

A study of sexual dimorphism of human hip bone by measurements between ileum and pubis

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Abstract

Background: Identification of sex of an individual from human skeletal remains is of great medicolegal significance. The hip bone is considered as an ideal bone for sex determination as it provides the highest accuracy levels for sex determination.

Aim: The present study was done to find out important measurements between ileum and pubis that would significantly differentiate the sex of human hip bone.

Methods: For this study 65 human hip bones (35 male and 30 female) of known sex were obtained from the department of Anatomy. Three parameters were used for determination of sex of human hip bone. These were 1) Distance between anterior inferior iliac spine to pubic tubercle 2) Distance between anterior inferior iliac spine to superior end of the symphyseal surface and 3) Distance from the anterior inferior iliac spine to iliopubic eminence. These parameters were measured using the instrument vernier caliper.

Results: In the present study significant statistical difference was seen in between the mean values of 1. Distance between the anterior inferior iliac spine to pubic tubercle. The mean value on the right side was found to be 8.86 cm in males and 6.93 cm in females. On the left side the mean value was found to be 8.12 cm in males and 6.20 cm in females. 2. Distance between the anterior inferior iliac to superior end of symphyseal surface. The mean value on the right side was found to be 10.05 cm in males and 8.26 cm in females. On the left side the mean value was found to be 8.42 cm in males and 9.83 cm in females. 3. Distance from the anterior inferior iliac spine to iliopubic eminence. The mean value on the right side was found to be 4.9 cm in males and 3.22 cm in females. On the left side the mean value was found to be 4.12 cm in males and 2.67 cm in females. The mean values of all the three parameters mentioned above showed statistically significant differences between male and female hip bones.

Conclusion: These parameters are useful in identifying the sex of ileum and pubis, thus determining the sex of the human hip bone.

Key words: Hip bone, ileum, pubis, sexual dimorphism, parameters.

Introduction

A basic issue in physical and forensic anthropology is sex determination from the complete and fragmentary skeletal remains.^[1] 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.^[2] 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^[3]. The introduction of precise measurement methods not only provides simplicity and accuracy but allows no individual variation and is therefore entirely an objective assessment.^[3] Superiority of objective assessment by metrical methods over simple morphological observations has been well stressed^[4]. 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^[5]. Hence the hip bone is considered as the most reliable sex indicator in the human skeleton^[6]. Many

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workers have studied various metric parameters for sexing the hip bone^[6,7]. The present study was done to identify the important measurements between ileum and pubis that will significantly differentiate the sex of hip bone which will be useful in anatomical, anthropological, archaeological and forensic studies.

Materials and Methods

Sixty five human hip bones (35 male and 30 female) of known sex collected in the department of anatomy are taken for the study. The hip bone was studied by various parameters^[8,9] and instrument such as vernier calipers are used for the measurements. The various parameters used are :

1. Distance between anterior inferior iliac spine to centre of pubic tubercle (Figure 1).
2. Distance between anterior inferior iliac spine to the most superior end of the symphyseal surface (Figure 2).
3. Distance from the anterior inferior iliac spine to centre of iliopubic eminence (Figure 3).

Figure 1. Distance between anterior inferior iliac spine to pubic tubercle



Figure 2. Distance between anterior inferior iliac spine to superior end of the symphyseal surface



Figure 3. Distance from the anterior inferior iliac spine to iliopubic eminence



The observations of all the parameters were statistically analyzed by using unpaired t-test.

Inclusion Criteria: Bones with the following conditions were included in the study:

1. Adult fully ossified
2. Not broken
3. Not having any deformities.

Exclusion Criteria: Bones with the following conditions were excluded from the study:

1. Deformed bones
2. Malunited bones
3. Bones with congenital anomalies.

Results:

The present study was done on 65 hip bones (35 male and 30 female) of known sex collected in department of Anatomy. All the 65 adult hip bones were measured using 3 parameters after all the measurements were done, the observations were statistically analyzed 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. The distance between the anterior inferior iliac spine to pubic tubercle in hip bone of male of right side varies from 8.8-8.9 cm with an average of 8.86 ± 0.05 cm and that of females of right side varies from 6.7-7.1 cm with an average of 6.93 ± 0.16 cm.
In hip bone of male of left side it varies from 7.0-8.4 cm with an average of 8.12 ± 0.50 cm and that of female of left side it varies from 3.5-6.9 cm with an average of 6.20 ± 1.22 cm.

The sex differences in the mean values of distance between the anterior inferior iliac spine to pubic tubercle of hip bone of males and females is

statistically significant ($p < 0.01$) for both right and left hip bones.

- The distance between the anterior inferior iliac spine to superior end of the symphyseal surface in hip bone of male of right side varies from 9.9-10.5 cm with an average of 10.05 ± 0.30 cm and that of females of right side varies from 8.2-8.3 cm with an average of 8.26 ± 0.05 cm.

In hip bone of male of left side it varies from 8.3-8.6 cm with an average of 8.42 ± 0.12 cm and that of females of left side it varies from 9.6-10.1 cm with an average of 9.83 ± 0.21 cm.

The sex differences in the mean values of distance between the anterior inferior iliac spine to superior end of the symphyseal surface of hip bone of males and females is statistically significant ($p < 0.01$) for both right and left hip bones.

- The distance from the anterior inferior iliac spine to iliopubic eminence in hip bone of male of right side varies from 4.4-6.4 cm with an average of 4.9 ± 1.00 cm and that of female of right side varies from 2.8-3.5 cm with an average of 3.22 ± 0.24 cm.

In hip bone of male of left side it varies from 3.6-6.9 cm with an average of 4.12 ± 0.97 cm and that of females of left side it varies from 2.6-2.9 cm with an average of 2.67 ± 0.85 cm.

