

Cephalometric Norms of Steiners, Tweeds, and Wits Analysis for Madhya Pradesh Ethnic Population - A Cephalometric Study

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Abstract

Objectives: Cephalometric norms derived for Caucasian population are routinely used for investigations. As these norms show a great degree of variation when applied to different populations, it becomes necessary to establish the norms for every ethnic group. The present study was designed to derive norms for the Madhya Pradesh ethnic population, which would be comparable in diagnosis and treatment planning, to the Steiner, Tweeds and WITS cephalometric analysis. **Materials and Methods:** The sample consisted of 100 adult subjects (50 males and 50 females) of Madhya Pradesh ethnic origin. The age ranged between 18 and 26 years. The cephalograms of the subjects were subjected to Steiner, Tweeds and WITS cephalometric analysis and were complemented by a few additional readings. **Result:** The cephalometric norms for Steiner, Tweeds and WITS cephalometric analysis of the Madhya Pradesh population differed significantly from the Caucasian population. Comparison of our sample with the other ethnic group reaffirmed the need to develop separate standards for different populations. **Conclusion:** Therefore, it is legitimate and important for those undertaking orthodontic treatment for patients of Madhya Pradesh ethnicity to use cephalometric norms for Madhya Pradesh ethnic population.

Keywords: Cephalometrics, ethnicity, Tweeds, Steiners, WITS.

INTRODUCTION

Orthodontics is a combination of art and science and facial esthetics is the reflection of the orthodontist's artistic intuition. One of the primary goals of orthodontic treatment is to attain and preserve optimal facial attractiveness. The successful treatment is dependent on careful diagnosis.^[1] The horizon of orthodontics and dentofacial orthopedics has increased multifariously in the last few years, and similarly, it redefined the concept of beauty, although it varies from one community to another.^[1]

The cephalometric analysis aims to determine the relationships of the dentofacial and skeletal complex. The cephalometric analysis also helps the orthodontist to assess the growth changes and orthodontic treatment. Furthermore, it aids in the diagnosis of skeletal and dental problems.^[2]

Cephalometry was introduced by Broadbent in 1931. It began a period of a new era in orthodontics. Radiographic cephalometry has been used extensively to study facial form and to develop norms to aid in orthodontic diagnosis and treatment planning. It is also used to assess treatment progress and craniofacial growth, to predict growth for individual patients and for other tasks in orthodontic research.^[3]

Nowadays, analyzing cephalometric radiographs is one of the most usually used clinical procedures most typically used analysis was the Steiner analysis, Downs analysis, Tweeds analysis, Wits analysis, and many more and its relative acceptance as compared to different analyses remained identical over the years. The most usually used analysis additionally was the Steiner analysis, utilized by 58% of the Dutch orthodontists, followed by the Downs analysis.^[4]

The Steiner numerical analysis, which was developed in the 1950s suggests a series of measurements not only to diagnose the matter but also provides guidelines for treatment planning based on the prediction of changes that take place as a result of growth and/or orthodontic therapy.

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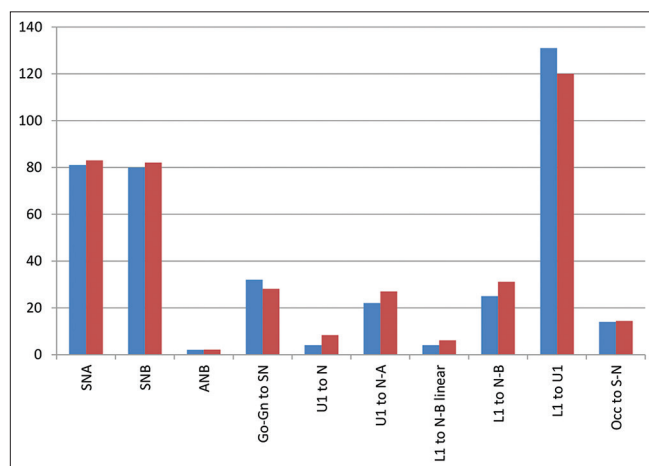
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Table 1: Steiner analysis: Comparison of Madhya Pradesh female and Caucasians

