Measurements of Occipital Condyles using Computerised Tomography from Sokoto State, Nigeria

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ABSTRACT

This study is empirical in nature designed to observe and measure the occipital condyles using computerized tomography from Sokoto State, Nigeria. The purpose of the study is to evaluate the occipital condyles in sex determination using computerize tomography scan, and to compare and contrast the respective measurements of the occipital condyles between sexes and various age groups. Cranial CT Scans were obtained from the local data base of the CT machine and back up compact disc from the CT library. Films were viewed on the computer monitor. Measurement was made with Dragon V3.1.1 Philips and Neusoft Medical System Company Limited software, the software provides a meter rule with which measurements were done. A total of 240 subjects were involved in the study. Out of the number, 26.25% were females and 73.75% were males. The ratio of male to female was 2.8:1. The age range of the subjects used in this study was 20 to 79 years. The mean anterior posterior diameter and width of the right occipital condyle were 23.5mm and 12.8mm respectively and for left occipital condyle were 23.7mm and 12.7mm respectively, the mean bicondylar distance was 49.4mm. This study reports that the dimensions of the occipital condyles are greater in Nigerian males than in their female counterparts and are statistically significant for width of the anteroposterior diameter of both condyles and bicondylar distance.

Keywords: *occipital condyles, measurement, CT, Sokoto, Nigeria.*

INTRODUCTION

Studies performed on the cranial base have determined sexual dimorphism by measuring specific bony landmarks on the cranial base, such as axial length of the occipital condyle (Çiçekçibasi, Murshed, Ziylan, Seker and Tuncer, 2004). Regression formulae for sex determination, was created from measurements on the occipital condyles (anteroposterior and transverse diameter) from a historic population (Gapert, Black and Last, 2009b). The occipital condyles are among the classical morphological indicators of sexual dimorphism that has been described (Krogman, 1955; Krogman, and Iscan, 1986). The diagnostic value of systematic observation studied by Suazo, Russo, Zavando and Smith (2009) has reported that sex determination by observation of the occipital condyles shows good sensitivity

and predictive value for males. Fragmentary human remains compromised by different types of inhumation, or physical insults such as explosions, fires, and mutilations may frustrate the use of traditional morphologic sex determination methods (Rene, Sue and Jason, 2008). The basicranium is protected by a large soft tissue mass comprising muscle, tendon, and ligaments. As such, the occipital condyles may prove useful for sex identification in cases of significantly fragmented remains (Rene, Sue and Jason, 2008). Adult human skulls measured indicated the expression of sexual dimorphism in the occipital condylar region within the St. Bride's population (Rene, Sue and Jason, 2008). Suazo, Russo, Zavando and Smit (2009) analyzed 215 human skulls, belonging to the collection of the Universidade Federal de Sao Paulo (UNIFESP).

The sample of 144 males and 71 females adult skulls of 18 years and above, which were in a good state of preservation that allowed for measurement, the mean age for males and females in the sample are 44.3 and 40.76 years respectively (Suazo, Russo, Zavando and Smit, 2009). The authors found that the level of general agreement in the diagnosis of sex, based on differences between the left and right sides to be 65.58%, this percentage was higher in the skull of women which is 83.09%, while the percentage of agreement in male skulls was 63.88%. The overall accuracy rate for diagnosing sex based on the Baudoin index was found to be 41.39% for both sides. The positive predictive value for males was 77.6% on the right side and 76.68% on the left side; for women, the positive predictive value of the Baudoin index was 36.6% on the right side and 38.65 % on the left side. It was concluded by the authors that the Baudoin condylar index has a low yield as a diagnostic test for determining the sex in the skulls studied (Suazo, Russo, Zavando and Smit, 2009).

Macaluso Jr (2011) in his study of the basal region of the occipital bone in a documented French collection was analyzed for sex differences using standard osteometric techniques. The results demonstrated that a low level of sexual dimorphism is present in the cranial base of the sample analyzed, with few of the variables measured exhibiting statistically significant differences between the sexes (Macaluso Jr, 2011). A stepwise procedure, which selected maximum length of the left occipital condyle and minimum distance between occipital condyles produced the best overall result with a classification accuracy rate of 67.7% (Macaluso Jr, 2011). The main objective of this study is to evaluate the occipital condyles in sex determination using computerize tomography scan. And to compare and contrast the respective measurements of the occipital condyles between sexes and various age groups.

MATERIALS AND METHOD

Selection of materials: All available Cranial CT scans of subjects done in the Radiology Department of the Usmanu Danfodiyo University Teaching Hospital

(UDUTH) Sokoto, from 2008 - 2012, which were reported as normal by a consultant Radiologist, with 3 years experience, were recruited for the study.

