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Sexual dimorphism in craniometric angular measurements: a study of Contai skull, West Bengal

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ABSTRACT

Background and objectives

Skull is resistant to fire, explosions, mutilations, and decomposition, which is one of the most preferred bones for identification and sexual dimorphism. Present study attempts to examine the sexual dimorphism of angular measurements of Contai skull, West Bengal.

Material and methods

This investigation is supported by a collection of contemporary skulls from Contai (Purba Medinipur district, West Bengal). 107 adult skulls in total, 50 males and 57 females, were examined for sexual dimorphism in angular measurements.

Results

Mesoprognathous and orthoprognathous total profile angle occur in higher percent in male skull, while, prognathous angle occurs in lesser frequency (14%). In case of female skull, a dissimilar trend is discernible. More than 52% female skull belonged to mesoprognathous type. There exists statistically significant difference between male and female skull in respect of profile angle of nasal roof.

Conclusion

Male Contai skull show higher means in five measurements out of seven measurements than their counterpart. Whereas, a reverse trend can be seen in female skull in case of two measurements out of seven measurements.

KEYWORDS: *Variability in angular measurements. Contai skull. Gender difference.*

INTRODUCTION

Form and shape of human as well as primate skull were studied by craniometry by various cut off measurements. A species can be determine by its smaller and larger shape of skull by the craniometric measurements. Saini et al. (2017) present an opinion that "skeletal features and craniometry are often used in forensic anthropology and bio-archaeology to make estimations of biological profile or identifications of unknown." The capability to differentiate males and females is fundamental in studies of human evolution and is particularly suitable for applied fields such as forensic anthropology and bio-archaeology. Human evolutionist study sexual dimorphism to understand how and why Homo sapiens became less sexually dimorphic as they evolved from their pre-human ancestors. Forensic anthropologists use their knowledge of sexual dimorphism to identify the sex of an individual from his or her skeletal remains (White et al. 2012). The sex differentiation of the skull mainly focus in various medico-legal purposes. It helps the law and forensic practitioner to identify the sex of their specimen (Rasidi and Kumar 2016).

The main objective of craniometry is to study the structural formation like size and shape of human and primate skulls by means of exact measurements. The absolute and relative development of the various parts of the skull is reliant on different factors, like genetic, morphological and functional (Singh and Bhasin 1989). Morphometry of the skeletal remains for identification of sex is of great importance to anatomists, forensic experts and anthropologists. Skull is one of the most preferred part of bones for identification and sexual dimorphism because it can resist fire, explosions, mutilations and decomposition (Krogman and Iscan 1986). Several metrical parameters and indices have been used in sexual dimorphism of skull. Measurements of the skull vary significantly in different populations and races of the world.

Anthropological Survey of India, Kolkata has had diverse skeletal remains in possession. The skeletal remains are of both ancient as well as contemporary period. These are one of the important subject matters of the present bio-anthropological investigation.

A virtuous number of Contai skulls is preserved in Skeletal Repository of Anthropological Survey of India, Kolkata. Contai is a place located in Purba Medinipur district, West Bengal. It is to be noted that Contai skulls are contemporary in nature, which were collected during 1960's. The present study attempts to examine the sexual dimorphism of angular measurements of Contai skull, West Bengal.

METHODOLOGY

Direct angular measurement is contributed with the techniques of measurements for determining different angles on the skull. In order to take the angular measurements, the skull is oriented on a fixed plane. Otherwise, with the variation of the plane, the measurement will be varied and it could not be comparable at all. This accepted plane of orientation of the skull is known as Frankfurt Horizontal plane or F. H. plane. It is used as a constant plane in measuring angles and describing a skull. In the present study 50 males and 57 females Contai skulls are measured according to Singh and Bhasin (1989) measuring technique to obtain following angular measurements:

