Published online: 2019-09-25

Original Article

Determination of Tweed's cephalometric norms in Bengali population

Lalima Kumari[1], Anuranjan Das[2]

[1]Department of Orthodontics and Dentofacial Orthopaedics, Patna Dental College and Hospital, Patna, Bihar, India,
[2]Department of Orthodontics and Dentofacial Orthopaedics, Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India

Correspondence: Dr. Lalima Kumari
Email: lali3dec@gmail.com

ABSTRACT

Objective: The purpose of this study was to establish Tweed's cephalometric norms for Indian Bengali population and to compare it with Caucasian norms. **Materials and Methods:** The participants were of 50 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 study showed more proclined lower incisors in comparison with Caucasians. The result of the study also indicated that separate norms should be considered for Bengali males and females during diagnosis and treatment planning as mean Frankfort mandibular angle value for females was found to be significantly higher than that of males (t_{48} = 2.97; $P < 0.01$) and the mean value of incisor mandibular plane angle for males was significantly higher than that of females. **Conclusion:** The findings emphasize the need for group-specific norms for orthodontic diagnosis and treatment planning and provide cephalometric standards for normal Bengali adults.

Key words: Cephalometric norms, diagnostic facial triangle, Tweed's analysis, Tweed's triangle

INTRODUCTION

The very definition of dentistry states that "Dentistry is an art and science of…" where art comes first. However, the art of achieving a desired result begins with the science of diagnosing and treating it.

Cephalometric analysis has become an indispensable tool for describing craniofacial morphology. Since skeletal and menial scaffolding influences facial morphology to a large extent with the ultimate esthetic appearance residing in the soft tissue drape, the analysis of lateral cephalograms has provided a useful method for clinicians to correlate dental, skeletal, and soft tissue factors.

Dr. Charles Tweed developed the diagnostic facial triangle as a guide in determining the normal mesiodistal position of the teeth in relation to their respective jaw bones and head structure. He developed this analysis as an aid to treatment planning, anchorage preparation, and determining the prognosis of orthodontic cases. He made use of three planes that form a diagnostic triangle. The planes used were Frankfort horizontal plane, Mandibular plane, and long axis of lower incisor. Three angles were used to make the diagnostic triangle: Frankfort mandibular incisor angle (FMIA), Frankfort mandibular angle (FMA), and incisor mandibular plane angle (IMPA).

Access this article online

Quick Response Code:

Website: www.eurjdent.com

How to cite this article: Kumari L, Das A. Determination of Tweed's cephalometric norms in Bengali population. Eur J Dent 2017;11:305-10.

DOI: 10.4103/ejd.ejd_274_16

Since the advent of roentgenographic cephalometry and its application in orthodontics, several analyses have been put forward for the evaluation of dentofacial structures with norms and ranges. Downs,[1] Steiner,[2] and Tweed[3] all developed cephalometric norms and analyses in an attempt to define the skeletal characteristics of a "good face" and a "good occlusion." The sample populations always consisted of North American children and young adults. With time, it became apparent that cephalometric standards for one ethnic group did not necessarily apply to other ethnic groups.

Gradually, a number of cephalometric analyses specific to racial or ethnic groups have been established including Park's[4] study of the Korean, Chan's[5] study of the Chinese, Nanda's[6] study of the North Indians, Garcia's[7] study of the Mexican American, Drummond's[8] study of the Negroes, and many more. All these studies indicate that normal measurements for one group should not be considered normal for every other race or ethnic group as there are differences in the dentofacial relationships of various ethnic and racial groups. Different racial groups must be treated according to their own characteristics, and hence, it is important to develop standards for various populations.

With these points in mind, we aimed in this study (1) to establish cephalometric norms for Bengali population with Tweed's cephalometric analysis, (2) to compare male and female cephalometric norms for the Bengali population, and (3) to analyze whether any significant variation in angular measurements of Tweed's diagnostic triangle occur in Bengali population.

