Research Paper

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Morphometric Analysis of Pubic Bone in Sex Dimorphism

Medical Science

KEYWORDS : Pubic length, Mid-pubic width, Pubic angle, Minimum pubic width

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ABSTRACT

Introduction:- The distinctive morphology of the human hip bone and its clear sexual dimorphism make it of interest in medical science field. Material and Method:- This study was carried out on 110 dried human hip bones and classified them in to three groups according to eight visual criteria Male, female and unidentified group. Out of 110 hip bones 50 were male, 35 were female and remaining 25 were related with unidentified group. Pubic length, mid pubic width, minimum pubic width and pubic angle was measured and index 1 (mid pubic width / Pubic length) and index 2 (minimum pubic width / Pubic length) was calculated. All these measurements and index were statistically analyzed. Results:- Mean values of Pubic length, mid pubic width, minimum pubic width, index 1 and index 2 were higher in female as compared male and unknown sex group hip bones. Mean value of pubic angle was less in female as compared to male. After statistical analysis of these measurements difference in mean of pubic length p value was 0.389, mid pubic width pubic angle, index 1 and 2 was <0.0001 and p value for pubic angle was 0.005 Conclusion:- After statistical analysis It was found that there was significant difference in the mean value of mid pubic width , minimum pubic width, pubic angle, index 1 and index 2.

Introduction:-

The four main features of biological identity are sex, age, stature and race. A reliable estimation of sex from the skeleton by using various criteria is important in the field of anatomy or forensic medicine or work with prehistoric osteological collections.[1]

Many bones of the skeleton present size related sexual differences, but those of the pelvis usually display marked sex differences in morphology independent of size due to different reproductive functions mainly influenced by sex hormones.[2]

The distinctive morphology of the human hip bone and its clear sexual dimorphism make it of interest from anatomical, anthropological and forensic points of view. It can therefore be a reliable criterion for estimation of sex of skeletal remains under study.

Methods of determining the sex of an individual based upon visual criteria, morphological or subjective observations like subpubic angle, sciatic notch, preauricular sulcus, auricular area or based on the measurements or objective techniques like ischiopubic index, pubic angle, pubic length, interpubic breadth and interobturator breadth. or based on discriminant function analysis. [3]

Phenice described new visual method for determination of pubic bone based on Ventral arc, Subpubic concavity and ridge on the medial aspect of ischiopubic ramus, and found estimation of sex with an accuracy of more than 95%.[4]

Luo[5] done study on adult human pubes (66 males and 56 females) by parameters like angle formed by the middle line of the superior ramus and inferior ramus of pubis, subpubic angle, the minimum distance from the symphysial surface to the obturator margin and the minimum thickness of the ischiopubic ramus, and concluded that that the sex could be determined with an accuracy of greater than 81% by using these parameters.[5]

Hooton[(6)] States that "the determination of sex from post cranial skeleton in adult is easy and certain in about 80% of the cases, difficult but possible in another 10% of cases and quite duboius in remainder."

Sex determination of human hip bone can be done by gross morphological anatomy and measurements of hip bone.

In this study measurements of pubic length, Mid-pubic width, Pubic angle, Minimum pubic width used to show sexual dimorphism of pubic part of hip bone.

Material and Methods:-

This study was done on 110 dried adult human hip bones in Department of Anatomy of in different medical colleges of Gujarat. Deformed and damaged hip bones were excluded for the study. Depending upon following visual criteria all hip bones were separated in male and female and unidentified sex group. Hip bones were classified according to the following criteria those were selected for the study.

A depression seen or felt just inferior to auricular part of sacropelvic surface of ilium it is Preauricular sulcus[(7)]. This was present in femle and absent in male.

The width and posterior angle of the greater sciatic notch[(7)] was observed in the entire bones. Greater sciatic notch wide in female and narrow in male.

Obturator foramen[(7)] oval in male, triangular in female.

The depth of iliac fossa[(7)] seen. Iliac fossa was deep in male and shallow in female.

Comparison between diameter of acetabulum and the distance of its anterior rim from pubic symphysis[(7)] done to assess the size of acetabulum. Acetabular diameter was more than distance of its anterior rim from pubic symphysis in male as compared to female.

Ischiopubic ramus[(7)] was everted in male because of attachement of crus of penis. This was not everted in female.

Study of Subpubic concavity[(7)] was seen from the dorsal aspect as a small curve of the ischiopubic ramus, a short distance below the lower margin of pubic symphysis. Subpubic concavity was present in female and absent in male.

A slightly elevated ridge of bone starting from pubic crest and extending inferiorly across the ventral surface of body of pubis, blending with the medial border of ischiopubic ramus known as Ventral arc[(4)] which was seen in female, not in male.

By these criteria hip bones were classified in to three group male, female and unidentified sex according to these visual criteria. Hip bone having 7 to 8 female criteria was classified as female, hip bone having 7 to 8 male criteria was classified as male bone, rest of bone had less than these male and female criteria was classified as unidentified sex. Out of 110 hip bones 50 bones were male, 35 were female and remaining 25 were classified in to unidentified group.

Pubic length, Mid-pubic width and Minimum pubic width were measured in mm with vernier caliper. Pubic angle was measured with help of goniometer.

