

SEXUAL DIMORPHISM OF MAXIMUM FEMORAL LENGTH

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ABSTRACT

Sexual identification from the skeletal parts has medico legal and anthropological importance. Present study aims to obtain values of maximum femoral length and to evaluate its possible usefulness in determining correct sexual identification. 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. Maximum length of femur was considered as maximum vertical distance between upper end of head of femur and the lowest point on femoral condyle, measured with the osteometric board. Mean Values obtained were, 451.81 and 417.48 for right male and female, and 453.35 and 420.44 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 maximum length more than 476.70 were definitely male and less than 379.99 were definitely female; while for left bones, femora with maximum length more than 484.49 were definitely male and less than 385.73 were definitely female. Maximum length identified 13.43% of right male femora, 4.35% of right female femora, 7.25% of left male femora and 8% of left female femora

Key-words: Maximum length, Sexual dimorphism, Femur

INTRODUCTION

The determination of sex from skeletal remains is of very much medico legal and anthropological importance. Nonmetrical (morphological) methods such as the visual inspection of bone morphology depend entirely on the ability and experience of an observer. Morphometrical 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 maximum length of femur is studied by several workers in different populations [Singh & Singh, (1972) in Varanasi zone India², DiBennardo R. and Taylor J. V. (1979)³, Dittrick J. and Suchey J. M. (1986) in the Prehistoric Central California skeletal remains⁴, Iscan M.Y. and Shihai D. in Chinese femora⁵, Steyn M. and Iscan M. Y. (1997) in South

African whites⁶, King C.A., Iscan M. Y. and Loth S.R. (1998) in Thai femur⁷, Leelavathi N. et al (2000) in femora from Karnataka⁸, Purkait R. and Chandra H. (2002) in Indians⁹].

According to Krogman and Iscan¹ standards of morphological and Morphometrical 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 maximum femoral length 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 length was measured with Femur on Osteometric board in such a manner that medial condyle touches the short vertical wall; the moveable cross-piece should touch the highest point of the head. Maximum vertical distance between upper end of head of femur and the lowest point on femoral condyle was measured.¹⁰ (Figure 1)

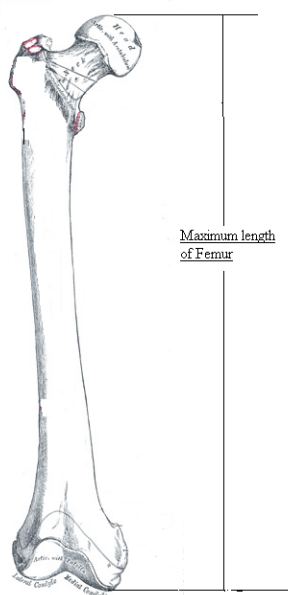


Figure 1: Maximum Femoral length

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.

RESULTS

a).Right femur: The maximum length of right male femur varied from 395mm to 506mm (Mean: 451.81 & S.D.: 23.94) and of right female femur varied from 376mm to 473mm (Mean: 417.48 & S.D.: 19.74).

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

By demarking points, definite sexual classification in male right bone (>476.70) was 13.43% (no=09) and in female right bone (<379.99) was 4.35% (no=1).

b).Left femur: The maximum length of left male femur varied from 395mm to 507mm (Mean: 453.35 & S.D.: 22.54) and of left female femur varied from 381mm to 469mm (Mean: 420.44 & S.D.: 21.35).

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

Table 1: Statistical values about the maximum femoral length (all dimensions in mm)

Statistical values	Right		Left	
	Male (n=67)	Female (n=23)	Male (n=69)	Female (n=25)
Range	395-506	376-473	395-507	381-469
Mean	451.81	417.48	453.35	420.44
S.D.	23.94	19.74	22.54	21.35
t-value	6.80		6.50	
P value	$P < 0.001$		$P < 0.001$	
Calculated Range mean \pm 3S.D.	379.99-523.63	358.26-476.70	385.73-520.97	356.39-484.49
Demarking Points(D.P)	>476.70		>484.49	
% & no. identified by D.P.	13.43% (no=9)	4.35% (no=1)	7.25% (no=5)	8% (no=2)

Definite sexual classification in male left bone (>484.49) was 7.25% (no=5) and in female left bone (<385.73) was 8.00% (no=2).