MATERIALS AND METHODS

The material comprised the lateral cephalometric radiographs of fifty patients, 25 men and 25 women of Bengali ethnicity; one of the ethnic groups of Eastern India selected from the dental students at Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal. Participants included in this study were within the age group of 12–18 years, selected randomly based on the following criteria: (1) bilateral Angle's Class I molar relation, (2) ANB ranging from 0° to 3°, (3) normal overjet and overbite, (4) harmonious profile, (5) no history of previous orthodontic treatment, (6) no history of compromised gingival and periodontal support to any teeth in the dentition, (7) Bengali ethnicity, and (8) no congenital or acquired malformations of the skeletal or dental origin.

The lateral cephalometric radiograph of each participant was taken with a target film distance of 5 feet or 152.4 cm. A voltage of 80 kvp and a current of 20 mA were used with an exposure time of 2.5 s to obtain the lateral head film.

The radiographs were traced and measured by the same investigator (LK). Each cephalogram was traced twice using 0.003 mm matte acetate tracing paper with 3H lead pencil. The average measurement for each cephalogram was taken in an attempt to minimize error. Three linear and 4 angular measurements were analyzed on each radiograph. The landmarks [Figure 1] were located according to the definitions given by Tweed.[9]

The following measurements were used:

Linear measurements

Frankfort horizontal plane

A plane connecting a point 4.5 mm above the geometric center of the ear rod and an orbitale point midway between the left and right lower borders of the orbit [Figure 2].

Mandibular plane

A plane tangent to the lower border of mandible which connects with the menton anteriorly and posteriorly it bisects the distance between the right and left lower borders of the mandible in the region of the gonial angle [Figure 2].

Mandibular incisor long axis

A plane made by extending the long axis of the mandibular central incisor downward to the mandibular plane and upward to the Frankfort plane [Figure 2].

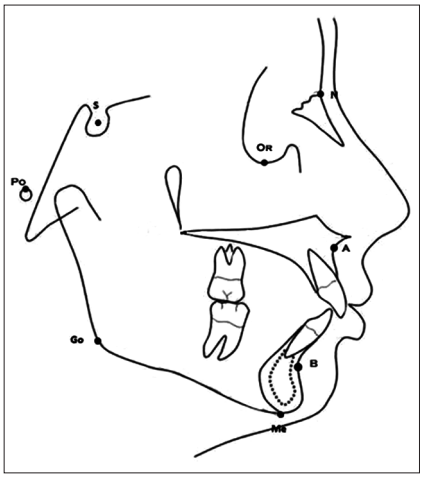

Figure 1: Various points used in the study

Angular measurements

Frankfort mandibular plane angle

Angle formed by extending mandibular plane to the Frankfort horizontal plane [Figure 3].

Incisor mandibular plane angle

Angle formed by extending lower incisor long axis to the mandibular Plane [Figure 3].

Frankfort mandibular incisor angle

Angle formed by extending mandibular incisor long axis to the Frankfort horizontal plane [Figure 3].

ANB angle

Angle formed by joining the lines AN and BN at nasion [Figure 3].

Statistical analysis was performed with help of Epi Info (TM) 3.5.3. EPI INFO is a trademark of the Centers for Disease Control and Prevention. Descriptive statistical analysis was performed to calculate the means with corresponding standard deviations (SD), median, and ranges. The "*t*"-test was used to test the difference between mean values. Chi-square (χ^2) test was also used to test the associations. $P < 0.05$ was taken to be statistically significant. All the parameters in this study were subjected to similar evaluation of mean, SD, range, and significance levels. Chi-square test was used to find out any significant association between FMA, IMPA, FMIA, and gender of the population. Student's *t*-test was used to compare the values of FMA, IMPA, and FMIA in Bengali males and females. The total sample was also compared to the Caucasian sample statistically by means of Student's *t*-test.

RESULTS

As sample consisted of equal number of male and female patients [Figure 4], test of proportion showed no significant difference in the proportion of male and female ($P > 0.05$). Chi-square test showed no significant association ($P > 0.05$) between FMA, IMPA, FMIA, and gender of the participants [Figures 5-7]. Student's *t*-test was used to compare the values of FMA, IMPA, and FMIA in Bengali males and females which showed that mean FMA of females was significantly higher than that of males ($t_{48} = 2.97$; $P < 0.01$), mean IMPA of males was significantly higher than that of females ($t_{48} = 2.45$; $P < 0.01$), but there was no significant difference between mean FMIA of males and females ($t_{48} = 1.12$; $P > 0.05$) [Figure 8].

