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Full Length Research Paper

Comprehensive Assessment of Cephalometric Measurements in the Iranian Demographic

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Anthropometry is the biological science of human body measurement. Anthropometry is applied in medical profession such as maxillofacial surgery, growth and development studies, plastic surgery, bioengineering and non-medical branches such as like shoe-making and eye-glasses industries. The aim of this study was to determine Iranian cephalometric parameters and cranial and facial anthropometric ratios. This cross sectional analytical study was done randomly on 137 people from Nikshahr (Iran) with normal face patterns. Facial and cranial ratios was estimated and compared. Data was analyzed by SPSS software. The regression line and the growth coefficient were determined for each Parameter. Finally, the mean values of these parameters were determined. At birth, Iranian population have hypereuryprosopic face and hypercephalic cranium form. While getting older, the midface height increased, face became more prominent, chin became shorter and face and cranium changed to eurycephalic and hyperleptoprosopic forms, respectively. Due to the wide racial combinations in Iran, more studies, with wider sample size, should be conducted among different Iranian race.

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Key words: Anthropometry, craniofacial, Nikshahr.

INTRODUCTION

Over the last century wars, poverty, and political turmoil in Europe, Asia and Africa have led to sharply increased migration of numerous peoples to North America. These newcomers represent a much broader spectrum of ethnic groups than were seen in earlier waves of immigration.This influx of diverse people has important implications for craniofacial surgeons and other medical professionals whose work involves analysis and correction of morphological disfigurements and anomalies of the head and face (Farkas, 1994).

Although physical anthropologists have long been aware of differences in facial measurements among ethnic groups (Muzj, 1979; Topinard, 1885), for centuries the neoclassical facial canons established during the Renaissance (Beall, 1984) went unchallenged .

Only in recent years has the validity of these canons

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been systematically investigated (Farkas et al., 1985; Le et al., 2002). These initial studies, based on anthropometric techniques, led to comparisons of facial anthropometric differences among Iranian and Canadian populations that were not presented in earlier investigations. To our knowledge, the present study is the broadest yet conducted in terms of geographical reach and diversity of subjects.

As a part of physical anthropology, anthropometry measures and examines linear and angular skeletal dimensions on living individuals (Mariclode, 1997). Understanding anthropometric parameters of face and cranium gives researchers and clinicians considerable insight into craniofacial growth and development which, in turn, has many practical applications including classification, diagnosis and treatment of craniofacial anomalies (Ainsowrth, 1979; Ramanathan and Chellappa, 2006), correction of craniofacial deformities using maxillofacial and plastic surgical methods and forensic medicine. By finding the mean value of anthropometric parameters in normal samples of a population, it is possible to create a

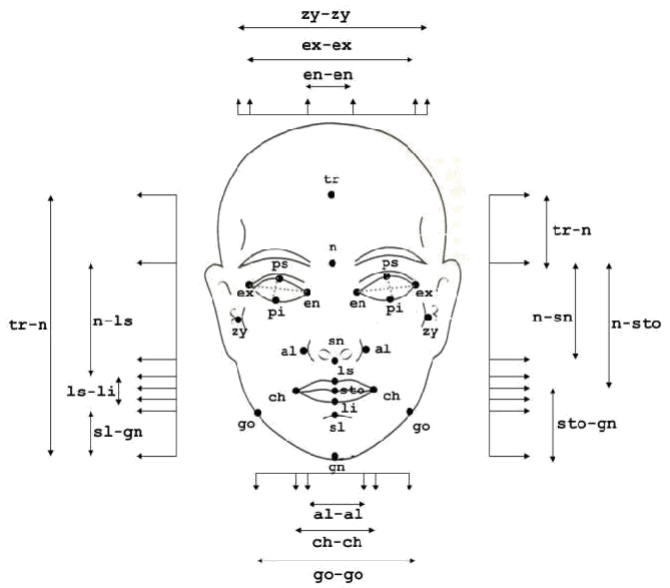

Figure 1. Face Anthropometry: of the 57 facial landmarks, 13 were chosen for the study.

template for facial analysis of this specific population (Mariclode, 1997).

