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Comparison of dentoskeletofacial cephalometric values of Malwa population of Madhya Pradesh with other racial and ethnic groups

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Keywords:
Indian cephalometric norms
Caucasian norms
Indian ethnic groups

ABSTRACT

Introduction: Different races have different dentoskeletal morphology and pattern. What is considered aesthetic and pleasing for one ethnic group may not be considered likewise in another group. Normative data, based on a single ethnic group or race, do not represent all. This study was undertaken to study and compare the cephalometric dentofacial values of the Malwa population of Madhya Pradesh state in India and to compare the craniofacial morphology of Malwa population with other races and Indian ethnic groups.

Methods: The study sample comprised of 50 normal adult subjects (26 males, 24 females). The lateral cephalograms were analyzed with cephalometric analysis for various parameters. The mean values of all parameters were compared to four international populations and five groups of Indian ethnic origin. The 'Z' test was applied to each parameter and the 'Z' value and the '*p*' value was determined for each parameter.

Results: Statistically significant differences were found between study population and different groups compared on certain parameters.

Conclusion: Compared to internationally well-acclaimed Caucasian norms, Malwa subjects had more protrusive lips, and protruded incisors. The maxillary apical base was found to be more anteriorly placed with normal or comparable mandibular apical base. Subjects exhibited horizontal growth pattern predominantly.

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1. Introduction

In the current orthodontic practice, it has become mandatory for the clinician to recognize the infinite variations inherent to the human race. A number of investigators noticed variations of the craniofacial morphology in different clinical groups. Since its inception, the cephalometrics has facilitated the clinician in making an accurate diagnosis, treatment planning and in evaluating the prognosis of orthodontic treatment. Normal measurement of one ethnic group should not be considered normal for another racial group. This, different racial groups will have to be treated according to their own individual characteristics. Thus, justifies the need to study the craniofacial morphology of the heterogeneous Indian population, which has been classified into six ethnic elements constituting the main types in the Indian population namely, Australoids, Dravidians, Indo-Aryans, Irano-Scynthians, Mundari speaking people of central India and Mongolians. Since India is a subcontinent with a large number of racial subgroups and several religions and interracial mixtures, it was proposed therefore to study only the individuals derived

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http://dx.doi.org/10.1016/j.jpfa.2013.11.002

from Madhya Pradesh Hindu population of the Malwa region. To date, no such cephalometric study has been carried out on the Malwa population and hence the study was undertaken.

2. Aims and objectives

1. The purpose of the present study was to evaluate the dento-skeleto-facial characteristics of subjects from Madhya Pradesh, Malwa region in the age group of 18–25 years.
2. To compare the Malwa population cephalometric values with the other races and Indian ethnic groups.

3. Material and methods

1000 patients coming to the department of orthodontics were screened for the study, from which 100 were selected based on the following selection criteria. Extraoral and intraoral photographs of these patients were taken and shown to 3 orthodontists, and final sample of 50 subjects (26 males and 24 females) were selected for the study. All the subjects were informed about the study. Approval was taken from the ethical committee of the institution.

1. Adult Madhya Pradesh subjects, age ranging from 18 to 25 years
2. Average built without any physical deformity
3. Subjects without any facial asymmetry and/or mandibular deviation
4. Molar and canine relation – Angle's class I
5. All permanent teeth from second permanent molar to second permanent molar on both sides were present.
6. Not more than 3 mm of overjet and 3 mm of overbite.
7. Absence of severe crowding, dental/skeletal protrusions, cross-bite, dental asymmetry ectopic eruptions, supernumerary teeth, retained deciduous teeth and deep curve of Spee
8. Pleasing soft tissue profile with competent lips
9. No history of previous orthodontic treatment.

