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RESEARCH ARTICLE

Sex determination from vertical diameter of femoral head in Gujarati population

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Abstract

Introduction: Femur is the longest and strongest bone in human body. Determination of sex is relatively easy if the entire skeleton is available for examination. In the absence of skull and pelvis long bones either individually or in combination has been used for determining sex.

Material and methods: Present Study was carried out on 141 human femora (115 male, 26 female) of known sexes in Anatomy Department, M. P. Shah Government Medical College, Jamnagar, Gujarat by using demarcating point method. Vertical diameter of femoral head is the straight distance between the highest and deepest point of the femoral head.

Results: Average vertical diameter of femoral head of right male femur was 44.07 mm, average vertical diameter of femoral head of right female femur was 39.50 mm, average vertical diameter of femoral head of left male femur was 44.22 mm and average vertical diameter of femoral head of left female femur was 39.07 mm. Demarcating point method identified 0% right and 5% left male femur correctly as male. Demarcating point method also identified 25% right and 21.43% left female femur correctly as female.

Conclusion: Mean Vertical diameter of femoral head of male femur is more than female femur in the Gujarati population of present study. Findings of the present study may be useful in medico legal cases for estimation of sex from available fragmentary femora. The study can also be useful to anatomist & physical anthropologist.

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INTRODUCTION

Femur is the longest and strongest bone in human body. ⁽¹⁾Determination of sex is relatively easy if the entire skeleton is available for examination. For determination of sex accurately, skull and pelvis are the highly reliable skeletal element. ⁽²⁾

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 sex. 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. ⁽³⁾

The study of sexual dimorphism of vertical diameter of femoral head has been carried out by other workers in different population, but in Gujarat few studies have been done. So, the present study has been carried out to establish sexual dimorphism of vertical diameter of femoral head in Gujarati populations.

Material and Methods

Present Study was carried out on Dry femora of known sexes in Anatomy Department, M. P. Shah Government Medical College, Jamnagar, Gujarat. The femora were obtained by maceration of the dead bodies received as voluntary donations or unclaimed bodies received at this department. A total of 141 human femora (115 male, 26 female) were used for the present study. Femora showing pathological abnormality, fractured and unknown sex were not included in 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. The present study was conducted after taking approval from the Institutional Ethics Committee.

Vertical diameter of femoral head was considered as a maximum diameter of femoral head ⁽⁴⁾. It was measured with a caliper. It measures the straight distance between the highest and deepest points of the femoral head. ⁽⁵⁾ **(Photograph 1)**

Demarcating point (DP) for femur: ⁽⁶⁾

Demarcating point was measured by using mean \pm 3SD (calculated range, cover 99.75% of sample) for all the parameters.

Demarcating point for maximum length of both male and female femur was calculated as follows:



Photograph 1:- Showing vertical diameter of femoral head.

Greatest length recorded for the female femur by using calculated range was the demarcating point for male femur and the shortest length recorded for the male femur by using the calculated range was the demarcating point for female femur. All bones having length more than the Demarcating point for male was identified as male femur and all bones having length less than the Demarcating point for female was identified as female femur.

Result

As shown in table 1, average vertical diameter of femoral head of right male femur was 44.07 mm, average vertical diameter of femoral head of right female femur was 39.50 mm, average vertical diameter of femoral head of left male femur was 44.22 mm and average vertical diameter of femoral head of left female femur was 39.07 mm.

DP for vertical diameter of femoral head of right male femur was >49.20 mm and for right female femur was <36.46 mm, while for left male femur >48.07 mm and for left female femur <36.17 mm. DP method identified 0 % right and 5% left male femur correctly as male. DP method also identified 25 % right and 21.43% left female femur correctly as female.

Data for vertical diameter of femoral head of both sides male and female was statistically highly significant, as p value was <0.01.

Mean vertical diameter of femoral head of male femur was more than the mean vertical diameter of femoral head of female femur and the data was statistically highly significant, as p value was <0.01.

Statistical values	RIGHT		LEFT	
	Male(N=55)	Female(N=12)	Male(N=60)	Female(N=14)
MEAN (mm)	44.07	39.50	44.22	39.07
SD (mm)	2.54	3.23	2.68	3.00
3SD (mm)	7.61	9.70	8.04	9.00
MEAN ±3SD(mm)	36.46-51.69	29.80-49.20	36.17-52.26	30.07-48.07
DP (mm)	>49.20	<36.46	>48.07	<36.17
% of DP(N)	0.00 (0)	25.00 (3)	5.00 (3)	21.43 (3)
P VALUE	<0.01		<0.01	
REMARKS	Highly significant		Highly significant	

Table 1 Showing the Vertical diameter of femoral head (mm) and its statistical analysis

(N= number, SD=standard deviation, mm= millimeter, DP = demarcating point)

Discussion

In present study found that the mean vertical diameter of femoral head of male femur was higher than the female femur & it was statistically highly significant which is similar with findings of Liu Wu⁽⁸⁾, Iscan MY & Shihai D⁽⁹⁾, Igbigbi PS & Msamati BC⁽⁶⁾, Maske SS et al.⁽¹⁰⁾, Srivastava R et al⁽¹¹⁾, Laeeque Md et al⁽¹²⁾.

