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Morphometric analysis of greater sciatic notch and its correlation to sexual dimorphisim in adult pelvic bones

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ABSTRACT

To identify the sex determination of an unknown person from the skeleton remains the first and primary important step come across by the anatomical, forensic and archaeological experts. Many researchers have considered various morphometric parameters for sex determination using hip bone. The current study was carried out to identify the sex of hip bone using various dimensions of the greater sciatic notch. Adult hip bones of a known person were studied and evaluated. The hip bones were assessed using various parameters. The posterior segment, posterior angle and index II of a hip bone were found to be more helpful in sex determination.

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INTRODUCTION

The pelvic girdle is shaped by the right and left pelvic bones in the lateral side, with the sacrum and the coccyx in the midline. The pelvic bone is made up of three parts, namely Ilium, Ischium and pubis connected by tri-radiate cartilage at birth, which later ossifies to form the acetabulum. The greater sciatic notch is sandwiched between the posterior inferior iliac spine above and the ischial spine below on the posterior part of the pelvic bone. The sacrotuberous and sacrospinous ligaments change the notch into a foramen. The greater sciatic forearm communicates the pelvic cavity with the gluteal region (Collins *et al.*, 2008).

The greater sciatic notch is highly dimorphic part of the pelvic bone, which helps to determine the sex of an individual from the pelvic bone of skeletal remains. It is extensive and shallow in female and deep and narrow in male. The difference between male and female pelvis is mainly due to the process of passing of foetus through the pelvic cavity during parturition. The pelvic bone is considered to be one of the ideal bone for determination of sex apart from showing the differences between the two sexes. It also shows the special adaptation of female pelvic bone for childbearing (Daniel, 2014). The greater sciatic notch and acetabulum are situating in the middle part of the pelvic bone; hence, they are better preserved (Sinha *et al.*, 2014). The greater sciatic notch has more advantage in identifying sex since it is even early recognizable in the foetus. Previous studies proved that pelvic inlet is compared with that of the shape and size of the greater sciatic notch (Walker, 2005). This study aims at measuring the angles, width, depth and other quantifiable parameters related to the greater sciatic notch and establishing the structural differences and physical dimensions of the notch in both sexes. Therefore, the learning of sexual dimorphism of bones in the human population is important stuff not for the Anthropologists, Anatomist, Obstetrician and Forensic experts (Trancho *et al.*, 1997). Differences are exaggerated by many etiological factors such as cultural anthropology, environmental and genetic factors (Leong, 2006).

MATERIALS AND METHODS

The study was conducted in the year 2018 after obtaining institutional review board clearance. About 90 adult pelvic bones of known sex (male 48, female 42) were obtained from the Department of Anatomy, Saveetha medical college and hospital, Thandalam. The differentiation of male and female hip bones was done by the presence of deep pre-auricular sulcus. Presence of deep, prominent pre-auricular sulcus was considered as female hip bone and with no pre-auricular sulcus was considered as male hip bone. The hip bones with shallow preauricular sulcus were not measured in this study.

The Piriformis tubercle was taken as the posterior point (A) (Figure 1), and the anterior point was considered as the tip of the ischial spine (B). The gap distance between posterior and anterior points is the width of the greater sciatic notch (AB). The point C is marked on the extreme depth of the greater sciatic notch. The measurement between the midpoint of A and B (O) to point C is the maximum depth of greater sciatic notch (OC). The OC depth was determined among the baseline (AB) and the deepest point (C) of the sciatic notch. OB was designated as the posterior segment.

1. The total angle of the greater sciatic notch is measured after construction (on paper) of the triangle ABC and depth OC from the above measurements, < ACB denoted the total angle.
2. Maximal width: the distance between the piriformis tubercle and the tip of the ischial spine (AB).
3. Maximal depth: perpendicular to the width (OC).
4. Index I: depth (OC) x 100/width (AB)
5. Posterior angle: < ACO.
6. Posterior segment of the width: (OB).
7. Index II: posterior segment (OB) x 100/width (AB).

The results were expressed as Mean $\pm$ SD, and statistical analysis were carried out. The posterior segment, total angle, posterior angle and index II were found to be statistically significant (P<0.05) of the unknown adult hip bone.

RESULTS AND DISCUSSION

In the present study, we measured the various parameters for determining the sexual dimorphism of the pelvic bone, and we analyzed that there are many morphometric differences in the male and female pelvic bone.

In this study, there was a significant difference between male and female hip bone morphometric measurements of the greater sciatic notch except bone depth (Tables 1, 2, 3, 4, 5, 6 and 7).

