Original Article

Comparative evaluation of Tweed's analyses in Class I, Class II, and Class III participants of Central India: A pilot study

ABSTRACT

Objective: Comparative evaluation of Tweed's analyses in Class I, Class II, and Class III participants of Central India in two different age groups.

Materials and Methods: Sample size comprised 240 participants belonged to Central India. Participants were divided into two main groups: Group I comprised 120 young children in the age group of 12–16 years and Group II comprised 120 young adults in the age group of 18–22 years. Tweed's analysis was performed from the collected sample.

Results: The lower incisor inclination (incisor-mandibular plane angle [IMPA]) in Central India participants was higher (100.13) compared to the original Tweed norm of IMPA 90 . Statistically higher value of IMPA was found in young male children compared to young female children in Class II div 1 and Class II div 2 participants and opposite trend was seen in Class III young adults. The Frankfort-mandibular plane angle was found to be significantly more in young adult females (24.93) than males (18.07) in Class III participants. Angle IMPA was found to be significantly higher in Class I compared to Class III participants and significantly higher in Class III compared to Class II div 2 participants.

Conclusion: The differences of Tweed's parameters in this pilot study indicate that Caucasian norms cannot be truly adhered to Central India participants during orthodontic treatment. Lower incisors were normally more proclined in Central Indian participants and their over retraction during orthodontic treatment would cause prominent chin. Proclination of lower incisor was more in young male children compared to young female children in Class II div 1 and Class II div 2 participants and opposite trend was seen in Class III young adults. Class III female adults show tendency toward vertical growth pattern compared to males. Proclination of lower incisor was found to be more in Class I compared to Class III participants and more in Class III compared to Class II div 2 participants.

Keywords: Cephalometric, incisor-mandibular plane angle, malocclusion, retrognathic, Tweed's analyses

INTRODUCTION

Broadbent had introduced radiographic cephalometrics and provided research and clinical tool to study the malocclusion and their underlying skeletal structures.[1] Skeletal and menial scaffolding influences had a large effect on the facial morphology, and lateral cephalograms analyses have provided an important method for clinicians to correlate the skeletal, dental, and soft-tissue factors.[2] Cephalometric values vary from one ethnic group to others, and even the same race gender varies from other.[3] Studies[4-8] had already established cephalometric norms based on different populations of the world. Different racial groups should be treated based on their racial characteristics. The principle behind the cephalometric analysis is to compare the participants with a normal reference group to find the difference between the actual dentofacial relationship with their racial and ethnic groups.[9,10]

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In an attempt to determine the mesiodistal position of the teeth and there relation to head structure and jaw bones, Dr. Charles Tweed had developed a guide in the form of diagnostic facial triangle.[2] Tweed's triangle provided the clinician with simple and basic definite guidelines in the treatment planning of malocclusion. Tweed by using cephalometric radiographs introduced new norms to achieve facial esthetics. His standards led orthodontics into the extraction of first premolars to achieve posttreatment stability, better facial esthetics, and harmony.[11]

The aim of this pilot study was to evaluate Tweed's analyses for Class I, Class II, and Class III participants from Central India in two age groups; 12–16 years of age (young children) and 18–22 years of age (young adults). The study was done to establish mean values for Tweed's parameters and also to compare the gender and malocclusions difference between two age groups and compared to original norms.

MATERIALS AND METHODS

This prospective and comparative study was approved by the Institutional Ethical Committee and consists of 240 participants from Central India. Participants were divided into two main groups: Group I (120 young children in the age group of 12–16 years) and Group II (120 young adults in the age group of 18–22 years). The participants were further divided into different skeletal subgroups based on the ANB angle as shown in Table 1. Both male and female participants aged 12–16 years and 18–22 years with permanent dentition and not undergone orthodontic treatment were only included in the study. Participants having any missing tooth/teeth, having any crown and bridges, and dentition having large proximal caries were excluded from the study.

