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Research Article

Stature estimation by Length of Femur

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Abstract

Stature is important parameter of personal identification of individual there are many studies conducted along with others parameters such as age, sex, race, etc. This study was done to estimate the stature of an individual by the length of femur. It was conducted in the department of Forensic Medicine of Al-Ameen Medical College, Bijapur. A total of 160 cases out of which 80 males and 80 females were studied. The results of present study showed that there was a definite relationship between the length of femur and cadaveric length. It was also clear from this study that prediction of stature is also influenced by sex and racial factor. This study indicates that all the segments of femur have a definite relation with the cadaveric length.

Keywords: Anthropology, Forensic, Investigation

Introduction

Identification of individual is a prime most task for investing officer when the decapitation deceased found, at list by estimation of stature of an individual from the skeletal remains from the mutilated and amputated limbs, has obvious significance in the personal identification. Studies on the estimation of stature from skeletal remains or from the mutilated limbs, mostly of the long bones have been reported as indicated by the published work of Pearson,[1] Trotter and Glesser[2] and Steel's formula.[3] The Indian perspective of the problem of stature estimation has been studied by the Thakur and Rai,[4] Saxena,[5] Bhatnagar et al.,[6] Abdel-Malek AK,[7] Rastogi et al.,[8] Estimation of stature from hand, finger and phalangeal length has been reported (Thakur and Rai,[4] Saxena,[5] Shintaku, Furuya,[9] Tyagi et al.,[10] Begum,[11] Sharma and Kapoor.[12]) To the best of our knowledge, Rastogi et al.[8] Sharma and Kapoor,[12] have reported from this aspect, therefore, in present study, an attempt has been made to estimate the stature from right middle finger length measurements. Stature estimation by the length of femur plays an important role in the identification of decomposed

body, whose muscular and anatomical structure has lost. It also helps in the estimation of age, sex, race, time since death of a person. There are various ways to estimate stature from bones, but the most easiest and reliable method is by regression analysis.

Materials and Methods

The present study has been carried out in the department of Forensic Medicine,Al-Ameen Medical College,Bijapur. The cadavers studied in the present work are those were received in the department for medico-legal post-mortem. Privacy of the cadavers was maintained and prior consent was also taken from their relatives. Confidentiality and ethical issues were also taken into consideration. A pre-designed printed proforma were used for collecting data, such as- sex, age, dental formula, socio-economic status, anybody disease or deformity, rigor-mortis, different measurements like cadaveric length (in mm), measurement of femur in dry state (in mm), measurement of different segments of femur (in mm), etc. Materials used for stature estimation were osteometric board, caliper, Tape, lukewarm water, acetone, soapy water, x-ray machine, ultraviolet lamp, brush, and standard post-mortem table. Each dead body was assigned with a particular number. A total of 160 cases have been studied, among which 80 were males and 80 were females. The different segments of the femur were observed on the osteometric board in the position, in which the femur was measured for its maximum length.

Calculations related to Stature prediction.

The steps were taken to develop data for prediction of cadaveric length and the entire series of calculation has been broadly divided into two sets.

A - from maximum length of femur as a whole.

B - from segment and combination of segments of femur.

For detailed statistical calculations an advance generation computer was programmed to find out the relationship between length of femur and cadaveric length and the relationship between various segments of femur and cadaveric length. The computer was programmed to go for a stepwise regression analysis, using the matrix of simple correlation co-efficient, and any combination of one or more independent variables have been selected for analysis from input.

At each step, those independent variables not included in the regression were inspected to find the one that will give the greatest reduction in the variation of Y. This variable was then tested for significance, i.e., the computed F-ratio of the variable was compared to the supplied critical F-value (confidence limit). If the computed value was greater than the critical value for measuring the length of femur, osteometry is the method of choice. In each case, the maximum length of the femur was measured and for this the bone was placed on a standard osteometric board with its posterior surface facing upwards. The bone was adjusted along the parallel axis of the board in such a manner that the most superior point of the bone touched the upper block of the osteometric board and the lower sliding block touched the most dependent point of the medial condyle and at this stage, the reading were taken on the scales fitted on both the sides of the osteometric board. The readings were taken only when scales on both the sides showed similar reading and this was done to ensure that the lower block was really parallel to the upper block and thus giving the maximum length of the bone. For measuring the different segments, first of all the following points were marked on the bones.

a) The most proximal point on the head.

b) The midpoint of lesser trochanter.

c) The most proximal extension of the popliteal surface, at the point where the medial and lateral supracondylar lines becomes parallel below the linia-aspera.

d) The most proximal point of the

intercondylar fossa.

e) The most distal point of the medial condyle.

The bone was divided into four segments with the help of these points.

Segment A – Between points 1 and 2 Segment B – Between points 2 and 3 Segment C – Between points 3 and 4 Segment D – Between points 4 and 5 (Where whole bone length = from point 1 to 5)

The variable was considered significant, and was added to the regression solution. After each new variable were added, those variables already in the regression were inspected to see if any of them can now be deleted, because their contribution to the reduction in the variation of Y is no longer significant. Those variables which have a computed F-ratio less than the critical value were considered insignificant and were deleted from the regression solution. The process was continued until no more variables could be added or deleted. Thus, the final regression solution contained only those variables that were statistically significant.

