

Morphometric and Morphological Variations of the Acetabulum of Adult Dry Hip Bones

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Abstract

Background: The hip bone's lateral surface has a cup-shaped depression called the acetabulum. There are articular and non-articular components. The lunate surface is the articular portion that articulates with the femur's head to form the hip joint. The acetabular fossa, which contains a pad of fat, is the non-articular portion. The objective of this study was to measure the acetabulum's morphometric characteristics, including the width of the acetabular notch, transverse diameter (TD), and anteroposterior diameter (APD). to investigate the acetabulum's morphological characteristics, such as the lunate articular surfaces' ends and the acetabulum's anterior end. **Material and Methods:** The present observational study was conducted on 90 adult dry hip bones (45 right and 45 left) of unknown sex. Morphometric parameters such as anteroposterior diameter (APD), transverse diameter (TD), and width of the acetabular notch were measured using vernier calipers. Morphological characteristics were noted, such as the acetabulum's anterior boundary and the lunate articular surface's ends. **Results:** In the present study, the mean APD of the right and left acetabula were 47.08 ± 2.8 mm, 46.88 ± 3.8 mm, and the mean TD of the right and left acetabula were 46.42 ± 3.42 mm, 45.8 ± 3.3 mm. The width of the acetabular notch in the right and left acetabula was 21.5 ± 3.8 mm and 20.5 ± 3.2 mm. The most frequent findings in this study are the acetabulum's curved anterior boundary and the lunate articular surface's conical anterior end. **Conclusion:** In the present study, the morphometric findings of the right acetabulum were slightly higher than those of the left. The anatomical knowledge of the acetabulum is essential for understanding the etio-pathogenesis of primary osteo- arthritis, and it also helps in early detection of disputed sex by forensic experts. Biomedical engineers will be better equipped to create appropriate prostheses if they have a complete understanding of the size of the femoral head and acetabulum in both sexes.

Keywords: Acetabulum, Width, Transverse Diameter, Antero-Posterior Diameter, Lunate Surface.

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INTRODUCTION

The hip bone's lateral surface has a cup-shaped depression called the acetabulum. The word "acetabulum" means "shallow vinegar cup" in Latin.^[1] The acetabulum is contributed to by the three components of the hip bone, such as the ilium, ischium, and pubis. The pubis forms the anterior 1/5th, the ileum forms the postero-superior 2/5th, and the ischium forms the remaining postero-inferior 2/5th of the acetabulum.^[1] It is divided into articular and non-articular parts. The articular part is called the lunate surface, which articulates with the head of the femur to form the hip joint. The non-articular part is known as the acetabular fossa, which is filled with a pad of fat.^[2] The knowledge of morphometric features of the acetabulum, like transverse diameter (TD), antero-posterior diameter (APD), and depth, is useful to the anthropologist in identifying the gender and clinically significant for surgical procedures such as total hip replacement. Prosthetists and radiologists are also informed by these qualities.^[1] During acetabular surgeries and the diagnosis of congenital acetabular dysplasia, the anterior acetabular ridge morphology is useful.^[1] Hip dysplasia results in hip joint instability, which accelerates articular cartilage deterioration and osteoarthritis.^[3] Because the

prosthesis overlaps at the anterior acetabular ridge during arthroplasty, variations in the anterior acetabular ridge impact the amount of anteversion and result in Ilio-psoas impingement.^[3] Based on this background, we in the current study aimed to describe the morphometric parameters and morphological variations of the acetabulum of the adult dry hip bones. With the primary objective of studying morphometric features of the acetabulum, like transverse diameter (TD), antero-posterior diameter (APD), width of the acetabular notch, and the secondary objective to study morphological features of the acetabulum, such as the form of the acetabulum's anterior end and the lunate articular surfaces' ends.

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MATERIALS AND METHODS

The present observational study was conducted on 90 adult dry hip bones (45 right and 45 left) of unknown sex in the Department of Anatomy, Osmania Medical College, Hyderabad, Telangana. Fully ossified dried hip bones were included in the present study, and the deformed, eroded bones and bones with congenital, pathological defects and fractures were excluded. Morphometric parameters like antero-posterior diameter (APD), transverse diameter (TD), and the width of the acetabular notch were measured using vernier calipers. The acetabulum's anterior boundary and the lunate articular surface's ends were among the morphological characteristics that were noted.

