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Original Research

Morphometric Analysis of Upper End of Tibia

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ABSTRACT:

Background: To assess morphometric parameters of upper end of tibia. **Materials & methods:** A total of 40 subjects were enrolled. The study group comprised of 20 male and 20 female adult human tibiae. An equal number of right and left sided bones were included. Student's t-test was done. P-value <0.05 was considered significant. Results were analysed using SPSS software. **Results:** A total of 40 tibia samples were enrolled. The mean values of antero-posterior measurement of medial condyle as observed on the two sides in both male and female bones. The difference between the two sexes on both the sides was highly significant statistically (p-value <0.001 on both right and left sides). **Conclusion:** Morphometric details of upper end of tibia provides baseline data with reference to total knee arthroplasty.

Keywords: tibia, medial condyle, transverse.

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INTRODUCTION

Tibia is the second largest and longest bone in the body. The proximal end of the tibia is widely expanded, has two condyles – medial and lateral, and between condyles there is inter condylar area. The condyles of tibia are articular and make joint superiorly with corresponding condyles of femur which is the femoro-tibial component of knee joint. [1]The lower limb is primarily adapted for weight bearing and locomotion. This functional need along with together with the attainment of a habitual erect bipedal posture has resulted in a change in both the functional and mechanical requirements of all skeletal structures. Therefore greater strength and stability is required for the lower limb as compared with the upper limb. [2]In man weight bearing is related mainly to extended knee positions. The relationship between the different weight bearing situations and the anteroposterior and medio-lateral dimensions of diaphysis and epiphysis of the tibia is well established. [3]

The knee joint is a compound synovial joint which brings out the significant function of adjusting the center of body mass and posture, requiring a great range of movement in three dimensions together with the capability to bear high forces. [4]The proximal end of tibia is a crucial component of the knee joint through the tibio-femoral articulation and plays a vital role in the conduction of body weight from the femur above to the talus below and is therefore unique in day-to-day functioning as well as in many sports. The knee joint is usually affected by several forms of arthritis such as inflammatory and posttraumatic arthritis due to regular playing of many sports like football and also osteoarthritis is the most common pathological disorder and the treatment for that is usually total knee arthroplasty (TKA) or unicompartmental knee arthroplasty (UKA). [5]

Total knee arthroplasty is extensively recognized to be one of the most popular and cost effective procedures in orthopedic practice. Substantial development in quality of life after TKA procedures have been showed by several studies. Additional improvements have been attained by current technological progressions in prosthetic design, instrumentation, surgical techniques, and rehabilitation. [6]Information regarding morphometry of upper end of the tibia is vital as it provides reliable method of assessing knee deformity. Morphometric parameters of upper end of tibia can be used to guide treatment and monitor outcome of total knee replacement surgeries. An accurate and repeatable tibial measurement system

aids in definition of tibial deformity and improvement of tibial prosthesis design. [7] Hence, this study was conducted to assess morphometric parameters of upper end of tibia.

MATERIALS & METHODS

A total of 40 subjects were enrolled. The study group comprised of 20 male and 20 female adult human tibiae. Anequal number of right and left sided bones were included.Morphometric measurements of medial condyle and lateral condyle of tibiae were recorded with digital Vernier calipers with a least count of 0.01 mm. Data was collected. Student's t-test was done. P-value <0.05 was considered significant. Results were analysed using SPSS software.

RESULTS

A total of 40 tibia samples were enrolled. The mean values of antero-posterior measurement of medial condyle as observed on the two sides in both male and female bones. The difference between the two sexes on both the sides was highly significant statistically (p-value <0.001 on both right and left sides). In transverse, the result was statistically significant in both sides. Overall, the antero-posterior measurement were greater than transverse measurement in both the sexes and on both the sides.

Table 1: Comparison of anteroposterior and transverse measurements of medial condyle

Diameters (mm)	Side	Sex	Mean	P- value
Antero-posterior	Right	Male	49.23	<0.001*
		Female	44.36	
	Left	Male	48.65	<0.001*
		Female	44.12	
Transverse	Right	Male	31.85	<0.001*
		Female	28.47	
	Left	Male	30.56	0.002
		Female	27.12	

*: significant

On comparing two condyles, it was seen that both antero-posterior and transverse measurement were greater in medial condyle on both sides and sexes. The antero-posterior measurement of inter condylar area when compared between the two sexes it was more in males, the difference being statistically significant on both sides (p-value <0.001 on both the sides).

