REVIEW ARTICLE

Sexual Dimorphism in Human Hip Bone- A Review

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Abstract

Skeletal characteristics vary among populations; therefore each population should have specific standards to optimize the accuracy of identification. Although many bones of skeleton present size related sexual differences, those of the hip bone usually displayed marked differences in morphology independent of size due to different reproductive functions mainly influenced by sex hormones. The distinctive morphology of the human hip bone and its clear sexual dimorphism makes it of interest from anatomical, anthropological and forensic points of views. In this review various aspects of hip bone are discussed in relation to sexual dimorphism.

***Keywords**: Hip bone, Sex determination, Sexual dimorphism*

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Introduction

The four main features of biological identity are sex, age, stature and ethnic background. A reliable estimation of sex from the skeleton by using various criteria is important while dealing with undocumented skeletal material. Skeletal characteristics vary among populations; therefore each population should have specific standards to optimize the accuracy of identification. Although many bones of skeleton present size related sexual differences, those of the hip bone usually displayed marked differences in morphology independent of size due to different reproductive functions mainly influenced by sex hormones. The distinctive morphology of the human hip bone and its clear sexual dimorphism makes it of interest from anatomical, anthropological and forensic points of views (SG Dixit 2007) [1].

It is widely recognized that skeletal characteristics vary among populations, thus each group should have specific standards to optimize the accuracy of identification. According to Krogman and Iscan 95% sexing accuracy can be expected if it is complete (Patriquin 2005) [2]. As far as sex differences and sex determination of skeletons are concerned, it has been universally accepted that the hip bones are most important part. Male bones are more massive and heavier than female bones the crest, ridges, tuberosities and lines of attachment of muscle and ligaments are more strongly marked in males (Davivongs 1963) [3]. Sex determination of a skeleton is a problem of concern to paleoanthropologist, paleodemographers and forensic scientists. The Hip bones are the most important for sex determination, followed by the skull and long bones [4].

It has emphasized the limitations in the ability of anthropologist to identify human skeletal remains. This attitude is somewhat at variance with the implications of Dr. Krogman's statements in the guide which he prepared for the FBI in 1939. There he says "The study of the skeleton is an exact science, permitting of identification in terms of individual age, sex and race". And again "This outline will have served its purpose if it has indicated that physical anthropology, with its precise method, can bring its techniques to bear upon problems of identification". Physical anthropology can and is making an important medico-legal contribution through careful identification of skeletal remains and that law enforcement agencies appreciates this help (TD Stewart 1948) [5]. The identification of the human skeletal remains is a critical

matter. To identify a single lot of bones one must be able to fit accurately into a tremendous jigsaw puzzle within that the total range of variation (Krogman WM 1946) [6]. Stewart (1948)[5] feels that for the entire adult skeleton or for the adult pelvis or for one adult hip bone, he can identify sex correctly in 90- 95% cases, for adult skull alone about 80%, but mandible presents 90% accuracy. Krogman (1962) [7] ranked accuracy of sex determination if entire skeleton present 100%, pelvis alone 95%, skull alone 92%, pelvis plus skull 98%, long bones alone 80%, long bones plus pelvis 98%.

The pelvic girdle is an entity consisting of the two hipbones and the sacrum. The pelvic girdle is massively constructed and serves as a weight bearing and protective structure. The hip bone is a large, irregular constricted centrally and expanded above and below. Each hip bone has three parts, ilium, ischium and pubis, connected to each other by cartilage in youth but united as one bone in adults [8]. The shape and size of the hip bones are influenced by hormonal, nutritional, mechanical and hereditary factors[9]. In this review various aspects of hip bone are discussed in relation to sexual dimorphism.

Total Pelvic Height

Steyn M and Iscan MY (2008)[9] studied samples of modern Greek population. In their study they observed total pelvic height in males is significantly more (mean 214.62) in comparison to females (mean 199.86). Nicholas Milne (1990)[10] found that total pelvic height in males is significantly more than females. Patriquin ML et al (2005)[2] compared hip bone measurement of South African black and white males and females. They found that mean values for white males exceeded the corresponding female measurements for total pelvic height. The same parameter total pelvic height was found to be larger in the black males (Range 179 – 221, mean 203.93) as compared with black females (Range 168 – 248, mean 190.87).

