Section: Anatomy

Original Research Article

# MORPHOMETRIC STUDY OF THE PROXIMAL END OF TIBIA

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*Received* : 28/04/2023
*Received in revised form* : 30/05/2023
*Accepted* : 10/06/2023

*Keywords:*
*Tibia, Human, Morphometric.*

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DOI: 10.47009/jamp.2023.5.3.347

Source of Support: Nil,
Conflict of Interest: None declared

*Int J Acad Med Pharm*
2023; 5 (3); 1736-1738

## Abstract

**Background:** To perform morphometric study of the proximal end of tibia. **Materials and Methods:** Seventy- eight human tibia bones of either gender were enrolled and parameters such as AP diameter of medial tibial condyle, transverse diameter (TD) of medial tibial condyle, AP diameter of lateral tibial condyle, TD lateral tibial condyle, TD of total tibial condyle, AP diameter of intercondylar region, circumference of the upper end, length between the upper end and tibial tuberosity, area of total tibial condyle, area of medial tibial condyle, area of lateral tibial condyle and presence or absence of groove for ligamentum patellae were recorded. Area of the condyle was measured using the formula: Area of condyle = AP × TD of condyle. **Result:** Out of 78 tibia bones, 48 (61.5%) were of males and 58 (38.5%) of females. Right and left area of lateral condyle was 10.4 and 11.0, area of medial condyle was 12.3 and 12.1, total area of tibial condyle was 31.6 and 31.2, length between the upper end and tibial tuberosity was 5.2 and 5.0, circumference of the upper end was 18.6 and 18.3, AP length of lateral tibial condyle was 4.5 and 4.7, transverse diameter (TD) of lateral tibial condyle was 2.7 and 2.6, AP length of medial region was 4.1 and 4.0, transverse diameter of medial condyle was 2.7 and 2.4, AP length of intercondylar region was 4.5 and 4.3 and transverse diameter of tibial condyle was 6.9 and 6.8 respectively. **Conclusion:** Data obtained in the study is beneficial in cases of UKA, full knee arthroplasty surgeries, and meniscal transplants for anthropologists, anatomists, and orthopaedics.

## INTRODUCTION

The knee joint is a compound synovial joint that performs the important role of altering body posture and the centre of mass, necessitating a wide range of movement in three dimensions as well as the capacity to withstand strong forces. The proximal end of the tibia, which is distinctive in daily functioning as well as in many sports, is an important part of the knee joint through the tibio-femoral articulation and plays a significant role in the conduction of body weight from the femur above to the talus below. The most prevalent pathological condition, osteoarthritis, as well as inflammatory and posttraumatic arthritis caused by frequent participation in sports like football, commonly affect the knee joint.[1-5]

It is crucial to have knowledge of the upper end of the tibia's morphometry since it offers a trustworthy way to detect knee deformity. The upper end of the tibia's morphometric characteristics can be utilised to direct therapy and track the effectiveness of total knee replacement procedures. Definition of tibial deformity and advancement of tibial prosthesis design are aided by a precise and reproducible tibial measurement method. Extensive anatomical research of this pertinent surgical sector would help in designing the necessary interventions in a variety of pathological and degenerative disorders of the knee joint. Knee joint surgeries are technically challenging and rapidly evolving procedures. The present study was morphometric study of the proximal end of tibia.[6-10]

## MATERIALS AND METHODS

After considering the utility of the study and obtaining approval from ethical review committee, we selected seventy- eight human tibia bones of either gender. The study was conducted in the department of Anatomy. The period of study was 6 months.

Parameters such as AP diameter of medial tibial condyle, transverse diameter (TD) of medial tibial condyle, AP diameter of lateral tibial condyle, TD lateral tibial condyle, TD of total tibial condyle, AP diameter of intercondylar region, circumference of the upper end, length between the upper end and


ISSN (O): 2687-5365; ISSN (P): 2753-6556

tibial tuberosity, area of total tibial condyle, area of medial tibial condyle, area of lateral tibial condyle and presence or absence of groove for ligamentum patellae were recorded. All measurements were recorded with the help of vernier caliper. Area of the condyle was measured using the formula: Area of condyle = AP × TD of condyle. Results were compiled and subjected for statistical analysis using Mann Whitney U test. P value less than 0.05 was set significant.

## RESULTS

Out of 78 tibia bones, 48 (61.5%) were of males and 58 (38.5%) of females [Table 1].

