

Original Article**Sex determination from distal epiphyseal breadth of tibia**

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ABSTRACT

Background: Epiphyseal breadth of tibia is considered as a better determinant of the sex than the other variables of that bone in sexual diagnosis.

Aim: To obtain values of distal epiphyseal breadth of tibia and estimate its role in sexual identification.

Methods: A cross sectional study was carried out at Anatomy department P.D.U. Govt. Medical College, Rajkot, Gujarat, India on 194 dry, normal, adult human tibiae (106 male & 88 female). Distal epiphyseal breadth was measured in centimeter with the help of sliding caliper by noting distance between farthest points on medial surface of medial malleolus medially and fibular notch laterally.

Results: Mean values obtained were 3.98 cm & 3.63 cm for right male & right female & 3.94 cm & 3.61cm for left male & left female respectively. Higher values in male were statically highly significant ($p < 0.001$) on both sides. Demarking point (D.P) analysis of the data showed that right tibia with distal epiphyseal breadth more than 4.85 were definitely male and less than 2.71 were definitely female. While for left bones, tibia with distal epiphyseal breadth more than 3.19 were definitely male and less than 2.86 were definitely female. Distal epiphyseal breadth identified 1.89% of right male tibia. It was not useful for right female and for left bones.

Conclusion: From the above study, it can be concluded that based on measurement of distal epiphyseal breadth of right and left tibia, sex differentiation can be made.

Keywords: Distal epiphyseal breadth of tibia, sexual dimorphism of tibia, demarking point analysis

INTRODUCTION

Determining sex is one of the first and most important steps in identifying decompose corpses or skeleton remains. It is having enormous medico-legal and anthropological importance. Non-metrical methods of sexing the bones depend entirely on ability and experience of observer. Metric method for sexing from bone, in addition to simplicity, also allows no individual variations are entirely objective assessment [1]. Skeletal collection permits the study of age, sex, stature and biological affiliation difference of morphometrical and morphological skeleton features. Several bones (pelvis, skull) show a marked sexual dimorphism, so they are suitable for sexing skeletons with high accuracy [1]. In many instances only some bare bones constitute sole remains of dead individual. It is therefore important to develop standards to determine sex from different parts of postcranial

skeletons. Although macroscopic sexual differences may be subtle in long bones, discriminate functions including several osteometric parameters allow a quite accurate sexing of several postcranial bones. However, it is also clear that there is considerable variation of these functions among different populations, so the standards for one population should not be used for another one [1].

Sexual dimorphism of distal epiphyseal breadth of tibia has been studied in different populations [2-8]. Iscan and Miller Shaivitz have suggested that epiphyseal measurements are more reliable indicators of sex because the functional demands of weight and musculature concentrate on these parts of the bone [9]. Epiphyseal breadth of tibia is considered as a better determinant of the sex than the other variables of that bone in sexual diagnosis [6, 8]. Present study was carried out to ascertain sexual

dimorphism of distal epiphyseal breadth of tibia & develop appropriate standards for determining a sex from the tibia in Gujarat region.

MATERIAL & METHODS

Material for the present study consisted of 106 male (53 of right & 53 of left side) and 88 female (44 of right & 44 of left side) human adult tibiae from the skeletal collection of anatomy department, P.D.U. Medical College, Rajkot Gujarat. Tibiae showing pathological abnormality or from the persons outside Gujarat region were not included in study.

Distal epiphyseal breadth: It is a distance between medial surface of medial malleolus and fibular notch and it was measured by sliding caliper, one end of caliper put on deepest center of the fibular notch and

other end on farthest point of medial surface of the malleolus tangent to the vertical axis of the bone [10].



Figure 1: DEB measurement by sliding calliper

Each bone was measured thrice and measurement was repeated by two independent observers, mean of these observations was taken as a final reading to nullify any intra and inter-observer error. Data collected was tabulated and analyzed statistically sidewise & sex-wise by demarking point (D.P.) analysis [11].

RESULTS

Table 1: Statistical values about the distal epiphyseal breadth

Statistical value	Right		Left	
	Male (n=53)	Female (n=44)	Male (n=53)	Female (n=44)
Range	3.4-4.9	2.8-4.2	3.2-4.3	3.1-4.3
Mean	3.98	3.63	3.94	3.61
S.D	0.29	0.3	0.25	0.25
t value	5.82		6.48	
p value	<0.001		<0.001	
Calculated Range mean±3S.D.	3.11-4.85	4.54-2.71	4.69-3.19	4.36-2.86
Demarking Points(D.P)	>4.85	<2.71	>4.69	<2.86
% & no. identified by D.P.	1.89% no=1	0.00% no=0	0.00% no=0	0.00% no=0

Right Tibia: The distal epiphyseal breadth right male tibia varied from 3.4cm to 4.9cm (average: 3.98 & S.D.:0.29); and of right female tibia varied from 2.8cm to 4.2cm (average: 3.63 & S.D.:0.30). Mean value of distal epiphyseal breadth was higher in male as compared to female. Calculated t-value and p value showed that the difference in the mean distal epiphyseal breadth in male and female is statistically significant with $p < 0.001$ (Table 1). Definite sexual classification in male right bone (>4.85) was 1.89 % (no=1) and in female right bone (<2.71) was 0.00%.

