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MORPHOLOGY AND MORPHOMETRY OF DRY ADULT ACETABULA IN NIGERIA

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RESUMEN

Objetivos: El presente estudio se llevó a cabo para medir la profundidad del acetábulo y el diámetro, para determinar la forma de la cresta acetabular anterior y para averiguar la relación entre la profundidad y diámetro que será útil en la preparación de tamaños adecuados de prótesis para los Nigerianos. Material y Método: Se utilizaron 100 secos huesos de la cadera adulto de género desconocido, pero los lados conocidos. Un pie de rey y gobernante se utilizaron para la medición. Se observaron las formas de la cresta acetabular anterior, y el transversal y diámetros superoinferior del acetábulo se midieron usando calibradores vernier. Los datos fueron registrados y analizados mediante el paquete estadístico SPSS. Resultado: El resultado mostró que había cuatro formas principales que son: curvas (35%), angulares (33%), recto (23%) e irregular (9%). El diámetro total del lado derecho fue ligeramente inferior a la izquierda. Hubo una relación positiva significativa entre la profundidad y la transversal, superoinferior y diámetros totales (p <0,05). Conclusión: Estas relaciones deben ser tenidos en cuenta en la prestación de prótesis para los nigerianos, durante la artroplastia de cadera, el tratamiento de las fracturas de las articulaciones de la cadera y en el diagnóstico de la displasia congénita de cadera.

Palabras clave: *Acetábulo, prótesis, displasia congénita de la cadera, diámetro acetabular, profundidad acetabular*

ABSTRACT

Objectives: The present study was undertaken to measure the acetabular depth and diameter, to determine the shape of the anterior acetabular ridge and to find out the relationship between the depth and diameter which will be useful in preparing suitable sizes of prosthesis for Nigerians. Materials and Method: 100 dry adult hip bones of unknown gender but known sides were used. A vernier caliper and ruler were used for the measurement. The shapes of the anterior acetabular ridge were noted, and the transverse and superoinferior diameters of the acetabulum were measured using vernier calipers. The data were recorded and analyzed using SPSS. Result: The result showed that there were four major shapes which are: curved (35%), angular (33%), straight (23%) and irregular (9%). The total diameter on the right side was slightly less than the left. There was a significant positive relationship between the depth and the transverse, superoinferior and total diameters ($p < 0.05$). Conclusion: These relationships should be borne in mind when providing prostheses for Nigerians, during hip arthroplasty, treatment of hip joint fractures and in diagnosing congenital hip dysplasia.

Keywords: *Acetabulum, prothesis, congenital hip dysplasia, acetabular diameter, acetabular depth.*

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INTRODUCTION

The acetabulum is a cup-like depression in the lateral surface of the hip bone, which articulates with the head of the femur (Moore et al, 2010). The articulation forms the hip joint, one of the major weight-bearing joints of the body. The acetabulum is formed by the fusion of the three components of the hip bone: ilium, ischium and pubis (Sinnatamby, 2006). The anthropometric study of the acetabulum may be helpful to the radiologist in diagnosing congenital hip dysplasia, and to the orthopaedic surgeons in planning before acetabular surgery, during hip arthroplasty, and treatment of hip joint fractures. This study would also be vital in understanding the pathophysiology of the hip joint (for example, femoroacetabular impingement) and preparing prostheses of desirable sizes of which are more functional to prevent complications like prosthetic loosening or dislocation (Tannast et al, 2007).

Chauhan et al (2002) conducted a study on 54 cadaveric hip bones in North India with the aim of determining the average diameter of the femoral head and the average diameter and depth of the acetabulum. Aksu et al (2006) determined the relationship between the acetabular depth and diameter on 154 os coxae in Turkey, and also described the anterior acetabular ridge morphology for use in diagnosing congenital acetabular dysplasia and during acetabular surgery. A study was also conducted in Serbia to determine sexual dimorphism of postural parameters of the human acetabulum (Jeremić et al, 2011). There has been no documented study on the anthropometry of the acetabulum in the South-Eastern part of Nigeria, hence this study.

