Evaluation of FMA, IMPA and FMIA in male and female of West Bengal population

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Abstract

Objective: This study aimed at determining variation of Tweed's norms in male and female of West Bengal population.
Materials and Methods: The study sample consisted of Standardized lateral cephalograms obtained from 50 subjects (25 males and 25 females) from West Bengal of 12-18 years age group with normal occlusion and pleasing facial profile. Tweed's cephalometric analysis was performed and difference between male and female samples was recorded. Any association between the three parameters of tweeds analysis and gender of the subjects was also calculated.
Results: 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 ($t_{48} = 2.45$; $p<0.01$).
Conclusion: The result of the study indicated difference in the norms of diagnostic facial triangle in males and females of West Bengal population.

Keywords: Tweeds analysis, Diagnostics facial triangle, Bengali ethnicity, Cephalometric study.

Introduction

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

Subjective clinical assessment has an important place in practice but must be supported by objective values that will lead different clinicians to arrive at the same diagnosis, hence a sound knowledge of anatomy and morphology, based upon quantitative data of craniofacial complex is essential. Cephalometric analysis has become an indispensable tool for describing craniofacial morphology. 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, Steiner, and Tweed[1], all developed cephalometric norms and analyses, samples for the study always consisted of Caucasian population. With time it became apparent that cephalometric standards for one ethnic group did not necessarily apply to other ethnic groups.

Dr Charles Tweed developed the Diagnostic facial triangle as a guide in determining the normal mesio-distal position of the teeth in relation to their respective jaw bones and head structure. The planes used were Frankfort horizontal plane, mandibular plane and long axis of lower incisor.In 1946, Tweed introduced the Frankfort Mandibular plane angle (FMA) which, as the name indicates, is formed between Frankfort horizontal plane and the mandibular plane. The angle is an indicator of prognosis according to Tweed (1946)[2]. This angle also indicates steepness of mandible according to Hocevar (1992)[3]. The mean value of Frankfort Mandibular plane angle for Caucasian population as developed by Tweed is 24.57±3.27 degrees.

According to Tweed, FMIA; which is the angle formed between Frankfort horizontal plane and long axis of mandibular incisor; value to be significant in providing balance and harmony of the lower face.Themean value of Frankfort Mandibular Incisor angle (FMIA) for Caucasian population as developed by Tweed is 68.20±5.19 degrees. Incisor Mandibular plane angle (IMPA) is the angle formed between mandibular plane and the long axis of the mandibular incisor. The position of the lower incisor has been recognised as a key to orthodontic diagnosis and treatment planning due to its effect on esthetics and stability. C.H. Tweed emphasized that for the desirable facial esthetics and stability, the lower incisors should be "upright over the basal bone".

It is evident from the studies of Cotton, Takano, Wong[4] and other investigators that the cephatometric norms vary not only as per age but also among ethnic groups.Sexual dimorphism has been reported in craniofacial structures which naturally appears between 12 and 15 years of age. Since most orthodontic treatments are performed in this age group, both male and female population groups in this age bracket must have their own cephalometric normative data for meaningful diagnosis. The purpose of this study was to determine gender variation in the norms of diagnostic triangle in West Bengal population for more accurate diagnosis and treatment planning.

Materials and Methods

50 subjects (25 males and 25 females) from West Bengal were selected for this study which was done in the department of Orthodontics and Dentofacial Orthopaedics of Dr. R. Ahmed Dental College and Hospital, 114, A.J.C. Bose Road, Kolkata-700014. Patients included in this study were within the age group of 12-18 years, selected randomly based on: 1) Bilateral Angle's class I molar relation, 2) ANB

ranging from 0° to 3°, 3) Normal overjet and overbite, 4) No history of previous Orthodontic treatment, 5) Harmonious profile, 7) Resident of West Bengal and 8) No congenital or acquired malformations of the skeletal or dental origin.

Materials used for the study included Siemens X-ray machine with hi-speed intensifying screen, lateral cephalometric radiograph with Kodak X-ray cassette and KG4 screen (size 8″ X 10″). Cellulose acetate tracing paper (0.003 mm), lead pencil - 0.5 mm, millimeter Scale and a radiograph illuminator. The lateral cephalogram was taken for all subjects selected under this study. Target film distance of 5 feet was used for all cephalograms obtained. The cassette-film assembly was positioned parallel with the midsagittal plane of the subject such that the x-ray beam is directed perpendicular to it. A voltage of 80kvp and a current of 20mA was used with an exposure time of 2.5 seconds to obtain the lateral head film.

