

A Descriptive Study Using Direct Morphometric Measurements of the Femoral Condyle to Assess Differences Between the Right and Left SidesPankaj Kumar¹, Radhika Raman², Amish Kumar³, Shambhu Prasad⁴¹Assistant Professor, Department of Anatomy, NMCH, Jamuhar, Sasaram²Assistant Professor, Department of Anatomy, DMCH, Laheriasarai, Darbhanga³Senior Resident, Department of Anatomy, NMCH, Jamuhar, Sasaram⁴Professor & Head, Department of Anatomy, NMCH, Jamuhar, Sasaram

Received: 14-02-2024 / Revised: 10-03-2024 / Accepted: 16-04-2024

Corresponding Author: Dr. Radhika Raman

Conflict of interest: Nil

Abstract**Background:** The femur is the long bone of the lower extremity, there are no published studies on the anthropometry of the distal femur in the Indian population. Hence the results obtained from this study would provide valuable data on the average dimensions of the distal femur which can serve as guidelines for designing a suitable femoral component of total knee prostheses for this population.**Methods:** After applying inclusion and exclusion criteria 41 dried femur of each side (total 82) of unknown age and sex will be selected for present study. The maximum anteroposterior distance & maximum transverse distance of lateral femoral condyle, maximum anteroposterior distance & maximum transverse distance of medial femoral condyle width was measured.**Results:** In the present study the mean AP diameter of the medial condyle on right side was 54.55±6.88 mm and on left side was 54.36±3.56 mm, The mean Transverse diameter of the medial condyle was 27.33±3.09 mm and 25.03±1.99 mm on right and left side respectively. In AP diameter parameters no statistically significant difference found between right and left side because p value was >.05 for both parameters. But in Transverse diameter parameters are statistically significant found between right and left side because p value was <.05.**Conclusion:** On comparison between right and left side measurements, no significant difference was found between values of parameters of right and left sided femur. This information will be useful to negate the need of side specific measurements for implant**Keywords:** Femur, left, Right.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

The lower limbs are the principle organ of locomotion and support the entire upper body weight. To fulfill both of these functions satisfactorily and for maintaining the strength and stability, bones of lower limb become more robust in comparison of upper limb and corresponding joints also become stronger and more stable.[1] The femur is the long bone of the lower extremity. It shows wide range of modifications in its architecture. Femur is susceptible to the functional hormonal disturbances in female, aging process and physical traumas which make femur fragile which account for its usual fractures and dislocations. The bone is highly vascular structure with unique features in its blood supply.[2] The distal end of femur has generous blood supply by branches of popliteal artery. It is so abundant that it seems unlikely for any fracture here could cause necrosis.[3] There are no published studies on the anthropometry of the distal femur in the Indian population. Hence the results obtained from this study

would provide valuable data on the average dimensions of the distal femur which can serve as guidelines for designing a suitable femoral component of total knee prostheses for this population.

Material and Methods

Descriptive type of observational study. Department of anatomy, Narayan Medical College and Hospital, Jamuhar Sasaram, Rohtas.

Study Design: Cross-sectional study. Sample size calculated at 95% confidence level and alpha-error of 0.05 expecting standard deviation of 3.17 mm in the mean inter condylar notch width of right and left side of femur as per result of seed article, To detect mean difference of at least 2mm in the mean intercondylar notch at the study power of 80% the required sample size would be 41 adult dry femur bone for each side.

Method

After applying inclusion and exclusion criteria 41 dried femur of each side (total 82) of unknown age and sex will be selected for present study. The bi-condylar width, maximum anteroposterior distance & maximum transverse distance of lateral femoral condyle, maximum anteroposterior distance & maximum transverse distance of medial femoral condyle and inter condylar notch width will be measured. All the measurements was performed by using digital vernier caliper. The femur will be clamped to facilitate the measurements.

The measurement will be taken by me on 3 occasions and the average of the 3 values will be taken as representative measure. The intra observer variation will be minimized by taking the measurement 3 times. The data will be tabulated and analyzed statistically.

Inclusion Criteria: Fully ossified Dried, intact bones of unknown sex and age.

Exclusion Criteria: Incomplete bone showing damage, bone deformity and gross pathological changes (like Arthritic changes).

Statistical Analysis: Statistical analysis was performed with the SPSS, version 21 for windows statistical software package (SPSS inc., Chicago, IL, USA). The categorical data was presented as numbers (percent) and were compared among groups using Chi square test. The quantitative data was presented as mean and standard deviation and were compared by student t-test. Probability was considered to be significant if less than 0.05.

Result

A total of 82 dry human cadaveric tibia used for present study, out of which 41 were from right side and 41 were from left side. Statistical analysis was carried out and obtained results of various parameters have been compared in tables and histograms accordingly. Following results were obtained-

Table 1: Lateral Condyle Anteroposterior Diameter (LC AP) in mm

	Right Side		Left Side	
	Mean	SD	Mean	SD
LC AP (in mm)	58.15	3.27	57.79	3.17
Median	58.42		57.36	
P value	0.579 (NS)			

Table 2: Lateral Condyle Transvers Diameter (LC T) in mm

	Right Side		Left Side	
	Mean	SD	Mean	SD
LC T(in mm)	28.53	2.92	28.63	3.23
Median	28.03		28.15	
P value	0.875 (NS)			

Table 3: Medial Condyle Antero Posterior Diameter (MC AP) in mm

	Right Side		Left Side	
	Mean	SD	Mean	SD
LC AP (in mm)	54.55	6.88	54.36	3.56
Median	56.49		54.70	
P value	0.872 (NS)			

