A cross-sectional study of soft tissue facial morphometry in children of West Bengal

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Abstract

Context: Facial analysis is the first step in the evaluation of patients with orthodontic, cosmetic, or reconstructive procedures of the face, and one of the most important components of orthodontic diagnosis and treatment planning. It is a well-established fact that human faces differ from one another on the basis of race and ethnicity. The study will provide the aesthetic guidelines to assess the facial discrepancy in Bengali children to develop a proper treatment plan. Aims: To find out the mean values for selective linear measurements on the facial soft tissue of Bengali children, to demonstrate gender differences in the measurements.

Materials and Methods: A cross-sectional study was done on 250 Bengali children of 6-14 years age, by measuring certain identified facial landmarks using a digital caliper. Statistical Analysis Used: Analytical statistical method with the help of student’s t-test was used to determine mean values, standard deviation, and gender differences in the measurements using SPSS version 11.0. Results: In 6-8 years age group, male’s average inter-endocanthion distance was significantly higher than that of females (P < 0.05), whereas in 12-14 years age group, the same parameter for females was significantly higher than that of males (P < 0.001). In 9-11 years age group, the average distance of exocanthion to exocanthion was higher for males compared to females, but the difference was not significant at 5% level (P > 0.05), though for 87% of cases, it was significant (P = 0.13). Total facial height for male subject was significantly high compared to that of females (P < 0.001) in 12-14 years age group. Conclusions: The study will provide the aesthetic guidelines to assess the facial discrepancy in Bengali children and provide a proper treatment plan through a simple and economically reasonable soft tissue analysis method.

Keywords: Anthropometry, face, facial analysis, soft tissue

Introduction

Every single human face is unique in its look, its shape, and proportions, as well as in the specific ways of articulation and expression that are so characteristic for an individual.

The analysis of human face is a science and an art, utilizing both aesthetic and anthropological tools. It is a well-established fact that human faces differ from one another on the basis of race and ethnicity. Therefore, it is impossible to determine a definitive definition of facial beauty; the ideal or attractive face of one generation is different from another and depends in large measure on racial, ethnic, national, personal, as well as gender preferences to name a few of the important factors involved in the determination of beauty.

Facial analysis is the first step in the evaluation of patients who present for orthodontic, cosmetic, or reconstructive procedures of the face, and one of the most important components of orthodontic diagnosis and treatment planning.

Facial aesthetics is one of the Principle Concerns of Orthodontists and Maxillofacial Surgeons and Pedodontists also have a role in it. Facial aesthetics play an important role in self-identification, self-image, self-presentation, and interpersonal confidence. Furthermore, they affect social behavior. Therefore, in most cultures, the face is regarded as the most salient characteristic of once identity. Anthropometry is the science of measuring the human body and its parts. Facial anthropometry is a direct means of facial measurement that uses standard landmarks and instrumentation to compare populations. Anthropometric analysis, a technique that yields accurate soft tissue measurements of the face, has been used to define soft tissue relationships.

This study is performed to find out the mean values for selective landmarks on the face of the Bengali children in West Bengal to demonstrate gender differences in the linear measurements. The purpose of the study is to gather...
baseline information regarding the selected soft tissue facial measurements in Bengali children with minimum armamentarium, which will help in diagnosis and treatment planning.

Materials and Methods

Sample
The study was performed on 250 (123 males and 127 females) Bengali children in 6-14 years age group who were selected randomly in the outpatient Department of Pedodontics and Preventive Dentistry. Children with maxillofacial trauma/pathology/developmental defects, medical complication, and with previous orthodontic treatment of any kind were excluded from the study.

Data collection
The linear soft tissue measurements were performed by a single examiner in the clinics after obtaining the written consent from the guardian. The facial measurements were performed according to the classical methods of physical anthropology. The subjects were made to stand in an upright position on the flat floor in an area with adequate natural light.

The standard natural orientation of the head was achieved by asking the subjects to look at the external source of eye reference, i.e., a wall mirror and the jaws were in habitual occlusion.

