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Anthropometric study of tibia in Bankura district of West Bengal: A cross- sectional study

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Abstract: *Anthropometry is a precise method for evaluation of different measurements of dried bones and have been used as a technique to bring out regional and racial differences all over the world. Being an important anatomic unit, different anthropometric studies (including the present) have been undertaken on the tibia.*
The mean of values of Cross- Section Index of right and left tibia were found to be 80.85 and 76.17 respectively. The mean of Cnemicus Index of right and left tibia was 80.43 & 75.59 respectively. The mean of Length-Thickness Index of right and left tibia was calculated to be 30.05 & 29.71 respectively. Out of these 3 indices, the values of Cross- Section Index & Cnemicus Index were found to be statistically significant.
Key words: *Anthropometry, Tibia, Cross- Section Index, Length Thickness Index, Cnemicus Index*

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I. Introduction

Anthropometry is a series of systematic measuring techniques that can be used to measure various dimensions of the human body & the skeleton. Since it is a highly reliable tool in the hands of trained anthropometrists, it still retains its importance in Forensic Science as the traditional method of identification of unknown human remains.

Many studies of tibia have been reported on various populations of the world. Tibial anthropometry among different populations have revealed great variations due to the fact that measurements from different areas of the world are likely to be affected by variations in race, diet, heredity, climate & other factors related to lifestyle. Anatomists and forensic experts have separately worked on various measurements of tibia to bring out significant differences in the morphometry of the right & left tibia as well as sexual dimorphism. However, since the sex of the dried bones under study was undetermined, this factor could not be taken into account.

The tibia (shinbone), situated in the anteromedial side of the leg is the second largest bone in the body[1]. On the posterior surface of the tibia a large vascular groove adjoins the end of the soleal line & descends distally into a nutrient foramina[2]. The nutrient canal runs inferiorly in tibia before opening into the medullary cavity[1].

The objective of this study is therefore twofold:-a) evaluation of the different morphometric measurements of the tibia in Bankura district of West Bengal and b) use the collected data to estimate bilateral differences between right & left tibia.

II. Materials and Methods

In this study, 83 (38 right and 45 left) human adult tibia were obtained from the bone bank of the Anatomy Department of Bankura Sammilani Medical College & Hospital. A total of 06 parametric variables were acquired from the shaft of the Tibia according to standard anthropometrical method[3,4]. The number of nutrient foramina for Tibia of both sides were also noted.
Tibia with obvious defects and deformities or which showed signs of previous fracture were excluded from the study. Digital Vernier Caliper, Osteometric Board, Measuring Tape were used to obtain all the measurements.

Formulae used in this study are:

Cross-Section Index in Middle
= (Transverse diameter in middle of Bone/ Maximum Diameter in middle of Bone) X 100
In this formula Transverse diameter in the middle of the Bone is calculated as the straight distance from the medial border of the tibia to the interosseous crest at the level of nutrient foramen. Maximum Diameter in the middle of Bone measures the straight distance of anterior crest from the posterior surface in the middle of the bone.

Fig:1: Measuring Cross Section Index

Cnemicus Index =

(Transverse Diameter at level of Nutrient Foramen/ Sagittal Diameter at level of Nutrient Foramen) X 100

Transverse Diameter at level of Nutrient Foramen is the straight distance from the medial border to the interosseous crest at the level of nutrient foramen. Sagittal Diameter at level of Nutrient Foramen measures straight distance of anterior crest from the posterior surface at the level of nutrient foramen.

Fig:2: Measuring Cnemicus Index

Length - Thickness Index =

(Maximum Girth of shaft/Total length of Tibia) X 100

Where Maximum Girth of shaft is maximum circumference of shaft wherever found. Total length of Tibia measures straight distance from the lateral condyle to the tip of medial malleolus.

Fig:3: Measuring Length-Thickness Index

III. Results

Following parameters were determined:

1) Number of nutrient foramina
2) Transverse diameter in middle of Bone : To measure Cross-Section Index
3) Maximum Diameter in middle of Bone
4) Maximum Girth of shaft : To measure Length - Thickness Index
5) Total length of Tibia
6) Transverse Diameter at level of Nutrient Foramen : To measure Cnemicus Index
7) Sagittal Diameter at level of Nutrient Foramen

Statistical analysis was done by Graphpad Prism software.

Out of 38 right tibia examined in this study, only *one* presented double nutrient foramina

1) Transverse diameter in middle of bone

P value and statistical significance:

The two-tailed P value equals 0.2806.

