

## AN ANATOMICAL STUDY OF DIMENSIONS OF ACETABULUM IN AN EASTERN INDIAN POPULATION

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### ABSTRACT

**Aim:** To measure various dimensions of acetabulum of hip bones.

**Materials and Methods:** The study included fifty four dried hip bones ( 27 right and 27 left) of unknown age and sex. The depth, diameter and volume of acetabulum were measured by suitable methods.

**Results:** The depth of acetabulum was found to be  $2.15 \pm 0.33$  cm and  $1.98 \pm 0.2$  cm on the right and left side respectively. The diameter of acetabulum was found to be  $4.53 \pm 0.37$  cm on the right side and  $4.41 \pm 0.39$  cm on the left side. The volume was determined to be  $36.3 \pm 9.84$  ml on the right side and  $30.12 \pm 7.05$  ml on the left side.

**Conclusion:** The findings of the study will be helpful for orthopaedicians, prosthetists, forensic scientists and anthropologists.

**KEY WORDS:** Acetabulum, hip joint, dimensions, prosthesis, arthroplasty.

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### INTRODUCTION

The acetabulum ( cotyloid cavity ) is a hemispherical cavity in hip bone. It's surrounded by an irregular margin deficient inferiorly called the acetabular notch. The articular part of acetabulum is called lunate surface while the nonarticular part is called the acetabular fossa. The acetabulum is contributed one fifth each by pubis and ilium and two fifths by ischium. Initially the three parts are separated by the triradiate cartilage which gets ossified at 12-14 years of age [1].

The head of femur articulates with the acetabulum to form the hip joint, a ball and socket variety of synovial joint. The hip joint is one of the principal weight bearing joints of the body. The

dimensions of acetabulum or the so called socket of the hip joint are highly sought after for manufacturing prosthesis used in hip replacement surgeries.

Morphometry of acetabulum can help to understand the mechanics and stability of hip joint. An incongruous joint is more likely to develop osteoarthritis compared to a more congruent one [2]. A bigger articular surface of acetabulum means a good grip of the head of femur inside the acetabulum and ensures better results for arthroplasty [3]. In the conversing case, the grasp of acetabulum for the head of femur will be weaker resulting in a comparatively unstable hip joint [4].

The various dimensions of acetabulum ( depth,

diameter and volume ) will be enormously helpful in performing surgical procedures such as acetabular reconstruction and planning reorientation procedures using spikes and screws for fixation. So the present study was conducted to find out the dimensions of the acetabular cavity as not much work has been done in this field in Indian population.

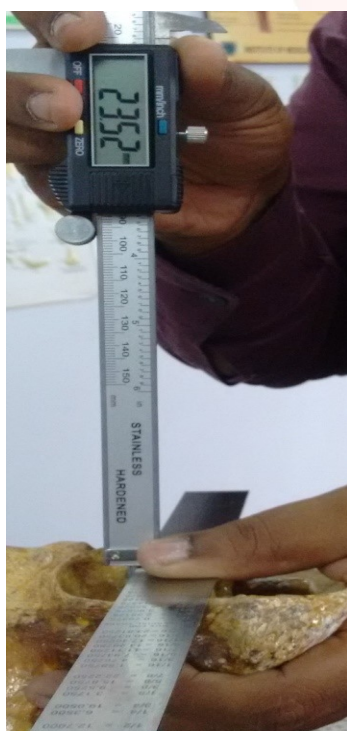
## MATERIALS AND METHODS

The study included fifty four unpaired and dried hip bones ( 27 right and 27 left ) available in the Departmental Museum of Anatomy of a Medical College of Bhubaneswar. The bones were of unknown age and sex. Broken, deformed bones and bones with osteoarthritic changes were excluded from the study.

The depth and diameter of acetabulum were measured with a digital Vernier caliper while for measuring the volume plasticine clay and a graduated measuring cylinder were used.

The depth of acetabulum was taken as the maximum vertical distance from the brim of the acetabulum to the deepest point of the acetabular cavity. A thin metallic strip was placed across the brim of the acetabular cavity and then the distance from the metallic strip to the deepest point in the acetabulum was measured by a digital Vernier caliper (Figure-1).

**Fig. 1:** Photograph showing measurement of depth of acetabulum with digital Vernier caliper.



The diameter of acetabulum was measured as the maximum transverse width across the margin of the acetabular cavity by a digital Vernier caliper (Figure-2).

To measure the capacity or volume of the acetabulum, the acetabular cavity was filled with plasticine clay upto the brim (Figure-3). The plasticine was then brought out of the acetabulum and put in a water filled graduated measuring cylinder (Figure-4). The volume of water displaced yielded the capacity or volume of acetabulum.

All the parameters were measured twice to eliminate observer bias. The data was tabulated and analysed using Microsoft Excel Software. Arithmetic mean and standard deviation were derived for each parameter.

