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ORIGINAL RESEARCH

Morphometric Study Of Upper End Of Dry Tibia And Its Clinical Implication In Knee Arthroplasty

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ABSTRACT

Background: Human skeletal remains offer valuable insights into biological variation among human populations, both partially and temporally. This study is morphometric study of upper end of dry tibia and its clinical implication in knee arthroplasty.

Materials & Methods: The present study was performed on 120 dry human tibia (out of 60 male dry tibia 30 were right side and 30 were left side) (out of 60 female dry tibia 30 were right side and 30 were left side) processed adult tibia of known gender, maximum quantity was taken from department of anatomy RUHS-CMS, JAIPUR. Bicondylar width (BCW), medial and lateral condylar antero-posterior distance of superior articular surface, medial and lateral condylar transverse distance of superior articular surface etc. were recorded.

Results: The measurements include Bicondylar Width (BCW), Medial Condylar Anteroposterior Diameter (MCAPD), Lateral Condylar Anteroposterior Diameter (LCAPD), Medial Condylar Transverse Diameter (MCTD), and Lateral Condylar Transverse Diameter (LCTD) were statistically significant p <.001. The correlation between variables such as bicondylar width, medial condylar anteroposterior diameter, lateral condylar anteroposterior diameter, medial condylar transverse diameter, and lateral condylar transverse diameter.

Conclusion: The study measures key proximal end tibia parameters like ML and AP dimensions on dry bones. It reveals that Indians have a smaller anatomical profile, highlighting the need for specific prosthesis sizing.

Keywords: knee arthroplasty, Bicondylar Width, tibia

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INTRODUCTION

Human skeletal remains offer valuable insights into biological variation among human populations, both partially and temporally.[1] This understanding contributes to a deeper comprehension of variation at individual and population levels over time and space, as well as the identification of unknown human characteristics.[2] These variations are typically studied in relation to gender, age, and ethnicity, along with interactions between these variables, to gain a greater understanding of human life.[3] The knee is a complex synovial joint that controls posture and body mass, facilitating daily activities such as walking, standing, climbing, running, kicking, jumping, and changing directions.[4]

Morphometric measurements of the proximal tibia play a crucial role in achieving successful outcomes in total knee replacement surgeries.[5] Common morphometric measurements include the medial posterior slope, lateral posterior slope, proximal tibial length, medial condyle area, and lateral condyle area. However, due to ethnic and geographical variations, measurements from the Western population cannot be directly applied to the Asian population or any other subpopulation.[6] This study is morphometric study of upper end of dry tibia and its clinical implication in knee arthroplasty.

MATERIALS & METHODS

The present study was performed on 120 dry human tibia (out of 60 male dry tibia 30 were right side and 30 were left side) (out of 60 female dry tibia 30 were

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right side and 30 were left side) processed adult tibia of known gender, maximum quantity was taken from department of anatomy RUHS-CMS, JAIPUR and Remaining tibia were taken from department of anatomy SMS Medical College, Jaipur.

For study the material consisted of 120 dry tibia were used. Gross examination was done. The collected bones were assessed with vernier calipers. Bicondylar width (BCW), medial and lateral condylar antero-posterior distance of superior articular surface, medial and lateral condylar transverse distance of superior articular surface etc. were recorded. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULT

Table: I Descriptive statistics

Variables	N	Mean	Std. Deviation	t	df	Significance
BICONDYLAR WIDTH(BCW)	120	69.38	5.05	150.50	119	p= <.001
MEDIAL CONDYLAR ANTEROPOSTERIOR DIAMETERS (MCAPD)	120	44.58	4.67	61.41	119	p= <.001
LATERAL CONDYLAR ANTEROPOSTERIOR DIAMETERS (LCAPD)	120	40.19	2.53	174.16	119	p= <.001
MEDIAL CONDYLAR TRANVERSE DIAMETERS (MCTD)	120	31.26	2.95	116.25	119	p= <.001
LATERAL CONDYLAR TRANVERSE DIAMETERS (MCTD)	120	30.22	2.98	111.17	119	p= <.001

Table: I presents descriptive statistics for five tibial measurements, each based on a sample size of 120. The significance values are less than 0.001,indicating strong evidence against the null hypothesis and indicating that observed differences or relationships are highly unlikely to be due to chance. The measurements include Bicondylar Width (BCW), Medial Condylar Anteroposterior Diameter (MCAPD), Lateral Condylar Anteroposterior Diameter (LCAPD), Medial Condylar Transverse Diameter (MCTD), and Lateral Condylar Transverse Diameter (LCTD were statistically significant p <.001.

