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nal o **ORIGINAL RESEARCH PAPER** Anatomy SEX DETERMINATION FROM FEMUR USING KEY WORDS: Femur, Mean, MID SHAFT CIRCUMFERENCE OF FEMUR IN Mid shaft circumference GUJARAT. Dr. Naimish R. Assistant Professor In Anatomy, Smt NHL Municipal Medical College, **Bhojak** Ahmedabad, Gujarat, India Dr. Samir H. Tutor In Anatomy Smt NHL Medical College, Anatomy Department, Vs Ram* Hospital Campus, Ahmedabd - 380006 *Corresponding Author Dr. Jitendra P. Professor& Head Of Anatomy Department of Anatomy, Smt NHL Municipal Medical College, Ahmedabad, Gujarat, India Patel INTRODUCTION-The assessment of human sex from skeletal parts is of very much medico legal and anthropological importance. The present study aims at obtaining results from mid shaft circumference of femur in Gujarat and to develop standards in determination of sex and compare the present study with those of other population. MATERIAL AND ABSTRACT METHOD-The study was carried out using 150 dry normal adult femora (97male, 53female) in NHL municipal medical college, Ahmedabad, Gujarat, India. RESULT- Mean Mid shaft circumference of male femur is more than female femur in the Gujarat population of present study. In Gujarat population, if mid shaft circumference of male femur is >98.52 mm than it is definitely male femur and if it is <60.18 mm than it is definitely female femur. CONCLUSION- The Mid shaft

circumference of Gujarat population is less than the mid shaft circumference of American White & California population. . Femoral mid shaft circumference is become very useful tool for sex determination where the skeletal partial and poorlypreserve. If skeletal in good condition femoral circumference can serve as a rapid and reliable validate of sexual assessments made by other means.

INTRODUCTION

Determination of sex from long bones of skeleton plays an important role in physical anthropology, osteology and demographic assessment in medico legal investigations.If the entire skeleton is available for examination determination of sex is relatively easy. For determination of sex accurately, skull and pelvis are the highly reliable skeletal element.¹

Sometimes determination of sex becomes a difficult task for the forensic anthropologist, especially in the absence of the skull and pelvis. So, most of the long bones, either individually or in combination, have been subjected to statistical and morphological analysis for determining sex². For the study of sexual dimorphism long bones are better alternative compared to short bones because of their small size, measurement error as small as half millimetre can amount to 5-6% of the total measurements.³ Sexual dimorphism in the femur is due to modification of the 'female pelvis with respect to its specialized function of reproduction. Therefore, the stress and strain experienced by the femur is different in a male than it is in a female.⁴

Techniques which require the measurement of the diameters, circumferences, or cross-sectional areas of the tubular bones may provide the needed means for sexing fragmentary remains. Several advantages of widths over lengths are apparent. The sexual dimorphism in widths, circumferences, and areas often exceeds the sexual dimorphism in bone lengths. The dimorphism in bone diameters is due to sexual differences in bone remodelling in the tubular bones during adolescence. During adolescence, cortical bone is laid down at a greater rate in males than in females, and, in males, a larger proportion of the bony growth is at the sub periosteal surface, so male tubular bones increase their circumference more than those of females during adolescence.4,5 The circumference of the tubular bones of both sexes continues to increase throughout life, but at a greatly reduced rate from that of adolescence, and male bones remain larger than female bones throughout adult life.⁶ The other advantage of circumferences over lengths derives from differences in preservation and restorability.

The present study has been carried out to ascertain sexual dimorphism of mid shaft circumference from femora in Gujarat populations and compare with the other populations.

MATERIAL AND METHOD

Present Study was carried out on Dry femora of known sexes in Anatomy Department of smt NHL municipal medical college, Ahmedabad, Gujarat, India. Prior ethical approval was sought from institutional ethical committee. The femora were obtained by maceration of the dead bodies received as voluntary donations at Anatomy department of Smt. NHL Municipal Medical College and B.J. Medical College. A total of 150 human femora (97 male, 53 female) were used for the present study. All the bones had completed femoral growth as evidenced by the complete fusion of the proximal and distal femoral epiphysis. Any femora exhibits any pathologies, fractured and unknown sex were excluded from the study. First of all, side of each femur will be determined. To avoid intra- observer error, each measurement was taken at three different times and their average was used as final reading. With the osteometric board mark the midpoint of shaft of femur and with the non-elastic tape measured the mid shaft circumference of femora.

