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Bilateral Variation in Various Indices of Femur

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ABSTRACT

Background: Physical Anthropology provides scientific method and technique for taking various measurements in different geographic regions and races. The femur itself is a complex anatomic unit so anthropometric study was devised on the same. **Aims & Objectives:** The study was aimed at determining measurements for obtaining Platymeric index, Robusticity index and Foraminal index for both right and left femur. **Material & Methods**: In the present study 106 (58 right and 48 left) intact adult femora were obtained from the bone bank of Anatomy Department of MGIMS, Sevagram. For this purpose a sliding caliper and osteometric board were used. **Results**: The Physiological Length of left femur came out to be 42.95 ± 1.67 cms and 42.69 ± 1.94 for right femur. Similarly Robusticity index was 14.44 ± 1.23 and 13.11 ± 0.93 for left and right femur respectively. The platymeric index for left and right femur came out to be 87.63 ± 7.34 and 86.49 ± 6.77 respectively. Whereas Foraminal index was between 33- 62% for left femur and between 31-61% for right femur when calculated from proximal end. Similarly number of nutrient foramina ranges from increasing frequency of single, double and triple foramina for left femur and in the increasing frequency of single, double and triple foramina per bone in right femur. **Conclusion:** Comparison of various indices in right and left femora has shown statistically insignificant but left one has shown higher values as compare to their right counterparts. The findings observed are of immense utility for medico legal experts. The details of data obtained with relevant review of literature will be discussed.

Keywords: Physical anthropology, Femur, Platymeric index, Robusticity index, Foraminal index, bilateral variation.

INTRODUCTION

Forensic medicine is an interdisciplinary science which in everyday practice applies all the knowledge that medical sciences and basic sciences, have accepted as reliable and scientifically solid facts or processes, and qualitative and quantitative definitions with the help of which accurate and reliable statements can be made. Anthropometry is a series of systematized measuring techniques that express quantitatively the dimensions of the human body and skeleton. It is often viewed as a traditional and perhaps the basic tool of biological anthropology, but it has a long tradition of use in forensic sciences and forensic medicine. The significance and importance of somatometry,

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cephalometry, craniometry and osteometry in the identification of human remains have been described and a new term of 'forensic anthropometry' is coined. The ultimate aim of using anthropometry and knowledge of human anatomy in forensic medicine/science is to help the law enforcement agencies in achieving 'personal identity' in case of unknown human remains.

By considering the importance of personal identity we have selected the human bone femur to study the bilateral variation in various indices of femur. The morphology and statistical analysis of femoral anthropometry among different populations reveals a great degree of variation. Femoral anthropometric measurements from different countries are likely to be affected by racial variations in diet, heredity, climate and other geographical factors related to life style**.** Similarly bilateral variation is also expected to occur owing to profession, habits etc. We took this study to know the bilateral differences between the right and the left bones among the population of this part of Maharashtra.

MATERIALS AND METHODS

A total 106 (58 right and 48 left) intact human adult femora were obtained from the department of Anatomy, MGIMS, Sevagram which were collected for teaching purpose. The study is based on a total of 07 parametric variables related to the femur and which were obtained from the head and shaft of the femur according to standard anthropometrical method.[1, 2] The number of nutrient foramina and their location in respect to the proximal end of femur on both sides were studied.

Instruments Used: Sliding Caliper, Osteometric Board

Formulae Utilized:

Fig. I. Figure showing measurement of Physiological Length

Sagittal Diameter of Middle of Shaft: It measures the distance between the anterior and posterior surfaces of the bone, approximately at the middle of the Shaft i.e., the most prominent part of the linea aspera or two points farthest apart in sagittal plane at mid-shaft

Transverse Diameter of Middle of Shaft: It measures the distance between the margins of the bone at right angle to sagittal diameter of the middle of the shaft or two points farthest apart in coronal plane at mid-shaft.

Physiological Length / Oblique Length (PL): It measures the projective distance between the highest point of the head and the tangent to the lower surface of the two condyles. (Figure I.)

