

Original Research Paper

A Study of Sexual Dimorphism of Femoral Head In Gujarat Region

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Abstract

Various diameters of head of femur have been in use for sex determination. These diameters vary region wise also. Therefore we undertook the study in Jamnagar region of Gujarat. Maximum diameter of the femoral head was measured in 184 dry, normal, adult, human femora (136 male & 48 female) obtained from M. P. Shah Medical College Jamnagar Gujarat. Mean Values obtained were, 43.75 and 40.33 for right male and female, and 43.88 and 40.64 for left male and female respectively. Higher value in male was statistically highly significant ($P < 0.001$) on both sides. The data was subjected to demarking point (D.P.) analysis. Maximum head diameter identified 11.90% of right male femora and 7.25% of left male femora; in female it identified 4% of left female femora while it was not useful (0.00%) for right female bone. Though the sex of the bone can be determined from head of the femur bone, in itself it is far from conclusive.

Key Words: Head diameter, Sexual dimorphism, Femur, Jamnagar region

Introduction:

The determination of sex from skeletal remains is immensely important medico-legally as well as anthropologically. Morphological (Non-metrical) methods such as the visual inspection of bone depend largely on the ability and experience of an observer. However, metrical methods for sexing from bones are simple, allow no individual variations and are entirely objective assessment.

Sex determination is relatively easy if the entire skeleton is available, pelvis and skull are the most reliable bones for this purpose. [1] However, in medicolegal cases one does not always have a complete pelvis or skull. Therefore it is important to be able to assess sex from the other parts of the skeleton also.

Sexual dimorphism of femoral head is studied by several workers in different populations: Javdekar, [2] Kate in sample from fifteen cities of India, [3] Singh & Singh, in Varanasi zone India, [4] Dittrick and Suchey in the Prehistoric Central California skeletal remains. [5]

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Iskan and Shihai in Chinese femora, [6] Steyn and Iskan in South African whites, [7] King, Iskan and Loth in Thai femur, [8] Trancho et al in Spanish people, [9] in Nigerian population, [10] Igbigbi and in Black Malawians, [11] Purkait and Chandra in Bhopal, India, [12] Asala in South African white and black [13] and in South African Blacks. [14]

According to Krogman and Iskan [1] standards of morphological and morphometric attributes in the skeleton may differ with the population samples involved and this is true with reference to dimensions and indices (average and range) and as a general rule standards should be used with reference to group from which they are drawn and upon which they are based, they are not interchangeable. So, present study was carried out to ascertain values of maximum head diameter of femora from Gujarat region; and to evaluate its possible efficacy in determining correct sexual identification.

Material and Methods:

Material for the present study consisted of 136 male (67 of right & 69 of left side) and 48 female (23 of right & 25 of left side) dry, human, adult femora from the skeletal collection of Anatomy department, M.P. Shah Medical College, Jamnagar, Gujarat. Femora showing pathological abnormality or from the persons outside Gujarat region were not included in study.

Vertical (superoinferior), mediolateral & anteroposterior diameters of head were measured as mentioned below-

Vertical diameter: The ends of the calliper touching the highest and lowest point on the margin of head [15]. (Figure: 1)

Mediolateral diameter: The ends of the calliper touching the medial most and lateral most point of the head [15]. (Figure: 1)

Anteroposterior diameter: The ends of the calliper touching the farthest point on the anterior and posterior surface of the head [15]. (Figure: 1)

Each bone was measured thrice and measurements were repeated by two independent observers, mean of these observations was taken as a final reading to nullify any intra and inter-observer error. Data collected was tabulated and analysed statistically side wise and sex wise by demarking point (D.P.) analysis.

Results:

Right femur: Table 1 showed that the maximum head diameter of right male femur varied from 37.00mm to 51.00mm (average: 43.75 & S.D.:2.72) and of right female femur varied from 37.00mm to 44.00mm (average: 40.33 & S.D.:2.18).

