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Skeletal cephalometric norms of Pakistani population

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Abstract

Introduction: Cephalometric measurements play a vital role in orthodontic diagnosis and treatment planning. This is done by comparing the patient's measurements with normal reference group of a certain population. The aim of this study was to establish norms of the commonly used skeletal cephalometric readings for Pakistani population.

Material and methods: A total of 1000 patients were selected from different areas of Pakistan (417 males of age 18 years and above, 583 females of age 15 years and above). The inclusion criteria were esthetically pleasing facial profiles as assessed on profile photographs which were analyzed by three different orthodontists separately. Patients having dentofacial defects, trauma, orthodontic treatment and facial cosmetic surgery were excluded. Cephalometric measurements of SNA, SNB, ANB, SN-MP, SN-PP, SN-Occ and MMA were recorded and analyzed for descriptive statistics in SPSS (version 24.0). The norms established in this way were then compared with the standard established values of Caucasians by independent t test keeping *p* value ≤0.05 as significant.

Results: The mean values and standard deviations obtained were SNA=81.87°±3.29, SNB=79.05°±3.28, ANB=2.85°±1.63, SN-MP=31.11°±4.34, SN-PP=7.31°±2.59, SN-Occ=14.94°±3.23 and MMA= 23.89°±3.71. The results of comparison with Caucasian norms were significant for all the measurements ($p<0.001$) except for SNA ($p=0.157$).

Conclusions: This study establishes the commonly used skeletal cephalometric norms for Pakistani population. These norms although being statistically significant have difference of not more than 2° for any of these measurements.

Keywords: Cephalometry; facial bones; orthodontics; reference values

Introduction

Current concepts in orthodontic diagnosis and treatment planning focus on the balance and harmony of various facial features. Cephalometric radiographs have been used for many years to evaluate these facial features geometrically and diagnose dentofacial deformity by comparing the patient's cephalometric values with statistically defined population norms.[1,2,3] The diagnostic norm is a standard, which helps us determine the extent of deviation from the "normal" or what is considered "healthy". [4,5] These norms have been developed by several researchers all over the world to set standard mean values for skeletal, dental, and soft tissue structures for different countries and ethnic groups. [6]

Orthodontic treatment is best when the facial and cephalometric characteristics of patients are considered. It is well established that a single standard of facial esthetics is not appropriate for application to diverse racial and ethnic groups. Since the principle of cephalometric analysis is to compare the patient's measurements with normal reference group, other researchers have

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compared cephalometric characteristics of different races with Whites, with an intention to establish race-specific cephalometric values for populations with different ethnic backgrounds. [7,8]

It is a common observation that like other parts of the world, the people of Pakistan also have facial forms that are esthetically different from those of the Western population. Therefore, while dealing with dentofacial esthetics in Pakistani population, we need cephalometric norms that are applicable to these people. Various authors have contributed to this by determining few commonly used cephalometric norms in different parts of the country, [9,10,11] but all these studies have been conducted at separate orthodontic centers with each one representing a localized population.

The aim of this study was to find out the norms of some of the commonly used cephalometric measurements in clinical orthodontics which can be used throughout Pakistan and to compare these means with those of the Caucasians that are well accepted all over the world including our country. This study constitutes data of patients from the orthodontic centers from all over the country hence providing a true representation of Pakistani population.

Material and Methods

It was a descriptive cross-sectional study performed after the approval of ethics review committee. A total of 1000 patients from different orthodontic centers from all regions of Pakistan were selected on the bases of their profile photographs. [12] Age was a critical factor while selecting the patients as complete growth of craniofacial skeleton was required. A study conducted on Caucasians by Rickets [13i] has established that in females the skeletal growth completes by 15 years whereas in males it continues up to 18 years of age. In reference to this the female patients included in this study were 15 years and older and the male patients 18 years and older.

The selection criteria included subjects with Pakistani ancestry with esthetically pleasing profiles as assessed on photographs. [14] These profiles were orthognathic, with normal vertical dimensions, competent lips, normal nasolabial angle and normal mentolabial sulcus on photographic examination. The photographs of all the patients were observed by three orthodontists on separate occasions to include the patients fulfilling the criteria. The assessment was done by each examiner independent and only those patients were included in the study who were qualified by all three examiners as being esthetically pleasing.[15] Patients having history of developmental dentofacial defects, trauma, orthodontic treatment and any facial cosmetic surgery were excluded from the study.

