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Comparison of cephalometric norms of esthetically pleasing faces

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ORIGINAL ARTICLE

Comparison of Cephalometric Norms of Esthetically Pleasing Faces

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ABSTRACT

Objective: To establish cephalometric norms of a sample of aesthetically pleasing Pakistani faces and to analyze differences and similarities with accepted standards for Caucasians.

Study Design: Analytical cross sectional study.

Place and Duration of Study: Carried out at Alvi Dental Hospital, Karachi, from August 2007 to February 2008.

Methodology: Cephalometric tracings were analyzed on a sample of 40 (20 males and 20 females) Pakistani young adults, aged 18-25 years, with full complement of permanent teeth, no previous orthodontic treatment and pleasing profile. To check the reliability of the measurements, 20 randomly selected cephalograms were retraced. None of the measurements showed a significant difference. Student's 't' test was applied for overall group comparisons. P-value of < 0.05 was considered significant.

Results: When compared with some classical standards, the results suggest that the Pakistani sample had greater cranial lengths ($p < 0.001$), shorter faces anteriorly ($p < 0.001$), and tended towards bimaxillary dental protrusion with more prominent chin ($p < 0.001$). Males had greater antero-posterior, horizontal and vertical measurements ($p < 0.001$). Females showed more dental protrusion ($p < 0.01$).

Conclusion: Comparisons revealed statistically significant differences in most variables between Pakistanis and Caucasians and between Pakistani males and females. Pakistanis have distinct cephalometric features, which should be used as a reference in treating Pakistani orthodontic and orthognathic surgery patients.

Key words: *Cephalometry. Esthetic. Profile. Pakistani population. Orthodontics. Orthognathics.*

INTRODUCTION

Current concepts in orthodontic diagnosis and treatment planning focus on the balance and harmony of various facial features. Treatment goals should be geared towards the achievement of an overall facial balance. In fact, the true objective from the point of view of esthetics is to treat the dentition of the face. The esthetics definition changes as society and its esthetic values change.[1-4] With a wider acceptance of these treatment goals, it is important to study what are esthetically balanced faces and the scope of acceptable compromises between different facial elements.

The study of cephalometric norms has been a part of orthodontic treatment for more than half a century. Steiner, Downs, Ricketts, Margolis, Tweed, Coben, Mc Namara, Ann Arbor and Sassouni have developed cephalometric analyses and corresponding norms.[5-12] All these investigators formed an opinion that normal measurements for one group should not also be considered normal for other racial groups.

As no study has been carried out yet to establish cephalometric norms of Pakistanis, the present study was conducted to determine cephalometric norms of esthetically pleasing Pakistani people, comparing these with Caucasians norms and investigating the gender differences between the esthetic norms.

METHODOLOGY

An analytical cross sectional study was carried out at Alvi Dental Hospital, Karachi, from August 2007 to February 2008. The data was collected by an orthodontist by using purposive sampling technique on Pakistani adults selected from different academic institutes of Karachi and caring from different ethnic groups.

The selection criteria were Pakistani ancestry (parents/ grandparents), esthetically pleasing profiles, age between 18-25 years, a full complement of permanent teeth, and no history of previous orthodontic treatment.

Informed consent was taken. Orthodontic records and cephalometric lateral skull radiographs were taken for all the subjects, with the teeth in maximum intercuspation and lips in repose. The head was positioned in the cephalostat with ear rods. Exposure was made at 80-90 Kvp and 32 mA for 1.4 seconds.

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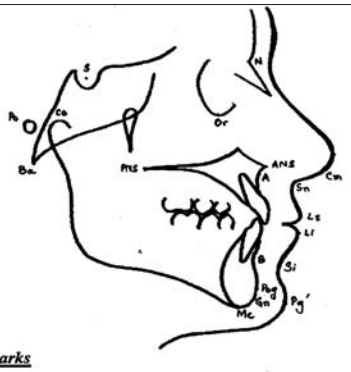
The facial structures (soft-issue and bony components) were traced on standard acetate paper using 4H pencil on all of the cephalograms on illuminator in a dark room. The mid line of double contour bilateral structures was drawn to minimize error caused by head positioning. Cephalometric landmarks were identified (Figure 1). Linear and angular measurements were measured to the nearest 0.005 millimeters and degrees, respectively. The method error/intra examiner reliability was determined by retracing randomly selected 20 radiographs at 1-month interval, without reference to prior tracings.