In females, all the parameters were increased significantly. The mean width of greater sciatic notch in the male in the right and left was 41.01, 39.70, and in female was 48.02, 46.44, respectively (Table 1). The mean total angle of greater sciatic notch right and left in male was 61.00, 60.01, and in female was 73.09, 68.25, respectively (Table 4). The mean posterior angle of greater sciatic notch right and left in male was 19.01, 20.01, and in female was 35.01, 31.06, respectively (Table 5). The mean of Index I and II of the greater sciatic notch in male was less compared to that of female (Table 6). The comparison of the greater sciatic notch between male and female is compared graphically for each parameter separately, and significance has been discussed below. In the present study, it was found that there was a noteworthy difference between male and female in most of the parameters. These results can be supported by a few studies where they showed a posterior angle is the best discriminating feature of the greater sciatic notch in Japan (Ari, 2005). A study done in pelvic bones showed that greater sciatic notch width is useful in differentiating male and female (Takahashi, 2006). Another study showed a posterior segment, Index 2 and posterior angle are the best to differentiate between male and female (Rajangam *et al.*, 1991). A Nigerian study showed only posterior angle, and Index 2 are most accurate 90% in differentiating the sexes (Dnyanesh, 2013). A study showed that the depth of the greater sciatic notch was more in male than females in South African peoples (Patriquin *et al.*, 2005). The same result was supported by a

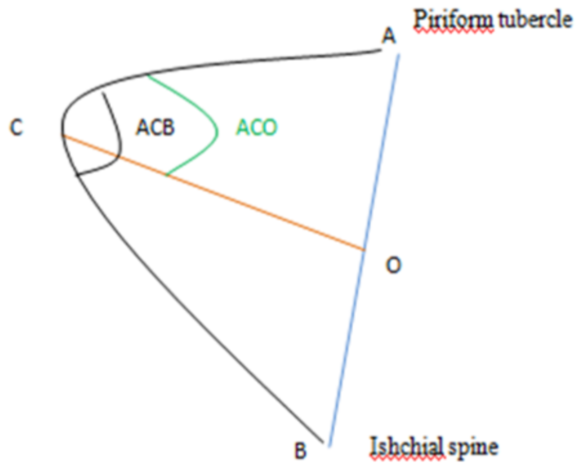

Figure 1: Showing Greater sciatic notch and various measurements

Table 1: Correlation of sex and greater sciatic notch width (mm)

Variable	Sex	Number	Mean	Standard deviation	P-value
Width right	Male	24	41.01	5.1	P<0.001
	Female	20	48.02	5.1	
Width left	Male	24	39.70	2.1	P<0.05
	Female	22	46.44	4.4	

Table 2: Correlation of sex and greater sciatic notch depth

Variable	Sex	Number	Mean	Standard deviation	P-value
Depth right	Male	24	32.34	5.2	P>0.05
	Female	20	33.25	2.7	
Depth left	Male	24	32.75	5.1	P>0.05
	Female	22	34.05	4.0	

Table 3: Correlation of sex and posterior segment of greater sciatic notch

Variable	Sex	Number	Mean	Standard deviation	P value
Posterior segment right	Male	24	12.02	2.8	P<0.05
	Female	20	22.00	4.7	
Posterior segment left	Male	24	11.89	3.7	P<0.05
	Female	22	22.54	5.1	

Table 4: Correlation of sex and greater sciatic notch total angle

Variable	Sex	Number	Mean	Standard deviation	P value
Total angle right	Male	24	61.00	6.9	P<0.05
	Female	20	73.09	6.2	
Total angle left	Male	24	60.01	5.5	P<0.05
	Female	22	68.25	6.3	

Table 5: Correlation of sex and posterior angle of greater sciatic notch

Variable	Sex	Number	Mean	Standard deviation	P value
Posterior angle right	Male	24	19.01	4.2	P<0.05
	Female	20	35.01	5.0	
Posterior angle left	Male	24	20.01	6.5	P<0.05
	Female	22	31.06	5.3	

Table 6: Correlation of sex and Index I of greater sciatic notch male

Variable	Sex	Number	Mean	Standard deviation	P value
Index I right	Male	24	81.02	12.5	P<0.05
	Female	20	67.01	6.2	
Index I left	Male	24	79.07	10.1	P<0.01
	Female	22	72.01	8.3	

Table 7: Correlation of sex and Index II of greater sciatic notch

Variable	Sex	Number	Mean	Standard deviation	P value
Index II right	Male	24	28.09	7.5	P<0.001
	Female	20	46.01	7.2	
Index II left	Male	24	28.05	9.6	P<0.001
	Female	22	45.55	8.3	

study done in dead human fetus among south Indian Population (Devadas *et al.*, 2017). The more widening of, the greater sciatic notch was seen in the posterior segment in the females, and that affects all the remaining parameters indicating posterior segment is the best discriminating parameter (Steyn and Iscan, 2008). The Index 2 parameter was more in a female with a significant difference. The index 2 differences depend on the posterior segment and in this study, posterior segment measurements are more, so the index 2 is also more in females. These parameters can be influenced not only by the posterior segment but also by the development of surrounding structures like the ischial spine, piriform tubercle and sacrum. These measurements are also influenced by age, obesity, nutritional condition, lifestyle and childbirth. This study used all the parameters for sex differentiation so that the conclusion can be exact. These measurements can be measured using digital and electronic software so that the error can be reduced and the result can be accurate.

CONCLUSION

This study concludes the total angle, posterior segment, posterior angle, Index I, Index II and width of the greater sciatic notch are significant in differentiating the sex. The results among the different population can be used for comparison to identify skeletal remains.

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