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval: The mean of Rt Tibia minus Lt Tibia equals - 0.051

95% confidence interval of this difference: From - 0.146 to 0.043

Intermediate values used in calculations:

t = 1.0863

df = 79

standard error of difference = 0.047

Group	Rt Tibia	Lt Tibia
Mean	1.958	2.009
SD	0.238	0.187
SEM	0.039	0.029
N	38	43

2) Maximum diameter in middle of bone

Group	Rt Tibia	Lt Tibia
Mean	2.432	2.658
SD	0.256	0.290
SEM	0.042	0.044
N	38	43

P value and statistical significance:

The two-tailed P value equals 0.0004

By conventional criteria, this difference is considered to be **extremely statistically significant.**

Confidence interval:

The mean of Rt Tibia minus Lt Tibia equals - 0.227

95% confidence interval of this difference: From - 0.348 to - 0.105

Intermediate values used in calculations:

t = 3.7089

df = 79

standard error of difference = 0.061

3) Transverse diameter at the level of nutrient foramen

P value and statistical significance:

The two-tailed P value equals 0.5395

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Rt Tibia minus Lt Tibia equals 0.034

95% confidence interval of this difference: From - 0.076 to 0.144

Intermediate values used in calculations:

t = 0.6162

df = 79

standard error of difference = 0.055

Group	Rt Tibia	Lt Tibia
Mean	2.253	2.219
SD	0.265	0.232
SEM	0.043	0.035
N	38	43

4) Sagittal diameter at the level of nutrient foramen

P value and statistical significance:
The two-tailed P value equals 0.0752
By conventional criteria, this difference is considered to be not quite statistically significant.

Confidence interval:
The mean of Rt Tibia minus Lt Tibia equals - 0.161
95% confidence interval of this difference: From - 0.338 to 0.017
Intermediate values used in calculations:
t = 1.8033
df = 79
standard error of difference = 0.089

Group	Rt Tibia	Lt Tibia
Mean	2.818	2.979
SD	0.325	0.456
SEM	0.053	0.070
N	38	43

5) Maximum girth of shaft
P value and statistical significance:
The two-tailed P value equals 0.4996
By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:
The mean of Rt Tibia minus Lt Tibia equals - 0.118
95% confidence interval of this difference: From - 0.464 to 0.228
Intermediate values used in calculations:
t = 0.6782
df = 79
standard error of difference = 0.174

Group	Rt Tibia	Lt Tibia
Mean	10.687	10.805
SD	0.647	0.881
SEM	0.105	0.134
N	38	43

6) Total length of tibia
P value and statistical significance:
The two-tailed P value equals 0.0555
By conventional criteria, this difference is considered to be not quite statistically significant.

Confidence interval:

The mean of Rt Tibia minus Lt Tibia equals - 0.817

95% confidence interval of this difference: From - 1.653 to 0.020

Intermediate values used in calculations:

t = 1.9440

df = 79

standard error of difference = 0.420

Group	Rt Tibia	Lt Tibia
Mean	35.576	36.393
SD	1.502	2.170
SEM	0.244	0.331
N	38	43

A) Cross section index in the middle:

P value and statistical significance:

The two-tailed P value equals 0.0179

By conventional criteria, this difference is considered to be **statistically significant.**

Confidence interval:

The mean of Rt Tibia minus Lt Tibia equals 4.6732

95% confidence interval of this difference: From 0.8262 to 8.520

Intermediate values used in calculations:

t = 2.4179

df = 79

standard error of difference = 1.933

Group	Rt Tibia	Lt Tibia
Mean	80.8476	76.1744
SD	8.5536	8.7911
SEM	1.3876	1.3406
N	38	43

B) Cnemicus Index

P value and statistical significance:

The two-tailed P value equals 0.0257

By conventional criteria, this difference is considered to be **statistically significant.**

Confidence interval:

The mean of Rt Tibia minus Lt Tibia equals 4.8371

95% confidence interval of this difference: From 0.6022 to 9.0721

Intermediate values used in calculations:

t = 2.2735

df = 79

standard error of difference = 2.128

Group	Rt Tibia	Lt Tibia
Mean	80.4292	75.5921
SD	8.6953	10.2548
SEM	1.4106	1.5638
N	38	43

C) Length Thickness Index:

P value and statistical significance:

The two-tailed P value equals 0.3983

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Rt Tibia minus Lt Tibia equals 0.3421

95% confidence interval of this difference: From - 0.4596 to 1.1438

Intermediate values used in calculations:

t = 0.8493

df = 79

standard error of difference = 0.403

Group	Rt Tibia	Lt Tibia
Mean	30.0539	29.7119
SD	1.5908	1.9816
SEM	0.2581	0.3022
N	38	43

IV. Discussion

Morphometric measurements of tibia are considered to be of medico-legal importance because it provides stature and group specific formulae for the determination of "personal identity" in circumstances of unknown and unclaimed human remains [5,6,7]. In addition, Agnihotri *et al*. (2009) recommended the combined use of tibial and ulnar lengths for exact modeling of stature[8].

In present study, the values of Cnemicus and Cross section indices showed statistical difference. This may be of value in medicolegal issues where sometimes identity is to be established from part of bone only [9, 10]. The values of the indices calculated from the morphometric measurements of tibia in this study shows a difference from other studies and could be a result of differences in factors such as age, sex, race, geographical area and also environmental factors affecting bone growth, such as nutrition, physical development and genetic factors. However, since this study is a cross sectional study done on a limited number of bones, for the purpose of comparison, further studies reporting on other race groups may be required.

The presence of single nutrient foramen throughout the samples studied (except one) is a remarkable difference as compared to other long bones of human body [11,12].