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

DISCUSSION

Mean value of maximum length was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean maximum

length 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 379.99-523.63 and for right female bone it was 358.26-476.70. Based on these calculated range, we can statistically fix a measurement above which no female bone can be found and another measurement below which no male femora can be seen, these measurements can be termed as demarking points.¹¹ With the help of these demarking points, right femur with maximum length more than >476.70 mm can be correctly classified as a male and right femur with maximum length less than <379.99 mm can be correctly

classified as a female. However if the length is between 379.99mm and 476.70mm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male right bone (>476.70) was 13.43% and in female right bone (<379.99) was 4.35%

For left male bone calculated range was 385.73-520.97 and for left female bone it was 356.39-484.49. With the help of these demarking points, left femur with length more than >484.49mm can be correctly classified as a male and right femur with length less than <385.73mm can be correctly classified as a female. However if the length is between 484.49 mm and 385.73 mm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male left bone (>484.49) was 7.25 % and in female left bone (<385.73) was 8%.

Dimensionally the adult male: female ratio is about 100: 92, i.e. female measurements are about 92% of male measurements, this does not precisely hold for the entire living body¹. Generally male bones are longer and massive and this difference is reflected by the greater values of the mean maximum femoral length in male on both the sides.

Comparison of maximum femoral length of male between present study and other studies has been shown in Table: 2. Mean maximum male femoral length value in present study was 451.81(right) & 453.35(left). In other studies it varies from 429.4 to 477.7. Mean maximum femoral length in present study was lower than the American Blacks³ & South African Whites⁶; was higher than the Thai⁷ & Chinese femora⁵ and it correspond with the value seen in American Whites³, Californian sample⁴ and sample from Bhopal¹⁰.

Table: 3 illustrated Comparison of maximum length of female between present study and other studies. Mean femoral length in female in present study was 417.18(right) & 420.44(left). In other studies it vary from 397-443. While mean maximum female femoral length in present study was lower than the American Blacks³ & South African Whites⁶; was higher than the Thai⁷, Chinese⁵ and sample from Bhopal¹⁰ and was similar to the value in American Whites³and Californian sample⁴.

Table 2: Comparison of maximum femoral length in male

Population & Study	Male			
	Mean	S.D.	%Identified	
Dibernardo & Taylor Ame. White	450	20.4	80%	
Dibernardo & Taylor Ame. Black	475	31.4	-	
Dittrick J & Suchey M., California	450	20.1	79.5%	
Iscan & Shihai , Chinese	442.19	22.9	-	
Iscan & Steyn, south Afr. whites	469.68	27.97	-	
King C.A. et al, Thai	429.4	21.38	-	
Purkait &Chandra, Indian	451.47	23.38	84.50%	
Present study	Rt.	451.81	23.94	13.40%
	Lt.	453.35	22.54	7.25%

This difference in mean femoral length 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 (D.P.) analysis.

Table 3: Comparison of maximum femoral length in female

Population & Study	Female			
	Mean	S.D.	%Identified	
Dibernardo & Taylor Ame. White	423	22.1	71.00%	
Dibernardo & Taylor Ame. Black	443	23.6	-	
Dittrick J & Suchey M., California	420.6	17.2	79.55%	
Iscan & Shihai , Chinese	400.97	19.71	-	
Iscan & Steyn, south Afr. whites	437.65	20.65	-	
King C.A. et al,Thai	397	19.6	-	
Purkait &Chandra, Indian	403.69	19.79	91.30%	
Ppresent study	Rt.	417.48	19.74	4.35%
	Lt.	420.44	21.35	8.00%

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 ($\pm 3S.D.$), 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 medico legal cases¹². The D.P. is also easy to work out as compared to multivariate analysis.

CONCLUSION

Mean values of maximum length of normal human adult femora from Gujarat region, in male were 451.81 mm (Right) & 453.35 mm (Left) and for female were 417.48 mm (Right) & 420.44 mm (Left). It identified 13.40% of right male femora, 7.25% of left male femora, 4.35% of right female bones and 8.00% of left female bones.

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