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MORPHOMETRIC ANALYSIS OF ILIAC CREST OF PELVIC BONE FOR SEX DETERMINATION

Bharathi R[1], Karthik Ganesh M[2]

[1]Saveetha Dental College and Hospitals,Saveetha Institute of Medical and technical Sciences, Saveetha University,Chennai.

[2]Assistant ProfessorDepartment of Anatomy,Saveetha Dental College and Hospitals,

Saveetha Institute of Medical and technical Sciences,Saveetha University,Chennai.

[1]151701041.sdc@saveetha.com ,[2]karthikm.sdc@saveetha.com

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ABSTRACT:

Identification of the sex of the skeletal remains is a important step in biological profiling of the skeletal remains or a badly burnt body in establishing the identity of the individual in forennsic medicine. The parameters of hip bone can be utilised for sex determination in South Indian population. To analyse the dry human pelvic bone with reference to iliac crest to determine the sexual dimorphism. In the present study a total of 40 dry human pelvic bones of unknown sex and without any gross abnormality were collected from the Department of Anatomy, Saveetha Dental College, Chennai for evaluation. With the help of Vernier Calliper, the measurements like the length between the anterior-superior iliac spine and mid iliac crest, length between the posterior-superior iliac spine and mid iliac crest and width of the iliac crest was measured. The results obtained were analysed, tabulated and represented graphically. The average distance between the anterior-superior iliac spine and mid iliac crest of pelvic bone in males and females was 57.11±1.32 and 59.23±0.68 respectively. The average distance between the posterior-superior iliac spine and mid iliac crest of pelvic bone in males and females was 114.04±0.53 and 117.37±2.02 respectively. The average width of the iliac crest of pelvic bone in males and females was 16.40±0.65 and 18.75±1.32, respectively. Size of the iliac crest of pelvic bone was larger in females compared to males with regard to parameters taken for the study, therefore these parameters can be used for sex determination.

INTRODUCTION

Pelvic bone is one of the major bones in the human skeleton and it is formed by three bones which are separately called ilii, ischium and pubis during the preadult period. It is directly involved in childbirth[1]. Pelvic bone contains an acetabular cavity which forms the ball-and-socket joint in the body and is more stable. This joint is formed with articulatio coxae, the head of the femur [2]. Acetabulum is formed by ilium (40%), ischium (40%) and pubis (20%) at certain ratios. When we look into the acetabulum, there is a cotyloid cavity containing fibro adipose tissue covered with synovial tissue and horse shoe shaped facies lunata [3]. The shape and dimensions of an acetabulum vary between individuals. They can be varied by age, gender or race [4].

The pelvis is a group of fused bones and may be considered the first step in the linkage of the axial skeleton (bones of the head, neck, and vertebrae) to the lower appendages. The femur is the appendicular skeletal bone connected to the pelvis at the acetabulum, a bony ring formed by the fusion of three bones: the ilium, ischium, and pubis. The main function of the pelvis is support for locomotion, as it provides attachment points for muscles, tendons, and ligaments [5]. Pelvis distinction can be made between the "pelvic spine" and the "pelvic girdle". The pelvic girdle, also known as the os coxae, Latin for “bone of the hip,” consists of the fused bones identified individually as the ilium, ischium, and pubis. The pelvic spine consists of the sacrum and coccyx. Together these two parts form the bony pelvis [6].

Ilium is the largest of the three bones in the pelvis. Iliac crest is the most prominent part of the ilium. The iliac crest is attached to many important muscles. They include the gluteus maximus of the hip itself, the main abdominals and the latissimus dorsi or largest muscle in the back. In biological profiling of the Skeletal remains or a badly burnt body, identification of the sex of the skeletal remains is a very important step in establishing the identity of the individual in forensic science [78]. It is very subjective in determination of hip bones by visualising [9]. Parameters of pelvis bone like total height of hip bone, iliac breadth, pubic length; posterior width of greater sciatic notch diameter of acetabulum in human pelvis bones of the Southern Indian population were studied by Takahashi [10].

