

## Sex Determination of Human Hip Bone by Metric Analysis of Ilium

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### Abstract

**Background:** Identification of sex of an individual from human skeleton is important for forensic experts. The hip bone is ideal bone for sex determination. **Material & Method:** Present study was done on 65 hip bones (35 male and 30 female) of known sex. Three parameters were used. **Results:** In the present study significant statistical difference was seen between the mean values of width and the distance from posterior superior iliac spine to posterior inferior iliac spine of male and female hip bones on both the sides. **Conclusion:** Since a significant difference was observed in values of width and distance from posterior superior iliac spine to posterior inferior iliac spine of male and female hip bones on the both the sides. Hence these parameters are useful in identifying the sex of ilium to determining the sex using the hip bone.

**Keywords:** Hip bone; ilium; sex determination.

### Introduction

Determination of sex of an unknown individual is one of the critical questions addressed when human skeletal remains are found both in forensic investigation and archeological studies. Therefore the study of sexual dimorphism of bones in human population is a matter of interest not only for the anatomist but also for the anthropologists and forensic experts[1]. Traditional non metrical methods such as visual impressions about the pattern of bone morphology for determination of sex from such skeletal remains depend entirely on the ability and experience of the expert and unless whole skeleton is available it is almost impossible to assign sex with hundred percent certainty in all cases. The introduction of precise metric methods not only provides simplicity and accuracy but allows no individual variation and is therefore entirely

an objective assessment[2]. Superiority of objective assessment by metrical methods over simple morphological observations has been well stressed[3]. The hip bone is the most reliable indicator for the sex determination because of the pattern of sexual dimorphism is common to whole human race[4]. Hence the hip bone is considered as the most reliable sex indicator in the human skeleton[5]. Many workers have studied various metric parameters for sexing the hip bone. The present study was done to identify the important measurements of ilium which significantly differentiates the sex of hip bone which will be useful in anatomical, anthropological, archaeological and forensic studies.

### Materials and Methods

For the study 65 hip bones (35 male and 30 female) of known sex collected from the Department of Anatomy of B.L.D.E.A's Shri B. M. Patil Medical College Hospital and Research Centre, Bijapur were selected to conduct present study. The measurements of ilium were measured by using a vernier caliper and osteometric board.

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*The following parameters measured*

1. Width: - Maximum distance between anterior and posterior ends of iliac crest measured using osteometric board (Fig 1).

2. Distance between the anterior superior iliac spines to anterior inferior iliac spine measured using vernier caliper (Fig 2).

3. Distance from posterior superior iliac spine to posterior inferior iliac spine measured using vernier caliper (Fig 3).

*Inclusion Criteria*

The adult human hip bones which were included in the study were fully ossified, not broken and not having any deformities.

*Exclusion Criteria*

The human hip bones with deformity, malunion and congenital anomalies were excluded from the study.

**Results**

All the 65 adult hip bones were measured using 3 parameters. After all the measurements were done, the observations were statistically analysed by using unpaired t- test. These male and female hip bones for both right and left sides were compared. The results are shown in tables 1-3 for all the variables used.

1) Width: The width of the hip bone of male of right side varies from 13-16 cm with an average of  $14.50 \pm 0.37$  cm and that of female of right side varies from 13.1 - 14.8 cm with an average of  $13.55 \pm 0.49$  cm. The width of the hip bone of male of left side varies from 14 -16 cm

with an average of  $14.68 \pm 0.34$  cm and that of female of left side varies from 13.4 - 14.7 cm with an average of  $13.92 \pm 0.35$  cm. The sex differences in mean values of width of hip bone of males and females is statistically significant ( $p < 0.01$ ) for both right and left hip bones.

2) Distance between the anterior superior iliac spine to anterior inferior iliac spine: - The distance between the anterior superior iliac spine to anterior inferior iliac spine in hip bone of male of right side varies from 2.6 - 4.1 cm with an average of  $3.31 \pm 0.18$  cm and that of female of right side varies from 2.6 - 3.7 cm with an average of  $3.31 \pm 0.08$  cm. In hip bone of male of left side it varies from 2.3 - 3.8 cm with an average of  $3.08 \pm 0.17$  cm and that of female of left side it varies from 2.1-3.6 cm with an average of  $3.28 \pm 0.15$  cm. The sex differences in the mean values of distance between the anterior superior iliac spine to anterior inferior iliac spine of hip bone of males and females is statistically not significant ( $p > 0.05$ ) for both right and left hip bones.

3) Distance from posterior superior iliac spine to posterior inferior iliac spine : - The distance from posterior superior iliac spine to posterior inferior iliac spine in hip bone of male of right side varies from 2.3 - 4.1 cm with an average of  $3.2 \pm 0.28$  cm and that of females of right side varies from 2.1 - 3.1 cm with an average of  $2.44 \pm 0.09$  cm. In hip bone of male of left side it varies from 2.4 - 3.9 cm with an average of  $3.10 \pm 0.23$  cm and that of females of left side varies from 2.1 - 3.8 cm with an average of  $2.62 \pm 0.31$  cm. The sex differences in mean value of distance from posterior superior iliac spine to posterior inferior iliac spine of hip bone of males and females is statistically significant ( $p < 0.01$ ) for both right and left hip bones.

