



A STUDY OF THE DIMENSIONS OF HUMAN ACETABULUM IN THE DRY HIP BONES OF SOUTH KERALA POPULATION

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ABSTRACT **Introduction:** In human anatomy the acetabulum is a cavity on the lateral aspect of the hip-bone. The purpose of this study is to record the depth and diameter of the acetabulum cavity to accumulate morphological data helpful for anthropologists, Forensic medicine experts and orthopedicians.

Materials And Methods: The study was done on 88 adult human hip bones (42 right and 46 left) collected from Department of Anatomy, Govt.T.D Medical College, Alappuzha, Kerala state. The diameters and maximum depth were measured using digital vernier calliper. The measurements were compared with other studies in the world. **Results:** The mean diameter of acetabulum was 48.08 ± 3.21 mm, 44.16 ± 2.60 mm in male and female respectively. The mean \pm S.D value of depth was 29.11 ± 2.37 and 27.20 ± 2.01 mm. in male and female respectively. The correlation between depth and diameter was significant only in the right male hip bones. **Conclusion:** There is significant variation in the anatomical parameters of hip bone between different Indian population groups. The data from this study may be used for designing population specific hip prosthesis.

KEYWORDS : Hip bone; Acetabular diameter; Acetabular depth; Morphology; Prosthesis

INTRODUCTION:

In human anatomy the acetabulum is a cavity on the lateral aspect of the hip-bone. It is cup shaped and directed laterally, downwards and slightly forwards. Its margin is deficient inferiorly and is called the acetabular notch. The floor of acetabulum is rough and non-articular and is called the acetabular fossa. The cavity presents a horseshoe-shaped articular surface which is called the lunate surface. It provides the only surface on which the head of the femur moves within the hip-joint. All three elements of the hip-bone take part in the formation of the acetabulum in humans. (1)

Many authors have recorded the measurements (depth and diameter) of the acetabular cavity in an attempt to accumulate morphological data helpful for anthropologists, Forensic medicine experts and orthopedicians to perform surgical procedures of hip and also for manufacture of prosthesis.(2) The purpose of this study is to collect such data on the depth and diameter of the acetabula of dried hipbones in South Kerala population and to compare these dimensions with earlier studies in different populations while looking for variations and similarities between right and left sides, male and female and relationship between diameter and depth.

MATERIALS AND METHODS:

The study was conducted on a sample of 63 adult human male and 25 female hip bones (total 88 including 42 right and 46 left) collected from the Department of Anatomy, Govt TD Medical College, Alappuzha, Kerala. Bones were documented with numbers put serially and coded as FR(female right), MR (male right), FL(female Left) and ML(male Left). The bones were grouped into female and male according to shape of the Obturator foramen, Sub pubic angle, eversion of Ischiopubic rami, features of Greater sciatic notch (Posterior angle, length of posterior segment, Index-II) and Pubo ischial index.(1) Hip bones with any extensive wear and tear, congenital anomalies and obscuring pathologies such as cortical bone deterioration were excluded from the study. The following measurements were taken on all acetabula using a digital vernier caliper (DVC).

(1)The diameters of the acetabulum. The internal jaws of the DVC was placed between the upper limit of the acetabular rim which forms the beginning of the upper margin of the acetabular notch to a point over the acetabular rim and measured as the maximum inner transverse diameter 1 (D1) was measured.(Fig 1) Similarly the DVC was placed in between the lower limit of the acetabular rim which forms the

terminal point of acetabular notch to a point over the acetabular rim and recorded as the maximum inner transverse diameter 2 (D2). (Fig 2)



(Fig 1) Measurement Of The Maximum Inner Transverse Diameter 1 (D1)



(Fig 2) Measurement of the maximum inner transverse diameter 2 (D2)

(2) Maximum depth . A metal scale was placed over margins of acetabulum in such a way that it crosses the maximum diameter of the boundary of the acetabulum. Then the distance between the deepest part of acetabulum to the surface of metal scale which is facing towards the acetabulum was measured with a DVC and the value recorded. (Fig 3)



(Fig 3) Measurement of the maximum depth

All the observations and results were tabulated and compared with previously reported studies.