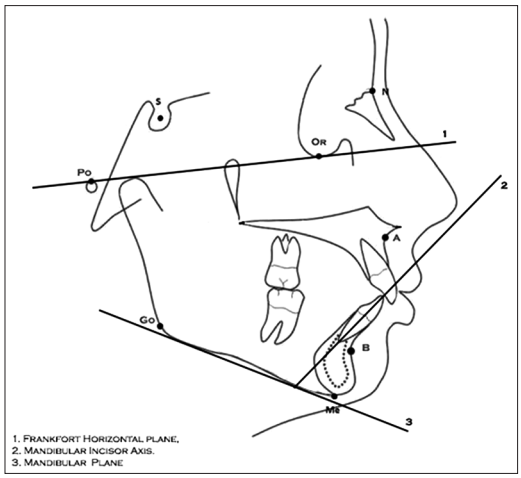

Figure 2: Various planes used in the study

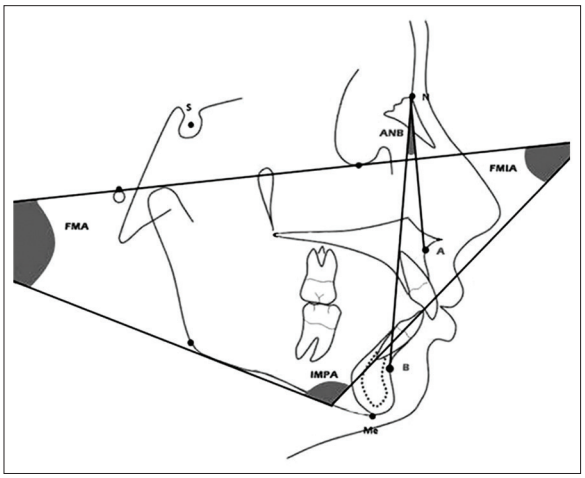

Figure 3: Various angles used in the study

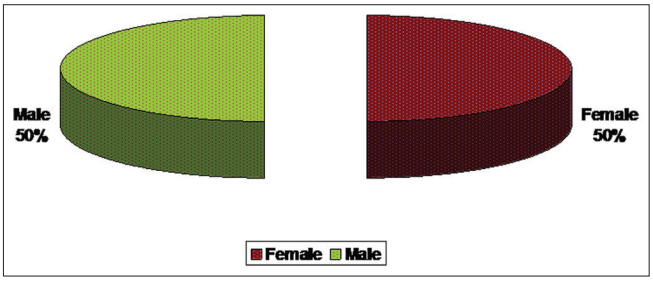

Figure 4: Gender distributions of the patients

When analysis was done using male and female together, Bengali population showed a mean value of 25.84 ± 5.08 for FMA, 95.01 ± 6.83 for IMPA, and 59.11 ± 6.76 for FMIA [Table 1 and Figure 9] On comparing the measurements of Bengali population with that of Caucasian population, it was found that mean FMA of Bengali Population was higher than that of Caucasian population, but the difference was not statistically significant ($t_{148} = 2.52$; $P > 0.05$). Mean IMPA of Bengali Population was significantly higher than that of Caucasian population (t_{98}

= 7.26; $P < 0.01$), and also the mean FMIA of Caucasian population was significantly higher than that of Bengali population ($t_{98} = 9.12$; $P < 0.01$) [Table 2 and Figure 10].

DISCUSSION

The improvement of facial esthetics has rapidly become one of the desirable objectives of orthodontic treatment and the concept of normal has become indispensable to an orthodontist. The term normal was defined by Tweed[9] as "The balance and harmony of proportions considered by the majority of us as most pleasing in the human face."

