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ORIGINAL RESEARCH

Anatomical & morphometric study of acetabulum in adult dry human pelvic bone

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ABSTRACT

Background: The acetabulum is a cup‑shaped cavity present on the lateral side of the hip bone. Morphometry of acetabular fossa serves as a baseline data for construction of prostheses of acetabulum in clinical practice. Present study was aimed to study Morphometric characteristics of acetabulum in adult dry human pelvic bone.

Material and Methods: Present study was descriptive, observational study, conducted in human adult dry hip bones of unknown age and sex.

Results: In present study, 96 undamaged acetabulum of adult dry human hip bone of unknown age and gender were studied. Mean diameter of acetabulum in left side was 48.12 ± 8.81 mm & right side was 44.71 ± 8.97 mm, difference was not significant statistically. Mean depth of acetabulum in left side was 26.62 ± 3.28 mm & in right side was 23.98 ± 3.19 mm, difference was not significant statistically. Width of acetabular notch in left side was 32.51 ± 3.92 mm & right side was 34.89 ± 3.35 mm, difference was not significant statistically. Anterior acetabular ridge was curved (45.83 %) in majority of cases, followed by straight (30.21 %), angular (19.79 %) and irregular (4.17 %). Hip bones showed pointed anterior end and lunate posterior end (73.96 %) in majority cases, while others were anterior and posterior ends of labrum are lunate shaped (18.75 %) & both anterior and posterior ends of labrum were pointed (7.29 %).

Conclusion: Morphometric studies of hip bone are of importance not only to anatomist and anthropologists, but is of great value to osteologists, forensic medicine experts and orthopedicians.

Keywords: Morphological parameters, acetabulum, hip bone, anterior ridge

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INTRODUCTION

The acetabulum is a cup‑shaped cavity present on the lateral side of the hip bone. All the three bones such as ileum, ischium, and pubis contribute to form the acetabulum. The articular surface is deficient inferiorly, known as the acetabular notch, and is bridged by transverse acetabular ligament.[1] The depth of acetabulum (DH) is increased by the

attachment of fibrocartilaginous rim known as acetabulum labrum. It holds the femoral head and maintains the joint stability.[2]

The various disease of the hip can be diagnosed by measuring the variations in hip morphology. Femoroacetabular impingement and dysplastic hip are associated with abnormalities in the depth, orientation, and diameter of acetabulum.[3] Morphometry of acetabular fossa serves as a baseline data for construction of prostheses of acetabulum in clinical practice.

Orthopedic surgeons use measurements of acetabular parameter for planning the total hip replacement.[2] Morphometric data of acetabulum is essential for clinical correlation and it also helps detection of disputed sex by Forensic experts. Study of regional variations of acetabular dimensions is crucial to provide valuable parameters in the Indian population which would exterminate the catastrophic consequences of prosthetic loosening or dislocation. Present study was aimed to study Morphometric characteristics of acetabulum in adult dry human pelvic bone.

MATERIAL AND METHODS

Present study was descriptive, observational study, conducted in department of anatomy, at ESIC medical college & hospital, Bihta, Patna, India. Study duration was of 6 months (January 2022 to June 2022). Study approval was obtained from institutional ethical committee.

Human adult dry hip bones of unknown age and sex were collected from the Department of Anatomy for present study. Hip bones with osteoarthritis of hip, evidence of trauma or any other skeletal disorders were excluded from study.

Measurements of diameter, depth of acetabulum and width of acetabular notch were taken by digital sliding vernier callipers and correlation between parameters was analysed using Pearson correlation test.

1. Diameter of the acetabulum: The distance between the acetabular ridge nearest to the ischial tuberosity to anterior iliac margin intersecting the acetabular ridge.
2. Depth of the acetabulum: A thin metallic scale was placed across the acetabulum & depth of the acetabulum was measured.
3. Width of acetabular notch: The distance between the two ends of lunate articular surface.
4. Anterior acetabular ridge shape was evaluated morphologically and classified as (curved, straight, angular& irregular).

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

RESULTS

In present study, 96 undamaged acetabulum of adult dry human hip bone of unknown age and gender were studied. Mean diameter of acetabulum in left side was 48.12 ± 8.81 mm & right side was 44.71 ± 8.97 mm, difference was not significant statistically. Mean depth of acetabulum in left side was 26.62 ± 3.28 mm & in right side was 23.98 ± 3.19 mm, difference was not significant statistically. Width of acetabular notch in left side was 32.51 ± 3.92 mm & right side was 34.89 ± 3.35 mm, difference was not significant statistically.

Table 1: Morphometric parameters of the acetabulum

Acetabulum	Side	Mean ± SD (mm)	P value
Diameter	Left	48.12 ± 8.81	0.55
	Right	44.71 ± 8.97	
Depth	Left	26.62 ± 3.28	0.48
	Right	23.98 ± 3.19	
Width of acetabular notch	Left	32.51 ± 3.92	0.76
	Right	34.89 ± 3.35	

In the present study anterior acetabular ridge was curved (45.83 %) in majority of cases, followed by straight (30.21 %), angular (19.79 %) and irregular (4.17 %).

