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Anatomy

# "STUDY OF THE DISTAL DIMENSIONS OF THE DRY TIBIA IN CORRELATION WITH THE LENGTH OF TIBIA IN ADULT HUMAN"

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**ABSTRACT** **Background:** The present study was aimed to determine the correlation of length of tibia with distal tibial dimensions tibia in bihar population.

**Materials and methods:** A total of 28 tibiae were obtained for the present study from the Department of Anatomy, Patna medical college and hospital patna bihar, Measurements taken directly from the bone using a digital pair of vernier calipers. data measurements were expressed in means ± standard deviation. For those dimensions that showed a linear association with the length of the tibia, Pearson's correlation test was carried out. Linear regression to derive equations for estimation of the length of the tibia.

**Conclusion:** The simple regression equation are deducted from the obtained data, caution should be observed when using these dimensions because the estimates from the equations incorporating them have low accuracy and maximum length of bone.

**KEYWORDS :** Dimension of tibia, length of tibia,parameters of tibia

## INTRODUCTION

The tibia is a long bone of the leg which lies medial to fibula and is exceeded in length only by femur. The stature of an individual can be estimated from long bones especially the tibia and the femur as these have direct correlation to the height of an individual The tibia is ideal in this application as it resists erosion and keeps its anatomical shape for long even after burial. Bones differ from individual to individual on osteometric parameters that include the length of these bones due to hormonal differences,differential loading at joints and muscles bulk. Estimation of stature from the length of the tibia has so far employed techniques that require

The present study was aimed to determine correlation of length of tibia with dimensions of distal length of tibia skeletal remains in forensic analysis.

Inter-individual differences in osteometric parameters, which include the length of these bones, have been attributed to hormonal differences, differential loading at joints as well as differences in muscle bulk . The long bones of the lower limb display these differences clearly and have thus been used in forensic analysis for stature estimation Mechanical loading is especially high in the distal ends of long bones of the lower limb and as such they display significant inter-individual differences

The long bone of lower limb Since the distal tibia.
body weight in a relatively small surface area during the stance phase of gait, it is subjected to high biomechanical strains that in turn affect bone modeling It is therefore plausible to postulate significant differences in distal tibial dimensions. Such differences in the dimensions of the distal tibia have been reported for the fibular incisura the medial malleolus and the tibial plafond The use of these dimensions in estimation of the length of the tibia from skeletal remains has however not been reported. Moreover, due to populational differences exhibited by osteometric dimensions, formulae derived for a particular population are not applicable to other populations There is therefore need to obtain this information for the Indian population.

## MATERIALS AND METHODS

A total of 28 tibiae, obtained from the department of Human Anatomy and the random collection at dry bone Patna medical college and hospital patna bihar, were used in the current study. These included tibiae, of both sexes, with completely closed epiphyseal plates indicating they belonged to adults. Tibiae with chipped condyles, malleoli and incisural tubercles or those that exhibited any sign of previous fracture in life were not included in the study. Measurements were taken directly on the bone using an osteometric board and a digital pair of vernier calipers.

On the fibular incisura, the following measurements were taken: the width of the fibular incisura which is the distance between anterior and posterior tubercles 1 cm proximal to the tibial plafond; the depth of the FI, the distance from the deepest point of the FI to a line between tips of the anterior and posterior tubercles and the height of the FI which is the vertical distance between the tibial plafond and the point where the interosseous border of the tibia splits into anterior and posterior edges.The dimensions of the medial malleolus (MM) measured included its height; the distance from its base at the tibial plafond to its tip and the breadth; defined as its anteroposterior length The width of the tibial plafond (TP) which is the mediolateral dimension of the talar facet at the middle of the joint and the length of the TP ; the anteroposterior dimension of the talar facet at the middle of the joint were also measured.

The means and standard deviations of the width, height and depth of the FI, the height and breadth of the MM and the length and width of the tibial plafond TP were calculated using SPSS software (Version 17.0, Chicago, Illinois). For those dimensions that displayed linear associations with the length of the tibia, Pearson's correlation test was carried out to establish the strength of the association. Linear regression to derive equations for tibial length estimation was carried out. Tables are used to present the data.