Unilateral Landmarks

Sella	S	Labrale Superius	L
Nasion	N	Labrale Inferius	Li
Anterior Nasal Spine	ANS	Mentolabial Sulcus	Si
Posterior Nasal Spine	PNS	Soft Tissue Pogonion	Pog'
Subspinale	Point 'A'		
Supramentale	Point 'B'	***Bilateral Landmarks***	
Pogonion	Pog		
Gnathion	Gn	Orbitale	Or
Menton	Me	Gonion	Go
Basion	Ba	Foramen Rotundum	PT
Collumella	Cm	Condylion	Co
Subnasale	Sn	Porion	Po

Figure 1: Cephalometric landmarks.

The basic descriptive statistics, including mean standard deviation, standard error of mean and minimum and maximum values were calculated for each variable, using SPSS 8.0 Statistical Software Program. An independent sample 't' test was used to determine the differences between the Pakistani and Caucasian norms. The Caucasian norms were taken from the most commonly used parameters of different cephalometric norms analysis. e.g. Down's, Bjork's, Tweed's, Rickett's Mc Namara's and Bell and Proffit and White's analysis.

Sexual dimorphism was also determined. The level of significance was set at 0.05 and 0.01.

RESULTS

No statistically significant differences were found between the two sets of tracings for all the parameters measured ($p > 0.05$).

Table I presents mean and standard deviation of measurement for the Pakistanis and Caucasian samples.

Table I: Comparison between Pakistani and Caucasian's norms.

Measurments	Pakistani norms n = 40	Caucasian norms	p-value
Cranial Base Lengths (mm)			
Anterior cranial length	74±3.7	71±3	< 0.001**
Posterior cranial length	37.5±4	32± 3	< 0.001**
Skeletal Angular Parameters (degrees)			
FMPA	21.5± 5	25±5.25	0.0004**
Facial angle	80.7±4	82±4	0.01*
Gonial angle	123± 5	130±7	< 0.001**
Articular angle	141±5.6	143±6	0.03*
Saddle angle	126±5.7	123±5	< 0.002**
Sum of posterior angles	388.6±9.7	396±6	< 0.001**
Skeletal Linear Parameters (mm)			
Convexity of point 'A'	1±2.6	2± 2	0.02*
Ramus height	52±5	44± 4	< 0.001**
Corpus length	79±4.7	71±5	< 0.001**
Anterior lower facial height	63±3.7	75±7	< 0.001**
Total anterior facial height	120±20.7	128±6	0.01*
Pogonion to NB line	3±2	2±2	0.003**
Dental Angular Parameters (degrees)			
IMPA	99.6±7	90±5.75	< 0.0001**
Interincisal angle	128±10	135±6	0.001**
Lower incisor to NB-line	27.4±6	25±6	0.018*
FMIA	57.4±11	65±6	< 0.0001**
Dental Linear Parameters (mm)			
Upper incisor to A-pogonion line	7±2	3± 2	<0.001**
Lower incisor to A-pogonion line	3±2	1±2	< 0.001**
Upper incisor to NA-line	6.6±2.4	4±3	< 0.001**
Lower incisor to NB-line	6±2.5	4.5±2	0.0006**
Upper incisor to 'ANS'	29±3	31.5±2	< 0.001**
Soft Tissue Parameters			
E-line to lower lip (mm)	-3±-3	-2±2	0.04*

**P < 0.05; ** P < 0.01; Only significant results are mentioned.*

The comparison of cranial lengths demonstrated significantly greater anterior and posterior cranial lengths of Pakistani subjects.

Most of the skeletal angular measurements showed no statistically differences between the two comparisons, indicating similar skeletal pattern. However, a significant difference existed in facial angle and FMPA (Frankfort Mandibular Plane Angle), with a mean value of 80.7 ± 4^{o} and 21.5 ± 5^{o} in the Pakistani sample indicating their hypodivergent pattern.

