

Morphometric Study of Acetabulum in Adult Dry Human Pelvic Bone

Ilankathir Sridharan¹, Sudagar Muthusamy², Rajan Thangarasu³, Sridhar Krishnamoorthy⁴, Sowmiya Ganesan⁵

Abstract

Background: Acetabulum together with the head of the femur forms the hip joint. Major defect involving the joint space needs to be reconstructed. Variations in acetabular dimensions remain a challenge for the surgeons during arthroplasty. Adequate knowledge about the various morphometric parameters of the acetabulum may assist them to deliver the best results by preferring prosthesis with appropriate dimensions. **Aim of the Study:** To study the morphometric measurements of Acetabulum from the adult dry human pelvic bone. **Materials and Methods:** The present study was carried out in the Department of Anatomy, Aarupadai Veedu Medical College and Hospital, Puducherry, Vinayaka Missions Research Foundation. The study sample consisted of 120 Human dry pelvic bones consisting of 60 right and 60 left sides. Classification of the bones regarding gender was not carried out. All the bones without any defect to the acetabulum were preferred for this study. **Results:** Mean diameter of the acetabulum was 50.43 ± 3.88 mm on the right side and 50.28 ± 3.85 mm on the left side. Mean depth of acetabulum was 24.34 ± 2.53 mm on the right side and 24.35 ± 2.54 mm on the left side. The mean width of the acetabular notch on the right side was 24.48 ± 1.89 mm and 24.29 ± 1.86 mm on the left. The mean diameter of the acetabulum on the right side is greater than the left. The mean depth on the right and on the left shows the only meager difference. The mean notch width on the left side is comparatively less than that on the right side. **Conclusion:** Morphometric values of the acetabulum compared on both sides provides adequate knowledge for the orthopedic surgeons to determine the appropriate size of the prosthesis during hip arthroplasty. Further studies involving gender may provide additional information to validate their surgical procedures.

Keywords: Morphometric measurements; Acetabulum; Reconstruction.

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Introduction

The hip joint, a three-dimensional ball and socket type of synovial joint usually formed by the

articulation of acetabulum (socket) of the hip bone and the head of the femur (ball). The acetabulum of the hip bone lies bilaterally and tries to occupy the lateral aspect of the hip bone very much close to the center, facing downwards, forwards and laterally. The three innominate bones of the hip bone namely the ilium, ischium, and pubis contribute unequally to form the acetabulum.¹ The limbus of the acetabulum presents with irregular projections all around except inferiorly to form the acetabular notch. The earlier also provides attachment to fibrocartilaginous acetabular labrum to deepen the cavity. Though the acetabulum is deepened but fails to enclose the femoral head completely making it an incongruous type of joint. The cavity of acetabulum includes two areas² – articular (Lunate surface) and non-articular (Acetabular fossa).

Author's Affiliation: ¹Associate Professor, ^{2,4,5}Assistant Professor, ³Professor, Department of Anatomy, Aarupadai Veedu Medical College and Hospital, Kirumampakkam, Puducherry 607402, India.

Corresponding Author: Sudagar Muthusamy, Assistant Professor, Department of Anatomy, Aarupadai Veedu Medical College and Hospital, Kirumampakkam, Puducherry 607402, India.

E-mail: anat9799@gmail.com

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Acetabular morphometric parameters like depth of the cavity, diameter and acetabular notch width in addition to various morphological parameters like an anterior acetabular ridge, end of the lunate surface along with the head of the femur determine the stability of the joint. Any cause affecting any one or multiple parameters will lead to deterioration in the stability, leading to conditions like acetabular dysplasia, pincer femoroacetabular impingement and osteoarthritis, and even fractures. Earlier interventions like periacetabular osteotomy, acetabular recontouring are required to overcome these clinical conditions.^{3,4} Recent advances like prosthetic replacement of acetabulum have carried the expected outcome to the next level. But surgical errors like malpositioned acetabular component in partial/total hip arthroplasty may lead to dysplasia,⁵ restricting the available range of movement, and even osteolysis. To overcome these surgical errors, appropriate selection of acetabular prosthesis size and proper positioning is a must. Though both morphology and morphometry of acetabulum carry equal importance in the selection of prosthesis, controversies still exist with surgical procedures. As a supportive measure, various dimensions that determine the prosthesis size of acetabulum like the diameter of the acetabulum, its depth and width of the acetabular notch were preferred for this study and to determine whether there exist any differences in anatomical parameters with respect to change inside.

Materials and Methods

The present study was carried out in the Department of Anatomy, Aarupadai Veedu Medical College and Hospital, Puducherry, Vinayaka Missions Research Foundation. The study sample consisted of 120 Human dry hip bones consisting of 60 right and 60 left sides. Specimens which retained its morphological features and in good condition after dissection from cadaver were only used for this study. Specimens with osteoarthritis of the hip, evidence of trauma or any other skeletal disorders were excluded. Gender classification of the samples was not carried out. Morphometric parameters like the diameter of the acetabulum, its depth, and width of the acetabular notch were evaluated.

The diameter of Acetabulum

The diameter of the acetabulum is measured using the following reference points:

Reference point 1: junction where anterior iliac margin meets the periphery of the acetabulum.

Reference point 2: a point on the periphery of the acetabulum nearest to the ischial tuberosity.

Inter distance between these references corresponds to the diameter of the acetabulum (Fig. 1).



Fig. 1: Shows the measurement of the diameter of the acetabulum.

