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Ascertainment of Tweed's Cephalometric Norms in Maratha Ethnic Population

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Abstract: ***Objective: The purpose of this study was to establish Tweed's cephalometric norms for Maratha ethnic population and to compare it with Caucasian norms. Materials and Methods: The participants were of 66 adults with normal occlusion and pleasant profile. Lateral cephalograms were taken in natural head position, and cephalometric norms were established using Tweeds diagnostic triangle. Results: The result of the study also indicated that larger IMPA of 101.63° instead of 86.93° and smaller FMIA of 52.66° in Maratha participants as compared to 68.20° in Caucasians indicated proclined mandibular incisors in Maratha population than the Caucasian norms developed by Tweed. Conclusion: The findings emphasize the need for group specific norms for orthodontic diagnosis and treatment planning and provide cephalometric standards for normal Maratha adults.***

Keywords: Cephalometric norms, diagnostic facial triangle, Tweed's analysis, Tweed's triangle

1. Introduction

Cephalometric analysis is an essential method for evaluation of craniofacial morphology. Menial and skeletal scaffolding affect the facial morphology to a significant degree, and the soft tissue draping maintains the final aesthetic look. The examination of lateral Cephalograms has given clinicians an efficient correlation between soft tissue, skeletal, and dental parameters, which in turn helps them to predict patient development and also, to evaluate treatment progress and craniofacial growth.

By providing balance measurements of skeletal or dental patterns as well as their ranges, Downs [1], Steiner [2] and Tweed [3] have conducted numerous cephalometric investigations in order to establish norms for appropriate facial proportions and occlusion for different population groups. The sample populations always included children and young adults from North America. Subsequently, it was found out that cephalometric criteria for one indigenous group did not always translate to other indigenous groups. As demonstrated by the cephalometric norms of diverse indigenous and racial groups, typical measurements for one group may vary from typical measurements for another; which means that each familial group needs to be accepted based on its unique traits. Thus, several criteria have been created for different racial and ethnic backgrounds. While taking the patient's treatment objectives and requirements into account, it's critical to compare a patient's cephalometric results with the norms for that patient's ethnic group for an accurate diagnostic assessment.

Cephalometric analyses of various racial or indigenous group-specific populations have been developed over time, such as Park's [4] study of Koreans, Chan's [5] study of Chinese, Nanda's [6] study of North Indians, Garcia's [7] study of Mexican Americans, Drummond's [8] study of African-Americans, and others.

Now-a-days, Tweed studies of different ethnic groups are available. The diagnostic facial triangle was developed as a guide to determine the normal mesiodistal position of the teeth in relation to their respective jaw bones and head structure by Dr. Charles Tweed. This analysis was developed as an aid for planning the treatment, preparing the anchorage, and determining the prognosis of orthodontic cases.

The diagnostic triangle used by Dr. Tweed was constructed using the following three angles: Frankfort mandibular incisor angle (FMIA), Incisor mandibular plane angle (IMPA) and Frankfort mandibular angle (FMA). For the first measurement, FMIA, he established a standard FMIA of 68° for individuals with a Frankfort mandibular angle (FMA) of 22° to 28°. If the FMA is more than 30° degrees, the standard FMIA should be 65° and similarly, FMIA increases if the FMA reduces.

The second measurement, FMA, specifies the direction of the lower face growth in both the horizontal and vertical growers. This angle is most likely the most important parameter for skeletal analysis. A skeletal pattern with a normal growth direction is projected by the typical range of 22° to 28°. Excessive vertical growth is indicated by an

FMA above the typical range, and inadequate vertical growth is indicated by an FMA below the typical range.

The third and another significant measurement, Incisal Mandibular Plane Angle (IMPA), is the angle formed by the incisors' axial inclinations with respect to the mandibular plane. The lower incisors should be positioned upright according to the 88° norm. This position represents the ideal harmony and balance of the lower facial profile with a normal FMA. In order to make up for the FMA being higher than normal, the orthodontist must further straighten the mandibular incisors. To compensate for the FMA below the usual range, the mandibular incisors might be positioned closer to the labial or left in their pretreatment position.

