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Evaluation of Sexual Dimorphism in Eastern India: A Comparative Analysis

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ABSTRACT

Background: Sex determination is a relatively convenient method if the entire skeleton is available, of which pelvis and skull are more reliable bones to be used for this purpose. Considering from medico legal point of view one does not always have a complete pelvis or skull, hence it is important to be able to assess sex from the other parts of the skeleton also .Out of all long bone, the femur received a special attention by the researchers. **Aim:** 1. To study the sexual differences between male and female femora. 2. To study the accuracy of various parameters and measurements in identifying the sex of the femur. **Methods:** Study design: A cross sectional study was conducted at Community Health Centre Jatni, Khordha, Odisha in the department of Anatomy SCB Medical College, Cuttack. Period of Study: 2019-20. Inclusive criteria: Undamaged, dried Non pathological 100 dried femora of both sexes and sides were available in the Department of Anatomy. Exclusive Criteria: Fractured bones, deformed bones, unclear bony landmarks. Since the femur is a long and stout bone, measurements of its different parameters can be taken for determination of the sex of the individual to whom it belonged to and is of importance for medico legal purpose especially for identification of the individual. The present study was conducted on 90 adult human femora. **Results:** Maximum length (ML),Proximal Breadth (PB), Transverse Diameter of Head(TDH),Vertical Diameter of Head(VDH),APDMC, APDLC were reported to be more in males in comparison to females and this was found to be statistically significant. ML and EB has the highest matrix of 0.656 and 0.659 respectively which is followed by APDLC, VDH, VDN and PB. Logistic regression for all parameters when done to confirm the results it was found that EB was significant with Odds ratio of 1.416 which states that EB is 1.416 times higher in males than in males. The results of our study predict that femur from the eastern Indian population is a good sex predictor with accuracy reaching 94%.**Conclusion:** The results of our study predict that femur length and breadth from the eastern Indian population is a good sex predictor with accuracy reaching 94%..

Keywords: Sexual, Dimorphism, femur.

INTRODUCTION

The determination of sex from the skeletal remains, especially from isolated long bones or its fragments is of paramount importance to the forensic experts.[1] But if the entire skeleton is available then the task of determination of sex for identification of an individual becomes easier, otherwise it is a great challenge for the Anthropologists as well as the forensic investigators.[2] Apart from the skull and pelvis having the highest reliability, the femur which is a long and stout bone is a better parameter as it takes more time to decay.

According to Noble P C, in total Hip Arthroplasty, it is mandatory that the design, align and dimensions of femoral component should match the anatomy of the proximal femur.[3] If the implant is not in proper alignment then dislocation and implant fractures are encountered.[4] According to Krogman (1962),[5] when a whole skeleton was taken into account the accuracy of determination of sex was found to be 100%, and it was upto 98% when both skull and pelvis were taken, 95% with pelvis alone, 90% with only skull and finally was upto 80% with the long bones. However even when the skull and pelvis are found to have the highest reliability, the femur which is a long and stout bone is a better parameter as it takes more time to decay.[6]

Sexual dimorphism of the femur has been studied in different population groups and with diversifying results.[7] Due to its strength and robustness it resists the normal wear and tear of environmental conditions and also damage due to animals.[8] Now it is seen that even though sexual dimorphism can be determined by morphological methods such as the visual inspection of the bones but metrical methods are much better as the non symetrical methods depend largely on the experience of the expert observer. So metrical methods which are

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simple are used as they do not allow any individual variation and are entirely objective in nature.[9]

The present work was an attempt to establish certain very relevant parameters suitable for the population in eastern Odisha, in order to determine and differentiate the sex of an individual, which will be of utmost help to the medicolegal and anthropological experts. Various dimensions of the femoral head in both sexes will not only help the anatomists and forensic experts in determination of the sex of the femora but will also be of immense importance in prosthesis of femoral head which may be used by the orthopaedic surgeons in femoral head replacement surgery.

Aims & objectives:

1. To study the sexual differences between male and female femora.
2. To study the accuracy of various parameters and measurements in identifying the sex of the femur.

MATERIALS AND METHODS

A cross sectional study was conducted in Department of Anatomy, S.C.B. Medical College, Cuttack, during the year 2019-20. The material used for the study contained 100 human femora of unknown sex obtained from Anatomy Department of S.C.B. Medical College, Cuttack, Odisha. The instruments used are metal sliding caliper and osteometric board which was used to measure the maximum length of femur and anterioposterior diameter of upper, middle and lower shaft of femur were measured.

Vertical diameter of head (VDH);
Straight length between the highest and deepest points of the head, for this sliding caliper is used.

