Biometry of the posterior border of the human hip bone: Normal values and their use in sex determination

Dr. Sandeep Mohite and Dr. Priya P Roy

Abstract

Aim: To find out whether any parameter can be used with accuracy in the medico-legal, anthropological and anatomical studies, when only few parts of hip bone are available in conditions such as accidents, natural emergencies and bomb-blasts.

Material and method: total 200 hip bones were studied. Out of these were of 100 males and 100 were of females. Each sex includes 50 bones each of right and left side.

Results: Distance from PIIS to superior border of ischial tuberosity [PIIS – IT] is highly significant on left side than that of on right side \( p(0.001) = 3.403 \). length of border between PSIS & PIIS [Arch PIN] is significant in the females than the males \( p(0.05) = 2.011 \). Arch of posterior border i.e. length of the border between PSIS and superior border of ischial tuberosity (Arch PB) is highly significant in males as well as in females.

Conclusion: we can say that the bones have much to tell as fossilized hominid remains to paleoanthropologists about early humans, as skeletal remains to anthropologists and archeologists about what humans are and especially to forensic osteologists, as remains provide details of individuals at their time of death. The bones, in their properties, offer us indisputable facts if only we knew how to look at them with keen questioning and unbiased eyes.

Keywords: Arch of posterior border, hip bone

Introduction

The identification of sex from skeletal remains is of great medico-legal and anthropological importance for Forensic experts, Anthropologists and the Anatomists also [1]. Lot of work has been done and ample literature is available in anatomy and anthropology for identification of human skeleton [2]. In forensic practice, experts are often called up to identify skeletal remains which often involve diagnosis of sex [3]. Accurate sexing of skeletal remains is a vital part of any medico-legal investigation and a challenge to physical anthropologists [4]. It becomes more challenging when only a single bone like the sternum or clavicle is available [5]. It is rather impossible to determine the sex of an individual from the skeletal remains unless all the bones are available. Except hip bone probably, no other single bone is as valuable in this regard [6]. These additional sex differentiating features of hip bone are due to different reproductive functions mainly influenced by sex hormones. Sex determination of adult hip bone is much easier than that of young ones. A reliability of 95% can be obtained from sex determination by the hip bone.

The determination of age at the death is an important part of physical and forensic anthropology [7]. The use of the hip bone elements for age and sex diagnosis from the skeleton is the primary and most widespread way to the identity of dead individuals in archeological and certain forensic scenarios [8]. It is well known that there are metric and non-metric variations in the expression of sexual dimorphism between racial phenotypes and populations. Selection intensity and phenotypic Total eight parameters were used in our study [9]. We analyzed these parameters statistically to find out whether any parameter can be used with accuracy in the medico-legal, anthropological and anatomical studies, when only few parts of hip bone are available in conditions such as accidents, natural emergencies and bomb-blasts. Total eight parameters were used in our study. We analyzed these parameters statistically to find out whether any parameter can be used with accuracy in the medico-legal, anthropological and anatomical studies, when only few parts of hip bone are available in conditions such as accidents, natural emergencies and bomb-blasts.
Materials and Methods
A sample of 200 human hip bones of known sex was collected from the department of Anatomy, Krishna Institute of Medical Sciences University, Karad and other medical colleges. To avoid the error in measurements, bones were collected undamaged i.e. without wear and tear and showed no pathological alterations. Out of 200 human hip bones; 100 were males and 100 were females out of which 50 were from each side i.e. right and left side.

To avoid the error, all the parameters were measured single handedly and by 3 methods. In these three methods, measurements were taken by sliding Vernier caliper, by inextensible thread and by standardized steel scale with the help of a diagram of posterior border of human hip bone. Mean value of these readings taken by three methods was taken as final reading. All the parameters were measured in centimeters on the posterior border of human hip bone. For each hip bone, following measurements were recorded:

1. The maximal width of the posterior border notch (PSIS-IT):
   It was measured from the posterior superior iliac spine (PSIS) to the superior border of the ischial tuberosity (IT). It was measured by above mentioned 3 methods.

2. The distance from the posterior superior iliac spine to the ischial spine (PSIS-IS):
   By using the mentioned 3 methods, the distance between two points i.e. posterior superior iliac spine (PSIS) to the ischial spine (IS) was measured by 3 methods mentioned above.

3. The maximum width of the posterior interspinous notch (PSIS-PIIS):
   The distance from the posterior superior iliac spine (PSIS) to the posterior inferior iliac spine (PIIS) was measured by 3 methods mentioned above.

4. The distance from the posterior inferior iliac spine to the ischial spine (PIIS-IS):
   The distance from the posterior inferior iliac spine (PIIS) to the ischial spine (IS) was measured by above mentioned 3 methods.

5. The distance from the posterior inferior iliac spine to the superior border of ischial tuberosity (PIIS-IT):
   By using the 3 methods mentioned above, the distance from the posterior inferior iliac spine (PIIS) to the superior border of ischial tuberosity (IT) was measured.

6. The arch of the posterior interspinous notch (Arch PIN):
   The length of the border between the posterior superior iliac spine (PSIS) and the posterior inferior iliac spine (PIIS) was measured by rolling the inextensible thread along the bony margins (fig no.1).

7. The length of the notch between the posterior inferior iliac spine and the ischial spine (Arch PIIS-IS):
   The length of the border between the posterior superior iliac spine (PSIS) and the ischial spine (IS) was measured by inextensible thread. The inextensible thread was rolled against these two points and then the length was measured.