Description of measurements

Pubic length: Pubic length was taken as straight distance from the mid point of acetabulum (from dorsal aspect, the point where the three elements forming the hip bone meet) to the uppermost margin of pubic symphysial surface.[8]

Midpubic width: Midpubic width was measured as the shortest distance from the midpoint of pubic symphysis to the nearest obturator foramen margin.[9]

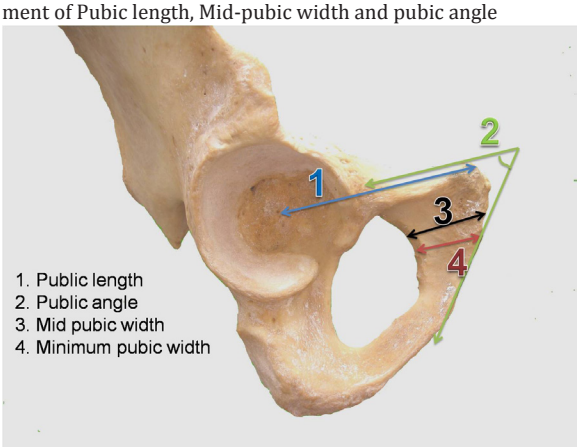
Pubic angle: Pubic angle was measured as the angle formed between the long axis of superior and inferior ramus of pubis.[5]

Minimum pubic width: Minimum pubic width was defined as the least straight distance from pubic symphyseal surface to the nearest obturator foramen margin.[5]

Index 1 - Mid pubic width / pubic length

Index 2 - Minimum pubic width / pubic length

Photograph:- Showing bony points and method of measurement of Pubic length, Mid-pubic width and pubic angle



Results:-

All measurements were statistically analyzed and their mean standard deviation was calculated. ANOVA test was applied to find out significance of these differences in male, female and unidentified sex. Summary of these measurement were shown in table 1, 2 and 3.

Table- 1 Summary of measurements of Pubic length, mid pubic width, minimum pubic width, pubic angle

	Pubic length			Mid Pubic Width		
	Male	Female	Unidentified	Male	Female	Unidentified
Mean	69.486	70.754	70.156	25.518	28.731	26.624
Minimum	60.5	62.3	64.9	18.200	22.5	21.5
Maximum	82.1	81.4	77.7	31.4	34.9	30.8
Standard deviation	4.770	4.001	3.062	3.266	2.929	2.326
F value (ANOVA test)	0.952			12.101		
P value	0.389			<0.0001		

Table 1 showed that mean value of public length was more in female (70.75 mm) as compared to male and unidentified sex group but this difference was less. And differences in the mean values of public length within the group were statistically not significant. Mean value of mid pubic width was higher in female(28.73 mm) as compared to male(25.52 mm) and unidentified sex(26.62 mm) .Difference between the mean of these group was statistically analyzed and found P value was <0.0001 that was highly significant.

Table- 2 Summary of measurements of minimum pubic width, pubic angle

	Minimum Pubic width			Pubic angle		
	Male	Female	Unidentified	Male	Female	Unidentified
Mean	20.426	23.403	21.496	49.5	46.0	49.6
Minimum	14.2	16.9	16.7	42	39	42
Maximum	26.4	29.1	25.5	72	66	66
Standard deviation	2.966	3.034	2.534	5.331	4.814	5.299
F value (ANOVA test)	10.898			5.587		
P value	< 0.0001			0.005		

As per table 2 mean value of minimum pubic width was higher in female (23.40 mm) as compared to male(20.42mm) and unidentified(21.49 mm). Difference of the mean was statistically significant (P Value <0.0001)

Mean value of public angle was less in female (46°) compared with male and unidentified group. But mean value of pubic angle was similar in male (49.5°) and unidentified group (49.6°) .

Table- 3 Summary of measurements of Index 1 and Index 2

	Index 1 (Mid Pubic Width/public length			Index 2 (Minimum Pubic Width/ Pubic length)		
	Male	Female	Unidentified	Male	Female	Unidentified
Mean	0.367	0.406	0.380	0.294	0.331	0.307
Minimum	0.291	0.329	0.319	0.227	0.245	0.252
Maximum	0.456	0.477	0.441	0.382	0.453	0.379
Standard deviation	0.037	0.038	0.033	0.038	0.043	0.307
F value (ANOVA test)	12.145			9.534		
P value	< 0.0001			0.000		

Table 3 showed that mean values of Index 1 and Index 2 were more in female as compared to male and unidentified sex. After analysis of difference of mean if was found that P value of Index 1 was <0.0001 and Index 2 was 0.000 It showed that index 1 and index 2 were statistically significant.

Discussion:-

Sexual differences in adult pelvis has been studied and measured extensively, these studies involved metrical and non-metrical characteristics whose range overlap between the sexes. Hip

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bone is having great value in sexual dimorphism.

Visual criteria for sex determination of hip bone are having high degree of subjective error and it requires experience. For Objective criteria, no standard charts are available for various parameters and different races.

In this study 110 adult human hip bones of unknown sex were selected. By 8 visual criteria these hip bone were categories in to male, female and unidentified group. Out of these 110 hip bones, 50 were male and 35 were female and 25 were unknown unidentified sex hip bones.

The result of our study showed that difference in the mean value of pubic length was statistically not significant.

Differences in the mean value of mid pubic width, minimum pubic width, pubic angle and index 1 and 2 were statistically highly significant.

Segebarth Orban[10] and Patriquin et al[11] observed that pubic length was not significant in male and female. Similar results found in this study.

Osunwoke, Emeka A, observed that pubic length was statistically significant in contrast to our study. This observation carried out on anterio posterior view of pelvis.

Study carried out by Milne had similar findings that mid pubic width was a more sexing character than pubic length.[9]

Conclusion and recommendation:-

This study showed that there was sexual dimorphism in the pubic part of hip bone. Pubic width and pubic length was more in female. Pubic angle was less in female. These differences are due to wider female pelvis. Pubic bone form anterior wall of pelvic cavity and upper border of pubic bone contributes in inlet of pelvis. And its inferior border forms pelvic outlet.

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