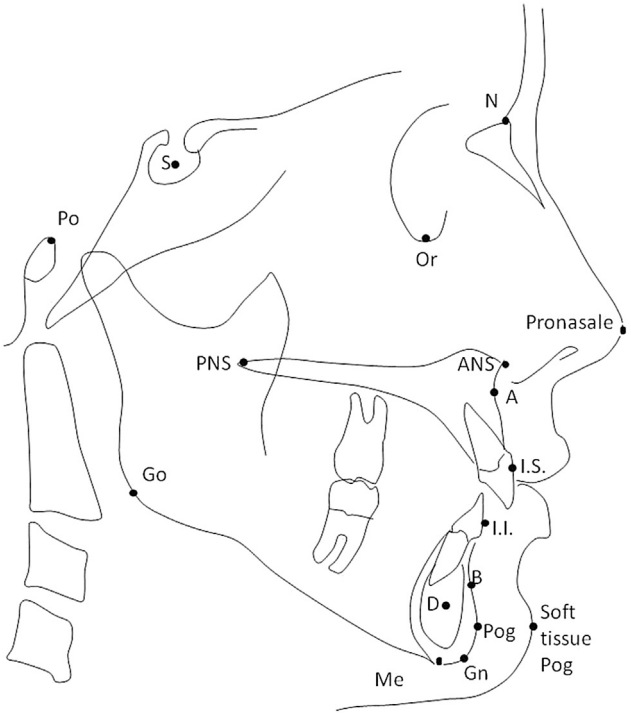


Fig. 1 – Landmarks used in the study. S – sella; Po – porion; N – nasion; Or – orbitale; A – subnasale (point A); ANS – anterior nasal spine; B – supramentale (point B); PNS – posterior nasal spine; D – point D, Pog – Ppgonion; Go – gonion; I.I. – incision inferius; Gn – gnathion; I.S. – incision superius; Me – menton.

The lateral cephalograms were taken in standardized way with the subject placed in the cephalostat and the Frankfurt horizontal plane parallel to the floor, looking straight in the mirror mounted on the wall. The subjects were asked to occlude the teeth with the lips in an unstrained position. The exposure was such that there was no burn-out of soft-tissue makings.

Tracing was done with a 3H lead pencil on acetate Matte tracing paper. To eliminate intra-operator error, each cephalogram was traced twice by the same operator and the mean of the two measurements were taken.

Several skeletal and dental hard tissue points were selected for linear and angular measurements (see Fig. 1).

The following dental, skeletal and soft tissue measurements were taken for the study. For the sake of classification, these were grouped under the following:

Landmarks	
1. Sella (S)	2. Porion (Po)
3. Nasion (N)	4. Orbitale (Or)
5. Subnasale (point A)	6. Anterior nasal spine (ANS)
7. Supramentale (point B)	8. Posterior nasal spine (PNS)
9. Point D	10. Pogonion (Pg)
11. Gonion (Go)	12. Incision inferius (I.I.)
13. Gnathion (Gn)	14. Incision superius (I.S.)
15. Soft tissue pogonion	16. Menton (Me)
17. Pronasale	

1. Skeletal parameters: (Fig. 2)

Measurements:
1. SNA angle
2. Facial convexity
3. SNB
4. SND
5. ANB
6. Facial angle
7. Y-axis angle
8. FMPA (Frankfurt mandibular plane angle)
9. Mandibular plane angle (Go–Gn–SN)
10. Anterior facial height (AFH)
11. Posterior facial height (PFH)
12. Jaraback's ratio

2. Dental parameters: (Figs 3 & 4)

Measurement
1. Upper incisor to SN plane
2. Upper incisor to palatal plane
3. 1/to NA (angle)
4. 1/to NA (linear)
5. 1/to A-Po (linear)
6. IMPA
7. Lower incisor to NB (angular)
8. Lower incisor to NB (linear)
9. Lower incisor to A-Po (linear)
10. Lower incisor to A-Po (angular)
11. Interincisal angle