RESULTS AND TABLES:

Out of 88 hip bones studied (46 Left and 42 Right) the following results were obtained.

In female left (FL), D1 ranges between 38.41 – 48.1 mm and D2 between 39.24 – 46.2 and depth between 23.36 – 30.08. In female right (FR), D1 ranges between 40.05 – 48.47 mm and D2 between 38.4 – 48.0 and depth between 23.5 – 30.89 mm.

In male left (ML), D1 ranges between 40.5 – 54.04 mm and D2 between 39.41 – 57.76 and depth between 23.70 – 33.21 mm. In male right (MR), D1 ranges between 40.96 – 55.54 mm and D2 between 40.84 – 56.01 and depth between 25.51 – 34.58 mm.

The mean diameter of acetabulum was 48.08 ± 3.21mm, 44.16 ± 2.60 mm in male and female respectively. The mean ± S.D value of depth was 29.11 ± 2.37 and 27.20 ± 2.01 mm. in male and female respectively. The correlation between depth and diameter was studied. Only in the Male Right (MR) it was significant (moderate or standard significance) (Table 4). In other groups the significance was low or very low.

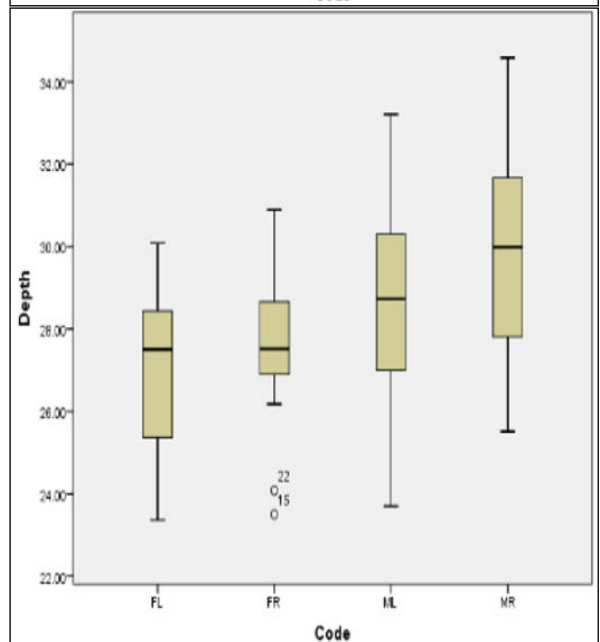
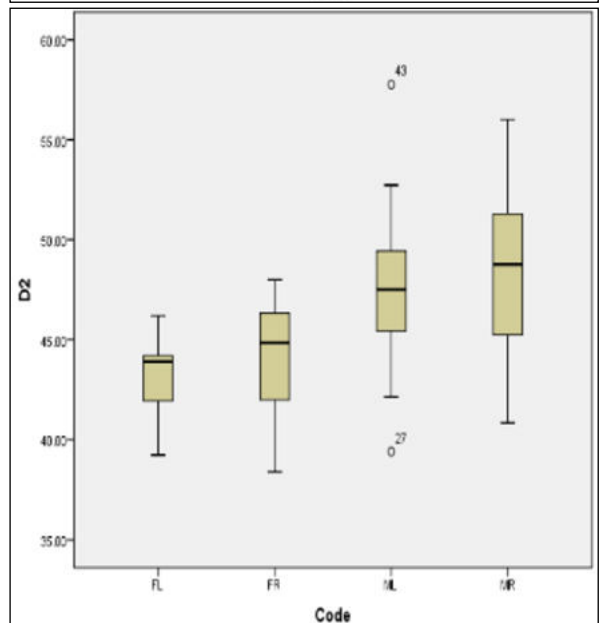
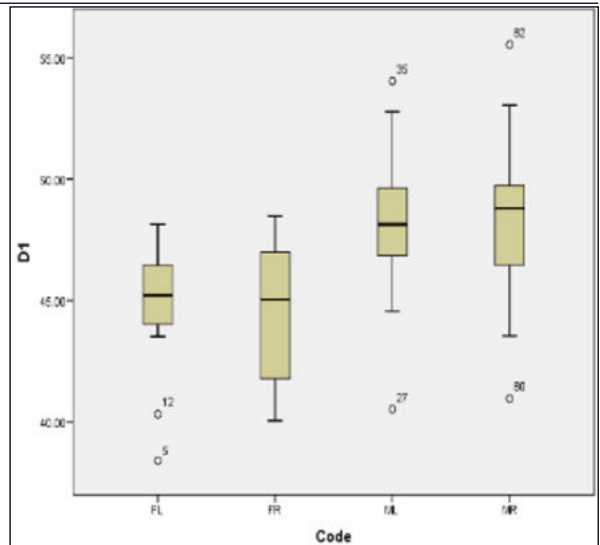
Distribution of anatomical parameters (diameter and depth) of hip bone and the sex and side related differences within these parameters are presented in Table 1 and 2 and their ANOVA analysis in Table 3. The correlation between diameter and depth was analysed using Pearson's test (Table 4). Statistical software - SPSS 27.0 - was used for data analysis.