Table 1. Distance (cm) between the anterior inferior iliac spine to pubic tubercle (V1)

Details of measurements	Right		Left	
	Male	Female	Male	Female
No. of Bones	3	9	7	7
Range	8.8-8.9	6.7-7.1	7.0-8.4	3.5-6.9
Mean	8.86	6.93	8.12	6.20
Standard Deviation	0.05	0.16	0.50	1.22
p Value	<0.01		<0.01	

Table 2. Distance (cm) between the anterior inferior iliac spine to superior end of the symphyseal surface (V2)

Details of measurements	Right		Left	
	Male	Female	Male	Female
No. of Bones	4	3	4	9
Range	9.9-10.5	8.2-8.3	8.3-8.6	9.6-10.1
Mean	10.05	8.26	8.42	9.83
Standard Deviation	0.30	0.05	0.12	0.21
p Value	<0.01		<0.01	

Table 3. Distance (cm) from the anterior inferior iliac spine to iliopubic eminence (V3)

Details of measurements	Right		Left	
	Male	Female	Male	Female
No. of Bones	4	13	11	6
Range	4.4-6.4	2.8-3.5	3.6-6.9	2.6-2.9
Mean	4.9	3.22	4.12	2.67
Standard Deviation	1.00	0.24	0.97	0.85
p Value	<0.05		<0.01	

The sex difference in the mean values of distance from the anterior inferior iliac spine to iliopubic eminence is found to be more significant of hip bone of left side in both males and females ($p < 0.01$) than on right side of hip bones in both males and females ($p < 0.05$).

Discussion:

1. Distance between the anterior inferior iliac spine to pubic tubercle (V1).

In the present study the mean value of the distance between the anterior inferior iliac spine to pubic tubercle in the hip bones of both sides the male hip bones is more than female hip bones by more than 1.5 cm.

The mean value on the right side was found to be 8.86 cm in males and 6.93 cm in females.

On the left side the mean value was found to be 8.12 cm in males and 6.20 cm in females.

Pellico and Camacho^[8] found the mean value to be 8.72 cm in males and 8.08 cm in females.

Sharma G and Vijayvergiya T^[9] in their study found the mean value to be 7.67 cm on right side and 7.57 cm on left side in males and 7.38cm on right side and 7.28 cm on left side in females.

Parameter	Present study				Pellico and Camacho ^[8] study Sharma G & Vijayvergiya T ^[9]		Sharma G & Vijayvergiya T ^[9] study			
	Right side		Left side		Male	Female	Right side		Left side	
Mean values of V1	Male	Female	Male	Female			Male	Female	Male	Female
	8.86cm	6.93cm	8.12cm	6.20cm	8.72cm	8.08 cm	7.67cm	7.38cm	7.57cm	7.28cm

In the present study significant statistical difference was seen in between the mean values of the distance between anterior inferior iliac spine to public tubercle of male and female hip bones.

2. Distance between the anterior inferior iliac to superior end of symphyial surface (V2).

In the present study the mean value of the distance between the anterior inferior iliac spine to superior end of symphyial surface in the hip bone of right side the male hip bones is more than female hip bones by

more than 1.5 cm.

On the left side it is more in female hip bones than male hip bones by more than 1cm. The mean value on the right side was found to be 10.05 cm in males and 8.26 cm in females. On the left side the mean value was found to be 8.42 cm in males and 9.83 cm in females.

Pellico and Camacho^[8] in their study found the mean value to be 10.21 cm in males and 9.88 cm in females.

Parameter	Present study				Pellico and Camacho ^[8] study Sharma G & Vijayvergiya T ^[9]	
	Right side		Left side		Male	Female
	Male	Female	Male	Female		
Mean values of V2	10.05cm	8.26cm	8.42cm	9.83cm	10.21cm	9.88cm

In the present study significant statistical difference was seen in the distance between anterior inferior iliac spine to superior end of symphyial surface of male and female hip bones.

3. Distance from the anterior inferior iliac spine to iliopubic eminence(V3).

In the present study the mean value of the distance from anterior inferior iliac spine of iliopubic eminence in the hip bone of right side the male hip bones is more than female hip bones by more than 1.5 cm.

On the left side it is more in male hip bones than

female hip bones by more than 1 cm.

The mean value on the right side was found to be 4.9 cm in males and 3.22 cm in females. On the left side the mean value was found to be 4.12 cm in males and 2.67 cm in females.

Pellico and Camacho^[8] in their study found the mean value to be 4.01 cm in males and 3.55 cm in females.

Sharma G & Vijayvergiya T^[9] in their study found the mean value to be 3.52 cm on right side and 3.62cm on left side in males and 3.44cm on right side and 3.52cm on left side in females.

Parameter	Present study				Pellico and Camacho ^[8] study Sharma G & Vijayvergiya T ^[9]		Sharma G and Vijayvergiya T ^[9] study			
	Right side		Left side		Male	Female	Right side		Left side	
	Male	Female	Male	Female			Male	Female	Male	Female
Mean values of V3	4.90cm	3.22cm	4.12cm	2.67cm	4.01cm	3.55cm	3.52cm	3.44cm	3.62cm	3.52cm

In the present study significant statistical difference was seen in the between mean values of the distance from anterior inferior iliac spine to iliopubic eminence of male and female hip bones.

Conclusion: In the present study significant statistical difference was seen in between the mean values of Distance between anterior inferior iliac spine to

pubic tubercle, Distance between anterior inferior iliac spine to superior end of the symphyial surface and Distance from the anterior inferior iliac spine to iliopubic eminence of male and female hip bones on the both the sides. Hence these parameters are the useful in identifying the sex of ileum and pubis, thus determining the sex of the human hip bone.

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