

Review

Role of Craniofacial Anthropometry in Medical Science

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Abstract

Craniofacial anthropometry is a technique used in physical anthropology comprising of precise and systematic measurement of the bones of the human skull. It has wide applications in Forensic Medicine, Plastic Surgery, Orthodontics, Archeology and identification of determining the origins of races. The origin of anthropometry is very ancient. The first known racial classification system was created in the 17th century when a french doctor name Francosis Bernier divided human races based on facial appearances and body types. Forensic anthropologist believed that by measuring 90 skulls they could correctly assign its owner's continent of origin; broadly speaking its race with 80 % accuracy. The dorsal nasal break point and the horizontal axis can act as nasal profile guides for surgical modifications that would achieve and influence the current concept of the aesthetic nose. Measurement of the human face from 3D facial images may help to diagnose patients with Fetal Alcohol Spectrum Disorders (FASD), even across ethnically disparate populations. Thus the human body dimensions are influenced by ecological, biological, geographical, racial, gender and age related factors.

Keywords: Craniofacial, Anthropometry, Archeology, Spectrum.

INTRODUCTION

Modern man is inclined to making comparison of various body parts in living or in cadaver for research and knowledge purpose (Kolar and Salter; 1997). Bodily measurements are the mainstay of anthropological research; however racial and sometimes ethnic variations do exist between these measurements because human body dimensions are affected by ecological, biological, geographical, racial, gender, age related and nutritional factors (John, 2003). Craniofacial anthropometry is a technique used in physical anthropology comprising of precise and systematic measurement of the bones of the human skull. It has wide applications in Forensic Medicine, Plastic Surgery, Orthodontics, Archeology and identification of determining the origins of races (Shah and Jhadav, 2004).

Using a strict skull based categorization method, the anthropologists estimated four racial groups (Huxley, 2006).

- a) Caucasoids were characterized by a dolicocephalic head shape with receding zygomas, large browridge and a narrow nasal aperture.
- b) Negroids were characterized by mesocephalic head shape with receding zygomas and wide nasal aperture.
- c) Mongoloids were characterized by brachycephalic head shape, absent browridge, small nasal aperture and projecting zygomas.
- d) Australoids whose craniofacial type fell between Negroids and Caucasoids. With the addition of this category, Thomas Huxley considered Indians to fall in this group's craniofacial measurements.

History of Craniofacial Anthropometry

The origin of Anthropometry is very ancient. The first known racial classification system was created in the 17th century when a french doctor name Francosis Bernier divided human races based on facial appearances and body types. He proposed four categories: Europeans, Far Easterners, Lapps, and finally Blacks (Brothwell, 1995).

Peter Camper in 18th century was responsible for

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studying the facial form and developed the facial profile angle to measure the extent of prognathism (Banister et al., 1995). The scientific anthropometry, however began with Johann Friedrich Blumenbach (1752-1840), who laid the foundation of craniology. He classified different races of human beings on the basis of skullforms as seen from above (Norma Verticalis). He distinguished three types i.e. square, long and laterally compressed skulls (Thompson and Mcininer, 1991)

Geographical Variation on Craniofacial Anthropometry

A remarkable case of differentiation in skull and nose indices noted by Dr. Ambedkar, was found to exist between the Brahmins and the Chamars of Uttar Pradesh. Detailed anthropometric survey carried out among people of Uttar Pradesh, Gujarat, Bengal and Tamil Nadu revealed significant regional differences within a caste and closer resemblance between sub-populations of the caste from different religions following analysis of stature and cephalic index (Ambedkar, 1948). Nicolova M studied 251 Burgarian population families of plovdiv, corresponding parents and children over 15 years considering 36 body and 11 craniofacial measurements. This study showed that the results do not support the hypothesis of X-linked heredity but chiefly determine the Autosomal genes with considerable environmental modification. He also found positive directional dominance and sex difference. There was a significant difference between mothers and fathers for Biacromial diameter (more maternal influence); while Head length, Nasal height and Ear size showed more paternal influence (Nicolova et al., 1996).