Table 2: Comparison of anteroposterior and transverse measurements of lateral condyle

Diameters	Side	Sex	Mean	P - value
Antero-posterior	Right	Male	42.54	<0.001*
		Female	38.02	
	Left	Male	42.12	0.005
		Female	39.35	
Transverse	Right	Male	29.16	0.003
		Female	27.38	
	Left	Male	29.85	0.003
		Female	27.03	

DISCUSSION

Total knee arthro plasty is a precision operation, requiring precise soft-tissue balancing and resection of bone thickness equal to the thickness of the prosthetic component implanted, so that the flexion-extension spacing are equal, permitting joint stability throughout the range of motion. Prosthetic selection, accurate sizing and proper placement of the components decide the success of this procedure. The anteroposterior (AP) measurement of the prosthesis is significant in sustaining flexion-extension spacing while the mediolateral measurement decides satisfactory coverage of the resected bone surface and tension free wound closure. [8]Maximal implant coverage on the resected bone surface would decrease the stress applied to the bone implant interface, which has been found to be a reason contributing to long term survivorship in TKA. [6]Hence, this study was conducted to assess morphometric parameters of upper end of tibia.

In the present study, a total of 40 tibia samples were enrolled. The mean values of antero-posterior measurement of medial condyle as observed on the two sides in both male and female bones. The difference between the two sexes on both the sides was highly significant statistically (p-value <0.001 on both right and left sides). In transverse, the result was statistically significant in both sides. Overall, the antero-posterior measurement were greater than transverse measurement in both the sexes and on both the sides. A study by Gandhi S et al, aims to assess different morphometric parameters of condylar and intercondylar surface of tibia and to compile the results, analyze and formulate a baseline data for future studies with relevance to Indian population and also to compare the current data with accessible

literature for pertinent surgical utilities. Morphometric parameters of upper end of tibia can be used to guide treatment and monitor outcome of total knee replacement surgeries. Information regarding morphometry of upper end of the tibia is vital as it provides reliable method of assessing knee deformity. The study group comprised of 50 male and 50 female adult human tibiae. Morphometric measurements of medial condyle, lateral condyle and intercondylar area of tibiae were meticulously recorded with digital Verniercalipers with a least count of 0.01 mm. All measurements were found to be statistically significant when compared between the two sexes on both sides (p-value<0.05). Anteroposterior measurements were found to be greater than transverse measurements for both medial and lateral condyles. Furthermore, both anteroposterior and transverse measurements were greater in medial condyle than in lateral condyle on both sides and sexes.[9]

In the present study, on comparing two condyles, it was seen that both antero-posterior and transverse measurement were greater in medial condyle on both sides and sexes. The antero-posterior measurement of intercondylar area when compared between the two sexes it was more in males, the difference being statistically significant on both sides (p-value <0.001 on both the sides). Another study by Gupta C et al, examined fifty (26 left and 24 right) adult fully ossified dry tibia were taken, and various parameters of the proximal end of the tibia were measured using a Verniercaliper. The mean transverse, the anteroposterior diameter of total, medial and lateral condyles of the tibia are 6.83, 4.57, 2.73, 4.45 and 2.79, 4.07 cm. The area of medial, lateral and total tibial condyle is 12.2, 11.42 and 31.39 cm 2 . The mean length between the upper end of the tibia and tibial tuberosity and the mean circumference of the upper end of the tibia is 5.15 and 19.02 cm. Groove for ligamentum patellae was found in 100% of cases. [10]So accurate morphometric anatomical data of the upper end of tibia and gender morphometric differences are very important in making the design of total knee joint replacement prosthesis. Mismatch between morphometric data and selected prosthesis for surgery may cause severe complications like cruciate ligament rupture, soft tissue misbalancing, less movements of knee joint after surgery and evenprosthesis loosening.[11,12] So knee prosthesismade according to morphometric data of femur and tibia i.e. components of knee joint and according to the gender will give excellent results in early mobility of patients as well as lesser complications after surgery. [13,14]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. They found the total tibial condylar, medial condyle, lateral condyle area on right and left side as 29.88, 11.52, 10.75 and 29.51, 11.01, 10.52 cm. [15]Srivastava et al. found that the area covered by medial tibial condyle is 38.56% and by lateral tibial condyle is 35.97% out of total condylar area in right side. The area covered by medial tibial condyle is 37.32% and by lateral tibial condyle is 35.65% out of total conylar area in the left side.[15]

CONCLUSION

Morphometric details of upper end of tibia provides baseline data with reference to total knee arthroplasty.

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