The measurement was done in a true horizontal plane with subject 3 feet away in front of the mirror. In case of small children, they were made to stand on a raised platform in order to keep the head of the examiner at the level of the head of the subject. The soft tissue landmarks to be studied were located by careful inspection and/or palpation of the face and a mark were created on the cutaneous surface of the face with a non-permanent marking pen. A digital caliper was used to measure the shortest linear distance between the marked points on the skin of the face. The marked landmarks were wiped out with cotton moistened with spirit after the completion of the measurements.

The data were analyzed using SPSS version 11.0 to determine mean values, standard deviation, and gender differences in the measurements. Student’s t-test was used to determine the significance in values of males and females.

Facial landmarks
The linear measurements of the soft tissue of the face were done according to the following landmarks: [Figures 1 and 2].

- Trichion: The midpoint of the hairline.
- Nasion: The midpoint on the soft tissue contour of the base of the nasal root at the level of the frontonasal suture.
- Subnasale: The midpoint on the nasolabial soft tissue contour between the columella crest and the upper lip.
- Gnathion: In the midline, the lowest point on the lower portion of the chin.
- Endocanthion: The soft tissue point located at the inner commissure of each eye fissure.
- Exocanthion: The soft tissue point located at the outer commissure of each eye fissure.
- Tragion: The point located at the upper margin of each tragus of the ear where the upper edge of the cartilage disappears into the skin of the face.
- Otubasion superius: The point of attachment of the helix in the temporal region, which determines the upper border of the ear insertion.
- Otubasion inferus: The point of attachment of the ear lobe to the cheek, which determines the lower border of the ear insertion.

Variables/measurements
To obtain reference data for 13 linear measurements of the face of Bengali children in West Bengal and to evaluate gender differences, the following measurements were studied:

Figure 1: Soft tissue facial landmarks

Figure 2: Soft tissue facial landmarks
Inter-endocanthion distance,
Inter-exocanthion distance,
Inter-trichion–nasion distance,
Inter-trichion–subnasale distance,
Inter-exocanthion–endocanthion distance; right and left,
Inter-otubasion superious–exocanthion distance,
Inter-otubasion inferus–exocanthion distance,
Inter-exocanthion distance,
Inter-otubasion superious–subnasale distance,
Inter-otubasion inferus–subnasale distance,
Inter-otubasion superious–otubasion inferus distance.

Results

Mean values, standard deviations, and significant differences between male and female subjects of various age groups are listed in Tables 1-4.

In 12-14 years age group, the linear distance facial height (Trichion to Gnathion) for male subject was significantly very high compared to that of female (t = 3.59, d-f = 61; P < 0.001).

Also in 9-11 years age group, the same linear distance was higher in males than females in 85% cases (t = 1.92, d-f = 96; P = 0.15). Though the gender difference was not significant at 5% level (P > 0.05), it was significant at 15% level.

In 6-8 years age group, male’s average endocanthion to endocanthion (En-En) distance was significantly higher than that of females (t = 2.42, d-f = 87; P < 0.05).

In 12-14 years age group, for En-En distance, the average for females (27.69) was significantly higher than that of males (25.96) (t = 4.12, d-f = 61, P < 0.001).

In 9-11 years of age group, the average distance of exocanthion to exocanthion (Ex-Ex) was higher for males compared to females, but the difference was not significant at 5% level (P > 0.05), though for 87% of cases, it was significant (P = 0.13).

In 12-14 years age group, the average Ex-Ex distance for males is greater than that of females in 93.5% of cases, a little short of 5% level of significance.

For exocanthion to endocanthion ([Ex-En] [right]) in the 9-11 years age group, the average distance for males was significantly higher than that of females in 83% of cases, though the difference was not significant at 5% level (P > 0.05).

In all other cases, there was no significant gender difference (P > 0.05).