As anthropometric and cephalometric parameters vary considerably depending on age, sex, geographical habitat and ethnic backgrounds of human beings (Mariclode, 1997; Williams et al., 1995), each anthropometric study should be conducted on a particular and predetermined age range, sex or ethnic group (Afak and Turgut, 1998). In his study, Porter compared anthropometric parameters of African-American males with those of North American whites and found significant differences (Porter, 2004). In a similar study, Choeks et al. (2004) showed significant differences between facial anthropometric measurements of Korean-American women and those of North American women. Farkas et al. (2005) depicted that the breadth of nose in Asians and Africans is larger than in North American whites. However, Middle Eastern people have nasal width similar to that of North American whites. By analyzing the anthropometric features of a group of 18-21-year-old Croatians, Buretic-Toljanovic showed that cranial measurements are influenced by geographical conditions (Buretic-Toljanovic et al., 2007).

The aim of this study was to determine Iranian cephalometric parameters and cranial and facial anthropometric ratios.

MATERIALS AND METHODS

This study was conducted on a sample of 137 four-to-eleven-year-old Iranian people. This study was performed as a research project with the permission of Ethics Board of Shirvan Islamic Azad University. Before the study Informed Consent was obtained from all human adult participants and from the parents or legal guardians of minors for all participants. The informed consent clearly indicated: title of research project, researcher name and colleagues, research goals and Organization name of research executive.

All the participants had Angle Class I dental occlusion and no history of orthodontic treatment, tooth extraction, maxillofacial surgery, cleft lip and palate or other facial anomalies. A D40 Nikon digital camera with 18/135 lens (Nikon inc., Japan, 2007) was used to take frontal full-face photographs of each child while his/her head was in natural head position (NHP). The samples were relaxed during imaging and no special facial expressions such as smiling, laughing or frowning were detectable in their faces. A 10-mm wide sticker on each sample forehead was employed to calculate the image magnification.

Images were transferred to a computer and classified according to the age of samples. Using Adobe Photoshop software (Adobe Inc., USA), the points indicating the desired anthropometric landmarks were put on each image. The newly developed software "Smile Analyzer", by the Orthodontic Department of Mashhad Dental School, was used to measure the anthropometric parameters on each image (Jahanbin et al., 2010). This software has specifically been designed for precise measuring of desired distances or angles on images and radiographs.

The following measurements were analysed in this study (Figure 1):

1. The width of the nose or Alare width (al-al).
2. The width of the mouth or the distance between Cheilion points (ch-ch).
3. Intercanthal width or the distance between left and right Endocanthion points (en-en).
4. Binocular width or the distance between left and right Exocanthion points (ex-ex).
5. Forehead width or the distance between soft tissue Frontotemporale points (ft'-ft').
6. Intergonial width or the distance between left and right soft tissue Gonion points (go'-go').
7. Facial height or the distance between soft tissue Nasion and Gnathion (n'- gn').
8. The height of the nose or the distance between soft tissue Nasion and Subansal points (n'-sn).
9. The depth of the upper third of face; distance between Tragion and soft tissue Glabella (t-g').
10. The depth of the lower third of face; distance between Tragion and soft tissue Gnathion (t-gn').
11. The depth of the middle third of face; distance between Tragion and Subnasal points (t-sn).
12. Cranial base width or the distance between Tragion points (t-t).
13. Facial width or the distance between soft tissue Zygion points (zy'-zy').

Data was analyzed using t-test, ANOVA and linear regression models of the SPSS software (SPSS Inc., Chicago, Il, USA). Furthermore, the mean anthropometric measurement of Iranians was compared with Canadians.

RESULTS

Anthropometric parameter study in Iranian face indicates a gradual increase in mean alare width by age although it suddenly drops at age 8. A sharp increase in mouth width between 5 and 6 years of age followed by a steady growth. Ch-ch / age equation shows more growth in mouth compared to nose width by age (Table 1). Intercanthal width showed a sharp drop between 4 and 5

Table 1. Linear regression equation between anthropometric ratio and age in Iranian face.