Pelvic Width (Iliac width)

Nicholas Milne (1990)[10] found pelvic width in male hip bones is significantly more in comparison to pelvic width in female hip bones. Dixit SG et al (2007)[1] studied hip bones at Delhi, India. They observed that pelvic width in male hip bones is significantly more in comparison to pelvic width of female hip bones. Patriquin ML et al (2005)[2] in their study revealed that there are no significant differences between iliac (Pelvic) width of South African white males (Range between 145 – 185 and mean 163.15) and South African white females (range between 142 – 183 and mean 160.99). They also observed no significant differences between pelvic width of South African black males (Range between 131 – 168 and mean 150.10) and South African Black females (Range between 123 – 179 and mean 145.43).

Acetabular Height

Steyn M and Iscan MY (2008)[9] in their study on modern Greek population, observed more acetabular height in male hip bones with the mean of 54.59 as compared to female hip bones with the mean of 49.15. In female hip bones acetabular height is less than male hip bone. Nicholas Milne (1990)[10] in his study observed that in male hip bones, acetabular height is more than acetabular height of female hip bones. Dixit SG et al (2007)[1] in their study found that acetabular height in male hip bones is significantly more than acetabular height of female hip bones. They showed highly significant differences between the two sexes.

Midpubic Width

Steyn M and Iscan MY (2008)[9] observed in their study on modern Greek hip bones that midpubic width is more in case of males and in case of female hip bones mid pubic width is less. Their study reveals significant differences in midpubic width of both sexes. Nicholas milne (1990)[10] in his study found that mid pubic width is a more useful sexing character than pubic length. He had used many parameters for sex determination using a variety of statistical methods. He observed that mid pubic width in males is significantly more in comparison to females. In females mid pubic width is less. This study showed highly significant differences between the two sexes. Dixit SG et al (2007)[1] studied hip bones of Delhi, India. They found that mid pubic width is more in male hip bones in comparison to female hip bones. In females midpubic width is significantly less than males.

Pubic Length

Steyn M and Iscan MY (2008)[9] found that pubic length is more in case of male hip bones and less in case of female hip bones. Nicholas Milne (1990)[10] observed that Pubic length showed insignificant differences between both the sexes. In his study he has not observed any significant differences between pubic length of male hip bones and female hip bones. Patriquin ML et al (2005)[2] observed that there is no significant differences between South African white male and female hip bones as far as pubic length is concerned. They also observed that for blacks, there are no significant differences in male pubic length as compared to female pubic length. Dixit SG et al (2007)[1] revealed in their study that there is no significant difference in pubic length of male as compared with pubic length of female hip bones. They found insignificant differences of pubic length between males and females.

Greater Sciatic Notch Width

Steyn M and Iscan MY (2008)[9] in their study on hip bones of modern Greek population, observed greater sciatic notch width of male hip bones significantly less in comparison to female hip bones. In males mean is 43.37 and in females mean is 50.96. Nicholas Milne (1990)[10] in his study found that greater sciatic notch width of male hip bones significantly less in comparison to female hip bones. Patriquin ML et al (2005)[2] compared hip bone measurement of South African black and white males and females. They found that greater sciatic notch width in South African white males is significantly less than white females. In South African white males, the observed range is between 30 – 56 and mean is 43.03. In South African white females, the observed range is between 34 – 72 and the mean is 48.83. Singh S and Potturi BR (1978)[11] studied greater sciatic notch parameters of Varanasi region of India. They observed that the greater sciatic notch width is significantly less in male hip bones and more in female hip bones. Albanese J (2003)[12] found that hip bone height, iliac breadth, (SPRL) Superior Pubic ramus length, correctly identified male and female bones in 98% situation. He found average total hip bone height as 204mm, iliac breadth 151mm, SPRL 66mm, of an individual male from the Coimbra collection. He opined that 98% accuracy is possible for very different samples from Europe and North America if Superior pubic ramus length measurement is included in the analysis and race-specific methods are not used. He also opined that the pubis and the ischium are important sources of information while determining sex but relying only on measurements of these two bones may produce misleading results.

Conclusion

Hip bone is one of the standard and ideal bones for sex determination followed by the skull and long bones. Various parameter of the hip bone are discussed in this review and found useful for sex determination. Various studies specifically highlighted the importance of Total pelvic height, Pelvic (iliac) width, Acetabular height, Midpubic width, Pubic length and Greater sciatic notch width as important determinant of either sex.

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