

MORPHOLOGICAL AND MORPHOMETRICAL ANALYSIS OF ILIUM WITH REFERENCE TO ILIAC CREST OF PELVIC BONE FOR SEX DETERMINATION

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ABSTRACT

Determination or identification of sex of an unknown individual is the most important step in forensic science and archeology. The morphometrical analysis of the human pelvic bone is considered to be the hallmark for sex determination. Morphometrical analysis is the study and measurement of shape, size and structure of the pelvic bone in this case. In the present study a total of 24 dry human pelvic bones of known sex (12 male and 12 female) and without any gross abnormality were collected from the department of Anatomy, Saveetha Dental College, Chennai, India for evaluation. Sliding vernier calipers were used for measuring the iliac crest length and depth. All the data obtained were statistically tabulated using SPSS and represented graphically. The average value of the right sided male pelvic bone was 41.47mm and the left sided average value for males was 40.92mm. The average value of the left side and right side of the iliac crest was 42.97mm and 43.63mm. Respectively for the females With clear varying mean values of the male and female pelvic bones it is clear that the sex can determined using iliac crest of pelvic bone and serves as a reliable criteria.

KEY WORDS: Iliac crest, ilium, pelvic bone, morphology, morphometry.

INTRODUCTION

Sex determination is a very vital step in both forensic investigations and archeological investigations(Johnson e t al., 2020)(Trancho e t al., 1997). Sexual dimorphism and its evaluation with bones in human population is an interesting concept and criteria for both forensic experts and anthropologists(Sekar e t al., 2019)(Seppan e t al., 2018)(Rösing e t al., 2007) The hip bone or the human pelvic bone is considered to be ideal for sex determination for its dimorphic characteristics (Krishna, Nivesh Krishna and Yuvaraj Babu, 2016; Ruparelia e t al., 2019)(Nandhini e t al., 2018). It provides great dissimilarities between the two sexes as the hip bone displays a specific adaptation in females for child bearing needs(Subashri and Thenmozhi, 2016)(Shoji e t al.

, 2016). It is said that pelvic bone shows highest accuracy while determining sex of the human skeleton(Thejeswar and Thenmozhi, 2015)(Bruzek, 2002; Shoji et al ., 2016).

The pelvic girdle is composed of three bones on each side; they are the ilium, ischium and pubis. The pelvis is connected in front at the pubic symphysis and behind by the sacrum .The ilium is the uppermost and largest part of the pelvic girdle . It is divided into two parts ; the body and wing , which is separated by a curved line called the arcuate line. The iliac crest is the curved superior border of the ilium. It is located on the superior aspect and lateral edge of the ilium and is very close to the surface of the skin . At the posterior aspect of the ilium, the iliac crest narrows and terminates as the posterior superior iliac spine. The iliac crest is one of the most important skeletal landmarks in the entire human body. It represents a major portion of the dividing line between the pelvis and the abdomen . The iliac crest is easily palpated, making it one of the more easier landmarks to examine. Sex determination is the first component of the biological profile to be assessed because other vital criterias such as age, stature and ancestry depends on it(Sriram, Thenmozhi and Yuvaraj, 2015)(Keerthana and Thenmozhi, 2016)(Bruzek, 2002).

Sex determination by examination of skull, Long bones like femur and humerus , sternum and scapula have been performed by forensic experts. The accuracy of sex determination using the skull is 90%, long bones is 80% and pelvis is 95%. In skull the features that are studied during sex determination are General appearance of skull, supraorbital ridges, orbits, glabella, zygomatic arches, mastoid processes, external occipital protuberance, mandible and palate. Sternum has variable usefulness in sex determination in males the body of the sternum is more than two times the length of manubrium and in females the body of sternum is less than two times the length of manubrium . Thus morphological and morphometrical analysis of bones can aid in sex determination. Innominate bones displays the greatest degree of sexual dimorphism in humans making it an essential criteria for sex determination(Pratha, Ashwatha Pratha and Thenmozhi, 2016)(Menon and Thenmozhi, 2016)(Gupta et al., 2012).

