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MORPHOMETRIC EVALUATIONS OF INTERCONDYLAR DISTANCES USING COMPUTED TOMOGRAPHIC SCAN IMAGES IN MAIDUGURI, NORTHEASTERN NIGERIA.

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ABSTRACT

Knowledge of the anatomy of the occipital condyle (OC) and the structures around it is significant in sex determination and in surgical operations involving the basicranium. The present study attempts to evaluate the anterior occipital intercondylar distance (AOID) and posterior occipital intercondylar distance (POID) in the sample population as well as its variability in different populations. The sample population for the present study comprised of computed tomographic (CT) images of 110 patients (60 males and 50 females) aged 18–65 years obtained from the Federal Neuropsychiatric Hospital, Maiduguri, Borno State-Nigeria. Males presented significantly higher mean values for both the parameters measured ($p<0.001$). Mean values of AOID in males and females are respectively 24.15 mm and 22.31 mm, while the POID mean values are 26.83 mm and 23.79 mm. The ratio of POID to AOID is 1.1:1.0 in both males and females in the sample. This ratio varies from population to population.

Key Words:

INTRODUCTION

The occipital condyles (OCs) are important structures of the skull base that form part of the cranio-vertebral junction. The OCs are unique bony structures that connects the skull and the vertebral column (Naderi *et al.*, 2005). Due to its significance, cranio-vertebral junction has been the focus of different types of anatomical and biomedical studies most of which are focused on the morphometric analysis of the OCs, while some of the studies provided information about the OCs based on the different surgical procedures (Mefty *et al.*, 1996).

The OCs are the cranial portion of the cranio-vertebral junction. There are several developmental variations involving the OCs. Therefore, a good understanding of the anatomy of OCs is vital for any kind of surgery involving the cranio-vertebral region (Vasudeva *et al.*, 1996). Knowledge of the anatomy of the OCs and the structures around them is also significant in sex determination. Determination of intercondylar distances play a significant role in sex determination and establishment of personal identity (Orbay *et al.*, 1989).

The present study attempts to find out whether the OC is sexually dimorphic in the sample population and to analyse the variability of the anterior and posterior intercondylar distances of the OCs.

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MATERIALS AND METHODS

The sample population for the present study comprised of basicranial CT images of 110 patients (60 males and 50 females) aged 18–65 years obtained by *purposive sampling technique* from the archive in the work station of the Radiology department, Federal Neuropsychiatric Hospital, Maiduguri, Borno State-Nigeria. Images of patients below 18 or above 65 years of age were not included in this study. Poorly produced CT images were also exempted from the study. The images used for this study, were made by 16-slice bright speed CT scanner.

The parameters measured are the anterior and posterior intercondylar distances, and the readings of the measurements were taken and recorded in millimetre (mm) to two decimal places. Measurements were conducted on the CT images according to following protocols:

1. Anterior intercondylar distance was taken from the tip of the anterior end of the right OC to the tip of the anterior end of the left OC.
2. Posterior intercondylar distance was taken from the tip of the posterior end of the right OC to the tip of the posterior end of the left OC.

The data obtained was subjected to statistical analysis using Instat GraphPad (version 3.05). The level of significance for the parameters tested was placed at p<0.05.

Index for sexual dimorphism (ISD) was used to assess whether the parameters measured were sexually dimorphic. ISD was calculated thus:

$$ISD = \frac{\text{males' mean value}}{\text{Females' mean value}} \times 100$$

ISD is expressed as a percentage and a value greater than 100% indicates sexual dimorphism while value less than 100% is considered not sexually dimorphic (Marin, 2006)

RESULTS

The mean values of the measurements made for the anterior and posterior occipital intercondylar distances are presented in table 1. The mean values of the parameters measured are higher in males compared to females (table 2). Index for sexual dimorphism (ISD), which is an indicator of sexual differences, was calculated for the parameters and the results recorded in table 2. Table 3 shows the mean values of anterior and posterior occipital intercondylar distances documented from previous studies.

Table 1: Mean Values of Anterior and Posterior Occipital Intercondylar Distances

	AOID	POID		
Sex	Mean±SD (mm)	Mean±SD (mm)	Mean difference	P value
Males (60)	24.15±3.87	26.83±3.87	2.68	<0.001
Females (50)	22.31±5.14	23.79±3.25	1.48	<0.05

AOID = anterior occipital intercondylar distance, POID = posterior occipital intercondylar distance, SD = standard deviation.

Table 2: Mean Values of Inter condylar Distance and Index of Sexual Dimorphism

Parameters	Sex	Mean±SD (mm)	Mean difference	ISD	P value
AOID	Males (60)	24.15±3.87	1.84	103	<0.001
	Females (50)	22.31±5.14			
POID	Males (60)	26.83±3.87	3.04	113	<0.001
	Females (50)	23.79±3.25			

AOID = anterior occipital intercondylar distance, POID = posterior occipital intercondylar distance.