1. *Total profile angle or facial profile angle (n-pr/FH):* It measures the angle made by nasion (n) – prosthion (pr) line with F. H. plane.
   Instrument used: stationary or attachable goniometer and craniophore
2. *Nasal profile angle (n-ns/FH):* It measures the angle made by nasion (n) – nasospinale (ns) line with F. H. plane.
   Instrument used: stationary or attachable goniometer and craniophore
3. *Alveolar profile angle (ns-pr/FH):* It measures the angle made by nasospinale (ns) – prosthion (pr) line with F. H. plane.
   Instrument used: stationary or attachable goniometer and craniophore
4. *Profile angle of nasal roof (n-rhi/FH):* It measures the angle made by nasion (n) – rhinion (rhi) line with F. H. plane.
   Instrument used: stationary or attachable goniometer and craniophore
5. *Metopic angle or profile or of forehead (n-m/FH):* It measures the angle made by nasion (n) – metopion (m) line with F. H. plane.
   Instrument used: stationary or attachable goniometer and craniophore
6. *Inclination angle of foramen magnum (ba-o/FH):* It measures the angle made by basion (ba) - opisthion (o) line with F.H. plane.
   Instrument used: stationary or attachable goniometer and craniophore
7. *Calvarial base angle (n-i/FH):* It measures the angle made by nasion (n) – inion (i) line with F. H. plane.
   Instrument used: stationary or attachable goniometer and craniophore

Sex of the skulls was determined according to Singh and Bhasin (1989) and www.futurelearn.com/info/courses/forensic-facial-reconstruction/0/steps/25656.

RESULTS

Mean and SD values of different angular measurements

The results of the present study depict that out of seven angular measurements male skull have higher mean value in five measurements (total profile angle, nasal profile angle, alveolar profile angle, inclination angle of foramen magnum and calvarial base angle) and the female skull exhibit higher mean value in two measurements (profile angle of nasal roof and metopic angle). The SD values ranges between 3.51 and 5.93 among the male skull, while it ranges between 2.44 and 5.11 among the female skull. When the t-test values are taken into consideration it is found that there exists statistically significant difference between male and female skull in respect of profile angle of nasal roof (Tables 1).

Table 1: Mean, SD and t values of different angular measurements

Angular measurements	Male (n=50)		Female (n=57)		t-value
	Mean	SD	Mean	SD	
Total profile angle (in ^{0})	83.70	3.80	82.53	4.16	1.5179
Nasal profile angle (in ^{0})	82.80	4.21	81.47	4.14	1.6489
Alveolar profile angle (in ^{0})	79.72	5.62	78.33	5.11	1.3336
Profile angle of nasal roof (in ^{0})	70.06	5.15	72.31	4.88	2.3020*
Metopic angle or profile of forehead (in ^{0})	81.18	4.63	82.23	4.55	1.1870
Inclination angle of foramen magnum (in ^{0})	130.18	3.51	129.19	2.44	1.6678
Calvarial base angle (in ^{0})	80.22	5.93	78.53	5.09	1.5728

*Significant at 0.05 level

Total profile angle or facial profile angle (n-pr/FH):

Types of total profile angle are furnished in Table 2 for male and female skull separately. Profile angles are categorized following Martin and Saller. In case of male skull, mesoprognathous and orthoprognathous total profile angle occur in higher percent, which ranges between 42% (mesoprognathous) and 44% (orthoprognathous). While, prognathous angle occurs in lesser frequency (14%). In case of female skull, a dissimilar trend is discernible. More than 52% female

skull belonged to mesoprognathous type. One fourth of the female skull belonged to orthoprognathous type (24.56%). However, more than 20 percent of the female skull belonged to prognathous type. Only 1.75 percent female skull belonged to hyperorthoprognathous type.

Table 2: Total profile angle (according to Martin and Saller)

Type	Male (n=50)		Female (n=57)	
	No.	%	No.	%
Hyperprognathous (X-69.9^0)	-	-	-	-
Prognathous (70^0-79.9^0)	7	14.0	12	21.05
Mesoprognathous (80^0-84.9^0)	21	42.0	30	52.63
Orthoprognathous (85^0-92.9^0)	22	44.0	14	24.56
Hyperorthoprognathous (93^0-X)	-	-	1	1.75

Nasal profile angle (n-ns/FH):

Nasal profile angles are furnished in Table 3 for male and female skulls separately. Nasal profile angles are categorized following Martin and Saller. Mesognathous type of nasal profile angle occurs in highest frequency in the skull of both the genders (male skull: 54.0%; female skull: 49.12%). Twenty percent of the male skull show prognathous type of nasal profile angle and 31.58% of the female skull show the same. However, prognathous type of nasal profile angle occurs in higher frequency in female skull than that of the males. In case of orthognathous nasal profile angle a reverse trend is perceptible. Occurrence of which is higher in male skull (26.0%) than that of the females (19.30%).