The following parameters were measured: APD: A line drawn through the center of the acetabulum from the anterior superior iliac spine to the ischial tuberosity was used to measure the maximum APD of the acetabulum.^[4] TD: Using a line perpendicular to the APD, the acetabulum's maximal TD was determined.^[4] The distance between the two ends of the acetabulum's lunate-shaped articular portion is known as

the width of the acetabular notch.

Shape of anterior ridge of the acetabulum: Was assessed and classified as curved, angular, straight, and irregular. The shape of the ends of the lunate articular surface was observed and classified as anterior end conical in shape, anterior end as lunate, both anterior & posterior ends were lunate, and both ends are conical in shape.

Statistical analysis: SPSS version 26 in Windows format was used to analyse all the accessible data once it had been separated, cleaned up, and transferred to an MS Excel spreadsheet. The continuous variables were expressed as a percentage, mean, and standard deviation. The Chi-square test was utilised to ascertain the differences between the groups, and the student's t-test was utilised to compare the mean values of two groups for categorical variables. P values less than 0.05 were regarded as significant.

RESULTS

The present study was conducted on 90 hip bones (Right n=45 and Left n=45), and the observations of various parameters were represented in tabular form below [Table 1-3]

Side	Number	Curved	Straight	Rounded
Right	45	33 (73.3%)	7 (15.5%)	5 (11.1%)
Left	45	25 (55.5%)	16 (35.5%)	4 (8.88%)

Chi square p value = 0.048 (Significant)



Figure 1: Showing curved Anterior margin

In the present study, curved anterior margins [Figure 1] of the acetabulum were more common than straight [Figure 2]

and rounded anterior margins of the acetabulum.



Figure 2: Showing a straight anterior margin

Articular surface	Right n=45	Left n=45
Anterior Conical	25 (55.5%)	29 (64.4%)
Anterior Lunate	06 (13.3%)	03 (6.6%)
Both Lunate	13 (28.8%)	11 (24.4%)
Both Conical	01 (2.2%)	02 (4.4%)

Chi square p value = 0.028 (Significant)



Figure 3: Showing conical Anterior end.

In the present study, the lunate articular surface's anterior end

was conical [Figure 3] in most of the hipbones, as compared to both ends being lunate [Figure 4] and conical.



Figure 4: Showing both ends were lunate

Table 3: Showing various Morphometric Parameters of Acetabulum

Parameters	Right hip bone Mean \pm SD	Left hip bone Mean \pm SD	p-value
Transverse diameter / TD (cms)	4.1426 \pm 0.343	3.98 \pm 0.33	0.049*
Antero-posterior diameter / APD (cms)	4.4085 \pm 0.283	4.38 \pm 0.39	0.51
Width of Acetabular notch (cms)	1.75 \pm 0.38	1.69 \pm 0.32	0.62

* Significant

The values of transverse diameter, antero-posterior diameter, and the acetabular notch's width were relatively greater in right hip bones than in left hip bones.



Figure 5: Showing the TD of the acetabulum.

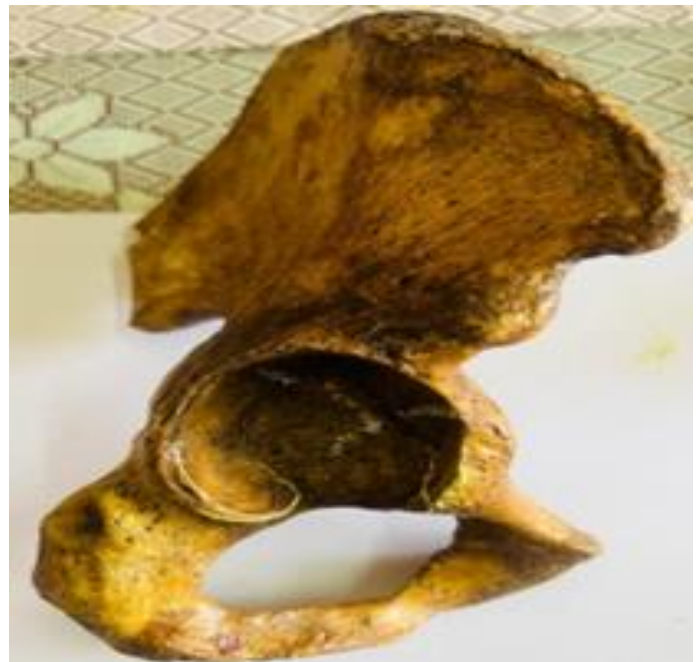


Figure 6: Showing the width of the acetabular notch

DISCUSSION

One type of synovial joint is the hip joint, which is a ball and socket type of joint. Orthopedicians use the acetabulum's

