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Determination of Sex by greater sciatic notch of Hip Bone in Bangladeshi Population

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Abstract

Background: *Identification of sex of an unknown individual from the skeletal remains is the first and the most important step encountered by the forensic experts and archiologists. The distinctive morphology of human skeleton and its clear dimorphism make it of interests from anatomical, obstetrical, radiological and anthropological point of view. The hip bone is considered as an ideal bone for sex determination as it provides the highest accuracy levels. The aim of this study was to collect data regarding morphometric measurements of greater sciatic notch of hip bone and to find out possible variations of greater sciatic notch index in different individuals in relation to sex.*

Objectives: *The cross sectional analytic study was planned to collect data regarding morphometric measurements of greater sciatic notch and also find out possible variations in male and female so that a standard data can be established for future studies in anatomy that can help orthopedic surgeons, radiologists and gynecologists to adopt appropriate plans for diagnosis and treatment.*

Methods: *The study was performed on 180 (one hundred and eighty) dry ossified human left hip bones of unknown sex collected from Department of Anatomy of different Medical College of Dhaka city. The study samples were distributed in male and female sex groups by discriminant function analysis. All the samples were studied morphologically. Measurements of greater sciatic notch were measured with the help of digital slide calipers. Paired students 't'test was done for statistical analysis of the result.*

Results: *In the present study the mean width of greater sciatic notch was greater in female than (P<0.001) male. In case of depth of greater sciatic notch significant difference (P<0.01) was found between male and female hip bone. In male, length of posterior segment of greater sciatic notch of hip bone was lower than (P<0.001) female. There was highly significant difference (P<0.001) in the mean of total angle and posterior angle of greater sciatic notch between male and female. The Genoves' sciatic notch index in male was significantly greater (P<0.001) than female.*

Key words: *Sex determination, greater sciatic notch, Genoves' sciatic notch index and discriminant function analysis.*

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Introduction

The four main features of biological identity are sex, age, stature and race. The distinctive morphology of human hip bone and its sexual dimorphism make it of interest from anatomical, anthropological and forensic points of view. The hip bone is one of the most informative bones in the skeleton because it is formed by three independent elements during sub adult life and is directly involved with childbirth.[1] The hip bone has the appearance of a propeller with a large blade (the ilium) directed upwards and a smaller blade

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(composed of the pubis anteromedially and the ischium posterolaterally) directed downwards. The two blades are almost at right angles to one another and meet in the acetabulum.[2] It not only reflects the general differences between two sexes but also special adaptation of female hip bone for child bearing.[3] Skeletal remains have been used for sexing the individual as bones of the body are last to perish after death, next to enamel of teeth. The accuracy of sex identification depends on skeletal completeness. According to workers who have studied previously, Krogman[4] found 100% accuracy with complete skeleton, 95% with pelvis alone, 92% with skull alone,98% with bone pelvis and skull together,80% with long bones alone and 98% with long bones plus pelvis together. Morphological criteria like greater sciatic notch, width of pelvis, preauricular sulcus, diameter of acetabular fossa and obturator foramen are used by most of investigator for study of sex determination. Pubic bone is the most reliable sex indicator but it is fragile, so greater sciatic notch is especially valuable in such situations because it is highly sexual dimorphic, is resistant to damage and thus can often be scored in poorly preserved skeletons. In male, greater sciatic notch tends to be narrow and U shaped while in females, it is comparatively open with lower width to depth ratio.[5] Hanihara and Kimura first used discriminant function analysis in sexing of hip bone. With discriminant function analysis and ischium-pubis index, they obtained the accuracy of 88.9% in sexing Japanese skeletons. Day and Pitcher have suggested that, in discriminant function analysis, most significant two values are total height of hip bone and index of diameter of acetabulum. Kimura described useful determinants were ischium-pubis index, greater sciatic notch index and diameter of acetabulum.[6]

Materials and Methods

The cross sectional study was carried out at Department of Anatomy, Dhaka Medical College, from January 2014 to December 2014. The study was performed on 180 dry ossified human left hip bones. Damaged, incomplete or broken hip bones were excluded. The study samples were grouped into male and female by discriminant function analysis technique and metric methods used by different authors. With the help of osteometric board, digital slide calipers and measuring scale different measurements of greater sciatic notch of hip bones were recorded in millimeters. Width of greater sciatic notch was measured as maximum distance from tubercle of pyriformis muscle located at the termination of posterior border of greater sciatic notch to ischial spine. Depth of greater sciatic notch is measured as the perpendicular distance from the deepest point (C) of sciatic notch to the width line AB. length of posterior segment of greater sciatic notch is the distance from pyriformis tubercle to the point (O) at which the greatest depth line intersected the width line i.e. (OB). Total angle of greater sciatic notch is denoted by <ACB in constructed triangle. Posterior angle of greater sciatic notch is denoted by <BCO in the constructed triangle (Fig. 1,2). Genoves' sciatic notch index was calculated by dividing the width of greater sciatic notch with the length of posterior segment of greater sciatic notch and multiplying by 100. Genoves, sciatic notch index= width of greater sciatic notch/ length of posterior segment of greater sciatic notch) x100.