A total number of 32 orthodontic centers were selected from all over the country. To ensure the homogeneity of data, the institutes were those where CPSP recognized post graduate training was being carried out in subject of Orthodontics, following standardized guidelines under the supervision of college faculty. According to the guidelines the photographs as well as the lateral cephalograms of all the patients were recorded in the Natural Head Position (NHP) with the image obtained at the same level. The cephalometric analyses were performed by post graduate residents who were well trained in the analyses of lateral cephalograms, therefore the data obtained was standardized and reliable. The commonly used skeletal sagittal and vertical readings were measured on the lateral cephalograms. These readings included SNA, SNB and ANB angles which tell us of sagittal relationship and SN-MP, SN-PP, SN-Occ and MMA angles which are indicative of vertical discrepancy. The demographic data was obtained from the history of each patient.

In Pakistan, people from different ethnic origins are mutually distributed in a way that they are residing in almost every region of country. Acquisition of data from major cities

may therefore include all ethnicities. Moreover, to ensure the representation of all ethnic origins, the data was obtained from all provinces and their major cities. This primarily includes the provincial capitals of Punjab, Sindh, KPK and Baluchistan which are Lahore, Karachi, Peshawar and Quetta respectively, and the capital of state Islamabad. In addition to these areas four other major cities Multan, Faisalabad, Hyderabad and Abbottabad were also included. Due to lack of tertiary care facility in less developed areas like Gilgit Baltistan, Azad Jammu and Kashmir and Federally Administered Tribal Areas [16] no sample could be included from these areas however, owing to the fact that many local people from these areas have migrated to nearby major cities, their representation was already included in the sample. [17] The uneven geographic distribution of population could also have affected the data; therefore, a greater number of patients were included from densely populated Punjab as compared to Sindh, KPK and Baluchistan.

All the data was recorded and analyzed statistically using SPSS 24.0 with confidence level set at 95% ($p \leq 0.05$). Descriptive analysis including mean and standard deviations were obtained. Independent 't' test was applied to compare the difference between Pakistani adults and standard cephalometric values. The Caucasian norms were taken from the most commonly used parameters of Steiner's[18] and Composite[19] cephalometric analyses.

Results

The sample included 1000 patients from different areas of Pakistan, (417 males and 583 females). The maximum representation was from the province of Punjab from where 571 patients were gathered (234 male 337 females) followed by Sindh which included 205 patients (93 males and 112 females). The representation of KPK was done by 180 patients (73 males and 107 females) and that of Baluchistan was done by 44 patients (17 males and 27 females). Descriptive statistics (Means and standard deviation) of the cephalometric readings of 1000 patients are given in Table I.

Table I: Descriptive statistics for cephalometric readings (n=1000)

Cephalometric Readings (°)	Mean	Std. Deviation
SNA	81.87	3.294
SNB	79.05	3.285
ANB	2.85	1.634
SN-MP	31.11	4.340
SN-PP	7.31	2.588
SN-Occ	14.94	3.232
MMA	23.89	3.713

To determine the difference between Pakistani and Caucasian norms, independent samples t-test was used to compare the means of SNA, SNB, ANB, SN-MP, SN-PP, SN-Occ and MMA which is shown in Table II. The results indicated that all cephalometric values assessed were statistically different for our population except for SNA (p=0.157). The norms established for SNB was 0.95° less in our population whereas that for ANB was 0.85° greater indicating the prevalence of more convex facial forms. The measurements SN-MP and MMA of vertical analysis were significantly decreased (by 0.89° and 1.11° respectively) whereas SN-PP and SN-Occ were increased (by 1.31° and 0.94° respectively) indicating a difference in vertical angles as well. The comparison of all the cephalometric values showed significant results ($p < 0.001$) except for the value of SNA.