For the linear distances in respect to exocanthion to the highest point of attachment of the external ear to the head (Ex-Obs), exocanthion to the lowest point of attachment of the external ear to the head (Ex-Obi), and exocanthion to the tragion (Ex-T), there was no significant variation in the

Table 1: Mean and SD (mm) of linear distances (facial heights) in 123 male and 127 female subjects

| Age group (years) | Sex (n) | Tr-N | Tr-Sn | Tr-Gn |
|-------------------|--------|------|-------|-------|
|                   | Mean   | SD   | t     | P     | Mean   | SD   | t     | P     | Mean   | SD   | t     | P     |
| 6-8               | Male (41) | 60.54 | 4.316 | 0.05 | >0.9 | 97.22 | 5.633 | 0.23 | >0.8 | 135.67 | 10.318 | 1.12 | >0.8 |
|                   | Female (48) | 60.57 | 6.45 | 0.13 | <0.1 | 96.95 | 5.57 | 0.05 | >0.8 | 133.38 | 8.12 | (NS) | (NS) |
| 9-11              | Male (49) | 62.80 | 4.49 | 0.22 | >0.9 | 100.41 | 7.04 | 0.43 | >0.6 | 142.32 | 10.01 | 1.92 | 0.15 |
|                   | Female (49) | 62.61 | 4.63 | 0.60 | >0.1 | 99.86 | 5.41 | 0.32 | >0.5 | 138.46 | 9.93 | (NS) | (NS) |
| 12-14             | Male (33) | 64.55 | 5.69 | >0.7 | (NS) | 106.02 | 5.46 | 0.50 | >0.6 | 148.36 | 7.10 | 3.59 | <0.001 |
|                   | Female (30) | 64.14 | 3.32 | 0.345 | (NS) | 105.33 | 5.55 | 0.23 | <0.1 | 141.49 | 8.07 | (NS) | (NS) |

Tr-N: Trichion to nasion; Tr-Sn: Trichion to subnasale; Tr-Gn: Trichion to gnathion; NS: Not significant

Table 2: Mean and SD (mm) of linear distances (eye measurements) in 123 male and 127 female subjects

| Age group (years) | Sex (n) | En-En | Ex-Ex | En-En (right) | Ex-En (left) |
|-------------------|--------|-------|-------|---------------|--------------|
|                   | Mean   | SD    | t     | P     | Mean   | SD   | t     | P     | Mean   | SD   | t     | P     |
| 6-8               | Male (41) | 28.66 | 1.75 | 2.42 | <0.05 | 86.45 | 4.76 | 0.10 | >0.9 (NS) | 28.73 | 3.02 | 0.77 | >0.4 (NS) |
|                   | Female (48) | 27.40 | 2.91 | 0.77 | >0.1 | 86.35 | 5.07 | 0.13 | >0.8 (NS) | 28.19 | 3.51 | 0.32 | >0.6 (NS) |
| 9-11              | Male (49) | 27.52 | 2.31 | 0.92 | >0.3 | 89.51 | 3.87 | 1.55 | 0.13 | 30.32 | 2.01 | 1.39 | 0.17 |
|                   | Female (49) | 27.92 | 1.96 | 0.13 | >0.8 | 88.22 | 4.37 | 0.13 | >0.5 | 29.71 | 2.34 | 0.67 | >0.4 (NS) |
| 12-14             | Male (33) | 25.96 | 1.52 | 4.12 | <0.001 | 92.34 | 3.65 | 1.90 | 0.065 | 28.83 | 3.62 | 0.73 | >0.4 (NS) |
|                   | Female (30) | 27.69 | 1.81 | 0.60 | >0.1 | 90.55 | 3.81 | 0.23 | <0.1 | 28.27 | 2.25 | 0.27 | >0.7 (NS) |

NS: Not significant; En-En: Endocanthion to endocanthion; Ex-Ex: Exocanthion to exocanthion exocanthion; Ex-En: Exocanthion to endocanthion
average measurements by sex in all the age groups viz., 6-8, 9-11, and 12-14 years.

