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Research Article

MORPHOMETRY OF THE ADULT HUMAN DRY HIP BONE

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ABSTRACT

Objective: To do the morphometry of 50 dry human hip bones in Indian population in order to evaluate the various parameters of the hip bone.

Methods: 50 randomly collected Indian adult unpaired hip bones of unknown sex were analyzed to evaluate the weight, length, width and the coxal index of hip bone. All the hip bones selected were dry, complete and showed normal anatomical features. Specimens showing osteoarthritic changes, evidence of any previous trauma or skeletal disorders was excluded from the study.

Results: The raw data obtained was statistically analyzed. Range, mean, standard deviation and standard error of mean were determined for each parameter. All values were compared with series of other workers to draw the conclusions.

Conclusion: There was an overall greater robusticity of the right hip bone. The difference seen between the values of present study and that of other workers could be explained on the basis of ethnic and racial variations. A sound knowledge of various parameters of the hip bone is important for the anatomists, forensic experts, anthropologists and orthopaedicians.

Keywords: Morphometry, Hip bone, Sexual dimorphism, Asymmetry

INTRODUCTION

The four main features of biological identity are sex, age, stature and ethnic background. Although many bones of the skeleton present sex, age and race related differences, the distinctive morphology of the human hip bone makes it of interest from anatomical, anthropological and forensic point of view. Thus by using visual criteria, metric techniques and discrimnant function analysis we can estimate the age, sex and race of an individual.

The hip or the innominate bone is one of the most informative bones in the skeleton because it is formed by three independent elements during the sub adult life and is directly involved with childbirth [1]. The hip bone has the appearance of a propeller with a large blade (the ilium) directed upwards and a smaller blade (composed of the pubis anteromedially and the ischium posterolaterally) directed downwards. The two blades are almost at right angles to one another and meet at a narrow, thick hub, in the acetabulum[2].

Morphometry of the hip bone is important for the anatomist as well as for the anthropologist for population studies. Moreover, specimen identification and sex determination from skeletal remains has great importance in forensic medicine. The sexual dimorphism of hip bone is a special adaptation in the females for child bearing. Therefore, awareness of the average dimensions of the hip bone in both sexes will also help in early detection of disputed sex by forensic experts [3-5]. It is possible to determine the sex by visual examination of the hip bone as reported by Asala et al [6].

Morphometric measurements done on right and left side indicate that there is bilateral asymmetry of hip bone [7-9]. Racial differences in Thais, Chinese, Nigerians and other populations have been compared [10, 11]. Various metrical parameters for hip bone have also been evolved [12-14]. Inspite of this not much work has been done in Indian population. Therefore, the need for present study to be carried out was felt. The present study will hence provide valuable parameters in the Indian population which would help the forensic experts, anthropologists and orthopaedicians.

The main objective of the present study was to do the morphometry of 50 adult dry human hip bones (25 right & 25 left) in Indian population to evaluate various parameters of hip bone.

MATERIAL AND METHODS

A total of 50 Indian adult unpaired right and left dry hip bones of unknown sex were studied from teaching collection of the Anatomy department, Dyanand Medical College, Ludhiana. Out of the total of 50 hip bones, 25 were of right side and 25 were of left side. All the hip bones selected were dry, complete and showed normal anatomical features. Specimens showing osteoarthritic changes, evidence of any previous trauma or skeletal disorders was excluded from the study.

All the measurements were taken with the help of osteometric board and weighing machine. Three readings were taken for each parameter at different times and the average was recorded. Range, mean, standard deviation and standard error of mean were determined for each parameter. All values were compared with series of other workers to draw the conclusions.

1. Weight of Hip Bone: Each bone was measured separately using an electronic weighing machine (Fig.1) and the weight was recorded in grams.

Fig. 1: Photograph showing measurement of weight of hip bone on weighing machine.

2. Length of Hip Bone: It is the maximum distance from the most superior point on the iliac crest to a plane drawn along the inferior surface of the ischium. It was measured with the help of an

osteometric board and the measurements were recorded in centimeters. The most superior point of the iliac crest was placed in contact with the fixed end of the board and the inferior surface of the ischium was placed against the movable arm (Fig.2).

Fig. 2:Photograph showing measurement of length of hip bone on osteometric board.

3. Width of Hip Bone: It is described as the maximum distance between the anterior superior iliac spine and the posterior superior iliac spine. It was measured with the help of an osteometric board and the measurements were recorded in centimeters. The posterior superior spine was placed in contact with the fixed end of the board and the anterior superior spine was placed against the movable arm (Fig.3).

Fig. 3: Photograph showing measurement of width of hip bone on osteometric board.

4. Coxal Index: It was calculated from the observed values of length and width of the hip bones. The formula used for finding out the coxal index is width of hip bone/ length of hip bone x 100.