Parameter	Caucasians standard values (mean±SD)	Female Madhya Pradesh population values (mean±SD)	t-value	P-value
SNA (in degrees)	82.0±2.0	84.1±2.9	3.85	<0.01***
SNB (in degrees)	80.0±2.0	82.0±2.7	4.17	<0.01***
ANB (in degrees)	2.0±2.0	2.1±1.9	0.28	0.77*
Go-Gn to SN (in degrees)	32.0	28.1±3.6	-6.03	0.01***
U1 to N (in mm)	4.0	8.3±2.6	8.94	0.01***
U1 to N-A (in degrees)	22.0	27.0±5.8	4.72	0.01***
L1 to N-B (in mm)	4.0	7.4±1.7	10.73	0.01***
L1 to N-B (in degrees)	25.0	31.1±4.3	7.78	0.01***
L1 to U1 (in degrees)	131.0	120.2±6.1	-9.76	0.01***
Occl to S-N (in degrees)	14.0	14.4±3.4	0.637	0.52*

**Graph 1:** Steiner analysis: Comparison of Madhya Pradesh female and Caucasians

Charles H. Tweed developed his analysis in the year 1966. In this analysis, he described the lower incisor position to the basal bone and therefore the face.

Jacobsen in 1975 published a piece of writing called “The Wits appraisal of jaw disharmony.” The name Wits is short for Witwatersrand, which is a University in South Africa. This analysis was created as a diagnostic aid to measure the disharmony between the AP°.

India is a polygenic country. States in India are created based on languages and not on ethnicity or racial differences. As these norms show a good degree of variation once applied to completely different populations, it becomes necessary to determine the norms for each group.^[4]

Many cephalometric analyses are developed to establish norms for ideal facial proportions and occlusion, presenting average measurements of skeletal or dental patterns and their ranges. Since well-established Indian ethnic norms are lacking, norms derived for the Caucasian population are habitually used for investigations.^[5]

As these norms show a good degree of variation once applied to completely different populations, it becomes necessary to determine the norms for each group.

The purpose of this study is to evaluate mean measurements for Madhya Pradesh ethnic population, which would be comparable in diagnosis and treatment planning, to the Steiner, Tweed, Wit’s cephalometric analysis. The established norms would be compared with those of the Caucasian population and between male and female sample subjects.^[6]

Aim and objective of the study

Aim

The aim of the study was to evaluate the mean cephalometric values for Steiner, Tweed, and WITS Analysis in Madhya Pradesh ethnic population.

Objective

The objectives are as follows:

- To evaluate the cephalometric features of a Madhya Pradesh population and to present an organized, comprehensive cephalometric norms for Steiner, Tweed, and WITS analysis
- To introduce mean values to assess skeletal, dental, and soft-tissue relationship using Steiner, Tweed, and WITS analysis for orthodontic diagnosis
- To compare standards that will be derived with the earlier established norms for other population
- To identify possible gender difference between the values.

MATERIALS AND METHODS

Study design/study type

A observational study.

Study design

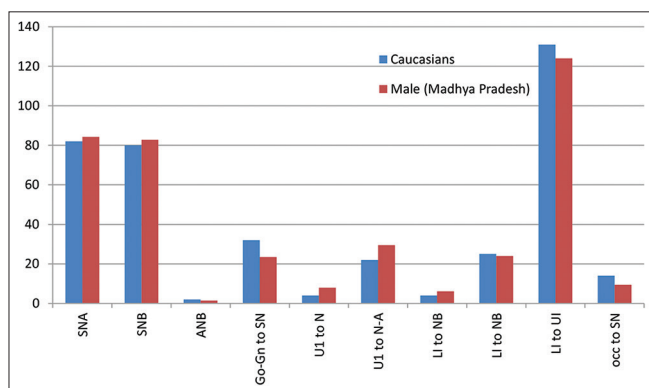
Study will comprise 100 patients (50 males and 50 females) who presented with Angles Class 1 with no or minimal discrepancy and pleasing profiles age ranged between 18 and 25 years of Madhya Pradesh ethnic population. The cephalograms of the subjects will be subjected to Steiner, Tweeds, and WITs analysis and complemented with some additional readings.