Table 3: Comparison of Mean Values of Anterior and Posterior Intercondylar Distances

Serial Number	Authors	Sex	AOID: mean±SD (mm)	POID: mean±SD (mm)	POID to AOID Ratio
1	Westcott and Moore-Jansen (2001)	Male	20.90±2.40	43.30±3.30	2.1 : 1.0
		Female	19.20±2.00	41.60±3.00	2.2 : 1.0
2	Uysal *et al.* (2005)	Male	5.60±0.97	26.69±2.49	4.8 : 1.0
		Female	4.91±0.83	24.69±2.82	5.0 : 1.0
3	Singh and Talwar (2013)	Male	14.88±2.26	26.15±3.31	1.8 : 1.0
		Female	14.33±2.56	24.71±4.57	1.7 : 1.0
4	Abdel-Karim *et al.* (2015)	Male	7.22±1.33	31.57±3.27	4.4 : 1.0
		Female	6.83±0.87	30.42±2.10	4.5 : 1.0
5	Present study	Male	24.15±3.87	26.83±3.87	1.1 : 1.0
		Female	22.31±5.14	23.79±3.25	1.1 : 1.0

AOID = anterior occipital intercondylar distance, POID = posterior occipital intercondylar distance.

DISCUSSIONS

From the results of the present study, there is statistically significant difference ($p<0.001$) between the mean values of AOID and POID of males and females. Males presented higher mean values of 24.15 mm and 26.83 mm for AOID and POID respectively. While that of females are 22.31 mm and 23.79 mm. ISD was calculated for both AOID and POID which are 103 and 113 respectively, and were both found to be greater than 100%, thus making AOID and POID sexually dimorphic parameters. The statistically significant differences of the mean values between AOID and POID of males and females may be due to natural robustness of males' skeletal structure.

Metrical analysis of the anterior and posterior occipital intercondylar distances have been reported by other authors (Spektor, 2000; Westcott and Moore-Jansen, 2001; Uysal *et al.*, 2005; Naderi *et al.*, 2005; Muthukumar *et al.*, 2005; Kizilkanat *et al.*, 2006; Manoel *et al.*, 2009; Avci *et al.*, 2011; Singh and Talwar, 2013; Abdel-Karim *et al.*, 2015).

The mean value for AOID of the present study for males and females are 24.15 mm and 22.31 mm respectively, while that of POID are 26.83 mm and 23.79 mm. Abdel-Karim *et al.* (2015), reported AOID mean values of 7.22 mm and 6.83 mm for males and females respectively, while the POID mean values are 31.57 mm and 30.42 mm in a study in Egyptian population (Abdel-Karim *et al.,* 2015). Similarly, Westcott and Moore-Jansen (2001), reported AOID mean values of 20.90 mm and 19.20 mm for males and females respectively, and POID mean values of 43.30 mm and 41.60 mm (Westcott and Moore-Jansen, 2001).

However, there is huge difference between the mean values of AOID reported by Abdel-Karim *et al.* (2015) which are 7.22 mm and 6.83 mm for males and females respectively compared to the results of the present study which are 26.83 mm and 23.79 mm for males and females respectively. Similarly, there is huge difference between the mean values of POID reported by Abdel-Karim *et al.* (2015) and Westcott and Moore-Jansen (2001) compared to the results of the present study. POID mean values reported by Abdel-Karim *et al.* (2015) for males and females are respectively 31.57 mm and 30.42 mm. While those reported by Westcott and Moore-Jansen (2001) are 43.30 mm and 41.60 mm for males and females respectively.

The wide difference between the mean values of AOID and POID of the present and the reports of Abdel-Karim *et al.* (2015) and Westcott and Moore-Jansen (2001), might be due to differences in ethnicity, diet, geographical location and climate.

The mean values of the AOID (males = 24.15 mm, females = 22.31 mm) and POID (males = 26.83 mm, females = 23.79 mm) of the present study agreed with those reported by Avci *et al.* (2011) who reported AOID and POID mean values of 23.6 mm 26.4 mm respectively (males and females combined) (Avci *et al.,* 2011).

Generally, the POID is greater than the AOID. However, the ratio of POID to AOID varies from population to population. It is greater in some populations compared to others (table 3). This could be due to differences in genetic makeup, diet or geographical location.

In conclusion, the anterior and posterior occipital intercondylar distances are sexually dimorphic with males presenting higher mean values compared to females in the sample population. The mean value of the anterior and posterior occipital intercondylar distances show wide variation between different populations. Also, the ratio of posterior occipital intercondylar distance to anterior occipital intercondylar distance shows some degree of variability between populations.

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