

Derivation of Demarcating Points for Sex Determination from Skull

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Research Article

Abstract: Craniometry is a branch of anthropometry through which cranial dimensions can be estimated. The study of sexual dimorphism is important clinically as well as in forensic anthropology. Head circumference and maximum biparietal diameter were measured in a total of 98 skulls (60 males and 38 females) from the bone bank of the Department of Anatomy, Govt. Medical College Aurangabad. All the measurements were expressed in descriptive statistics i.e. mean; SD, range and mean \pm 3S.D. are calculated. The p value of both parameters i.e. Head Circumference and Maximum Biparietal diameter are found to be highly significant. (P value <0.001). Demarcating points were derived for the male and female skulls and these demarcating points were cross validated from the available samples. Accuracy of the demarcating points was established. A comparison of the data with the earlier works demonstrated the identical outcomes and highly significant results. The values are a reference tool for the evaluation in Indian race especially of Maharashtra. This study is recommended to forensic anthropologists, craniofacial surgeons and medical practitioners and also serves as the basis for future studies on other ethnic group.

Introduction

One of the important aspects in medico legal cases is establishing the identity of the deceased. The question becomes much difficult when the remains available are very less or only skeleton, In particular when only a few bones. The reliability of the assessment lies with the base being used for evaluation of such materials. Osteometry and morphological examinations of bones is the key to reach at final conclusions. Craniometry is a part of this broad step in such difficult case evaluations. Craniofacial anthropometry is vital in making a precise and systematic measurement of human skull. The technique is primarily used to determine ancestry, population distances and sex. It differs greatly from the pseudoscientific fields of phrenology and physiognomy, although in the general population the distinction is not so clear. The morphological nonmetrical methods are mainly focused on morphological traits and not reliable because a feature depends on race, geographical regions and visual impressions, which often vary between any two observers. The most important of craniometric dimension are height and width of head that were used in cephalic index determination by a number of earlier workers.¹

Cranial dimensions are age related hence gender differentiation is achieved only at adulthood. Dimensions in newborns are not stable because cranial length, height and width increase as growth progress (Trenouth, 1991)². Hence, this study was undertaken in adult males and females. As discussed earlier the establishing of identity of the deceased involves commenting on gender with 100 % accuracy. Amongst this skull dimensions evaluation is therefore of vital importance and hence this study was undertaken regarding head circumference and biparietal diameter for determination of gender. The aim of this study is to document the Demarcating points of head circumference and maximum biparietal diameter of human adult skull and to provide a comprehensive data for use by anthropologists and medical practitioners which can be useful for determination of gender from skull.



Photograph 1: Showing Instruments Used In the Study

Materials and Methods

98 adult human skulls were studied out of which 60 were of males and 38 of females. Samples were taken from the Bone bank of Department of Anatomy Govt. Medical College Aurangabad.

The skulls were dry, fully ossified and free from any deformity. Sex was particularly labeled for all the skulls. Instruments used in the present study were (shown in the photograph 1.)

1. Osteometer.
2. Scale.
3. Flexible measuring tape.
4. Marker pencil.

Following parameters were studied.

1. Head circumference.
2. Maximum Biparietal diameter

1. Head circumference: was measured using flexible measuring tape starting from a fixed point (marked) running along the maximum circumference and back to the marked point as shown in the photograph 2.

2. Maximum Biparietal diameter: Was measured using the osteometer, the Maximum transverse distance

between outer surfaces of the parietal bones using osteometer as shown in the photograph 3.

Data obtained was recorded on a recording sheet, and then transferred into SPSS 11.0 for analysis. We calculated mean, standard Deviation (S.D.), Mean \pm 3 S.D. (Demarcating points) and P values for males and females.

Cross Validation of the Data was done using the obtained Demarcating points.



Photograph 2: Measuring Head Circumference by Using Measure Tape

Observation

Table 1: Statistical analysis of Head Circumference

Details of measurement	Male (mms)	Female(mms)
Mean	494	478
S.D.	1.58	1.32
Range	460-530	445-490
Mean \pm 3S.D.	446-541	438-518
Demarcating point	>518	<446
P value	< 0.001	

The mean value of head circumference of males is 494 mms, and that of females is 478 mms, with the value of males and females ranging between 460-530 mms and 445-490 mms respectively. The standard deviation in males is 1.58 and in females it is 1.32. The range of mean

\pm 3 S.D. in males is 446-541 mms and in females it is 438-518 mms. The demarcating point for males is > 518 mms and for females it is < 446 mms. T-test is highly significant as $P < 0.001$. Hence head circumference is a reliable parameter for identification of sex from skull.