Inclusion Criteria: Computerized tomographic scan for the study were selected based on the following:

(a) Good positioning of the patient. With the Passage of the lowest tomographic section through a line 15-20 degrees to and 1cm above the cantho-meatal line which represents the base of the skull.

(b) Distinctly shown foramen magnum and occipital condyles with clear margins.

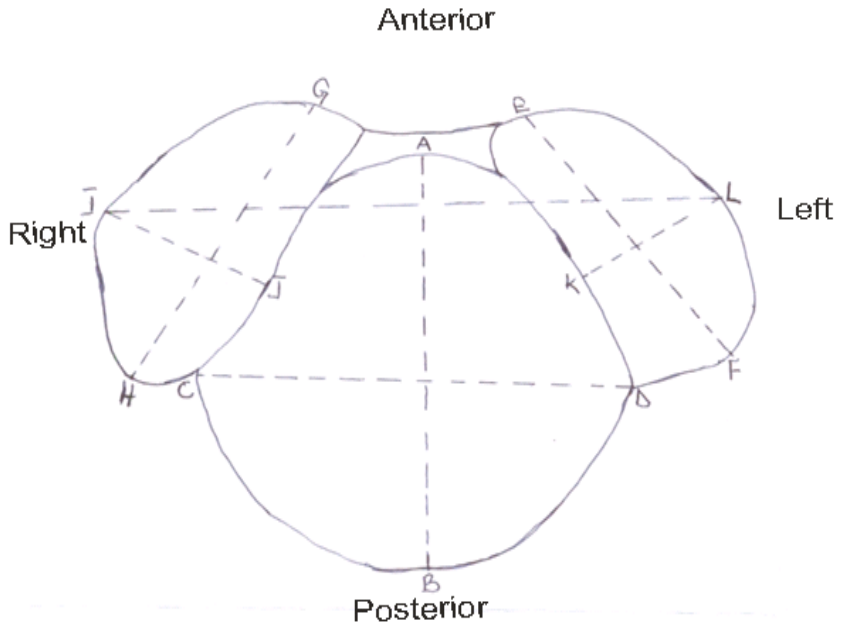
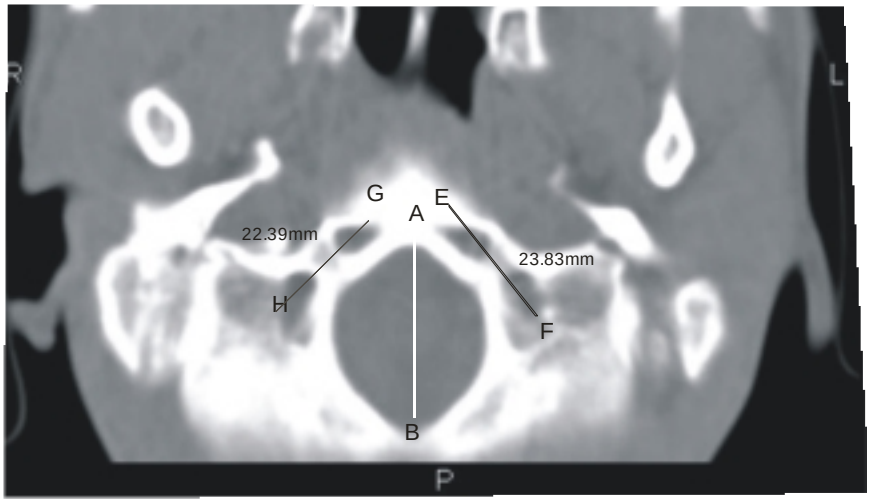


Fig 1: An Annotated Diagram of Foramen Magnum and Occipital Condyles Showing Landmarks of Measurement.

A = Summit of anterior border of the foramen magnum.
B = Summit of posterior border of the foramen magnum.
C = Point at which the lower part of right condyle meets the lateral boundary of foramen magnum.
D = Point at which the lower part of left condyle meets the lateral boundary of foramen magnum.
E = middle of the anterior border of the left condyle.
F = middle of the posterior border of the left condyle.
G = middle of the anterior border of the right condyle.
H = middle of the posterior border of the right condyle.
I = middle of the lateral border of the right condyle.
J = middle of the medial border of the right condyle.
K = middle of the medial border of the left condyle.
L = middle of the lateral border of the left condyle.

Statistical methods: Data was initially sorted out, tabulated and then entered into computer using Microsoft word and Microsoft Excel manually. Minitab 16.0 statistical package was used for data analysis. The mean lengths and widths of foramen magnum and occipital condyles were determined.

