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ROBUSTICITY AND PLATYMERIC INDICES OF HUMAN FEMORA

Dr. Shashikant Kiragi [1*], Dr. Venkateshu Kodinahalli Venkatappa [2]

[1] Assistant Professor, Sri Siddhartha Institute of Medical Sciences T. Begur Nelamangala, Bangaluru Rural Dist.

Email Id: krgsasi@gmail.com

[2] Professor, Sri Devaraj Urs Medical College, Kolar.

Email Id: venkkodi1991@gmail.com

Corresponding Author: Dr. Shashikant Kiragi, Assistant Professor, Sri Siddhartha Institute of Medical Sciences T. Begur Nelamangala, Bangaluru Rural Dist.

Email Id: krgsasi@gmail.com

ABSTRACT:

Introduction: Anthropometry provides scientific method and technique for taking various measurements in different geographic regions and races. The morphology of femur itself is a complex anatomic unit which requires more studies, so anthropometric study was devised on the same.

Aim of the study; To obtain and study the Platymeric Index (PI), Robusticity Index (RI) and Foraminal Index (FI) for both right and left femur**.**

Materials and Methods: In the present study 100 (54 right and 46 left) intact adult femora were obtained from the Anatomy Department of SDUMC, Kolar. By using sliding caliper and osteometric board the following measurements were obtained: Physiological length (PL), Upper SD, TD, Middle SD and TD of the shafts of both femur.

Results: The mean & standard deviations of PL in right femur 43.32± 3.18 & left femur is 43.01± 3.07, RI in right16.44 ± 1.23 & left femora is 16.40 ± 0.93 PI in right is 86.86 ± 13.51 and left 83.62 ± 12.65 FI in right is1.70 to 41% and in left is 0.78 to 36.6%.

Conclusion: These measurements may help to indicate the characteristic morphological features of femoral segments in Kolar region and assist the orthopedic surgeon to place various implants in the reconstruction of femoral fragments and for designing the prosthesis and plates for hip joint reconstructive surgeries.

Keywords: Anthropometry, Femur, Orthopedic Surgeons, Hip Joint, Prosthesis & Implants.

INTRODUCTION:

Femoral anthropometric measurements are different in different countries due to racial distinctions in diet, heredity, climate, and other geographical factors related to life style.[1] Genetics along with epigenetics influences the bone forming process and morphology due to this there will be impact on skeletal robusticity**.**[2] So the femoral anthropometry among diverse populations discloses a great extent of discrepancy. Bones like femur and tibia make maximum share of the physique so measurements of these bones are more accurate than upper limb bones. The femoral and tibial measurements in stature estimation also find useful for forensic anthropologists and clinicians in the treatment of proximal and distal part of femur fractures.[3] The aim of the study was to determine the Platymeric Index (PI), Robusticity Index (RI) and Foraminal Index (FI) in femora of the Kolar region. The objectives were to evaluate the morphometry of the femora of Kolar region of South India and to estimate the bilateral differences between the right and left femora.

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MATERIALS AND METHODS:

Study Material: In this study total 100 (54 right and 46 left) intact human adult femora of unidentified sex and age were studied from skeletal collections at the Anatomy museum of Sri Devaraj Urs Medical College, Kolar.

Study Area: Sri Devaraj Urs Medical College, Kolar. In this study, a total 07 parametric variables were measured.
Exclusion Criteria: The pathological femurs, deformity (fracture), variations, unossified/ incomplete ossified femurs were excluded from the study.
Inclusion Criteria: All human adult femora were included.

Methodology: The instruments used were Sliding Vernier Caliper and Osteometric Board to measure following measurements. Sagittal Diameter of Middle of Shaft, Transverse Diameter of Middle of Shaft, Physiological Length / Oblique Length, Subtrochanteric Sagittal Diameter, Upper Sagittal Diameter of shaft were observed, Number of nutrient foramen present, Distance from the proximal end of the femur to the nutrient foramen and following formulae were also used to calculate the following indices. [4] Two observers done the measurements separately and the average of the two observations taken to reduce the errors.
1) 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
2) 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.
3) Physiological Length (PL)/ Oblique Length: It measures the projective distance between the highest point of the head and the tangent to the lower surface of the two condyles.
Formulae for calculation:

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

4).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 the base of lesser trochanter. Transverse plane is to be understood with regard to upper epiphysis.
5).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.

$$\text{Platymeric Index (PI)} = \frac{\text{Upper Sagittal Diameter of Shaft}}{\text{Upper Transverse Diameter of Shaft}} \times 100$$

6) No of Nutrient Foramen seen
7) The distance from the proximal end of the bone to the nutrient foramen

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$$\textbf{Foraminal index (FI)} = \frac{\textit{Distance from proximal end of the bone to nutrient foramen}}{\textit{Physiological Length}} \times 100$$

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

Table I : Standard ranges of platymetry

S.No	Flattening of superior No. 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 100.0 and more)

RESULTS:

The following right and left femoral measurements Physiological length, Robusticity index, Platymeric index and Foraminal indices are shown in Table II. Numbers of foramina are shown in Table III.

