Reliability of Foramen Magnum Length & Breadth and Mastoid Length in Identification of Gender of North Chennai Region

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ABSTRACT

Identification of the sex from the skeletal remains is the prime work of forensic experts. The present study is carried out to determine the sex of the skull bone from foramen magnum length, breadth and mastoid length. One hundred adult human skull bones of known sex (50 male and 50 female) available in the Department of Anatomy and Forensic Medicine& Toxicology, Madha Medical College and Hospital, Chennai are used for the present study. Among all the three variables statistically analyzed, the most reliable parameter is foremena magnum length which helps to sort out 38% of male skulls and 06% of female skulls i.e. overall 22% of skull bones can be sorted out with this parameter alone. This parameter is also found to be statistically significant.

Keywords: *Foramen magnum, length, breadth, mastoid length and Gender*

INTRODUCTION

Identification of sex of the deceased from skeletal remains is in practice since long ago, as it becomes important expert evidence in the court of law. In medico-legal cases forensic experts are often asked for their expert opinion regarding species, age, sex, race, stature and probable cause of death from skeletal remains. Bones form important evidence in establishing identity of deceased in medico-legal cases. The determination of sex of the deceased is prime step in skeletal analysis. As the studies on sexual dimorphism of skull were very few, present study is an attempt to enhance the accuracy of sexing skull. This will be helpful in anthropometric and medico-legal studies. Similar works were conducted earlier by Harihara[1] (1959) who worked on Japanese skull, Giles and Elliot[2] (1963) who worked on American crania and Hong Wei Song[3] (1992) studied on Chinese skull. Results of these studies have shown wide range of variations in standards of morphological and morphometric sex differences. These variations occur because the skeletal growth is mostly influenced by factors like race, heredity, climate, environment, nutrition, etc., which are likely to change from region to region, hence, it is essential to carry out such studies in different regions.

MATERIALS AND METHOD

One hundred adult human skull bones of known sex available in the Department of Anatomy and Forensic Medicine, Madha medical college, Chennai are used for the present study.

Out of 100 skull bones, 50 are of males and 50 are of females. All the skull bones are dry, free of damage or deformity and were completely ossified.

Following instruments are used for the measurements of various parameters of hip bone:

1) Sliding Vernier caliper
2) Chalk
3) Marker pencil

Sufficient care is taken to avoid manual error and all measurements are taken personally. From each skull following parameters are measured. The points used for various measurements are as follows:

1. Foramena magnum length (FML): Foramena magnum length is the distance between basion and opisthion. It was recorded with the help of sliding vernier caliper.

a. Basion: Basion is the most anterior point on anterior margin of foramena magnum.

b. Opisthion: Opisthion is the most posterior point on the posterior margin of the foramena magnum.

2. Foramena magnum breadth (FMB): Maximum breadth of foramena magnum was measured at broadest part of foramena magnum with the help of sliding vernier caliper.

3. Mastoid length (ML): Mastoid length is the distance between highest point on the upper border of external auditory meatus to the tip of mastoid process. It was measured perpendicular to Frankfurt plane with the help of sliding vernier caliper. The upper arm of sliding vernier caliper was aligned with upper border of external auditory meatus and the distance to the tip of mastoid process was measured.

The values of range, mean, standard deviation, calculated range (mean±3SD), Demarking points (D.P.) and Identification points (I.P.) were obtained. For each parameter with male range of a – b and female range of c – d, values 'a' and 'd' were the identification points for females and males respectively. Any parameter reading less than 'a' was regarded as female skull and greater than 'd' was regarded as male skull and in case where female range is more than male then 'b' and 'c' were identification points for female and male respectively. Similarly Demarking Points was calculated from calculated range i.e., Mean ± 3 S.D (a = minimum value in male range, b = maximum value in male range, c = minimum value in female range and d = maximum value in female range). Subsequently 't' test was applied.