Table 1: Participant distribution based on ANB angle

Class	Young children Group I		Young adults Group II		ANB angle (°)
	Male	Female	Male	Female	
Class I	15	15	15	15	2±2
Class II div 1	15	15	15	15	>4
Class II div 2	15	15	15	15	>4° with retroclined incisors
Class III	15	15	15	15	<0

Lateral cephalograms of all the 240 participants were taken as per standard protocol from the same X-ray machine with natural head position with lips in relax position and in maximum intercuspation. The radiographs were taken at 85 kV/10 mA for 17.6 s, with effective dose 3–6 μSv and with film to source distance as 5 ft 2" and film to patient's mid-sagittal plane as 6". To eliminate the error of measurement by magnification, the magnification of all cephalogram was kept uniformly as 1:1.[7] The cephalometric tracing for all the participants was carried out on 0.003-inch matt lead acetate paper using soft black HB pencil by a single observer to eliminate the interobserver error. Tweed's analysis was performed from the data collected to asses Tweed's parameters for Central India population.

The data collected were tabulated for each subgroup, and the mean, range, and standard deviation with standard error of the mean were calculated. The gender difference was calculated using *t*-test. The differences in the group were calculated using paired *t*-test and analysis of variance test.

RESULTS

The results of Tweed's analyses are shown in Tables 2-7. The mean difference of angular measurement of participants and the Tweed's mean were compared. In general, it was found that the lower incisor inclination (incisor-mandibular plane angle [IMPA]) in Central India participants was higher (100.13°) compared to original Tweed norm of IMPA 90°. In Class I participants, the Frankfort-mandibular plane angle (FMA) and Frankfort-mandibular incisor angle (FMIA) were found to be less and IMPA was found to be more compared to Caucasian norms. A statistically higher value of IMPA was found in young male children compared to young female children in Class II div 1 and Class II div 2 participants and opposite trend was seen in Class III young adults. Angle IMPA was found to be significantly higher in Class I compared to Class II div 2 participants. Angle FMIA was found to be significantly lower in Class I compared

Table 2: Present study mean values of Tweed's analysis for Class I participants and comparison of males, females, young children, and young adults

Parameters (°)	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*
	Young male children (b)	Young female children (c)			Young male adults (e)	Young female adults (f)			Young children combined (bc)	Young adults combined (ef)		
IMPA	97.53±7.78	99.40±6.33	0.7221	0.4762	103.93±8.76	99.67±7.82	1.4050	0.1710	98.47±7.03	101.80±8.45	1.6593	0.1025
FMA	26.27±4.06	25.33±6.27	0.4874	0.6298	22.33±7.45	25.13±5.85	1.1448	0.2620	25.80±5.21	23.73±6.74	1.3309	0.1884
FMIA	56.20±8.18	57.93±8.28	1.2412	0.2248	54.40±6.81	55.20±8.29	0.2888	0.7749	57.07±8.13	54.80±7.47	1.1261	0.2647

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

Table 3: Present study mean values of Tweed's analysis for Class II div 1 participants and comparison of males, females, young children, and young adults

Parameters (°)	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*
	Young male children (b)	Young female children (c)			Young male adults (e)	Young female adults (f)			Young children combined (bc)	Young adults combined (ef)		
IMPA	104.93±9.50	97.67±7.52	2.320	0.0278*	101.53±7.67	101.27±7.52	0.0937	0.9260	101.30±9.19	101.40±7.46	0.0463	0.963
FMA	25.73±5.48	27.87±5.72	1.046	0.3044	25.47±6.04	25.80±4.43	0.1706	0.8657	26.80±5.61	25.63±5.21	0.8370	0.406
FMIA	50.67±10.08	55.80±9.73	1.418	0.1672	53.00±6.32	52.93±6.47	0.0300	0.976	53.23±10.08	52.97±6.29	0.1199	0.905

*$P<0.05$ which is statistically significant. SD: Standard deviation, FMA: Frankfort-mandibular plane angle, FMIA: Frankfort-mandibular incisal angle, IMPA: Incisor-mandibular plane angle

Table 4: Present study mean values of Tweed's analysis for Class II div 2 participants and comparison of males, females, young children, and young adults