Platymeric Index: This index measures the degree of antero-posterior flattening of the femoral shaft. It is calculated as shown in the following formula-

$$\text{Robusticity Index} = \frac{\text{Sagittal Diameter of Middle of Shaft + Transverse Diameter of Middle of Shaft}}{\text{Physiological Length}} \times 100$$

Platymeric Index (PI) =

Upper Sagittal Diameter of Shaft / Upper Transverse Diameter of Shaft X 100

Upper Transverse diameter of shaft / Subtrochanteric Sagittal Diameter: It measures the transverse diameter of the upper end of the shaft, where it shows maximum lateral projection. When the projection is not clear, this measurement is taken 2.5cm below of the base of lesser trochanter. Transverse plane is to be understood with regard to upper epiphysis.

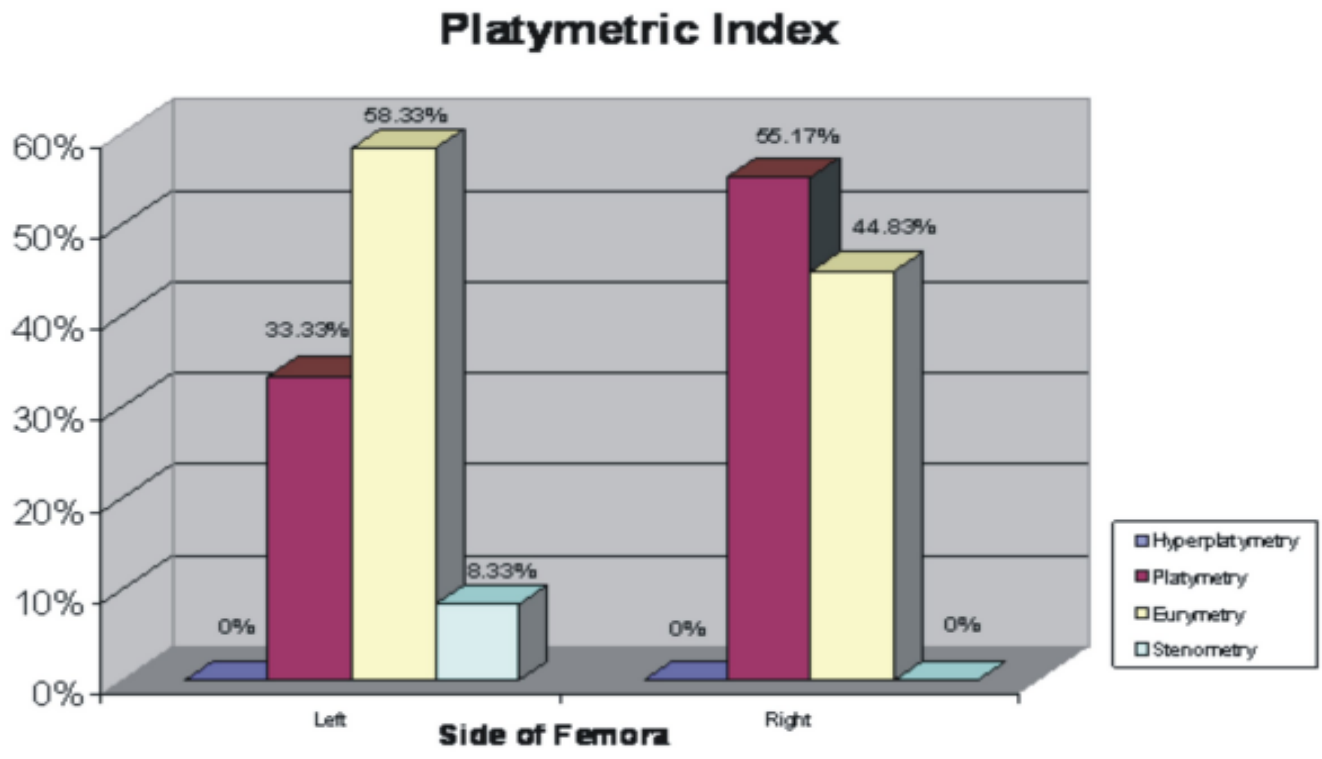
Upper Sagittal Diameter of Shaft: It measures the antero-posterior diameter of the upper shaft taken at right angle to the upper transverse diameter of shaft.