For the measurement from the subnasale to the highest point of attachment of the external ear to the head (Subnasale to Otubasion superious) however, measurement for male subjects was significantly higher compared to female subjects in all age groups.

For the measurement from the subnasale to the lowest point of attachment of external ear to the head (Subnasale to Otubasion inferus), measurement for male subjects was significantly higher than that of females (t = 2.33, d-f = 61, P < 0.05) in 12-14 years age group.

For the measurement between the highest and the lowest point of attachment of external ear to the head (Otubasion superious to Otubasion inferus), in 9-11 years age group, there was no significant difference in males or females. However, in 6-8 years age group though the difference was not significant at 5% level (t = 1.35, d-f = 87, P > 0.05), yet in about 82% cases, male subjects were of higher average distance compared to that of females.

Three out of thirteen linear measurements were significantly higher (P < 0.001) in males and one out of thirteen linear measurements were significantly higher (P < 0.001) in females, both in 12-14 years age group.

### Discussion

One of the most important components of orthodontic diagnosis and treatment planning is the evaluation of the patient’s soft tissue. Soft tissue dimensions vary as a result of thickness, length, and postural tone of the tissues. The soft tissue covering the teeth and bones can vary making the dentoskeletal pattern an inadequate guide in evaluating facial disharmony.

As very few studies have been done to establish soft tissue norms for the Indian population, a comprehensive comparative study was required to obtain the data of soft tissue norms of Indian population. Therefore, this study was conducted in West Bengal, India.

Any study on facial analysis must be viewed within the limits of racial, regional, and cultural concepts. There is an importance of ethnic group in all population. This study was performed on children of Bengali ethnic origin. Similarly, Hyeon-Shik Hwang, Wang-Sik Kim, and James McNamara did a study on Korean and European-American adults in order to understand the ethnic differences in the soft tissue profile between these two groups.

In this study, 6-14 years age group was chosen, as during this period growth spurts are seen both in males and females. According to Hagg and Taranger, most of the growth modification orthodontic appliances can be effectively utilized for the patient benefit during this age group. Thus,
knowing the anthropometric norms for this particular age group would be helpful in treatment planning. It is contemporary to the study done by Nizam et al.,[9] in which the soft tissue facial measurements were performed on Malaysian children between 6 years and 15 years.

The soft tissue facial measurements in this study were done using selective landmarks and linear measurement. There were 9 landmarks and 13 linear measurements which were concurrent to the study done by Nizam et al.[9]

Eleven out of thirteen linear measurements were significantly higher ($P < 0.001$) in males than in females at 15 years of age in the study done by Nizam et al.,[9] and by Virgilo et al.,[10] in the sample of healthy young adults, the size of the soft tissue facial contour was significantly higher in males than in females. In this study, three out of thirteen linear measurements were significantly higher ($P < 0.001$) in males and one out of thirteen linear measurements were significantly higher ($P < 0.001$) in females, both in 12-14 years age group.

The upper facial height is the distance between trichion and nasion. Long upper third of face indicates vertical maxillary excess. Increased total facial height is seen in individuals with adenoid facies. In this study, the upper facial height in 12-14 years age group was 60.54 mm in males and 60.57 mm in females. This value is less when compared to the values of different ethnic groups. Upper facial height in North American White young adult in 18-30 years age group as given by Farkas et al.,[11] was 70.1 mm in male and 63.3 mm in females, and in Indian males and females in 12-14 years age group.

The highest inter-sample variability was observed for the distance from the highest point of attachment of external ear to the head in Malaysian adolescent of 14.5-15.5 years age group; the values were 73.2 mm in males and 66.5 mm in females. In 6-8 years age group, the values were 68.58 mm in males and 68.01 mm in females, whereas in 9-11 years age group, it was 69.98 mm in males and 69.52 mm in males and females, respectively, in this study.

The highest inter-sample variability was observed for the measurements from subnasale to the highest point of attachment of external ear to the head in the study of Nizam et al.[9] Whereas the inter-sample variability was much less for the same parameters in this study.