OBSERVATION AND RESULTS Table-1: Showing the mid shaft circumference of femur (mm) and its statistical analysis

Statistical	RIGHT		LEFT		
values	Male	Female	Male	Female	
	(N=47)	(N=28)	(N=50)	(N=25)	
MEAN (mm)	81.36	75.86	82.02	74.80	
SD (mm)	6.80	8.26	7.57	7.20	
3SD (mm)	20.40	24.78	22.71	21.60	
MIN-MAX(mm)	67-100	61-99	61-99	62-88	
IP (mm)	>99	< 67	>88	<61	
%of IP (N)	2.13 (1)	10.71 (3)	16.00 (8)	0.00 (0)	
MEAN+3SD (mm)	60.97-	51.08-	59.31-	53.20-	
	101.75	100.63	104.73	96.40	
DP (mm)	>100.63	<60.97	>96.40	<59.31	
% of DP(N)	0.00 (0)	0.00 (0)	4.00 (2)	0.00 (0)	
P VALUE	<0.01		<0.01		
REMARKS	Highly sig	gnificant	Highly significant		

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As shown in table-1, average mid shaft circumference of right male femur was 81.36 mm, average mid shaft circumference of right female femur was 75.86 mm, average mid shaft circumference of left male femur was 82.02 mm and average mid shaft circumference of left female femur was 74.80 mm.

IP for mid shaft circumference of right male femur was >99 mm and for right female femur was <67 mm, while for left male femur >88mm and for left female femur <61 mm. IP method identified 02.13 % right and 16 % left male femur correctly as male. IP method also identified 10.71 % right and 0 % left female femur correctly as female.DP for mid shaft circumference of right male femur was >100.63 mm and for right female femur was <60.97 mm, while for left male femur >96.40 mm and for left female femur <59.31 mm. DP method identified 0 right and 4.0 % left male femur correctly as male. Although the percentage of correctly identifying bone decreased from IP to DP, but the accuracy of the method increased. Data for mid shaft circumference of both sides male and female was statistically highly significant, as p value was < 0.01.

Table-2, Showing the range, mean, SD, DP and p value of mid shaft circumference of femur in male and female

Range	MALE (N=97)	FEMALE (N=53)
61-65	1	4
66-70	4	10
71-75	8	14

76-80	30	12			
81-85	29	8			
86-90	14	4			
91-95	8	1			
96-100	3	0			
MEAN	81.70	75.36			
SD	7.18	7.72			
DP	>98.52	<60.18			
% of DP (N)	2.06 (2)	0.00(0)			
P VALUE	< 0.01				
REMARKS	Highly significant				

As shown in table-2, average mid shaft circumference of male femur was 81.70 mm and mid shaft circumference of female femur was 75.36 mm.

Mean mid shaft circumference of male femur was more than the mid shaft circumference of female femur and the data was statistically highly significant, as p value was <0.01.

30 male femurs out of 97 male femurs were in the range of 76-80mm while 14 female femurs out of 53 femurs were in range of 71-75mm.

DISCUSSION

Mid shaft circumference of femur was also measured by Dibernardo & taylor et al⁷, Dittrick J & Myers et al⁸, Liu wu⁹, King CA et al¹⁰, Purkait R & Chandra², Maske SS et al.¹¹laeequeMd et al¹² Bhosle R.S. et al¹³ and Gaikwad et al¹⁴.

TABLE 3 SHOWING THE COMPARISON OF MID SHAFT CIRCUMFERENCE OF FEMUR OF MALE AND FEMALE FEMUR (MM) OF GUJARAT POPULATION WITH THE FINDINGS OF OTHER AUTHORS.