The distinctive morphology of the human pelvic bone also known as os coxae and its sexual dimorphism make it of great interest from its anthropological, anatomical and forensic view [11]. In anthropometry, the importance of the pelvic girdle is well accepted. There are additional differences in the girdle relating to reproduction, in addition to the sex differences between bones in general [12]. The aim of this study is to assess the size, shape, normality of iliac crest of pelvic bone for sex determination.

Previously our team had conducted numerous survey studies [13141516], in vivo laboratory animal studies [17], bioinformatics study [18], anthropometric study [19], morphological studies [202122], in vitro and genetic studies [23], over the past 5 years, this vast research experience has inspired us to research about size, shape, normality of iliac crest of pelvic bone for sex determination.

MATERIALS AND METHODS

In the present study a total of 40 dry human pelvic bones of unknown sex and without any gross abnormality were collected from the Department of Anatomy, Saveetha Dental College, Chennai for evaluation. Damaged or deformed hip bones were excluded from the study. Out of 40 pelvic bones, 27 male and 13 female bones were segregated based on morphological features like ischiopubic ramus, obturator foramen, ischial spine and greater sciatic notch. With the help of digital Vernier Calliper, the measurements like the length between the anterior-superior iliac spine (ASIS) and mid iliac crest (MIC), length between the posterior-superior iliac spine (PSIS) and mid iliac crest (MIC) and width of the iliac crest was measured. The results obtained were analysed, tabulated and represented graphically. All the obtained values are expressed as mean ± SD.

RESULTS AND DISCUSSION

Iliac crest of pelvic bone showing measurements of distance between the anterior-superior iliac spine (ASIS) and mid iliac crest (MIC), distance between the posterior-superior iliac spine (PSIS) and mid iliac crest (MIC) and width of the iliac crest shown in Figures 1 and 2. The average distance between the anterior-superior iliac spine and mid iliac crest of pelvic bone in males and females was 57.11±1.32 and 59.23±0.68 respectively. The average distance between the posterior-superior iliac spine and mid iliac crest of pelvic bone in males and females was 114.04±0.53 and 117.37±2.02 respectively. The average width of the iliac crest of pelvic bone in males and females was 16.40±0.65 and 18.75±1.32, respectively. These measurements in iliac crest of pelvic bone in males and females are depicted in Figure 3 as graphical representation.

Figure 1: Iliac crest of pelvic bone showing measurements of distance between the anterior-superior iliac spine (ASIS) and mid iliac crest (MIC) and distance between the posterior-superior iliac spine (PSIS) and mid iliac crest (MIC). Lateral view

Figure 2: Iliac crest of pelvic bone showing measurement of width of the iliac crest. Posterior view.

