

Sexual Dimorphism of Bicondylar width of Femora

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Abstracts: Background: Sexual identification from the skeletal parts is very important medicolegally as well as anthropologically. Present study aims to ascertain values of femoral bicondylar width and to evaluate its possible efficacy in determining correct sexual identification. Methods: Study sample consisted of 184 dry, normal, adult, human femora (136 male & 48 female) from skeletal collections of Anatomy department, M. P. Shah Medical College, Jamnagar, Gujarat. Bicondylar width was considered as maximum distance between medial and lateral femoral condyle, measured with the Vernier caliper. Results: Mean Values obtained were, 76.84 and 72.34 for right male and female, and 76.64 and 72.84 for left male and female respectively. Higher value in male was statistically highly significant ($P < 0.001$) on both sides. Demarking point (D.P.) analysis of the data showed that right femora with bicondylar width more than 80.20 were definitely male and less than 65.50 were definitely female; while for left bones, femora with bicondylar width more than 80.76 were definitely male and less than 66.53 were definitely female. Conclusions: Bicondylar width identified 22.40% of right male femora and 14.49% of left male femora; it was not useful for female bone [Pandya A NJIRM 2011; 2(4) : 68-71]

Key Words: Bicondylar width, Sexual dimorphism, Femur

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Introduction: The determination of sex from skeletal remains is of immense medicolegal and anthropological importance. Nonmetrical methods such as the visual inspection of bone morphology depend entirely on the ability and experience of an observer. Metrical methods for sexing from bone in addition to providing simplicity also 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 bicondylar width of femur is studied by many workers in different populations.²⁻¹⁰

According to Krogman and Iscan¹ 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 sexual dimorphism of bicondylar width in femora from Gujarat region.

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) 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.

Maximum distance between medial and lateral femoral condyles in coronal plane at right angle to the long axis of femur was measured in millimeter with the help of Vernier caliper¹¹ (Figure 1).

Each bone was measured thrice and measurement was 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 analyzed statistically sidewise & sexwise by demarking point (D.P.) analysis.

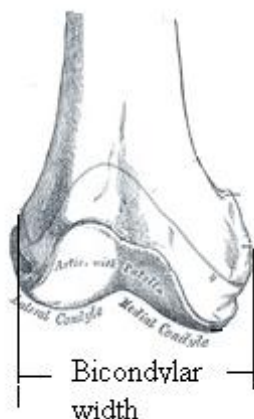


Figure 1: Bicondylar width

Result: a).Right femur: The Bicondylar width of right male femur varied from 68.00mm to 85.00mm (Mean: 76.84 & S.D.: 3.78) and of right female femur varied from 66.00mm to 76.00mm (Mean: 72.43 & S.D.: 2.59). Mean value of bicondylar width was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean bicondylar width in male and female was statistically highly significant with $P < 0.001$. By demarking points, definite sexual classification in male right bone (>80.20) were 22.39 % (no=15) and in female right bone (<65.0) was 0.00%

b).Left femur: The Bicondylar width of left male femur varied from 69.00mm to 85.00mm (Mean: 76.64 & S.D.: 3.37) and of left female femur varied from 67.00mm to 78.00mm (Mean: 72.84 & S.D.: 2.64). Mean value of bicondylar width was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean bicondylar width in male and female was highly statistically significant with $P < 0.001$.

Table: 1 Statistical values about the Bicondylar width of the femur (all dimensions in mm)

Statistical values	RIGHT		LEFT	
	MALE (n=67)	FEMALE (n=23)	MALE (n=69)	FEMALE (n=25)
Range	68-85	66-76	69-85	67-78
Mean	76.84	72.43	76.64	72.84
S.D.	3.78	2.59	3.37	2.64
t-value	6.19		5.70	
P value	$P < 0.001$		$P < 0.001$	

Calculated Range mean \pm 3S.D.	65.50-88.18	64.66-80.20	66.53-86.75	64.92-80.76
Demarking Points(D.P)	>80.20	<65.50	>80.76	<66.53
% & no. identified by D.P.	22.39 % (n=15)	0.00% (n=0)	14.49% (n=10)	0.00% (n=0)

Definite sexual classification in male left bone (>80.76) was 14.49% (no=10) and in female left bone (<66.53) was 0.00%.

Differences in the bicondylar width value between right & left male and right & left female were not statistically significant, so were not evaluated further.

