ORIGINAL RESEARCH PAPER

Anatomy

KEY WORDS: Femur, Sex Determination, Osteometric Board, Vernier Callipers

SEX DETERMINATION FROM ADULT HUMAN FEMUR IN NORTH INDIAN POPULATION

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ABSTRACT

Femur is a latin word which means "thigh". Femur is the longest and strongest bone of the body. It articulates with acetabulum of the hip bone to form hip joint. Assessment of human sex from skeletal parts is important in anthropology, archaeology, comparative anatomy and forensic medicine where it provides accurate information for medico-legal information. The present study was conducted on 80 left femurs (40 males & 40 females). Four measurement of femur were taken. The mean value were significantly higher in males as compared to females ($p \geq 0.0001$)

INTRODUCTION

Femur is the longest and strongest bone in the human body. It has a proximal rounded, articular head projecting medially from its short neck which in turn is a medial extension of the proximal shaft. In standing, the femoral shafts show an inclination upward and outwards from their tibial articulations[1].

The length of femur is 18" (45cm). The head faces upwards, medially and slightly forwards. Long axis of the shaft is directed downwards and medially with convexity of the shaft facing anteriorly. It is an angle between the long axis of neck and shaft of the femur hence called neck shaft angle. The normal neck- shaft angle is 125° in adults and 160° in children. It is less in females. The angle of femoral torsion is an angle between the long axis of between long axis of head & neck of femur, and transverse axis of the femoral condyles. It measures about 7° in males and 12° in females[2].

The angle of inclination is low in females because of the increased width of the acetabulum (a consequence of a wider lesser pelvis) and the greater obliquity of the femoral shaft. The torsion angle, combined with the angle of inclination, allows rotatory movements of the femoral head within the obliquely placed acetabulum to convert into flexion and extension, abduction and adduction and rotational movements of the thigh[3].

The neck of the femur is inclined at an angle with the shaft at 160° in adults and at 125° in children. A decrease in the angle is referred to as coxa vara and it occurs in fractures of the neck of femur and in slipping of the femoral epiphysis. In this condition abduction of the hip joint is limited Stenton`s line is a useful means of assessing the angle of femoral neck on a radiograph of the hip region[4].

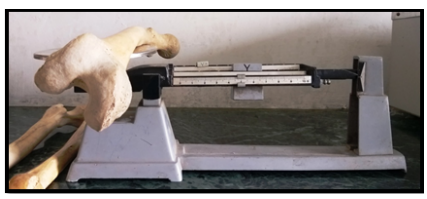
MATERIAL & METHODS

This study was done in the department of Anatomy at K.D.Medical College, Mathura, U.P. on 80 dry adult human left sided femurs (40 males and 40 females). We measured four parameters and the measurements were using:

1. Vernier callipers
2. Osteometric Board
3. Weight, using balance Weighing Machine

Vernier Callipers

Osteometric Board



Weighing Machine

The following measurements were taken:-

1. Maximum length of femur (head to the medial condyle)
2. Maximum diameter of head
3. Maximum mid-shaft Antero-Posterior diameter
4. Weight

RESULTS

- Maximum Length from the head to medial epicondyle, measured by Osteometric Board was found to be 449.52 mm in males & 411.41 mm in females.
- Maximum Head diameter, measured by Vernier Calliper was found to be 42.88 mm in males & 39.64 mm in females.
- Maximum Antero-Posterior diameter measured by Vernier Calliper was found to be 27.40 mm in males & 25.50 mm in females.
- Weight measured using by weight machine was to be 343.55 g in males & 254 g in females.

The average of maximum length of male femur was 449.52 mm (mean) and SD value was 23.85. The average of maximum length of female of femur was 411.41 mm (mean) and SD value was 21.92. p-value was calculated to be 0.0001.

Diagram showing the Maximum Length of Femur using Osteometric Board

The average of maximum head diameter of male of femur was

42.88 mm (mean) and SD is 2.26. The average of maximum head diameter of female of femur was 39.64mm, and SD is 2.14. And p-value is 0.0001.

Diagram showing the Maximum Diameter of Head of Femur using by Vernier Calliper

The maximum mid shaft antero-posterior measurement was significantly higher in males as compared to females. The average of maximum mid shaft antero-posterior measurement of male femur was 27.41 mm (mean) and SD was 2.01. The average of maximum mid shaft antero-posterior of female of femur was 25.51 mm (mean) and SD was 1.52. p-value was calculated to be 0.0001.

Diagram Showing the Maximum Midshaft Antero-Posterior diameter of femur

The average weight of male femur was 343.55 (g) and SD value was 49.99. The average weight of female femur was 254.12 (g) and SD value was 39.27. p-value was calculated to be 0.0001.