However, since soft tissue, dental and skeletal structures exhibit different pattern for different

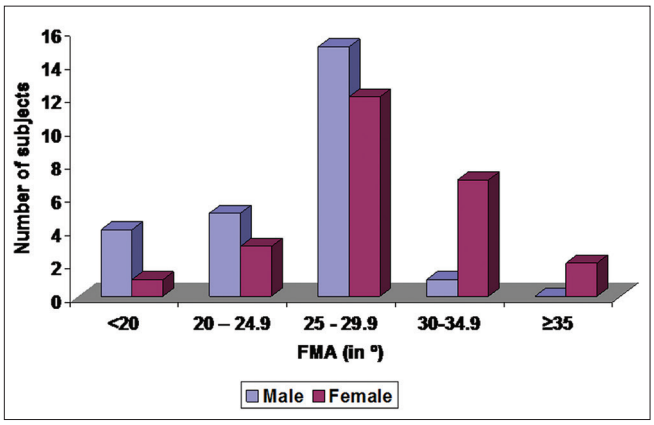

Figure 5: Distribution of Frankfort mandibular plane angle (in degrees) for male and female

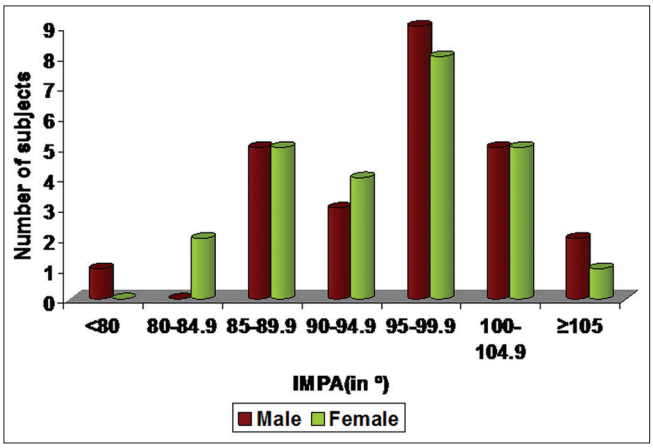

Figure 6: Distribution of incisor mandibular plane angle (in degrees) for male and female

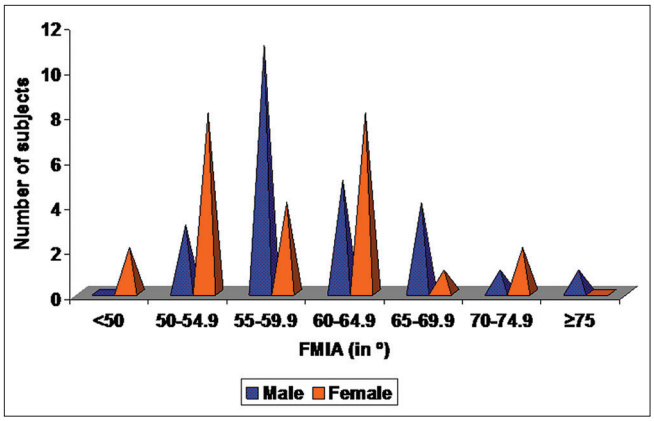

Figure 7: Distribution of Frankfort mandibular incisor angle (in degrees) for male and female

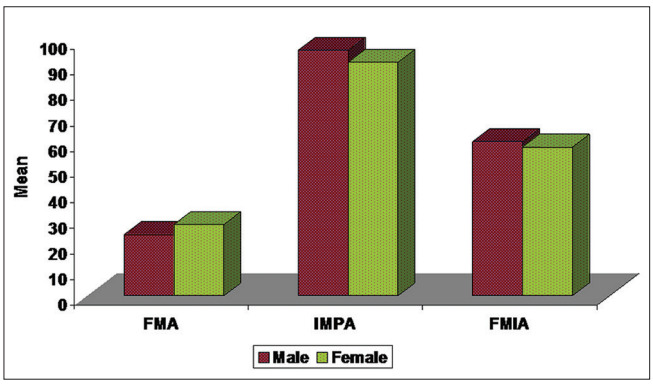

Figure 8: Mean values (in degrees) of Frankfort mandibular plane angle, incisor mandibular plane angle, and Frankfort mandibular incisor angle for male and female