Left tibia: The distal epiphyseal breadth of left male tibia varied from 3.2cm to 4.3cm (average: 3.94 & S.D.:0.25); and of left female tibia varied from 3.1cm

to 4.3cm (average: 3.61 & S.D.:0.25). Mean value of distal epiphyseal breadth was higher in male and calculated t-value and P value showed that the difference in the mean distal epiphyseal breadth in male and female was highly statistically significant with $P < 0.001$ (Table 1). Definite sexual classification in male (>4.69) and female (<2.86) left bone was 0.00%.

DISCUSSION

Mean value of distal epiphyseal breadth was higher in male as compared to female. Calculated t value and p value showed that the differences in mean of distal epiphyseal breadth in male and female was highly statistically significant with $p < 0.001$ on both side.

Table 2: Comparison of Distal epiphyseal breadth of tibia

Population & Study		Distal epiphyseal breadth					
		Male			Female		
		Mean	S.D.	%Identified	Mean	S.D.	%Identified
Kazuhiro sakaue (2004) Recent Japanese(n=64)		4.8	2.5	89%	4.24	1.92	89.00%
Iscan M Y et al (1994) Japanese (n=84)		4.53	2.18	87%	4.05	2.55	79.40%
M Iscan & Maryan steyn (1997), south African whites(n=50)		5.02	2.89	83.90%	4.44	2.35	94%
Mario slaus et al		5.56	3.61		4.94	3.74	
G.Singh et al (1972), Varanasi zone (n=244)	Rt. side	4.8	0.41	7%	4.27	0.29	3%
	Lt. side	4.77	0.65	16%	4.26	0.26	0%
present study (n=194)	Rt.side(106)	3.98	0.29	1.89%	3.63	0.3	0.00%
	Lt.side (88)	3.94	0.25	0.00%	3.61	0.25	0.00%

For right male bone calculated range (mean \pm 3SD) was 3.11 -4.8 and for right female bone it was 2.71-4.54. With the help of these demarking points right tibia with distal epiphyseal breadth more than 4.85cm can be correctly classified as a male and right tibia with distal epiphyseal breadth less than 2.71cm can be correctly classified as a female. However if the distal epiphyseal breadth of bone is between 4.85 cm and 2.71 cm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male right bone (>4.85) was 1.89% (no=1) and in female right bone (<2.71) it was 0.00% (no=0).

For left male bone calculated range (mean \pm 3SD) was 3.19 to 4.69 cm and for left female bone it was from 2.86 cm to 4.36 cm. So, left tibia with distal epiphyseal breadth more than 4.69 cm can be correctly classified as a male and left tibia with distal epiphyseal breadth less than 2.86 cm can be correctly classified as a female. However if the distal epiphyseal breadth is between 2.86 cm and 4.69cm, Sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male (>4.69) and in female (<2.86) left bone was 0.00%.

Axial skeleton weight of the male is relatively and absolutely heavier than that of the female, and the initial impact of this weight is borne by the articular surfaces in transmission of the bodyweight [8]. As a result articular surfaces taking part in weight transmission are massive in male resulting in higher value of epiphyseal breadth in male.

Comparison of distal epiphyseal breadth of male between present study and other studies has been shown in table: 2. Mean of male distal epiphyseal breadth value in present study was 3.98 cm (right) & 3.94 cm (left). In other studies it varied from 4.53 cm to 5.5 cm. Mean distal epiphyseal breadth in male tibiae of both side in present study was lower as compared to the Recent Japanese [4], Japanese Contemporary [3], Varanasi zone [2], South African Whites [7] and Contemporary Croatia [5].

Comparison of distal epiphyseal breadth of female between present study and other studies has been shown in table: 2. Mean female distal epiphyseal breadth value in present study was 3.63 cm (right) & 3.61 cm (left) while in other studies it varied from 4.08 cm to 4.94 cm. Mean female distal epiphyseal breadth of tibiae on both side in present study was lower as compared to the Recent Japanese [4], Japanese Contemporary [3], Varanasi zone [2], South African Whites [7] and Contemporary Croatia [5].

Table 1 and Table 2 showed most marked difference between the present study and other studies, which is the low percentage of correct sexual classification in present study. This could be explained on the basis of statistical method applied. While most of the studies referred above were based on multivariate analysis, present study had used the demarking point analysis. Percentage of correctly sexed bone dropped down sharply with the statistically calculated demarking points but 100% classification accuracy is achieved for any sample from the region which is very useful in medico legal cases [11]. The Demarking point

analysis is also easy to work out as compared to multivariate analysis.

CONCLUSION

Mean values of distal epiphyseal breadth in Gujarat region for male were 3.98 cm (right) & 3.94 cm (Left); and for female were 3.63 cm (Right) & 3.61 cm (left). In the study population, the right sided tibia with distal epiphyseal breadth more than 4.85 cm can be definitely identified as a male and less than 2.71 cm can be definitely identified as a female; while on the left side, tibia with distal epiphyseal breadth more than 4.69 cm can be definitely identified as a male and less than 2.86 cm can be definitely identified as a female.

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