The iliac crest is derived from the endochondral bone(Samuel and Thenmozhi, 2015)(Siddapur and Siddapur, 2014). The iliac crest is thinner at the centre and thicker at the extremities(Hafeez and Thenmozhi, 2016)(Schulter-Ellis, Hayek and Schmidt, 1985). The iliac crest stretches posteriorly from the anterior-superior iliac spine to the posterior superior iliac spine (Choudhari and Thenmozhi, 2016)(Schulter-Ellis et al., 1983). Pelvimetry measurements carried out on the right and left sides show that there is asymmetry bilaterally. Earlier studies have proven there is racial differences found . Thus, the present study will provide an insight for sex determination using pelvic bones for a restricted South Indian population.

MATERIALS AND METHODS

In the present study, a total of 24 dry human pelvic bones of known sex (12 male and 12 female) and without any gross abnormality were collected from the department of Anatomy ,Saveetha Dental College, Chennai, India for evaluation. The Length Of the ilium with reference to the iliac crest was measured both on the right and left sides of each sample. Using a sliding vernier caliper. All the data collected were tabulated, analyzed and represented graphically. A comparative analysis using SPSS software was done with all statistically significant parameters with respect to sex and side. The type of statistical test used was chi square test.

RESULTS AND DISCUSSION

The mean diameter of iliac crest in males was 41.48 ± 1.67 mm for right side and 40.98 ± 1.23 mm for the left side. The mean diameter of iliac crest in females was 42.23 ± 1.51 mm for the right side and 41.98 ± 1.12 mm for the left side. The measurement of mean diameter of the right iliac crest in male and female pelvic bone is shown in Figure 1. The measurement of mean diameter of the left iliac crest in male and female pelvic bone is shown in Figure 2. The measurement of mean diameter of the right and left iliac crest in both the male and female pelvic bone is shown in Figure 3.

The hip bone is considered an important sexually dimorphic region of the human skeleton and it is also considered to be the most accurate and reliable source for sex determination (Takahashi, 2006)(Bytheway and Ross, 2010).

The mean diameter of the right iliac crest of a female is greater than the mean diameter of the right iliac crest of male ($p < 0.05$) which is statistically significant. The mean diameter of the left iliac crest of a female is greater than the mean diameter of the left iliac crest of male ($p < 0.05$) which is statistically significant. The mean diameter of the right iliac crest and left iliac crest of the male and female is shown in Figure 1. Given that the pelvic bone and its importance in sexual dimorphism this fact can be varied to specific populations (Walker, 2005). This morphometrical analysis cannot be standardized to the entire human population as many factors such as geographical history and racial differences would bring variations in the morphometrical study (Bruzek and Murail, 2010). By performing this study digitally we have reduced the chances of error, that is by using digital tools to confirm the morphometric values which are more accurate and easier to do a proper analytical study.

There are many studies that have used the human pelvic bone to determine sex as the hip bone is considered one of the best region of the human skeleton to show sexual dimorphism (Schutkowski, 1987). The results and conclusion of many other studies correlate and coincide with the result of the present study as the pelvic bone is an ideal morphological part of the human body tho use for sex determination(Velemínská e t al., 2013). However only a few studies were done on the morphometrical analyses of ilium and iliac crest for sex determination. But from the present study we have clearly achieved some factors and values which show some factors of dissimilarities in comparison to both the sexes.

CONCLUSION

Accurate sex estimation of bones and remains is very vital to medico legal authorities in the forensic department. With results from the present study, the length of the iliac crest can be taken as one of the best parameter for sex determination . From the above observations of this study, the length of the ilium of the male pelvic bone with account to both right and left sides is shorter than the female pelvic bones. From the above data provided in the present study it is evident that this would be helpful in sex determination of skeletal remains in forensic analysis and anthropological studies.

AUTHOR CONTRIBUTIONS

S. Santhosh Bala

Author contributed in the conception, design, acquisition of data, analysis, drafting article and interpretation of data.

Dr.M. Karthik Ganesh

Author contributed in guiding, revising it critically for important and intellectual content, author made contributions to final approval of the submitted version of the manuscript and supervision.

Dr.Sivakumar

Author made formatting and other alignment corrections and supervision.

CONFLICT OF INTEREST

None to declare.