In light of these considerations, the objectives of the current study were: (1) To establish cephalometric norms for the Maratha ethnic population using Tweed's cephalometric analysis; (2) To compare the cephalometric norms for males and females in the Maratha population; and (3) To determine whether there are any notable differences in the angular measurements of Tweed's diagnostic triangle within the Maratha population.

2. Methodology

The sample data comprised of the lateral cephalometric radiographs of 66 patients, which included 33 men and 33 women of Maratha ethnicity. Groups were selected by the dental students at Ajeenkya D.Y. Patil Dental School Pune, Maharashtra. Participants fall within the 15-30 years age group and were selected based on the following criteria:

1) Angle's Class I molar relation
2) Acceptable profile
3) No history of previous orthodontic treatment
4) No history of compromised gingival and periodontal support to any teeth in the dentition
5) Maratha ethnicity
6) No congenital or acquired malformations of the skeletal or dental origin
7) No history of facial trauma
8) Patients with mild crowding or spacing up to 3mm per jaw, with overjet and overbite up to 4mm

The lateral cephalometric radiograph for each participant was taken at a target film distance of roughly 152.4cm or 5feet. The lateral head film was obtained with a peak kilovoltage of 80kVp and a current of 20mA for an exposure length of 2.5seconds.
The researcher traced and measured the radiographs. Each cephalogram was traced twice using a 3H lead pencil on a 0.003mm matte acetate tracing paper. To reduce inaccuracy, the average measurement was made for every cephalogram. Three linear and three angular parameters were examined for every radiograph. The locations of the landmarks [FIG. 1] were determined using Tweed's definitions.

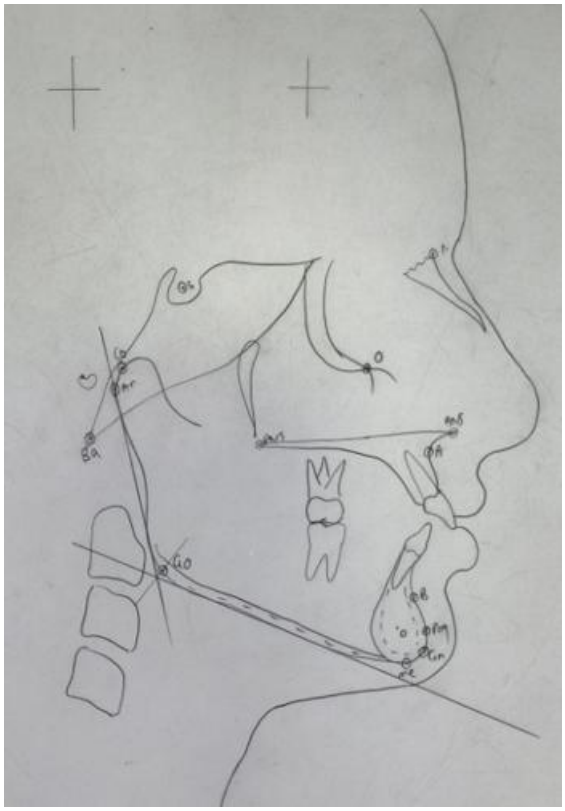

Figure 1

Linear parameters:
The plane that joins an orbital point halfway between the orbit's left and right lower borders with a point 4.5mm above the ear rod's geometric center is the Frankfort horizontal plane [FIG. 2].

The plane which is perpendicular to the mandibular lower border and connects to the menton, both anteriorly and posteriorly is the Mandibular plane. It divides the space between the mandibular lower borders on the right and left in the gonial angle region [FIG. 2].

The axis made by extending the long axis of mandibular central incisor downward to the mandibular plane and upward to the Frankfort plane is the Mandibular incisor long axis [FIG. 2].