Source of data

The sample consists of 100 participants (50 males and 50 female) of Madhya Pradesh ethnic origin, having Class I

Table 2: Steiner analysis: Comparison of Madhya Pradesh Male and Caucasians

Parameter	Caucasians standard values (mean±SD)	Male Madhya Pradesh population values (mean±SD)	t-value	P-value
SNA (in degrees)	82.0±2.0	84±3.0	4.19	<0.01***
SNB (in degrees)	80.0±2.0	82.8±2.7	5.67	<0.01***
ANB (in degrees)	2.0±2.0	1.5±2.6	-1.06	0.29*
Go-Gn to SN (in degrees)	32.0	23.5±4.2	-9.44	<0.01***
U1 to N-A (in mm)	4.0	7.9±3.7	5.75	<0.01***
U1 to N-A (in degrees)	22.0	29.5±8.3	4.97	<0.01***
L1 to N-B (in mm)	4.0	6.1±2.6	4.5	<0.01***
L1 to N-B (in degrees)	25.0	24.7±5.8	-0.2	<0.80*
L1 to U1 (in degrees)	131.0	124.5±9.2	-3.84	<0.01***
Occl to S-N (in degrees)	14.0	9.4±2.9	-8.24	<0.01***

**Graph 2: Steiner analysis: Comparison of Madhya Pradesh male and Caucasians**

dental and skeletal relationship with no or minimal intra arch discrepancies.

Participant size

100 patients out of which 50 males and 50 females.

Study variables

- Age of the patient
- Gender of the patient
- The skeletal growth pattern of the patient.

Inclusion criteria

The following criteria were included in the study:

1. Subjects should be Madhya Pradesh ethnic population traced back to two generations
2. Class 1 molar relationship which normal overjet and overbite with no or minimal crowding and spacing
3. Good quality radiographs.

Exclusion criteria

The following criteria were excluded from the study:

1. History of the previous orthodontic treatment
2. Should not be the migrant from any other states
3. Presence of severe crowding
4. Presence of missing teeth other than the third molar.
5. Presence of gross deformity or asymmetry.

Apparatus and materials

- Lateral of patient
- Matt acetate transparent paper (tracing paper)
- Pencil
- Cello Tape
- View box
- Protector
- Eraser
- Pencil.

Data collection procedure

Lateral cephalogram of the subjects is subjected to Steiners, Tweeds, and Downs analysis. The tracings were done on 75 µm lacquered polyester papers using a 0.05 mm lead pencil. A single operator performed the tracings in a standardized manner to avoid errors due to intra-operator variations. All the tracings were subjected to Steiner, Tweed, WITS.

Statistical analysis

The measurement of statistics by calculation their means an standard deviation (SD) and the mean of the Madhya Pradesh population will be compared with the mean of Caucasians populations with the help of students *t*-test. The comparative study will also be done between males and females in the present study and the results will be drawn.

RESULTS

Different races in the world have different ethnic origins. Hard- and soft-tissue cephalometric parameters are different for different ethnic groups [Table 1]. Hence, cephalometric norms of one population can't be applied to other groups. Hence, an attempt is made to establish norms for population of Madhya Pradesh. Various skeletal, dental, and soft-tissue parameters (Steiner, Tweed, and WITS analysis) were checked to establish the cephalometric norms of Madhya Pradesh population. To check the operator's reliability and reproducibility, 50 males and 50 females' lateral cephalograms were randomly selected and retraced after an interval of 1 week.

Table 3: Steiner analysis: Comparison of Madhya Pradesh male and females

Parameter	Female Madhya Pradesh population values (mean±SD)	Male Madhya Pradesh population values (mean±SD)	t-value	P-value
SNA (in degrees)	84.1±2.9	84±3.0	-0.26	0.79*
SNB (in degrees)	82.0±2.7	82.8±2.7	-1.06	0.29*
ANB (in degrees)	2.1±1.9	1.5±2.6	1.02	0.31*
Go-Gn to SN (in degrees)	28.1±3.6	23.5±4.2	4.08	<0.01***
U1 to N-A (in mm)	8.3±2.6	7.9±3.7	0.44	0.66*
U1 to N-A (in degrees)	27.0±5.8	29.5±8.3	-1.33	0.18
L1 to N-B (in mm)	7.4±1.7	6.1±2.6	2.22	<0.05**
L1 to N-B (in degrees)	31.1±4.3	24.7±5.8	4.84	<0.01***
L1 to U1 (in degrees)	120.2±6.1	124.5±9.2	-2.15	<0.05**
Occl to S-N (in degrees)	14.4±3.4	9.4±2.9	6.00	<0.01***

