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Original Research

Estimation of Bilateral Morphometric Variations in Greater Sciatic Notch of Human Hip Bones: An Anatomical Study

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ABSTRACT:

Background: Hip bone is an enigmatic bone and has surprised investigators every time they have tried to determine sex by using any part of hip bone. On the other hand, some parts of the hip bone are liable for decomposition and this makes sex determination of deceased more difficult. Thus, in current study we planned to establish the greater sciatic notch as reliable sex indicator even if we have only hip bone of one side available. **Materials and Methods:** The present study was conducted on 50 adult dry human hip bones of unknown age and sex procured from the post graduate department of anatomy, Government medical college Jammu, India. Later, the sex of bones were identified and various parameters under study viz., width of notch (AB), depth of notch (OC), posterior segment width of notch (OB), total angle of notch (ACB), posterior angle of notch (BCO), Index I of notch (depth/width×100) and Index II of notch (posterior segment/width ×100) were measured and data were analyzed. The data collected was recorded in Microsoft Excel Spreadsheet, compiled and thus subjected to the appropriate analytical statistical tests (t-test) using SPSS v.17 statistical software. P value below 0.05 was considered as significant. **Results and Conclusion:** The results of the current study concluded that the maximum width of the notch (AB), total angle of notch (ACB), posterior segment width of notch (OB), depth of the notch (OC), posterior angle of notch (BCO), Index I of notch (depth/width×100) and Index II of notch (posterior segment/width ×100) were highly indicative of sexual difference (with p value below0.05) on both the sides.

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INTRODUCTION

The hip bone or pelvic girdle has universally been accepted as the most dimorphic bone and the most reliable sex indicator. These differences exhibited by human hip bone are present right from the fetal stage (1). Apart from the sexual differences, the differences in the morphometry are also seen bilaterally. Besides Anatomy, in forensic science as well as in archaeological context; gender, age, and stature are considered as the three main factors in Taxonomy and the very first step of identification of any individual includes the determination of sex from its skeletal remains (2). The pelvis and the skull are the most dependable sources for determination of sex amongst human bone fragments (3).

This enigmatic bone serves as sex indicator because of the fact that most of the parts of the hip bone decompose at a slower pace as compared to the central parts of the bone viz. acetabulum, greater sciatic notch which is covered by a thin layer of cortical bone and can be easily scored for identification of deceased (4, 5, 6).

The nature has allowed the individual anatomical variation and departures from the set norms within each sex as well on both sides within same individual as well and these variations can be attributed to environmental, ethnic and genetic characters (7). The greater sciatic notch is especially valuable for determination of sex because it has significant sexual differences. Female sciatic notches are wider, open and have lower width to depth ratio; while in males, the greater sciatic notch tends to be narrow and U-shaped (5, 8, 9). Coherently, males and females have different greater sciatic notch shapes due to a sex-linked adaptation of the pelvis for locomotion and reproduction in the context of a large brain size and encephalization of the fetus during evolution (2, 5, 10). With this much background, it is clearly evident that human hip bones (os coxae) can be widely used as a reliable indicator for sex determination.

MATERIALS AND METHODS

The current descriptive observational study was conducted on 50 dry adult human hip bones of unknown sex and age which were procured from the Post- graduate Deptt. Of Anatomy, Govt. Medical College, Jammu. The bones included in the study were completely ossified, were devoid of any malformations (both congenital as well as pathological) and were not broken or incomplete with intact greater sciatic notch. At first, the sex of the hip bones was decided on the basis of certain morphological features. The morphological features used for assessing sex were: acetabular diameter, obturator foramen, ischiopubic ramus, ischial tuberosity and pre-auricular sulcus. For measuring the variables under study three points were marked on the bone viz., point A- Ischial spine, point B- Piriformis Tubercle and point C- Deepest point of greater sciatic notch. Later, for each of the hip bones, the following seven variables confined to the grater sciatic notch were measured with the help of sliding vernier calipers:

1. Width of notch (AB)
2. Depth of notch (OC) where O is the point where perpendicular drawn from C intersects the imaginary line joining A and B.
3. Posterior segment width of notch (OB)
4. Total angle of notch (ACB)
5. Posterior angle of notch (BCO)
6. Index I of notch (depth/width×100)
7. Index II of notch (posterior segment/width ×100)

The data thus collected was recorded in Microsoft Excel Spreadsheet, compiled, segregated on basis of sex and side; and then subjected to the appropriate analytical statistical tests (t-test) using suitable statistical software.

