Estimation of Stature from fragments of femur

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Abstract

Introduction: Estimation of stature from bone has anthropological and forensic importance. The bones of lower limbs particularly femur has yielded good results. It is well known fact that the intact femur has the highest correlation with stature & and it is widely used in the derivation of regression equations for the stature estimation. An intact femur is not always present for analysis in forensic cases, so it is necessary to derive regression equation for the estimation of stature from fragments of the bone.

Aims and Objectives: The present study is aimed at estimating the length of the femur from femur bone fragments i.e. intertrochanteric crest length, transverse diameter of head & bicondylar width and subsequent estimation of stature from length of femur.

Materials Methods: Samples of 100 femora were taken from the department of Forensic Medicine & Anatomy.

Results: Intertrochanteric crest length, transverse diameter of head & bicondylar width were measured and regression equations were derived. The mean value of femur length is 43.05cms, the mean value of Intertrochanteric crest length is 65.85cms, the mean value of transverse diameter of head of femur is 41.12cms and the mean value of condylar width is 72.53cms.The Pearson's correlation coefficient for Intertrochanteric crest is 0.645, transverse diameter of head is 0.764 and for condylar width is 0.728.

Discussion: one study done by Sandeep Singh shows the comparison result with our study wirth mean value of 43.26cms. In study by Chandran have shown positive correlation for intertrochanteric length which is similar to our study. Bidmos have published regression equation with respect to transverse diameter of head is comparable with our study, majority of the work available in the literature by different workers has a positive correlation with our study.

Conclusion: Among the above the transverse diameter of the head shows more statistically significant value compared to the others. Hence in the present study we can estimate the femoral length from femoral fragments by regression equation, then we can subsequently calculate the stature from the length of femur.

Keywords: Anthropometry; Forensic; Femur; Fragment; Stature

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Introduction

Identification of the dead is very important factor in post mortem examination, to establish the identity of person stature is one of the criteria. To know the stature the length of the long bones is required particularly tibia and femur. Femur in particular yields very good results as the stature is concerned.

Femur is longest and strongest bone in human body.[1] Estimation of stature from femur has got direct correlation, and most of the times, police/investigating authorities approach forensic specialist with fragments of the femur rather than entire bone.it becomes a tougher job to identify the individual with only available fragments of femur, so it becomes necessary to derive regression equation for the estimation of stature from fragments of this bone.

Karl Pearson (1958) and Trotter and Glesser (1952) had developed regression equation based on measuring the cadaver height and length of long bones. In the present study fragments of femur were measured, and then derived regression equation subsequently we calculate the bone length then we can assess the stature from the bone length.

Material and Methods

One hundred dried and completely ossified adult male right femurs were collected from the department of anatomy and forensic medicine in MVJ Medical college and research hospital. Bones with injury, deformity and implants were discarded. Measurements of the bones were taken using Osteometric board and digital Vernier caliper. Fragments of the bone were measured in millimeters and length of bone is measured in centimeters.

A single author performed all measurements for consistency; each measurement was repeated three times and mean value was recorded. In our study we have taken the following measurements

1. Maximum length of the femur - distance from most superior point on the head of femur to the most inferior point on the distal condyles.[2]
2. Intertrochanteric crest – it is the distance between highest point on the greater trochanter to the middle of lesser trochanter.[2]

3. Transverse/ Sagittal/ Antero-posterior diameter of head measures the straight distance between the most laterally projected points on the equatorial plane taken at right angle to the vertical diameter.[2]
4. Bicondylar width – it is the maximum distance between the two condyles.[2]

The measurement obtained were analyzed using SPSS statistical software for windows version 13, metric data were reported as mean standard deviation, median and 95% confidence interval. P value of 0.05 was taken as significant. Pearson's correlation coefficient was used to examine the association between the maximum femoral length to their intertrochanteric crest, transverse diameter of head and Condylar width.

Results and Discussion

The anthropological assessment of stature from femoral segments is an important, essential and sometimes only necessary method to evaluate the stature of an individual with unknown identity.

This is a unique presentation being done to assess the stature from fragments of femur applying various formulae available in the literature. The effort of stature estimation started early in the 19th century and came to conclusion at the maiden time.[3]

In a study done by Stevenson on dry bones from Northern Chinese male skeletons in a Mangoloid group has given a ratio between bone length and height of the individual. The study is given a stimulus to take up our present research activity.[4]

The components of femur have been divided in four parts with accepted and anatomical landmark in femur. These were intertrochanteric length, transverse diameter of head and bicondylar width were measured by digital Vernier caliper by individual and repeated three times to eliminate the error.[5]

The mean femoral intertrochanteric length is 65.8cms with a standard deviation of 6. A study done by sandeep Singh shows intertrochanteric crest length with mean of 43.26cms which is comparable.[6]