Parameters (°)	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*
	Young male children (b)	Young female children (c)			Young male adults (e)	Young female adults (f)			Young children combined (bc)	Young adults combined (ef)		
IMPA	94.73±7.08	86.33±8.72	2.8964	0.0072*	91.67±10.75	89.73±8.48	0.5488	0.5875	90.53±8.90	90.70±9.56	0.0713	0.9434
FMA	22.60±5.15	24.07±5.13	0.7832	0.4401	25.47±6.13	24.07±8.049	0.5359	0.5962	23.33±5.11	24.77±7.06	0.9050	0.3692
FMIA	62.47±6.13	69.47±10.60	2.2141	0.0351*	62.87±9.46	66.20±7.76	1.0541	0.3009	65.97±9.22	64.53±8.67	0.6232	0.5356

*$P<0.05$ which is statistically significant. SD: Standard deviation, FMA: Frankfort-mandibular plane angle, FMIA: Frankfort mandibular incisal angle, IMPA: Incisor-mandibular plane angle

Table 5: Present study mean values of Tweed's analysis for Class III participants and comparison of males, females, young children, and young adults

Parameters (°)	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*	Mean±SD		*t*	*P*
	Young male children (b)	Young female children (c)			Young male adults (e)	Young female adults (f)			Young children combined (bc)	Young adults combined (ef)		
IMPA	92.80±7.33	91.60±8.96	0.4015	0.6911	92.47±8.47	99.07±8.67	2.1089	0.0440*	92.20±8.07	95.77±9.06	1.6116	0.1125
FMA	23.73±6.06	25.13±5.73	0.6501	0.5209	18.07±5.48	24.93±5.62	3.3848	0.0021**	24.43±5.84	21.50±6.48	1.8397	0.0709
FMIA	63.47±9.03	62.60±8.57	0.2707	0.7886	69.47±9.73	56.00±8.63	4.0112	0.0004**	63.03±8.66	62.73±11.34	0.1152	0.9087

*$P<0.05$ which is statistically significant, **$P<0.005$ which is highly significant. SD: Standard deviation, FMA: Frankfort-mandibular plane angle, FMIA: Frankfort-mandibular incisor angle, IMPA: Incisor-mandibular plane angle

Table 6: Present study mean values comparison of Tweed's analysis for Class I, Class II div 1, Class II div 2, and Class III participants

Parameter (°)	Difference between Group A and Group B	*P*	Difference between Group A and Group C	*P*	Difference Between Group A and Group D	*P*	Difference between Group B and Group C	*P*	Difference between Group B and Group D	*P*	Difference between Group C and Group D	*P*
IMPA	−1.22	0.445	9.52	0.000**	6.15	0.000**	10.73	0.000**	7.37	0.000**	−3.37	0.042*
FMA	−1.45	0.161	0.72	0.543	1.80	0.117	2.167	0.041*	3.25	0.002**	1.08	0.376
FMIA	2.83	0.063	−9.32	0.000**	−6.95	0.000**	−12.15	0.000**	−9.78	0.000**	2.37	0.156

*$P<0.05$ which is statistically significant, **$P<0.005$ which is highly significant. FMA: Frankfort-mandibular plane angle, FMIA: Frankfort-mandibular incisor angle, IMPA: Incisor-mandibular plane angle

Table 7: Present study mean values of Tweed's analysis for Class I participants and comparison with Tweed's mean

Parameter	Tweed'smean (a)	Present study mean for Class I							Difference		
		Mean±SD		Young children combined mean (d)	Mean±SD		Young adults combined mean (g)	Combined mean (h)	(a−d) (i)	(a−g) (j)	(a−h) (k)
		Young male children (b)	Young female children (c)		Young male adults (e)	Young female adults (f)					
IMPA	90	97.53±7.78	99.40±6.33	98.46	103.93±8.76	99.67±7.82	101.8	100.13	−8.46	−11.8	−10.13
FMA	25	26.27±4.06	25.33±6.27	25.8	22.33±7.45	25.13±5.85	23.73	24.76	−0.8	1.27	0.24
FMIA	65	56.20±8.18	57.93±8.28	57.06	54.40±6.81	55.20±8.29	54.8	55.93	7.94	10.2	9.07

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

to Class II div 2 participants. Angle IMPA was found to be significantly higher in Class I compared to Class III participants and significantly higher in Class III compared to Class II div 2 participants. FMA was found to be significantly

more in young female adults (24.93°) than males (18.07°) in Class III participants.