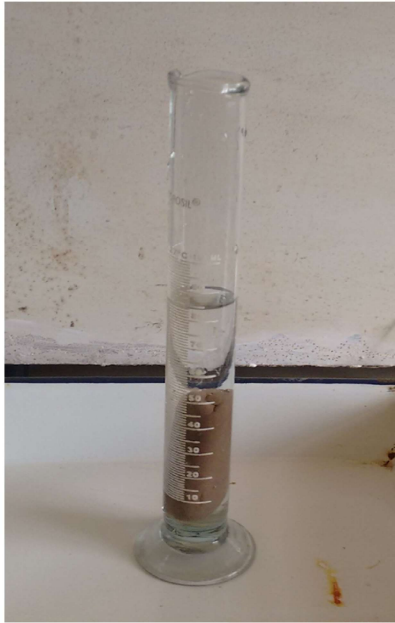
**Fig. 2:** Photograph showing measurement of diameter of acetabulum with digital Vernier caliper.



**Fig. 3:** Photograph showing acetabular cavity filled with plasticine clay upto its brim.



**Fig. 4:** Photograph showing measurement of volume of acetabulum by putting the plasticine cast in a water filled graduated cylinder.



## RESULTS

The results of the study are depicted in Table 1 ( Depth of acetabulum ), Table 2 ( Diameter of acetabulum ) and Table 3 ( Volume of acetabulum ).

**Table 1:** Depth of Acetabulum.

Side	Mean	Standard deviation
Right side	2.15 cm	0.33 cm
Left side	1.98 cm	0.2 cm
Both sides	2.07 cm	0.28 cm

**Table 2:** Diameter of Acetabulum.

Side	Mean	Standard deviation
Right side	4.53 cm	0.37 cm
Left side	4.41 cm	0.39 cm
Both sides	4.47 cm	0.37 cm

**Table 3:** Volume of Acetabulum.

Side	Mean	Standard deviation
Right side	36.3 ml	9.84 ml
Left side	30.12 ml	7.05 ml
Both sides	33.57 ml	8.93 ml

## DISCUSSION

The present study has established the depth of the acetabulum as  $2.15 \pm 0.33$  cm on the right side and  $1.98 \pm 0.2$  cm on the left side. Combining both the sides, the depth has been established as  $2.07 \pm 0.28$  cm. Mukhopadhyay and Barooah [5] have reported mean values of 2.47 cm on the right side and 2.45 cm on the

left side. Luna et al [6] have reported a mean depth of 2.58 cm. Salamon et al [7] have reported mean depth of 3 cm. Chauhan et al [8] have reported mean values 2.75 cm ( right side ) ; 2.82 cm ( left side ) in males and 2.47 cm ( right side ) ; 2.57 cm ( left side ) in females. The diameter of acetabulum was found to be  $4.53 \pm 0.37$  cm on the right side and  $4.41 \pm 0.39$  cm on the left side. Combining both the sides the diameter was found to be  $4.47 \pm 0.37$  cm. Mukhopadhyay and Barooah [5] have found mean diameter of 4.57 cm on the right side and 4.59 cm on the left side. Luna et al [6] have established mean diameter as 4.95 cm. Chauhan et al [8] have established mean diameter as 4.71 cm ( right side ) ; 4.75 cm ( left side ) in males and 4.44 cm ( right side ) ; 4.6 cm ( left side ) in females. Salamon et al [7] have reported mean diameter of 5.16 cm. Derry [9] has found mean diameter as 5.2 cm in males and 4.68 cm in females. Rosenberg [10] has reported mean diameter as 4.72 cm. Genser- Strobl and Sora [11] have reported a mean diameter of 4.89 cm. Wu et al [12] have found mean diameter as 5.53 cm in males and 4.96 cm in females.

The volume of acetabulum in the current study was found as  $33.57 \pm 8.93$  ml. Taher [4] has reported volume of acetabulum as 28 ml in males and 21.5 ml in females.

In the current study, all the parameters showed a higher value for the right side as compared to the left side. The most striking difference was found for the volume of acetabulum. It may be due to the use of unpaired hip bones in the current study. The right and left side hip bones did not essentially belong to the same skeleton. Ideally the bones of opposite sides should have belonged to the same skeleton.

The difference between values of the current study and other authors can be attributed to ethnic and racial variations.

The present study has also observed that the volume of acetabulum is directly proportional to the diameter of acetabulum. Higher volumes of acetabulum were observed for higher diameters.

## CONCLUSION

The findings of the present study will aid orthopaedicians for geometric modelling and



proper development of prosthetic implants. The study will help forensic scientists in identification and determination of sex from skeletal remains. It will also be useful for anthropologists in racial studies.

**Conflicts of Interests: None**

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