morphometric data for accurate prosthetic implant fabrication and geometric modelling.^[5] comprehension hip joint pathologies, such as osteoarthritis, requires a comprehension of the irregularities in the acetabulum's dimensions. Degeneration is more likely to occur in an

incongruous hip joint than in a normal joint.^[3] The results of the current study were compared to those of earlier research in order to gain a better understanding, and the results are given below. [Table 4].

Table 4: Showing comparison of various morphometric parameters of the acetabulum with the previous studies

Author and Year	Sample size	APD (in cms)	TD (in cms)	Width of Acetabular notch in cms
A Singh et al 2020, ^[1]	Rt - 42	48.70 ± 4.54	47.43 ± 3.43	-
	Lt - 50	48.86 ± 3.68	48.13 ± 3.33	-
G. Sreedevi et al 2017, ^[2]	Rt - 39	49.40 ± 3.5	-	22.2 ± 2.7
	Lt-41	48.06 ± 5.65	-	22.5 ± 2.4
K R Arun kumar et al 2021, ^[3]	Rt - 54	-	48.76 ± 2.94	-
	Lt - 50	-	49.2 ± 2.92	-
Leena et al 2017, ^[4]	Rt - 51	47.96 ± 4.02	48.01 ± 4.15	-
	Lt-59	47.98 ± 3.92	48.44 ± 4.45	-
B. Pullann et al 2022, ^[5]	Rt -50	4.70	-	19.2
	Lt -50	4.77	-	18.2
Neeru G et al 2020, ^[6]	Rt - 50	41.56 ± 3.55	38.37 ± 3.48	-
	Lt - 50	41.53 ± 3.63	38.16 ± 3.33	-
Mridul Tripathi et al 2022, ^[7]	Rt - 100	49.90 ± 2.13	48.62 ± 2.79	-
	Lt - 100	50.24 ± 1.78	48.48 ± 2.79	-
Gursharam Singh et al 2013, ^[6]	Rt - 25	-	5.13 ± 0.26	-
	Lt - 25	-	5.03 ± 0.35	-
Rekha Kumari et al 2024, ^[10]	Rt - 30	-	-	22.55 ± 3.20
	Lt - 30	-	-	22.72 ± 2.85
Navneet Kumar et al 2025, ^[11]	Rt - 25	-	48.42 ± 3.40	22.55 ± 3.07
	Lt - 25	-	47.05 ± 5.55	22.82 ± 3.06
Sanya Khurana et al 2025, ^[12]	Rt - 28	47.14 ± 2.1	46.81 ± 3.64	22.14 ± 4.32
	Lt - 28	52.74 ± 3.84	52.86 ± 3.89	25.28 ± 5.77
Present study 2026	Rt - 50	47.08 ± 2.8	46.42 ± 3.42	21.5 ± 3.8
	Lt - 45	46.88 ± 3.8	45.8 ± 3.3	20.5 ± 3.2

The current study's mean acetabulum APD was in line with the results of previous research by Leena et al.^[4] The findings of the mean TD of the acetabulum were close to the observations of previous studies conducted by Kumar N et al.^[10] The width

of the acetabular notch findings was close to the values of Kumar N et al.'s study.^[10] The difference between the observations of the present study and those of previous studies was due to ethnic and racial variations.