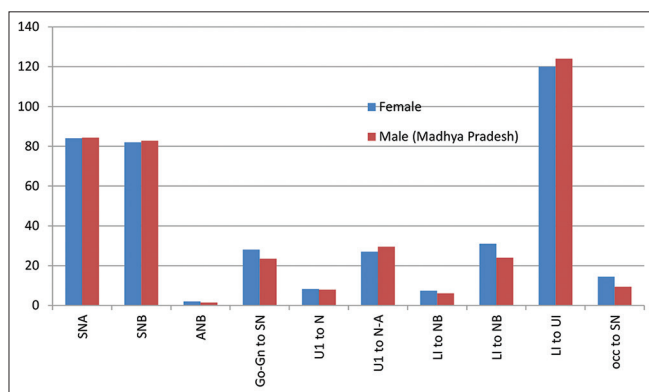
**Graph 3:** Steiner analysis: Comparison of Madhya Pradesh male and females

Table 1 and graph 1 depict Statistically, there was no significant difference found in mean, standard of deviation, t-value and P-value. It indicated that there was no significant intra-examiner variability found.

Table 2 and Graph 2 depict the comparison of Steiner analysis parameters between Madhya Pradesh Male and Caucasian population. There was highly significant difference seen in SNA angle SNB angle, U1 to NA angle, Go – Gn to SN, U1 to L1 angle, U1 to NA distance, L1 to NB distance, and Occlusal plane to SN in Madhya Pradesh than Caucasians ($P < 0.01$). No significant difference was seen in ANB angle.

Table 3 and graph 3 depict Statistically, the Go – Gn to SN angle, L1 to NB distance, and Occlusal plane to SN angle were highly significantly lesser in Madhya Pradesh male than Madhya Pradesh female. No statistical significant difference was seen in SNA.

Statistically, the Go – Gn to SN angle, L1 to NB distance, and Occlusal plane to SN angle were highly significantly lesser in Madhya Pradesh male than Madhya Pradesh female. No statistical significant difference was seen in SNA.

Tweed analysis comparison of Madhya Pradesh female and Caucasian population Table 4 and Graph 4 depict the comparison of Tweed analysis parameters between Madhya

Pradesh Female and Caucasian population. There was highly significant difference seen in FMIA angle IMPA angle. No significant difference was seen in FMA angle in Madhya Pradesh.

Table 5 and Graph 5 depict the comparison of Tweed analysis parameters between Madhya Pradesh male and Caucasian population. There was highly significant difference seen in FMA angle and IMPA angle in Madhya Pradesh than Caucasians. No significant difference was seen in FMIA angle in Madhya Pradesh.

Table 6 and Graph 6 depict the comparison of Tweed analysis parameters between Madhya Pradesh male and female population. There was highly significant difference seen in FMIA. Significant difference was seen in FMA angle, whereas no significant difference was seen in FMIA.

Table 7 and graph 7 depict the wits appraisal for the male and female subjects was significantly different:

The female Wits values on the other hand were significantly greater than all reported all the samples taken were selectively Class I malocclusion. The female Wits values were significantly greater in Caucasians as compared to the Madhya Pradesh females.

Table 8 and graph 8 depict the Wits analysis in Caucasian male shows a significantly greater value as compared to Madhya Pradesh male.

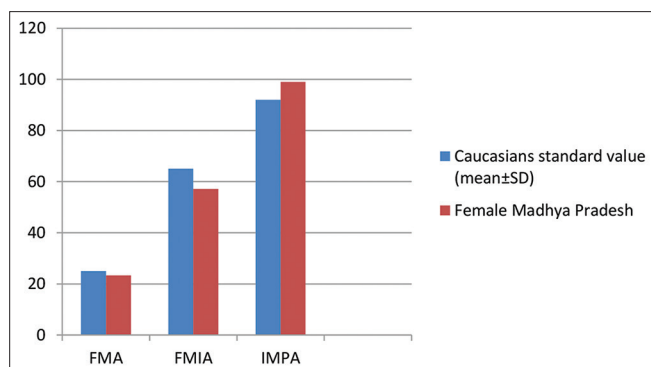
Table 9 and graph 9 depict The mean values of both the genders were compared to each other the Wits mean values were greater in males as compared to females with a significant gender difference.