The Pakistani subjects had a larger mean value of Facial Plane Angle and Pogonion to NB – Line, indicating their prominent chin. A statistically significant lesser convexity of Point 'A' of face was found in the group. This finding also corresponds to the results obtained above.

Interestingly, all the posterior angular measurements of the Pakistani group were significantly less than the accepted norms of white Americans, except for the Saddle angle. Other posterior angular findings suggest that Pakistani people revealed less vertical, counter-clock wise growth pattern of the mandible i.e. anterior and forward growth of the chin.

Although the two races showed a similar skeletal angular pattern there were significant differences in dental parameters. The acute interincisal angle, increased distance of upper incisor and lower incisor to A-Pogonion plane, increased angulation and distance of upper incisor to NA – line, lower incisor to NB – line, FMIA and IMPA of the sample indicated that both the upper and lower incisors were found to be proclined and forwardly placed in their respective arches.

Amongst all the soft tissue parameters measured, Pakistani subjects only exhibited significantly greater distance from lower lip to esthetic plane, showing either retrusive lower lip or protrusive chin and long nose.

Table II demonstrates the descriptive statistics on 48 cephalometric variables for both Pakistani males and females. Cranial base dimensions indicated that male subjects revealed significantly greater cranial base length dimensions. Considering the skeletal angular parameters compared, both maxilla and mandible were found to be prognathic in males. Only the articular angle was less in the females; otherwise, all other posterior angles were greater. This shows a downward and backward growth pattern of their mandible.

It should be emphasized that most of the observed differences between the two genders were in the skeletal linear parameters. All measurements are statistically significant more ramus height, corpus length anterior lower facial height, posterior facial height, mandibular and mid facial length in the males. In the male gender, upper as well as lower anterior teeth were found to be retroclined and retropositioned.

Table II: Sexual dimorphism.

Measurements	Pakistani male norms n=20	Pakistani female norms n=20	p-value
Cranial Base Lengths (mm)			
Anterior cranial length	76±3	72±3	0.001**
Posterior cranial length	39.5±4	35.5±2.7	0.002**
Skeletal Angular Parameters (degrees)			
SNA	82±3	79.5±3	0.04*
SNB	80±2.7	77±4	0.02*
Articular angle	143± 5	139.6±5.6	0.02*
Saddle angle	123± 5	128.6±5	< 0.001**
Sum of posterior angles	385±12	392±5.6	0.04*
Skeletal Linear Parameters (mm)			
Ramus height	55±5	49±4	< 0.001**
Corpus length	81.6±4	77±4	0.003**
Anterior lower facial height	70.4±6.4	63±3.7	< 0.001**
Total posterior facial height	89.6±7.5	79±4	< 0.001**
Mandibular length	128±4.5	118.5±4.6	< 0.001**
Midfacial length	97.6±4	92.4±5	0.003**
Dental Angular Parameters (degrees)			
Upper incisor to palatal Plane	110.6±7	114± 5	0.05*
Interincisal angle	132°± 10	124°±7.4	0.01**
Dental Linear Parameters (mm)			
Lower incisor to menton	43±4	40.5±2.6	0.04*
Soft Tissue Parameters			
Mentolabial sulcus (mm)	7±1.6	6±1	0.02*

** P < 0.05; ** P < 0.01; Only significant results are mentioned.*

All the soft tissue parameters findings were statistically non-significant, except for the Mentolabial Sulcus. A more acute nasolabial angle was observed in males. This also supports the findings of males having retrusive upper teeth; but the result was statistically non-significant.

DISCUSSION

It has been suggested that factors such as gender, age, and racial origin, as well as face type, contributes to facial variation. Superimposed on these factors are those characteristics that are unique for each individual. Because of such inherent variation, standards developed for any population should be used only as a reference line and not as absolute values to which all the individuals in that population should conform to be considered “normal”.

The concept of facial esthetics is becoming increasingly important. With the expanding application of orthodontic techniques to patients from diverse ethnic backgrounds, it is timely that more elaborate methods for the evaluation of facial form are adopted.