Table 5: Comparing the acetabulum's anterior edge with earlier research

Author and year	Curved	Straight	Irregular	Angular	Round
A Singh et al 2020, ^[1]	57	14	05	24	-
G. Sreedevi et al 2017, ^[2]	44	28	6.3	23	-
Arun Kumar et al 2021, ^[3]	63.5	3	11	23	-
B. Pullamma et al 2022, ^[5]	39	22	15	24	-
Mridul Tripathi et al 2022, ^[7]	50	10	30	30	-
S Khurana et al 2025, ^[12]	43	-	-	-	-
Present study et al 2026	54	20	-	-	10

In the present study, the curved anterior margin of the acetabulum was a common finding, and it was similar to the

observations of the studies done by Archana et al,^[1] and Mridul et al.^[7]

Table 6: Comparing the acetabulum's anterior and posterior lunate articular surface shapes with those from earlier research

Author and year	Anterior end conical	Both ends lunate	Both ends conical
A Singh et al. 2020, ^[1]	46	54	-
G. Sreedevi et al. 2017, ^[2]	80	15	5
K. Yugesh et al. 2016, ^[9]	93	5	7
Present study 2026	78	19	3

In the majority of the hip bones examined in this study, the anterior end of the lunate articular surface was conical. These observations were close to the findings of Sreedevi et al.'s study.^[2]

Study Limitations: The sample size of the present study was

small (90). This study was conducted on an unknown sex. Further studies must be conducted on a larger sample size, and a multicenter study will determine the exact morphological variations that exist between the hip bones.

CONCLUSION

The morphometric findings of the right acetabulum are slightly higher than those of the left in the present study. This may be because the hip bones that we measured were taken at random, and the right and left hip bones did not belong to the same skeleton. The anatomical knowledge of the acetabulum is essential for understanding the etiopathogenesis of primary osteo- arthritis, and it also helps in early detection of disputed sex by forensic experts. Biomedical engineers will be better equipped to create appropriate prostheses if they have a complete understanding of the size of the femoral head and acetabulum in both sexes.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Singh A, Gupta R. et al. Morphological and morphometric study of the acetabulum of dry human hip bone and its clinical implications in hip arthroplasty. *J. Anat. Soc.* 2020; 69(4): 220-25.
2. Gangavarapu S, Muralidhar RS. The study of morphology and morphometry of the acetabulum on dry bones. *Int J Anat Res* 2017; 5:4558-62.
3. KR Arunkumar, U Delhiraj, S Satish Kumar. Morphologic and Morphometric Study of Human Acetabulum and Its Clinical Significance. *J Clin of Diagn Res.* 2021; 15(2): AC16- AC19.
4. Khobragade L, Vatsalaswamy P. Morphometric study of depth of acetabulum. *International Journal of Research in Medical Sciences.* 2017; 5(9):3837-42.
5. Pullanna B, Bindhu S. R Avadhani, Meera Jacob. Morphometry of the adult human dry hip bone in South Indian population. *Int J Anat Res.* 2019; 7(1.2): 6178- 82.
6. Neeru G. Sanjay G, N Ghalawat. Anthropometric study of various acetabular diameters in the hip bones of north indian origin. *Int J of Scientific Res.* 2020; 9 (12):1-2.
7. Tripathi M, Gajbhiye V. Morphometric and morphology study of acetabulum of human hip bone in Central Indian population. *Int. J. Health Sci.* 2022; 6: 1064- 72.
8. Gursharan Singh Dhindsa, Acetabulum: a morphometric study. *Journal of Evolution of Medical and Dental Sciences.* 2013; 2(7):657-665
9. Yugesh K, Kumar SS. Morphometric analysis of acetabulum and its clinical correlation in South Indian population. *Int J Anat Res.* 2016; 2(6): 1011-14.
10. Rekha K, Javed A, et al. A Morphometric Study of the Acetabulum in the Population of Bihar and Its Clinical Significance. *Int. J. Pharm. Sci. Rev. Res.* 2024; 84(7): 193-196.
11. Navneet Kumar, Rajnish Kumar et al. Morphometric Analysis of Acetabulum and Its Clinical Correlation in Total Hip Arthroplasty. *European j of Cardiovascular Medicine.* 2025; 15(4): 774 – 78
12. Sanya Khurana, Nidhi Lal, et al. Morphologic and Morphometric Evaluation of Acetabulum of Hip Bone among North Indian Population. *Journal of Neonatal Surgery.* 2025; 14(8).
13. Standring S. *Gray's Anatomy.* 41st Ed. New York: Elsevier; 2016; p. 1339-76.
14. Moore KL, Dalley AF, Agur AM. *Pelvis and Perineum: Clinically Oriented Anatomy,* 6th Edition, Philadelphia, Lippincott Williams and Wilkins, 2010; p.328.