Lateral cephalograms were traced upon a 0.003 mm matte acetate tracing paper the tracings were analysed using linear and angular measurements according to Tweed's analysis. Linear and angular measurements were done to an accuracy of 0.5 mm and 0.5 degrees respectively. The mean, standard deviation and range values of each measurement were tabulated. All the measurements values of different parameters were collected, arranged properly and computed for statistical analysis.

The following three planes that form Tweed's diagnostic triangle were used
1. Frankfort horizontal plane: Line joining from external auditory meatus to orbitale
2. Mandibular plane: Line passing tangent to the lower border of mandible
3. Long axis of lower incisor

The following three angles formed in Tweed's triangle were measured
1. Frankfort Mandibular plane Angle (FMA)
2. Frankfort Mandibulaar Incisal Angle (FMIA)
3. Incisor Mandibular Plane Angle (IMPA)

Statistical Analysis

Each cephalogram was traced twice and average value of each parameter was taken as the data. Different measurements were tabulated and subjected for statistical analysis to calculate the means with corresponding standard deviations (s.d.), median and ranges. Chi-square test was used to find out any significant association between FMA, IMPA, FMIA and gender of the population. Students 't' test was used to compare the values of FMA, IMPA, and FMIA in males and females. The statistical significance for all the tests carried out was defined as $p < 0.05$.

Table 1: Distribution of FMA for males and females

FMA (in°)	Gender		Total
	Male	**Female**	
<20	4	1	5
Row %	80	20	100
Col %	16	4	10
20 – 24.9	5	3	8
Row %	62.5	37.5	100
Col %	20	12	16
25 - 29.9	15	12	27
Row %	55.6	44.4	100
Col %	60	48	54
30-34.9	1	7	8
Row %	12.5	87.5	100
Col %	4	28	16
≥35	0	2	2
Row %	0	100	100
Col %	0	8	4
Total	25	25	50
Row %	50	50	100
Col %	100	100	100
Mean ± s.d.	23.86±4.41	27.82±5.01	

Table 2: Distribution of (IMPA) for males and females

IMPA (in °)	Male	Female	Total
<80	1	0	1
Row %	100	0	100
Col %	4	0	2
80-84.9	0	2	2
Row %	0	100	100
Col %	0	8	4
85-89.9	5	5	10
Row %	50	50	100
Col %	20	20	20
90-94.9	3	4	7
Row %	42.9	57.1	100
Col %	12	16	14
95-99.9	9	8	17
Row %	52.9	47.1	100
Col %	36	32	34
100-104.9	5	5	10
Row %	50	50	100
Col %	20	20	20
≥105	2	1	3
Row %	66.7	33.3	100
Col %	8	4	6
Total	25	25	50
Row %	50	50	100
Col %	100	100	100
Mean ± s.d	60.18±6.46	58.04±7.02	

Table 3: Distribution of FMIA for males and females

FMIA	Male	Female	Total
(in °)			
<50	0	2	2
Row %	0	100	100
Col %	0	8	4
50-54.9	3	8	11
Row %	27.3	72.7	100
Col %	12	32	22
55-59.9	11	4	15
Row %	73.3	26.7	100
Col %	44	16	30
60-64.9	5	8	13
Row %	38.5	61.5	100
Col %	20	32	26
65-69.9	4	1	5
Row %	80	20	100
Col %	16	4	10
70-74.9	1	2	3
Row %	33.3	66.7	100
Col %	4	8	6
>75	1	0	1
Row %	100	0	100
Col %	4	0	2
Total	25	25	50
Row %	50	50	100
Col %	100	100	100

Table 4: Mean (mean ± s.d.) values of FMA, IMPA and FMIA for males and Females

	FMA		IMPA		FMIA	
Values of descriptive statistics	(in °)		(in °)		(in °)	
	Male	Female	Male	Female	Male	Female
	(n=25)	(n=25)	(n=25)	(n=25)	(n=25)	(n=25)
Mean + s.d.	23.86+4.41	27.82+5.01	95.88+6.96	91.14+6.74	60.18+6.46	58.04+7.02
Median	25	28.5	98	96	57	59
Range(Minimum – Maximum)	10-31	14 - 36	78 – 106	82 – 105	50 – 75	47 - 74

Result

Statistical analysis was done with help of Epi Info (TM) 3.5.3. EPI INFO is a trademark of the Centres for Disease Control and Prevention (CDC). Chi-square test showed no significant association (P > 0.05) between FMA, IMPA, FMIA, and gender of the participants (Table 1-3). Student's t-test was used to compare the values of FMA, IMPA, and FMIA in males and females which showed that mean FMA of females was significantly higher than that of males (t48 = 2.97; P < 0.01), mean IMPA of males was significantly higher than that of females (t48 = 2.45; P < 0.01), but there was no significant difference between mean FMIA of males and females (t48 = 1.12; P > 0.05) (Table 4).