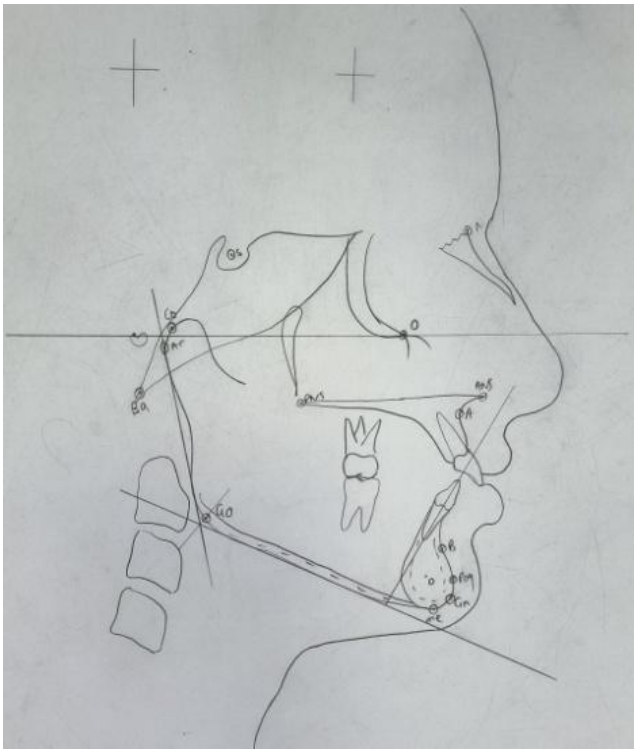

Figure 2

Angular parameters:
The angle created by extending the lower incisor long axis to the mandibular plane is the incisor mandibular plane angle [FIG. 3].

The angle created by extending the mandibular plane to the Frankfort horizontal plane is the Frankfort mandibular plane angle [FIG. 3].

The angle created by extending the mandibular incisor's long axis to the Frankfort horizontal plane is the Frankfort mandibular incisor angle [FIG. 3].

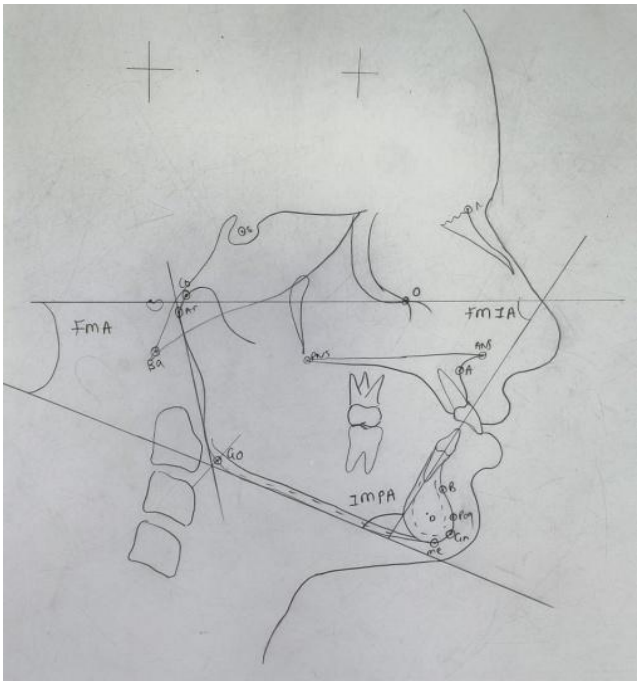

Figure 3

To do statistical analysis, EPI INFO (TM) Version 3.5.3 was used. The Center for Disease Control and Prevention own the trademark EPI INFO. Descriptive statistical analysis was used to determine the means, corresponding standard deviations (SD), medians and ranges. The difference between mean values was tested using the "t" test and the connections were tested using the chi-squared ($\chi 2$) test. A value of $p<0.05$ was considered for determining statistical significance. Similarly, the mean, standard deviation, range, and significance levels of each parameter were evaluated in this study. The chi-square ($\chi 2$) test was also employed to determine whether there was a significant correlation between the population's gender and FMA, IMPA, and FMIA. The "t" test was used to compare the FMA, IMPA, and FMIA values in Maratha males and females as well. Additionally, the "t" test was used to statistically compare the entire Maratha sample to the Caucasian sample.

3. Results

Since the sample data consisted of equal number of male and female patients [FIG. 4], test of proportion showed no significant difference in the proportion of male and female ($p>0.05$).