Anthropometric ratio	Regression equation	Anthropometric ratio	Regression equation
al-al	0.5 × age + 26.8	n'-sn	1.4 × age + 29
ch-ch	1.25 × age + 30	t-g'	1.2 × age + 57
en-en	0.35 × age + 25	t-gn'	2.2 × age + 76.6
ex-ex	1.35 × age + 68	t-sn	1.28 × age + 53.4
ft'-ft'	1.6 × age + 89	t-t	2.1 × age + 99
go'-go'	1.7 × age + 77.3	zy'-zy'	2.17 × age + 90.98
n'-gn'	2.6 × age + 71.5		

years if age and then a dramatic increase between 5 and 6 followed by a gradual rise after 7. Also, the binocular width followed a noticeable increase between 5 and 6 years of age to reach a plateau between 6 and 7 and then, it raised gradually. The binocular width / age equation revealed a binocular growth rate of about four times as growth rate as the intercanthal width (Table 1). Forehead width increased more steadily, compared to the parameters above mentioned. Furthermore, data analysis demonstrated two growth acceleration periods between 5 to 6 and 9 to 11 years of age in intergonial width separated by an almost steady state. According to these findings, facial height increased gradually by age, although it accelerated at 5-6 and 9-10 intervals. Based on the n-gn / age equation, facial height has the largest growth rate among anthropometric measurements of the face (Table 1). The height of nose accelerated in three age ranges: 4-6, 7-8 and 9-10. The equation showed changes is nasal height as age increased. The depth of the upper third of face increased dramatically between 5-6 and 10-11 years. This study illustrated that the depth of the lower third of face increased steadily except for two plateaus between 6-7 and 10-11 years of age. The t-gn equation suggested rapid growth in this part of face. A growth-related change in the depth of the middle third of the face resembles those of the lower third. However, the growth rate was slower according to t-sn equation. Results showed that the growth curve of the cranial base width followed a sharp rise between 5 and 6 years to reach a plateau and then increase gradually after 7. The equation indicated a relatively fast growth in cranial base width. Facial width growth rate increased almost gradually except for a sharp rise between 5 and 6 years. The zy-zy equation shows that facial width has a rapid growth rate compared to most other parts of the face (Table 1).

DISCUSSION

As each ethnic group possesses its own specific facial and cranial form which changes with age as well, it is essential to specify the ethnic group and the age range to determine the anthropometric standards. The aim of our study was to measure 13 anthropometric parameters on facial frontal images of 137 people from Nikshar (Iran) to assess facial and cranial and anthropometric ratios in Iranian population.

Our findings showed that craniofacial dimensions change at different rates at each age range, as did other investigators (Enlow and Hans, 1996; Proffit et al., 2007). The changes may be faster at an age but insignificant at another age. Interestingly, in almost all measured dimensions we found significant growth acceleration between 5 and 6 years of age. Another growth spurt was also seen between 9 and 11, although it was less significant.

Comparisons of the linear regression equations suggest that different craniofacial dimensions do not grow similarly: some parts grow at much slower pace compared to others. The intercanthal width had the least growth rate followed by the alar width while facial height and then facial width showed fastest growth.

The intercanthal width growth curve displayed a dramatic rise before 7 years of age. The growth of this dimension is related to the growth of brain and cranial base which is essentially complete by this age (Proffit et al., 2007). The orbital dimensions also reach the adult size at about 7, the reason why intercanthal growth continues much slowler after this age.

As body grows by age, facial height increases more than facial width. Thus, nasal cavities length progressively increases to facilitate air flow to expanding lungs. We found faster growth rate in facial height compared to width.

Being able to predict an individual's facial form at different ages has many practical applications. For instance, in forensic medicine, by analyzing a picture of a kidnapped child, the experts can guess how his /her facial form is after many years. Based on our findings and of other researchers and using artificial intelligence technology, computer programs can be designed to reconstruct facial forms of the individuals from a specific ethnicity at different ages.

Considering the differences in the facial and cranial anthropologic ratios and size among Iranian population (Resident in Nikshahr) and due to the wide ethnic combination in Iran, studies should be conducted

covering wider scope.

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