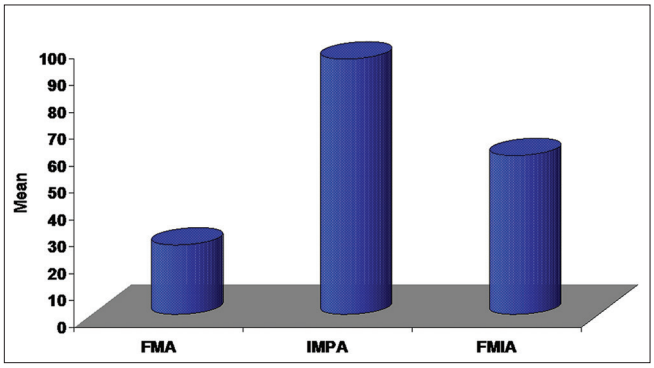

Figure 9: Mean values (in degrees) of Frankfort mandibular plane angle, incisor mandibular plane angle, and Frankfort mandibular incisor angle for all samples

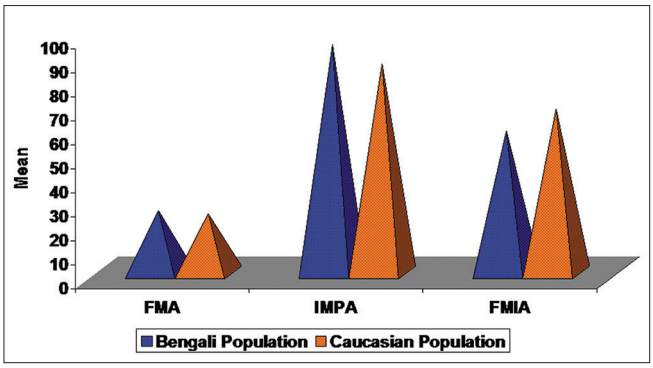

Figure 10: Mean values (in degrees) of Frankfort mandibular plane angle, incisor mandibular plane angle, and Frankfort mandibular incisor angle for Bengali and Caucasian population

Table 1: Mean±standard deviation of Frankfort mandibular angle, incisor mandibular plane angle, and Frankfort mandibular incisor angle for all samples (males and females taken together)

Values of descriptive statistics	FMA° (*n*=50)	IMPA° (*n*=50)	FMIA° (*n*=50)
Mean±SD	25.84±5.08	95.01±6.83	59.11±6.76
Median	26	97	58.5
Range (minimum–maximum)	10-36	78-106	47-75

FMIA: Frankfort Mandibular Incisor angle, FMA: Frankfort mandibular plane angle, IMPA: Incisor Mandibular plane angle, SD: Standard deviation

Table 2: Comparision of angular measurements of Bengali population with Caucasian population

Parameter	Range		*t*	Inference
	Bengali population	Caucasian population		
FMA	25.84	24.570	2.52	Not significant *P*>0.05
FMIA	59.11	68.200	9.12	Highly significant *P*<0.01
IMPA	95.01	86.930	7.26	Highly significant *P*<0.01

FMIA: Frankfort mandibular incisor angle, FMA: Frankfort mandibular plane angle, IMPA: Incisor mandibular plane angle

races, it has become relevant to define norms for various ethnic groups of population for successful diagnosis and treatment planning. India is a land of diversified race of people. Hence, many research workers in India have initiated to undertake racial studies. Sidhu (1970),[10] Nanda (1969),[6] Ashima Valiathan (1976),[11] Chandranee N. J. *et al*. (1983),[12] Kapoor D. N. (1987),[13] 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.

In the present study, an attempt was made to find out Tweed's cephalometric norms of Bengali population, one of the ethnic groups of Eastern India and the values were compared with that of the Caucasians on which Tweed developed his famous diagnostic facial triangle.