Nizam et al.,[9] established the value for the distance from subnasale to the lowest point of attachment of the external ear to the head in Malaysian adolescent of 14.5-15.5 years age group. The values were 109.9 mm in males and 101.1 mm in females. The values of same parameters in this study in children of 12-14 years age group were 109.08 mm in males and 101.1 mm in females which was concurrent with the findings of Nizam et al.,[9] in children of 6-15 years age group.

The value of the distances between the highest and lowest point of attachment of external ear to the head in this...
study was 44.85 mm in males and 44.73 mm in females of 12-14 years old children, which was slightly more than the values of Malaysian adolescent in 14.5-15.5 years by Nizam et al.,[9] it was 45.1 mm in males and 45.1 mm in females.

**Conclusion**

Studies in different parts of the world on soft tissue facial analysis have yielded variety of results. No investigators have yet conducted a study on soft tissue facial morphometry in children of West Bengal. Hence, the study will provide the data on soft tissue facial measurement in children of Bengali ethnic group to assess differences with age and sex. It will provide the aesthetic guidelines to assess the facial discrepancy in Bengali children and provide a proper treatment plan through a simple, economically reasonable soft tissue facial analysis method, which can be used easily in rural clinical set ups where sophisticated instruments are not available.

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**References**

1. Bashour M. An objective system for measuring facial attractiveness. Plast Reconstr Surg 2006;118:757-74.
2. Auger TA, Turley PK. The female soft tissue profile as presented in fashion magazines during the 1900s: A photographic analysis. Int J Adult Orthodon Orthognath Surg 1993;14:7-18.
3. Naini FB, Moss JP, Gill DS. The enigma of facial beauty: Esthetics, proportions, deformity, and controversy. Am J Orthod Dentofacial Orthop 2006;130:277-82.
4. Porter JP, Olson KL. Analysis of the African American female nose. Plast Reconstr Surg 2003;111:620-6.
5. Farkas LG. Craniofacial norms Anthropometry of the Head and Face. New York, NY: Raven Press; 1994. p. 46.
6. Wang D, Qian G, Zhang M, Farkas LG. Differences in horizontal, neoclassical facial canons in Chinese (Han) and North American Caucasian populations. Aesthetic Plast Surg 1997;21:265-9.
7. Hwang HS, Kim WS, McNamara JA Jr. Ethnic differences in the soft tissue profile of Korean and European-American adults with normal occlusions and well-balanced faces. Angle Orthod 2002;72:72-80.
8. Hagg U, Taranger J. Maturation indicators and pubertal growth spurt. Am J Orthod Dentofacial Orthop 1982;82:299-309.
9. Abdullah N, Naing L, Ismail NM, Ismail AR. A cross-sectional study of soft tissue facial morphometry in children and adolescents. Malays J Med Sci 2006;13:25-9.
10. Ferrario VF, Sforza C, Schmitz JH, Miani A Jr, Taroni G. Fourier analysis of human soft tissue facial shape: Sex differences in normal adults. J Anat 1995;187:593-602.
11. Farkas LG, Katic MJ, Forrest CR, Alt KW, Bagic I, Baltadjiev G, et al. International anthropometric study of facial morphology in various ethnic groups/races. J Craniofac Surg 2005;16:615-46.
12. Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning. Part I. Am J Orthod Dentofacial Orthop 1993;103:299-312.
13. Naini FB. Anthropometric craniofacial surface landmarks Facial Aesthetics Concepts and Clinical Diagnosis. West Sussex UK: Wiley- Blackwell; 2011. p. 205.
14. Fledelius HC, Stubgaard M. Changes in eye position during growth and adult life as based on exophthalmometry, interpupillary distance, and orbital distance measurements. Acta Ophthalmol (Copenh) 1986;64:481-6.
15. Pryor HB. Objective measurement of interpupillary distance. Pediatrics 1969;44:973-7.
16. Ngeow WC, Aljunid ST. Craniofacial anthropometric norms of Malaysian Indians. Indian J Dent Res 2009;20:313-9.

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