

ORIGINAL RESEARCH

Sexual Dimorphism of the Greater Sciatic Notch in South Indian Population: A Morphometric Analysis

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ABSTRACT

Background: The greater sciatic notch is a critical anatomical landmark in the human pelvis, and its morphology exhibits sexual dimorphism with females exhibiting a wider and deeper notch, and longer anterior and posterior segments. These results have implications for forensic anthropology, orthopedic surgery and obstetrics, particularly in sex determination from skeletal remains and surgical approaches to the pelvis. This study investigated the sexual dimorphism of the greater sciatic notch (GSN) in adult human pelvises to determine its reliability for sex determination. **Methods:** The study was conducted for period of 3 year from 2016 to 2019 after obtaining institutional board clearance. Forty pelvic bones (20 male, 20 female) were analyzed, and six parameters were measured: width, depth, anterior segment, posterior segment, total angle, and posterior angle of the GSN. **Results:** The results showed that females have greater values in most parameters, with significant mean differences in width (10.95 mm), anterior segment (8.15 mm), posterior segment (4.34 mm), and posterior angle (8.90 degrees) The results showed statistically significant differences ($p < 0.05$) between males and females in width, anterior segment, and posterior angle, with females having greater values. The width of the GSN was found to be the most reliable parameter for sex determination, with a mean difference of 11.2mm between males and females. **Conclusion:** The study concludes that the GSN is a useful parameter for sex determination in forensic anthropology and osteology, particularly when other skeletal elements are unavailable or damaged. The findings support the use of GSN measurements in sex determination, with potential applications in human identification and forensic investigations.

Keywords: Greater Sciatic Notch, Sexual Dimorphism, Width.

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INTRODUCTION

In every element of the adult human skeleton has been shown to exhibit some degree of sexual dimorphism including the cranium, clavicle, sternum and long bones. However, it is generally accepted that the innominate bone displays the greatest degree of sexual dimorphism in humans, making it the ideal bone for sex determination.¹ Generally, the difference between male and female pelvis is the greater sciatic notch is narrower in males compared to females.² The Greater sciatic notch of hip bone is trabecular which is encased by two layers of compact bone and can survive for long time because of its high density. The greater sciatic notch has shown higher survivability

rate and it is used to determine sex of individual. The sciatic notch may be referred to by any one of several names: the greater sciatic notch, the ilio-sciatic notch, the great Sacro-sciatic notch (Grays, 1974),³ or, less commonly, incisuraischiadia major (Letterman, 1974).⁴ The structure lies on the posterior border of the innominate bone, and is formed mostly by the iliac portion but also by the ischial portion. The two portions, along with the pubic portions, achieve complete fusion as late as 17 years of age.

Thus, the greater sciatic notch shape, width, and angles helps in determining sex. The greater sciatic notch is narrower in males, wider in females. The greater values for the width and angle in females are

associated with increased backward sacral tilt and anteroposterior pelvic diameter.

AIM

To analyze the morphology and morphometry of greater sciatic notch for sex determination.

The Greater Sciatic notch which resist decomposition for long time (because of its high density) compared to other parts of hip bone is used for determining sex even from the fragmented skeletal remains. Parameters studied are Width, Depth, width of anterior segment, posterior segment, total angle and posterior angle of the greater sciatic notch.

MATERIALS AND METHODS

The study was conducted for period of 3 year from 2016 to 2019 after obtaining institutional board clearance. About 40 adult embalmed cadavers (20 male and 20 female) from Institute of Anatomy, Madras Medical College, Chennai were placed in supine position and the anterior superior iliac spine

were identified and transverse incision was made above the anterior superior iliac spine, which is extended anteriorly and posteriorly up to midline. The pelvic region was separated from the rest of the abdomen. The pelvic organs were dissected and removed. Further processing was done in 40 adult pelvic bone of known sex and marked as 20 males and 20 females. The pelvic bone was then immersed in caustic soda solution for 24 hours. The caustic soda solution was used to loosen the muscles and the ligaments that were closely applied to the bone which were resistant for removal by conventional dissection. After the removal from the caustic soda solution, they were scrubbed thoroughly with a metal brush to remove loosened muscles and ligaments. After separation of the individual hip bone, further clearing of soft tissue was done by dissection. The hip bone was immersed in hydrogen peroxide solution for 2 to 3 days. The hip bone dried in sunlight. This process was done to ensure that bone was extracted with minimal tissue.