**Table I.** Width (V1) in centimeters

Details of measurements	Right		Left	
	Male	Female	Male	Female
No. of Bones	16	15	19	15
Range	13-16	13.1-14.8	14-16	13.4-14.7
Mean	14.5	13.55	14.68	13.92
Standard Deviation	0.37	0.49	0.34	0.35
p Value	<0.01		<0.01	

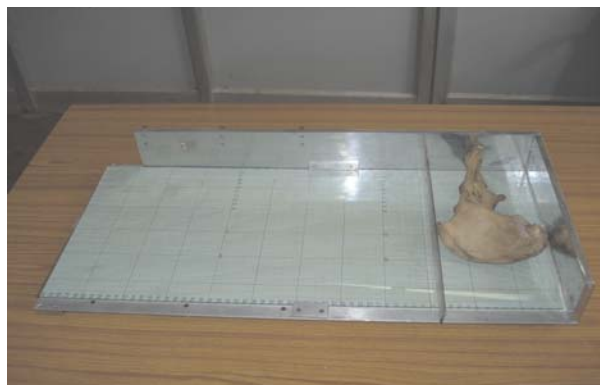
**Table II.** Distance between the anterior superior iliac spine to anterior inferior iliac spine (V2) in centimeters

Details of easurements	Right		Left	
	Male	Female	Male	Female
No. of Bones	16	15	19	15
Range	2.6-4.1	2.6-3.7	2.3-3.8	2.1-3.6
Mean	3.31	3.31	3.08	3.28
Standard Deviation	0.18	0.08	0.17	0.15
p Value	>0.05		>0.05	

**Table III.** Distance from posterior superior iliac spine to posterior inferior iliac spine (V3) in centimeters

Details of Measurements	Right		Left	
	Male	Female	Male	Female
No. of Bones	16	15	19	15
Range	2.3-4.1	2.1-3.1	2.4-3.9	2.1-3.8
Mean	3.2	2.44	3.10	2.62
Standard Deviation	0.28	0.09	0.23	0.31
p Value	<0.01		<0.01	

**Fig 1.** Width measured using osteometric board (Photo 1)



**Fig 2.** Distance between the anterior superior iliac spines to anterior inferior iliac spine measured using vernier caliper (Photo 2)



**Fig 3.** Distance from posterior superior iliac spine to posterior inferior iliac spine measured using vernier caliper



## Discussion

### Width

In the present study the mean value of the width in the hip bones of right side of male hip bone is 14.50 cm and in female is 13.55 cm and on the left side it is 14.68 cm in males and 13.92 cm in female hip bones. Steyn and Iscan[6] found in their study that the mean value was 15.92 cm in males and 15.45 cm in females. Patriqnin and Steyn[7] based on the study of 400 bones found the mean value to be 16.31 cm with range of 14.5 - 18.5 cm in males and 16.09 cm the mean value, with the range of 14.2 - 18.3 cm in females. Davivongs[8] studied 50 male and 50 female bones and found that the mean value to be 14.79 cm with the range of 13.3 - 16.7 cm in males and mean value in females to be 14.21 cm with the range of 12.6 - 16.1 cm. Rajangam and Janakiram[9] studied 140 hip bones of Karnataka origin and found that the mean value is 14.43 cm in males and 13.50 cm in females. Singh and Raju[10] based on the measurements of 120 male and 80 female hip bones found the mean value to be 14.31 cm in males and 13.77 cm in females of right side and 14.35 cm in males and 13.77 cm in females of left side. Camacho and Pellico[11] found the mean value to be 15.07 cm in males and 14.78 cm in females based on study of 42 hip bones.

### *Distance between anterior superior iliac spines to anterior inferior iliac spine*

In the present study the mean value of the distance between the anterior superior iliac spine to anterior inferior iliac spine in the hip bones of right side of male's hip bone is 3.31 cm and of female is 3.31 cm and on the left side it is 3.08 cm in males and 3.28 cm in female hip bones while results of study conducted by Camacho and Pellico[11] showed the mean value to be 4.26 cm in males and 4.37 cm in females.

### *Distance from posterior superior iliac spine to posterior inferior iliac spine*

In the present study the mean value of the distance from the posterior superior iliac spine

to posterior inferior iliac spine in the hip bones of right side the male hip bone is 3.20 cm and of female is 2.44 cm and on the left side it is 3.10 cm in males and 2.62 cm in female hip bones as compared to Isaac[12] in his study found the mean value to be 2.76 cm in males and 2.52 cm in females.

## Conclusion

In the present study significant statistical difference was seen in between the mean values of width and the distance from posterior superior iliac spine to posterior inferior iliac spine of male and female hip bones on the both the sides. Hence these parameters are useful in identifying the sex of ileum thus determining the sex of the human hip bone.

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