

**Determination of length of tibia by its upper end parameters.**

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**Abstract**

length of tibia is an important parameter for Anthropometric, forensic and racial studies. It has been found that upper end of tibia has profound effect on its length. In this study we have made an attempt to estimate the length of tibia by its upper end parameters.

**Objective:** To determine length of tibia by multivariate analysis of the upper end of tibia.

**Materials and methods:** 60 human tibia from MGM MCH Aurangabad bone bank were studied. All were dry, free of damage or deformity.

**Result:** Length of tibia is well determined by multivariate regression equation. Right tibia has better predictive value than left.

**Keywords:** Osteometric board, Maximum Tibia length (MTL), Bicondylar tibial width (BTW), Anterior- posterior inter condylar diameter (APID), Anterior-posterior diameter of medial condyle (APDMC), Transverse diameter of medial condyle (TDMC), Anterior-posterior diameter of lateral condyle (APDLC).

**Introduction**

The tibia is a strong and long bone of inferior extremity which is homologous with radius of upper extremity. The stature of an individual forms part of their biological profile. It is particularly useful in identifying missing persons and or criminal cases, cases of mass burial, dead bodies in mass disasters, discoveries, and medico-legal issues.<sup>1</sup>The long bones of lower limbs show significant differences and therefore these bones are more reliable in anthropological and forensic study.<sup>2</sup>It has been found that upper end of tibia has profound effect on its length. Various human races differ but very little in the degree in which the males surpass the females in the length of long bone.<sup>3</sup>

Anatomists are consulted frequently by law enforcement authorities regarding identification of skeletal remains found under suspicious circumstances, while the Anthropologist are also interested in finding the age, sex, stature and other details about the skeletal remains found during archaeological excavations<sup>4</sup>.It is found that there is

positive correlation between stature and long bones of human bodies and hence we can estimate stature of an known individual with the help of long bones like tibia, humus, femur, etc. the proximal end of tibia is expanded side to side, it has two condyle medial and lateral condyles, an intercondylar area, and a tibial tuberosity. The medial condyle is larger than the lateral condyle, between both the condyle intercondylar eminence is present<sup>5</sup>.

### Aim of the present study

To achieve highest possible accuracy in establishing length of tibia with its upper end.

### Material and methods

#### Material required

The following instruments were used for calculation of various parameters of tibia.

- 1) Osteometric board.
- 2) Digital Vernier calliper.
- 3) Non elastic thread, scale.
- 4) Marker and pencils.

Following measurements were calculated on each tibia bone.

Maximum tibial length (MTL) is measured as the maximum distance from the highest point of the upper part of the tibia to the lowest point of the tibia using the osteometric board.

Figure 1:



Bicondylar tibial width (BTW) is measured as the maximum transverse distance from the medial side of the medial condyle and lateral side of the lateral condyle by using digital Vernier calliper.

Figure 2:



Anterior- posterior intercondylar diameter (APID) is measured as the maximum anterior-posterior distance of the medial condyle using digital Vernier calliper.

Figure 3:

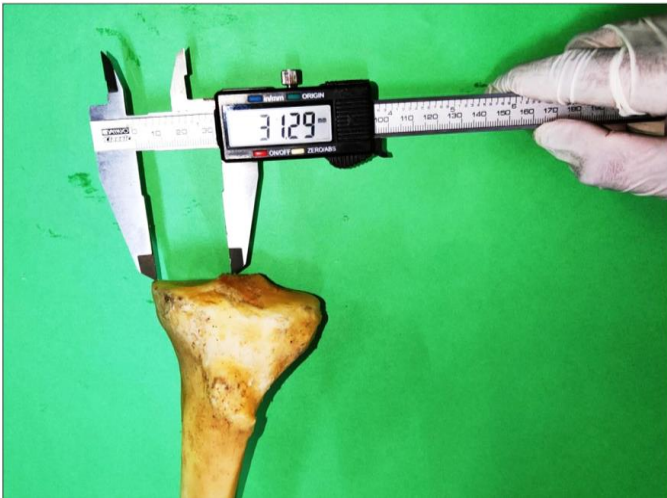


Anterior-posterior diameter of medial condyle (APDMC) is measured as the maximum distance from the medial side of the medial condyle to the medial intercondylar

tubercle of intercondylar eminence by using digital

Vernier calliper.

Figure 4:



Transverse diameter of medial condyle (TDMC) is measured as the maximum anterior-posterior distance of the lateral condyle by using digital Vernier calliper.

Figure 5:



Anterior-posterior diameter of lateral condyle (APDLC) is measured as the maximum distance from the lateral side of the lateral condyle to the lateral intercondylar tubercle of the intercondylar eminence by using digital Vernier calliper.