Table 1: Summary Statistics

Descriptive statistics	Femur Length	Inter Trochanteric Length	Transverse Diameter of Head	Bicondylar Width
Mean	43.06	65.86	41.12	72.54
Median	43.45	66.28	41.68	74.53
Variance	8.27	36.54	9.97	33.44
Std. Deviation	2.88	6.05	3.16	5.78
Minimum	33.50	52.88	33.50	54.00
Maximum	47.6	81.15	46.36	83.32

Table 2: Correlations between Femur length with Inter Trochanteric Length, Transverse Diameter of Head and Bicondylar Width

Femur Length	Inter Trochanteric Length	Transverse Diameter of Head	Bicondylar Width
Pearson Correlation	.645**	.764**	.728**
P Value	0.0001	0.0001	0.0001
N	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

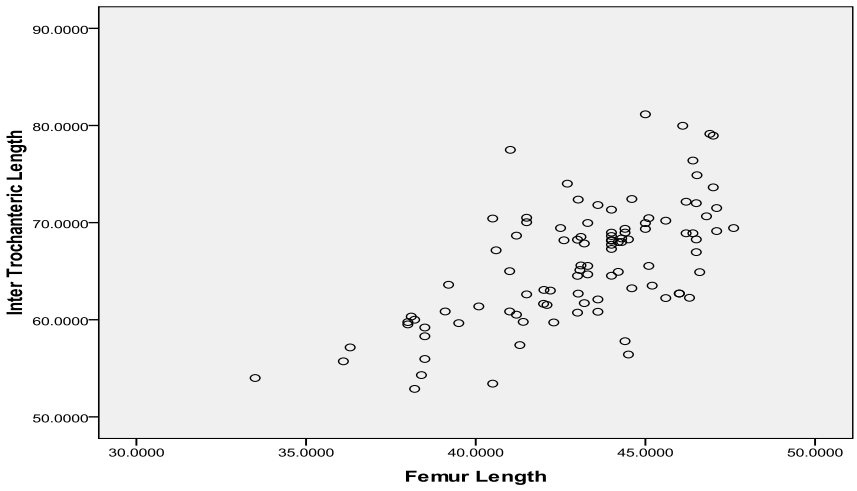

Fig. 1: Scatter plot showing positive correlation between length of femur and Intertrochanteric length

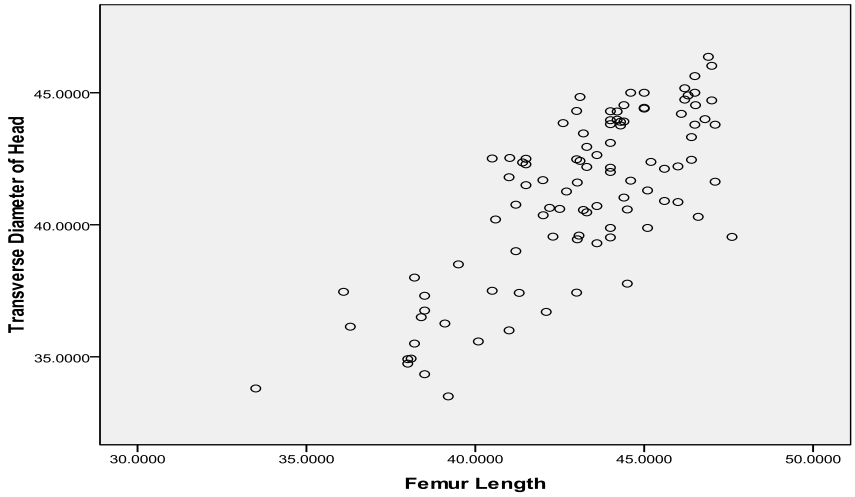

Fig. 2: Scatter plot showing positive correlation between length of femur and transverse diameter of head

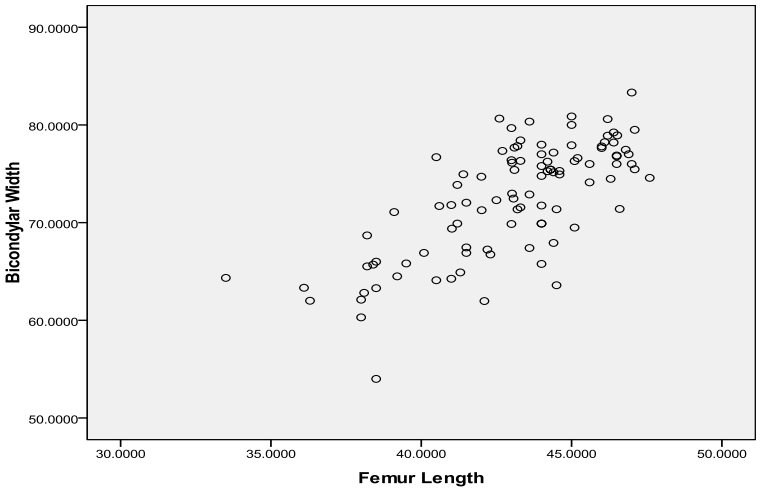

Fig. 3: Scatter plot showing positive correlation between length of femur and bicondylar width