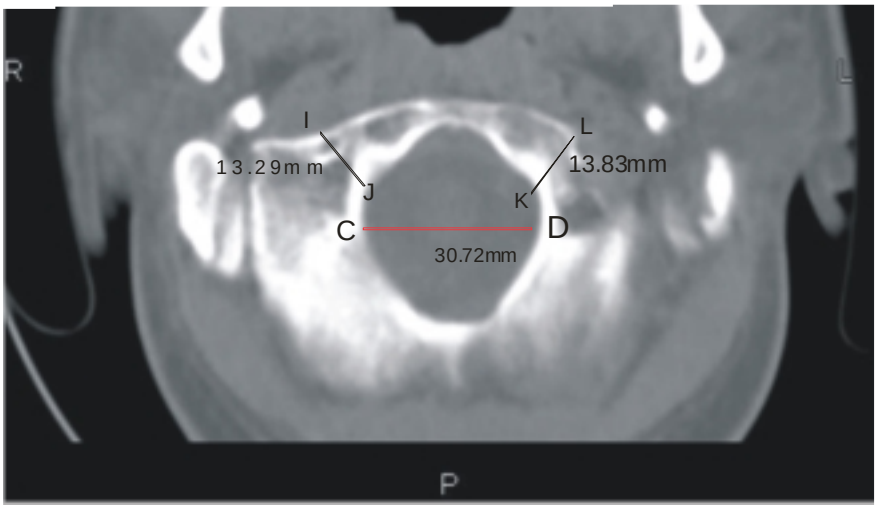
Anterior



R = Right L = Left P = Posterior

Figure 2: A CT Image of a 45-Year Old Female Showing Oval Shape Foramen Magnum and Measurement of the Length of the Foramen Magnum A-B= 39.17mm, Length of the Right Occipital Condyle E-F= 23.83mm and Length of the Left Occipital Condyle G-H= 22.39mm.

Anterior



R = Right L = Left P = Posterior

Figure 3: A CT Image of a 23-Year Old Male Showing Diamond Shape Foramen Magnum and Measurement of the Width of the Foramen Magnum C-D= 30.72mm, Width of the Right Occipital Condyle K-L= 13.83mm and Width of the Left Occipital Condyle I-J= 13.29mm

RESULTS AND DISCUSSION

Table 1 shows the mean and standard deviation of the foramen magnum diameters. A total of 240 subjects were involved in the study. Out of the number, 26.25% were females and 73.75% were males. The ratio of male to female was 2.8:1. The age range of the subjects used in this study was 20 to 79 years, and the mean age was 42.7years (table 1). The range of the right occipital condyle diameters were 15.8mm to 32.2mm for anterior posterior diameter and 9.0mm to 16.7mm for the width (table 1). The range of the left occipital condyle diameters were 16.7mm to 33.9mm for anterior posterior diameter and 7.6mm to 17.2mm for the width (table 1). The range of the bicondylar diameter was 38.2mm to 60.3mm (table 1). The mean anterior posterior diameter and width of the right occipital condyle were 23.5mm (±2.7) and 12.8mm (±1.7) respectively and for left occipital condyle were 23.7mm (±2.8) 12.7mm (±1.4) respectively, the mean bicondylar distance was 49.4mm (±3.8) (table 1).

Table 2 compares the mean and standard deviation of the occipital condyle diameters, for males and females used in the study. The mean anteroposterior diameters of the right occipital condyle in males was 23.7mm (±2.5) and in females the mean was 22.7mm (±2.9). The P Value =0.014601. This indicates that there was statistically significant difference between the sexes. The mean width of the right occipital condyle in males was 12.9mm (±1.6) and that of the females was 12.7mm (±1.7) and the P Value = 0.426. This indicates that there was no statistically significant difference between the sexes. The mean anteroposterior diameters of the left occipital condyle in males was 24.1mm (±1.7) and in females the mean was 22.7mm (±2.9) and the P Value = 0.0012. This indicates that there was statistically significant difference between the sexes. The mean width of the left occipital condyle in males was 12.8mm (±1.3) and that of the females was 12.4mm (±1.6) and the P Value = 0.126. This indicates that there was no statistically significant difference between the sexes. The mean bicondylar distance in males was 49.9mm (±3.4) and in females it was 47.6mm (±4.5) and the P Value = 0.00029. This indicates that there was statistically significant difference between the sexes.

