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Original Research Article

NEWER DIMENSIONS IN SEX DIFFERENCES OF ISCHIAL PARAMETERS OF HUMAN HIP BONE- A MORPHOMETRIC STUDY IN NORTH INDIAN POPULATION

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ABSTRACT

Background: Hip bone is the most sexually dimorphic bone in adult human skeleton, which provides sufficient evidence for sex determination even if fragmentary remains are available, and thus it is of great use both for medico-legal and archaeological purposes. Recent improved researches on metric assessment of various parameters of hip bone are an effort to decrease ambiguity in assessment methods. Present study aims to determine the sexual dimorphism in the morphometric parameters of ischial component of dry hip bone.

Material and Methods: Present study was conducted on 100 undamaged hip bones, of known sex and unknown age (M:F=80:20, R:L= 50:50) procured from the Department of Anatomy, Government Medical College, Amritsar. The various dimensions measured were (1) Height of Ischium, (2) Length of Ischium upto the farthest point on acetabular rim, (3) Lower Spinal Height, (4) Front Spinal Height. The observations were statistically evaluated to find out sex & side related differences.

Results: All these parameters were significantly longer in males as compared to females. Also these were more on right side in both sexes but the difference was statistically insignificant.

Conclusions: The results of the present study can be used for sex determination from the fragmentary remains of hip bone. The study also advocates a need for more studies of similar parameters for other regional populations to build up larger databases due to paucity of comparative data.

KEY WORDS: Ischium, Hip Bone, Sex Determination, Sexual Dimorphism, Forensic.

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INTRODUCTION

The nature and degree of sexual differentiation in the pelvis has long been of interest to anatomists and anthropologists. It is also of practical importance to obstetricians and to forensic experts who would identify skeletal remains. The need for accurate identification of human skeletal remains is gaining importance in recent years, due to worldwide increasing crime rates. Thus new and more accurate means of determining the age, sex and race are needed [1].

Ascertaining a biological profile from the skeleton is a vital component in both medico-legal and archaeological settings and one of the prime attributes to identify is the individual's sex. Sexual dimorphism between the male and

female can be best observed primarily on the cranium and pelvis of human [2].

Hip Bone is the most sexually dimorphic bone in adult human skeleton, which provides sufficient evidence for sex determination even when fragmentary remains are available [3-5]. It displays differences in morphology in the two sexes due to different reproductive functions, which are influenced by sex hormones. Therefore, shapes and sizes of hip bone are different in males and females that make it interesting anatomically and anthropologically [6]. Thus an awareness of the average dimensions of the hip bone in both sexes will also help in early detection of disputed sex by forensic experts [7-9].

A great deal of variation in skeleton, also exists at the population level, necessitating group specific standards. Race and population differences have been found throughout the skeleton [1]. Though non-metric methods such as visual examination of bone morphology for sex determination is entirely dependent on experience and expertise but anthropometry plays some role in creating a data which can be useful for sex determination [6].

MATERIALS AND METHODS

The material for the present study consisted of 100 undamaged adult human hip bones of known sex (Males:Females= 80:20) and side (Males Right: Left= 40:40, Female Right: Left= 10:10). These were procured from Department of Anatomy, Government Medical College, Amritsar, Punjab, India. The bones were without any pathological changes. For each of these hip bones, the following four variables were measured:

Height of Ischium: It was termed as Length of ischium by Davivongs. [10] Seidler [11] described it as the greatest distance between the central point of acetabulum and the farthest point on inferior aspect of ischial tuberosity which has been named *ischial point* by Thieme [12] (AB in Fig. 5). For locating the central point of acetabulum, Schultz [13] had described that there is frequently an irregularity both in the acetabulum and inside the pelvis. He also described a change in thickness of bone in acetabulum which may be seen by holding the bone upto the light. He further mentioned that often there is a notch in the border of the articular surface in the acetabulum. All these have been used as landmarks of central point, however in the present study, the first method; i.e similar irregularity both on inner and outer surface of acetabulum was taken as the central point to determine the length of ischial bone. The height of ischium was recorded with the help of vernier calipers.

