	SND (°)	78.2 ± 3.5	78 ± 3.4	0.3656	≫0.20
9.	ANB (°)	1.9 ± 1.9	2.2 ± 1.9	0.6874	>0.20
10.	Mandibular base length (mm)	50.1 ± 4.9	51.2 ± 4.3	1.1082	>0.20
Mandibular dental					
11.	1 to NB (°)	29.6 ± 5	27.8 ± 6	1.5120	>0.10
12.	1 to NB (mm)	6.1 ± 1.7	6 ± 1.7	0.2904	≫0.20
Soft tissue					
13.	Nasolabial angle (°)	99.3 ± 8.3	96.3 ± 6.9	1.8298	**<0.05***
14.	Lower lip to E-plane (mm)	−1.2 ± 8.3	−0.7 ± 2	1.0200	>0.20
Angular measurements					
15.	Saddle angle (°)	125 ± 5.2	124.4 ± 4.9	0.5439	>0.05
16.	Articular angle (°)	139.1 ± 5.5	140.7 ± 6.7	1.1673	>0.02
17.	Gonial angle (°)	123.7 ± 6	122.1 ± 5.4	1.2993	>0.10

* Significant.
** Highly significant.

Table 3 – Statistical comparison of all the parameters for the Malwa sample II and Caucasian sample.

S. no.	Parameter	Standard norms (Caucasians) Mean ± SD	Present study (n = 89) Mean ± SD	z-Test	p-Value
Maxillary skeletal					
1.	SNA (°)	82 ± 2	82.6 ± 3.5	2.9414	<.01**
2.	Angle of facial convexity (°)	166.5 ± 1.2	168.4 ± 3.9	14.1743	≪.01**
Maxillary dental					
3.	1 to SN (°)	104 ± 4	108.5 ± 5.3	10.7987	≪.01**
4.	1 to NA (°)	22 ± 4	25.8 ± 4.8	9.0629	≪.01**
5.	1 to NA (mm)	4 ± 2	6.9 ± 1.8	13.7269	≪.01**
Mandibular skeletal					
6.	SNB (°)	80 ± 2	80.5 ± 3.5	2.3584	<.01**
7.	SND (°)	76.5 ± 0.7	78.1 ± 3.4	21.8896	≪.01**
8.	ANB (°)	2 ± 1	2.1 ± 1.9	0.9539	≫0.1
Mandibular dental					
9.	1 to NB (°)	25 ± 4	28.6 ± 5.6	8.6787	≪.01**
10.	1 to NB (mm)	4 ± 2	6.1 ± 1.7	9.9904	≪.01**
Soft tissue					
11.	Nasolabial angle (°)	105 ± 8	97.8 ± 7.7	8.4667	≪.01**
12.	Lower lip to E-plane (mm)	−2 ± 2	−1 ± 2	4.7169	<.01**
Angular measurements					
13.	Saddle angle (°)	123 ± 5	124.7 ± 5	3.2435	<.01**
14.	Articular angle (°)	143 ± 6	139.9 ± 6.1	4.7434	≪.01**
15.	Gonial angle (°)	128 ± 7	122.9 ± 5.8	6.8672	≪.01**

* Significant.
** Highly significant.

Therefore, as an integral part of systematic evaluation of dentofacial discrepancies, it is important to define differences among various facial types. So the present study was chosen to evaluate craniofacial characteristics in different growth patterns and also to find out differences between male and female subjects in Malwa Region of Madhya Pradesh.

Cephalometric norms of adults of Malwa population (labeled as Malwa sample I) was used as standard. Present study sample was labeled as Malwa sample II. One should expect a degree of interrelation between the different structures which form the craniofacial complex. Therefore, a single parameter should not be expected to accurately reflect all these interactions. Hence the parameters, SN-GoGn angle and Jarabak ratio were used to classify 89 cases into average, horizontal and vertical growth patterns. z-Test was applied to each parameter and 'z' value and 'p' value was determined for each parameter. Each parameter was analyzed to find out sexual dimorphism, if any. The results of this study were compared with the standard norms of Caucasian population given by Steiner[4] which are mostly highly accepted universally. Different parameters for different growth patterns were compared to each other.

These cephalometric norms of Malwa sample II were comparable to previous study[3] conducted on Malwa sample of smaller sample size.

Results obtained in the present study showed slightly more protrusive skeletal bases with more bimaxillary dental protrusion than that of Caucasians. Less gonial angle was found in the present study implying anterior direction of growth of mandible in Malwa sample II subjects than Caucasians. ANB angle commonly used to determine the relative position of maxilla and mandible showed similarity to Caucasians (Table 3).

Soft tissue evaluation showed slightly less nasolabial angle than that of Caucasians. This could be because of protrusive maxillary skeletal and dental measurements in comparison to Caucasians. Lower lip to esthetic plane was significantly higher as compared to Caucasians (Table 3).

No previous study has been conducted which compared skeletal, dental and soft tissue cephalometric norms in different growth patterns. Among different growth patterns, horizontal growers showed more protrusive bases than vertical growers while vertical growers showed more protrusive and proclined incisors than horizontal growers. Saddle angle was more in vertical growers indicating distal position of glenoid fossa that might be the reason for less protrusive bases in vertical growers as compared to horizontal growers. Although the mandibular base length was similar in vertical and horizontal growers but mandible was placed more distally in vertical growers (large saddle angle). Gonial angle was more in vertical growers than horizontal growers. On soft tissue evaluation it was found that lips were more protrusive in vertical growers. This could be because of more protrusive incisors in vertical growers (Table 4).

