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Morphometric study of tibial condylar area in Rajasthan population

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Abstract--Background: Indians are the part of Asian-Pacific population and they have a smaller build and stature in comparison of western population. The prosthesis for knee replacement surgeries which are presently being used are best suited for the western population therefore leading to implant size incompatibility with the resected bony surfaces. Aim of the study: To perform morphometric study of tibial condylar area in Rajasthan population. Materials and methods: The present study was conducted in the Department of Anatomy, S.M.S. Medical College, Jaipur. The study period was from approval of plan till 15th December 2019. The study is a descriptive type of observational study. 120 dry tibiae (60 right sided and 60 left sided) were required as sample size. The ethical clearance for the study was approved from the ethical committee of the hospital. Results: The mean AP diameter of the total tibial condyle was 45.28 ± 2.93 mm on the right side and 44.68 ± 4.29 mm on the left side and the total mean AP diameter of total tibial condyle was 44.98 ± 3.67 mm. The difference in the mean AP diameter values between right and left side was found to be statistically not significant. The mean transverse diameter of the total tibial condyle was 67.92 ± 4.13 mm on the right side and 66.77 ± 5.40 mm on the left side and the total mean transverse diameter of total tibial condyle was 67.35 ± 4.82 mm. The difference in the mean transverse diameter values between right and left side was found to be statistically not significant. Medial condyle

covers the 39.52% area and lateral condyle covers 36.38% out of total tibial condylar area on the right side and on the left side medial condyle covers 40.80% area and lateral condyle covers 36.15% area out of total tibial condylar area. Conclusion: On comparison of present study with studies in different populations, it was concluded that anatomical profile of Indians is smaller so this study also emphasizing the need of population specific prosthesis. To obtain the best possible stability and load transfer after knee replacement surgery, it is essential for the geometry of the tibial component to match the resected surface as closely as possible.

Keywords---condylar area, tibial condyle, knee replacement, implant.

Introduction

The Tibia forms the skeleton of medial part of leg. TIBIA is a Latin word which means shin bone or reed pipe.^{1, 2} So it also called shin bone. It is preaxial bone in lower limb. It is the second largest bone in the body.³ Tibia has a triangular shaft and two expanded ends. The Proximal end of tibia plays an important role in transmission of body weight from the femur above to the talus below. Proximal end of tibia consists medial condyle, lateral condyle and in between there is the irregular intercondylar area. Superior articular surface of Medial and lateral Condyle articulates with the corresponding medial and lateral condyles of femur. Upper end of tibia, lower end of femur and posterior articular surface of patella combinedly form the knee joint. Information regarding morphometry of proximal end of tibia is vital as it provides reliable method of assessing knee deformity. Knee replacement surgeries- Unicompartamental knee arthroplasty (UKA) and Total knee arthroplasty (TKA) are the most popular and cost effective treatment of present days which give a painfree stable knee to the patient⁴ and improve the quality of life of patient. Further improvement in quality of life of patient have been achieved by recent technological advancements in prosthetic design, instrumentation, surgical techniques and rehabilitation. Indians are the part of Asian-pacific population and they have a smaller build and stature in comparison of western population. The prosthesis for knee replacement surgeries which are presently being used are best suited for the western population therefore leading to implant size incompatibility with the resected bony surfaces.⁵ This geometric mismatch between patient anatomy and implant components responsible for failure of knee replacement surgeries. So proper Implant sizing can help to avoid complications and maximize outcome. Hence, the present study was conducted to perform morphometric study of tibial condylar area in Rajasthan population.

Materials and Methods

The present study was conducted in the Department of Anatomy, S.M.S. Medical College, Jaipur. The study period was from approval of plan till 15th December 2019. The study is a descriptive type of observational study. 120 dry tibiae (60 right sided and 60 left sided) were required as sample size. The ethical clearance for the study was approved from the ethical committee of the hospital.

Eligibility criteria

- Inclusion Criteria – Dried, intact bones of unknown age and sex.
- Exclusion Criteria – Damaged bone, incomplete bone, bone with gross pathological changes, and bone with damaged superior articular surface.

After applying inclusion and exclusion criteria 120 dried human tibiae (right sided=60) (left sided=60) of unknown age and sex were selected for present study from the Department of Anatomy, S.M.S. Medical College, Jaipur, Rajasthan. Medial condyle and lateral condyle of proximal end of each bone were identified. The anteroposterior and transverse diameter of medial condyle, lateral condyle, total tibial condyle were measured with the help of digital Vernier Calipers. The measurements were taken on 3 occasions and the average of the 3 values were taken as the representative measurement. The intra observer variation was minimized by taking the measurement at 3 times. The data were tabulated and analyzed statistically. 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 students t-test. Probability was considered to be significant if less than 0.05.