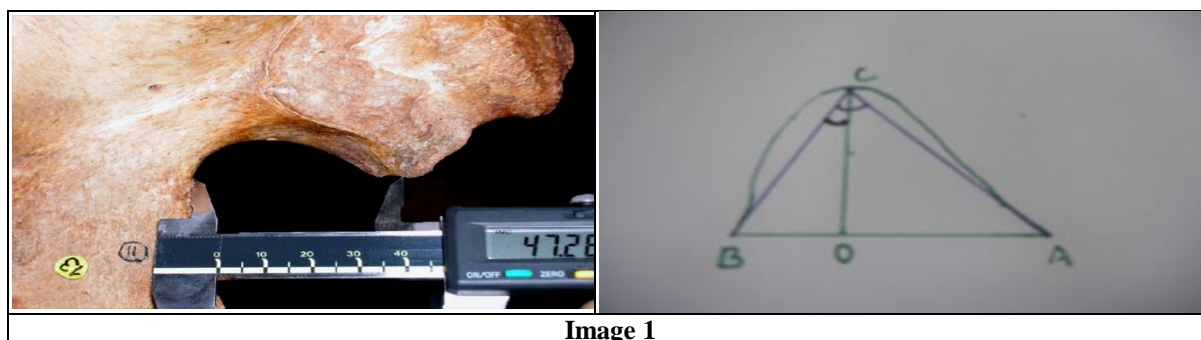


Image 1

A-Ischial spine

B-Piriform tubercle or the posterior inferior iliac spine

C-Deepest point in the greater sciatic notch

O- Point where the C meets the AB

The morpho metric measurements of the width was done by using digital vernier calipers, other parameters were measured after reconstruction of greater sciatic notch on the paper and measured with help of scale and protractor.

1. Width of the greater sciatic notch (AB): It is a distance between the ischial spine and the piriform tubercle of ilium. It can be measured from the bony prominence in the posterior inferior iliac spine if piriform tubercle is absent. This is measured by vernier calipers
2. Depth of the greater sciatic notch (OC): This is measured by reconstruction of greater sciatic notch on paper, taking a deepest point on notch and a perpendicular line drawn to AB

3. Width of the anterior segment (OA): The distance between the ischial spine to the point O
4. Width of the posterior segment (OB): The distance between the piriform tubercle or the posterior inferior iliac spine to the point O.
5. Total angle of greater sciatic notch $\angle ACB$ denotes total angle. Construction of the triangle on paper.
6. Posterior angle of greater sciatic notch $\angle BCO$ denotes the posterior angle.
7. Index I= depth / Width x 100
8. Index II= Anterior segment / Width x 100
9. Index III= Posterior segment / Width x 100

RESULTS

The results were expressed as Mean \pm SD and statistical analysis were carried out. There is statistically significant ($P < 0.05$) differences between males and females in the width, anterior segment and posterior angle of the GSN.

Sexual difference between male and female						
Table 1						
Variable	Sex	N	Mean	Std. deviation	Mean difference	p value
Width	Male	40	44.1	1.85	10.95	<0.001
	Female	40	55.68	4.84		
Depth	Male	40	28.86	3.79	1.16	0.525

	Female	40	30.02	4.21		
Anterior segment	Male	40	30.99	3.75	8.15	0.001
	Female	40	39.14	4.87		
Posterior segment	Male	40	11.86	1.33	4.34	<0.001
	Female	40	16.20	2.59		
Total Angle	Male	40	57.60	6.06	7.50	0.060
	Female	40	65.10	10.13		
Posterior angle	Male	40	22.00	3.94	8.90	<0.001
	Female	40	30.90	4.79		
Index I	Male	40	62.5	10.65	8.45	0.071
	Female	40	54.09	8.95		
Index II	Male	40	70.23	6.60	-0.37	0.890
	Female	40	70.60	5.08		
Index III	Male	40	26.83	3.54	-2.61	0.199
	Female	40	29.44	5.08		