In present study, by using DP method for vertical diameter of femoral head, 2.61 % of male femur was correctly identified as male femur and 19.23 % of female femur was correctly identified as female femur.

Igbigbi PS & Msamati BC⁽⁶⁾ found average 03.50 % of right male femur was correctly identified as male femur while 01.80 % of right & 01.70 % of left female femur was correctly identified as female femur.

Maske SS et al⁽¹⁰⁾ correctly identified 0 % of male femur & 10.58 % of female femur by using vertical diameter of femoral head.

Laeque Md et al⁽¹²⁾ identified male and female femora using only vertical diameter of femoral head in 50% femora.

There was difference in vertical diameter of femoral head between the present study and Igbigbi PS & Msamati BC⁽⁶⁾, Maske SS et al⁽¹⁰⁾, Srivastava R et al⁽¹¹⁾, Laeeque Md et al⁽¹²⁾ may be due to variation in population.

Dittrick J & Suchey JM⁽⁷⁾ identified male and female femora using only vertical diameter of femoral head in 88.70 % femora.

Liu Wu⁽⁸⁾ identified male and female femora using only vertical diameter of femoral head in 85.1 % femora.

Iscan MY & Shihai D⁽⁹⁾ correctly identified 83.10 % of male femur & 79.50 % of female femur by using vertical diameter of femoral head.

The Vertical diameter of femoral head of Gujarati population is less than the vertical diameter of California, Chinese, Thai & Black Malawians population, while more than the vertical diameter of Maharashtra population.

There was more marked difference in vertical diameter of femoral head between the present study and Dittrick J & Suchey JM⁽⁷⁾, Liu Wu.⁽⁸⁾, Iscan MY & Shihai D⁽⁹⁾ is the low percentage of correct sexual classification in the vertical diameter of femoral head due to different statistical method applied.

Researcher	Population	Sex	N	Mean (mm)	SD (mm)	DP (mm)	% Of Identified Bones	P Value	Re-Mark
Dittrick J & Suchey JM (1986) ⁽⁷⁾	California	M	175	47	2.5	-	88.70	-	-
		F	171	42.2	1.9	-			
Liu Wu (1989) ⁽⁸⁾	Chinese	M	74	45.3	3.2	-	85.1	<0.001	HS
		F	67	40.4	1.9	-			
Iscan MY & Shihai D (1995) ⁽⁹⁾	Chinese	M	37	46.16	2.62	-	83.10	<0.001	HS
		F	39	41.13	2.64	-	79.50		
Ighigbi PS & Msamati BC (2000) ⁽⁶⁾	Black Malawians	M(R)	260	48.30	3.51	54.93	03.50	<0.01	HS
		F (R)	236	44.61	3.44	37.77	01.80		
		M(L)	260	48.30	3.11	54.76	0	<0.01	HS
		F(L)	236	44.50	3.42	38.95	01.70		
Maske SS et al (2012) ⁽¹⁰⁾	Marathwada	M	189	43.61	1.9	48.86	0	<0.0001	HS
		F	179	38.7	3.4	37.66	10.58		
Srivastava R et al (2012) ⁽¹¹⁾	North Central India	M	94	43.77	2.70	>46.84	8.5	<0.000	HS
		F	28	39.40	2.48	<35.67	14.28		
Laeque Md et al (2013) ⁽¹²⁾	Maharashtra	M	137	43	2.13	>43	50	<0.001	HS
		F	66	37	1.89	<37			
Present study	Gujarat	M	115	44.15	2.60	>48.43	2.61	<0.01	HS
		F	26	39.27	3.05	<36.34	19.23		

Table 2 showing the comparison of vertical diameter of femoral head of male and female femur (mm) of Gujarati population with the findings of other workers (N= number, mm= millimeter, M= male, F= female, R= right, L=left, HS = highly significant, DP = Demarcating Point)

Conclusion

Mean Vertical diameter of femoral head of male femur is more than female femur in the Gujarati population of present study. In Gujarati population, if Vertical diameter of femoral head of male femur is >48.43 mm than it is definitely male femur and if it is <36.34 mm than it is definitely female femur.

Findings of the present study may be useful in medico legal cases for estimation of sex from available fragmentary femora. The study can also be useful to anatomist & physical anthropologist.

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