MATERIALS AND METHOD

The study was conducted on 100 dry adult hip bones of unknown gender and age collected from Anatomy museums in the South-Eastern part of Nigeria. The bones were dry, without gross damage or congenital anomalies. The acetabular diameter (transverse and superoinferior) and depth were measured using a vernier caliper (Mitsutoyo, Japan; accuracy: 0.01mm), and the shape of the anterior acetabular ridge was noted. The relationship between the acetabular depth and diameter was also evaluated.

- The transverse diameter of the acetabulum was defined as the maximum distance between the anterior and posterior ends of the acetabular cavity while the superoinferior diameter was defined as the maximum distance between the upper and lower margins of the acetabular cavity.
- The total diameter was defined as the average of the transverse and superoinferior diameter.
- The depth of the acetabulum was defined as the maximum vertical distance from the deepest point in the acetabular cavity to the brim of the acetabulum. A thin plastic ruler was placed across the diameter of the acetabular cavity and then depth of the acetabulum was measured on the vernier calliper from the deepest point in the acetabulum to the plastic ruler.
- The shape of the anterior acetabular ridge was classified as curved, angular, straight and irregular.

The data was summarized with SPSS 16.0 using descriptive statistics of mean, standard deviation and frequency, and analysed using Pearson's Correlation Test. Level of significance was set at $p < 0.05$.

Parameters (cm)	Range		Mean±SD		t-value
	Right (n=44)	Left (n=56)	Right (n=44)	Left (n=56)	
Transverse Diameter	4.65-6.06	4.69-6.01	5.39±0.35	5.32±0.33	0.300
Superoinferior Diameter	4.75-6.29	4.83-6.25	5.58±0.37	5.46±0.30	0.064
Total Diameter	4.75-6.11	4.78-6.04	5.48±0.35	5.39±0.30	0.135
Depth	2.21-3.54	2.17-3.57	2.97±0.31	3.02±0.31	0.438

Table 1: Range, mean and standard deviation of the acetabular dimensions

RESULTS

The results are shown in Tables 1, 2 and 3.

Shape	Frequency
Angular	33
Curved	35
Irregular	9
Straight	23
Total	100

Table 2: Frequency of anterior acetabular ridge shapes

DISCUSSION

Knowledge of the morphology of the acetabulum is critical for successful hip arthroplasty and provision of suitable prostheses. The range, mean and standard deviation of the acetabular dimensions of both sides are shown in Table 1. Comparative analysis showed that even though the diameters of the acetabulum were larger on the right side, it was not statistically significant ($p>0.05$). The superoinferior diameter was insignificantly greater than the transverse diameter. The values of the average total diameter are almost similar to the value of Aksu et al (2006). However, they are much greater than the findings of Chauhan et al (2002), Gaurang et al (2010), and Vyas et al (2013). Ethnic differences may be implicated in this disparity between the present result and other foreign studies.

Correlation	Coefficient	Sig
Depth vs Transverse Diameter	0.253	0.011
Depth vs Total Diameter	0.266	0.008
Depth vs Superoinferior Diameter	0.260	0.009