3. Soft tissue parameters: (Fig. 4)

Measurement
1. Nasolabial angle
2. Lower lip to E-plane

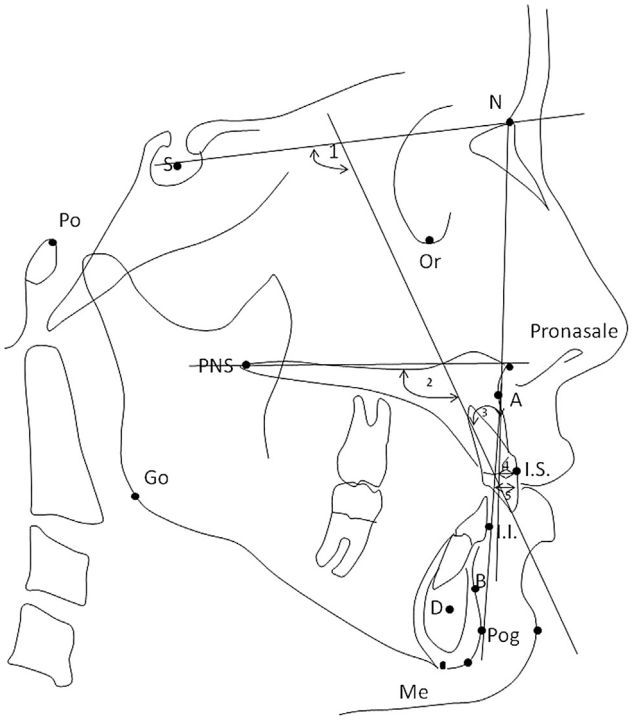


Fig. 3 – Maxillary dental measurements. 1 – upper incisor to SN plane; 2 – upper incisor to palatal plane; 3–1/to NA (angle); 4–1/to NA (linear); 5–1/to A-Po (Linear).

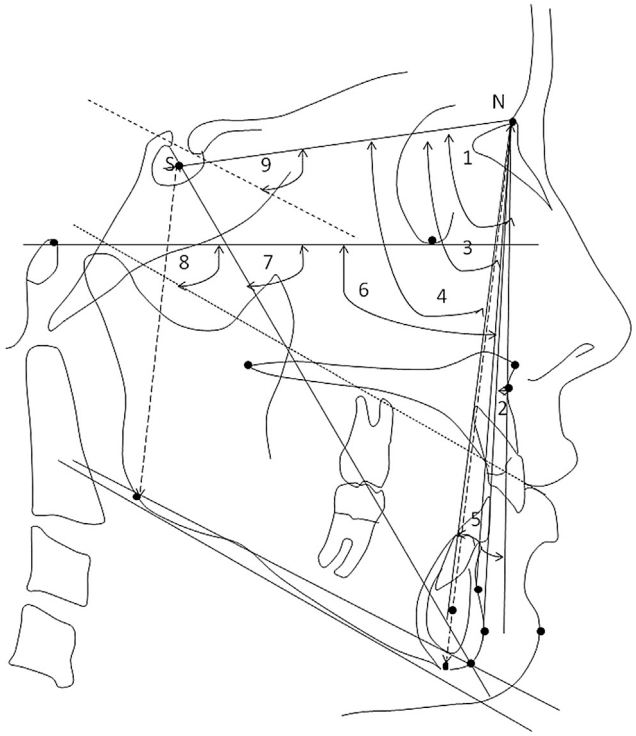


Fig. 2 – Skeletal measurements used in the study. 1 – SNA angle; 2 – facial convexity; 3 – SNB angle; 4 – SND angle; 5 – ANB angle; 6 – Facial Angle; 7 – Y-Axis angle; 8 – FMPA (Frankfurt mandibular plane angle); 9 – Mandibular plane angle (Go–Gn–SN).