DISCUSSION

In the present study, we measured the various parameters for determining the sexual dimorphism. The study concludes that the GSN can be used as a parameter for sex determination, with the width and anterior segment being the most reliable indicators. The females, all the parameters were increased significantly. The mean width of Greater sciatic notch in Males: 44.26mm (right), 43.94mm (left) and in Females: 55.21mm (right), 56.15mm (left). (table 1). the mean depth of greater sciatic notch in Males: 28.66mm (right), 26.66mm (left), respectively. (Table 2). The mean Anterior segment of greater sciatic notch in Males: 30.99mm (right), 31.09mm (left), respectively. (table 3). the mean posterior segment in Males: 11.86mm (right), 11.77mm (left), respectively. (Table 4). the mean total angle of greater sciatic notch is On construction of triangle, total angle measured in males right and left side were 57.60 and 56.20 degrees with standard deviation of 6.06 and 7.39. On construction of triangle, posterior angle was measured in males right and left side 22 and 24.4 degree with standard deviation of 3.94 and 4.09 respectively. The present study of width of greater sciatic notch found a mean difference of 11.2mm between males and females, which correlates with the study by Sanjeev Kumar Jain et al (2013)⁵ and also with Apoorva Tripathi et al (2014)⁶ with a mean difference of 10.85mm. The width of GSN was found to be more in females in previous studies, which is attributed to child-bearing adaptability. - The present study found a depth with a mean difference of 1.5mm co-relates with Sanjeev Kumar Jain et al (2013)⁵ with a mean difference of 1.65mm. The present study found a statistically significant difference between males and females with a mean difference of 8.06mm. The present study found a mean posterior segment with a mean difference of 4.39mm and result was supported by Shiaval Shah et al (2011)⁷ found a mean posterior segment length with a mean difference of 5.65mm. It

was observed that in the present study total angle was more for females than males 9 which was supported by Shiaval shah et al (2011)⁷ study that the total angle of GSN for males and females were 69.45 and 82.85 respectively. In the present study it was found that in females the posterior angle was more when compared to males with mean difference of 8.3-degree value is less than 0.001, extremely statistically significant. Posterior angle was more for females in previous study conducted on GSN. This parameter is of great use when determining sex. In the present study of Index I of GSN, there is statistically significant difference between males and females which was 8.74 and correlates with Gohil Dilip et al study (2013) stated that the mean Index I of GSN for male and females were 67.95 and 58.93 respectively. Index II of GSN between males and females which was statistically insignificant and in Index III mean difference of 2.61 was found between males and females which will be useful for sex determination. Overall, the discussion highlights the usefulness of the GSN as a parameter for sex determination, particularly the width and posterior segment. However, the depth of GSN was found to be less reliable for sex determination. These parameters can be influenced by the development of ischial spine, piriform tubercle and this study was done from bone retrieval from human cadaver and conclusion can be exact. These measurements can be measured using digital and electronic software so that error can be reduced. Overall, the study suggests that the GSN can be a useful parameter for sex determination in forensic anthropology and osteology.

CONCLUSION

In conclusion, our results suggest that the greater sciatic notch of hip bone is found to be useful in sex determination when a bone of unknown sex is found. The width of GSN, anterior segment of GSN, total angle of GSN, posterior angle of GSN is good sex discriminators. The depth of GSN is poor discriminators. Thus, we would have better guidelines for forensic and archeological analysis.

LIMITATIONS

The study had a small sample size of 40 pelvic bones. The study only analyzed adult pelvic bones, and further research is needed to determine the reliability of GSN measurements in sub-adult and juvenile pelvises. The study only analyzed six parameters of the GSN, and further research is needed to determine the reliability of other parameters.

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