Original Article

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Estimation of Total Femoral Length from Epicondylar Breadth of Femur

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Abstract

Introduction: Stature is an important tool for identification and unique data of human being. Estimation of stature from bones is important for forensic as well as anthropological studies. It is necessary to derive the regression equations from the fragments of femur for medico legal situations. Thus from lower end of femur, estimation of total femoral length can be calculated and then this can be used to get stature by deriving statural formulae. In this study, regression equation for the estimation of total femoral length from epicondylar breadth of femur was computed. **Subjects and Methods**: Total 208 normal dry human femur bones which were preserved in antomy department of different medical colleges of Gujarat were studied. Total Femoral Length and Epicondylar Breadth of the Femur bone were measured for this study. **Results:** Epicondylar Breadth of femur displayed the higher correlation (0.828) with Total Femoral Length (TFL) for an individual measurement. As per regression analysis, regression equation is derived which is, B=338.004 + A * 1.390, Where A=Epicondylar Breadth of femur, and B= Total Femoral Length. Then the stature can be estimated by this total Femoral Length by the regression equations or the multiplication factors which are already established by various studies. **Conclusion:** The total Femoral Length can be estimated from fragmentary lower end of the femur. The total femoral length can be estimated by the equation presented in this study even in the absence of intact femur bone, and by which the stature can be estimated in sex and population sample.

Keywords: Epicondylar breadth, Femur, Total femoral length, stature.

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Introduction

Stature is an important tool for identification and unique data of human being. Estimation of stature from bones is important for forensic as well as anthropological studies. But in archaeological and forensic study, occasionally only fragments of long bones (because of injury, mutilation, destruction, post-mortem gnawing by wild animals) are present as the only available source of identity.[1,2] In this cases, equations to estimate stature from whole bone length are not of use for analysis. Stature thus estimated would be significantly inaccurate and the medico legal importance, significantly eroded. It is necessary to derive the regression equations from the fragments of femur for medico legal situations. So from lower end of femur, estimation of total femoral length can be calculated and then this can be used to get stature by deriving statural formulae.[3-5] Similar studies were already presented in American population and South African population.[3,6] But significant differences in the proportions of the limb bone dimensions were reported in many studies.[7,8] In India, there is wide variation in anthropometric dimensions among its population types. Owing to this variations observed in different population groups, this study was done to generate regression equations for the estimation of total femoral length from epicondylar breadth of femur for Indian population.

Subjects and Methods

Total 208 normal dry human femur bones which were preserved in antomy department of different medical colleges of Gujarat were studied. Among these femur bones, 104 are of Right side and 104 of Left side while 150 are of male and 58 are of female. Prior to study, the femur bones were examined for any damage or any pathological alterations.[9] Femur bones with signs of cortical bone deterioration, extreme osteophytic activity, diffuse osteoarthritis or prosthesis were excluded from the study.[10-12]

For measurement of variables, following instruments were used:

1) Osteometric board with ruler and graph paper
2) Sliding vernier caliper (digital) with an accuracy of + 0.05 mm

The following parameters of the Femur bone were considered:

- Total Femoral Length: Distance from the most superior

point on the proximal end of the femur to the most inferior point on the distal end using osteometric board. The medial condyle was placed against the vertical endboard whereas applying the movable upright to the femoral head.

- Epicondylar Breadth: Distance between the two most laterally projecting points on the epicondyles parallel to the infracondylar plane. The measurement was taken with placing the bar of the calliper touching the infracondylar plane and the arms of the calliper touching the condyles of the femur.

The measurement was repeated three times at three different sessions by the same observer, using the resulting mean value to reduce intra-observer error. After collecting data, the measurements of femora were subjected to a paired t-test for assessment of bilateral variation in the measurements.[13]

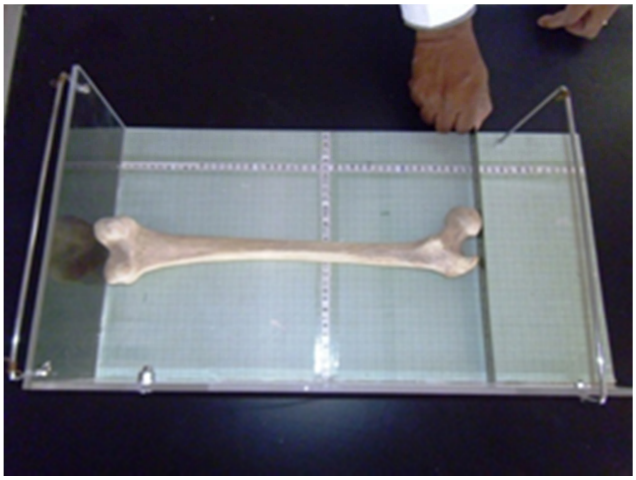


Figure 1: A photograph showing measurement of total femoral length using osteometric board