Table 1: Comparison of Weight, Length, Width and Coxal index of Hip bone

Parameters		Weight (gms)	Length (cms)	Width (cms)	Coxal Index
MEAN	R	136.71	19.77	14.14	71.56
	L	124.82	19.60	13.86	70.85
	T	130.77	19.69	14	71.21
SD	R	25.04	1.11	0.88	3.95
	L	27.25	1.27	0.68	3.31
	T	26.15	1.19	0.78	3.63
SEM	R	5.11	0.23	0.18	0.81
	L	5.56	0.26	0.14	0.68
	T	5.34	0.25	0.16	0.75
RANGE	R	88.2-178.6	17.5-22.1	12.6-16.1	60.86-78.28
	L	70.4-173.8	17-22	12.8-15.1	63.10-78.23
	T	70.4-178.6	17-22.1	12.6-16.1	60.86-78.28

SD: Standard Deviation SEM: Standard Error of Mean

R: Right L: Left T: Total

Table 2: Distribution of Weight of Hip Bone

Weight (gms)	No. of Right Hip Bones	Percentage	No. of Left Hip Bones	Percentage
70-94.9	2	8	4	16
95-119.9	5	20	6	24
120-144.9	9	36	10	40
145-179.9	9	36	5	20

Table 3: Distribution of Length of Hip Bone

Length (cms)	No. of Right Hip Bones	Percentage	No. of Left Hip Bones	Percentage
17-18.4	3	12	3	12
18.5-19.9	11	44	14	56
20-21.4	10	40	5	20
21.5-22.9	1	4	3	12

Table 4: Distribution of Width of Hip Bone

Width (cms)	No. of Right Hip Bones	Percentage	No. of Left Hip Bones	Percentage
12-12.9	2	8	1	4
13-13.9	9	36	14	56
14-14.9	10	40	6	24
15-15.9	3	12	4	16
16-16.9	1	4	0	0

Table 5: Distribution of Coxal Index of Hip Bone

Coxal Index	No. of Right Hip Bones	Percentage	No. of Left Hip Bones	Percentage
60-64.99	1	4	1	4
65-69.99	7	28	9	36
70-74.99	11	44	13	52
75-79.99	6	24	2	8

RESULTS AND DISCUSSION

The overall goal of this study was to generate data that would be useful to the orthopaedicians for geometric modeling. The study would also help the forensic experts in specimen identification and sex determination from skeleton remains. It would also be valuable for the anthropologists in their racial and population studies.

The mean weight of hip bone as studied by Singh and Raju [3] was 134.94 gm and that in the present study is 130.77gms. In the present study mean weight of hip bone is more on right side than on left side, which also holds true for the previous study. Thus the present values are consistent with the previous values.

The mean length of the hip bone in the present study is 19.77 cm on the right side and 19.60 cm on the left side. These values are again more consistent with those of Singh and Raju [3], which are 19.75 cm and 19.72 cm for right and left side respectively in males whereas in females these values are 18.13 cm on the right side and 18.21 cm on the left side. The values noted by Verneau [15] were 22.0 cm for males and 19.7 cm for females. According to Garson JG [16] the length of the hip bone in females of European population was 20.17 cm, of Australian population was 18.44 cm and of Andamanese population was 16.70 cm. The values noted by Lander [17] are 21.4 cm and 21.2 cm for right and left sides respectively. Maruyama et al [18] noted that in males the length of hip bone in males was 22.0 cm and that in females was 20.0 cm. According to Rosenberg K [19] the average length of the hip bone on the right side was 13.78 cm. The studies done by Verneau [15], Lander [17] and Maruyama et al [18] show a slightly more mean length of hip bone as compared to the present study. This probably may be due to racial variations.

In the present study mean width of hip bone is 14.14 cm on right side and 13.86 cm on left side. Singh and Raju [3] noted that in males the width of hip bone was 14.32 cm on the right side and 14.35 cm on the left side in males, whereas in females the values were 13.78 cm on both the right and 1eft side. The readings noted by Verneau [15] were 16.4 cm in males and 15.6 cm in females which are higher than the present study. Maruyama et al [18] noted that in males the width of the hip bone was 13.6 cm and in females it was 13.1 cm, which are lower than the present study readings. According to Griffith [20] the readings on the left side were more than on the right side (width of hip bone was 14.48 cm and on left side it was 15.24 cm), whereas in the present study the values for the width of hip bone are more on the right side.

The coxal index in present study is 71.56 on right side and 70.85 on left side. The values are consistent with values taken by Garson [16] in Andamenese, Peruvian, New Caledonian and Savage Islander populations. The values noted by Verneau [15] and Broad [21] are higher compared to present study values.

CONCLUSION

In the present study it was observed that there was an overall greater robusticity of right hip bone. The values noted during the present study are more consistent with the study conducted by Singh and Raju [3]. The difference seen between the values of present study and that of other workers could be explained on the basis of ethnic and racial variations.

However it should be kept in mind, that the present study had a smaller number of hip bones, so it is worthwhile to perform similar study on more number of hip bones for its theoretical and practical importance in the coming years.

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