DISCUSSION

This study was carried out to evaluate and compare the cephalometric parameters between the male and females in a local population of Madhya Pradesh and compare them with that of the Caucasian population. Certain variations in the dimensions of the present study were significantly different than those obtained by Steiner, although all selected individuals

Table 4: Tweeds analysis: Comparison of Madhya Pradesh females and Caucasians

Parameter (in degrees)	Caucasians standard value (mean±SD)	Female Madhya Pradesh values (mean±SD)	t-value	P-value
FMA	25.0	23.3±4.3	-1.35	0.17*
FMIA	65.1	57.2±5.8	-7.2	<0.01***
IMPA	92	99±5.2	8.1	<0.01***

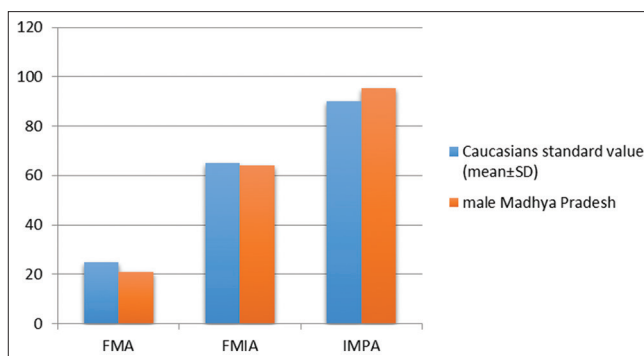
**Graph 4: Tweeds Analysis: Comparison of Madhya Pradesh females and Caucasians**

had a pleasant appearance and good facial harmony. The Steiner's analysis suggested of SNA angle: The mean value of SNA angle in the present study was slightly greater for males (84.25 ± 3.9) than females (83.65 ± 4.2) than those presented by Steiner ($82 \pm 2^\circ$) indicating maxillary protrusion relative to cranial base as compared to those given by Steiner. SNB angle: The mean value of SNB angle in the present study was significantly less. ($77.15^\circ \pm 2.52^\circ$) than those presented by Steiner ($80 \pm 2^\circ$), indicating mandibular retrusion relative to cranial base. The SNB angle found in the present study is in agreement with the studies done by Bishara SE^[7] (1981) (SNB- 78.5°) and Tweed CH. *et al.*^[8] (1954) (SNB- 78.52°) on North Indian and Aryo Dravidians, respectively.

ANB angle: The mean value of ANB angles for Madhya Pradesh ($3.05 \pm 1.38^\circ$) was slightly more than those presented by Steiner^[2] (2°), indicating greater convexity. This is in agreement with the study done by Bishara^[7] (1982) on North Indian (ANB- 3.12°), Holdaway RA *et al.* (1983)^[9] on North Indian preschool (4.95°) and McNamara^[11] in (2001) on South Kanara (ANB- 3.2°). Significant difference of ANB angle in all these studies was found when compared with those presented by Steiner. Occlusal plane angle: In the present study, the mean of occlusal plane angle for ($19.73^\circ \pm 1.52^\circ$) showed a significant difference than measurements given by Steiner (14°).^[2] This indicates more anteriorly placed occlusal plane as compared to those given by Steiner. This is in agreement with the study done by Tweed CH *et al.*^[8] (1984) on North Indian preschool (occlusal angle- 21.7°) which is greater than those presented by Steiner. Mandibular plane angle suggests growth patterns in individuals,

Table 5: Tweeds analysis: Comparison of Madhya Pradesh males and Caucasians

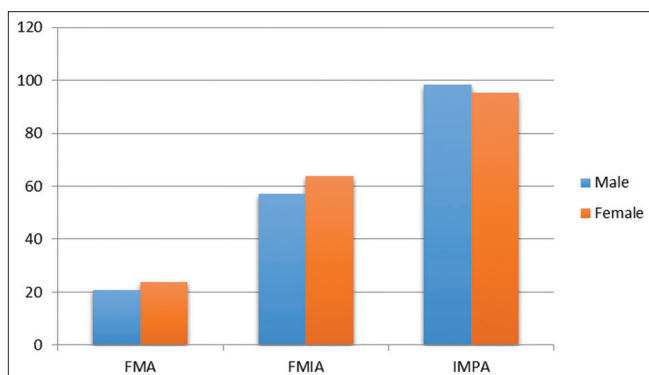
Parameter (in degrees)	Caucasians standard value (mean±SD)	male Madhya Pradesh values (mean±SD)	t-value	P-value
FMA	25.0	20.8±6.2	-3.70	<0.01***
FMIA	65	63.9±7.2	-0.81	0.42*
IMPA	90	95.3±6.2	4.62	<0.01***