Measurements of Craniofacial Anthropometry (Jahanshahi et al., 2008)

Maximum Head Length: It is the distance between glabella (g) to opisthocranium (op). Figure 1

- Opisthocranium (op)-Most prominent point on dorsal surface of head in Midsagittal plane.
- Glabella(g)-Median eminence between two ciliary arches.

Maximum Head Breadth: It is the maximum breadth taken right angle to Midsagittal plane using a spreading caliper. Figure 2

Cephalic Index (C.I): It is the ratio of maximum head breadth to maximum head length multiplied by 100.

$$C.I = \frac{\text{Head Breadth}}{\text{Head Length}} \times 100$$

Face Length: It is the distance between nasion(n) to the gnathion(gn). Figure 3.

- Nasion(n): Most anterior point midway between the frontal and nasal bones on the fronto-nasal suture.

- Gnathion(gn): It is the most antero-inferior point on the symphysis of the chin.

Face Width: It is the distance between the Zygomatic arches. Figure 4.

Prosopic Index (P.I): It is the ratio of face length to face width multiplied by 100.

$$P.I = \frac{\text{Face Length}}{\text{Face Width}} \times 100$$

Depending upon indices the types of head and face shapes were classified as given below (Panero, 1979). Table 1 and 2.

Craniofacial Anthropometry in Criminal Investigation

Forensic anthropological techniques can be used in the recovery and analysis of human remains. A forensic anthropological analysis assesses the age, sex, stature, ancestry and evidence for an estimate of the predominant geographical ancestry of the individual, as well as determine if the individual was affected by accidental or violent trauma or disease prior to or at the time of death. Forensic anthropologists frequently work in conjunction with forensic pathologists, odontologists, and homicide investigators to identify a decedent, discover evidence of trauma, and determine the postmortem interval. Though they typically lack the legal authority to declare the official cause of death, which is the job of forensic pathologists, their opinions are taken into consideration by the medical examiner. They may also testify in court as expert witnesses. Data from some infrequently used techniques, such as forensic facial reconstruction, are in admissible as forensic evidence in the United States (ABFA; 2011). Sometimes cephalo-facial remains are brought for forensic examination for the identification purpose. Forensic anthropologist believed that by measuring 90 skulls they could correctly assign its owner's continent of origin; broadly speaking its race with 80 % accuracy (Singer; 1995).

Research Work on Craniofacial Anthropometry

Swedish Professor of Anatomy, Anders Retzius (1796–1860), first used the cephalic index in physical anthropology to classify ancient human remains found in Europe. He classified head form into three main categories, "dolicocephalic" (from the Ancient Greek kephalê, head, and dolikhos, long and thin), "brachycephalic" (short and broad) and "mesocephalic" (intermediate length and width) (Pierre-André Taguieff, 2002).

In order to find the representative indices of facial dimension for Chinese population, cluster analysis was used to determine five facial dimensions to represent the main characteristics of Chinese head and face type. The five dimensions are face length, face width, nose

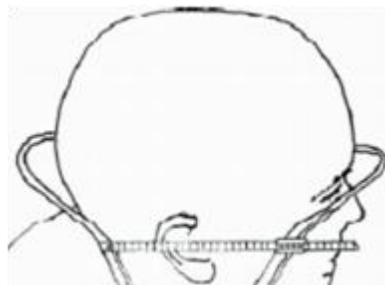


Figure 1. Showing Maximum Head Length



Figure 2. Showing Maximum Head Breadth

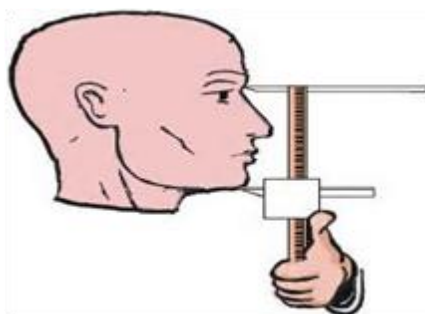


Figure 3. Showing Total Facial Length



Figure 4. Showing Facial Width

Table 1. Head Shape Range Of Cephalic Index (CI)(%)