Table II: Comparison of cephalometric readings between Pakistani population and Caucasians

Cephalometric readings (°)	Pakistani	Caucasians	Significance (*p* value)
SNA	81.87	82	0.157
SNB	79.05	80	<0.001
ANB	2.85	2	<0.001
SN-MP	31.11	32	<0.001
SN-PP	7.31	6	<0.001
SN-Occ	14.94	14	<0.001
MMA	23.89	25	<0.001

$p \leq 0.05$ significant

Discussion

In orthodontic diagnosis and treatment planning, it is essential to accurately assess an individual's facial skeletal pattern. [20] The vast majority of cephalometric norms used in contemporary orthodontics are those obtained from Western population on a relatively small sample size. [21] The aim of this study was to determine the norms of the commonly used cephalometric measurements for the entire Pakistani population therefore a larger sample size representing all regions of Pakistan was approached and analyzed.

The results of independent t test show that all readings except SNA are significantly different from those of norms already being used. The difference in the value of SNB (0.95) shows that mandible is slightly retrusive in our population and this also supports the difference of ANB (0.85) which indicates a tendency towards more convex facial profile. Nisa and Khayam[22] also carried out a similar study in localized population of Jamshoro and reported similar results (ANB increased by 1.8°). In another study by Khan et al[11] the results were however different, SNA and SNB were significantly less whereas ANB had no difference. Alam[23] [ii] and coworkers have established a similar difference in the value of ANB between Caucasians and South Asian population hence supporting the evidence that esthetically pleasing facial profile in this part of the world include more convex faces than that considered in the West. This also suggests that in certain individuals having borderline Class II skeletal relationship, correction of sagittal discrepancy of maxilla and mandible may be an overtreatment.

The values of vertical parameters i.e. SN-MP and MMA are significantly less than the standard norms of Western population showing a tendency of low facial angle. Nisa and Khayam[22] have also reported prevalence of lower mandibular plane angle similar to our study and so were the results of the study conducted by Shekih and Alvi.[9] The values of SN-MP and MMA are also similar to those given by Asad and Naeem[24] as a result of their study. This is also in agreement to the findings of Alam[25] et al in which the vertical readings of South Asian population were lesser than that of the Caucasians. This holds the significance that while carrying out the diagnosis of vertical discrepancy certain individuals may fall in the range of higher angle and may not be identified if Caucasian norms are being used. This may lead to complications such as increased facial angle, open bite and anchorage loss.

The norms of SN-PP and SN-Occ are significantly higher for Pakistani population which is in agreement to the results of Asad and Naeem[24] indicating the prevalence of higher facial angle in normal looking faces. This contradicts the results of Khan et al which have reported insignificant difference in these values when compared to those of Caucasian norms. The higher values of SN-PP and SN-Occ may be due to the downward and backward maxillary rotation and its compensation by forward mandibular rotation, hence MMA and SN-MP are decreased. The increased facial convexity (ANB higher by approximately 1°) may be a combination of two factors, downward mandibular rotation and retrusive mandibular length. As SN-MP is decreased (31.11°) the downward rotation factor has been ruled out and the facial convexity is primarily because of the retrusive mandible.

The reason for the discrepancy between these results and those of the previous studies may be due to the fact that all previous studies in this region of the world have been carried out on a smaller sample size in localized population. This study constitutes a comparatively larger sample size and includes patients from all over the country hence it is a true depiction of the nationality as a whole.

This study is the first of its kind to establish a few cephalometric norms for the entire Pakistani population. These results clearly demonstrate that a difference does exist between the normal cephalometric values of

facial skeleton for Pakistani adults when compared to the established norms of Caucasians. The overall difference in all the values, however is less than 2° which is hardly appreciable if assessed on the patient clinically.

Moreover, the values assessed in this study are fundamental readings in various commonly used cephalometric analyses such as Stiener's, Down's, Ricket's, Cloumbia and COGS. Therefore, other values of cephalometric norms of these analyses may also be different and should be investigated in Pakistani population.

Conclusions

This study establishes the norms of a few of the commonly used skeletal cephalometric measurements for the Pakistani population i.e. SNA, SNB, ANB, SN-MP, SN-PP, SN-Occ and MMA.

The comparison of these norms with those of Caucasians reveals statistically significant results for all measurements except for SNA. The difference in the value of each reading is not more than 2° which shows a close resemblance in terms of craniofacial skeletal features between the two populations.

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