Mean value of maximum femoral head diameter was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean head diameter in male and female was statistically highly significant with $P < 0.001$. With the demarking points definite sexual classification in male right bone (>46.87) was 11.94 % (no=8) and in female right bone (<35.59) was 0.00%.

Left femur: As illustrated in Table 1 the maximum head diameter of left male femur varied from 36.00mm to 51.00mm (average: 43.88 & S.D.:2.83) and of left female femur varied from 35.00mm to 45.00mm (average: 40.64 & S.D.:2.22).

Mean value of maximum femoral head diameter was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean head diameter in male and female was statistically highly significant with $P < 0.001$.

By means of demarking points, definite sexual classification in male left bone (>48.20) was 7.25 % (no=5) and in female left bone (<35.59) was 4% (no=1).

Differences in the maximum femoral head diameter value between right & left male and right & left female were not statistically significant, so were not evaluated further.

Discussion:

Mean value of femoral head was higher in male as compared to female. Calculated t-

value and P value showed that the difference in the mean Femoral head in male and female was highly statistically significant with $P < 0.001$ on both side.

For right male bone calculated range (Mean \pm 3S.D.) was 35.59-51.91 and for right female bone it was 33.79-46.87. With the help of these demarking points, right femur with maximum head diameter more than >46.87 can be correctly classified as a male and right femur with maximum head diameter less than <35.59 can be correctly classified as a female. However if the head diameter of bone is between 35.59 mm and 46.87 mm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male right bone (>46.87) was 11.94 % (no=8) and in female right bone (<35.59) was 0.00%.

For left male bone calculated range was 35.39-52.37 and for left female bone it was 33.08-48.20. So, left femur with maximum head diameter more than >48.20 can be correctly classified as a male and left femur with maximum head diameter less than <35.39 can be correctly classified as a female. However if the head diameter is between 35.39 mm and 48.20 mm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male left bone (>48.20) was 7.25 % (no=5) and in female left bone (<35.59) was 4% (no=1).

Axial skeleton weight of the male is relatively and absolutely heavier than that of the female, and the initial impact of this weight is borne by the femur in transmission of the bodyweight [16]. As a result articular surfaces taking part in weight transmission are massive in male resulting in higher value of head diameter in male bilaterally.

Comparison of maximum head diameter of male between present study and other studies has been shown in (Table 2). Mean maximum male femoral head diameter value in present study was 43.75 (right) & 43.88 (left). In other studies it varied from 41.50 to 48.46. Mean male value of maximum head diameter in present study was lower than all populations except sample from various cities of India [3] with the mean male value of 41.50mm. (Table2). However, values from study in Bhopal [12] correlated with present study.

Mean maximum female femoral head diameter value in present study was 40.33 (right) & 40.64 (left). In other studies it varied from 38.39 to 43.02 (Table: 2). Mean female value of maximum head diameter in present study was lower than American Blacks & Whites, [17] South African Whites[6] and Californian sample

[5]; was higher than what was observed by Purkait et al in Bhopal [12] and in various other Indian samples studied by Kate, [3] but was identical to that found in Thai [8], Chinese [6] and Spanish femora [9]. This difference in the value of maximum femoral head diameter in between populations may possibly be a result of factors affecting bone morphology like genetic constitution, diet, nutrition status, environment and physical activity.

The most marked difference between the present study and other studies is the low percentage of correct sexual classification in present study (11.94% & 7.25% for right & left male respectively, 0% for female bones bilaterally).(Table 2) This could be explained on the basis of statistical method applied. While most of the studies referred above were based on multivariate analysis, present study had used the demarking point analysis. Percentage of correctly sexed bone dropped down sharply with the statistically calculated demarking points. Though the bones which could be identified by Demarcation Points are mostly few in numbers but identification of bone is with 100% accuracy, this makes demarking point analysis and results obtained from it very much vital in medicolegal cases. [18]

Conclusion:

Mean values of maximum femoral head diameter of normal human adult femora from Gujarat region, in male were 43.75 mm (Right) & 43.88 mm (Left) and for female were 40.33 mm (Right) & 40.64 mm (Left). By demarking point analysis maximum head diameter identified 11.94% of right male femora, 7.25% of left male femora, 0.00% of right female femora and 4% of left female femora.