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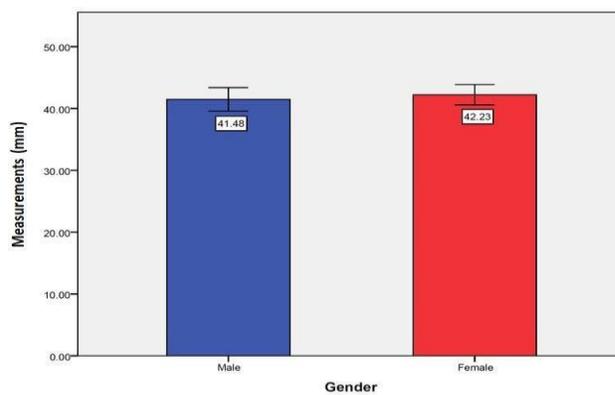


Figure 1: Bar chart showing comparison of mean diameter of the right iliac crest in males and females. X axis represents gender and the y axis represents the measurements in mm. The blue colour represents male and red colour represents female. From this analysis, there is an increase in the mean diameter of the right iliac crest in females than males and also the difference is statistically significant. Independent student t-test showing $p=0.05$ ($p=0.05$ indicating statistically significant).

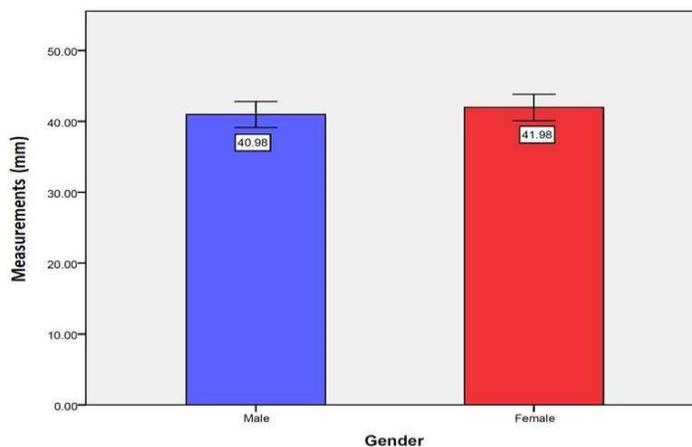


Figure 2: Bar chart showing comparison of mean diameter of the left iliac crest in males and females. X axis represents gender and the y axis represents the measurements in mm. The blue colour represents male and red colour represents female. There is an increase in the mean diameter of the left iliac crest in females than males

and the difference is significant statistically. Independent student t-test showing $p=0.05$ ($p=0.05$ indicating statistically significant).

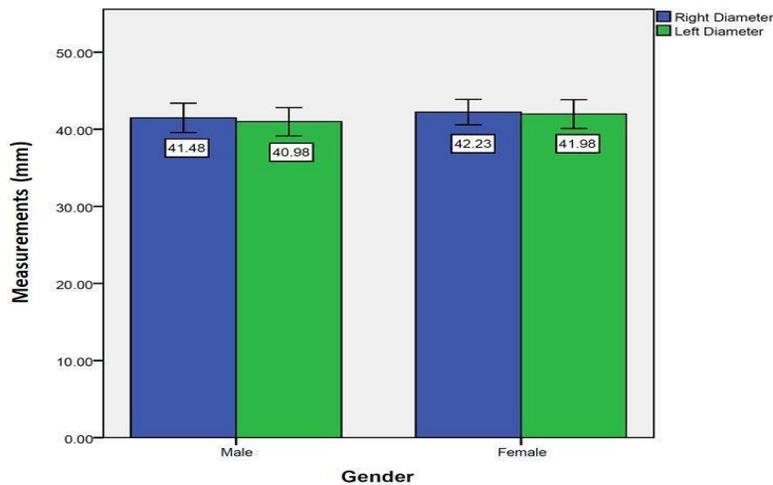


Figure 3: Bar chart showing comparison of mean diameter of the iliac crest of right and left side in males and female pelvic bone. X axis represents gender and the y axis represents the measurements in mm. The blue colour represents the diameter of the iliac crest of the right side in male and female; green colour represents the diameter of the iliac crest of the left side in male and female. An increase in the mean diameter of both the right and left iliac crest in females than males and the difference is statistically significant. Independent student t-test showing $p=0.015$ ($p<0.05$ indicating statistically significant).