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Sexual Dimorphism of proximal epiphyseal breadth of tibia

Dangar K P [a], Pandya A M [b*], Rathod S P [c], Tank KC [d], Akbari VJ[e], Solanki S V [f]

[a,d] Department of anatomy, M. P. Shah Medical College, Jamnagar, Gujarat, India
[*b, e] Department of anatomy, P. D. U. Medical College, Rajkot, Gujarat, India
[c]Department of anatomy, Govt Medical College, Bhavnagar, Gujarat, India
[f] Department of anatomy, B. J. Medical College, Ahmedabad, Gujarat, India

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ABSTRACT

Sexual identification from the skeleton or its parts is very vital medico-legally and anthropologically. Present study aims to obtain values of proximal epiphyseal breadth of tibia and to estimate its role in determining correct sexual identification. Study was carried out on 194 dry, normal, adult, human tibiae (106 male & 88 female) at Anatomy department, P.D.U medical college, Rajkot Gujarat (India). Proximal epiphyseal breadth was measured by noting maximum distance between outer most points on the lateral and medial tibial condyles with sliding caliper in centimeter. Mean values obtained were 7.12 cm & 6.29 cm for right male & female and 7.08cm & 6.31cm for left male and female respectively. Higher values in male were statistically highly significant (P< 0.001) on both sides. Demarking point (D.P.) analysis of the data showed that right tibia with proximal epiphyseal breadth more than 7.87 were definitely male and less than 5.04 were definitely female; while for left bones, tibia with proximal epiphyseal breadth more than 8.14 were definitely male and less than 5.34 were definitely female. Proximal epiphyseal breadth identified 2.27% of right female tibiae. It was not useful for right male bones or for left bones.

1. Introduction

Forensic experts have long recognized the importance of osteological measurement that provide a reliable means of sexing human remains .The determination of sex from skeletal remains is of enormous medico-legal and anthropological importance. Nonmetrical methods such as the visual inspection of bone morphology depend entirely on the ability and experience of an observer. Metrical methods for sexing from bone in addition to providing simplicity also allow no individual variations and are entirely objective assessment.

Sex determination is relatively easy if the entire skeleton is available, pelvis and skull are the most reliable bones for this purpose [1]. However, in medico-legal cases one does not always have a complete pelvis or skull. Therefore it is important to be able to assess sex from the other parts of the skeleton also.

Sexual dimorphism of proximal epiphyseal breadth is studied by few workers in different population [2-6].

According to Krogman and Iscan [1], standards of morphological and morphometric attributes in the skeleton may differ with the population samples involved and this is true with reference to dimensions and indices (average and range) and as a general rule standards should be used with reference to group from which they are drawn and upon which they are based they are not interchangeable.

So, present study was carried out to ascertain sexual dimorphism of proximal epiphyseal breadth & develop appropriate standards for determining a sex from the tibia in Gujarat region.

2. Material and Method:

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 of P.D.U medical college Rajkot Gujarat. Tibiae showing pathological abnormality or from the persons outside Gujarat region were not included in study.

* Corresponding Author : Dr. Ashish M. Pandya
  Asst Prof., Anatomy, P.D.U. medical College
  Rajkot, Gujarat, 360001, INDIA
  Email:ashishmpandya@gmail.com
  Cell: 9426239635

Maximum distance between outer most points on the lateral and medial tibial condyles was measured by help of sliding caliper in centimeter [7] (Photo 1). 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 & sexwise by demarking point (D.P.) analysis

3. Results

a).Right tibia: As shown in table 1, the proximal epiphyseal breadth of right male tibia varied from 6.5cm to 7.8cm (mean: 7.12 & S.D:0.25) and of right female tibia varied from 4.7cm to 7.1cm (mean: 6.29 & S.D.:0.41).Mean value of proximal epiphyseal breadth was higher in male as compared to female. Calculated t-value and P value showed that the difference in the proximal epiphyseal breadth in male and female was statistically highly significant with $P < 0.001$.

By demarking points, definite sexual classification in male right bone (>7.87) was 0.00 %(no=0) and in female right bone (<5.04) was 2.27% (no=1).

b).Left tibia: The proximal epiphyseal breadth of left male tibia varied from 6.0cm to 7.8cm (average: 7.08 & S.D.:0.35) And of left female tibia varied from 5.3cm to 7.0cm (average: 6.31 & S.D.:032). (Table 1)

Table: 1 Statistical values of the proximal epiphyseal breadth of the tibia (all dimensions in cm)

| Statistical value | Right | | Left | |
	Male n=53	Female n=44	Male n=53	Female n=44
Range	6.5-7.8	4.7-7.1	6.0-7.8	5.3-7.0
Mean	7.12	6.29	7.08	6.31
S.D	0.25	0.41	0.35	0.32
t value	12.43			11.67
p value	<0.001			<0.001
Calculated Range mean±3S.D.	7.87-6.36	7.53-5.04	8.14-6.01	7.28-5.34
Demarking Points(D.P)	>7.87	<5.04	>8.14	<5.34
% & no. identified by D.P.	0.00% no=0	2.27% n=1	0.00%no=0	0.00% no=0