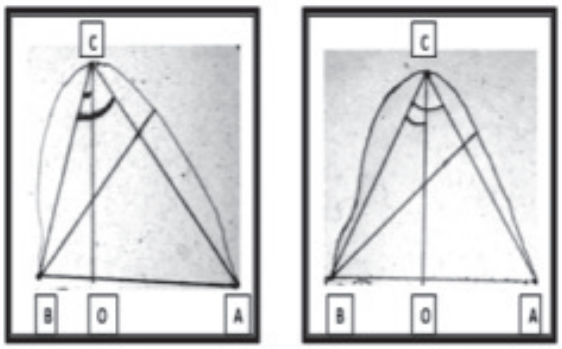

Fig-1: *Diagramatic representation of greater sciatic notch*

A - Ischial Spine,
B - Pyriformis tubercle
C - Deepest point of greater sciatic notch,
AB - Width of greater sciatic notch.
OB - Posterior segment of greater sciatic notch.
OC - Depth of greater sciatic notch.
<ACB - Total angle of greater sciatic notch.
<OCB - Posterior angle of greater sciatic notch

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The curvature of greater sciatic notch was plotted on a paper. From the deepest point(C) of the sciatic notch perpendicular line was drawn to the base line (AB) which meets at 'O'. The posterior segment designated as OB. ABC was constructed on paper.

Fig.-2: *Photograph showing the measurement of width of greater sciatic notch of left hip bone by using digital slide calipers.*

Results:

The mean width of greater sciatic notch and length of posterior segment of greater sciatic notch were higher in female than male. The mean of Genoves' sciatic notch index was higher in male than female.

Mean(±SD) width of greater sciatic notch in male and female was 37.37±2.91 mm and 45.56±4.85 mm respectively. The mean length of posterior segment of greater sciatic notch in male and female was 6.52±1.28 mm and 18.40±5.44 mm respectively.Genoves' sciatic notch index was 574.90±81.05mm in male and 247.62±56.89 mm in female (Table I, Fig. 3, 4, 5).

Table-I

Comparison of width, length of posterior segment and Genoves' sciatic notch index of greater sciatic notch of dry ossified male and female left hip bone.

Parameter	Sex		P value
	Male (n=112)	Female (n=112)	
Width in mm (Mean±SD)	37.37±2.91 (30.30-48.30)	45.56±4.85 (35.90-55.30)	0.0001***
Length of posterior Segment in mm (Mean±SD)	6.52±1.28 (30.20-13.14)	18.40±5.44 (10.20 30.20)	0.0001***
Genoves' Sciatic Notch Index (Mean±SD)	574.90±81.05 (364.86-799.42)	247.62±56.89 (188.41-520.88)	0.0001***

Figures in parentheses indicate range. Comparison between male and female done by unpaired Student's 't' test, *** = significant at P<0.001)

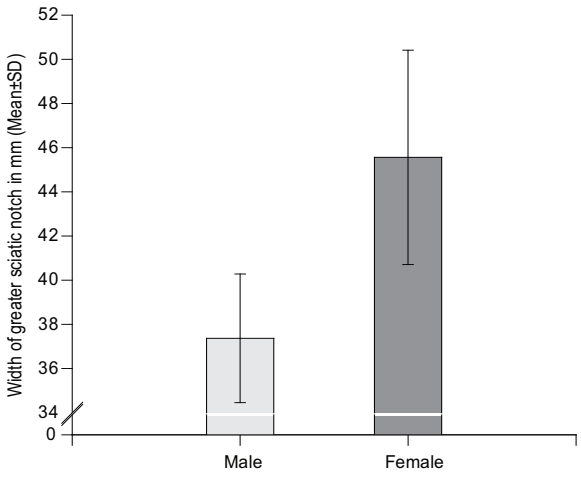

Fig-3: *Width of greater sciatic notch of dry ossified male and female left hip bone.*