Table 3: Correlation between depth and diameter of the acetabulum

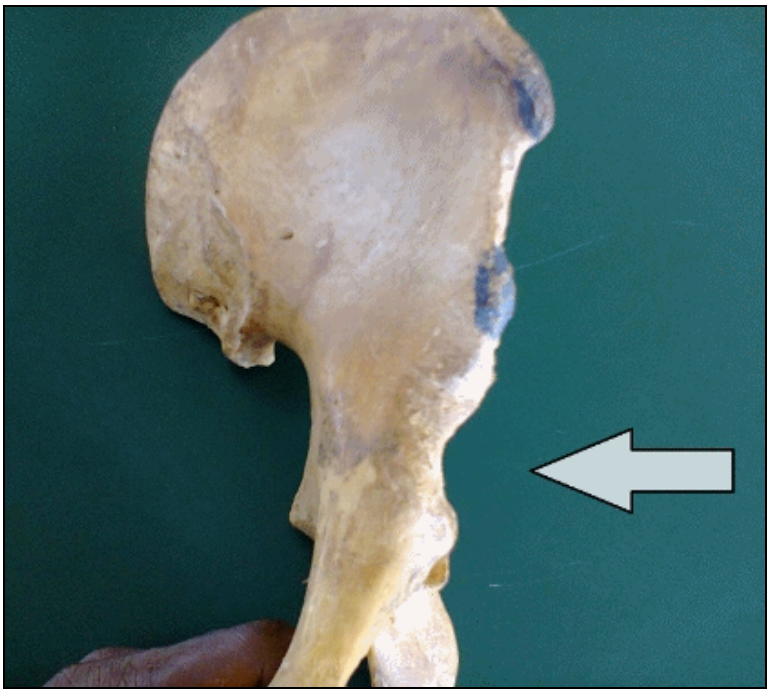

Figure 1: Curved shape of anterior acetabular ridge

For the average depth of the acetabulum, the result is comparable to studies by Aksu et al (2006) and greater than the findings of Chauhan et al (2002) and Vyas et al (2013).
In a study done by Vandenbussche et al (2008) who used computed tomography (CT) scans taken from 50 men and 50 women, it was noted that acetabular diameter was related to gender. Jeremic et al (2011) also reported in his study from radiographs of 370 patients that acetabular depth and diameter significantly differed with gender. However, in the present study which was carried out on dry hip bones of unknown gender, sexual dimorphism is beyond the scope of the present study.
In the present study, the anterior acetabular ridge shapes recorded (Table 2) were compared to those of other researchers. The shape with the highest frequency was the curved shape (Figure 1) with 35%. These findings were similar to results by Vyas et al (2013) whose frequency was 37.5%, but were smaller than the findings of Aksu et al (2006) and Govsa et al (2005). Maruyama et al (2001) reported a frequency of 61%, while Gaurang et al (2010) reported 60.5%. The disparity could also be mainly attributed to racial differences.
The next common shape was the angular shape (Figure 2) with 33%, greater than results by Maruyama et al (2001) who reported 25.5% and Govsa et al (2005) who documented 28.33%. It is important to note that that the curved and the angular shapes had almost the same frequency of occurrence in the present study.

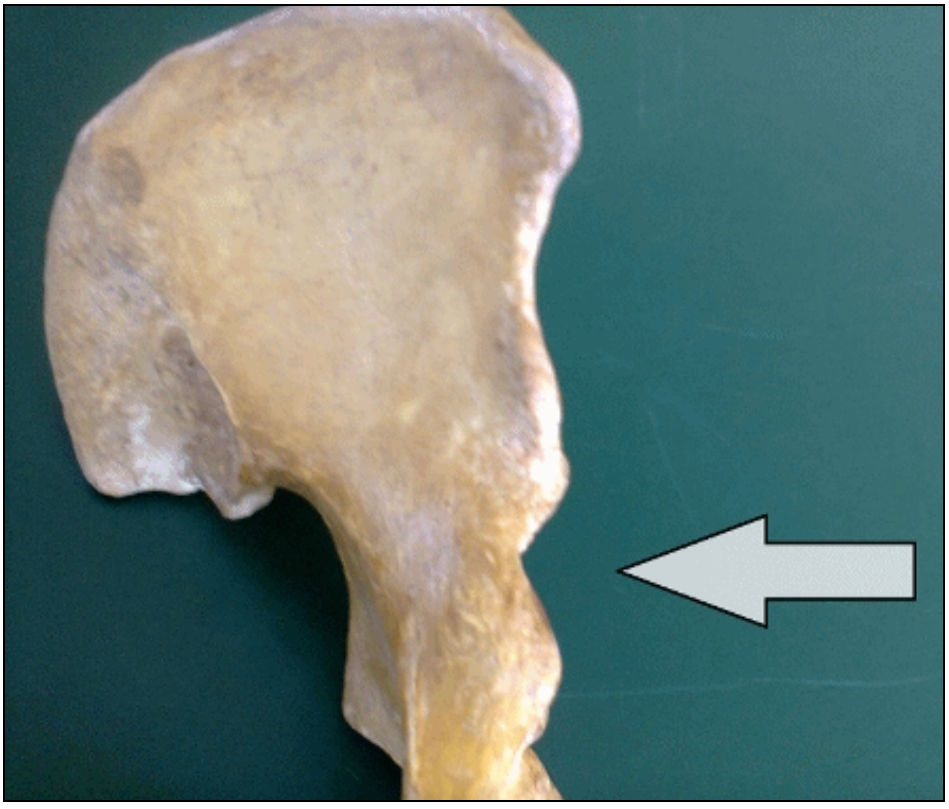

Figure 2: Angular shape of anterior acetabular ridge.