**Graph 5: Tweeds analysis: Comparison of Madhya Pradesh males and Caucasians**

and the mean values of this angle for Madhya Pradesh ($30.36 \pm 1.59^\circ$) were slightly less than those presented by Steiner^[2] (32°). This finding is in agreement with the study done by Ricketts^[10] on dentofacial patterns of Gurkhas (mandibular plane angle- 29.7°) Maxillary incisor position represents the relative location and axial inclination of the upper incisors. The upper incisor to N-A reading in degrees indicates the relative angular relationship of the upper incisor teeth to N-A line, and the mean value of maxillary incisor position in degrees in the present study for Madhya Pradesh ($23.98 \pm 5.19^\circ$) is significantly higher than those presented by Steiner indicating more labial inclination of maxillary teeth in Madhya Pradesh. The upper incisors to N-A reading in millimeters provide information on the relative forward or backward positioning of the incisor teeth to N-A line, and the mean value in the present study for Madhya Pradesh (5.11 ± 2.39 mm) is significantly higher than those presented by Steiner indicating more forward positioning of maxillary teeth in Madhya Pradesh. This finding is in agreement with the study done by (1975) on Indian population in which she had concluded that the teeth of people from India were more labially placed. This finding is also in agreement with the study done by McNamara^[11] (1976) on Madras population (Angular measurement - 23.5° , linear measurement - 4.2 mm) and also study done by Bishara SE^[7] (1982) on North Indian\ (angular measurement - 24.9° , linear measurement - 4.9 mm) where both the angular and linear measurements were more as compared to those given by Steiner. Mandibular incisor position represents the relative anteroposterior location and angulation of the lower incisor teeth.

Table 6: Tweeds analysis: Comparison of Madhya Pradesh males and females

Parameter (in degrees)	Female Madhya Pradesh values (mean $\pm$ SD)	Male Madhya Pradesh values (mean $\pm$ SD)	t-value	P-value
FMA	23.9 $\pm$ 4.3	20.8 $\pm$ 6.2	2.26	<0.05**
FMIA	57.2 $\pm$ 5.8	63.9 $\pm$ 7.2	-4.00	<0.01***
IMPA	98.2 $\pm$ 5.2	95.3 $\pm$ 6.2	1.97	0.053*

**Graph 6:** Tweeds analysis: Comparison of Madhya Pradesh males and females

The lower incisor to N-B line in degrees indicates relative angular relation. The mean value of mandibular incisor position in degrees in the present study for Madhya Pradesh ($28.36 \pm 4.18^\circ$) is significantly higher than those presented by Steiner indicating more labial inclination of mandibular teeth in Madhya Pradesh.

The lower incisors to N-B reading in millimeters provide information on the relative forward or backward positioning of the incisor teeth to N-B line, and the mean values in the present study for Madhya Pradesh (5.34 ± 2.07 mm) are significantly higher than those presented by Steiner, indicating more forward positioning of mandibular teeth in Madhya Pradesh.

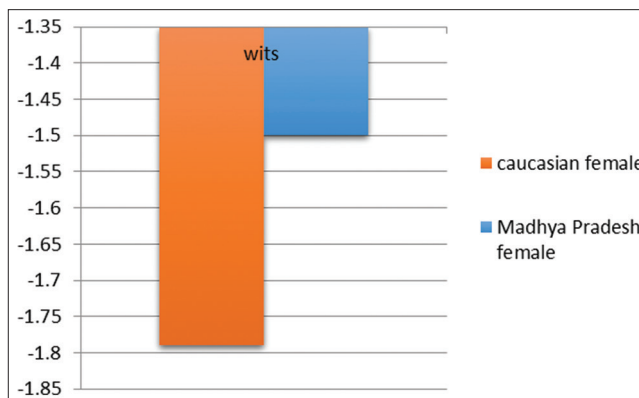
This finding is also in agreement with the study done by McNamara JA Jr^[11] in which it was found that interincisal angle was less for North Indians as compared to Caucasians and was concluded that North Indians have more proclined lower incisors as compared to Caucasians.