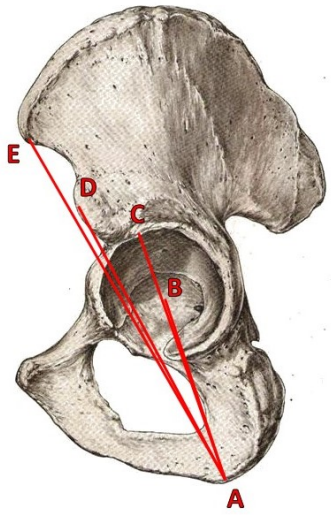
Length of Ischium upto the farthest point on acetabular rim: It was measured with vernier calipers as the distance from the ischial point (vide sr. no. 1 above) to the farthest point on the rim of acetabulum (AC in Fig. 1) [12].

Lower spinal height – It was measured with vernier calipers as the distance between ischial tuberosity and anterior inferior iliac spine [11]. (AD in Fig. 1).

Front spinal height – It was measured with the vernier calipers as the distance between ischial tuberosity and anterior superior iliac spine [11]. (AE in Fig. 1).

The values recorded for all these parameters were then tabulated and statistically analyzed using SPSS Version 17, to find out the sexually dimorphic significant parameters and to find if there is any significant difference between the sides in both the sexes.

Fig.1: Left sided hip bone showing points to measure ischial parameters.



RESULTS

For all the measured parameters, the mean, standard deviation and SE of mean were calculated. To this the Independent Student's t-test for equality of means was applied and 't' and

Table 1: Mean values, Standard deviation, Range and P-values for various parameters studied in both sexes on both sides.

Sr. No.	Parameter	Males (N=80) Mean ± S.D.		Females (N=20) Mean ± S.D.		P-value	
		Right	Left	Right	Left	For Sex	For Side
1	Height of Ischium	8.09 ± 0.53 (7.04 – 9.10)	8.05 ± 0.61 (7.21 – 9.40)	7.33 ± 0.81 (6.02 – 8.41)	7.30 ± 0.79 (6.37 – 8.77)	0	0.607 (M) 0.833(FM)
2	Length of Ischium upto farthest point on acetabular rim	10.68 ± 0.58 (9.75 – 11.90)	10.67 ± 0.64 (9.62 – 12.13)	9.62 ± 0.93 (8.43 – 11.01)	9.51 ± 0.87 (8.53 – 11.71)	0	0.878(M) 0.426 (FM)
3	Lower Spinal Height	12.66 ± 0.80 (11.06 – 14.40)	12.57 ± 0.85 (11.17 - 14.30)	11.57 ± 1.05 (9.62 – 12.97)	11.34 ± 1.13 (9.40 – 13.23)	0.02	0.878(M) 0.426 (FM)
4	Front Spinal Height	16.52 ± 0.95 (15.00 – 18.70)	16.39 ± 1.01 (15.00 – 18.50)	15.10 ± 1.65 (12.22 – 17.20)	14.96 ± 1.30 (12.52 – 16.50)	0	0.087 (M) 0.516 (FM)

'p-values' were calculated to find out the significance of the differences between the means for the two sexes. The results have been tabulated in Table 1. On interpretation it can be seen that all the four parameters i.e. Height of Ischium, Length of Ischium upto farthest point on acetabular rim, Lower Spinal Height, Front Spinal Height are showing significant difference between the two sexes, being larger in males. Also when compared between the two sides, all these parameters were longer on right side as compared to left side in both the sexes, although no significant difference could be found in either sex.

DISCUSSION

Sex differences in the human pelvis are well defined in different literature and contributions from anatomists, anthropologists, and obstetrician all are there on this topic. The action of oestrogens on osteoblastic activity is a well-known fact, today leading to its differential growth according to reproductive requirement [14].