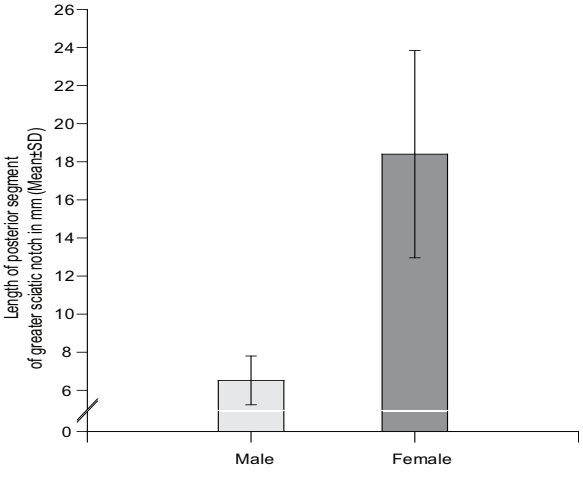

Fig-4: *Length of posterior of greater sciatic notch of dry ossified male and female left hip bone.*

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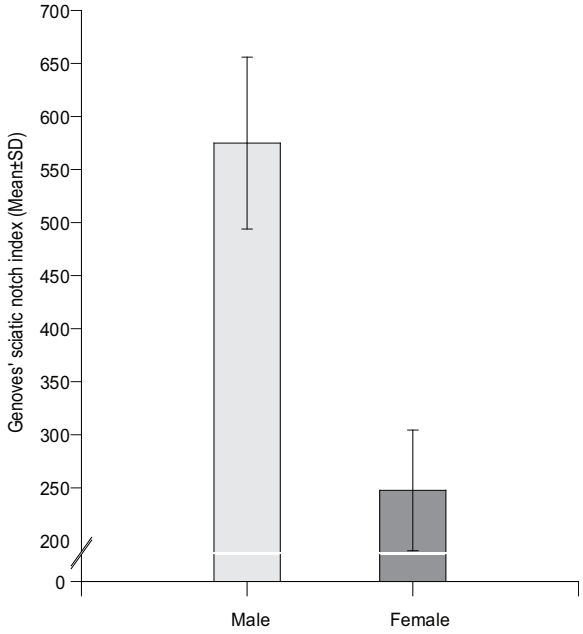

Fig-5: *Genoves sciatic notch of dry ossified male and female left hip bone.*

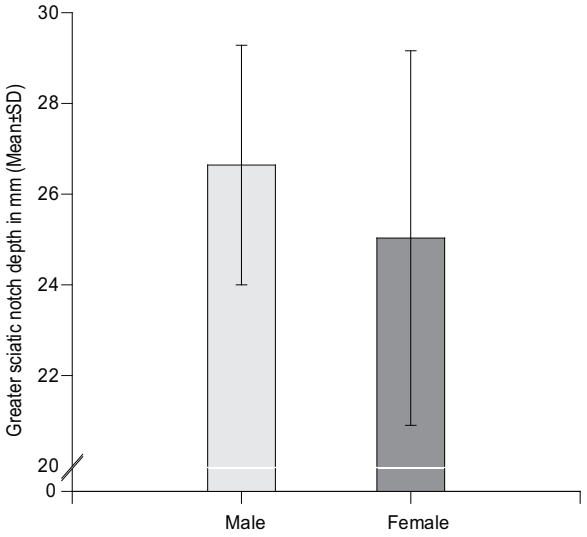

Fig-6: *Depth of greater sciatic notch of dry ossified male and female left hip bone.*

The mean (±) SD depth of greater sciatic notch was 26.64±2.64 mm and 25.03±4.13 mm in male and female respectively. Difference was significant in depth of greater sciatic notch between male and female (P<0.01) hip bone (Table II, Fig. 6).

Table II

Comparison of depth of greater sciatic notch of dry ossified male and female left hip bone.

Parameter	Sex		P value
	Male (n=112)	Female (n=112)	
Depth of greater sciatic notch in mm Mean±SD	26.64±2.64 (20.10-37.20)	25.03±4.13 (18.20-35.12)	0.002**

Figures in parentheses indicate range. Comparison between male and female done by unpaired Student's 't' test, ** = significant at P<0.01.

The mean of total angle of greater sciatic notch was 66.71±3.98 in male and 74.57±4.23 in female. Total angle of greater sciatic notch was higher in female than male. The mean posterior angle of greater sciatic notch was 21.93±3.59 and 31.38±4.60 in male and female respectively. Both total angle and posterior angle of greater sciatic notch were higher in female than male (Table III, Fig. 7).

Table-III

Comparison of total angle and posterior angle of greater sciatic notch of dry ossified male and female left hip bone.