The straight shape (Figure 3) of the anterior acetabular ridge was found to be 23%. This percentage is quite similar to the 23.3% reported by Aksu et al (2006), less than that for Vyas et al (2013) but greater than studies by Gaurang et al (2005), Govsa et al (2005) and Maruyama et al (2006). Once again, as in the total diameter, the Nigerian and Turkish population studies bear similarity in frequency of the straight shape.
The irregular shape (Figure 3) has the least incidence amongst all the acetabular ridge shape with a percentage of 9%. This percentage is similar to the 9.5% documented by Maruyama et al (2001), but smaller than those of Aksu et al

(2006) and Vyas et al (2013) who reported 13.6% and 18.4% respectively.

In Table 3, the present study showed a positive and significant relationship between acetabular diameter and depth ($p<0.05$), just as reported by Aksu et al (2006). Here, total diameter had the highest correlation ($r=0.266$).

The importance of the knowledge of acetabular dimensions, which vary between populations, cannot be over-emphasized. The present study showed that the curved shape was the most prevalent acetabular ridge shape, followed by the angular shape. This study will prove useful to the forensic anthropologists, radiologists, prosthetists, in having a better knowledge about the pathology and physiology of the hip especially during hip arthroplasty, diagnosing of congenital hip dysplasia, in the treatment of hip joint fracture and in providing suitable prosthetics for Nigerians.

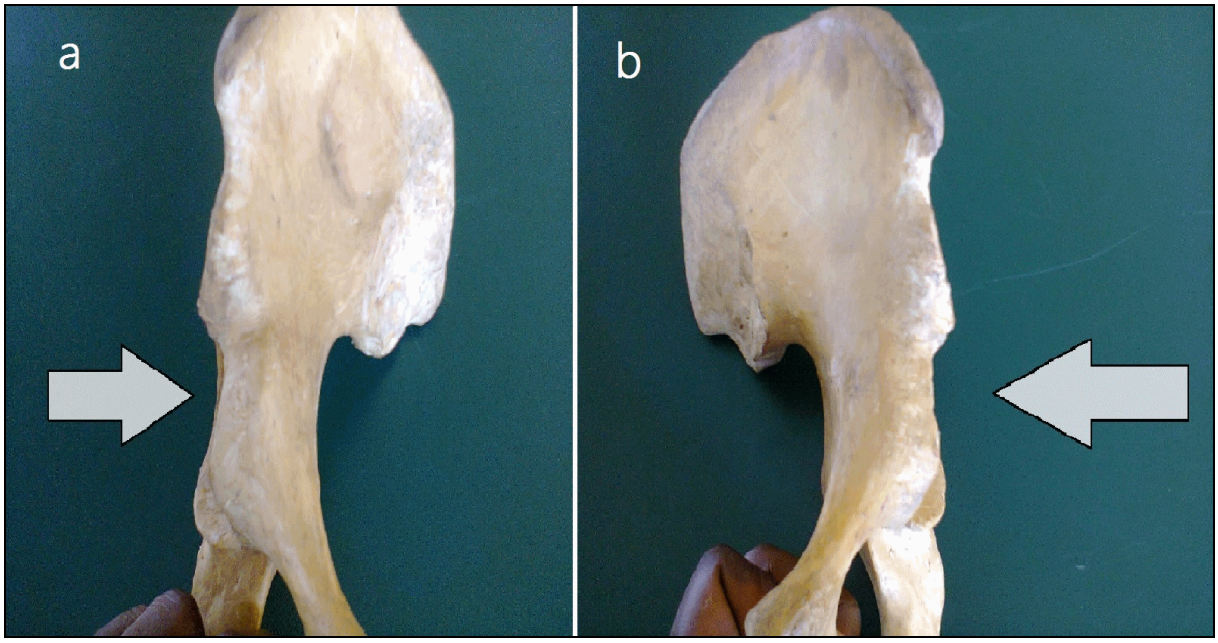

Figure 1: a. Irregular shape of anterior acetabular ridge, **b.** Straight shape of anterior acetabular ridge

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