Lower incisor to chin indicates the prominence of chin when compared with lower incisors. The mean value of the lower incisor to chin in the present study for Madhya Pradesh (1.71 ± 1.38 mm) is significantly lesser than those presented by Steiner^[2] (4 mm), indicating less prominence of chin to the lower incisors for Madhya Pradesh as compared to those given by Steiner in Caucasians.

In the present study, mean values comparison of Tweed's analysis IMPA was found to be significantly different. Hence, many research workers in India have initiated to undertake racial studies. Sidhu (1995)^[3], Nanda and Nanda(1969)^[13],

Table 7: WITS analysis comparison of Madhya Pradesh female with Caucasians

Parameter	Caucasian female	Madhya Pradesh female	t-value	P-value
Wits	-1.79	-1.5	-4.26	<0.001***

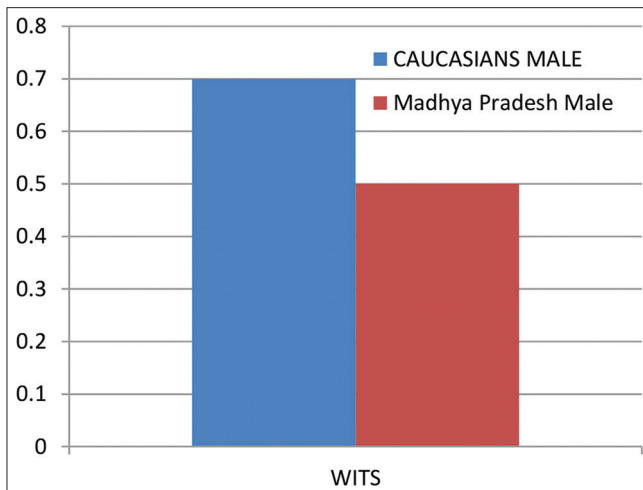
**Graph 7:** WITS analysis comparison of Madhya Pradesh female with Caucasians

Ashima Valiathan(2001)^[14], Holdaway RA (1983)^[9], Mohode R(2008)[16], Bosch C^[12] and many more have studied various racial groups and showed that the skeletal, dental, and soft-tissue measurements vary significantly from one racial group to other.^[12-14]

FMA-The Madhya Pradesh sample presented a mean FMA of 23.1° which was lesser than that of the Caucasian mean value of 25° . The Madhya Pradesh sample suggests of horizontal growth pattern when compared to the Caucasian norms. FMIA-The Madhya Pradesh male samples presented a mean FMIA of 57.1° which was lesser than that of the Caucasian mean value of 65° . The mean difference of 7.9° suggests that the Madhya Pradesh subjects tend to have a proclined lower incisor when compared to Caucasian norms. IMPA - The Madhya Pradesh samples presented a mean IMPA of 99.4° , compared with Tweed's Caucasian norms, the population showed an increase of 9.4° suggesting that the Madhya Pradesh have more proclined lower incisors than the Caucasian group. The Wits appraisal was introduced to prevent such errors. It provided adequate anteroposterior measurement for skeletal disharmony of the jaw because the reference plane used is neither a cranial nor an extra-cranial plane, but it is a common plane to both dentures, the occlusal in many subjects. Therefore, Jacobson recommended that the most suitable and convenient method of standardizing the plane of occlusion was to join the midpoint of overlap of the mesiobuccal cusps of the rest molars and the buccal The Wits appraisal was introduced to prevent such errors. It provided adequate anteroposterior measurement for skeletal disharmony of the jaw because the Wits appraisal provided adequate anteroposterior measurement for skeletal disharmony of the jaw because the reference plane used is neither a cranial nor an extra-cranial plane, but it is a common plane to both dentures, the occlusal plane. However, this plane