Table 3: Nasal profile angle (according to Martin and Saller)

Type	Male (n=50)		Female (n=57)	
	No.	%	No.	%
Hyperprognathous (X-69.9^0)	-	-	-	-
Prognathous (70^0-79.9^0)	10	20.0	18	31.58
Mesognathous (80^0-84.9^0)	27	54.0	28	49.12
Orthognathous (85^0-92.9^0)	13	26.0	11	19.30

Alveolar profile angle (ns-pr/FH):

Different types of alveolar profile angle are furnished in Table 4 for male and female skulls separately. Alveolar profile angles are categorized following Martin and Saller. Prognathous type of alveolar profile angle occurs in highest frequency in both the gender's skull (male: 48%; female:

57.89%). Mesognathous alveolar profile angle also occurs in moderately higher frequency in both the genders skull (male: 30%; female: 35.09%). However, orthognathous type of alveolar profile angle occurs in much higher frequency in case of male skull (20%) than that of the females (7.02%).

Table 4: Alveolar profile angle (according to Martin and Saller)

Type	Male (n=50)		Female (n=57)	
	No.	%	No.	%
Ultraprognathous (X-59.9^0)	-	-	-	-
Hyperprognathous (60^0-69.9^0)	1	2.0	-	-
Prognathous (70^0-79.9^0)	24	48.0	33	57.89
Mesognathous (80^0-84.9^0)	15	30.0	20	35.09
Orthognathous (85^0-92.9^0)	10	20.0	4	7.02
Hypergnathous (93^0-X)	-	-	-	-

Profile angle of nasal roof (n-rhi/FH):

It appears from Tables 1that means of profile angle of nasal roof estimated to be little higher in case of female skull (72.31) than that of the male skull (70.06). SD value vary more in the male skull (5.15) than the female skull (4.88).

Metopic angle or profile of forehead (n-m/FH):

It is seen from Tables 1 that means of metopic angle is little higher in case of female skull (82.23) than that of the male skull (81.08). SD value vary more in the male skull (4.63) than that of the female (4.55).

Inclination angle of foramen magnum (ba-o/FH):

Means of inclination angle of foramen magnum (Table 1) is estimated to be more in male skull (130.18) than that of the female skull (129.19). Side by side, SD value vary more in the male skull (3.51) than that of the females (2.44).

Calvarial base angle (n-i/FH):

Means of calvarium base angle (Table 1) is found to be more in male skull (80.22) than that of the females (78.53). Side by side, SD value vary more in the male skull (5.93) than that of the females (5.09).

DISCUSSION

Bio-archaeologists use their knowledge of sexual dimorphism in skeletal remains to reconstruct the demographic profile of historic and prehistoric populations. Alongside sex, ancestral affinity is quite relevant to biological anthropology in general. Anthropologists have traditionally studied many morphological variations between historically disparate groups of humans and its origin in order to understand biological adaptation in response to climate and geographical disparities. While, the biological concept of fixed races of humans is no longer accepted among many anthropologists (American Anthropological Association 1998).

Angular measurement can be discussed as a part of craniometry – the measurement included of the brain case, facial part and the lower jaw. The measurement of different angles is very useful to detect the racial differentiation. The findings of angular measurements can enrich the study of the craniofacial complex in relation to the fields of functional anatomy and comparative anatomy. Various measurements can be made to compare the skulls of human with those of other primates in order to establish the evolutionary trends in human and other primates.

It appears from the present study that the different angular measurements of male Contai skull show higher means in five consecutive measurements out of seven measurements than their counterpart. But a reverse trend can be seen in female skull in case of two measurements out of seven measurements. Finally, it can be said that these are the general characteristics of male and female Contai skulls.

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