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Anthropometric Study of Various Parameters of Pubis of Hip Bones of North Indian Region

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Abstract: ***Background: The morphological differences that are present on a hip bone can be attributed to the different reproductive functions of the two sexes and are influenced by sex hormones. The anatomy of the hip bone is morphologically different in males and females, making it of great interest in anthropology. Though nonmetric methods, such as visual examination of bone morphology for sex determination are entirely dependent on experience and expertise, anthropometry plays a crucial role in creating a quantifiable method that can be applied for sex determination from hip bones, allowing for a more objective and widespread application. This study examines sexual dimorphism in hip bones based on pubic parameters and their indices. Results: For this study, human hip bones were obtained from the Department of Anatomy, PGIMS Rohtak. A total of 86 paired hip bones of known sex, as recorded in official documentation, were analyzed, which included 58 male and 28 female specimens. Metrical parameters such as pubic length, length of the pubic crest, mid – pubic width, and the length of the pubic bone up to the acetabulum were measured and compared between sexes. Results indicate that all measured pubic parameters were significantly larger in female hip bones compared to male hip bones, with the exception of mid - pubic width, which exhibited minimal variation between the sexes. Conclusion: Sexual dimorphism and the bilateral asymmetry of hip bones are appreciated in this study.***

Keywords: Sexual dimorphism, pubic parameters, hip bone asymmetry

1. Background

The hip bone usually exhibits differences in morphology independent of size, due to variations in the sexual and reproductive functions of the two sexes. As a result, its shape differs between males and females, making it a subject of significant anthropological interest. [1].

It is challenging to know the sex of an unknown individual in a forensic investigation when unknown skeleton remains are found. Since the hip bone plays a vital role in the determination of the sex of the individual, the study of sexual dimorphismis, therefore, of great interest in anatomy and forensic science [2].

The hip bone is a large, irregularly shaped bone, that is said to be shaped like a ship propeller. The lateral surface of the hip bone has anacet abulum, which is cup – shaped and serves as the articulation site for the femur. Anterior and a little inferior to this structure is the large obturator foramen, and on the medial, anterior side of the pubic bone is the symphy seal surface, which serves as the articulation site for the two pubic bones that form the pelvicgirdle. The hip bone is made of three parts: ilium, ischium, and pubis, and all three of these bones connect at the acetabulum. The ilium forms the upper part of the acetabulum; the ischium includes the lower acetabulum while the pubis forms the anterior acetabulum [3].

A hip bone is considered an ideal bone for sex determination as it provides a higher accuracy level for sex determination [4]. Various studies that were conducted have identified ethnic and racial variations in hip bone morphology, highlighting the importance of a thorough understanding of its parameters for anatomists, forensic experts, and anthropologists. [5].

2. Materials and Methods

This was a study cross - sectional. Theprimarymaterialsforthisstudyconsistedof86dry hip bones of known gender (58 males, 28 females). The gender of the hip bone was assessed through the records maintained by the Department of Anatomy at Post Graduate Institute of Medical Sciences, Rohtak, Haryana.

All the bones were fully ossified and free from any congenital orpathological defects as deformed bones were excluded from the study. The bones were collected from PGIMS Rohtak. Pubic parts of these bones were assessed with the metrical parameters. All the measurements were carried out using a vernier caliper. The following four parameters were taken in each bone.

- Mid pubic width: This bone feature was measured using vernier calipers as the shortest distance from the middle of the symphy seal surface of the body of the pubis to the margin of the obturator foramen
- Length of pubic crest: This bone feature was measured using vernier calipers as the length of the superior border of the body of the pubis, from the symphyseal surface

upto the pubic tubercle

- Length of pubic bone: This bone feature was measured using vernier calipers as the distance of the central point of the acetabulum from the upper end of the symphyseal surface of the body of the pubis. To determine the central point, irregularities on both the inner and outer surfaces were used as reference points [6].