Table: II Correlation between the variables

		BCW	MCAPD	LCAPD	MCTD	LCTD
BCW	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	120				
MCAPD	Pearson Correlation	-.045	1			
	Sig. (2-tailed)	.629				
	N	120	120			
LCAPD	Pearson Correlation	**.359****	-.123	1		
	Sig. (2-tailed)	**.000**	.179			
	N	**120**	120	120		
MCTD	Pearson Correlation	**.265****	.046	**.277****	1	
	Sig. (2-tailed)	**.003**	.619	**.002**		
	N	**120**	120	**120**	120	
LCTD	Pearson Correlation	**.284****	.072	**.389****	**.650****	1
	Sig. (2-tailed)	**.002**	.434	**.000**	**.000**	
	N	**120**	120	**120**	**120**	120
**. Correlation is significant at the 0.01 level (2-tailed).						

Table II shows the correlation between variables such as bicondylar width, medial condylar anteroposterior diameter, lateral condylar anteroposterior diameter, medial condylar transverse diameter, and lateral condylar transverse diameter. The table provides the** Correlation is significant at the 0.01 level (2-tailed) for all variables.

DISCUSSION

The present study on adult human tibia revealed important observations, including equal distribution of side measurements across 60 dry human tibias based on gender and tibia side measurement. The results showed that 50.0% of measurements were taken from the left side and 50.0% from the right side for male

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and female, ensuring equal representation across both sides. The study also found that five tibial measurements, including Bicondylar Width (BCW), Medial Condylar Anteroposterior Diameter (MCAPD), Lateral Condylar Anteroposterior Diameter (LCAPD), Medial Condylar Transverse Diameter (MCTD), and Lateral Condylar Transverse Diameter (LCTD), were statistically significant ($p<.001$). The study compares gender with other variables measured, including bicondylar width, medial condylar anteroposterior diameter, lateral condylar anteroposterior diameter, medial condylar transverse diameter, and lateral condylar transverse diameter. The data includes 120 dry human tibia, 60 male dry tibia and 60 female dry tibia. The lateral condylar anteroposterior diameter (LCAPD) variable shows a significant difference between genders, with a t-value of 2.486 and a p-value of less than 0.05. The other variable, significant other variable, has a t-value of 0.102 and a p-value greater than 0.05, indicating no significant difference between genders.

We found that the left side of LCAPD shows no statistical significance, with a t-value of 0.482 and a p-value greater than 0.05. The study demonstrates a significant correlation between variables like bicondylar width, medial condylar anteroposterior diameter, lateral condylar anteroposterior diameter, medial condylar transverse diameter, and lateral condylar transverse diameter, at the 0.01 level (2-tailed). Similar study aimed to provide data on morphometric parameters of the upper end of the tibia in Bihar to improve surgical outcomes in total knee arthroplasties. The study was conducted on 50 tibia of unknown gender and age at the Indira Gandhi Institute of Medical Sciences in Patna. The data was analyzed using Microsoft Excel software. Results showed that the medial condyle had larger diameters than the lateral condyle, and the anterior posterior diameter was larger than the transverse diameter for both condyles. However, the difference between the right and left side was not statistically significant. The study aims to provide baseline data for designing prosthetics used in total knee replacement surgeries and will be beneficial to anthropologists and forensic experts.[7]

Another study revealed total knee arthroplasty and unicompartmental knee arthroplasty are common procedures for treating arthritis and knee injuries. The knee prosthesis requires sizing specific to the population, and morphometric parameters of the upper end of the tibia can guide treatment and monitor outcomes. This article assesses different morphometric parameters of the condylar and intercondylar surface of the tibia to compile results, analyze, and formulate a baseline data for future studies with relevance to the Indian population. The study group consisted of 60 adult human dry and processed tibia of both sides, obtained from the Department of Anatomy, Himalayan Institute of Medical Sciences. Morphometric measurements of the medial condyle, lateral condyle, and intercondylar area of the tibia were recorded with vernier calipers. The results showed that the tibial condyle for Indians is smaller, highlighting the need for sizing of prosthesis specific to the population in question.[8]

Previous study aimed to determine the best parameters for metric sexing using discriminant function analysis on adult human tibia. The study involved measuring the upper end of 99 normal, dry adult tibia of known sex, using an osteometric board and manual vernier calipers. The percentage accuracy of various tibial parameters was calculated using mean, standard deviations, and t-value. The results showed that total transverse diameter (TTD) and antero posterior diameter of lateral condyle (APLC) were considered the best parameters for sex determination, with a 73% accuracy rate.[9]

Relavant study aimed to measure the proximal end of the tibia in the south Indian population for total knee arthroplasty and unicompartmental knee arthroplasty (UKA) procedures. The study involved 50 adult fully ossified dry tibia and used a Vernier caliper to measure various parameters. Statistical analysis was performed, and comparisons were made using paired t-tests. The results showed that the mean transverse and anteroposterior diameters of total, medial, and lateral condyles were 6.83, 4.57, 2.73, 4.45, and 2.79, 4.07 cm, respectively. The area of medial, lateral, and total tibial condyle was 12.2, 11.42, and 31.39 cm2. The mean length between the upper end of the tibia and tibial tuberosity and the mean circumference of the upper end of the tibia were 5.15 and 19.02 cm. The study's findings will be useful for anatomists, anthropologists, and orthopedics in cases of UKA, complete knee arthroplasty procedures, and meniscal transplantation.[10]