Maximum Length (ML): Highest distance between the highest point of the head and the deepest point on the lateral medial condyle.

Proximal Length (PB): Distance from most medially placed point on the head to the most laterally placed point on great trochanter.

Transverse diameter of head (TDH)
Straight distance between the most laterally projected points on the equatorial plane taken at right angle to the vertical diameter, sliding calliper is used for this measurement.

Epicondylar breadth (EB)
Distance between the most projected points on the epicondyles (lateral and medial), for this Osteometric board is used.

Anteroposterior diameter of lateral condyle (APDLC): Projected distance between the most posterior point on the lateral condyle and the lateral lip of the patellar surface taken perpendicular to the axis of the shaft.

Antero-posterior diameter of medial condyle (APDMC): Projected distance between the posterior point on the medial condyle and the medial lip of the patellar surface taken perpendicular to the axis of the shaft.

Neck shaft angle:
Angle made by axis of shaft with the axis of the upper anterior column. Axis of column is determined by means of a thread which divides the anterior surface of the column in two equal halves. Axis of the shaft is determined by a thread which extends in the mid sagittal plane over the anterior surface of the bone from the upper end of the oblique line of the condyle.

ML, PB, APDLC, APDMC were measured using osteometric board and also by using digital sliding calipers the parameters are used.

Statistical analysis:
The data was entered in SPSS 21 and analysed with appropriate statistical tests.

RESULTS

Table 1: Sexwise Different Parameters of Femora.

Different Variables of Femur (in mm)	Male (N=65)	Female (N=35)	P value
Maximum Length	413.23±14.18	399.15±11.14	P< 0.001
Proximal breadth	76.19±2.18	72.14±3.41	
Vertical Diameter of neck	28.15±4.15	24.14±3.11	
Epicondylar Breadth	72.16±6.17	70.12±3.14	
Vertical diameter of Head	29.31±2.17	27.15±1.24	
Transverse Diameter of head	35.18±2.45	32.26±2.23	
Anteroposterior diameter of Lateral Condyle (APDLC)	57.41±4.45	53.91±4.01	
Anteroposterior diameter of Medial Condyle (APDMC)	55.31±3.61	51.14±2.18	

Table 2: Multivariate discriminant function and sectioning points analysis for Different parameters of femur

Variable	Unstandardised coefficients	Discriminant function Coefficient	Centroids in Male Gp	Centroids in Female Gp	% identified
Maximum length	0.086	12.231	0.432	0.478	90
APDMC	0.213	10.956			79
APDLC	0.204	11.432			89
EB	0.289	12.432			85
VDN	0.101	10.713			82
TDH	0.206	13.243			83
VDH	0.06	11.145			8485
PB	0.013	14.541			

DISCUSSION

[Table 1] Shows that the variables in femora was less in females than in males. Sex determination was done using various indices and different measurements. Maximum length (ML),Proximal Breadth (PB), Transverse Diameter of Head (TDH), Vertical Diameter of Head (VDH), APDMC, APDLC were reported to be more in males in comparison to females and this was found to be statistically significant.

Mean Value of maximum length in males was higher than that of females, it is also noted that from the t-Value and p-Values the difference in mean length in males and females was found to be statistically significant with $p < 0.001$ on both sides (right and left). Generally it is found that male bones are longer and massive for which there occurs greater value of mean of maximum femoral length in male on both sides. Bhosale et al in a study conducted found the calculated range for femora length was 385.83-476.80 mm and for left female femora it was between 356.49-484.39 mm. The mean for maximum femoral length in present study was 450.82 mm (right) and 452.37 mm (Left). The mean maximum length in present study was higher than Thai 13 and Chinese 14 femora and lower than Americans. According to Alan M W Proter discriminative analysis confirmed that male femur usually larger than the female femur.[15] In the study of Yasar Iscan M distal epicondylar breadth, maximum length and anteriopostero diameter of midshaft gives 92.3% classification accuracy, distal epicondylar breadth alone proved 94.9% of accuracy.[16]

[Table 2] Shows that ML and EB has the highest matrix of 0.656 and 0.659 respectively which is followed by APDLC, VDH, VDN and PB. Logistic regression for all parameters when done to confirm the results it was found that EB was significant with Odds ratio of 1.416 which states that EB is 1.416 times higher in males than in males. The Axial skeleton in males is heavier than in females. Moreover the articular and muscular impressions are more. EB is the best parameter for sex determination which can be correlated with other data.[17]

CONCLUSION

Breadth and length of femur contribute to sexual dimorphism. The results of our study predict that in eastern Indian population,it is a good sex predictor with accuracy reaching 94%.

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