Classification	Range
Dolicocephalic (long and narrow head)	<74.9
Mesocephalic (average head shape)	75.0-79.9
Brachycephalic (broad and short head)	80.0-84.9
Hyperbrachycephalic (very broad and short head)	85.0-89.9

Table 2. Face Shape Range Of Prosopic Index (PI) (%)

Classification	Range
Hypereuryprosopic (very broad face)	<79.9
Euryprosopic (broad face)	80.0-84.9
Mesoprosopic (round face)	85.0-89.9
Leptoprosopic (long face)	90.0-94.9
Hyperleptoprosopic(very long face)	>95.0

protrusion, bigonial breadth and nasal root breadth which were compared among Chinese population as published in 1981 and 1998 for both genders and were found to be increased (Zhuang et al., 2007).

A study conducted in Nigeria showed that the percentage of Mean C.I in Kanuri male and female neonates were found to be 70.03% and 77.15% respectively, while that of Babur/Bura male and female

neonates were 73.60% and 77.23% respectively. The dominant type of head shape in Kanuri and Babur/Bura neonates were dolicocephalic and mesocephalic respectively. The dominant type of face shape classified by Prosopic Index (PI) was hypereuryprosopic type in Kanuri males(46.7%), Babur/Bura males(43%) and Babur/Bura females (40%) (Garba et al., 2008).

In the survey conducted in Iran, Mean and Standard

deviation of C.I in native Fars group was found to be 84.8 ± 6.9 . Therefore, dominant type of head shape was hyperbrachycephalic type (52%) followed by brachycephalic (25%), mesocephalic (21.5%) and dolicocephalic (1.5%) (Chamella, 1997). Anthropological studies based on racial changes revealed that people from Africa, India, Australia, Central part of Europe and North America are dolicocephalic. The head shape of people in the Pacific Ocean is of the brachycephalic type, while people living in the Middle East, Russia, Central part of Europe and those living along the borders of the Atlantic Ocean, are mostly of the mesocephalic type (Golalipour et al., 2000).

One of the studies was conducted in Nepal, in which head length, head breadth were measured and Cephalic Index (C.I) was determined among 267 subjects of Gurung village. The mean C.I for male and female was 83.1 and 84.6 respectively which was statistically significant. Thus Gurung community people in Nepal can be categorised as brachycephalic (Lobo et al., 2005).

Nicolova M studied 251 Bulgarian population families of Plovdiv, corresponding parents and children over 15 years considering 36 body and 11 craniofacial measurements. This study showed that the results do not support the hypothesis of X-linked heredity but chiefly determine the autosomal genes with considerable environmental modification. He also found positive directional dominance and sex difference. There was a significant difference between mothers and fathers for biacromial diameter (more maternal influence); while head length, nasal height and ear size showed more paternal influence (Nicolova, 1996).

Craniofacial Anthropometric data used for Surgical Implication

Migrim and Lawson 1996, studied 97 Latino and 40 White women separating according to geographical area of origin as either central America or South America which determined whether the aesthetic concept was set for rhinoplasty by measuring nasal index. After photographic and statistical analysis, he concluded that Latino noses were categorised as mesorhine. He finally emphasized that the dorsal nasal break point and the horizontal axis can act as nasal profile guides for surgical modifications that would achieve and influence the current concept of the aesthetic nose.

Computerized Craniofacial Anthropometry: Future trends

Recently people are performing anthropometry with three-dimensional scanners. The subject has a three-dimensional scan taken of their body, and the anthropometrists extract measurements from the scan rather than directly from the individual. The aim is to

establish the Body Volume Index as the potential to be used as a long-term computer based anthropometric measurement for health care (ISO 20685; 2005).

CONCLUSION

Craniofacial anthropometry is very useful for Forensic experts for criminal case investigation, Plastic Surgeons, Oral and Maxillofacial Surgeons and Orthodontists dealing with clinical cases for treatment of congenital, cosmetic and post traumatic esthetic facial reconstruction. Thus, it can be concluded that the human body dimensions are influenced by ecological, biological, geographical, racial, gender and age related factors.

RECOMMENDATION

Therefore, there is still a need for further research in this field to know the scientific reasons behind variations in measurements among different ethnic races

Conflict of interests

Doesn't exist.

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