Table 2: Shape of anterior acetabular ridge

Shape	Frequency	Percentage
Curved	44	45.83%
Straight	29	30.21%
Angular	19	19.79%
Irregular	4	4.17%

In the present study hip bones showed pointed anterior end and lunate posterior end (73.96 %) in majority cases, while others were anterior and posterior ends of labrum are lunate shaped (18.75 %) & both anterior and posterior ends of labrum were pointed (7.29 %).

Table 3: Morphology of anterior acetabular ridge

Shape	Frequency	Percentage
Pointed anterior end and lunate posterior end	71	73.96%
Lunate shaped anterior and posterior ends of labrum	18	18.75%
Pointed anterior and posterior ends of labrum	7	7.29%

DISCUSSION

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.[4]

To establish normal radiological anatomy is very important for every population. The morphometric analysis is useful for the physical and forensic anthropology of a population. It is also useful for designing of orthopedic implants and prostheses.[5] Gupta S et al.,[6] studied 100 hip bones (female = 32, males = 68). The mean diameter of acetabulum in male was 41.29±3.06 (R), 41.22±3.09 (L) mm and female was 37.15±3.88 (R), 36.75±3.75 (L) mm. The mean diameter of acetabulum on right was significantly greater in male than females.

In study by Yugesh K,[7] depth of acetabulum was found to be more in males (30±0.223 mm) than in females (21.45±0.22 mm). Diameter was found to be more in the males than in females ($P<0.005$). Notch width was found to be more in females than in the males. There is no significant difference between the right and left sides of acetabulum.

Tripathi M. et al.,[8] studied 200 human hip bones of both sexes, the most common shape of acetabulum was curved which was 50% and rest angular straight or irregular 30%, 5 %, 15% as follow, the mean transverse diameter of the acetabulum left side 48.4 mm and on right side it is 48.6 mm, found the mean total Diameter of the acetabulum left side 49.26 mm and right

49.36 mm, we found that the mean depth of acetabulum right side 25.36 mm and left side was 25.46 mm.

In study by Bollavaram P et al.,[9] mean diameter of acetabulum in males was found to be 5.03 cm and in females it was 4.44 cm, whereas on right side it was 4.70 cm and on left side it was 4.77 cm. The mean depth of acetabulum in males was 2.85 cm and in females it was 2.49 cm, whereas on the right side was 2.71 cm and 2.63 cm on the left. The mean notch width of the acetabulum in males was 2.07 cm and in females it was 1.71 cm, whereas on the right side it was 1.92 cm, and 1.85 cm on the left. Total range for the acetabular capacity was 22-30.68 ml. The curved shape anterior acetabular ridge was the most predominant type (39%) and the least type was irregular shaped (15%).

Singh A et al.,[10] studied 92 undamaged acetabulum of adult dry human hip bone of unknown age and gender, the anterior acetabular ridge was curved in 45.7% (42), angulated in 26.17% (24), straight in 13% (12), and irregular in 13% (12) bones. The anterior end of the lunate articular surface was angulated, and the posterior end was lunate in shape in 45.7% (42), whereas in 54.3% (50), bone both the ends were lunate in shape. Morphometric values were as follows: 48.21 mm ± 3.31 mm (VD), 47.81 mm ± 3.37 mm (TD), 48.79 mm ± 4.08 mm (APD), 23.58 mm ± 2.77 mm (ND), 27.45 mm ± 3.02 mm (D), 4162.56 mm2 ± 755.58 (SA), and 36,563.65 mm3 ± 9408.67 (V).

Ina Bahl et al.,[11] noted that the mean diameter of acetabular cavity on right side was found to be 48.3 ± 3.4mm and on the left side 48.9 ± 3.5mm. The mean depth on right side was measured to be 27.1 ± 3.4mm and on left side 27 ± 3mm. We observed positive co-relation between the mean and standard deviation of total diameter and depth of acetabular cavity. The Curved shape anterior acetabular ridge was the most predominant type (41.1%) and the least type was straight shaped (5.5%). In the study conducted by Parmar et al.[12] within the Indian population, the shape of the acetabular margin was observed to be either curved, straight or irregular only. They attributed the difference in morphology of the acetabular margin to ethnic origins

Knowledge of the anatomical parameters of bony components of the hip joint are also very much essential to get a better understanding of the etiopathogenesis of primary osteoarthritis and will help in early detection of disputed sex by Forensic experts.

CONCLUSION

Morphological parameters observed in present study, will serve as baseline data of acetabulum morphology. Morphometric studies of hip bone are of importance not only to anatomist and anthropologists, but is of great value to osteologists, forensic medicine experts and orthopedicians.

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