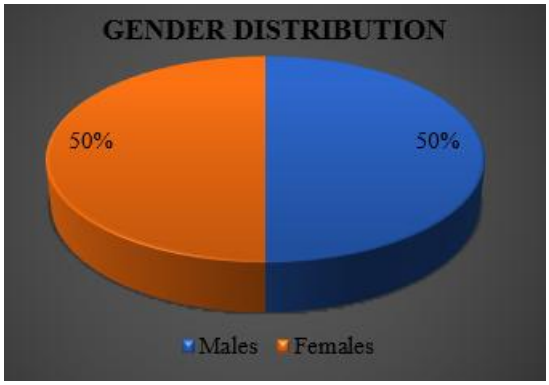

Figure 4

At the same time, the chi-square ($\chi 2$) test showed no significant association ($p>0.05$) between FMA, IMPA, FMIA, and gender of the participants [FIG. 5-7].

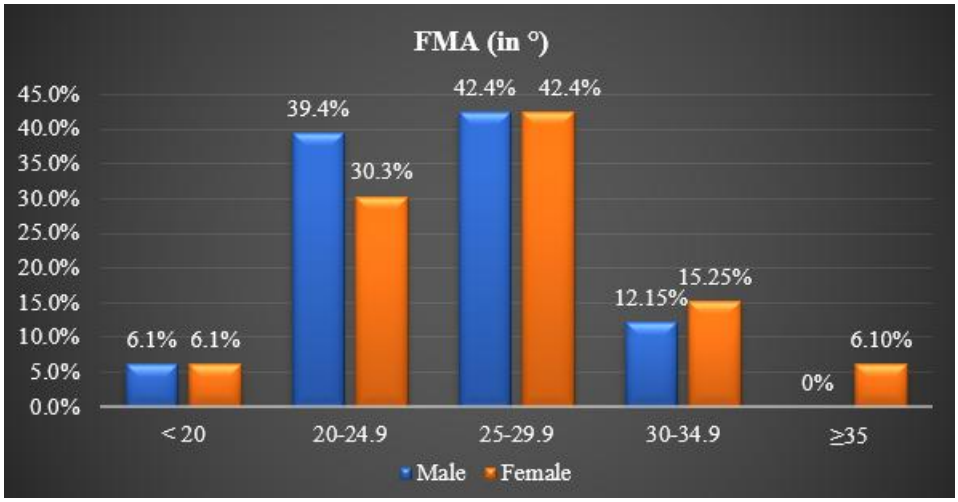

Figure 5

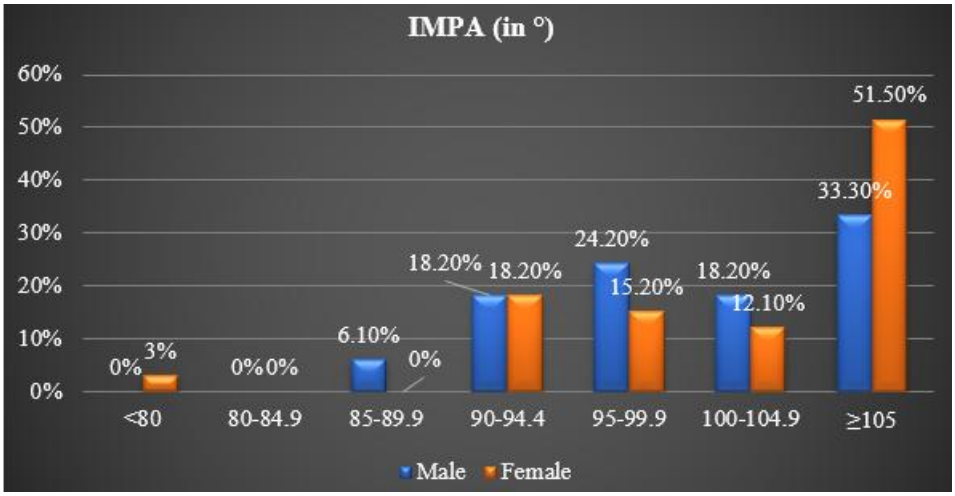

Figure 6

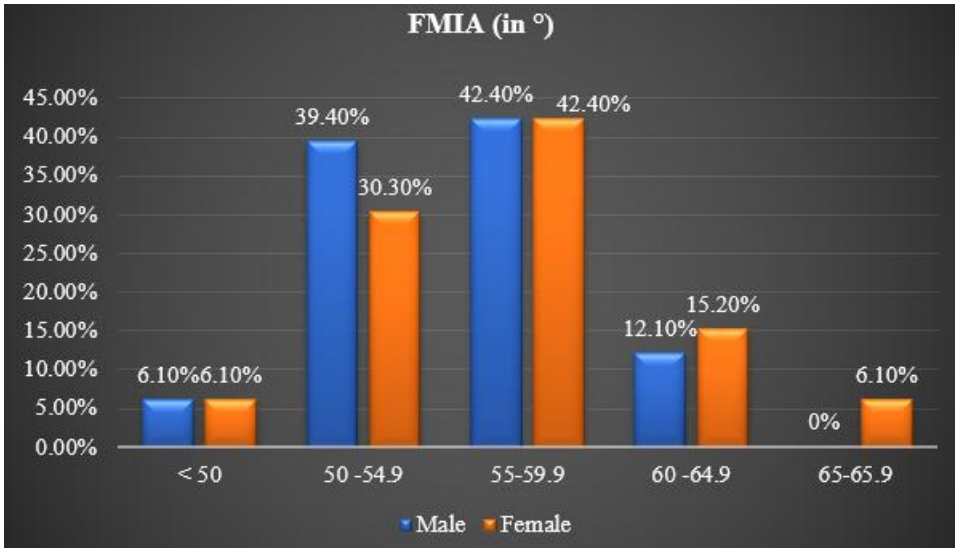

Figure 7

The "t" test was used to compare the values of FMA, IMPA and FMIA in Maratha males and females. The test showed that no significant difference between mean FMA (t=-1.014, p=0.314), mean IMPA (t=-0.983, p=0.329) and mean FMIA (t=1.348, p=0.182) of females and males [FIG. 8].

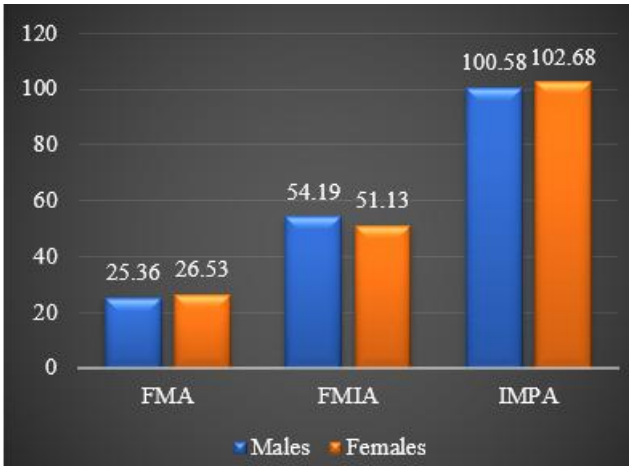

Figure 8

When analysis was done using male and female together, Maratha population showed a mean value of 25.36° ± 4.49° and 26.53° ± 4.84° for FMA, 100.58° ± 8.15° and 102.68° ± 9.21° for IMPA, and 54.19° ± 8.15° and 51.13° ± 10.18° for FMIA for males and females respectively [TAB. 1].

Table 1

	Males Mean (SD)	Females Mean (SD)	Unpaired t test	p value, Significance
FMA	25.36 (4.49)	26.53 (4.84)	-1.014	0.314 (NS)
FMIA	54.19 (8.15)	51.13 (10.18)	1.348	0.182 (NS)
IMPA	100.58 (8.15)	102.68 (9.21)	-0.983	0.329 (NS)
Total	180.08 (0.77)	180.35 (1.2)	-1.093	0.279 (NS)

p>0.05 – no significant difference

After the comparison of the above measurements of Maratha population with that of Caucasian population, it was found that mean FMA of Maratha Population was higher than that of Caucasian population, but the difference was not statistically significant (t=1.98; p>0.05). Mean IMPA of Maratha Population was also higher than that of Caucasian population (t=19.06; p<0.001) but the difference was statistically significant. Whereas, mean FMIA of Maratha Population was lower than that of Caucasian population (t =-15.87; p<0.001) and the difference is statistically significant [TAB. 2].