**Table 1: Patients distribution**

| **Total- 78** | | |
|---|---|---|
| **Gender** | **Males** | **Females** |
| Number (%) | 48 (61.5%) | 58 (38.5%) |

**Table 2: Assessment of parameters**

| **Parameters (mm)** | **Right** | **Left** | **P value** |
|---|---|---|---|
| Area of lateral condyle | 10.4 | 11.0 | 0.93 |
| Area of medial condyle | 12.3 | 12.1 | 0.97 |
| Total area of tibial condyle | 31.6 | 31.2 | 0.58 |
| length between the upper end and tibial tuberosity | 5.2 | 5.0 | 0.87 |
| circumference of the upper end | 18.6 | 18.3 | 0.74 |
| AP length of lateral tibial condyle | 4.5 | 4.7 | 0.90 |
| Transverse diameter (TD) of lateral tibial condyle | 2.7 | 2.6 | 0.95 |
| AP length of medial region | 4.1 | 4.0 | 0.84 |
| Transverse diameter of medial condyle | 2.7 | 2.4 | 0.92 |
| AP length of intercondylar region | 4.5 | 4.3 | 0.16 |
| Transverse diameter of tibial condyle | 6.9 | 6.8 | 0.23 |

Right and left area of lateral condyle was 10.4 and 11.0, area of medial condyle was 12.3 and 12.1, total area of tibial condyle was 31.6 and 31.2, length between the upper end and tibial tuberosity was 5.2 and 5.0, circumference of the upper end was 18.6 and 18.3, AP length of lateral tibial condyle was 4.5 and 4.7, transverse diameter (TD) of lateral tibial condyle was 2.7 and 2.6, AP length of medial region was 4.1 and 4.0, transverse diameter of medial condyle was 2.7 and 2.4, AP length of intercondylar region was 4.5 and 4.3 and transverse diameter of tibial condyle was 6.9 and 6.8 respectively. The difference was significant (P< 0.05) [Table 2].

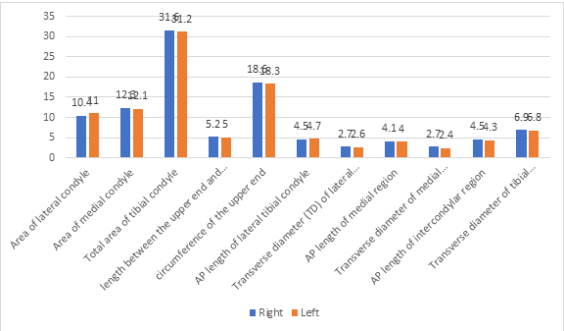


**Figure 1: Assessment of parameters**

## DISCUSSION

In order to achieve appropriate flexion-extension spacing and joint stability throughout the range of motion, total knee arthroplasty requires accurate soft-tissue balance and bone resection of a thickness equal to that of the prosthetic component implanted. The effectiveness of this treatment depends on the choice of prosthetic, correct size, and proper positioning of the components. The prosthesis' anteroposterior (AP) measurement is important for maintaining flexion-extension spacing, whereas the mediolateral measurement determines whether the resected bone surface is adequately covered and whether the incision can heal without strain. Maximal implant coverage on the surface of the resected bone would reduce the stress placed on the bone implant interface, which has been identified as a factor in TKA's long-term survival. The present study was morphometric study of the proximal end of tibia.[11-14]

In our study, out of 78 tibia bones, 48 (61.5%) were of males and 58 (38.5%) of females. Gandhi et al examined the various morphometric characteristics of the tibia's condylar and intercondylar surfaces. 50 mature human tibiae from males and 50 from females made up the study group. Digital Vernier callipers were used to precisely record the morphometric measures of the medial condyle, lateral condyle, and intercondylar region of the tibiae with a minimum count of 0.01 mm. When compared on both sides and between the sexes, all measurements were found to be statistically significant. For both the medial and lateral condyles, it was discovered that anteromedial measurements were greater than transverse values. Furthermore, on both sides and in both sexes, the medial condyle had larger anteroposterior and transverse dimensions than the lateral condyle.[15,16]

Our results showed that right and left area of lateral condyle was 10.4 and 11.0, area of medial condyle was 12.3 and 12.1, total area of tibial condyle was 31.6 and 31.2, length between the upper end and tibial tuberosity was 5.2 and 5.0, circumference of the upper end was 18.6 and 18.3, AP length of


ISSN (O): 2687-5365; ISSN (P): 2753-6556

lateral tibial condyle was 4.5 and 4.7, transverse diameter (TD) of lateral tibial condyle was 2.7 and 2.6, AP length of medial region was 4.1 and 4.0, transverse diameter of medial condyle was 2.7 and 2.4, AP length of intercondylar region was 4.5 and 4.3 and transverse diameter of tibial condyle was 6.9 and 6.8 respectively. Gupta et al measured several parameters on 50 adult completely osseous dry tibia (26 on the left and 24 on the right). The average transverse, anteroposterior, medial, and lateral condyles of the tibia in our study measured 6.83, 4.57, 2.73, 4.45, and 2.79, 4.07 cm respectively. 12.2, 11.42, and 31.39 cm are the medial, lateral, and total tibial condyle areas, respectively. 2. The average distance between the tibial tuberosity and upper end of the tibia.

