Evaluation of Soft Tissue Facial Profile in Adult Bengali Population by Photogrammetric Method with Angular Measurements

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ABSTRACT

Introduction: Social acceptance, psychological well-being and self-esteem of an individual are related to physical appearance. With emphasis on achievement of balanced facial harmony and smile esthetic, proper clinical photographic record has become more essential for good treatment planning and follow-up. The study aimed to evaluate the soft tissue facial profile using angular photogrammetric norms and gender difference from standardized photographs of adult Bengali population.

Material and methods: The study was conducted among 100 dental students aged 18-25 years with Angle's class I occlusion, normal overjet-overbite, normal growth and development, normal maxillary and mandibular arches with all teeth excluding third molars. The dental students were selected from family with a minimum of three consecutive Bengali generations. Individuals with pleasing facial profile were judged by 1 layman, 8 post-graduate students and 2 orthodontists. Profile photographs were obtained at natural head position. Soft tissue landmarks were marked.

Result: Comparison of mean soft tissue profile measurement between male and female subjects using unpaired *t*-test showed statistically significant gender differences (<0.01) in facial, total facial, nasolabial and upper lip angles.

Conclusion: The derived mean values can be considered as normal values for Bengali population. It can be used for comparison of subjects with malocclusion. Further studies are required in this area.

Keywords: Esthetic; Facial profile; Natural head position; Photogrammetric analysis

INTRODUCTION

Physical appearance is a significant feature of the face and self-esteem is strongly influenced by facial appearance.[1] So, evaluation of the patient's soft tissue profile become one of the most important components of orthodontic diagnosis and treatment planning.[2] It has been established that the primary goal of orthodontic treatment is to attain and preserve optimal facial attractiveness.[3]

Radiographic cephalometrics and photographic systems are the most suitable and most commonly used for facial soft tissue evaluation. These photographic systems do not expose the patient to potentially harmful radiation and could provide better evaluation of the harmonic relationships.[4]

Nowadays with more and more emphasis from the orthodontic community on the achievement of balanced facial harmony and smile esthetics for the patients, in addition to the traditional orthodontic treatment objectives of a proper alignment and functional dentition, a well clinical photographic record of the patient has become more obvious and essential for good treatment planning and follow-up.[5]

The soft tissue profile features vary for different ethnic groups.[6] In India, the population comprise of different ethnic groups belonging to different race and Bengali population constitutes a large section of the Indian sub-continent. They are included in the Caucasoid type of human race. The other two types are Mongoloid and Negroid. The Caucasoid type includes the Europeans, the white Americans, the Punjabis, the Bengalis, etc. So it is an accepted fact that norms for different ethnic groups can differ widely. Therefore it is not correct to apply the norms for the western population blindly to the Indian population. Hence there is a need to develop norms pertaining to Indian ethnic groups.

The aim of this study was to establish angular photogrammetric norms from standardized photographs of adult Bengali population and to identify possible gender differences between adult Bengali males and females.

MATERIAL AND METHODS

It was a cross-sectional study conducted in the department of orthodontics of Dr. R. Ahmed Dental College and Hospital, West Bengal, India. The study population comprised of 100 dental students (50 males and 50 females) aged 18-25 years. The criteria of selection included Bengali population, family with a minimum of three consecutive generations with no previous history of orthodontic or surgical treatment, Angle's class I occlusion with normal overjet-overbite relationship with minimal or no crowding, normal growth and development, normal maxillary and mandibular arches and all teeth present except third molars and good facial symmetry. Individuals with pleasing facial profile were judged by 1 layman, 4 post-graduate students and two orthodontists before inclusion.

The photographic set-up was done with a tripod for supporting the digital camera (Nikon D80, Thailand). All the pictures were taken in the aperture priority mode of camera with aperture at 11 and built in flash light was used for uniform or constant illumination. Adjustment of the tripod height allowed the optical axis of the lens which was maintained in a horizontal position during the recording, adapted to each

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How to cite this article: Laishram Bijaya Devi, Anuranjan Das, Avinash Keisam. Evaluation of soft tissue facial profile in adult bengali population by photogrammetric method with angular measurements. International Journal of Contemporary Medical Research 2016;3(5):1336-1339.

subjects' body height. In a standing position, each subject was asked to relax with both the arms hanging freely beside the trunk. The camera to the subject distance was maintained at a constant distance of 5 feet for all the subjects. The subject was asked to look at an object at his or her eye level. Then the subject was asked to keep the lips in relaxed position so that the right-side profile record was taken in Natural Head Position (NHP). The same procedure was repeated for every subject. The subject`s forehead, neck and ear were clearly visible and their lips were in repose.