Intertrochanteric length

Similar studies to estimate stature by using long bones by Mukhopadyay P.[7] And by Chandran over 60 south Indian female femurs.[8] In a study done by Chandran M have shown

positive correlations with intertrochanteric length as seen in our study

The equation derived from our study to estimate femur length by intertrochanteric length is Height= 22.85 + Intertrochanteric length (0.307).[3,4,5,6,7,8]

With the available data femur length is used to estimate the stature with the following formula as referred in

1. Stature= Femur x3.75 as per Mehta and Thomas in Mysoreans.[15]
2. Stature= 2.15xFmur + 72.57 OR Femur x 3.80. (K S Narayana Redddy).[16]
3. Stature= Femur x 3.7 (Gautham Biswas).[17]
4. Total femur length accounts for 27 % of total height of an individual. (C K Parikh).[18]

Transverse diameter of head

The earlier regression formula introduced by the field of Forensic medicine was Krogman.[9] He did successfully reconstruct the total length of femur by available fragments of femur which included transverse diameter of femur also.

In our study the mean transverse diameter of head of femur is 41.1cms and standard deviation is 3.1 and the equation to estimate the femur length is

Height= 14.44 + Transverse diameter of head of femur (0.69)

With the available data femur length is used to estimate the stature with the following formula as referred in

1 Stature= Femur x 3.75 as per Mehta and Thomas in Mysoreans.[15]
2 Stature= 2.15 x Femur + 72.57 OR Femur x 3.80. (K S Narayana Redddy).[16]
3 Stature= Femur x 3.7.(Gautham Biswas).[17]
4 Total femur length accounts for 27% of total height of an individual. (C K Parikh).[18]

The above equation is significant in assessing the length of femur thus it is evident to say that it is reliable to estimate the stature from fragment of femur.

The study done by us shows a correlation with shroff et al.[10]

In a study done by Dupertain & Hadden to estimate stature from combination of long bones gives approximately near equation being mentioned in our study.[11]

In a study done by Bidmos on South African population have shown the regression equation similar to our study.[12]

The parameter considered in our study is having high significance and easy to estimate the length of femur without much error was transverse diameter of head of femur.

Biocondylar width

In 2005, Peterson had considered that to estimate the stature from fragments of long bones is equally important and accurate as and when the fragments of long bones are available.[13]

In the present study the mean value of Bicondylar width to assess the length of femur is 72.5 cms with standard deviation 5.7 having the equation as mentioned below.

Height=16.80 + condylar width (0.36)

With the available data femur length is used to estimate the stature with the following formula as referred in

1 Stature= Femur x3.75 as per Mehta and Thoms in Mysoreans.[15]
2 Stature= 2.15xFmur + 72.57 OR Femur x 3.80. (K S Narayana Redddy).[16]
3 Stature= Femur x 3.7.9 (Gautham Biswas).[17]
4 Total femur length accounts for 27% of total height of an individual.(C K Parikh).[18]

This is comparable with study earlier done by Simmons et al.[14]

Most of the studies mentioned in the available literature to estimate the femur length by different worker are correlating with our study, but the importance of our study is,

1. We have included only male bones.
2. Belonging to right side and we have unable to trace the origin of these bones as these bones have been disposed and distributed among medical students. Hence multi centric study with sex, side and possible available origin of the bones has to be confirmed before concluding the study.

Conclusion

Different authors have presented their studies in the literature forum which was appearing to us as mixed one, hence it is our best effort to segregate the sex of a individual, side of the available bone for evaluation which is equally important. None the less the origin, genometric forum and life style of an individual have to be taken into consideration before coming to conclusion.

Our study is being inspired to estimate the stature of individual by available fragments of femur bones. After thorough evaluation and correction of the errors in the statistical view, we have tried to minimize the errors being occurred in measuring points being included in our study. We are concluding that the mentioned equation can be applied to estimate the stature. The parameters used in our study are basically either head end or tail end of the bone, as the possibility of breakage of bones in the center is very high as seen in the bones produced to the department of forensic medicine for expert opinion

Limitations of our study

1 The stature so estimated is excluding the soft tissue parts, which varies from 2.5 to 4 cms.
2 After the age of 30 yrs due to natural process of degeneration there will be 0.6 mm decrease per year in stature.
3 The bones obtained in the department of Forensic medicine & Anatomy were presumed to be of

South Indian origin, whereas the exact origin could not be traced since the bones have been recovered from the grave yard.

4 Since the bones subjected to our study are above 18 yrs where exact age could not be assessed.

5 The genetic, disease and nutritional factor deficiencies have to be considered separately to arrive at conclusion.

6 The mentioned reference in the above studies are not clear about multiplication factor applicable to South Indian population.

Conflict of interest: Nil

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