The level of "platymetry" (flattening of the superior femoral diaphysis) was divided into 4 groups in relation to the PI: hyperplatymetry, platymetry eurymetry and stenometry[3]as shown in Table I.

OBSERVATIONS

With the aid of caliper and osteometric board various measurements were done. Physiological length, Robusticity index, Platymeric index and foraminal indices are shown in Table II. Numbers of foramina seen are shown in Table III of both the sides of femur. The difference between right and left femur is not statistically significant but left one has shown higher values as compare to their right counterparts. The Physiological Length of left femur came out to be 42.95 ± 1.67 cms and 42.69 ± 1.94 for right femur. Similarly Robusticity index was 14.44 ± 1.23 and 13.11 ± 0.93 for left and right femur respectively. The platymeric index for left and right femur came out to be 87.63 ± 7.34 and 86.49 ± 6.77 respectively. Whereas Foraminal index was between 33 to 62% for left femur when calculated from proximal end and between 31 to 61% for right femur.

Figure II. Figure showing platymeric index observed in femur of both sides



Similarly number of nutrient foramina ranges from increasing frequency of double, single and triple foramina for left femur and in the increasing frequency of single, double and triple foramina per bone in right femur.

Levels of Platymery are also shown graphically in Figure II.

DISCUSSION

The left femora were generally showed larger values than the right, but the difference was statistically insignificant and in accordance with those of previous study.[4]

Femoral anthropometry from the two different sides revealed slight variations that are likely to be the result of compounding factors such as nature of work, mode of life, metabolic status, continuous modifications that may affect the characteristics of man and the effects of civilization on the composition of the human body in both positive and negative ways.

None of the femora in the present study has shown more than three foramina which correspond to earlier work[5] and also not in accordance with [6] who have shown even 4 foramina also.

The means of the PL measurement of the femora indicated that Central Indian individuals have retained medium femora when compared with those from other data available.[6] It seems obvious that anthropometric measurements could show differences between various populations from different ages, and these may considered to be constantly updated.

In the present study, the absence of any records that could help us in the determination of the sex of bones was the main obstacle to include. However, it should be kept in mind that the present study and the previous studies have a small number of femora it is worthwhile to perform a similar further study with a large number of bones from different regions.

CONCLUSION

The femur has been studied successfully by physical anthropologists for many years. Such traits as femoral head diameter and bicondylar width have been examined extensively and are of great value to forensic anthropologists. The findings are of immense utility for medicolegal experts. The observations made can be utilized in cases of exhumation and unidentified remains of bones. This study is also relevant to fracture treatment. The findings can also be useful in

Table I. Showing levels of platymetry

S No.	Flattening of superior Femoral diaphysis	PI range (min-max)
1.	Hyperplatymetry	Less than 75.0
2.	Platymetry	75.0–84.9
3.	Eurymetry	85.0–99.9
4.	Stenometry (transverse platymetry)	100.0 and more

Table II. Showing various measurements observed.

S.N	Indices	Left Femur (cms)	Right Femur (cms)	P value
1.	Physiological Length	42.95 ± 1.67	42.69 ± 1.94	P>0.05
2.	Robusticity Index	14.44 ± 1.23	13.11 ± 0.93	P>0.05
3.	Platymetric Index	87.63 ± 7.34	86.49 ± 6.77	P>0.05
4.	Foraminal Index*	Between 33 to 62%	Between 31 to 61%	

*Position of Nutrient Foramina in relation to proximal end.

Table III. Showing number of nutrient foramina seen in femur of both sides

S.No.	Number of Foramina	Left Femur (n=48)	Right Femur (n=58)
1.	Single	19 (39.6%)	29 (50%)
2.	Double	26 (54.2%)	24 (41.4%)
3.	Triple	03 (6.3%)	05 (8.6%)

intramedullary reaming and nailing of long bone in case of correction of fractures particularly in the weight bearing femur.

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