Srivastava et al. found the mean transverse, AP diameter of medial and lateral condyle on right side as 2.97, 3.86 cm and 2.92, 3.64 cm. They found the mean transverse, AP diameter of medial and lateral condyle on the left side as 2.75, 3.99 cm and 2.97, 3.69 cm. Ivan discovered that the average circumference of the upper end of the tibia on the left, right, and total tibia was 19.36 cm, 19.33 cm, and 19.35 cm, respectively. These values were very identical to those from our study, which were 19.07 cm, 18.95 cm, and 19.02 cm. In her investigation, the average distance between the upper end of the tibia and the tibial tuberosity measured 4.47, 4.60, and 4.54 cm on the left, right, and whole tibia, respectively, but in our study, the measurements measured 5.24, 5.06, and 5.15 cm. She discovered that the ligamentum patellae groove was present in 73.9% of all bones, however in our investigation, we discovered that in 100% of bones. She did not discover any parameters to be statistically significant.

According to Geoffrey, asymmetrical prostheses with smaller lateral condylar surfaces perform better than symmetrical ones. Due to unnecessary mediolateral overhanging while striving to provide optimal anteroposterior coverage of the articular surface, the metric parameters of the medial and lateral plateaus deviate symmetrically with respect to one another.

## CONCLUSION

Data obtained in the study is beneficial in cases of UKA, full knee arthroplasty surgeries, and meniscal transplants for anthropologists, anatomists, and orthopaedics.

## REFERENCES


1. Mark DG. Consistency and accuracy of measurement of lower limb amputee anthropometrics. JRRD. 2005;42:131-40.
2. Servien E, Saffarini M, Lustig S, Chomel S, Nevret P. Lateral versus medial tibial plateau: morphometric analysis and adaptability with current tibial component design. J Knee Surg. 2008;16:1141-45.
3. Kwak DS, Surendran S, Pengatteeri YH, Park SE, Choi KN, Gopinathan P et al. Morphometry of the proximal tibia to design the tibial component of total knee arthroplasty for the Korean population. Knee. 2007; 14: 295-300.
4. Jacobsen K. Area intercondylaris tibiae: osseous surface structure and its relation to soft tissue structures and applications to radiography. J Anat. 1974; 117: 605- 18.
5. Kennedy JC and Fowler PJ. Medial and anterior instability of the knee. An anatomical and clinical study using stress machines. J Bone Joint Surg. 1971; 53A:1257-70.
6. Cheng FB, Ji XF, Lai Y, Feng JC, Zheng WX, Sun YF, et al. Three dimensional morphometry of the knee to design the total knee arthroplasty for Chinese population. Knee. 2009;16:341-47.
7. Westrich GH, Haas SB, Insall JN, Frachie A. Resection specimen analysis of proximal tibial anatomy based on 100 total knee arthroplasty specimens. J Arthroplasty. 1995;10:47-51.
8. Zanasi S. Innovations in total knee replacement: new trends in operative treatment and changes in peri-operative management. Eur Orthop Traumatol. 2011; 2: 21–31.
9. Standring S, Ellis H, Johnson D, Healy JC, Williams A. Gray's Anatomy. In Pelvic Girdle and Lower Limb. Newell RLM. Edr. 39th Edn, Edinburg, London, Churchill Livingstone. 2005; p.1399.
10. Ljunggren AE. The Tuberositas Tibiae and Extension in the knee joint. Acta Morphol Neerl Scand. 1976; 14: 215-39.
11. Surendran S, Kwak DS, Lee UY, Park SE, Gopinathan P, Han SH, et al. Anthropometry of the medial tibial condyle to design the tibial component for unicondylar knee arthroplasty for the Korean population. Knee Surg Sports Traumatol Arthrosc 2007;15:436-42.
12. Vaidya SV, Ranawat CS, Aroojis A, Laud NS. Anthropometric measurements to design total knee prostheses for the Indian population. J Arthroplasty 2000;15:79-85.
13. Gandhi S, Singla RK, Kullar JS, Suri RK, Mehta V. Morphometric analysis of upper end of tibia. Journal of clinical and diagnostic research: JCDR. 2014 Aug;8(8):AC10.
14. Gupta C, Kumar J, Kalthur SG, D'souza AS. A morphometric study of the proximal end of the tibia in South Indian population with its clinical implications. Saudi J Sports Med 2015;15:166-9.
15. Srivastava A, Yadav A, Thomas RJ, Gupta N. Morphometric Study of Tibial Condylar area in the North Indian population. J Med Sci Clin Res 2015;2:515-9
16. Ivan AS. Morphometric Study of Proximal End of Tibia; 2014. p. 75.




ISSN (O): 2687-5365; ISSN (P): 2753-6556