8. The arch of the posterior border (Arch PB):
   By rolling the inextensible thread against the bony margins, the length of the border between posterior superior iliac spine (PSIS) and the superior border of ischial tuberosity (IT) was measured.

Statistical Analysis
The data was summarized sexwise as well as sidewise into range (minimum- maximum), mean and standard deviation. Sexwise comparison of each study factor was done by applying paired ‘t’ test and sidewise comparison of each study factor was done by applying student’s (unpaired) ‘t’ test.

Difference in parameters while comparison of same sides of males and females (unpaired ‘t’ test) and right and left side of male as well as female (paired ‘t’ test) was said to be significant if ‘p’ was less than 0.05.

Results
Maximum width of posterior interspinous notch [PSIS – PIIS] is significant in the males than in the females [p(0.02) = 2.4066]. Maximum width of posterior interspinous notch [PSIS – PIIS] is not significant on both sides. The distance from PIIS to ischial spine [PIIS-IS] are not significant in both sexes i.e. males and females. Distance from PIIS to ischial spine [PIIS-IS] in centimeters in both sides i.e. left side is highly significant than the right side [p (0.001) = 3.403] the distance from PIIS to superior border of ischial tuberosity [PIIS-IT] is significantly higher in females than that of males [p (0.001) = 3.5095]. Distance from PIIS to superior border of ischial tuberosity [PIIS-IT] is highly significant on left side than that of on right side [p (0.001) = 3.403].

Length of border between PSIS & PIIS [Arch PIN] is significant in the females than the males [p (0.05) = 2.011]. Arch of posterior border i.e. length of the border between PSIS and superior border of ischial tuberosity (Arch PB) is highly significant in males as well as in females.

Discussion
The hip bone has been accredited traditionally with the most marked sexual characteristics in the skeletal framework of the human body Krogman claims that 95% accuracy can be achieved in sexing adult skeletal remains with the pelvis alone. Hip bone is an ideal bone for sex determination because it is not only reflects the general differences between the two sexes but also the special adaptation of female hip bones for child bearing. In the past, many workers have evolved various metrical parameters and indices for sexing of hip bone [1].

We studied a random sample of 200 human hip bones from Krishna institute of medical sciences university, Karad and other medical colleges of western Maharashtra. They were undamaged and showed no pathological alterations that could lead to error in measurements; 100 were males and 100 were females.

Osteometric studies of the hip bone had given importance to features relating to its total size or to those of various components such as the greater sciatic notch, the symphysial surface, the acetabulum, the obturator foramen or the distance between defined morphological points on its borders such as...
anterior and posterior borders. There are very few studies that have established the morphological pattern of the posterior border of the human hip bone by osteometric method and its possible influence on sexual dimorphism or side on its morphology. We therefore undertook the present study.

Sex-wise distribution of PSIS-IT in our study showed that the male bones on right side have mean of 11.711 cm and that of left side being 11.304 cm. The female bones of right side have mean of 11.338 cm and on left side as 11.901 cm. The demarking point for male hip bones of right side is > 13.004 cm and that of left side is < 10.110 cm. Out of 100 male hip bones, 12% of left sided male bones crossed the said demarking point. Thus, by using the demarking point as < 10.110 cm for PSIS-IT, one can 95% accurately identify the male bones, that too of left sided one. Out of 100 male hip bones, 4% of right sided male bones crossed the said demarking point. Thus, by using the demarking point as < 13.004 cm for PSIS-IT, one can 95% accurately identify the male bones that too of right sided one.

In our study, we found that mean value of 11.507 cm in males and 11.619 cm in females respectively i.e. mean values are greater in females than the males. So, in sex wise comparison of PSIS-IT with other study, the results of these two studies are not going in correlation with each other. Results of our study go in favour of conclusion by Tague (2005) that among species in which males are larger than females in body size; females are larger than males in some pelvic dimensions. In comparison of our study with the study done by Isaac in which he found mean value of 7.869 cm on right side and 7.662 cm on left side respectively i.e. mean values were greater on right side than on left side. In our study, we found that mean value of 8.440 cm on right side and 8.935 cm on left side respectively i.e. mean values are greater on left side than on right side. When we studied it separately into male and female bones, left sided variables are statistically significant than on the right side. Demarking point for left sided bones in males is > 5.203 cm and in females is < 2.611 cm. 4% of female bones crossed the demarking point. So that, we can identify left sided female bones with 95% accuracy. Present study of eight parameters used for sexing hip bones using posterior border parameters have revealed that length of Dist. PSIS-IT, Dist. PSIS-IS, Dist. PIIS-IT, Arch PIN and Arch PB are more useful for identification of sex. Out of these, Dist. PIIS-IT, Arch PIN and Arch PB are more useful for identification of side. Demarking points of Dist. PIIS-IT, Arch PIN and Arch PB are the best criteria for sexual dimorphism as well as side determination of hip bones.

Conclusion
We can say that the bones have much to tell as fossilized hominid remains to paleoanthropologists about early humans, as skeletal remains to anthropologists and archeologists about what humans are and especially to forensic osteologists, as remains provide details of individuals at their time of death. The bones, in their properties, offer us indisputable facts if only we knew how to look at them with keen questioning and unbiased eyes.

References

" 135 "