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Figure 1: Measurements of femoral head

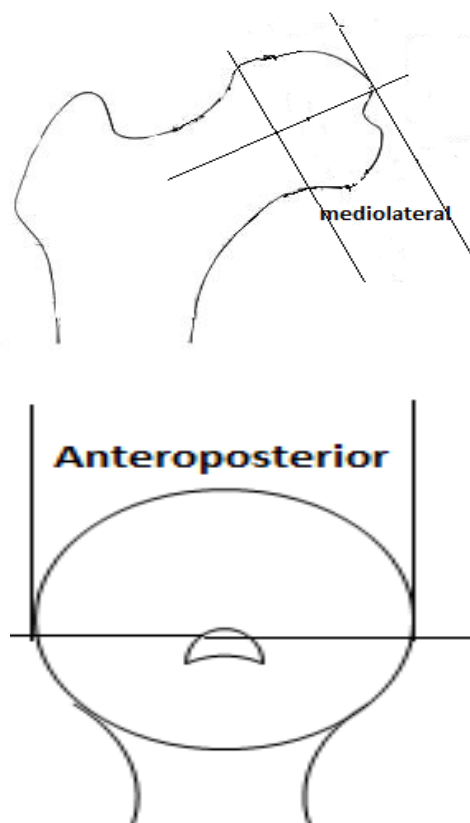


Table: 1
Statistical Values of the Maximum Head Diameter of the Femur (All Dimensions in Mm)

Statistical values	RIGHT		LEFT	
	Male (N=67)	Female (N=23)	Male (N=69)	Female (N=25)
Range	37-51	37-44	36-51	35-45
Mean	43.75	40.33	43.88	40.64
S.D.	2.72	2.18	2.83	2.22
t-value	6.07		5.81	
P value	P< 0.001		P< 0.001	
Calculated Range mean±3S.D.	35.59-51.91	33.79-46.87	35.39-52.37	33.08-48.20
Demarking Points(D.P)	>46.87	<35.59	>48.20	<35.39
% & no. identified by D.P.	11.94% (no=8)	0.00% (no=0)	7.25% (no=5)	4% (no=1)

Table: 2
Comparison of Maximum Head Diameter

Population & Study	Maximum Head Diameter						
	Male			Female			
	Mean	S.D.	% Identified	Mean	S.D.	% Identified	
Javdekar B.S.(1962),	45.26	-	-	40.37	-	-	
Kate B.R.(1964), India	41.50	-	-	39	-	-	
Iscan & Miller(1984), Amer. Blacks	47.8	2.39	-	42	2.33	-	
Iscan & Miller(1984), Amer. Whites	48.2	2.52	-	42.2	2.28	-	
Dittrick J & Myers (1986), California	47	2.5	88.70	42.2	1.9	88.70	
Iscan & Shihai (1995), Chinese	46.16	2.62	83.10	41.13	2.64	79.50	
Trancho et al (1997), Spanish	47.15	2.46	91.23	41.13	1.93	91.23	
Iscan & Steyn(1997), south African whites	48.46	2.65	87.50	43.02	2.42	84.00	
King C.A. et al (1998),Thai	45.1	1.98	88.40	39.3	1.93	97.10	
Purkait & Chandra(2002), Indian	44.28	2.48	91.00	38.39	2.14	91.30	
Present Study	Rt.side	43.75	2.72	11.90	40.33	2.18	0.00
	Lt.side	43.88	2.83	7.25	40.64	2.22	4.00