The width was kept 6 inch and height at 8 inch for all photographs. Computerized printout of all photographs was taken out. Tracing was done using 0.003-inch acetate matte tracing paper and 3H hard lead pencil. Soft tissue landmarks were marked and angular photogrammetric analysis was carried out.

The landmarks used for the study are given in figure 1. Angular parameters used are given in figure 2.

Figure-1: Profile photograph of female.The soft tissue landmarks used for the study: glabella (G), nasion (N), nasal dorsum (Nd), pronasal (Prn), columella (Cm), subnasal (Sn), labial superior (Ls), labial inferior (Li), supramental (Sm), pogonion (Pg).

STATISTICAL ANALYSIS

Data entry and analyses was done using the Statistical Package for Social Sciences (SPSS) for Windows software version 21.0. Descriptive statistics such as mean and standard deviation (SD) were used. The p-value less than 0.01 will be treated as significant. Unpaired *t*-test was done for comparison between male subjects and female subjects.

RESULTS

Descriptive statistics data including mean and the result of the Student's *t*-test for male and female Bengali photogrammetric angular measurements are shown in Table 1.

The nasolabial (Cm-Sn-Ls), mentolabial (Li-Sn-Pg) and nasomental (N-Prn/N-Pg) angles were larger in Bengali males when compared to those of females. The facial (G-Sn-Pg), total facial (N-Prn-Pg), nasofrontal (G-N-Nd), nose tip (N-Prn-Cm) and upper lip (Sn-Ls/Sn-Pg) angles were larger in Bengali females than those of males. The projection of upper lip to chin angle (N-Pg/N-Ls) was slightly larger in males (8.610°) than in females (8.092°), whereas the projection of lower lip to chin angle (N-Pg/N-Li) was slightly larger in females (3.938°) than in males (3.828°). Statistically significant gender differences were present in four angles such as facial (G-Sn-Pg; p = 0.0001, total facial (N-Prn-Pg; p = 0.0012, nasolabial (Cm-Sn-Ls; p = 0.0077 and upper lip (Sn-Ls/Sn-Pg; p = 0.008) angles. The nasofrontal (G-N-Nd; p = 2.507), mentolabial (Li-Sm-Pg; p = 0.459), projection of upper lip to chin (N-Pg/N-Ls; p = 0.182), projection of lower lip to chin (N-Pg/N-Li; p = 0.771), nose tip (N-Prn-Cm; p = 0.139) and nasomental (N-Prn/N-Pg; p = 1.372) angles showed no statistically significant gender differences.

Figure 3 represents the chart for comparison of mean soft tissue parameters between male and female subjects.

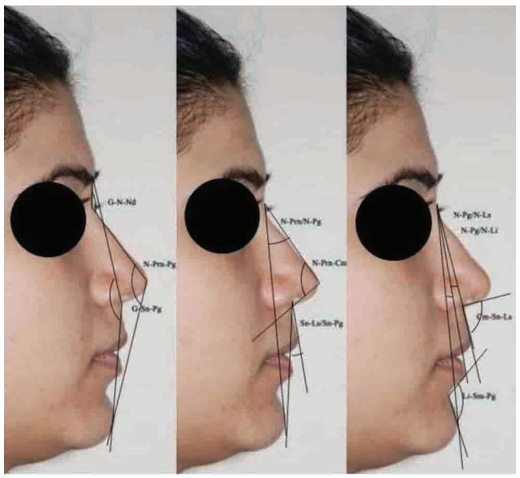


Figure-2: Angular measurements: G-Sn-Pg, N-Prn-Pg, G-N-Nd, N-Prn-Cm, N-Prn/N-Pg, Sn-Ls/Sn-Pg, Cm-Sn-Ls, Li-Sm-Pg, N-Pg/N-Ls, N-Pg/N-Li.