Discussion: Mean value of bicondylar width was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean bicondylar width 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 65.50-88.18 and for right female bone it was 64.66-80.20. Based on these calculated range, we can statistically fix a measurement above which (>80.20) no female bone can be found and another measurement below which (<65.50) no male femora can be seen, these measurements can be termed as demarking points.¹² With the help of these demarking points, right femur with bicondylar width more than >80.20 mm can be correctly classified as a male and right femur with bicondylar width less than <65.50 mm can be correctly classified as a female. However if the width is between 65.50mm and 80.20mm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male right bone (>80.20) was 22.39% (no=15) and in female right bone (<65.0) was 0.00%

For left male bone calculated range was 66.53-86.75 and for left female bone it was 64.92-80.76. With the help of these demarking points, left femur with bicondylar width more than >80.76 mm can be correctly classified as a male and right femur with bicondylar width less than <66.53 mm can be correctly classified as a female. However if

the bicondylar width is between 66.53 mm and 80.76 mm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male left bone (>80.76) was 14.49 % (no=10) and in female left bone (<66.53) was 0.00%.

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 bodyweight¹³. As a result articular surfaces taking part in weight transmission are massive in male resulting in higher value of bicondylar width in male on both the side

Comparison of bicondylar width of male between present study and other studies has been shown in Table: 2. Values of bicondylar width in present study were 76.84 (right) & 76.64 (left) while in other studies it varied from 78.04 to 84.63. Mean male value of bicondylar width in present study was lower than all other populations except value obtained from Bhopal (India) femora⁹.

Table: 2 Comparison of Bicondylar widths in male

Population & Study	Male			
	Mean	S.D.	%Identified	
Iscan & Miller, Amer. Blacks	83.2	3.99	–	
Iscan & Miller, Amer. Whites	83	4.1	–	
Dittrick J & Myers California	81.7	4.1	85.80%	
Iscan & Shihai ,Chinese	80.32	4.27	94.40%	
Iscan & Steyn, south Afr. whites	84.63	4.63	89.30%	
Trancho et al, Spanish	80.6	2.99	97.56%	
King C.A. et al,Thai	79.7	3.63	94.30%	
Purkait &Chandra, Indian	78.04	4.48	87.50%	
present study	Rt.	76.84	3.78	22.40%
	Lt.	76.64	3.37	4.00%

Table: 3 illustrated Comparison of bicondylar width of female between present study and other studies. Values of bicondylar width in females in present study were 72.43 (right) & 72.84 (left). In other studies it varied from 67.13 to 75.1. Mean female value of bicondylar width was lower than South African Whites⁶; was higher than Bhopal India⁹ and Thai femora⁷; was almost close to American Blacks & American Whites², Chinese⁵, Spanish⁸ and Californian sample³.

Table: 3 Comparison of Bicondylar widths in female

Population & Study	Female			
	Mean	S.D.	%Identified	
Iscan & Miller, Amer. Blacks	74	3.64	–	
Iscan & Miller, Amer. Whites	74.1	3.66	–	
Dittrick J & Myers California	73.5	3.4	85.80%	
Iscan & Shihai ,Chinese	70.62	3.2	94.90%	
Iscan & Steyn, south Afr. whites	75.1	3.32	91.80%	
Trancho et al, Spanish	70.82	2.36	97.56%	
King C.A. et al,Thai	70	3.3	91.20%	
Purkait &Chandra, Indian	67.13	3.92	95.00%	
present study	Rt.	72.43	2.59	0.00
	Lt.	72.84	2.64	0.00

This difference in mean bicondylar width in between populations may possibly be a result of factors affecting bone morphology like genetic constitution, diet, nutrition status, environment and physical activity

Table: 2 and Table: 3 revealed that most marked difference between the present study and other studies is the low percentage of correct sexual classification in present study. 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. Biological

variables may show wide variations, which the simple analysis may not cover even if the sample size is large, this problem can be overcome by subtracting and adding S.D.s to mean value (± 3 S.D.), these will give the maximum and minimum values the range of which covers 99.75% of population of that area, while percentage of correctly sexed bone dropped down sharply with the statistically calculated demarking points but 100% classification accuracy is achieved for any sample from the region which is very useful in medicolegal cases¹⁴. The D.P.s are also easy to work out as compared to multivariate analysis.

Conclusion: Mean values of bicondylar width of normal human adult femora from Gujarat region, in male were 76.84 mm (Right) & 76.64 mm (Left) and for female were 72.43 mm (Right) & 72.84 mm (Left). It identified 22.4% of right male femora and 14.49% of left male femora. It was not useful for female bones.

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