OBSERVATIONS

Human dry hip bones 68 in number were studied out of which 34 were of male (17 right and 17 left) and 34 were of female (17 right and 17 left). The data obtained for different parameters under study of hip bones were noted and tabulated as in Table no.1 which shows statistical distribution of all the parameters of the greater sciatic notch of hip bones and these results were then compared for sex determination. The comparative analysis of results was then tabulated as Table no.1 which shows comparison of all the parameters of greater sciatic notch between male and female hip bones, Table no.2 which shows comparison of all the parameters of greater sciatic notch on left side and right side of male hip bones and Table no.3 which shows comparison of all the parameters of greater sciatic notch of female hip bones on both sides .

The results of the current study inferred that all the parameters of greater sciatic notch viz; maximum width AB, maximum depth OC, posterior segment of width OB, total angle ACB, posterior angle BCO, index I and index II were more in case of females as compared to males which was a statistically significant correlation for sex determination (Table 1). On the contrary, the parameters on right and left side in case of males had a statistically significant correlation for posterior segment of width of notch (OB), total angle of notch (ACB), posterior angle of notch (BCO) and index II whereas the correlation was insignificant for width of notch (AB), depth of notch (OC) and index I. While taking into consideration the comparison of all the parameters of greater sciatic notch in case of females on both right and left side, it was inferred that all the parameters viz; maximum depth (OC), posterior segment of width (OB), total angle (ACB), posterior angle (BCO), index I and index II; had statistically significant correlation except maximum width AB which had insignificant correlation. Thus, concluding that right sided hip bones are more apt in sex determination as compared to left side bones.

Table 1: Showing comparison of parameters of greater sciatic notch in male and female hip bones.

		N	Mean	Std. Deviation	Significance	
					t-value	p-value
Maximum width AB (in cm)	Males	25	3.6375	0.25676	-12.035	<0.001
	Females	25	4.8917	0.44126		
Maximum depth OC (in mm)	Males	34.	2.6167	0.28387	-3.169	0.003
	Females	34	2.9042	0.34196		
Posterior segment of width OB (in cm)	Males	34	1.0667	0.31021	-8.441	<0.001
	Females	34	1.8833	0.35834		
Total angle ACB (in degree)	Males	34	64.312	4.63402	-5.388	<0.001
	Females	34	77.166	10.7285		
Posterior angle BCO (in degree)	Males	34	22.458	7.19287	-3.334	0.002
	Females	34	30.125	8.66935		
Index I (OC/AB X100)	Males	34	72.085	7.68689	5.601	<0.001
	Females	34	59.675	7.66432		
Index II (OB/AB X100)	Males	34	29.195	7.93581	-4.538	<0.001
	Females	34	38.424	6.02566		

Table 2: Showing comparison of parameters of greater sciatic notch in left side and right side bones of males.

		N	Mean	Std. Deviation	Significance	
					t-value	p-value
Maximum width AB (in cm)	Left side	17	4.1083	0.73302	-1.267	0.212
	Right side	17	4.3583	0.63033		
Maximum depth OC (in mm)	Left side	17	2.6625	0.35486	-.872	0.388
	Right side	17	2.7542	0.37298		
Posterior segment of width OB (in cm)	Left side	17	1.2417	0.47358	-3.047	0.004
	Right side	17	1.6542	0.46436		
Total angle ACB (in degree)	Left side	17	67.687	9.32250	-1.948	0.058
	Right side	17	68.062	9.78721		
Posterior angle BCO (in degree)	Left side	17	22.083	7.54647	-4.084	<0.001
	Right side	17	30.791	7.22303		
Index I (OC/AB X100)	Left side	17	66.190	11.2397	.883	0.382
	Right side	17	63.741	7.64233		
Index II (OB/AB X100)	Left side	17	29.699	8.11762	-3.561	0.001
	Right side	17	37.604	7.23407		

Table 3: Showing comparison of parameters of greater sciatic notch of female hip bones on left side and right side.