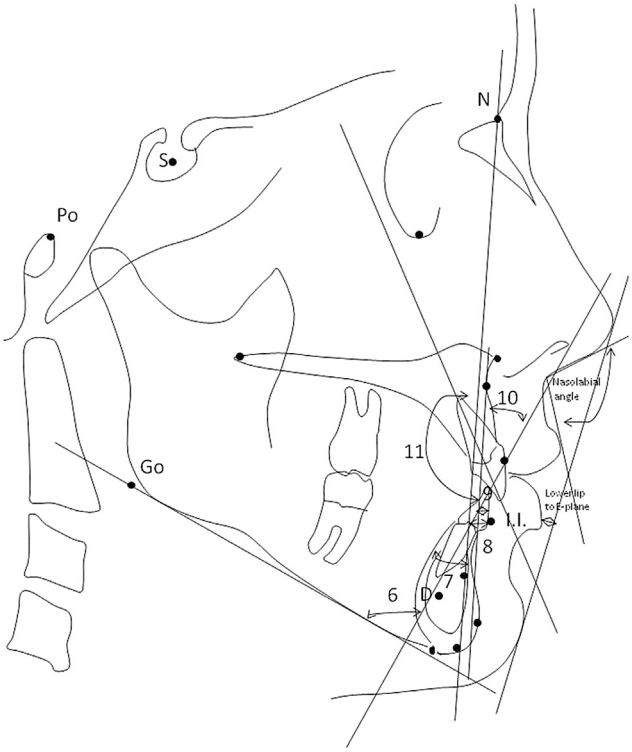


Fig. 4 – Mandibular dental measurements and soft tissue measurements. 6 – IMPA; 7 – lower incisor to NB (angular); 8 – lower incisor to NB (linear); 9 – lower incisor to A-Po (linear); 10 – lower incisor to A-Po (angular); 11 – interincisal angle.

Table 1 – Mean, standard deviation, minimum value, maximum value and range of all the parameters in the Malwa sample.

Sr. no.	Parameter	Mean	SD	Minimum value	Maximum value	Range
I. Skeletal parameters						
1	SNA (°)	82.98	3.6796	76	92	16
2	Facial convexity (mm)	+1.56	2.8442	−4	+7	11
3	SNB (°)	80.62	3.8930	75	91	16
4	SND (°)	77.35	3.0070	72	87	15
5	ANB (°)	2.36	2.0761	−2	6	8
6	Facial angle (°)	86.2	3.7598	78	91	13
7	Y-axis (°)	59.96	4.2229	54	70	16
8	FMPA (°)	25.18	4.7987	16	35	19
9	Go–Gn–SN (°)	27.64	5.8643	15	40	25
10	Anterior facial height (mm)	118.9	7.5874	102	132	30
11	Posterior facial height (mm)	82.58	6.6815	71	95	24
12	Jaraback's ratio (%)	69.17	5.1589	59	77.6	18.6
II. Dental parameters						
13	1 to SN (°)	110.22	6.1426	98	127	29
14	1 to PP (°)	117.88	5.3801	104	130	26
15	1 to NA (°)	26.14	5.9363	15	37	22
16	1 to NA (mm)	5.56	2.5310	0	10	10
17	1 to A-Po (mm)	6.28	1.8979	3	12	9
18	IMPA (°)	100.46	6.1096	78	119	41
19	Lower incisor to NB (°)	29.44	4.0306	20	40	20
20	Lower incisor to NB (mm)	6.02	1.8628	2	10	8
21	Lower incisor to A-Po (mm)	3.4	1.8939	0	9	9
22	Lower incisor to A-Po (°)	28.9	3.4423	22	38	16
23	Interincisal angle (°)	122.4	5.8053	110	134	24
III. Soft tissue						
24	Nasolabial angle (°)	99.6	10.738	85	124	39
25	Lower lip to E-plane (mm)	−0.18	2.3038	−5	+5	10

4. Results/observations

The following measurements were significantly increased in Malwa population as compared to the Caucasian norms.

1. SNA
2. Facial convexity
3. Jaraback's ratio
4. Upper incisor to SN
5. Upper incisor to PP
6. Upper incisor to NA (angle)
7. Upper incisor to NA (mm.)
8. Upper incisor to A-Pog (mm.)
9. Lower incisor to N–B plane (Angle)
10. Lower incisor to N–B plane (mm.)
11. IMPA
12. Lower incisor to A-Po plane (Angle)
13. Lower incisor to A-Po plane (Linear)
14. Lower lip to E-line

The following measurements showed statistical similarity to Caucasians (insignificant difference):

1. SNB
2. SND
3. ANB
4. Facial angle
5. Y-axis
6. FMPA,

while the following showed statistically significant decrease:

1. Go–Gn–SN
2. Interincisal angle
3. Nasolabial angle

The measurement error for linear measurements and angular measurements was within 0.25 mm and 0.25° respectively. Mean values of the current study are compared to the Indian ethnic groups and other races (Tables 1–3).

5. Discussion

Knowledge of the normal dentofacial and skeletal cephalometric patterns of adults belonging to various ethnic groups is extremely important to the orthodontist for clinical and research purpose. Since dentofacial characteristics and norms vary from one race to another, awareness of the normal dentofacial pattern of each ethnic group will undoubtedly ensure better success of treatment to establish optimal facial harmony.