Table II : Showing PL, RI, PI, FI measurements of Right and left Femora with P Value

S.No	Indices	Right Femur(cms)	Left Femur (cms)	P value
1	Physiological Length	43.32± 3.18	43.01± 3.07	P>0.05
2.	Robusticity Index	16.44 ± 1.23	16.40 ± 0.93	P>0.05
3	Platymetric Index	86.86 ± 13.51	83.62 ± 12.65	P>0.05
4.	Foraminal Index	1.70 to 41%	0.78 to 36.6%	P>0.05

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

S.No.	Number of Foramina	Right Femur (n=54)	Left Femur (n=46)	Total no of femora (n=100) %
1.	Single	29(53.7%)	29(63%)	58%
2.	Double	23 (42.59%)	16 (34.78%)	39%
3.	Triple	02 (3.7%)	nil	02%
4.	Quadraple	nil	1(2.17%)	01%

Statistical evaluation

The data collected coded and entered into an excel format. All the quantitative measures were expressed by Mean, SD & qualitative measures by proportions. Independent student t test was the test of significance to compare the mean differences. (SPSS 22 version software).The difference between right and left femur is not statistically significant.

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Table IV: Comparison of PL, RI, PI from other studies to our study results

Sl No	Author & Year	PL,RI,PI	Measurements of Right & left Femora	
1	P Bokariya et al .2009 Sevagram,Wardha(Maharashtra)		Rt (58)	Lt(48)
		PL	42.69±1.94	42.95±1.67
		RI	13.11±0.93	14.44±1.23
		PI	86.49±6.77	87.63±7.34
2	Shakil Md Khan et al. 2014	(250)	Rt	Lt
	Davanagere, (Karnataka)	PL	43.98±2.15	44.15±2.35
		RI	14.34±1.21	15.26±1.17
		PI	86.32±6.15	85.70±6.35
3	Datta M et al . 2016		Rt (36)	Lt(24)
	Kolkata, (West Bengal).	PL	41.85±3.34	42.44±2.87
		RI	12.36±0.99	12.5±0.83
		PI	93.94±14.94	89.76±9.57
4	Ravi G O et al . 2016		Rt (281)	Lt(311)
	Davanagere (Karnataka)	PL	447.9±28.72	446.2±29.12
5	**Our Study Results**		Rt (54)	Lt(46)
		PL	43.32±3.18	43.01±3.07
		RI	16.44±1.23	16.40±0.93
		PI	86.86±13.51	83.62±12.65

DISCUSSION:

In present study, both the right and left femora showed statistically similar mean values of the lengths. Although the right femora showed greater values than the left, had same value of right femora of previous study by Bokariya et al.[1] The values of PL, RI, PI of both femora are coinciding but with slight changes in measurements of Datta, Khan, Khaleel, Bokariya, Strecker [4,5,6,1,7] but in our study right femur measurements are more than left. The alterations in femoral anthropometry of right & left femora are due to compounding effects such as mode of work, life style, genetic factors, epigenetic factors continuous modifications that may affect the characteristics of man and added to that the effects of civilization on the composition of the human skeletal system. [1]

Both right and left femora having single foramen are equal in number. Double foramina is more in the right femur (42.6%) than left (35%). Triple foramina seen only in the right femur of 3.7%. Only 1 left femur has shown four foramina this matches with Longia study. [8] Our data of triple foramina only is matching with the Datta, Longia and Pereira studies.[4,8,9] None of the femora has absence of nutrient foramen in our study. The single foramen in both femora was 58% which is similar to the study of Datta and Campos studies.[4,10]

The means of the PL measurement of the femora indicated that south Indian individuals have retained medium femora when compared with those from other data available, explained in table IV. The values of our study are significant, but if compared to right and left not statistically variant. So if compared between male and female, it may be added more to data.

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CONCLUSION:

The findings can be useful in intramedullary reaming and nailing of long bone in case of correction of fractures particularly in the weight bearing femur. However, it should be kept in mind that the present study and the previous studies have included small number of femora and though the results showed significant differences, it is worthwhile to perform a similar further study with a large number of bones from different age groups and from diverse population of India. We believe that the present study has provided additional information on this subject and these data might be useful to the clinicians who are involved in the diagnosis. The measurements may help to indicate the characteristic morphological features of femoral segments in south Indian population and also help the orthopedic surgeon to use various implants in the reconstruction of femoral fragments. These parameters can be used for designing the prosthesis and plates for hip joint reconstructive surgeries. There are very less studies like our study. This knowledge will helpful in anthropological and medico-legal practice for sex determination and as well as to radiologists, rheumatologists and orthopedic surgeons for diagnosis and planning of treatment.

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CONFLICT OF INTEREST:

None has declared conflict of interest.

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