Diagram showing the Weight of femur using Weight Machine

Table no. 1. Showing means value of various variables of femur in males and females.

values	Males		Females		p-value
	Mean (mm)	SD	Mean (mm)	SD	
1) Maximum Length	449.52	23.85	411.40	21.92	0.0001
2) Maximum diameter of Head	42.87	2.26	39.64	2.13	0.0001
3) Maximum Mid Shaft Antero-Post. diameter	27.40	2.013	25.50	1.50	0.0001
4)Weight (g)	343.55	49.99	254.12	39.27	0.0001

DISCUSSION

The present study was conducted in the Department of Anatomy, KD Medical College, Mathura, UP. The four measurement of femur show the presence of sexual dimorphism. Our study shows that maximum length of femur is 449.52 mm (mean) in males, SD value is 23.85, and in females it is 411.41 mm (mean) and SD is 21.92, p-value 0.0001, in the North Indian population.

According to E-nock Prabhakar[5] (P) 1988, the maximum length of femur in males was 43cm and in females was 41cm. So there is much difference observed in the North Indian population.

According to Di Bernardo and Taylor am black[6], the femoral length in males was 475mm and SD was 31.4. According to Dittrick j and Suchey M[7], California measured length of femur in males as 420.6 mm (mean) and SD value as 17.2. According to J. Schan and Shihai Chinese[8], the femoral length in male was 400.97mm (mean) and SD was 19.71

J.Schan and Steyn, South Africans[9] white, said that the femoral length in males was 469.68 mm (mean) and SD was 27.97. According to King CA et al[10] Thai the femoral length in males was 429.4 mm (mean) and SD was 21.38. According to Deepak S, Howale R.Tandel[11], that the length of femur in males was 439.57 mm (mean) and SD was 30.14, and in females was 410.6 mm (mean) and SD was 21.9.

Gargi Soni & Usha Dhull[12] conducted a study in which the length of femur in males was 439.57 mm (mean) and SD was 30.14. And in females was 410.60 mm (mean) and SD was 21.90. The value of the mean measurement of length in male femur in Maharashtra was 450.82 mm (Rt) and 452.37 mm (Lt) and that of female femur was 416.49 mm (Rt) and 420.23 mm (Lt). Our study shows the maximum head diameter in males to be 42.88 mm (mean) SD 2.26 and p-value 0.0001. In females the values were found to be 39.64 mm (mean) SD is 2.14 and p-value is 0.0001. Kalpna et al[13] identified only 47% bone with demarcating point of maximum head diameter of femur.

Asla SA[14] found out that the mean head diameter of the male femur was significantly greater than the mean head diameter of female femur in the both population groups (White and Black South Africans).

These values were corresponding greater in white than the Black population. Akhtari Afroze et all[15] studied the Northern zone (Rajshahi) of Bangladesh. This study suggests that femoral head diameters are of value in sex determination among the inhabitants. In our study, the maximum midshaft antero-posterior diameters in males are 27.41 mm (mean) and SD value 2.01 and p-value 0.0001. and in females are 25.51 mm (mean) and SD value 1.52 and p-value is 0.0001. According to Gargi Soni, Usha Dhull[12], the maximum mid shaft antero-posterior diameter of femur in males was 27.82mm (mean) and SD was 3.09. And in females was 25.25 mm (mean) and SD was 2.10.

According to Deepak S,Hawale, R Tandel[11], the maximum mid shaft antero-posterior diameter of femur in males was 27.82mm (mean) and SD was 3.09. And in females was 25.25 mm (mean) and SD was 2.10. According to K.Monisha, Dr K.K. Karpagam[16], the maximum mid shaft antero-posterior diameter of femur in males was 2.765cm (mean) and SD was 0.147. And in females was 3.695 cm (mean) and SD was 0.209. Purkait R[17], said that the mid shaft antero-posterior diameter in males was 2.78 cm (mean) and in females were 2.52 cm. Table no. 4 shows the Weight of femur. In our study the weight of femur in males is 343.55 (g) SD is 49.99 and p-value is 0.0001. And in females is 254.12 (g) and SD is 39.27 and p-value is 0.0001. The axial skeleton weight is heavier in male as compared to female[1]. The femur receives weight and takes part in transmission of body weight. So the stress and strain on the femur is different in a male than in a female.

Kate[18] worked on femur different regions of India and he found variations in value according to region. Therefore, most of the long bone, either individually or in combination were subjected to statistical and morphological analysis of determining sex[19].

CONCLUSION

To conclude, the results of the present study will help in accurate diagnosis of sex from both complete and fragmentary femora from North Indian population and thus constitute an important tool for forensic experts.

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