Discussion

Some researchers have developed cephalometric norms without regard to the sex of the subjects, whereas others have investigated males and females separately. Although some researchers did not find any significant differences between sexes, others established considerable important differences. The present study in the West bengal population

showed no significant association between Frankfort Mandibular plane angle (FMA), Incisor Mandibular plane angle(IMPA), Frankfort Mandibular Incisor angle (FMIA) and gender of the subjects (p>0.05). The Frankfort Mandibular plane angle for the males and females under the present study was found to be 23.86 ± 4.41 degrees and 27.82±5.01 degrees respectively. Males exhibited a mean Incisor Mandibular plane angle of 95.88±6.96 degrees and females exhibited a mean IMPA of 91.14±6.74 degrees. The study showed a mean Frankfort Mandibular Incisor angle

for male subjects to be 60.18±6.46degrees and mean FMIA for female subjects was found to be 58.04±7.02degrees.

When comparisons were made between the sexes in a population of West Bengal, 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).

Chandranee N.J. et al. (1983)[5] observed flatter Mandibular plane angle for girls and average Mandibular plane angle for boys in a cephalometric study of North Indian preschool children. They found a mean Mandibular plane angle for girls to be 23.2 degrees and 25.2 degrees for boys. Their study observed statistically significant difference (p<0.05) between sexes. The present study also showed significant difference between sexes (p<0.01) for FMA and IMPA values in West Bengal Population. Statistically significant difference between sexes was also

reported by Donald Swlerenga et al (1994)[6] for Mexican-American population .He found FMA to be 20.70±5.91 degrees in males and 25.20±3.97 degrees in females and IMPA was found to be 96.30±5.40 degrees in males and 97.24±4.20 degrees in females. Similarly, Argyropoulus et al. (1989)[7] reported statistically significant (p <0.05) differences of FMA value between sexes for Greek population; 26.71 degrees for males and 28.68 degrees for females. Kapoor D.N et al (2001)[8] observed a mean FMA of 24.56 degrees for males and a mean FMA of 23.48 degrees for girls of Lucknow population. They observed a statistically significant difference between sexes (p<0.05). In the present study on normal occlusion subjects of West Bengal, there was statistically significant difference between the males and females.

KuniakiMiyajima et al (1996)[9] found statistically significant difference (p<0.01) between sexes for FMA whereas the value of IMPA was statistically not significant between sexes. The present study also showed significant difference between sexes (p<0.01) for FMA value. ParvizRiazDavoody et al (1978)[10] reported statistically significant (p< 0.05) differences for IMPA in Iranian population; 99.36 degree in males and 94.45 degree in females But for mean FMA value, difference between males and females was statistically not significant; the value of FMA being 28.39 degree in Iranian males and 27.65 degree in Iranian females.

Sunil Kapila(1987)[11],MayuryKuramae et al (2004)[12], Mohammed Nahidh et al (2011), P Bhattarai et al (2011), Ravindra Nanda et al (1969)[13]and Ali H. Hassan (2006)[14]found statistically non-significant differences between the sexes. However, the result of present study showed significant difference between males and females (p<0.01).

Summary and Conclusion

Following conclusions were made from the study:
1. Statistical analysis indicated that there was no significant association between FMA, IMPA, FMIA and gender of the subjects from West bengal (p>0.05).
2. The FMA angle for males and females under the present study was found to be 23.86 ± 4.41degree and 27.82±5.01 degree respectively. The males exhibited a mean IMPA of 95.88±6.96 degree and females showed a mean IMPA of 91.14±6.74 degree. FMIA value for male subjects was found to be 60.18±6.46degree and for female subjects it was 58.04±7.02degrees.

3. 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). But 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 males and females of West Bengal during diagnosis and treatment planning.

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