Table 3 demonstrates the diameters of the occipital condyles in relation to age group of the subjects. The mean A-P diameters of the right occipital condyle across the groups were 23.2mm (±2.4) for age group 20-29 years, 23.9mm (±3.4) for 30-39 years, 23.4mm (±3.4) for 40-49 years, 23.9mm (±2.9) for 50-59 years, 23.5mm (±2.3) for 60-69 years and 22.5mm (±2.7) for age group 70-79 years. The mean width of the right occipital condyle across the groups were 12.6mm (±1.8) for age group 20-29 years, 12.8mm (±1.8) for 30-39 years, 12.8mm (±2.2) for 40-49 years, 12.8mm (±1.4) for 50-59 years, 13.4mm (±1.2) for 60-69 years and 12.8mm (±1.8) for age group 70-79 years.

The mean A-P diameters of the left occipital condyle across the groups were 23.6mm (±2.6) for age group 20-29 years, 24.0mm (±3.2) for 30-39 years, 23.8mm (±3.2) for 40-49 years, 23.8mm (±2.8) for 50-59 years, 23.9mm (±2.2) for 60-69 years and 23.0mm (±2.5) for age group 70-79 years. The mean width of the left occipital condyle across the groups were 12.5mm (±1.4) for age group 20-29 years, 12.6mm (±1.6) for 30-39 years, 12.4mm (±1.4) for 40-49 years, 12.9mm (±1.3) for 50-59 years, 12.8mm (±1.4) for 60-69 years and 13.1mm (±1.3) for age group 70-79 years. The mean bicondylar distance of the occipital condyles across the groups were 49.2mm (±3.9) for age group 20-29 years, 50.7mm (±4.0) for 30-39 years, 49.4mm (±3.1) for 40-49 years, 49.1mm (±4.0) for 50-59 years, 48.9mm (±3.4) for 60-69 years and 48.4mm (±4.5) for age group 70-79 years. The mean anteroposterior diameter and the width of the right occipital condyle in males were 23.7mm (±2.5) and 12.9mm (±1.6) respectively, while in females, the mean anteroposterior diameter and the width of the right occipital condyle were 22.7mm (±2.9) and 12.7mm (±1.7). This shows a larger value in males than in female subjects. The anteroposterior diameter for the right occipital condyle is statistically significant $p<0.05$ while that of the width is not significant statistically $p>0.05$.

The mean anteroposterior diameter and the width of the left occipital condyle in males were 24.1mm (±1.7) and 12.8mm (±1.3) respectively, while the mean anteroposterior diameter and the width of the left occipital condyle in females were 22.7mm (±2.9) and 12.4mm (±1.6). The anteroposterior diameter for the left occipital condyle is statistically significant $p<0.05$ while that of the width is not significant statistically $p>0.05$. The mean bicondylar distance in males was 49.9mm (±3.4) and in females it was 47.6mm (±4.5), which shows a larger value in males than in female subjects which is statistically significant $p<0.05$. This is in line with the study in which the values of the occipital condyle measurements from the study were bigger in males 46.8mm than in females 43.9mm8.

CONCLUSION

This study was designed to evaluate the occipital condyles in sex determination using computerize tomography scan, and to compare and contrast the respective measurements of the occipital condyles between sexes and various age groups. Cranial CT Scans were obtained from the local data base of the CT machine and back up compact disc from the CT library. This study reports that the dimensions of the occipital condyles are greater in Nigerian males than in their female counterparts and are statistically significant for width of the anteroposterior diameter of both condyles and bicondylar distance.

Table 1: Mean and Standard Deviation (±SD) of the Occipital Condyles Diameters for Subjects Used in the Study

Occipital Condyle Diameters	Age Range	Range of Mean (±SD) measurement	(mm)
Right occipital condyle A-P diameter n=240	20-79	15.8-32.2	23.5 (±2.7)
Right occipital condyle width (mm) n=240	20-79	9.0-16.7	12.8 (±1.7)
Left occipital condyle A-P diameter n=240	20-79	16.7-33.9	23.7 (±2.8)
Left occipital condyle width (mm) n=240	20-79	7.6-17.2	12.7 (±1.4)
Bicondylar distance n=240	20-79	38.2-60.3	49.4 (±3.8)

A-P = Anteroposterior

Source: Empirical Observation, 2013

Table 2: The Mean and Standard Deviation (±SD) of Occipital Condyles Diameters in Relation to Sex of the Subjects Used in the Study

Occipital condyle (OC) diameters	Mean(mm) (±SD) Males	Mean(mm) (±SD) Females	P Value
Anteroposterior diameter Right OC	23.7(±2.5)	22.7(±2.9)	*0.014601
right OC Width	12.9 (±1.6)	12.7(±1.7)	0.425596
Anteroposterior diameter Left OC	24.1 (±1.7)	22.7(±2.9)	*0.001203
Left OC Width	12.8 (±1.3)	12.4(±1.6)	0.126091
Bicondylar distance	49.9(±3.4)	47.6(±4.5)	*0.00029