Figure 2: A photograph showing measurement of epicondylar breadth of femur using digital sliding vernier caliper

Results and Discussion

Total 208 Femur bones were examined for this study, among which 150 are of male and 58 are of female. Epicondylar Breadth and Total Femoral Length of Femur bones were measured (in mm with 2 decimal).The statistical data which were extracted from the calculation and analysis are tabulated in Table-1 to Table-3 to show different parameters at a glance. [Table 1] shows the descriptive statistics of Epicondylar Breadth (EB) and Total Femoral Length (TFL).

Table 1: Descriptive Statistics of Epicondylar Breadth (EB) and Total Femoral Length (TFL)

	N	Min.	Max.	Mean	Std. Deviation
Epicondylar Breadth(mm)	208	40.65	82.14	67.21	10.88
Total Femoral Length (mm)	208	401.06	478.23	431.45	18.29

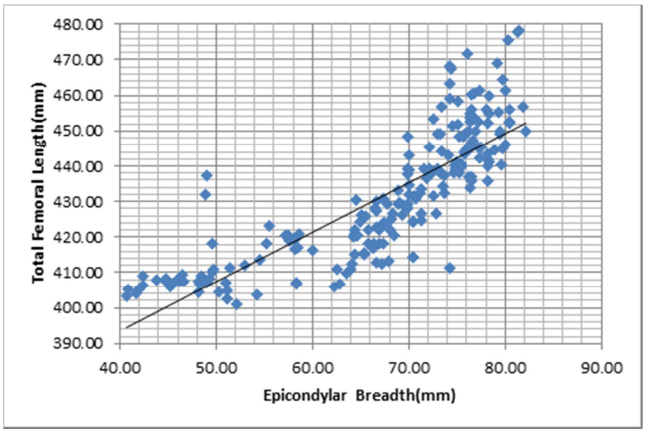
Now Epicondylar Breadth (EB) and Total Femoral Length (TFL) are correlated by applying simple linear regression. To find the degree of relationship between Epicondylar Breadth (EB) and Total Femoral Length (TFL), Pearson correlation has been calculated, which is shown in [Table 2]. Epicondylar Breadth of femur displayed the higher correlation (0.828) with Total Femoral Length (TFL) for an individual measurement.

Table 2: Correlations between Epicondylar Breadth (EB) and Total Femoral Length (TFL)

		Epicondylar Breadth(mm)	Total Femoral Length(mm)
Epicondylar Breadth (Mm)	Pearson Correlation	1	.828**
	Sig. (2-tailed)		.000
	N	208	208
Total Femoral Length(Mm)	Pearson Correlation	.828**	1
	Sig. (2-tailed)	.000	
	N	208	208

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

In the Graphical representation shown below, Epicondylar Breadth of femur is plotted on the X-axis and Total Femoral Length (TFL) is plotted on Y-axis. The scattered graphs clearly show that the linear relationship exist between X and Y. So there is Positive Correlation between Epicondylar Breadth (EB) and Total Femoral Length (TFL).



Graph 1: Scatter graph showing Correlation between Epicondylar Breadth and Total Femoral Length

The regression equation was derived using the Epicondylar Breadth (EB) and Total Femoral Length (TFL) among which highest correlation was found for an individual

measurement, which is shown in Table-3. Regression equation with the epicondylar breadth as the independent variable and Total Femoral Length (TFL) as dependant variable is obtained using the total sample (N=208).

Table 3: Regression Analysisa between Epicondylar Breadth (EB) and Total Femoral Length (TFL)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	338.004	4.474		75.545	.000
Epicondylar Breadth(mm)	1.390	.066	.828	21.157	.000

a. Dependent Variable: Total Femoral Length(mm)

So as per regression analysis, regression equation is derived which is as follow:
B=338.004 + A * 1.390
Where A=Epicondylar Breadth of femur, and B= Total Femoral Length.

In this study, to find the correlation between Epicondylar Breadth (EB) and Total Femoral Length (TFL), Pearson's coefficient was derived. Epicondylar Breadth of femur displayed the highest correlation (0.828) with Total Femoral Length (TFL) for an individual measurement as compared to other studies in Indian population.[14,15] In this present study, to estimate Total Femoral Length from Epicondylar breadth, regression equation was derived which is as follow:
B=338.004 + A * 1.390
Where A=Epicondylar Breadth of femur, and B= Total Femoral Length.