Table-1: Diameter And Depth Of Acetabula In Male And Female.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
D1	Male	63	48.3194	2.95475	.37226
	Female	25	44.6120	2.72920	.54584
D2	Male	63	47.8308	3.47325	.43759
	Female	25	43.7116	2.47959	.49592
Depth	Male	63	29.1125	2.37457	.29917
	Female	25	27.2012	2.01637	.40327

Table – 2 : Diameter And Depth Of Acetabula In Right And Left Sides.

	Side	N	Mean	Std. Deviation	Std. Error Mean
D1	Left	46	47.2680	3.13892	.46281
	Right	42	47.2640	3.57047	.55094
D2	Left	46	46.4120	3.58463	.52853
	Right	42	46.9329	3.87295	.59761
Depth	Left	46	28.0891	2.29603	.33853
	Right	42	29.0957	2.48449	.38337



Graphs showing the comparison of diameters and depth across all groups

Table 3: ANOVA, Analysis Of Variance; D1, Diameter1; D2 , Diameter2; Depth

			Sum of Squares	df	Mean Square	F	Sig.
D1 * Code	Between Groups	(Combined)	247.140	3	82.380	9.625	.000
	Within Groups		718.915	84	8.559		
	Total		966.055	87			
D2 * Code	Between Groups	(Combined)	315.272	3	105.091	9.987	.000
	Within Groups		883.907	84	10.523		
	Total		1199.179	87			
Depth * Code	Between Groups	(Combined)	96.681	3	32.227	6.509	.001
	Within Groups		415.873	84	4.951		
	Total		512.555	87			

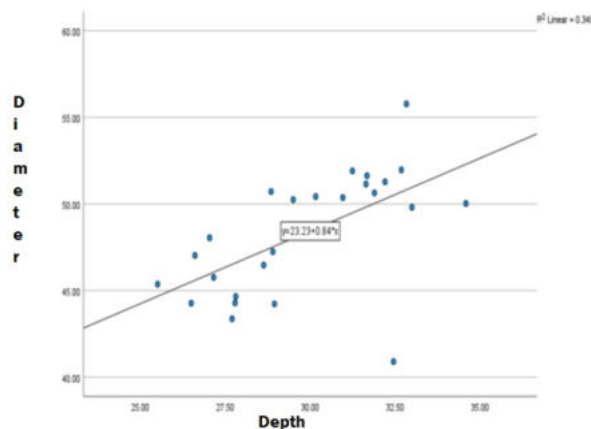
Table 4: Correlation Of Depth And Diameter In Male Right(MR)

X axis- Depth Y axis- Average diameter

Descriptive Statistics			
	Mean	Std. Deviation	N
Depth	29.8652	2.31009	29
Average Diameter	48.3303	3.28674	29

Correlations			
		Depth	Diameter
Depth	Pearson Correlation	1	.591**
	Sig. (2-tailed)		.001
	N	29	29
Average Diameter	Pearson Correlation	.591**	1
	Sig. (2-tailed)	.001	
	N	29	29

** . Correlation is significant at the 0.01 level (2-tailed).



DISCUSSION:

In the present study, the mean depth and diameter of acetabulum of the dried hip bone were found to be 28.16± 2.19 and 46.12± 3.28 respectively . A comparison of this data with previous studies is given in Table 5.