Results

In the present study, following standard procedure mentioned earlier, the cadaveric length, length of the femur, and length of its different established segments have been measured in millimeters. A sum total of 160 cases of which 80 male, and 80 female have been studied. The age group taken into consideration is of 18 to 55 yrs. and although the difference between the length of the femur of right and left side is insignificant (steele 70), but even then to maintain uniformity the femur of right side only have been taken into consideration. The least square curve fit and regression as applicable have been worked out for calculation of cadaveric length from a length of femur and its segment (s) and these calculations have been made for two sexes and two social groups separately. In the present study, while remaining agreeable to the view of the earlier workers but to maintain the uniformity followed so far as the size of the body is concerned, the bones of right side only have been taken into consideration. Trotter & Gleser (1952)[13] calculated regression formula for stature estimation from the average of the bone of both sides from individual and later on in 1958, in another project they considered the bones of both the sides separately and the resulting recursion formula later being combined. Genoves (1967)[14], Steele & Mc Kern (1969)[15], Lal S (1978)[16] analyzed the combined samples of bones from the right and left side of the body without attaching any significance to the sides. They were of the view that the differences between the bones of two sides were insignificant. Chandra et al (1966)[17] divided the whole femur into four segments 1-2, 2-3, 3-4, and 4-5, with the help of five bony points-

a. most proximal point on the head

b. most distal point on the circumference of the head

c. most proximal point on the lesser trochanter

d. base of the adductor tubercle, and

e. most distal point at the medial condyle, in an attempt to reconstruct the femur length from its segments.

The value of index of determination for segment-1 of femur in the rural male group with either curve is not more than 0.63 and so it is not much good with either curve, but on the other hand the value of this index for segment-2 of femur is round about 0.89 with every curve which in turn indicates that with this segment prediction of stature can be made with reasonable degree of accuracy in 89% of the cases. In the present study the index of determination for the length of femur with curve no. 1 is 0.612 in the rural female and the value of two constants i. e. A & B are 700.005 and 2.00829 respectively. For the males the value of index of determination with curve no-1 is 0.901, and the value of constants, i.e. A & B are 626.1124 and 2.29316 respectively.

The present work indicates that all the segments of the femur have definite relation with the cadaveric length, but out of four different segments, segment-2 is preferable over segment-3, 4 and 1 in the order of relativity as the segment-3 over preferably segment-4 and segment-1 as indicated by the index of determination. This in turn supports the established view expressed by earlier worker Lal S 1978[16] and others that longer is the segment length, better is the correlation with the stature. In the present work, when segments of femur and the cadaveric length, when taken into consideration using stepwise multiple linear regression mathematically, it appears quite contradictory that while segment-1 does not find any room when all segments are considered together for determination of cadaveric length, it is possible if segment-1 is having counter affect against segment-2, 3 and 4. In case of individual segment versus cadaveric length segment-1 has index of determination around 0.65 which is very much close to index of determination of segment-4. Still, segment-1 has to leave to four equations, while segment-4 remains there, and this is because of counter effects exerted by segment-1 on the other segments. The relative significance is the most significant followed by segment-3 and 4. Similar amount of change on segment-2 will cause more variation in cadaveric length compared to segment-3 and 4.

Discussion

In the present study the femur of only one side i.e. right side has been studied and the femora were measured in dry state devoid of articular cartilages. The maximum length of the femur was taken into consideration by keeping the posterior surface of the femur facing upwards. While measuring with the help of osteometric board and in the similar position the different segments of femur have also been measured with the help of five fixed bony points selected on the femur. In the present work the least square fit and regression equation as applicable have been employed for prediction of stature from the complete femur, its specified segments, and combination of segment. After completion of present work, the following facts have emerged and they are as follows:

i. There is a definite relation between the length of femur and cadaveric length.

ii. The prediction of stature is influenced by racial factor.

iii. The prediction of a stature is influenced by sex also, and so better prediction can be achieved only when the data developed for a particular sex is applied that particular sex group only.

iv. Out of all the segments of femur the segement-2 has been found to be the most significant followed by segment-3 & 4 and so the prediction of stature from segment will be better if segment-2 is applied,will be further better if it is applied in combination with segment-3 & 4. The segment-1 does not hold good for the prediction of stature.

Male (Confidence level 0.68):

Cadaveric length = 6.864634 x Segment-2 + 2.696712 x groups, namely rural male, rural female and so curve no-1 finds better position over other curves and statistical value in this connection for determination of stature from complete femur bones are as follows:

Index of Determination

	Index of Determination	A	B
Female	0.612	700.005	2.008291
Male	0.901	668.095	2.210383

vi) Using least square curve fit the curve no-1 usually holds good for all the four different specified segment of femur in both the racial groups and in both the sexes, and various statistical values with curve no-1, are as follows which can be used for prediction of cadaveric length, directly from the particular segment of the femur.

Female(Confidence level 0.68):

Cadaveric length = 3.929261 x Segment-2 + 3.523732 x Segment-3 + 1.223041 x Segment-4 + 350.141037 ± 23.419 mm

The application of above said data, the prediction of the cadaveric length and to convert that into living stature a deduction of 20 mm is to be made from the estimate and a further correction for the effect of aging estimate has to be made following the formula of Trotter & Gleser. 0.06 (age in year-30) cms.

Conclusion

After completion of the present work, we reached on this conclusion that: Males are larger & stronger in comparison to female. Height loss in cm = 0.06 (age in yr.- 30) cm due to aging, due to different life style of person. Maximum living stature obtained during 18 to 30 yrs. of age. Regression Formula is more efficient in comparison to others and Multiplication Factor obtained for femur in Bijapur = 3.78 for males and 3.74 for females.

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