In south Indian population study of Mukhopadhyay,[14] regression equation was derived to estimate Total Femoral Length from Epicondylar Breadth. The regression equation is:-
y=7.02 + 4.83x
Where "x" is the Epicondylar breadth (in cm.) and "y" is the Total Femoral Length.

In another south Indian female population study of Magendran Chandran,[15] the regression equations derived from combination of different fragments (whichever available) produce the lowest error of estimates and therefore should be used as the first preference to estimate Total Femoral Length. Then the stature can be estimated by this total Femoral Length by the regression equations or the multiplication factors which are already established by the various studies. The greatest accuracy in estimating living stature from long bones length will be obtained when sex and ethnic identity are available. Thus it is possible to estimate stature of female individuals from the Epicondylar breadth with reasonable accuracy by the regression equations derived in our study. Necessary correction for soft tissue can be made to obtain the living stature in practical cases of forensic interest in a population specific geographic area.[16]

Conclusion

I To find the correlation between Epicondylar Breadth (EB) and Total Femoral Length (TFL), simple linear regression was applied, which displayed significant correlation (Pearson correlation coefficient = 0.828). As per regression analysis, regression equation is derived which is as follow:
B=338.004 + A * 1.390
Where A=Epicondylar Breadth of femur, and B= Total Femoral Length.
The results of this study are useful for anthropology study of unknown skeleton and for academic study in anatomy. From the results of this study, the total Femoral Length can be estimated from fragmentary lower end of the femur. The total femoral length can be estimated by the equation presented in this study even in the absence of intact femur bone, and by use of Total femoral length, the stature can be estimated in sex and population sample.

References

1. Kahana T, Ravioli JA, Urroz CL, Hiss J. Radiographic identification of fragmentary human remains from a mass disaster. Am J Forensic Medicine Pathol, 1997; 18(1) : 40-44.
2. Mundorff AZ, Bartelink EJ, Mar-Cash E. DNA preservation in skeletal elements from the World Trade Center disaster: Recommendations for mass fatality management. J Forensic Sci, 2009. 54(4): 739-745.
3. Simmons T, Jantz R., Bass W. Stature estimation from fragmentary femora; a revision of the steele method. J. Forensic Sci; 1990, 35(3): 628-36.
4. Bidmos Ma. Estimation of stature using fragmentary femora in indigenous south Africans. Int J Legal Med; 2008, 122(4): 293-9.
5. Mysorekar Vr, Nandedkar An , Sarma Rcsr.Estimation of stature from parts of ulna and tibia. Med Sci Law; 1984; 24:113-116.
6. Steele G, McKern T. A method for assessment of maximum long bone length and living stature from fragmentary long bones. Am J Phys Anthropol; 1969, 31:215-27.
7. Lundy J.K, Regression equations for estimating living stature from long limb bones in the South African Negro. S. Afr. J. Sci; 1983, 79: 337–338.
8. Trotter M, Gleser G.C. Estimation of stature from long bones of American Whites and Negroes. Am. J. Phys. Anthropol; 1952, 1: 463–514.
9. C.L.B. Lavelle, An analysis of the human femur, Am. J. Anat; 1974, 141: 415–426.
10. T.P. Andriacchi, A. Mu¨ndermann, R.L. Smith. A frame work for the in vivo pathomechanics of osteoarthritis at the knee, Ann. Biomed. Eng; 2004, 32(3): 447–457.
11. D.T. Felson, A. Naimark. The prevalence of knee osteoarthritis in the elderly, Arthritis Rheum; 1987, 30: 914–918.
12. D.F. Martin, Pathomechanics of knee osteoarthritis, Med. Sci. Sports Exerc; 1994, 26(12): 1429–1434.
13. SPSS. SPSS/PC- A statistical guide for IBM PC/XT/AT and PS/2. Chicago, IL: SPSS Inc, 1988.
14. Mukhopadhyay PP, Ghosh TK, Utpal Dan, Biswas S. Correlation between Maximum Femoral Length and Epicondylar breadth and Its Application in Stature Estimation: A Population Specific Study in Indian Bengali Males.Indian Acad Forensic Med; 32(3): 204-207.
15. Magendran Chandran, Reconstruction of Femur Length From Its Fragments in South Indian Females. International Journal of Medical Toxicology and Forensic Medicine; 45-53.
16. E. Perissinotto, C. Pisent, G. Sergi. Anthropometric measurements in the elderly: age and gender differences, Br. J. Nutr; 2002, 87(2): 177–186.

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