Table 2: Comparison of proximal epiphyseal breadths in male

| Population & Study | | Proximal epiphyseal breadth | | |
		Mean	S.D.	% Identified
Kazuhiro sakaue		7.45	3.15	94%
Recent Japanese Iscan M Y et al		7.35	2.78	93.2%
Japanese M Iscan & Maryan steyn, south African whites		7.91	4.88	83.9%
Kieser J A et al	Caucasoid	7.47	2.73	94%
	Negroid	7.36	3.08	92%
G.Singh et al, Varanasi zone	R	7.25	0.364	9%
	L	7.33	0.273	19%
Present study	R	7.12	0.25	0.00%
	L	7.08	0.35	0.00%

Table 3: comparison of proximal epiphyseal breadths in female

Population & Study		Proximal epiphyseal breadth		
		Female		
		Mean	S.D.	% Identified
Kazuhiro sakaue Recent Japanese		6.58	2.77	94%
Iscan M Y et al Japanese		6.58	4.68	79.4%
M Iscan & Maryan steyn, south African whites		6.98	3.65	90%
Kieser J A et al	Caucasoid	6.61	2.96	92%
	Negroid	6.56	3.24	84.62%
G.Singh et al, Varanasi zone	R	6.33	0.45	32%
	L	6.44	0.41	44%
Present study	R	6.29	0.41	2.27%
	L	6.31	0.32	0.00%

Photo 1 Measurement of proximal Epiphyseal breadth of tibia

Mean value of proximal epiphyseal breadth was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean proximal epiphyseal breadth in male and female was statistically highly significant with P<0.001.

By demarking points, definite sexual classification in male left bone (>8.14) was 0.00 % (no=0) and in female left bone (<5.34) was 0.00% (no=0). Differences in the proximal epiphyseal breadth value between right & left male and left male & female were not spastically significant, so were not evaluated further.

4. Discussion

Mean value of proximal epiphyseal breadth was higher in male as compared to female. Calculated t-value and P value showed that the difference in the mean proximal epiphyseal breadth in male and female was highly statistically significant with P < 0.001 on both side.

For right male bone calculated range(mean±3SD) was 6.36 - 7.87 and for right female bone 5.04-7.53.With help of these demarking points right tibia with proximal epiphyseal breadth more than 7.87 can be correctly classified as a male and right tibia with proximal epiphyseal breadth less than 5.04 can be correctly classified as a female. However if the proximal epiphyseal breadth of bone is between 5.04cm and 7.87cm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male right bone (>7.87) was 0.00 %(no=0) and in female right bone (<5.04) was 2.27% (no=1).

For left male bone calculated range was 6.01 to 8.14cm and for left female bone it was from 5.34cm to7.28cm. So, left tibia with proximal epiphyseal breadth more than 8.14cm can be correctly classified as a male and left tibia with proximal epiphyseal breadth less than 5.34cm can be correctly classified as a female. However if the proximal epiphyseal breadth is between 5.34 cm and 8.14 cm, sexing was not possible due to overlapping. With the demarking points, definite sexual classification in male left bone (>8.14) was 0.00 % and in female left bone (<5.34) was 0 %.

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 proximal epiphyseal breadth of male between present study and other studies has been shown in table: 2. Mean

of male proximal epiphyseal breadth value in present study was 7.12 (right) & 7.08 (left). In other studies it varied from 7.25 to 7.91.Mean value of proximal epiphyseal breadth in male on both side tibiae in present study was lowest as compare to the other populations

Evaluation of proximal epiphyseal breadth of female between present study and other studies has been shown in table: 3. Mean of female proximal epiphyseal breadth value in present study was 6.29 (right) & 6.31(left). In other studies it varied from 6.33 to 6.98. Mean female value of proximal epiphyseal breadth in present study was lower on both sides as compare to the recent Japanese [4], Japanese contempory [3], and South African whites [9]. While values were similar to results obtained from Varanasi zone [2]This difference in mean proximal epiphyseal breadth in between populations may possibly be a result of factors affecting bone morphology like genetic constitution, diet, nutrition status, environment and physical activity.

Table: 2 and Table: 3 revealed that 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 medicolegal cases [10]. The D.P.s are also easy to work out as compared to multivatiate analysis.

5. Conclusion

Mean values of proximal epiphyseal breadth normal human adult tibiae in Gujarat region, in male were 7.12cm (right) & 7.08cm (Left) and for female were 6.29 cm (Right) & 6.31 cm (left). It identified 2.27% of right female tibiae. It was not useful for male bones or for left female bones.

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