		N	Mean	Std. Deviation	Significance	
					t-value	p-value
Maximum width AB (in cm)	Left side	17	5.1833	0.75308	-1.348	0.246
	Right side	17	5.1587	0.53143		
Maximum depth OC (in mm)	Left side	17	1.8813	0.32786	-.967	0.008
	Right side	17	2.3642	0.35689		
Posterior segment of width OB (in cm)	Left side	17	1.3017	0.42362	-3.012	0.002
	Right side	17	1.6412	0.48564		
Total angle ACB (in degree)	Left side	17	70.517	9.35612	-1.594	0.044
	Right side	17	73.062	8.67543		
Posterior angle BCO (in degree)	Left side	17	26.089	7.46579	-3.123	<0.001
	Right side	17	33.782	7.20234		
Index I (OC/AB X100)	Left side	17	64.120	10.24567	.946	0.003
	Right side	17	66.461	8.94563		
Index II (OB/AB X100)	Left side	17	26.649	8.14567	-3.212	0.001
	Right side	17	39.521	7.59784		

DISCUSSION

The present study was conducted on 50 dry human hip bones which were procured from the Post- graduate Deptt. of Anatomy of Govt. Medical College Jammu. These bones were then categorized as male and female and side determination was also done depending upon various morphological parameters. Then the various parameters related to greater sciatic notch were measured taking three landmarks into consideration viz. point A- Ischial spine, point B- Piriformis Tubercle and point C- Deepest point of greater sciatic notch. The results of the afore mentioned study statistically inferred that mean width of GSN was 3.6375± 0.25676 cm in case of males and 4.8917±0.44126 cm in case of females with a statistically significant correlation ($p<0.001$). These findings were supported positively by evidence derived from the literature of past (1, 6, 7, 11 and 12) but statistically insignificant relationship was documented by some authors (10, 14, 15). However, when both the sides were compared, the width on right side was more (4.3583± 0.63033) as compared to left side (4.1083± 0.73302) with non significant statistical correlation of 0.212. These findings derive positive support from the work done by various authors (1, 11, 12 and 13).

The observations for maximum depth of the greater sciatic notch summarized that maximum depth was more in females as compared to males with mean standing out at 2.9042 ± 0.34196 cm in case of females and 2.6167 ± 0.28387 cm in case of males with significant p value of 0.003. These findings were negated by various investigators as they concluded that depth of greater sciatic notch was more in males as compared to females (2, 6, 7, 10, 12, 14 and 16). However, the inference derived from current study related to depth of greater sciatic notch of current study was accepted by many investigators (1, 11, 12 and 15). While comparing the dimensions for depth of greater sciatic notch on both sides, it was observed that statistically significant correlation existed in females but not in males. This fact was in accordance

with findings of Kalsey G et al; 2011 (1) whereas this inference was negated by various authors (11-13).

The estimated values for the total angle of greater sciatic notch (ACB) was that it is more in females as compared to males with highly significant p value < 0.001. This conclusion was in concordance with the findings of 1, 4, 6, 7, 10 and 14. Further while comparing the measurements of total angle of greater sciatic notch on either side in both sexes, it was concluded that in both the sexes there was a statistically significant correlation. However, the posterior angle (BCO) of the greater sciatic notch was also more in females with respect to males but it carried highly significant p-value of 0.002. Various investigators also concluded that the posterior angle of the notch is more in case of females as compared to males (1, 4, 6, 7, 10 and 14). Thus, irrefutably supporting results of the afore mentioned study.

The values of the indices of greater sciatic notch calculated from the observations of present study concluded that index I was more in males as compared to females but on the contrary index II was more in females as compared to males but both carried statistically highly significant p value < 0.001. These results were in accordance with the results of 1, 6, 7, 10, and 14 but Takahashi H reported the results of indices in converse which stated that index I is more in females as compared to males and index II being more in males as compared to females (4). Further, while statistically comparing indices on right and left side; it was concluded that index I was having statistically insignificant correlation in males whereas it was significant relationship in females. However, the conclusive data related to index II revealed that the statistical relationship stood significant both in males and females. These findings were negated by some authors who reported that the relationship of these indices was insignificant (1, 12 and 14).

CONCLUSION

Human hip bones have been considered the beau ideal bone for assessing the sex from the skeletal remains of a deceased person. However, it is also liable for decomposition as well; but central parts of the bone like greater sciatic notch decomposes at a slower pace and hence, can be utilized for assessing sexual dimorphism. The results of afore mentioned study thus infer that all the parameters of greater sciatic notch viz; width, depth, total angle, posterior angle, index I and index II can be considered as reliable indicators for identifying sex from the skeletal remains of a exanimate person.

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CONFLICT OF INTEREST

None

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