Parameter	Sex		P value
	Male (n=112)	Female (n=112)	
Total angle in degree Mean±SD	66.71±3.98 (54.00-74.00)	74.57±4.23 (61.00-84.00)	0.0001***
Posterior angle in degree Mean±SD	21.93±3.59 (11.00-32.00)	31.38±4.60 (17.00-45.00)	0.0001***

Figures in parentheses indicate range. Comparison between total angle and posterior angle done by paired Student's 't' test and comparison between male and female done by unpaired Student's 't' test, *** = significant at P<0.001.

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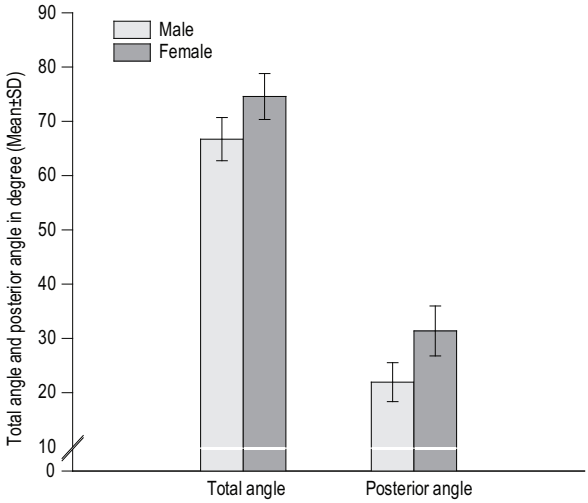

Fig-7: *Total angle and posterior angle of greater sciatic notch of dry ossified male and female left hip bone.*

Discussion

The study revealed some statistically important findings about morphometric variations of greater sciatic notch of hip bones. But there is no published work on anthropometric measurements of hip bones in our country. A comparative discussion on the results of different variables of the measurements of greater sciatic notch of hip bones were done with that of different authors and researchers of the other countries.

In the present study there was highly significant difference (P<0.001) in mean width of greater sciatic notch between male and female hip bone.The findings of the study conducted by Raut, Hosmani and kulkarni[7] were dissimilar (P>0.1) to present study. According to Dnyanesh[8] and Singh[9] male value of greater sciatic notch was greater (P<0.001) than present study but female value of present study was similar (P>0.1) with the findings published by them.

In the present study there was highly significant difference in mean (±SD) length of posterior segment (P<0.001) between male and female. The mean length of posterior segment of greater sciatic notch was similar (P>0.1) with male value of present study but female value of present study was greater (P<0.01) than the value reported by Tripathi, Bhatnagar, Deshwal.[3] Highly significant difference was found in Genoves' sciatic notch index between male and female hip bones. Shah et al[10] 2011 reported that Genoves' sciatic notch index of male was significantly greater than female (P<0.001). In the present study there was significant difference (P<0.001) in mean depth of greater sciatic notch between male and female. The findings of the present study are similar (P>0.1) to their studies. According to Dnyanesh[8], depth of greater sciatic notch was significantly higher (P<0.001) in female than male. Highly significant difference (P<0.001) was found in total angle of greater sciatic notch between male and female hip bones. Total angle of greater sciatic notch reported by Raut[7]and Dnyanesh[8], Singh[9] were significantly greater (P<0.001) in female than male. According to Shah et al[10] total angle of greater sciatic notch was significantly greater (P<0.001) than female value of the present study but no significant difference was found in male value. Tripathi, Bhatnagar and Deshwal[3] conducted a study and their values were greater (P<0.001)than female value of present study but male values of their study were similar (P>0.1) to present study.

Mean posterior angle of greater sciatic notch was studied by Dnyanesh[8] and Singh[9] and Shah et al.[10] When compared with present study their values were greater (P<0.001) than male value of present study but mean posterior angle of greater sciatic notch was similar with female value. Raut, Hosmani and Kulkarni[7] reported that posterior angle of greater sciatic notch of female was significantly greater (P<0.001) than male. Tripathi, Bhatnagar and Deshwal[3] conducted a study on Indian people. When compared with present study, mean posterior angle of greater sciatic notch of male was less(P<0.001) than present study but no significant difference was found in female value. The findings of their study was similar(P>0.1) with the present study.

Observed results of morphological parameters showed some similarities as well as dissimilarities with the available publications. The findings of the present study are similar to other studies. These similarities may be due to the use of hip bones of

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same subcontinent. The present study also shows some dissimilarity with the other studies. Because they collected hip bones from American white and black people, Nigerian population. The reason of dissimilarities might be due to racial variation and use of different measurement techniques.

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