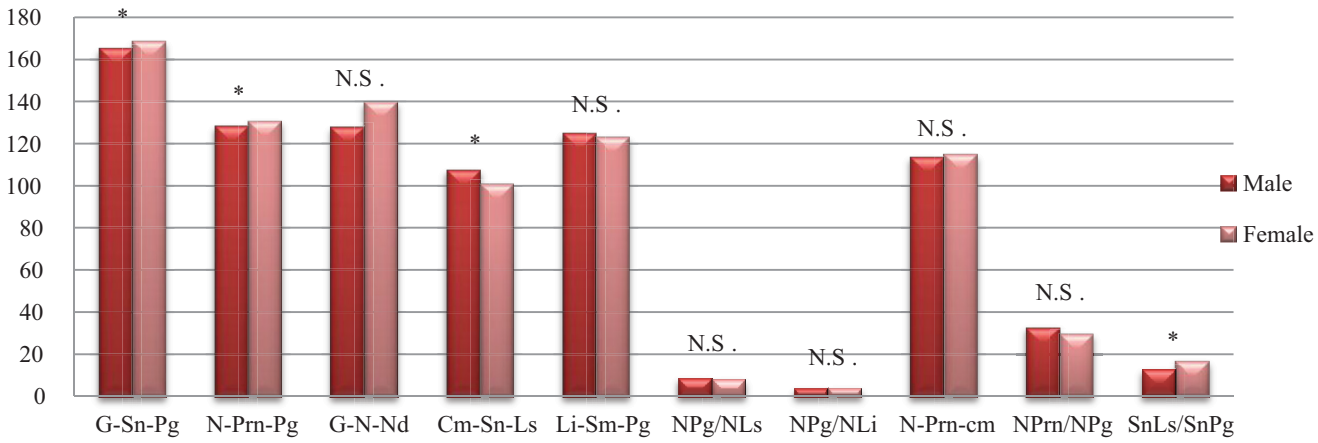
Parameter	Male	Female	p-Value	Significance
G-Sn-Pg	165.138	168.52	0.0001	*
N-Prn-Pg	128.502	130.552	0.0012	*
G-N-Nd	128.06	139.568	2.507	NS
Cm-Sn-Ls	107.39	100.882	0.0077	*
Li-Sm-Pg	124.85	123.064	0.4593	NS
N-Pg/N-Ls	8.61	8.092	0.1821	NS
N-Pg/N-Li	3.828	3.938	0.7715	NS
N-Prn-Cm	113.532	114.762	0.1394	NS
N-Prn/N-Pg	32.604	29.534	1.372	NS
Sn-Ls/Sn-Pg	12.846	16.528	0.008	*
* - Statistically significant; NS - Statistically not significant				

Table-1: Mean soft tissue profile measurements and comparison between male and female subjects

DISCUSSION

The thickness of soft tissue is variable over different parts of facial skeleton. However, correlation of hard tissues to normal values need not always bring about the improvement in the facial esthetics. Soft tissue appearance is only partially dependent on underlying skeletal structure. To this end, a lateral cephalometric radiograph is probably the most valuable diagnostic tool available. In this context, photogrammetric analysis was brought for soft tissue assessment as a photograph picturizes how a face actually looks.[7,8]

The study was based on the photographs of aesthetically pleasing and balanced soft tissue profiles. Standardized photogrammetric records taken in NHP were used for analysis.



*Statistically significant ; N.S. Statistically not significant

Figure-3: Comparison of Mean Soft Tissue Parameters between Males and Females

Several studies have also been performed based on the records taken in NHP.[9-12]

In the study, the value for the facial angle (G–Sn–Pg) for Bengali males (165.1 ± 3.3°) and females (168.1 ± 4.1°) showed statistically significant gender difference (p=0.0001).The previous studies by Riveiro PF et al[11,12](males = 168.2°; females = 167.0°), Milosevic SA et al[1](males = 168.78°; females = 169.05°), Malkoc S et al[2] (males = 170.60°; females = 168.78°) and Arnett and Bergman[9,10] (males = 169.4° and females = 169.3°) showed no significant gender difference.

In the study, total facial angle (N-Prn-Pg) for males (128.50°) and females (130.55°) showed statistically significant gender difference (p = 0.0012). Riveiro PF et al[11,12] found no significant gender difference (males = 139.9°; females = 139.2°). Milosevic SA et al[1] (males = 130.47°; females = 130.19°) and Malkoc S et al[2] (males = 142.35°; females = 142.57°) also found no significant gender difference.

In the study, the nasofrontal angle (G-N-Nd) was 128.06° for males and 139.56° for females with no statistical significant gender difference. However, Riveiro PF et al[11,12] found gender difference (males = 138.57°; females = 141.98°). Milosevic SA et al[1] also found gender difference (Caucasian males = 136.38°; females = 139.11°). Malkoc S et al[2] found no significant gender difference (Turkish males = 146.03°; females = 148.61°) supporting the present study.

In the study, the nasolabial angle (Cm-Sn-Ls for males = 107.39°; females = 100.88°) showed statistically significant gender difference in agreement with the findings of previous study by Milosevic SA et al.[1] They found the nasolabial angle as the most significant angular variable between the genders (Croatian males = 105.42° and females = 109.39°). Malkoc S et al[2] also found this angle with large variations between males and females (Turkish males = 101.09°; females = 102.94°). This should be interpreted with caution.[2] According to Bergman[3], this angle should be 102 ± 8° for every indicated orthodontic or surgical correction. This is useful for assessing the upper lip position and used as a part of extraction decision.[3] Burstone[15] reported a nasolabial angle of 74 ± 8° in a Caucasian adolescent sample with a normal facial appearance. Riveiro PF et al[11,12] found no gender difference (males = 137.6°; females = 134.5°).