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

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

Comparison of cephalometric norms for Bengali males and females

The present study in the Bengali population showed no significant association between FMA, IMPA, FMIA, and gender of the participants ($P > 0.05$). When comparisons were made between the sexes in Bengali population, it was found that mean FMA of females was significantly higher than that of males ($t_{48} = 2.97$; $P < 0.01$), mean IMPA of males was significantly higher than that of females ($t_{48} = 2.45$; $P < 0.01$), but there was no significant difference between mean FMIA of males and females ($t_{48} = 1.12$; $P > 0.05$).

Comparison of Bengali population (males and females taken together) with Caucasian population

In the present study, angle FMA in Bengali Population was found to be closer to that of Caucasian Population, and the difference between the two ethnic groups was statistically not significant ($t_{148} = 2.52$; $P > 0.05$). The mean FMIA differed significantly ($t_{98} = 9.12$; $P < 0.01$) when compared to Caucasian standard as developed by Tweed (1962). Similarly, Bengali normal occlusion participants exhibited significantly higher ($t_{98} = 7.26$; $P < 0.01$) IMPA values when compared to Tweed's (1962) norm for Caucasian samples (24.57° ± 3.27°).

CONCLUSION

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

Following conclusions were made from the study:

1. Mean FMA value for females was found to be significantly higher than that of males ($t_{48} = 2.97$; $P < 0.01$) and the mean value of IMPA for males was significantly higher than that of females ($t_{48} = 2.45$; $P < 0.01$). However, there was no significant difference between mean FMIA of males and females ($t_{48} = 1.12$; $P > 0.05$).The result of the study indicated that separate norms should be considered for Bengali males and females during diagnosis and treatment planning
2. All the parameters in the study showed statistically significant difference, except FMA

when compared to Caucasian standard. Average FMA of 25.84° in Bengali participants indicated similar orientation of mandible to Frankfort horizontal plane in Bengali participants as in Caucasian population

3. Larger IMPA of 95.01° instead of 86.93° and smaller value of FMIA (59.11°) in Bengali participants as compared to Caucasians (68.20°) indicated proclined mandibular incisors in Bengali population than the Caucasian norms developed by Tweed.

The difference found in the present study as compared to the standard Caucasian population may be due 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.

The present study was done with a limited number of Bengali samples. For standardization of result, further extensive study is necessary with greater number of samples and meticulous sample selection.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Downs WB. Variations in facial relationships; their significance in treatment and prognosis. Am J Orthod 1948;34:812-40.
2. Steiner CC. The use of cephalometrics as an aid to planning and assessing orthodontic treatment. Am J Orthod 1960;46:721-35.
3. Tweed CH. The diagnostic facial triangle in the control of treatment objectives. Am J Orthod 1969;55:651-7.
4. Park IC, Bowman D, Klapper L. A cephalometric study of Korean adults. Am J Orthod Dentofacial Orthop 1989;96:54-9.
5. Chan GK. A cephalometric appraisal of the Chinese (Cantonese). Am J Orthod 1972;61:279-85.
6. Nanda R, Nanda RS. Cephalometric study of the dentofacial complex of North Indians. Angle Orthod 1969;39:22-8.
7. Garcia CJ. Cephalometric evaluation of Mexican Americans using the Downs and Steiner analyses. Am J Orthod 1975;68:67-74.
8. Drummond RA. A determination of cephalometric norms for the Negro race. Am J Orthod 1968;54:670-82.
9. Tweed CH. Clinical Orthodontics. Vol. 1. St Louis: Mosby; 1966. p. 31-82.
10. Sidhu SS, Shourie KL, Shaikh HS. The facial skeletal and denture pattern in Indians: A cephalometric study. J Indian Orthod Soc 1970;2:1-13.
11. Valiathan A. Tweed's analysis applied to Indian adults. J Indian Dent Assoc 1976;48:215-17.
12. Chandranee NJ, Jain RL, Tewari A, Utreja A. Tweed's diagnostic facial triangle for north Indian pre-school children. J Indian Soc Pedod Prev Dent 1983;1:1-5.
13. Kapoor DN. A Hand Book of Cephalometric Norms for Indian Ethnic Groups. Edited by Jyothindra Kumar; Published by Indian Orthodontic Society; 1987.