Table 2

	Indian population Mean	Caucasian population Mean	Unpaired t test	P value, Significance
FMA	25.94	24.5	1.98	p>0.05 (NS)
FMIA	52.66	68.2	-15.87	p<0.001** (HS)
IMPA	101.63	86.93	19.06	p<0.001** (HS)

p>0.05 – no significant difference (NS)
**p<0.001 – highly significant difference

4. Discussion

The idea of "normal" has become very essential to an orthodontist, and improving face aesthetics has rapidly become recognized as one of the desired goals of orthodontic treatment. Tweed [9] defined "normal" based on the balance and harmony of proportions that the majority considers as most pleasing.

However, it has become equally important to establish criteria for different ethnic groups of the population for the purpose of successful diagnosis and arrangement of treatments, as soft tissue, dental, and skeletal structures show diverse patterns across different races.

India is home to a diverse population. This diversity has caused Indian researchers to start working on race studies. Numerous racial groupings have been investigated by Sidhu (1970) [10], Nanda (1969) [6], Ashima Valiathan (1976) [11], Chandranee N. J. et al. (1983) [12], Kapoor D. N. (1987) [13], and many others. These have demonstrated that there are considerable differences in skeletal, dental, and soft tissue measures across different racial groups.

The goal of the current study was to determine Tweed's cephalometric norms for one of the Western Indian ethnic groups, the Maratha population. The values measured for Maratha population were then compared with those measured for the Caucasians, using which Tweed derived his well-known diagnostic face triangle.

The findings of this study can be discussed under two headings:

1) Comparison of cephalometric norms for Maratha males and females
2) Comparison of cephalometric norms of Maratha population (males and females taken together) with that of Caucasian population

Comparison of cephalometric norms for Maratha males and females:

The present study showed no significant association between FMA, IMPA, FMIA, and gender of the participants (p>0.05). When comparisons were made between the sexes in Maratha population, it was found that FMA, IMPA, and FMIA showed that no significant difference between mean FMA (t=-1.014, p=0.314), mean IMPA (t=-0.983, p=0.329), and mean FMIA (t=1.348, p=0.182) of females and males.

Comparison of cephalometric norms of Maratha population (males and females taken together) with that of Caucasian population:

In the present study, the mean FMA of Maratha Population was found to be higher than that of Caucasian population, and the difference was not statistically significant (t= 1.98; p>0.05). Additionally, the mean IMPA of Maratha Population was higher than that of Caucasian population (t=19.06; p<0.001) and the difference was statistically significant. Lastly, the mean FMIA of Maratha population was smaller than that of Caucasian population (t = -15.87; p<0.001) and the difference was statistically significant as well.

5. Conclusion

The present study was undertaken to develop cephalometric norms of Tweed's diagnostic facial triangle for Maratha population and to find out if there is any variation from Caucasian standard.

1) When comparisons were made between the sexes in Maratha population, it was found that FMA, IMPA, and FMIA showed that no significant difference between

mean FMA (t=-1.014, p=0.314), mean IMPA (t=-0.983, p=0.329), and mean FMIA (t=1.348, p=0.182) of females and males. This indicated that no separate norms should be considered for Maratha males and females during diagnosis and treatment planning.

2) Excluding FMA, the other parameters in the study showed statistically significant differences. Mean FMA of 25.94° for Maratha participants indicated similar orientation of mandible to Frankfort horizontal plane in Maratha participants as in Caucasian population.
3) Larger IMPA of 101.63° instead of 86.93° and smaller FMIA of 52.66° in Maratha participants as compared to 68.20° in Caucasians indicated proclined mandibular incisors in Maratha population than the Caucasian norms developed by Tweed.

In the present study, the difference found in the measurements of Maratha population when compared to the measurements of standard Caucasian population may be attributed to racial variations. The present study highlights the fact that the excellence of facial pattern is peculiar to its racial group and such variations are of relative significance when planning out treatment objectives.

It should be noted that the present study was done with a limited number of Maratha samples. For standardization of results, an extensive study is necessary with greater number of samples and meticulous sample selection.

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