Rajkumar et al(2014) had reported that the mean depth and diameter of acetabulum of the dried hip bone was 27.14mm and 47.57mm respectively in Indian population.(2) SSSN Rajasekhar et al.(2017) ascertained that in South Indian population, the acetabular diameter values in males(mean= 48.13) were more when compared to females(mean= 45.24). (3) KR Arunkumar et al(2021) conducted a study in the

South Indian state of Tamilnadu and states that the mean depth and diameter of acetabulum of the dried hip bone was 24.12±2.54 mm and 48.98±2.91 mm respectively. They further concluded that the acetabular measurements on left side were slightly greater than that of right side but not statistically significant. (4) Another Indian study by Thoudam Bedita Devi and Chandra Philip X (2014) reports the measurements at 28.32±1.32mm and 50.99±1.99mm of mean depth and mean diameter of acetabulum respectively with a significant correlation between them. (5)

Acetabular depth is an important factor that maintains the normal range of movements of hip joint.(6) The mean depth of acetabulum was measured to be at 29.49mm by Funda Tastekin Aksuet al (2006) (7) in dry hip bones of Turkish population.

Similarly there are studies conducted on anteroposterior radiographs of pelvis also. In such studies the mean depth was found out to be 14.4mm by Croft et al(8) in European population and as 11.9 ±2.8 mm by Dejan Jeremic et al(2011) in Serbian population (9) whereas the diameter was found to be 59.94 mm in males and 59.72 mm in females respectively in North Indian population by Jawahar Mehmood et al (2018).(10) In relation to this Lau et al(1995) had defined hip dysplasia as having an acetabular depth of less than 9 mm in radiographs.(11)

Table - 5 : Comparison Of The Dimensions Of Acetabulum In Other Study Populations From Previous Studies In Dry Bone Specimens.

Study	Mean (Depth)	Mean (Diameter)
Present study	28.16± 2.19	46.12± 3.28
Funda Tastekin Aksu-2006	29.49mm	54.29mm
Rajkumar et al-2014	27.14mm	47.57mm
Thoudam Bedita Devi et al-2014	28.32±1.32mm	50.99±1.99mm
KR Arunkumar et al-2021	24.12±2.54	48.98±2.91
Ranjan and Deep-2021(12)	27.14mm	47.57mm

The diameters and depth were higher in the left side compared to the right and this was statistically significant. This finding is similar to KR Arunkumar et al(2021) which had a higher value on left side than the right side but there was no statistical significance.(4) This could be due to the fact that the left lower limb is dominant as it is used by most people for weight bearing irrespective of their right or left handedness. So the dimensions of the left acetabulum is more than the right to bear the greater loading force on left femur according to Chhibber SR and Singh I. (13)

As expected, the acetabular depth and diameters were significantly higher in male hip bones than in the female. This is similar to earlier studies like Khobragade L and Vatsalawamy P. (6)

There was no correlation between the the acetabular depth and diameter in females. The left male hip bones had a positive correlation but were not statistically significant. But in the right male hip bones there was moderate or standard correlation. This is in contrast to the positive significant correlation earlier reported by Mahmut Cay et al between the average diameter and depth in both males and females.(14)

CONCLUSION:

Most of the previous Indian Studies were not done after determining the gender variations in the hip bones. After comparing the findings of the present study with the previous data available it is noted that there is significant variation in the anatomical parameters of hip bone even between different Indian population groups. Such differences could be due to environmental and ethnic factors (15). The purpose of this work is to contribute to the scientific literature, providing anatomical data on the similarities and variations. In the current study the depth of acetabulum correlates with acetabular diameter significantly in the males on the right side. This information may be helpful during hip arthroplasty, treatment of joint fracture and in diagnosing congenital hip dysplasia. An increasing number of patents are taken each year for designs in hip replacement prosthesis in an attempt to reduce prosthesis failure.(16) Available data from this study may be utilized for revising prosthesis designs to suit specific populations to reduce

revision surgeries of Total Hip Arthroplasty. We suggest that a radiological study if added may increase further accuracy in this regard.

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