Length of pubic bone upto acet abulum: This bone feature was measured using vernier calipers as the distance from the upper medial end of the pubic bone to the nearest edge of the acetabulum [6].

3. Results

ThemeanparametersofthepubisofthehipboneinNorthIndianmaleswerefoundtobe less than the mean parameters of the pubis in North Indian females. However, the mid - pubic width was found to be more prominent on the left side pubis in both males and females. The length of the pubic crest was found to be less on the left side pubis in males, while the same was found to be greater in females. Similarly, the length of the pubic bone in males was found lesson the left side while in females, the length of the pubic bone was found to be greater on the left side. The length of pubic bone up to the acetabulum was again less on the left side in both cases (table 1).

However, the p - values are significant in only one parameter – the length of the pubic crest shows a significant difference (p= 0.042) in males and females. The length of the pubic bone up to the acetabulum in males and females shows an insignificant difference (p=0.154). Both these values are significantly appreciated in males and females. The rest of the parameters demonstrate insignificant p - values. Also, the differences between the right pubic and left pubic bone show insignificant p values.

4. Discussion

Sexual dimorphism in the human pelvis is well established. The findings of this study further contribute valuable data on sexual dimorphism in hip bones. Additionally, consistent with previous research, the mean pubic length is universally greater in females across all studies (Table 2).

Pubic length is greater in females due to its increased responsiveness to female sex hormones [7]. Additionally, while differences in the mean values between right and left hipbones were observed in both males and females, these differences were not statistically significant. However, the correlation between different parameters within the same bone was found to be statistically significant.

Table 1: Measurements of the mean of various parameters of pubis of the hip bone

S. No.	Pubic Parameters (mm)	Males (N=58) (Mean ± SD)		Females (N=28) (Mean ± SD)		P - value (for overall bone)	
		Right	Left	Right	Left	For sex	For side
1	Mid Pubic width	29.11± 4.74	30.40 ± 4.83	30.38 ± 2.45	30.93 ± 2.85	0.265	0.249
2	Length of Pubic Crest	20.99 ± 4.01	20.61 ± 4.72	22.15 ± 3.27	22.98 ± 3.48	0.042	0.988
3	Length of Pubic bone	67.30 ± 7.17	65.04 ± 10.9	68.88 ± 7.20	69.26 ± 9.83	0.154	0.476
4	Length of Pubic Bone upto Acetabulum	72.32 ± 9.73	70.14 ± 10.8	73.29 ± 6.83	72.39 ± 6.13	0.377	0.375

Table 2: Comparison of various studies of various authors on mean pubic length

S. No.	Authors		Mean Pubic Length
1	Oladipo G. S. et al 2014 [8]	Nigerian Males	91.99 ± 17.76
		Nigerian Females	103.12 ± 13.11
2	Kanika Sachdeva et al 2014 [7]	Males	79.2± 7.1
		Females	85.6 ± 4.7
3.	Kumari & Singh 2016 [10]	Males (Jharkhand)	66± 8.6
		Females (Jharkhand)	66.8± 7.6
4.	Mostafa et al 2017 [11]	Egyptian Males	93.3±4.8 (R) 93.4±4.4 (L)
		Egyptian Females	84.2±3.8 (R) 84.5±3.6 (L)
5.	Present study	North Indian Males	72.32 ± 9.73 (R) 70.14 ± 10.8 (L)
		North Indian Females	73.29 ± 6.83 (R) 72.39 ± 6.13 (L)

This study provides valuable data that reinforces findings from previous research. It identifies two parameters that were statistically significant, supporting the presence of sexual dimorphism in hip bones and contributing important information to the field.

Authors' contributions

Conceptualization: SG Methodology: SG, GA Software: NA Validation: NA
Formal Analysis: GA, SB Investigation: SG, GA, SB Resources: SG, AG
Data curation: SB, GA Writing original draft: SG, SB
Writing review & editing: AG, GA Visualization: SG
Supervision: SG

Project administration: NA Funding acquisition: NA

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