OBSERVATIONS

One hundred skull bones (50 males and 50 females) are studied in the present study. In all the skull bones Foramen magnum length, breadth and mastoid length are measured. As the first part of study parameter is analyzed statistically and mean, standard deviation, range, calculated range (mean±3 SD), Demarking points and Identification point are obtained. Percentage of the skull bones identified by demarking point, percentage of skull bones identified by identification point is calculated. Then't' test is applied.

Table 01: Statistical analysis of Foramena magnum length of skull

Details of measurement	Male (mm)	Female (mm)
Mean	33.46	29.62
SD	5.04	2.01
Range	26-43	24-34
Identification point (IP)	>34 mm	<26 mm
Percentage of bones identified by IP	38%	06%
Standard error	0.71	0.28
Calculated range (Mean±3SD)	18.33-48.59	23.59-35.65
Demarking point (DP)	>35.65	<18.33
Percentage of skull sexed correctly by DP	34%	0%

't' test: P<0.001 (Highly significant)

The mean foramena magnum length of male skull was 33.46 mm ranging between 26-43 mm. The mean foremena magnum length of female skull was 29.62 mm with the values ranging between 24-34 mm. The identification point of male skull was >34 mm and of female skull was <26 mm and percentage of skull identified by I.P alone was 38% of males and 06% of females. The SD for male and female were 5.04 and 2.01 respectively. The calculated range of mean±3SD in males and females was 18.33-48.56 mm and 23.59-35.65 mm respectively. The demarking point for males was >35.65 mm and for female it was <18.33 mm. The percentage of skull identified by DP alone was 34% for males and 0% for female. 't' test was highly significant with p<0.001.

Table 02: Statistical analysis of Foramena Magnum Breadth (FMB) of Skull

Details of measurement	Male (mm)	Female (mm)
Mean	29.86	27.64
SD	2.09	2.35
Range	25-36	23-33
Identification point (IP)	>33mm	<25mm
Percentage of bones identified by IP	02%	08%
Standard error	0.30	0.33
Calculated range (Mean±3SD)	23.59-36.13	20.58-34.70
Demarking point (DP)	>34.70	<23.59
Percentage of skull sexed correctly by DP	02%	02%

't' test: P<0.001 (Highly significant)

The mean foramena magnum breadth of male skull was 29.86 mm ranging between 25-36 mm. The mean

foramena magnum breadth of female skull was 27.64 mm with the values ranging between 23-33 mm. The identification point of male skull was >33 mm and of female skull was <25 mm and percentage of skull identified by I.P alone was 02% of males and 08% of females. The SD for male and female were 2.09 and 2.35 respectively. The calculated range of mean±3SD in males and females was 23.59-36.13 mm and 20.58-34.70 mm respectively. The demarking point for males was >34.70 mm and for females it was <23.59 mm and the percentage of skull identified by DP alone was 2% of both male and females. 't' test was highly significant with p<0.001.

Table 03: Statistical analysis of Mastoid length (ML) of skull

Details of measurement	Male (mm)	Female (mm)
Mean	26.64	24.7
SD	2.74	2.66
Range	20-34	20-33
Identification point (IP)	>33 mm	<20 mm
Percentage of bones identified by IP	2%	0%
Standard error	0.39	0.38
Calculated range (Mean±3SD)	18.42-34.86	16.72-32.68
Demarking point (DP)	>32.68	<18.42
Percentage of skull sexed correctly by DP	2%	0%

't' test: P<0.001 (Highly significant)

The mean mastoid length of male skull was 26.64 mm ranging between 20-34 mm. The mean mastoid length of female skull was 24.7 mm with the values ranging between 20-33 mm. The identification point of male skull was >33 mm and of female skull was <20 mm and percentage of skull identified by I.P alone was 02% of males and 0% of female. The SD for male and female were 2.74 and 2.66 respectively. The calculated range of mean±3SD in males and females was 18.42-34.86 mm and 16.72-32.68 mm respectively. The demarking point for males was >32.68 mm and for female it was 18.42 mm. The percentage of skull identified by DP alone was 2% for males and 0% for female. 't' test was highly significant with p<0.001.