In this study, the mentolabial angle (Li-Sm-Pg) was found no significant gender difference (males = 124.8°; females = 123.06°). According to Bergman[3], in Class II and vertical maxillary deficiency cases, a more pronounced mentolabial angle can be observed. This angle tends to be more when the lower incisors are uprighted[3] In a study by S. Anic-Milosevic et al.[1] in Croatian sample, there was a great gender difference for this angle (males = 129.6°; females = 134.50°). In a study of Turkish adults, Malkoc S et al[2] also found significant gender difference (males = 130.19°; females = 137.19°). These results differ from those of Riveiro PF et al[11] in agreement with the present study. Lines et al[13] in a study of silhouettes reported that deeper mentolabial sulci were preferred in males and it ranged between 120 and 130 degrees.

The study showed no statistical significant gender difference on projection of upper lip to chin angle (N-Pg/N-Ls = 8.61° for males; 8.09° for females). Similar finding was also observed by Milosevic SA et al[1] in their study in Caucasian population. Arnett et al[14] measured this angle from subnasal to upper lip and found that this angle was another angle that reflected the position of upper incisors and the thickness of the soft tissue overlying these teeth.

The projection of lower lip to chin angle (N-Pg/N-Li) in the present study was 3.8 ± 1.8° in males and 3.9 ± 1.9° in females. The angle was found with no gender difference. This finding showed in agreement with Milosevic SA et al[1] where mean value was 3.27 ± 1.7° for males and 3.6 ± 1.4° for females with no gender difference among Caucasian population.

The nose tip angle (N-Prn-Cm) in the present study was found having no significant gender difference (males = 113.53 ± 4.4°; females = 114.76 ± 3.7°). Milosevic SA et al.[1] in Caucasian population with good soft tissue profile found gender diamorphism (p<0.001; 79.85 ± 6.36° for male; 84.1 ± 5.2° for female). According to Lines et al[13] in silhouette profiles, it is most acceptable between 60-80° in agreement with Milosevic SA et al, but it is lower than those of Bengali subjects.

In this study, the nasomental angle (N–Prn/N–Pg) showed no significant gender difference (males = 32.6 ± 4.2°; females = 29.5 ± 2°). Milosevic SA et al[1] stated no gender differences (males = 29.5 ± 2.5°; females = 30.4 ± 2.4°) supporting the present study. According to Lines et al[13] this angle showed

statistically significant gender differences that a more prominent nose in relation to the chin is preferable for males and the opposite in case of females. This angle is most acceptable within a range of 20-30°.[13] Clements[16] stated that in most faces illustrated in art throughout history, the nasomental angle was around 30° or less.

In this study, the upper lip angle (Sn–Ls/Sn–Pg) showed statistically significant gender difference (p = 0.008; males = 12.8 ± 5.7°; females = 16.5 ± 7.7°). Milosevic SA et al[1] also found no gender difference in Caucasian population (males = 11.7°; females = 12.9°). Burstone[7] used an angle called 'total facial contour' defined as the intersection of the upper facial (G – Sn) and anterior lower facial (Sn – Pg) planes. The mean value from a sample of lateral and frontal photographs of 40 young Caucasians with aesthetically pleasing faces found was 11.3 ± 4°. For assessing convexity/concavity of the facial profile, the profile angle was used.[7] According to Arnett et al[14], the position of the upper incisors and the thickness of the soft tissue overlying these teeth can also be assessed by using this angle.

CONCLUSION

The derived soft tissue values can be considered as normal values for Bengali population and used for comparison of subjects with malocclusion, thereby providing orthodontists for proper diagnosis and treatment plan of any malocclusion associated soft tissue segments of the face.

However, further experiments are to be suggested with larger sample size through a meticulous screening procedure for standardization of norms.

LIST OF ABBREVIATIONS

Glabella (**G**); Soft tissue nasion (**N**); Nasal dorsum (**Nd**); Pronasal (**Prn**); Columella (**Cm**); Subnasal (**Sn**); Labial superior (**Ls**); Labial inferior (**Li**); Supramental (**Sm**); Soft tissue pogonion (**Pg**); Facial angle or angle of facial convexity excluding the nose (**G-Sn-Pg**); Total facial angle or angle of facial convexity including the nose (**N-Prn-Pg**); Nasofrontal angle (**G-N-Nd**); Nasolabial angle (**Cm-Sn-Ls**); Mentolabial angle (**Li-Sm-Pg**); Projection of upper lip to chin angle (**N-Pg/N-Ls**); Projection of lower lip to chin angle (**N-Pg/N-Li**); Nose tip angle (**N-Prn-Cm**); Nasomental angle (**N-Prn/N-Pg**); Upper lip angle (**Sn-Ls/Sn-Pg**)

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 20-03-2016; **Published online**: 19-04-2016