*statistically significant at P Value > 0.05

Source: Empirical Observation, 2013

Table 3: Mean and Standard Deviation of the Occipital Condyle Diameters in Relation to Age Group of Subjects Used in the Study

Age	Number of subject in the age group (mm)±1SD	A-P diameter of the right occipital condyle (mm)±1SD	Width of the right occipital condyle (mm)±1SD	A-P diameter of the left occipital condyle (mm)±1SD	Width of the left occipital condyle	Bicondylar distance (mm)±1SD
20-29	70	23.2(±2.4)	12.6(±1.8)	23.6(±2.6)	12.5(±1.4)	49.2(±3.9)
30-39	41	23.9(±3.4)	12.8(±1.8)	24.0(±3.2)	12.6(±1.6)	50.7(±4.0)
40-49	35	23.4(±3.4)	12.8(±2.2)	23.8(±3.2)	12.4(±1.4)	49.4(±3.1)
50-59	42	23.9(±2.9)	12.8(±1.4)	23.8(±2.8)	12.9(±1.3)	49.1(±4.0)
60-69	31	23.5(±2.3)	13.4(±1.2)	23.9(±2.2)	12.8(±1.4)	48.9(±3.4)
70-79	21	22.5(±2.7)	12.8(±1.8)	23.0(±2.5)	13.1(±1.3)	48.4(±4.5)

Source: Empirical Observation, 2013

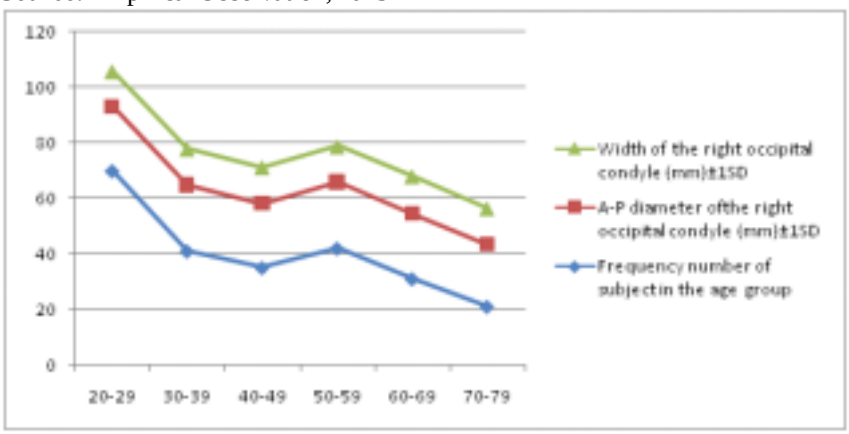


Figure 4: Graphical Representation of the Mean Length and Width of the Right Occipital Condyle in Relation to Age Group and Frequency of Subjects Used in the Study.

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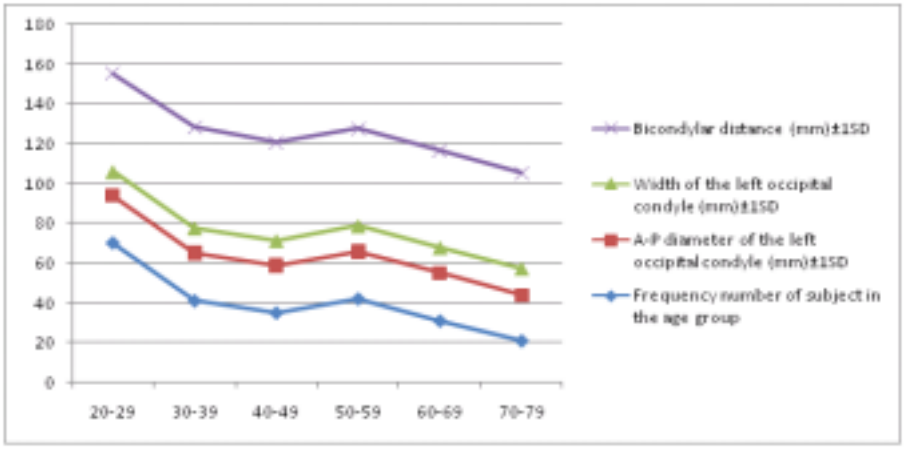

Figure 5: Graphical Representation of the Mean Length and Width of the Left Occipital Condyle and Bicondylar Distance in Relation to Age Group and Frequency of Subjects Used in the Study.

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