## RESULTS

The mean± standard deviations in the sample population (N=28) of the dimensions of the tibia measured are presented in the table:

| Measure | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|
| Length of the tibia (cm) | 30.7 | 45.5 | 38.2 | 2.75 |
| Width of the tibial plafond (mm) | 21.7 | 35.4 | 26.55 | 2.18 |
| Length of the tibial plafond (mm) | 21.7 | 36.2 | 28.61 | 2.39 |
| Height of the fibular incisura (mm) | 21.2 | 43.8 | 32.35 | 4.14 |
| Depth of the fibular incisura (mm) | 1.8 | 6.4 | 3.44 | 0.87 |
| Width of the fibular incisura (mm) | 10.1 | 26.6 | 21.50 | 2.37 |
| Height of the medial malleolus (mm) | 9.3 | 19.5 | 14.19 | 1.89 |
| Breadth of the medial malleolus (mm) | 16.8 | 27.8 | 21.88 | 2.22 |

**Table: Correlation between the length of the tibia and dimensions of the distal tibia**

| Length of tibia and: | Pearson's correlation | *p* value |
|---|---|---|
| Length of tibial plafond | 0.454 | <0.001 |
| Width of the tibial plafond | 0.551 | <0.001 |
| Height of fibular incisura | 0.479 | <0.001 |
| Width of the fibular incisura | 0.410 | <0.001 |
| Breadth of medial malleolus | 0.419 | <0.001 |

Models were generated to estimate the length of the tibia in millimeters from dimensions of the distal The equations, correlation coefficients (*r*), coefficients of determination ($R^2$) and standard errors of the estimates (SEE) of each of the models are presented.

**Equations for estimation of the right are presented below:**
In these equations: WTP- Width of the tibial plafond; LTP- Length of the tibial plafond; HFI- Height of the fibular incisura; WFI- Width of the fibular incisura; BMM- Breadth of the medial malleolus.

Among these models, model 3 is preferred because the inclusion of the width of the FI and the breadth of the MM in model 4 and 5 was not beneficial. The contribution of the width of the FI, indicated by the significance of its *t* statistic, to model 4 was not statistically significant ($p$=0.472). Similarly, the contribution of the width of the FI and the breadth MM to model 5 was not statistically significant ($p$ =0.520 and 0.594 for width of the FI and breadth of the MM respectively).

## DISCUSSION

The identification of individual in medicolegal cases by forensic and archeological analysis of skeletal remains, estimation of stature of an individual is central as such data can be used to identify an individual and, in archeological studies, analysis of the nutritional status and general body size of the population The tibia can be used in the estimation of stature as it displays significant inter-individual and sexual differences. The use of distal tibial dimensions, which are reported to display significant seual differences to estimate the length of the tibia is therefore useful in estimating the height of an individual. Pertinent to this is the fact that the systematic use of regression formulae derived in a specific population can under- or over-estimate stature when applied in another population authors have recommended that regression equations which are obtained in a certain population should not be applied to other populations. In the current study, data was sex aggregated, though the greatest accuracy in estimating stature would be obtained when the sex was available However, it has been noted that differences of the femur length were independent of sex. Therefore in our analysis both sexes were aggregated. Similar methods have been applied in the estimation of the length of the humerus.

In the estimation of the length of the long bone from its fragments, the use of accurately recognizable landmarks is mandatory. Because of these reasons, the measures used to derive a regression equation to estimate the length of the long bones become limited. Usually, the transverse dimensions along the diaphysis are not appropriate for estimating the length because of their inability in defining the precise landmarks. Therefore, the only leftover location opts for measurements on the fragments of the proximal or distal diaphysis. Hence, for our present study, the dimensions of the distal segments of the tibia alone were selected. This is so because these dimensions are affected greatly by the modeling that results from intensive biomechanical loading at the ankle joint.

Several authors have derived linear regressions to estimate the maximum length of long bones from the measurement of its fragments in different populations Wright and In our present study we also derived regression equations to measure the length of the tibia from dimensions of its distal articular facets, with right and left sides separately,in indian population.

The current study has demonstrated moderate correlations between the dimensions of the distal tibia and its length. The length of the tibia shows positive correlation with the width of the tibial plafond ($r$= 0.551), the breadth of the medial malleolus ($r$=0.419) and the height of the fibular incisura ($r$=0.479). These findings concur with and extend the findings by who demonstrated correlations between the length of the tibia and the dimensions of the fibular incisura Determination of the length of the tibia is important in the estimation of stature and Since these dimensions display positive correlation with the length of the tibia, they can be used in estimation of the length of they are used in this regard because the moderate positivecorrelations observed imply that their use in estimation of the length of the tibia would yield low accuracies. The equations derived for length estimation showed strong positive correlations and low coefficients of determination. This indicates that estimates obtained in their use would have lower accuracy compared to incorporating the distance between the tibial plateau and plafond, and other landmarks along the length of the shaft of the tibia used by previous workers The equations derived in the current study may however be more be useful in analysis of more fragmentary tibiae. There is positive correlation between these dimensions and length of the tibia.

## CONCLUSION

This study mainly aimed at finding the correlation between the various dimension of the tibia to estimate the length of the tibia from the dimensions of the fibular incisura, tibial plafond and medial malleolus, caution should be applied in this regard as the equations.

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