Depth of Acetabulum

A metal scale was placed across the diameter of the acetabulum representing the horizontal plane and stem of the vernier scale was later placed from the deepest point of the acetabular cavity. The vertical distance between their intersections determines the depth of the acetabulum (Fig. 2).



Fig. 2: Shows the measurement of depth of the acetabulum.

Width of Acetabular notch

The width of the acetabular notch was determined by the Inter distance between the ends of the lunate surface of the acetabulum (Fig. 3).

All the dimensions were recorded in millimeters and were analysis was carried out comparing the dimensions bilaterally and between genders.

The data obtained were processed using Microsoft Excel software – version 2007. Statistical analysis was carried out using Student's t-test and Pearson correlation test.

Statistical Analysis

The data obtained for depth was tabulated and analyzed statistically to find Mean, Standard deviation (SD) and Range in both the sexes and both the sides. The results were analyzed statistically, by unpaired Student's 't' test. *p*-value of <0.05 was considered for Statistical significance. Statistical analysis was done using SPSS (Statistical Package for the Social Sciences) version 19 and Microsoft Excel 2007.

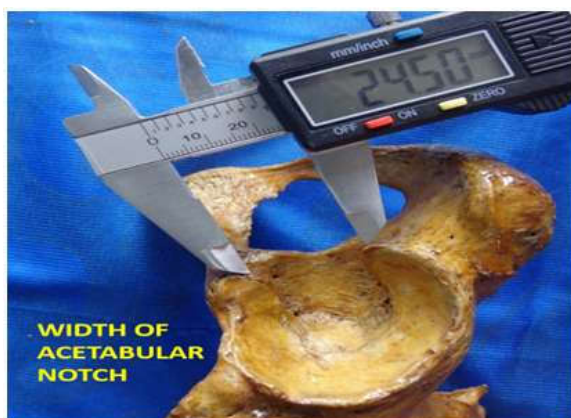


Fig. 3: Shows the measurement of the width of the acetabular notch.

Results and Discussion

This study would be helpful for the surgeons to determine the appropriate dimension for the acetabular prosthesis during total/hemiarthroplasty. In the present study, the mean diameter of the acetabulum on the right side is

50.43 mm and on the left side, it is 50.28 mm. The mean depth on the right is found to be 24.34 mm and on the left, it is 24.35 mm. The mean width of the acetabular notch on the right side is 24.48 mm, whereas on the left it is 24.29 mm, except the depth all the other parameters showed higher values on the right compared to the left. The value when compared with that of Gursharan Singh Dhindsa,⁶ the diameter on the right side 5.13 cm is slightly higher but on the left side 5.03 cm, coincides with his study. The values of the depth on both right and left are comparatively less than his values which are 2.67 cm and 2.64 cm. The values of the diameter and depth were comparatively less than that of Lander *et al.*,⁷ where diameter found to be 5.70 cm on the right, 5.60 cm on the left and the depth found to be 2.75 cm and 2.82 cm respectively. Values of the diameter of this present study were found to be greater when compared with that of Chauhan *et al.*,⁸ which is 4.71 cm and 4.75 cm respectively, but the values of the depth being 2.47 cm on right and 2.57 cm on left coincides with our present study. Similarly, the values meet the findings of Kareddy Pratibha *et al.*,⁹ the diameter being 4.85 cm, 4.74 cm, and depth 3.0 cm, 3.06 cm respectively. The mean depth on the right is 26.24 mm and 26.11 mm on the left which is greater than that of reported by Khobragade L *et al.*¹⁰ The values of the diameter and the depth were comparatively less than that of the report by Funda Tastekin where the average diameter is 54.29 ± 3.8 mm and the depth being 29.49 ± 4.2 mm but greater than that of Gaurang parmara *et al.*,¹¹ average diameter being 42.54 ± 3.6 mm and average depth being 19.07 ± 2.47 mm. The value of the mean notch width is comparatively greater than

Table. 1: Morphometric Parameter in Dry Acetabulum (N=120)

Sr. No	Morphometric Parameters	Side	Number	Mean (mm)	SD	t-value	p-value
1.	Diameter of Acetabulum	Right	60	50.43	3.88	0.148	0.883
		Left	60	50.28	3.85	0.309	0.760
2.	Depth of Acetabulum	Right	60	24.34	2.53	2.585	0.015
		Left	60	24.35	2.54	2.299	0.029
3.	Width of Acetabular Notch	Right	60	24.48	1.89	0.148	0.883
		Left	60	24.29	1.86	0.030	0.977

that of Gangavarapu Sreedevi *et al.*,¹² reported on the right to be 22.25 mm and on the left to be 22.52 mm, but comparatively less than that of Yugesh *et al.*¹³ were it is 30.8 ± 0.42 mm and 31.1 ± 0.72 mm respectively.¹³

Conclusion

Mean diameter of the acetabulum was 50.43 ± 3.88 mm on the right side and 50.28 ± 3.85 mm on the left side. Mean depth of acetabulum was 24.34 ± 2.53 mm on the right side and 24.35 ± 2.54 mm on the

left side. The mean width of the acetabular notch on the right side was 24.48 ± 1.89 mm and 24.29 ± 1.86 mm on the left. Adequate knowledge about the morphometric parameters of the acetabulum is required for any reconstructive procedures of the hip joint resulting from mechanical damage to the structures concerned. The reports of this study provide only the data with reference to varying insides. Further studies involving the difference in gender may help the surgeons to gain more detailed knowledge and other researchers to compare with their studies.

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