Author	Population	Sex	No.	Mean	SD	DP	% of Identified Bone	Р	Re-
				(mm)	(mm)	(mm)		value	Mark
Dibernardo & taylor (1979) ⁷	American	М	50	90	5.9	-	83.00	-	-
	white	F	35	82	3.9	-			
DittrickJ& Myers	California	М	146	86.6	5.3	-	79.9	-	-
(1986)8		F	143	78.1	5.1	-			
Li wu	Chinese	Μ	74	84.6	6.9	-	79.4	< 0.001	HS
(1989)9		F	67	75.7	4.5	-			
King CA et	Thai	Μ	70	83.7	4.7	-	88.60	<0.01	HS
al.(1998)10		F	34	75.4	5.49	-	79.40		
Purkait R &	Central	Μ	200	81.19	5.01	-	82.00	0.05	NS
Chandra	India	F	80	71.31	4.35	-	90.00		
(2002)2									
Maske SS et al (2012)11	Marath wada	Μ	189	84.2	4.6	89.59	48.60	< 0.0001	HS
		F	179	74.7	4.9	70.31	43.57		
Laeeque Md et.al (2013)12	Maharashtra	Μ	137	84	4.4	>81	57	< 0.001	HS
		F	66	72	3.01	<63			
Gaikwad K.R et al(2014)14	Western	Μ	100	83.96	4.43	>86.78	26	< 0.001	HS
	maharastra	F	100	74.78	4.01	<70.66	14	1	
Present	Gujarat	Μ	97	81.70	7.18	>98.52	2.06	<0.01	HS
study		F	53	75.36	7.72	<60.18	00	< 0.01	HS

In present study found that the mean mid shaft circumference of male femur was higher than the female femur & it was statistically highly significant which is similar with findings of Liu wu et al, 9 King CA et al 10 , Maske SS et al. 11 , laeeque Md et al 12 , Bhosle R.S. et al 13 , Gaikwad K.R et al 14 .

By using DP method for mid shaft circumference of femur

In present study, by using DP method for mid shaft circumference of femur, 2.06 % of male femur was correctly identified as male femur and 0% of female femur was correctly identified as female femur. Maske SS et al¹¹, correctly identified 48.60 % of male femur & 43.57 % of female femur by using mid shaft circumference of femur. Laeeque Md et al¹² correctly identified male and female femora using only mid shaft circumference of femur in 57 % femora. Gaikwad K.R. et al¹⁴, correctly identified 26 % of male femur & 14 % of female femur by using mid shaft circumference of femur. There was more marked difference in www.worldwidejournals.com mid shaft circumference of femur between the present study and Maske SS et al^{11} , Laeeque Md et al^{12} may be due to variation in population.

By discriminante analysis for mid shaft circumference of femur.

Dibernardo & taylor et al⁷, correctly identified male and female femora using only mid shaft circumference of femur in 83 % femora.Dittrick J & Myers et al⁸, correctly identified male and female femora using only mid shaft circumference of femur in 79.9 femora. Liu wu et al⁹, correctly identified male and female femora using only mid shaft circumference of femur in 79.4 % femora.King CA et al¹⁰, correctly identified 88.60 % of male femur & 79.40 % of female femur by using mid shaft circumference of femur.Purkait R & Chandra et al², correctly identified 82 % of male femur & 90 % of female femur by using mid shaft circumference of femur. Gaikwad K.R. et al¹⁴, correctly identified 26 % of male femur & 14 % of female femur by using mid shaft circumference of femur.The Mid shaft circumference of Gujarat population is less than the mid shaft circumference of American White & California population.

There was more marked difference in mid shaft circumference of femur between the present study and Dibernardo & taylor et al⁷Dittrick J & Myers et al⁸, Liu wu et al⁹, King CA et al¹⁰, Purkait R & Chandra et al² is the low percentage of correct sexual classification in the mid shaft circumference of femur in present study. This could be explained on the basis of statistical method applied. While the studies referred above were based on discriminate analysis, present study had used the demarcating point analysis

CONCLUSION

Mean Mid shaft circumference of male femur is more than female femur in the Gujarat population of present study. In Gujarat population, if mid shaft circumference of femur is >98.52 mm than it is definitely male femur and if it is <60.18 mm than it is definitely female femur. The mid shaft circumference of Gujarat population is less than the mid shaft circumference of American White & California population. Femoral mid shaft circumference is become very useful tool for sex determination where the skeletal partial and poorly preserve. If skeletal in good condition femoral circumference can serve as a rapid and reliable validate of sexual assessments made by other means.

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