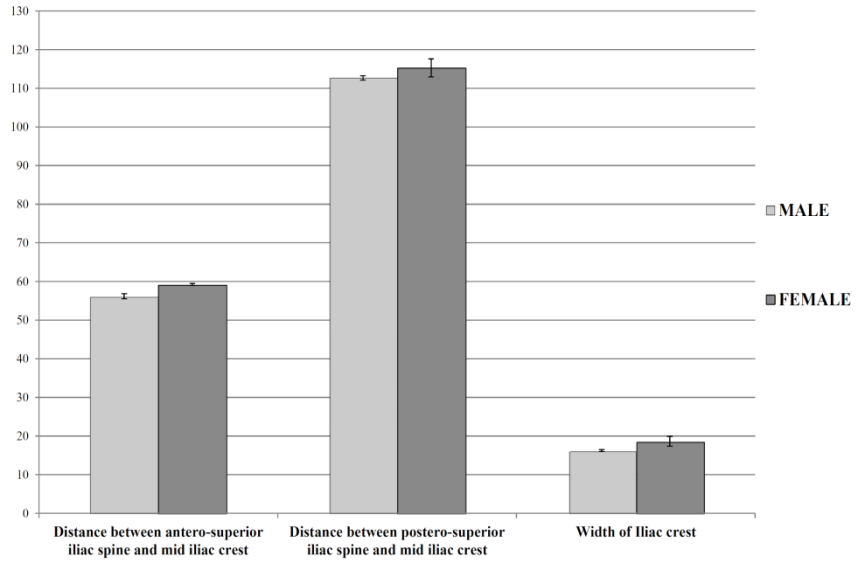

Figure 3: Bar graph representing the average value of measurements of distance between the anterior-superior iliac spine and mid iliac crest of pelvic bone, distance between the posterior-superior iliac spine and mid iliac crest of pelvic bone and width of the iliac crest in males and females. The x-axis represents the above parameters and y-axis represents the mean of measurements. The light grey colour represents the males and dark grey colour represents the females. The average value of all the parameters were found to be higher in females compared to males. All the values are expressed as Mean ± SD in mm.

Owing to its changes of the hip bone during parturition, sexual dimorphism is more pronounced in the hip bone among all the bones of the body. Eversion of ischiopubic ramus, oval shape of obturator foramen, and shallow iliac fossa are the non metric characteristic features that have been associated with male pelvis compared to female pelvis [24]. The sex is identified based on the following characteristics in this study; greater sciatic notch in females is wider (>90 degree) whereas in males it is narrower(<90 degree), in females ischial spine is not inverted and in males it is inverted, ischiopubic ramus is not everted in females and everted in males and the obturator foramen is triangular in females and oval in males [2526].

In the previous study, the following parameters were statistically significant between means in relation to sex; distance from the anterior superior iliac spine to the pubic tubercle, distance from the anterior inferior iliac spine to the iliopubic eminence, distance from the anterior inferior iliac spine to the pubic tubercle, length of the notch between the anterior inferior iliac spine and the iliopubic eminence [27]. Another study done in which width, depth and length of the posterior segment (width) of the greater sciatic notch were measured. Depth and width of the greater sciatic notch were useless criteria for sex determination purposes while the posterior angle of the greater sciatic notch was found to be the best parameter [2829].

The parameters such as straight distance between Anterior Superior Iliac Spine (ASIS) and Symphyseal Surface (SS) of pubis, straight distance between ASIS and Pubic Tubercle (PT), straight distance between Anterior Inferior Iliac Spine (AIIS) and SS of pubis, straight distance between AIIS and PT, Arch of Anterior Interspinous notch (ASIS– AIIS), arch between AIIS and Ilio-Pubic Eminence (IP), depth of notch between AIIS and IP and arch of anterior border (ASIS–SS) of the pelvic bone were taken into study for sex determination by Sachdeva [30]. A study done by Dixit SG et al., included 100 pelvic bone for sex determination and had used parameters like acetabular height (acetabular vertical diameter), total pelvic height/acetabular height, midpubic width/acetabular height and pubic length/ acetabular height [31].

In this study we have considered parameters such as length between the anterior-superior iliac spine (ASIS) and mid iliac crest (MIC), length between the posterior-superior iliac spine (PSIS) and mid iliac crest (MIC) and width of the iliac crest that are primary features of the ilium of pelvic bone. All these parameters were found to be higher in females compared to males. Therefore this can used to increase the accuracy of the sex determination. Limitation of this was that the sample size was small and inadequate. This study included the sample predominantly from the South Indian population. Future scope is that samples from various parts of India should be analysed for better results.

CONCLUSION

This study employed measurements such as length between the anterior-superior iliac spine (ASIS) and mid iliac crest (MIC), length between the posterior-superior iliac spine (PSIS) and mid iliac crest (MIC) and width of the iliac crest that are primary features of the prominent part of the ilium of pelvic bone. This parameters can be used for sex determination if the determining landmarks such as ischiopubic ramus, obturator foramen, ischial spine and greater sciatic notch are deformed or fractured due to trauma or during exhumation. However these parameters can be synergistically used with the other parameters to ascertain the sex determination.

SOURCE OF SUPPORT

Nil

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Nil

CONFLICT OF INTEREST

None declared

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