Table 4: Medial Condyle Transvers Diameter MC T (in mm)

	Right Side		Left Side	
	Mean	SD	Mean	SD
MC T(in mm)	27.33	3.09	25.03	1.99
Median	27.87		25.13	
P value	P<0.001 (S)			

Discussion

Total knee arthroplasty and unicompartmental knee arthroplasty are both precision surgeries which require accuracy in the prosthesis sizing to ensure a successful outcome as well as long term survival of the same. Appropriate prosthetic design is essential to restore as much normal function in patients as possible post operatively. Insufficient tibial coverage can lead to tibial implant collapse because of the

load being transferred to cancellous bone instead of cortical bone. As most of the conventional prostheses available in the market are designed for Caucasians, Indians having smaller anatomical profiles would need smaller sized components of knee prosthesis. As there are no published studies on the morphometric measurements of the distal end of femur in the Bihar Population, the present study was carried out to measure various parameters of the distal end of femur which would provide data for sizing of tibial

component in UKA and TKA prosthesis in Bihar Population. In the present study the mean AP diameter of the medial condyle on right side was 54.55±6.88 mm and on left side was 54.36±3.56 mm. The mean Transverse diameter of the medial condyle was 27.33±3.09 mm and 25.03±1.99 mm on right and left side respectively. In AP diameter

parameters no statistically significant difference found between right and left side because p value was >0.05 for both parameters. But in Transverse diameter parameters are statistically significant found between right and left side because p value was <0.05.

Table 5: Comparison of Mean AP and Mean Transverse diameter of Medial Condyle among various studies

Study	Mean AP diameter (mm)		Mean Transverse diameter (mm)	
	Right	Left	Right	Left
Chavda et al	53.71±4.56		26.79±2.16	
Fatih Yazar et al	57±4.71	57±4.71	24.61±2.58	24.61±2.57
Ioannis Terzidis et al	58.6±4.1	58.6±4.1	-	-
Synnapu U.R et al	56.64±4.8	58.02±5.3	29.74±4.74	28.90±3.13
Rajan M et al	56.62±4.19	57.14±4.82	22.64±3.96	23.12±2.17
Present study	54.55± 6.88	54.36±3.56	27.33±3.09	25.03±1.99

In the present study the mean AP diameter of lateral condyle on right side was 58.15±3.27 mm and on left side was 57.79±3.17 mm. The mean Transverse diameter of the lateral condyle was 28.53±2.92 mm and 28.63±3.23 mm on right and left side respectively. In both of these parameters no statistically significant difference found between right and left side because p value was >0.05 for both parameters.

Table 6: Comparison of Mean AP and Mean Transverse diameter of Lateral condyle among various studies

Study	Mean AP diameter (mm)		Mean Transverse diameter (mm)	
	Right	Left	Right	Left
Chavda et al	54.87±4.13		29.93±2.58	
Fatih Yazar et al	60.94±4.5	60.94±4.5	23.61±2.18	23.61±2.18
Ioannis Terzidis et al	58.4±4.0	58.5±4.0	-	-
Synnapu U.R et al	57.40±4.5	59.30±4.2	30.26±4.0	30.72±2.9
Rajan M et al	58.52±3.44	56.92±3.41	22.86±3.12	23.1±2.34
Present study	58.15±3.27	57.79±3.17	28.53±2.92	28.63±3.23



Figure 1: Showing measurement of Maximum anteroposterior distance of lateral femoral condyle (LC AP)



Figure 2: Showing measurement of Maximum anteroposterior distance of medial femoral condyle (MC AP)



Figure 3: Showing measurement of Maximum transverse distance of medial femoral condyle (MC T)

Figure 4: Showing measurement of Maximum transverse distance of lateral femoral condyle (LC T)

Showing measurement of Maximum anteroposterior distance of lateral femoral condyle (LC AP)

Conclusion

On comparison between right and left side measurements, no significant difference was found between values of parameters of right and left sided femur. This information will be useful to negate the need of side specific measurements for implant.

References

1. Stranding S. Editor in chief 41st edition and Churchill livingstone (2015) Gray's anatomy the anatomical basis of clinical practice; section 9 pelvic girdle and lower limb pp. 1316-1333.
2. Laroche M. intraosseous circulation from physiology to disease. *Joint bone spine*. 2002; 69: 262-69.
3. Rogers WM, Gladstone H. vascular foramina and arterial supply of the distal end of the femur. *J Bone Joint Surg Am*. 1950 oct; 32 (A:4): 867-74.
4. Yazar F, Imre N, Battal B, Bilgic S, Tayfun C. Is there any relation between distal parameters of the femur and its height and width. *Surgical and Radiological Anatomy* 2012; 34:122-125
5. Chavda H. S., Jethva N. K., Gupta S. A study of Morphometric analysis of condyles of adult femur of humans in Gujarat region. *International Journal of Anatomy, Radiology and Surgery*. 2019; 8 (3): AO01-AO05.
6. Terzidis, I., Totlis, T., Papathanasiou, E., Sideridis, A., Vlasis, K., Natsis, K. Gender and side-to-side differences of femoral condyles morphology. *Osteometric data from 360 Caucasian dried femori*. *Anatomy Research International*. 2012; 679658.
7. Sunnapu UR, Veerraju A. N. V. V, Vasanthi A. morphometric study of femoral condyles in visakhapatnam zone of andhra pradesh region. *international journal of scientific research*, 2020;9(4)
8. Rajan M, Ramachandran K. Morphometric analysis of lower end of adult dry femur in south Indian population – A cross-sectional observational study and its clinical significance; *Biomedicine*: 2020; 40(2): 128- 133.