Table 2: Statistical analysis of Maximum Biparietal diameter

Details of measurement	Male (mms)	Female(mms)
Mean	132	125
S.D.	0.5	0.56
Range	117-145	115-136
Mean \pm 3S.D.	117-147	108-142
Demarcating point	>142	<117
P value	< 0.001	

The mean value of Maximum Biparietal diameter of males is 132 mms, and that of females is 125 mms, with the values of males and females ranging between 117-145 mms and 115-136 mms respectively. The standard deviation in males is 0.5 and in females it is 0.56. The range of mean \pm 3 S.D. in males is 117-147 mms and in females it is 108-142 mms. The demarcating points for

males is > 142 mms and for females it is < 117 mms. T-test is highly significant as $P < 0.001$. Hence Maximum Biparietal diameter is also a reliable parameter for identification of sex from skull. The obtained demarcating points were used for cross validation and were found to be reliable in determination of gender.

Discussion

Table No.3: Showing Comparison of Head Circumference with Previous Studies

Sr. No	Name Of The Author	Mean (mms)		P Value
		Male	Female	
1.	Hug (1939) ^{3,4}	520-534	500-514	-----
2.	Keen (1950) ^{4,5}	516	498	-----
3.	Deshmukh AG (2006) ⁶	496	479	< 0.001
4.	Shalini (2008) ⁷	550.90	506.94	P = 0.000
5.	G.S. Oladipo (2010) ⁸	57.49cm	56.25 cm	p<0.05
6.	North eastern Nigeria/ Raji et al (2010) ⁹ (scale calibrated from cms to mms)	572.5	572.2	-----
7.	M. B. Maina (2011) ¹⁰	566.7	561.5	-----
	Fulani	564.7	537.5	-----
	Tangale	568.1	565.2	-----
	Tera	567.1	558.8	-----
8.	North-Eastern Nigeria/Maina et al. (2011) ¹¹	564.51	570.03	-----
9.	Present study (2013)	494	478	< 0.001

From the above table it can be seen that the mean values of head circumference are comparable between the present study and the earlier workers barring a few racial differences. The p values whatever available are significant and establishes reliability. In the present study p value is less than 0.001 (highly significant).

Demarcating points of most of the studies were not available for comparison however on tallying with the available literature (viz Hug) it can be seen that the values are comparable slight difference seen is due to different ethnical groups of study in the two works.

Table 4: showing comparison of Maximum Biparietal Diameter with Previous studies

Name	Male (mms)		Female(mms)	
	Mean	D.P.	Mean	Mean
Hug (1939) ^{3,4}	140-149	>155	Hug (1939) ^{3,4}	140-149
Keen (1950) ^{4,5}	135/0.7	----	Keen (1950) ^{4,5}	135/0.7
Hanihara(1959) ¹²	139	----	Hanihara(1959) ¹²	139
Present Study (2013)	132	>142	Present Study (2013)	132

Biparietal diameter was less emphasized in the earlier studies hence only a few works are available for

comparison. Values of the present study are comparable with the values of the earlier works.

Table 5: showing comparison of demarcating points with previous studies.

Name of Author	Male (mms)		Female(mms)	
	Mean	D.P.	Mean	Mean
Hug (1939) ^{3,4}	140-149	>532	Hug (1939) ^{3,4}	140-149
Present study (2013)	494	>518	Present study (2013)	494

The values of mean and demarcating points match with the previous workers, except slight differences which can

be explained on the basis of different racial groups of the two studies.



Photograph 3: Measuring Maximum Biparietal Diameter of Skull

Conclusion

Maximum Biparietal diameter and Head circumference are important parameters in the determination of gender from skull. The demarcating points are accurate enough for the evaluation of gender of unknown skull. Metrical parameters are of immense help in determination of sex from skeletal remains, particularly when the available material is less. Demarcating points are 100 % accurate although the sorting percentage is less.

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