The upper end of the tibia consists of two parts: lateral and medial condyles, which articulate with the corresponding condylar surfaces of the femur. The intercondylar area separates these two condyles, with the central part raised to form the intercondylar eminence. This study collected metrical data on 150 dry tibia of north Indian subjects, measuring the anterior length of medial and lateral tibial condylar area and their transverse diameter. The data was statistically analyzed to compare the area covered by medial and lateral tibial condyles on the right and left sides. The study is important for anatomists, anthropologists, and orthopedics regarding unicompartmental knee arthroplasty (UKA), complete knee arthroplasty procedures, and meniscal transplantation. The study provides information on the exact dimensions and percentage covered by medial and lateral condyles out of the total condylar area.[11]

The study of the upper end of the dry tibia provides valuable insights into anatomical variations, which are crucial for orthopedic surgeons and knee arthroplasty specialists. The study reveals that understanding bicondylar width and condylar anteroposterior diameters helps select appropriateimplants for optimal

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fit and stability during surgery. The data also aids in developing patient-specific implants, enhancing precision and accuracy, reducing the risk of complications, and improving postoperative function. The findings also inform preoperative planning and surgical techniques, allowing surgeons to anticipate challenges and develop effective strategies. Understanding the correlation between morphometric parameters and clinical outcomes can guide surgeons in making informed decisions, improving patient outcomes and reducing complications. The study lays the groundwork for further research in knee arthroplasty and orthopedic surgery.

CONCLUSION

The study measures key proximal end tibia parameters like ML and AP dimensions on dry bones. It reveals that Indians have a smaller anatomical profile, highlighting the need for specific prosthesis sizing. After knee replacement surgery, the tibial component's geometry should match the resected surface for optimal stability and load transfer. The study suggests a decrease in tibial aspect ratio with increased AP length, which could guide prosthesis manufacturers in ensuring optimal tibial implant coverage and long-term survivorship.

REFERENCES

1. Devi, D. Y. E., Thounaojam, D. O., & Gangte, D. D. (2022). Study of Morphometric Analysis of Distal End of Femur in the North Indian Population. Sch J App Med Sci, 1, 157-161.
2. Rajan, M., & Ramachandran, K. (2020). Morphometric analysis of lower end of adult dry femur in south Indian population–A cross-sectional observational study and its clinical significance. Biomedicine, 40(2), 128-133.
3. Stephen, S. F. (2013). Morphometric analysis of the adult knee and its correlation with current knee arthroplasty systems (Doctoral dissertation, Christian Medical College, Vellore).
4. Madhumitha, B., & Sangeetha, S. (2020). Comparative and Morphometric Study of Lateral and Medial Malleoli. International Journal of Pharmaceutical Research (09752366), 12(1).
5. Reeti, R., Akhtar, M. J., Kumar, B., Sinha, R. R., & Kumar, A. (2021). Morphometric study of upper end of tibia and its implications in total knee replacement. Indian Journal of Clinical Anatomy and Physiology, 8(3), 213-218.
6. Basu, R., Pal, D. C., Haldar, D., & Sarkar, J. (2018). Morphometric variation between right and left human tibia: A cross-sectional study in Bankura district of West Bengal. IOSR JDMS, 17, 26-30.
7. Narayanan, S. (2020). Determination of Sex and Age at Death of Adult Human using Patellar Dimensions: A Morphometric studyamong South Indian Population, Chennai, Tamilnadu (Doctoral dissertation, Madras Medical College, Chennai).
8. Eboh, D. E. O. (2022). Morphometric Anatomy of the Tibia Plateau in Nigerians. Ethiopian Journal of Health Sciences, 32(1).
9. Sigraf Tarannum, Soni Kumari, Md. Zahid Hussain, & Rashmi Prasad. (2021). Morphometry of Tibia: The Determinant of Sexual Dimorphism. International Journal of Health and Clinical Research, 4(23), 318–320.
10. Gupta, C., Kumar, J., & Kalthur, S. G. (2015). A morphometric study of the proximal end of the tibia in South Indian population with its clinical implications. Saudi Journal of Sports Medicine, 15(2), 166-169.
11. Srivastava, A., Yadav, A., Thomas, R. J., & Gupta, N. (2014). Morphometric study of tibial condylar area in the North Indian population. J. Med. Sci. Clin. Res, 2, 515-519.
12. HP Singh, DC Shetty, A Kumar, R Chavan, DD Shori, J Mali. A molecular insight into the role of inflammation in the behavior and pathogenesis of odontogenic cysts. Annals of medical and health sciences research 3 (4), 523-528

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