In view of the extensive anatomy of the tibia, there is much reference to the role of embryological development to tibial morphology and morphometry[13]. As a characteristic long bone, the tibia is derived from the mesenchymal tissue of limb buds and ossifies via endochondral ossification during 7 to 12 weeks of fetal development [13,14]. The structural stages in the formation of the tibial diaphyseal and epiphyseal regions are characterized by the presence and apposition of the primary and secondary ossification centres, respectively[13]. As a result, the natural course of ontogenesis has been identified as the rate-enhancing determinant of bone morphology and morphometry which is specific to the individual in terms of genotype, occupational habits and metabolic changes [15,16].

V. Conclusion

By providing the mean values of the different morphometric measurements of the tibia and calculation of various indices, this study may help to indicate the characteristic morphological features of tibial segments in the population of Bankura district of West Bengal.

The knowledge of these morphometric values of tibia segments will be of immense importance in forensic, anatomic and archaeological cases where identification of unknown bodies and stature is required.

Presence of single nutrient foramen throughout our study (excepting one), place the tibia separately from other long bone of humans.

Since the vascular supply to the tibia is a pivotal factor in ensuring the success of orthopaedic procedures in the proximal tibial region, the understanding of the regional distribution of nutrient foramina may provide important surgical landmarks necessary to avoid injury to such regions during surgery which could result in complications.

References

[1]. Moore K.L; Dalley A.F, Agur A.M.R. Lower limb. Clinically Oriented Anatomy. 6th ed.,Lippincott Williams Wilkins.Baltimore.2010: 520-521

[2]. Standring S.(ed).Chapter 83- Leg. Gray's Anatomy: The Anatomical Basis of Clinical Practise. 41st ed., Churchill Livingstone Elsevier. Philadelphia. 2016:1403

[3]. Singh IP, Bhasin MK. A manual of Biological Anthropology. 1st ed, Kamla Raj Enterprices.1970.

[4]. Strecker W, Keppler P, Gebhard F, Kinzl L. Length and torsion of the lower limb. Br J Bone Joint Surg 1997, 79: 1019 - 23.

[5]. Pelin IC, Duyar I. Estimating stature from tibia length: a comparison of methods. J Forensic Sci 2003 Jul;48(4):708-12.

[6]. Akhlaghi M et al. The value of the anthropometric parameters of the tibia in the forensic identification of the Iranian population over the age of 20. Journal of Forensic and Legal Medicine. August 2011, Vol. 18(6): 257-263, doi: 10.1016/j.jflm.2..

[7]. Bokariya P et al. The anthropometric measurements of tibia. Journal of Indian Academy of Forensic Medicine. October 2012 .34(4);322-323.

[8]. Agnihotri et al. Estimating stature from percutaneous length of tibia and ulna in Indo- Mauritian population. Forensic Sci. Int. 2009. 187(1-3): 109.

[9]. Zaslan A, Ubcan MY, Zaslan U. Estimation of stature from body parts. Forensic Sci Int 2003; 3501: 1- 6.

[10]. Mohanty NK**.** Prediction of height from percutaneous tibial length amongst Oriya population Forensic Science International 98 (1998) 137–141

[11]. Longia GS, Ajmani ML, Saxena SK, Thomas RJ. Study of diaphyseal nutrient foramina in human long bones. Acta Anat (Basel). 1980;107(4):399-406

[12]. Bokariya P, Bokariya R , Gudadhe D , Shyamal A, Tirpude BH, Shende MR. The Anthropometric Measurement of Humerus Segments. Journal of Forensic Medicine & Toxicology 2011; 28(1):53-55

[13]. Shapiro F. Bone development and its relation to fracture repair. The role of mesenchymal osteoblasts and surface osteoblasts. Eur. Cell Mater., 15:53-76, 2008.

[14]. Lee et al. Length measurement of fetal long bone and fetal anomaly detection. Obstet, Gynaecol., 4(5): WMC004236, 2013

[15]. Golding J.S. The mechanical factors which influence bone growth. Eur. J. Clin. Nutr. 1994. 48 Suppl. I: S178-85.

[16]. Gosman et al. Development of cortical bone geometry in the human femoral and tibial diaphysis. Anat. Rec. (Hoboken) 2013. 296(5): 774-87.

[17]. Tejaswi HL, Shetty K, Dakshayani KR. Anatomic study of nutrient foramina in the human tibiae and their clinical importance. Int J Recent Trends Sci Technol. 2014; 9: 334-6.

[18]. Shapiro F. Bone development and its relation to fracture repair. The role of mesenchymal osteoblasts and surface osteoblasts. Eur. Cell Mater. 2008; 15:53-76.

[19]. Lee S, Kim T, Lee H, Park J, Chung S, Jeon D. Length measurement of fetal long bone and fetal anomaly detection. Obstet, Gynaecol. 2013; 4(5): WMC004236.

[20]. Golding J S. The mechanical factors which influence bone growth. Eur. J. Clin. Nutr. 1994; 48 Suppl. I: S178-85.

[21]. Gosman JH, Hubbell ZR, Shaw CN, Ryan TM. Development of cortical bone geometry in the human femoral and tibial diaphysis. Anat. Rec. (Hoboken) 2013; 296(5): 774-87.