DISCUSSION

Foramena magnum Length:

Present study determined I.P. for male skull as >34 mm and that for female skull as <26 mm. Similarly D.P. for males as >35.65 mm and for female as <18.33 mm.

The findings of present study was similar with Hong Wei Song[3] (1992) on Chinese skulls as shown in table no.4

Table 04: Showing Comparison of Foramena Magnum Length

Studies	Male				Female				SS
	N	M	R	SD	N	M	R	SD	P
Keen[4] (1950)	50	36.3	30-44	2.9	50	34.8	30-40	2.4	—
Hong Wei Song et al[3] (1992)	30	34.1	—	2.6	30	32.1	—	2.1	<0.001
Deshmukh & Deverthi[5] (2003)	40	34	26-40	3.09	34	34	30-38	2.05	>0.05
Present study (2011)	50	33.46	26.43	5.04	50	29.62	24-34	2.01	<0.001

Where N – no of skull, M – Mean, SD – Standard deviation, R – Range, SS – Statistical significant, scale in mm.

Foramena magnum Breadth

Present study determined I.P. for male skull as >33 mm and that for female skull as <25 mm. Similarly D.P. for males as >34.70 mm and for female as <23.59 mm.

The findings of present study are similar with Hong Wei Song (1992) on Chinese skulls

Table 05: Showing Comparison of Foramena Magnum Breadth

Studies	Male			Female			SS
	N	M	SD	N	M	SD	P
Hong Wei Song et al[3] (1992)	30	27.5	2.4	30	25.8	1.8	<0.001
Deshmukh & Deverthi[5] (2003)	40	29	1.97	34	28	2.09	>0.05
Present study (2011)	50	29.86	2.09	50	27.64	2.35	<0.001

Where N – no of skull, M – Mean, SD – Standard deviation, SS – Statistical significant, scale in mm.

MASTOID LENGTH

Present study determined I.P. for male skull as >33 mm and that for female skull as <20 mm. Similarly D.P. for males as >32.68 mm and for female as <18.42 mm.

Findings of present studies were similar with previous workers as shown in table no.06.

Table 06: Showing Comparison of Mastoid Length

Studies		Male			Female		SS					
		N	M	R	SD	DP	N	M	R	SD	DP	P
Keen[4] (1950)		50	29.3	21-27	3.6	—	50	26.5	19.3	3.1	—	—
Giles & Elliot[2] (1963)	White	75	28.06	2	2.67	—	75	25.21	—	2.74	—	<0.05
	Negro	75	30.32	2	2.75	—	75	26.34	—	2.65	—	
Bagde[6] (1981)		70	31.8	25.3	2.8	>32	30	27.8	23-32	2.24	<25	<0.001
Maryna Steyn & Yasar Iscan[7] (1998)		43	34	—	3.39	—	46	30.9	—	3.9	—	<0.001
Deshmukh & Deverthi[5] (2003)		40	29	22-36	3.16	>39	34	27	21-36	4.02	<19	<0.05
Present study (2011)		50	26.64	20-34	2.74	>32.68	50	24.7	20-33	2.66	<18.42	<0.001

CONCLUSION

With parameter like foremena magnum length, 34% of male skulls and 0% of female skull.i.e., overall 17% of skulls can be sorted out using demarking point and similarly using identification point, 38% of male skulls and 06% of female skulls i.e., overall 22% of skull can be sorted out and this parameter is statistically highly significant. Likewise, with foramena magnum breadth, 02% of male skulls and 02% female skulls i.e., overall 02% of skulls can be sorted out using demarking point and 02% of male skulls and 08% of female skulls i.e., overall 05% of skulls can be sorted out using identification points and this parameter too is statistically highly significant. With parameter, mastoid length 02% of male skulls and 0% of female skull i.e., overall 01% of skull can be sorted out with demarking point and 02% of male skulls and 0% of female skulls i.e., overall 01% of skull can be sorted out with identification point and like other parameters, this is also statistically highly significant.

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