



IDENTIFICATION OF SEX FROM INION-OPISTHOCRANIUM-ASTERION TRIANGLE IN INDIAN SKULL

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ABSTRACT

Determination of sex from human skull is of great importance for anatomists, anthropologists and forensic medical personnel from medico-legal point of view. Present study investigated the presence of sexual dimorphism in the dimensions, area and index of Inion-Opisthocranium-Asterion (IOA) triangle. 38 male and 32 female skulls were examined using Vernier slide calliper in the Department of Anatomy, IPGME&R, Kolkata. All the parameters were compared between two sexes. Male parameters were significantly ($P < 0.05$) higher than female parameters. The left IOA index of male (86.97%) was higher than right (85.73%). All other parameters were higher on right side in both sexes. The total area of IOA triangle was 2998.78 mm² in male and 2270.69 mm² in female. The anthropometry of IOA triangle can impart an immense value in sex determination of unknown individual.

KEYWORDS : Inion, Opisthocranium, Asterion.

The skull is probably the most studied bone for determination of sexual dimorphism from medico-legal point of view (C.N.Orish, B.C.Didia, H.B.Fawehinmi, 2014). Researches on this topic are of immense help for forensic experts. When the entire skeleton is present sex assessment can be done with levels of reliability of 100 %, 92% using the skull alone and 98% when combining pelvis with skull (W.M.Krogman, M.Y.Iscan, 1986). Different authors had studied earlier on European (G.Boulinier, 1968 and E.Defrise-Gussenhoven, 1966), Americans (E.Giles, O.Elliot, 1963), South Africans (M.Steyn, M.Y. Iscan, 1998 and M.Steyn. M.Y.Iscan, 1999), Japanese (K.Hanihara, 1959 and M.Y.Iscan, M.Yoshino, S.Kato, 1995), Chinese (M.Y.Iscan, S.Ding, 1995), & Nigerian (C.N.Orish, B.C.Didia, H.B.Fawehinmi, 2014) skulls to determine the sex. In spite of the increase in research on prediction of sex using craniofacial parameters, information on such is sparse in Indian population. The aim of this study was to determine the sex using a triangle defined by Inion, Opisthocranium and Asterion.

Method

A total of 70 adult dry skulls (38 male, 32 female) were used for this descriptive morphometric study done in the Department of Anatomy, IPGME&R, Kolkata. Only intact, undamaged, undeformed and fully ossified skulls without any congenital anomaly or pathology of known sex were selected. We used Vernier slide calliper (precision of 0.02 mm) and marker for measurement of the length of Opisthocranium-Asterion (OA), Opisthocranium-Inion (OI) and Inion-Asterion (IA). The skulls were kept in Norma occipitalis facing the observer. Following landmarks were selected for cranial measurements. Inion: The most prominent point in the posterior aspect of occipital calvarium at the junction of right and left superior nuchal lines. Opisthocranium: The most posteriorly protruding point on the back of the skull at mid sagittal plane. Asterion: The meeting point of temporal, parietal and occipital bones. The area of IOA triangle was calculated by using Heron's

formula: Area = $\sqrt{s(s-a)(s-b)(s-c)}$

Where s=perimeter, $s = (a+b+c) \div 2$.(a, b, c represents sides of the triangle).

IOA index was calculated as: IOA index = $(IO \div IA) \times 100$.

The data obtained was analysed statistically to find out the mean, standard deviation, standard error of mean, range and sexual dimorphism of two sexes. We measured each parameter thrice and took the mean value to overcome observational bias. The 'P' value

was determined to find out whether the sexual dimorphism and side differences between means were significant or not.

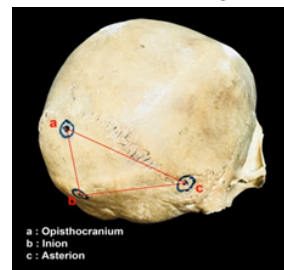


Figure: 1 showing three points.

Result

Mean, standard error of mean (SEM), standard deviation (SD), minimum value and maximum value of length of IO, left IA, right IA, left OA, right OA of both sexes of present study were shown along with the Nigerian study (C.N. Orish et al in 2014).