The 50 subjects taken from the sample of 1000 subjects represents only 5% of the original sample. Since the starting

Table 2 – Comparison of mean values of various parameters of current study with the international racial mean values.

Sr. no.	Parameter	Current study (Mean ± SD)	Caucasians Mean (*p* value)	Japanese Mean (*p* value)	Chinese Mean (*p* value)	Negro Mean (*p* value)
I. Skeletal parameters						
1	SNA (°)	82.98 ± 3.68	82 (<0.05)	81.3 (<0.0005)	83.78 (>0.05)	84.7 (<0.05)
2	Facial convexity (mm)	1.56 ± 2.84	−2 (<0.0005)			
3	SNB (°)	80.62 ± 3.89	80 (>0.10)	76.3 (<0.0005)	79.88 (>0.05)	79.2 (<0.01)
4	SND (°)	77.35 ± 4.00	76–77 (>0.10)	73.4 (<0.0005)		75.8 (<0.005)
5	ANB (°)	2.36 ± 2.08	2 (>0.10)	4.5 (<0.0005)	3.9 (<0.0005)	5.5 (<0.0005)
6	Facial angle (°)	86.2 ± 3.76	87 (>0.05)		80 (<0.0005)	
7	Y-Axis (°)	59.96 ± 4.22	59 (>0.05)		70.25 (<<0.0005)	
8	FMPA (°)	25.18 ± 4.80	25 (>>0.10)			30.6 (<0.0005)
9	Go–Gn–SN (°)	27.64 ± 5.86	32 (<0.0005)	36.2 (<<0.0005)	33.2 (<0.0005)	38.2 (<<0.0005)
10	Anterior facial height (mm)	118.9 ± 7.59				
11	Posterior facial height (mm)	82.58 ± 6.68				
12	Jaraback's Ratio (%)	69.17 ± 5.16	62–65 (<0.0005)			
II. Dental parameters						
13	1 to SN (°)	110.22 ± 6.14	104 (0.0005)		107.11 (<0.01)	108.9 (>0.05)
14	1 to PP (°)	117.88 ± 5.38	110 (<<0.0005)			
15	1 to NA (°)	26.14 ± 5.94	22 (<0.0005)	24.1 (<0.01)	23.5 (<0.01)	24.1 (<0.005)
16	1 to NA (mm)	5.56 ± 2.53	4 (<0.0005)	5.9 (>0.10)		7.4 (<0.0005)
17	1 to A-Po (mm)	6.28 ± 1.90	2.7 (<<0.0005)		10.12 (<<0.0005)	
18	IMPA (°)	100.46 ± 6.11	90 (<<0.0005)		98.38 (<0.05)	100 (>>0.10)
19	Lower incisor to NB (°)	29.44 ± 4.03	25 (<0.0005)	31.2 (<0.0005)		36.7 (<<0.0005)
20	Lower incisor to NB (mm)	6.02 ± 1.86	4 (<0.0005)	7.8 (<0.0005)		11.4 (<<0.0005)
21	Lower incisor to A-Po (mm)	3.4 ± 1.89	1 (0.0005)		7.03 (<<0.0005)	
22	Lower incisor to A-Po (°)	28.9 ± 3.44	22 (<<0.0005)			
23	Interincisal angle (°)	122.4 ± 5.81	135.4 (<<0.0005)	120.3 (<0.0005)	121.68 (>>0.10)	113.8 (<0.0005)
III. Soft tissue						
24	Nasolabial angle (°)	99.6 ± 10.74	105 (<0.0005)			
25	Lower lip to E-plane (mm)	−0.18 ± 2.30	−2 (<0.0005)		2.8 (<<0.0005)	

sample was representative of the Malwa adults between 18 and 25 years, the studied sample could be taken as a representative of the middle socio-economic strata of the Indore Malwa population. The results of this study are compared with the standard norms of the Caucasian population which are most highly accepted universally.

The values of various cephalometric parameters were compared with caucasian norms given by Steiner[1] and with various other groups, those comprising Indian population and those not comprising the Indian population. The ethnic groups which were taken for comparison included the Japanese,[2] the Chinese,[3] and the Negro race.[4] Those comprising the Indian population included the Bombay Cosmopolitan group,[5] the Keralites,[6] and the Indo-Aryans.[7] Care was taken to ensure that the different groups that were compared with the Malwa sample comprised of subjects within the same approximate age group as that of the current study.