Table 8: WITS analysis comparison of Madhya Pradesh male with Caucasians

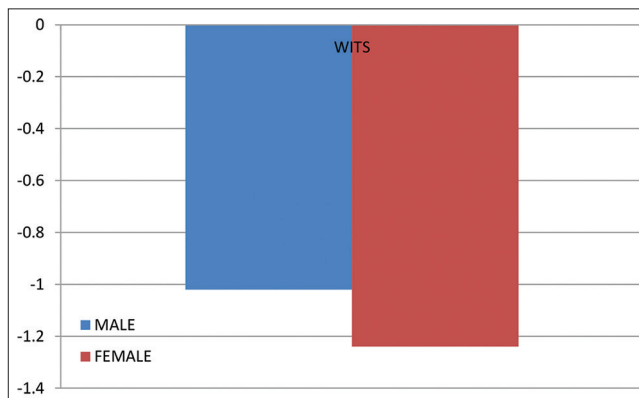
Parameter	Caucasian male	Madhya Pradesh male	t-value	P-value
Wits	0.7	0.5	-1.26	<0.001***

**Graph 8: WITS analysis comparison of Madhya Pradesh male with Caucasians**

was observed to be concave in many subjects. Therefore, Jacobson recommended that the most suitable and convenient method of standardizing the plane of occlusion was to join the midpoint of overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars (functional occlusal lane). Since Wits values were shown not to be affected by age, it was critical to evaluate other variables such as race and gender, which may affect the normal skeletal, dental, and soft tissues characteristics of an individual. Therefore, identifying the normal features of a specific race or ethnic group, as well as gender, is considered important for proper diagnosis and treatment planning, and hence, the need for ethnicity-and gender-specific norms. In a previous study conducted in the central region of Madhya Pradesh, involving dental students, the Wits mean values were 0.82 and 0.41 for males and females, respectively. However, it does not represent the multi-racial background of the Caucasians. This is supported by the present study where the values from the central region were found to be significantly different for both genders. This difference could be attributed to the diversity of the ethnic background of the people in the western region compared with the central region. Furthermore, Al-Barakati found no gender differences whereas in the current study females exhibited a significantly greater value than males. It is interesting to note that this finding is in agreement with Jacobson^[15] with regard to the existence of gender dimorphism. The mean value of Wits appraisal in males was similar to a number of previously reported data, but not all. For females' values, the case was different. Their Wits values were significantly different from all previously published reports. One limitation of the current comparisons with the previously published works is that there could be

Table 9: Wits analysis comparison with Madhya Pradesh male and female

Parameter	Male	Female	t-value	P-value
Wits	-1.02	-1.24	4.9	0.826

**Graph 9: Wits analysis comparison with Madhya Pradesh male and female**

a serious problem with the interference of great systematic errors between the different studies, and specifically when defining the occlusal plane. The distance between the points used, that is, the line through the overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars is too short and variation in the definition between the observers could lead to errors. It is agreeable that such comparisons can be important; however, risk of errors due to systematic differences in the definition of the points should be recognized. One method to overcome this obstacle is to perform comparisons between different ethnic groups by a group of researchers who will perform the measurements themselves after careful calibration to reduce inter-and intra-examiner errors.

Suggestions for future studies

The future studies can be planned with the following considerations:

- A similar study can be carried out using a larger sample size. A large sample will allow a better representation of the test population
- The landmark identification error can be minimized by averaging multiple measurements done by a number of operators
- Advent of cone-beam computed tomography allows for the 3D reconstruction of the dentofacial structures. Hence norms for ethnic population could be derived in the 3 dimensional plane of space.

CONCLUSION

The present study was done on population of Madhya Pradesh indicates that their facial pattern is not similar to Caucasians. However, this population has a predominant tendency toward horizontal growth pattern of the mandible and this is more

so in case of males. This population also has bimaxillary dentoalveolar protrusion. Comparison of our sample with other ethnic group reaffirmed the need to develop separate standards for different populations. Therefore, it is legitimate and important for those undertaking orthodontic treatment of Madhya Pradesh ethnicity to use cephalometric norms for Madhya Pradesh ethnic population. At the same time, one needs to acknowledge, as stated by McNamara and Ellis, that “infinite combinations of dentoskeletal and soft-tissue relationships are possible to arrive at a face that is well-balanced.

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