Height of Ischium: The authors of the present study have already discussed regarding the dimorphism in height of ischium in their previous study [15]. Further comparative data from more studies has been added in Table 2.

Table 1 shows that in the present study, Ischium was significantly longer in males as compared to females. As far as the sides were concerned, though it was slightly more towards the right side in both the sexes, the differences were statistically insignificant.

It can be seen in Table 2 that previous studies in various population groups yielded similar results. It can also be interpreted that the values of the present study are more than those of Theresa [17] & Gupta et al [7] on Lagos & North Indian population respectively. Also the values are less than all other population groups i.e. Japanese, American Whites, American Blacks, Jharkhand & Egyptian populations. [16,18, 19] Although results of all these studies are in consonance with Washburn's [20] view who suggested that the height of Ischium is proportional to the overall body size and reflects robusticity of male skeleton, nevertheless a wide range of racial influence can be seen in the height of Ischium.

Length of Ischium to farthest point on acetabular rim: As can be seen in Table 1, in the present study this parameter was found to be statistically longer in males as compared to females, and was also longer on right side in both sexes although the difference was insignificant. Thieme [12] found this diameter to be an improved index over ischio pubic index. No previous data was available for comparison.

Lower Spinal Height: It can be seen in Table 1 that in the North Indian sample, the average lower spinal height was significantly more in males as compared to males. But when compared on the two sides, although being slightly more towards right side in both the sexes, the difference was statistically insignificant. However no comparative data could be traced in the accessible literature.

Front Spinal Height: Table 1 shows the front spinal height to be significantly longer in males as compared to females. Although being slightly

Table 2: Comparison of Ischial Length/Height in different populations.

Authors	Race	Mean ± S.D.	
		Males	Females
Kimura (1982) [16]	Japanese	10.8 ± 3.78	9.82 ± 3.98
Kimura (1982) [16]	American Whites	11.6 ± 6.38	10.17 ± 5.18
Kimura (1982) [16]	American Blacks	11.17 ± 0.58	10.68 ± 0.58
Theresa (2014) [17]	Lagos	6.89 ± 0.58	6.69 ± 8.47
Kumari & Singh (2016) [18]	Jharkhand	10.68 ± 0.58	10.68 ± 0.58
Gupta et al (2017) [7]	North Indian	7.024 ± 4.58[R] 6.992 ± 4.71[L]	6.526 ± 3.78[R] 6.50 ± 3.73[L]
Mostafa et al (2017) [19]	Egyptian	9.58 ± 4.1[R] 9.61 ± 3.9 [L]	8.49 ± 3.5 [R] 8.53 ± 3.4 [L]
Present Study	North Indians	8.07 ± .0.567	7.31 ± 0.781

more towards right side in both sexes, difference was statistically insignificant. However no earlier data was available for comparison.

Although countless studies discussing the sexual dimorphism in several parameters of hip bone are available in the accessible literature, but none of them have described the sex differences in these three parameters, i.e. Length of Ischium upto farthest point on acetabular rim, Lower Spinal Height, Front Spinal Height. Thus the present study is the pioneer study to report significant sexual dimorphism in the above said variables of hip bone. Further studies on these parameters will add to the geographic data and will aid in the interpretation of racial variations of the same.

The results of the present study thus suggest that sex of a hip bone can be determined with certainity using these parameters even when partial remains of the bone including ischium and anterior border of hip bone are found intact.

CONCLUSION

The hip bone is the most reliable sex indicator in adult individuals [21]. However the degree of sexual dimorphism varies geographically. There are not general diagnostic criteria that can be transferred from one population to another. Forensic anthropologists are thus attempting to develop population-specific objective standards that can be used in identification of human skeletal remains [22,23]. The results of the present study adds to the existing data and provides baseline data for some of the less studied parameters of hip bone which can help in sex determination of the hip bone when fragmentary remains are available. The study also advocates more studies of similar parameter on various regional populations to build up databases.

Conflicts of Interests: None

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