The different parameters analysed on lateral cephalometric radiographs and compared to the standard norms of other races and Indian ethnic groups have been discussed below (Tables 2 and 3).

Evaluating SNA angle, it is interesting to note that the maxillary base is more prognathic as compared to the Caucasian norms, but less prognathic as compared to Japanese and Negroes. The value was comparable to Chinese subjects. When compared to Indian ethnic groups, maxillary base was significantly more pronounced when compared to Bombay cosmopolitan group and Indo-Aryans; whereas the same was significantly less pronounced in comparison to Keralite subjects.

The mean value of SNB angle was quite similar to Caucasian norms indicating the similarity in position of mandible between two groups but the position of mandible was more retrognathic in comparison to Japanese and Negroes. The position of mandible was similar to Chinese group. Compared to Indian groups, our value was significantly increased, showing prognathic mandible in comparison to Bombay population and Indo-Aryans. The position of mandible was significantly retrusive in comparison to Keralite group. Thus, Malwa subjects showed less pronounced skeletal bases as compared to the Keralite group and more pronounced as compared to Bombay group.

SND angle showed that position of centre of symphysis was placed more forward than Caucasian, Japanese, and Negroes. Compared to Bombay population, Keralite groups and Indo-Aryans, it was significantly more forward.

ANB angle which is used as most common indicator to determine the relative position of maxillary and mandibular jaws to each other showed similarity to Caucasians. However, it was significantly decreased as compared to Japanese, Negroes but increased as compared to Chinese group.

The relative position of maxilla and mandible in a present study was similar to Bombay, and Keralite populations.

The mean value of facial convexity was significantly more as compared to Caucasians, showing convex profile as compared to Caucasians.

Table 3 – Comparison of mean values of various parameters of current study with the other Indian ethnic groups' mean values.

Sr. No.	Parameter	Current study (Mean ± SD)	Indo-Aryans females Mean (*p* value)	Bombay sample Mean (*p* value)	Keralite sample Mean (*p* value)
I. Skeletal parameters					
1	SNA (°)	82.98 ± 3.68	81.16 (<0.0005)	81.4 (>0.05)	84.14 (<0.01)
2	Facial convexity (mm)	1.56 ± 2.84			
3	SNB (°)	80.62 ± 3.89	78.46 (<0.0005)	79.18 (<0.005)	81.85 (<0.01)
4	SND (°)	77.35 ± 4.00	76.02 (<0.0005)	76.22 (<0.05)	79.36 (<0.0005)
5	ANB (°)	2.36 ± 2.08	3.15 (<0.0005)	2.22 (>>0.10)	2.27 (>>0.10)
6	Facial angle (°)	86.2 ± 3.76	82.42 (<0.0005)		
7	Y-Axis (°)	59.96 ± 4.22	64.05 (<0.0005)		
8	FMPA (°)	25.18 ± 4.80			29.4 (<0.0005)
9	Go–Gn–SN (°)	27.64 ± 5.86		28.75 (>0.05)	27.91 (>0.10)
10	Anterior facial height (mm)	118.9 ± 7.59			
11	Posterior facial height (mm)	82.58 ± 6.68			
12	Jaraback's Ratio (%)	69.17 ± 5.16			
II. Dental parameters					
13	1 to SN (°)	110.22 ± 6.14	103.82 (<0.0005)		
14	1 to PP (°)	117.88 ± 5.38			
15	1 to NA (°)	26.14 ± 5.94		27.26 (>0.05)	27.44 (>0.10)
16	1 to NA (mm)	5.56 ± 2.53	5.15 (>0.10)	9.19 (<0.0005)	7.46 (<0.0005)
17	1 to A-Po (mm)	6.28 ± 1.90	2.25 (<<0.0005)		
18	IMPA (°)	100.46 ± 6.11	96.84 (<0.0005)		98 (<0.005)
19	Lower incisor to NB (°)	29.44 ± 4.03		30.21 (>0.10)	30.75 (<0.05)
20	Lower incisor to NB (mm)	6.02 ± 1.86	5.16 (<0.005)	8.89 (<0.0005)	7.5 (<0.0005)
21	Lower incisor to A-Po (mm)	3.4 ± 1.89			
22	Lower incisor to A-Po (°)	28.9 ± 3.44			
23	Interincisal angle (°)	122.4 ± 5.81	128.29 (<0.0005)	120.79 (>0.10)	119.69 (<0.005)
III. Soft tissue					
24	Nasolabial angle (°)	99.6 ± 10.74			
25	Lower lip to E-plane (mm)	−0.18 ± 2.30	−0.26 (>>0.10)		