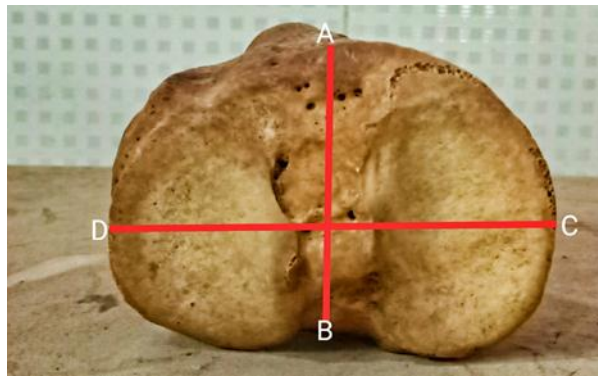


Fig 1. Showing AP (anteroposterior) diameter (AB) and Transverse diameter (CD) of total tibial condyle of left tibia



Fig 2. Showing measurement of ATC (anteroposterior diameter of total tibial condyle)



Fig 3. Showing measurement of TTC (transverse diameter of total tibial condyle)

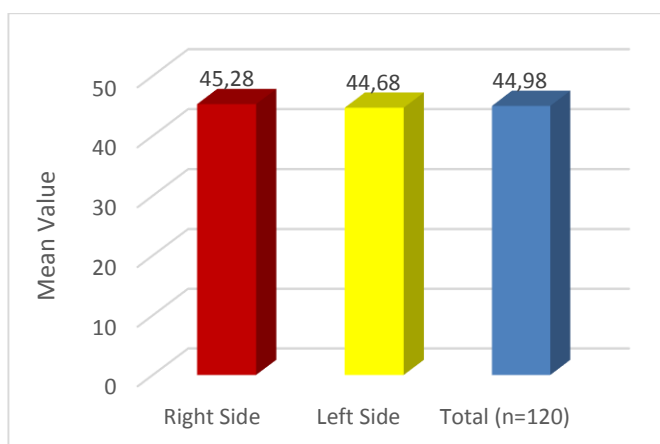
Results

Table 1 shows comparison of AP diameter of total tibial condyle between right and left tibia. The mean AP diameter of the total tibial condyle was 45.28 ± 2.93 mm on the right side and 44.68 ± 4.29 mm on the left side and the total mean AP diameter of total tibial condyle was 44.98 ± 3.67 mm. The difference in the mean AP diameter values between right and left side was found to be statistically not significant ($p=0.372$) [Graph 1]. Table 2 shows comparison of transverse diameter of total tibial condyle between right and left tibia. The mean transverse diameter of the total tibial condyle was 67.92 ± 4.13 mm on the right side and 66.77 ± 5.40

mm on the left side and the total mean transverse diameter of total tibial condyle was 67.35 ± 4.82 mm. The difference in the mean transverse diameter values between right and left side was found to be statistically not significant ($p=0.191$) [Graph 2]. Table 3 shows the comparison of the area covered by medial, lateral and total tibial condyle between right and left tibia. Medial condyle covers the 39.52% area and lateral condyle covers 36.38% out of total tibial condylar area on the right side and on the left side medial condyle covers 40.80% area and lateral condyle covers 36.15% area out of total tibial condylar area [Graph 3].

Table 1
Comparison of AP diameter of total tibial condyle between Right and Left Tibia

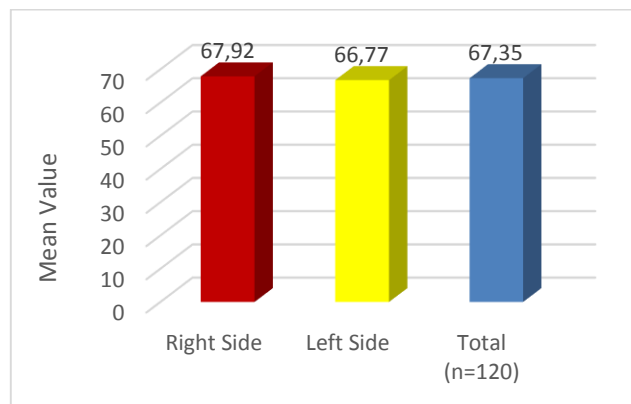
	Right Side		Left Side		Total (n=120)	
	Mean	SD	Mean	SD	Mean	SD
AP Diameter (mm)	45.28	2.93	44.68	4.29	44.98	3.67
Median	46		45		45	
P value	0.372 (NS)					



Graph 1. Showing Comparison of AP diameter of total tibial condyle between Right and Left Tibia

Table 2
Comparison of transverse diameter of total tibial condyle between Right and Left Tibia