Figure 6:



Transverse diameter of lateral condyle (TDLC) is measured as the maximum distance from the medial intercondylar tubercle to the lateral intercondylar tubercle by using digital Vernier calliper.

Figure 7:



### Observation

proximal end parameters of 60 tibia are measured by descriptive statistic. Following table shows the calculation.

Table 1: Right Tibia

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Error of mean	Std. Deviation
MTL	30	313.0	415.0	372.079	4.8674	27.9610
BTW	30	62.92	77.91	70.0161	.75146	4.31682
APID	30	46.92	60.91	53.9409	.75196	4.31969
APDMC	30	40.42	58.23	47.0479	.80348	4.61564
TDMC	30	28.61	35.91	31.2633	.34915	2.00572
APDLC	30	37.98	50.32	44.6529	.59582	3.42274
TDLC	30	28.78	36.01	31.5903	.35882	2.06127

Table 2: Left tibia

	N	Minimum	Maximum	Mean	Std. Error of Mean	Std. Deviation
MTL	30	334	415	376.93	3.244	17.768
BTW	30	62.52	76.32	71.8413	.65699	3.59847
APID	30	47.55	66.59	56.2420	.76739	4.20319
APDMC	30	40.11	52.32	47.7210	.57049	3.12472
TDMC	30	26.38	36.41	31.4350	.42192	2.31096
APDLC	30	41.83	55.44	47.6203	.55617	3.04629
TDLC	30	28.54	39.15	32.4293	.42511	2.32840

- Length of right tibia extends between 313-415 mm whereas length of left tibia extends between 334-415 mm
- Bicondylar tibial width of right tibia ranges between 62.92-77.91 mm and bicondylar tibial width of left tibia ranges between 62.52-76.32 mm
- Anterior-posterior intercondylar diameter of right tibia ranges between 46.06—60.91 mm whereas APID on left side ranges between 47.55-66.59 mm.
- Anterior posterior diameter of medial condyle ranges between 40.42-58.53 mm whereas APDMC on left side ranges between 40.11-52.32 mm
- Transverse diameter of medial condyle on right side ranges between 28.61-53.91 mm and on left side ranges between 26.38-36.41 mm

- Anterior posterior diameter of lateral condyle on right side ranges between 37.98-50.32 mm and on left side ranges between 41.83-55.44mm.
- Transverse diameter of lateral condyle on right side ranges between 28.78-36.01 mm and on left side ranges between 28.54-39.15 mm
- Intercondylar diameter on right side ranges between 9.31-19.39 mm and on left side ranges between 11.27-17.54 mm.

From above observation we can say that

- MTL, APID and APDLC are more on left side of tibia than on right side.
- BTW and TDLC on both side of tibia are approximately same.
- TDMC and TDLC are more right side than on left side.

Following regression equations are derived.

**Right side.**

**Tibial Length:**  $131.037 + 2.547 \text{ (TDMC)} + 3.280 \text{ (TDLC)} + 4.086 \text{ (APDMC)}$   $R = 0.704$

**Tibial Length:**  $56.671 + 0.904 \text{ (BTW)} + 2.773 \text{ (APID)} + 2.179 \text{ (APDMC)}$   $R = 0.840$

Using 3 parameters both formula have equivalent predictive value as R value of both equations is near 1.

**Left side**

**Tibial Length:**  $234.154 - 3.210 \text{ (TDMC)} + 1.817 \text{ (TDLC)} + 3.872 \text{ (APDMC)}$   $R = 0.607$

**Tibial Length:**  $239.402 - 0.202 \text{ (BTW)} - 0.195 \text{ (APID)} + 3.416 \text{ (APDMC)}$   $R = 0.538$

Using same 3 parameters, both formulae do not give predictive value as R value of both equation is far away from 1.

**Discussion**

Tibia is a commonly studied long bone of lower extremity to find out structure. In the present study we have analysed the data by both routine statistical methods and multivariate linear discriminate analysis method.

We measured 7 parameters of proximal end.

It is concluded that stature can be estimated with height accuracy by these proximal parameters by using SPSS.

Many studies on adult tibia have been carried out using different techniques and materials such as dry bones, computed tomography (CT) scan, magnetic resonance imaging (MRI) scan and plane radiographs.

The present study was done on dry bones. In this study we have analysed data by both routine statistical methods and multivariate linear discriminate analysis method. In present study we found that we can find out the length of tibia from its various upper end parameters. Length of tibia is statistically a very significant parameter.

**Conclusion**

Length of tibia is well determined by multivariate regression equation. Right side tibia has better predictive value than left.

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