No statistical significant differences were seen in between average and horizontal growers except lower lip protrusion which was more in horizontal growers. Individuals with vertical growth pattern had retrognathic maxilla and mandible than average growers (Table 4).

In gender differentiation, among all parameters male showed more maxillary base length while females showed more nasolabial angle that could be due to less maxillary base length (Table 2).

Table 4 – Mean and standard deviation of all the parameters in cases of average, vertical and horizontal growth pattern of Malwa sample II and the statistical comparison between average with vertical, vertical with horizontal and average with horizontal growth patterns.

S. no.	Parameter	Average growth pattern Mean ± SD	Vertical growth pattern Mean ± SD	Horizontal growth pattern Mean ± SD	Average vs vertical growth pattern *p*-Value	Vertical vs horizontal growth pattern *p*-Value	Average vs horizontal growth pattern *p*-Value
Maxillary skeletal							
1.	SNA (°)	83.5 ± 2.6	80.9 ± 3.4	83.8 ± 3.6	**<.01****	**<.01****	≫.10
2.	Angle of facial convexity (°)	167.5 ± 3.8	168.4 ± 4	169 ± 3.8	>0.10	≫.10	>.05
3.	Maxillary base length (mm)	51.5 ± 3.5	50.5 ± 2.4	51.5 ± 3.1	>.10	>.05	≫.10
Maxillary dental							
4.	1 to SN (°)	108.7 ± 8.2	107 ± 3.5	109.9 ± 5.3	≫.10	**<.01****	≫.10
5.	1 to NA (°)	24.5 ± 6.3	25.7 ± 4.3	26.3 ± 4.6	≫.10	**≫.10****	≫.10
6.	1 to NA (mm)	6.6 ± 2.4	7.4 ± 1.7	6.5 ± 1.6	>.05	**<.01****	≫.10
Mandibular skeletal							
7.	SNB (°)	81 ± 3.1	78.7 ± 3	81.9 ± 3.6	**<0.01****	**<.01****	≫.10
8.	SND (°)	78.7 ± 2.8	76.3 ± 2.9	79.5 ± 3.5	**<0.01****	**<.01****	≫.10
9.	ANB (°)	2.4 ± 1.8	2.2 ± 1.7	1.8 ± 2	≫.10	≫.10	≫.10
10.	Mandibular base length (mm)	49.4 ± 3.7	51.4 ± 4.7	50.4 ± 4.8	>.05	≫.10	≫.10
Mandibular dental							
11.	1 to NB (°)	28.3 ± 5.4	29.6 ± 5.2	27.4 ± 5.8	≫.10	**<.05***	≫.10
12.	1 to NB (mm)	5.9 ± 1.6	6.8 ± 1.5	5.4 ± 1.7	>.05	**<.01****	≫.10
Soft tissue							
13.	Nasolabial angle (°)	97.5 ± 6.8	98.1 ± 6.9	97.2 ± 8.7	≫.10	≫.10	≫.10
14.	Lower lip to E-plane (mm)	−0.08 ± 2.3	−0.7 ± 2	−1.6 ± 1.8	≫.10	**<.05***	**<.05****
Angular measurements							
15.	Saddle angle (°)	123.6 ± 5.4	125.7 ± 5.1	123.7 ± 4.8	>.10	<0.5	≫.10
16.	Articular angle (°)	141.4 ± 7.3	141.4 ± 6.2	139.1 ± 6.4	≫.10	**>.05***	≫.10
17.	Gonial angle (°)	122.6 ± 4.4	125.1 ± 5.4	120.51 ± 5.5	>0.05	**≪.01****	>.05

* Significant.
** Highly significant.

In comparison to other Indian ethnic groups, Malwa sample II had more protrusive maxilla and mandible than that of Bombay cosmopolitan sample[5] and Indo-Aryans[6] whereas maxillary and mandibular apical base was less protrusive in Malwa sample II than that of adult Keralites.[7] Upper incisors were more proclined in relation to SN and NA plane in Malwa sample II compared to Indo-Aryans whereas less proclined upper and lower incisors compared to Bombay cosmopolitan sample and adult Keralites. Articular angle and Saddle Angle were less and Gonial angle was more in Malwa sample II as compared to Indo-Aryans.

6. Conclusion

1. Significant prognathic maxillary and mandibular skeletal bases and bimaxillary dental protrusion were found in Malwa population than that of Caucasians. Gonial angle and nasolabial angle in Malwa sample subjects were less as compared to Caucasians.
2. Males showed more maxillary base length while females showed more nasolabial angle.
3. Horizontal growers showed more protrusive bases than vertical growers while vertical growers showed more of dental protrusion along with increased saddle angle and gonial angle than horizontal growers. Significant lip protrusion was found in vertical grower.
4. No significant difference was seen for all the variables between average and horizontal growers except lower lip protrusion which was more in horizontal growers. Individuals with vertical growth pattern had retrognathic maxilla and mandible than average grower individuals.

Conflicts of interest

The authors have none to declare.

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