	Right Side		Left Side		Total (n=120)	
	Mean	SD	Mean	SD	Mean	SD
Transverse Diameter (mm)	67.92	4.13	66.77	5.40	67.35	4.82
Median	68		66		68	
P value	0.191 (NS)					

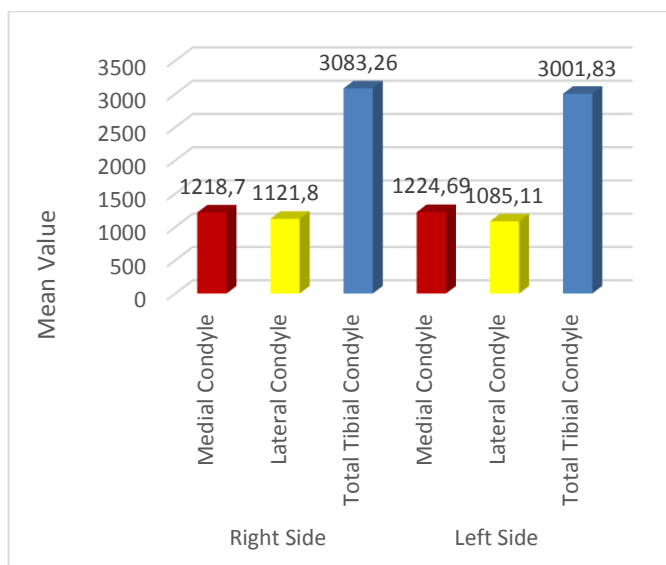


Graph 2: Showing Comparison of Transverse diameter of Total Tibial Condyle between Right and Left Tibia

Table 3

Comparison of the area covered by medial, lateral and total tibial condyle between Right and Left tibia

		Mean Area (mm ²)	SD	%
Right Side	Medial Condyle	1218.70	236.94	39.52
	Lateral Condyle	1121.80	255.39	36.38
	Total Tibial Condyle	3083.26	346.29	100%
Left Side	Medial Condyle	1224.69	264.18	40.80
	Lateral Condyle	1085.11	280.91	36.15
	Total Tibial Condyle	3001.83	498.12	100%



Graph 3. Comparison of the area covered by medial, lateral and total tibial condyle between Right and Left Tibia

Discussion

Superior articular surface of proximal end of tibia plays an important role in the function of the knee. There is a significant variability is found in the Anthropometry of different populations across the world as well as across the nation. As the Indians having smaller anatomical profiles and most of the commercially available prostheses are designed for the western population. So Indian patients are at the risk of getting a prosthesis which is oversized in procedures like UKA and TKA ⁶ Implantation of oversized prosthesis can lead to incompatibility with the resected bones⁵. The present study establishes the data for the various parameters of the proximal end of tibiae in Rajasthan population. After taking measurements of medial condyle, lateral condyle and total tibial condyle, the area is calculated by this formula-

$$\text{Area of condyle} = \text{AP diameter} \times \text{Transverse diameter of condyle}$$

Thus mean has been calculated for areas of medial condyle, lateral condyle and total tibial condyle. Then the percentage has been calculated of medial and lateral condyle area out of total tibial condylar area. In present study area covered by medial condyle was 39.52% and by lateral condyle was 36.38% out of total condylar area on right side. And the area covered by medial condyle was 40.80% and by lateral condyle was 36.15% out of total condylar area on left side in Rajasthan population. Srivastava et al studied and calculated the area in North Indian Population and reported that the area covered by medial tibial condyle was 38.56% and by lateral tibial condyle was 35.97% out of total condylar area in right side. And the area covered by medial tibial condyle was 37.32% and by lateral tibial condyle was 35.65% out of total condylar area in left side. ⁷

Gupta C et also studied and calculated the area in South Indian population and observed that the area covered by medial and lateralcondyles on right and left side were 38.87%, 34.4%, 38.89% and 38.25% respectively. ⁸ Srivastava A et al collected metrical data about the medial and lateral condyles of tibia. The present study was performed on 150 dry tibia of north Indian subjects, Out of which 70 tibia belonged to right side and 80 were of left side. The age and sex of these bones were not known. The anteroposterior length of medial and lateral tibial condylar area was measured. The data was statistically analyzed to hold comparisons between tibia of right and left side and also between medial and lateral tibial condyles of the same side. The area covered by MTC was 38.56% and by LTC was 35.97% out of total condylar area in right side. The area covered by MTC was 37.32% and by LTC was 35.65% out of total conylar area in the left side. Thus the data of Rajasthan population regarding this parameter found closely similar to the North Indian population.

Conclusion

On comparison of present study with studies in different populations, it was concluded that anatomical profile of Indians is smaller so this study also emphasizing the need of population specific prosthesis. To obtain the best possible stability and load transfer after knee replacement surgery, it is essential

for the geometry of the tibial component to match the resected surface as closely as possible.

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