Table: 1 Comparison between present and Nigerian study: bilateral lengths of IO, IA and OA in both sexes

Sex	Particular	Side	Mean	SEM	SD	Max	Min
Male	IO	-	50.83 (30.03)	0.98 (0.50)	6.03	59.2 (46.59)	38.18 (22.21)
Female	IO	-	40.42 (22.34)	0.69 (2.10)	3.89	49.42 (32.22)	35.2 (14.10)
Male	IA	Right	60.49 (63.64)	0.75 (0.40)	4.60	74.9 (74.17)	50.5 (55.06)
Female	IA	Right	57.20 (57.48)	0.52 (1.56)	2.95	62.38 (61.22)	50.2 (47.76)
Male	IA	Left	58.69 (64.69)	0.63 (0.40)	3.87	64.92 (75.49)	50.34 (56.94)
Female	IA	Left	55.82 (59.74)	0.66 (0.65)	3.71	61.94 (61.32)	50.2 (54.63)
Male	OA	Right	75.15 (69.73)	1.02 (0.49)	6.30	86.92 (81.79)	63.32 (57.71)
Female	OA	Right	69.15 (60.92)	0.73 (2.10)	4.14	74.34 (75.00)	56.28 (48.00)
Male	OA	Left	73.01 (71.09)	0.97 (0.56)	5.97	84.28 (82.95)	54.92 (52.51)
Female	OA	Left	66.38 (61.68)	0.88 (3.35)	5.00	73.2 (74.10)	54.3 (44.00)

Values in bold represents present study and values in () represents Nigerian study1

Table:1 shows there is significant difference between the parameters of male and female as well as right and left sides of both sexes. 'P' values of all the parameters between male and female were < 0.05 ie statistically significant. 'P' value of IO and right, left OA length between both the sex was < 0.0001 ie extremely significant statistically.

Table: 2 Comparison of IOA index of our study with that of Nigerian

Sex	Left IOA index (%)	Right IOA index (%)	Average IOA index (%)
Male	86.97 (46.42)	85.73 (47.19)	86.34 (46.81)
Female	72.09 (37.40)	73.36 (38.87)	71.73 (38.14)

Values in bold represents present study and values in () represents Nigerian study1

Table:2 shows that IOA index is larger on left side in case of male and in case of female larger on right side, but they found the right one in both male and female to be larger. We found average IOA index greater in male as same as their finding.

Table: 3 Comparison of area of IOA triangle in mm2 of present study with that of Nigerian

Sex	Left	Right	Total Area
Male	1473.57 (972.17)	1525.21 (966.71)	2998.78 (1938.88)
Female	1120.05 (664.04)	1150.64 (641.64)	2270.69 (1305.68)

Values in bold represents present study and values in () represents Nigerian study1

Table:3 shows that the Nigerian measurement differs from that of Indians. The areas of IOA triangle we found larger on right side than left in both sexes where as they found the left one larger in both. Here in both right and left triangle areas are larger in male than female and extremely statistically significant ('P' value < 0.0001) in both right and left.

Discussion

Males are generally robust than females and the weight of skeleton of male is relatively and absolutely heavier than that of female by 8% (L.E. St.Hoymes, M.Y.Iscan, 1989). The morphological difference and phenotypic expressions between both sexes can be the result of multiple factors, where as the only constants are biological sex which is controlled by sex chromosomes and genetic and/or racial heritage (S.Mays, S.Cox, 2000 and L.L.Klepiner, 2006) Regarding sexual dimorphism ratio (male mean/ female mean) of IO, OA, IA we found it to be 1.23, 1.09 and 1.05 respectively ie greater than unity indicating that male crania were larger in all liner dimensions than female crania. C.N.Orish et al also found the ratios to be greater than unity as of ours and they found the highest ratio for IO 1.34 and lowest one for IA 1.09 (C.N.Orish, B.C.Didia, H.B.Faweihinmi, 2014). Ahmed et al (A.A.Ahmed, H.A.Mohammed, M.A.Hassan, 2011) reported that sexual dimorphism ratio in Sudanese populations (male/female ratio) for the mean measurements was greater than unity indicating male crania is larger in all linier dimensions than female crania.This finding is also similar to our present study.

Determination of sex from human skull is of great importance for forensic anthropologist as well as anatomist as it is critical for individual identification. In cases of missing persons it eliminate approximately 50% of the population from further consideration (C.N.Orish, B.C.Didia, H.B.Faweihinmi, 2014). Our study reveals statistically significant differences between male and female as well as right and left sides of skulls.Thus our finding can impart immense importance for determination of sex medico-legally.

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