The aim of the present study was to describe the dentofacial and soft tissue pattern of Pakistanis. Subjects with ‘esthetically pleasing profiles’ were intentionally chosen as the sole criterion in the selection process because the focus of this study was to obtain culture based norms to assist in treatment planning. The concept of treatment is to obtain an esthetic profile that appears reasonable because most of the patients prefer to be corrected to “excellent” esthetics rather than an average (norm) facial profile. Facial esthetics is an important attribute upon which opinions and perceptions of character and social ability is conceived.[13-18] A proper recognition of dental and facial esthetic defects at the outset of treatment is the most important key to esthetic success and is, therefore, essential to satisfying the patients’ needs.

Another basic criterion for inclusion in this sample was young adulthood. This is important because the cephalometric norms are known not only to be specific for racial types but also to be age related.

The results obtained in the present study showed that Pakistani subjects had a similar skeletal angular pattern as that of Caucasians but with a more prominent chin and hypodivergent pattern. Pakistanis have more bi-maxillary protrusion.

These results also are in accordance with other Asian studies. Hamdam and Rock identified cephalometric norms for a Jordanian population.[19] They found that SNA (Sella Nasion-point ‘A’ angle) and SNB (Sella Nasion-point ‘B’ angle) were very close to the Eastman

standards. MMPA was significantly lower and incisors were proclined. Al-Jasser's results also showed that Saudis have relatively similar skeletal relationship and dentally have a tendency towards bimaxillary protrusion.[20] The lower facial height of Saudis was less. Nanda also observed that North Indians had a similar skeletal pattern as that of white Americans but were more retrusive as compared to the Chinese and Negroes.[21] Lew found that compared to the Chinese and Malays, Indians appeared to have less prognathic mandibles and maxillae and less protrusive upper and lower incisors and lips.[22] Kenneth *et al.* found that in comparison with white norms, the Chinese nose was less prominent, the nasolabial angle was less obtuse, the upper and lower lips were more protrusive, the upper lip curvature was greater, and the soft tissue chin thickness was less.[23]

Miyajima and Mc Namara compared 54 Japanese adults with 125 European American adults.[24] The Japanese adults were found to have smaller antero-posterior facial dimensions, larger vertical facial dimensions and tended toward bi-maxillary and bi-labial protrusion with an acute nasolabial angle. Park *et al.* concluded that the skeletal pattern of Koreans is in general similar to that of Caucasians but the facial convexity of Koreans is slightly larger with bimaxillary and bilabial proclination.[25] Hajighadimi found that Iranian people had a more retrusive skeletal pattern, convex profile, high mandibular and occlusal plane angles and bimaxillary dental protrusion.[26]

Comparison between males and females showed that skeletally, the denture bases of the females were in a slightly more posterior position as compared to the cranial bases of the males. The female sample group revealed a significantly greater Saddle angle and sum of all posterior angles indicative of their clockwise growth pattern, i.e. downward and backward growth of mandible.

In most of the linear values, the males revealed greater measurements than females. This is to be expected since males are, in general, larger than females.

The results for dental measurements indicate that the upper incisor in the male sample was retroclined and retropositioned in the facial complex. The lower incisor inclination and relative antero-posterior position was also comparatively less in males, confirming their backward position in the mandibular arch.

Interestingly, among the large numbers of soft tissue parameters compared, the only significant difference found between the males and females was in the *Mentolabial sulcus*, which was 1 mm more in males than their counterparts.

The results of this study support the premise that a single standard of facial esthetics is not appropriate for diverse racial and ethnic groups. Significant differences were found between Pakistanis and Caucasians. However, sufficient dimorphism existed to warrant studying the sexes as distinct entities.

CONCLUSION

The Pakistani people revealed less vertical, counter-clock wise growth pattern of the mandible i.e. anterior and forward growth of the chin. They had a tendency towards bimaxillary dental protrusion; especially the females. In view of the findings of this study, it is evident that these differences should be considered in the orthodontic/orthoganthic surgery diagnosis and in the treatment plan for Pakistanis, together with the patient's individual opinion and perception of beauty.

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