Facial angle showed insignificant decrease as compared to Caucasians. Chinese subjects had lower value which was highly significant than our group. Indo-Aryans also have highly significant lower value as compared to our group.

Y-axis was increased as compared to Caucasians but the increased value was not statistically significant. Chinese subjects had very high significant greater value as compared to our group, while as compared to Indo-Aryans, our value is significantly greater.

Mandibular plane to cranial base plane revealed that the angle was significantly smaller as compared to Caucasians. It can be said that the Malwa population exhibits more horizontal pattern as compared to Caucasians, Japanese, Negroes and Chinese subjects.

Bombay population and Keralite subjects were quite similar to Malwa group regarding Go–Gn to SN plane angle.

As far as FH- mandibular plane angle was concerned, it was statistically similar to the Caucasians, Negro subjects. Keralites had significantly higher value in comparison to Malwa subjects, showing relatively vertical growth.

Jaraback ratio showed significantly higher percentage value as compared to Caucasians indicating relatively horizontal growth pattern of Malwa population.

Dental parameters were significantly different from Caucasians. There was bidental protrusion in Malwa population as compared to Caucasian norms. Both linear and angular dental measurement showed protrusive maxillary and mandibular incisors.

These findings along with more acute interincisal angle demonstrated the fact that upper and lower incisors of Malwa subjects were more procumbent and proclined when compared with that of Caucasian subjects. Interincisal angle demonstrated similar value as compared to Bombay while Keralites had lower value and Indo-Aryans had higher value.

Compared to Indo-Aryans, Malwa group showed procumbent upper incisors as demonstrated by upper incisor to SN plane angle. Malwa sample showed statistically similar values of upper incisor to NA angle with Bombay and Keralite subjects but linear measurements showed significant decrease as compared to Bombay and Keralite subjects, however, Indo-Aryans had similar values as compared to our group.

IMPA was significantly higher in comparison to Keralites and Indo-Aryans. Lower incisor to NB angle was statistically similar to Bombay population but Keralite subjects had significantly higher values. Lower incisor to NB linear measurement demonstrated significantly lower value as compared to Bombay and Keralite subjects while Indo-Aryans reported lower value than Malwa subjects.

Nasolabial angle was significantly decreased as compared to Caucasians. This could be because of protrusive maxillary skeletal and dental measurements in comparison to Caucasians. Lower lip to aesthetic plane was significantly higher as compared to Caucasians.

6. Conclusion

In all, 17 measurements were found to have statistically significant difference from the Caucasian norms.

1. The maxillary apical base in Malwa population is significantly more prognathic (SNA = 82.98) in relation to the anterior cranial base. The skeletal facial profile in the Malwa subjects was more convex than in the Caucasians. (facial convexity = 1.56 mm). This can be attributed to the increased maxillary prognathism.
2. The maxillary incisors in the study sample were significantly more protrusive in relation to SN plane, palatal plane, NA plane and A-Po plane as compared to the Caucasians.
3. The antero-posterior position of the mandibular apical base in relation to the anterior cranial base in Malwa sample subjects was similar to the Caucasians.
4. The lower incisors were significantly more procumbent in the study sample, relative to the mandibular plane as evidenced by a higher IMPA.
5. The lower incisors were more procumbent relative to NB plane and A-Po plane in the study sample
6. The interincisal angle in the Malwa sample subjects was significantly decreased indicating proclination of upper and lower incisors.
7. The Malwa sample had a predominantly horizontal growth pattern as evidenced by the decreased Go–Gn–SN angle and increased Jaraback's ratio.
8. The Malwa sample had more protrusive lower lips as compared to the Caucasians.

Conflicts of interest

All authors have none to declare.

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