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ORIGINAL RESEARCH

Study to Estimate the Femur Length using fregmantory

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Abstract

Background: Stature reconstruction from skeletal remains forms a part of the forensic anthropological analysis for the purpose of identification of an individual. The present study was conducted to estimate total length of femur from its fragments.

Material & methods: 50 dry and processed femora of both sides were randomly collected from grossly normal and complete adult cadavers, from department of anatomy. The total length of the femur was noted first by using the osteometric board and then confirmed with the measurements taken by using a thread. In order to compare all measurements of the segments of femur, it had been divided arbitrarily into five segments. Data analysis was carried out using Statistical Package for Social Science (SPSS) package.

Results: The mean length of segments on left side were segment 1= 8.08 ±0.712, segment 2= 8.28± 1.248, segment 3= 10.33± 2.214, segment 4= 13.92± 1.932 and segment 5= 2.76± 0.539. While mean length of segments on right side were segment 1= 8.10 ±0.706, segment 2= 8.30 ±1.346, segment 3= 10.43± 1.914, segment 4= 13.52 ±1.543 and segment 5= 3.10± 0.413. The mean length of femur bone on left side was 43.53± 2.785 while on right side was 43.43± 2.434 with p value= 0.782.

Conclusion: The present study concluded that the mean length of femur bone on left side was 43.53± 2.785 while on right side was 43.43± 2.434.

Keywords: Femur, Stature reconstruction, skeletal remains.

Introduction

Age, sex, ancestry, and stature are the four elements of forensic anthropology used to establish the identity of an individual.[1] Stature reconstruction from skeletal remains form a part of the forensic anthropological analysis for the purpose of identification of an individual. The estimation of total length of long bones from fragments of the bone was first demonstrated by Muller.[2] According to physical anthropologists, long bones limbs are most suitable to estimate the height of an individual.[3]The femur is the longest and strongest bone in the human body. It has one shaft, proximal end and distal end.[4] Damage to long bones occurs by accidents like plane crash, earthquakes or crush injuries, making them fractured; hence reconstruction of height of body becomes difficult. In such cases, the ratio between fragment of a long bone and length of that bone would help in estimating height of that individual. Therefore, the length of the fragment of the long bone and the total length of that long bone were calculated and the ratio between each fragment and the total length of the bone was found out. Then, by applying the regression formula, the height of the individual can be

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estimated.[5]The present study was conducted to estimate total length of femur from its fragments.

Material & methods

The present study was conducted to estimate total length of femur from its fragments. 50 dry and processed femora of both sides were randomly collected from grossly normal and complete adult cadavers, from department of anatomy. Unossified bones, bones with diseases and injuries were excluded from the study. This estimation was done considering total length of femur mean± SD= 43.93 ± 2.75. Here we are considering alpha error as 5% and allowable error as 1%. The total length of the femur was noted first by using the osteometric board and then confirmed with the measurements taken by using a thread. These two values were taken because of the forward curvature of the femur. In order to compare all measurements of the segments of femur, it had been divided arbitrarily into five segments by taking following landmarks on the basis of morphological characters of femur from the top of head to distal point on medial condyle, i.e. a-b; b-c; c-d; d-e; e-f. This enabled us to take advantage of numbers of segments and make a study with broad prospective.

a. The most proximal point on head.
b. Lower border of lesser trochanter.
c. Point where gluteal and spiral lines join to form lineaaspera.
d. Point where lineaaspera divides into medial and lateral supracondylar lines.
e. Most proximal point on the intercondylar fossa.

In this way, with the help of above landmarks, the whole length of femur is divided into five segments, i.e.
segment1= a-b,
segment2= b-c,
segment3= c-d,
segment4=d-e,
segment5= e-f.
The lengths of the segments were measured with the help of 'osteometric scale' to the nearest millimeter. Thus the maximum total length of all femur bones were measured with standard procedure, and linear measurements of all segments mentioned above were taken simultaneously to nearest millimeter. Data analysis was carried out using Statistical Package for Social Science (SPSS) package.

Results

The lengths of 50 femora and the lengths of individual segments of all the 50 femora were noted in which 25 were left femora and 25 were right femora.

Table 1: Showing the comparison between the mean lengths of corresponding left segments and right segments of Femora

Segment		Mean±SD	p-value
Segment 1	**Left**	8.08 ±0.712	0.825
	Right	8.10 ±0.706	
	Total	8.09± 0.709	
Segment 2	**Left**	8.28± 1.248	0.803
	Right	8.30 ±1.346	
	Total	8.29± 1.297	
Segment 3	**Left**	10.33± 2.214	0.784
	Right	10.43± 1.914	
	Total	10.38± 2.064	
Segment 4	**Left**	13.92± 1.932	0.125

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	Right	13.52±1.543	
	Total	13.72±1.737	
Segment 5	**Left**	2.76± 0.539	<0.001
	Right	3.10± 0.413	
	Total	2.93 ±0.476	
Total length	**Left**	43.53± 2.785	0.782
	Right	43.43± 2.434	
	Total	43.48± 2.609	

The mean length of segments on left side were segment 1= 8.08 ±0.712, segment 2= 8.28± 1.248, segment 3= 10.33± 2.214, segment 4= 13.92± 1.932 and segment 5= 2.76± 0.539. While mean length of segments on right side were segment 1= 8.10 ±0.706, segment 2= 8.30 ±1.346, segment 3= 10.43± 1.914, segment 4= 13.52 ±1.543 and segment 5= 3.10± 0.413. The mean length of femur bone on left side was 43.53± 2.785 while on right side was 43.43± 2.434 with p value= 0.782.

Discussion

Height, sex, age and ethnicity of an unknown person can be gauged from skeletal remains. Forensic anthropologists often find it challenging to identify a person with only a few fragmentary skeletal remains in hand. Using specific formulae the length of a long bone is calculated from its fragments. Statural formulae are then employed to estimate stature from the calculated length of the bone. Lengths of long bones have been estimated from "bony markers" of humerus,[6] femur,[7] radius[8] and ulna.[9]

The mean length of segments on left side were segment 1= 8.08 ±0.712, segment 2= 8.28± 1.248, segment 3= 10.33± 2.214, segment 4= 13.92± 1.932 and segment 5= 2.76± 0.539. While mean length of segments on right side were segment 1= 8.10 ±0.706, segment 2= 8.30 ±1.346, segment 3= 10.43± 1.914, segment 4= 13.52 ±1.543 and segment 5= 3.10± 0.413. The mean length of femur bone on left side was 43.53± 2.785 while on right side was 43.43± 2.434 with p value= 0.782.

Solan S et al determine the lengths of the femoral fragments and to compare with the total length of femur in south Indian population and found that the 'p' value of all the segments was significant (‹0.001). When comparison was made between segments of right and left femora, the 'p' value of segment-5 was found to be ‹0.001. Comparison between different segments of femur showed significance in all the segments.[10]

Madadi S et al estimated the femur length from proximal and distal femoral fragments in the Iranian population. The result of this study showed that the value of segmental measurements was different between the right and left sides, but it was not statistically significant. All segmental measurements were positively correlated and found to have a linear relationship with the maximum femoral length (P< 0.05) except for femoral neck circumference, which was not significantly different.[11]

Ajay M et al find out the correlation between maximum length of femur and its proximal & distal fragments. The study concluded that positive correlation between maximum femoral length and its proximal and distal fragments and regression equations derived in this study helpful to estimate stature in Medico-legal investigations and in Anthropometry.[12]

Conclusion

The present study concluded that the mean length of femur bone on left side was 43.53± 2.785 while on right side was 43.43± 2.434.

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