DISCUSSION

The results of Tweed's analyses in the present pilot study showed very important finding related to differences in morphological characteristics between the different races, age groups, sexes, and different malocclusions. These findings can be very useful guidelines for the diagnosis and treatment planning of orthodontic patients of Central India participants. In the present study, the mean values of Tweed's analysis for Class I participants, there was significantly no differences seen between sex and age. Similar results were obtained in a study by Bhattarai and Shrestha[12] in the Nepalese population. Contradictory results were obtained in the study by Kumari and Das[2] for IMPA being more in males than in females in the Bengali population.

In present study, the mean values for IMPA of Class II div1 participants was found to be significantly more in young male children (104.93°) than females (97.67°). This difference was due to more proclination of lower incisor in young male children when compared to females. Similar trend was observed in Class II div 2 participants. In Class II div 2 participants, FMIA was found to be significantly less in young male children (62.47°) than females (69.47°), due to increase IMPA in young male children. In the present study, the mean values of Tweed's analysis for Class III participants, IMPA was found to be significantly more in young female children (99.07°) than males (92.47°), this may be attributed to dental compensation associated with retrognathic mandible. FMIA was found to be significantly less in young female adults (56°) than males (69.47°), due to increase IMPA in young female adults. FMA was found to be significantly more in young female adults (24.93°) than males (18.07°), this may be attributed to forward growth rotation of mandible in male.

In the present study, mean values comparison of Tweed's analysis for Class I with Class II div 2, IMPA was found to be significantly more in Class I than Class II div 2, obviously attributed to retroclination of lower incisor in Class II div 2, similar trend was seen with Class II div 1 and with Class II div 2. In comparison of Class II div 1 population with Class 1 participants, no significant difference was obtained in the present study, but contradictory results were obtained in a study by Tukasan *et al*.[13] in the Brazilian population were they found a significant difference in IMPA. IMPA was found to be significantly more in Class I than Class III, this may be attributed to dental compensation associated with prognathic mandible in Class III participants, and a similar trend was seen for Class II div1 with Class III. Similar results were obtained in a study by Zegan *et al*.[14] in the Romania population. IMPA was found to be significantly more in Class III than Class II div 2, obviously attributed to retroclination of lower incisor in Class II div2.

Generally, it was found that the lower incisor inclination in Central India participants was higher (IMPA-100.13°) compare to the original Tweed norm of IMPA-90°. Similar results were obtained in study by Bhattarai and Shrestha[12] in the Nepalese population.

The limitations of the present study were that it is a pilot study and only the central Indian population was included in the study. Further study with more sample size, including the entire Indian population should be done to come to a definitive conclusion which can be helpful in planning orthodontic treatment for patients belonging to this region.

CONCLUSION

Although the present pilot study had shown promising results enumerated below, still further study with more sample size, including entire Indian population should be done to come to a definitive conclusion. Within the limitations of the present pilot study, following conclusions were drawn:

1. The mean values of Tweed's analysis for Class I participants, there was significantly no differences seen between sex and age
2. In general, it was found that the lower incisor inclination (IMPA) in Central India participants was higher (100.13°) compared to the original Tweed norm of IMPA 90°
3. Proclination of lower incisor was more in young male children compared to young female children in Class II div 1 and Class II div 2 subjects, the opposite trend was seen in class III young adults
4. Proclination of lower incisor was found to be significantly higher in Class I compared to class III participants and significantly higher in Class III compared to Class II div 2 subjects
5. Class III female adults show a tendency toward vertical growth pattern compared to males.

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Conflicts of interest

There are no conflicts of interest.

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