

# A Morphometric Study Of Upper End Of Tibia In The Region Of Andhra Pradesh

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## ABSTRACT

### Introduction:

Knee joint is the major weight-bearing joint in the human body that has the ability to endure day to day stress. However the incidence of Osteoarthritis of Knee and need for Knee Replacement is on rise in recent times and the Tibial morphometry plays a pivotal role in designing the prosthesis. Hence the comprehensive knowledge of the morphometry, regional and ethnic differences have significant role thus warranting the study of morphometric parameters of upper end of Tibia.

### Aim:

The current study aims to measure the morphometric parameters of condylar and intercondylar surface of tibia, analyze the data with relevance to Indian population and also to correlate the current data with pertinent literature .

### Material and Methods:

The present study is done on 100 dry adult human tibia of unknown sex out of which 50 belong to right side and 50 belong to left side and measurements were taken on both sides of upper end of tibia, and the study is confined to samplings belonging to Rayalaseema zone of Andhra Pradesh.

**Results:** In this study anteroposterior measurements of medial condyle of tibia is slightly more on right side than the left side and the parameters of Lateral condyle were more on the left side. The Transverse measurement of intercondylar area reveals a statistically significant dominance on the left side. In concern with epiphyseal width of upper end of tibia, it is more in males than females and forms one of the important parameters in deciding the gender.

**Conclusion:** The present study is a modest endeavor to cast some light on the significance of parameters of upper end of tibia which ultimately may aid in designing the prosthesis for knee surgeries.

**Key words:** Tibia, medial condyle, lateral condyle, Intercondylar

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## I. Introduction :

Knee joint is the largest compound modified hinge type of synovial joint and is the major weight-bearing joint in the body [1]. Knee joint consists of three articulations: right and left Tibiofemoral articulations and one Patellofemoral saddle joint. Structurally, the knee joint is relatively weak due to incongruent Tibio Femoral articular surfaces and the integrity of the joint depends of the anatomy of the articular surfaces of Tibia and framework of ligaments surrounding the joint. The Tibia being the second largest and weight bearing bone is the crux of Knee articulation which consists of Tibial condylar interface formed by the medial and lateral Tibial condyles or tibial plateau [2]. The Intercondylar surface of Tibia bears attachment of the cruciate ligaments and menisci. In the Recent times there has been a phenomenal rise in the prevalence of degenerative osteoarthritis of Knee, often requiring Knee Replacement. The morphometric dimensions of the articular surface of Tibia are influenced by factors like genetic, geographical, ethnicity and age emphasized in various studies throughout the world. Hence the morphometric dimensions of the Tibial articular surface have substantial clinical implications and play a very important role success of knee replacement surgeries The aim of this study is to obtain data about morphometric parameters of upper end of tibia , observe the Phenotypic variations and to compare with the literature.

## II. Materials and Methods:

The present study is done on 100 dry adult human tibia of unknown sex out of which 50 belong to right

side and 50 belong to left side which were obtained from the Department of Anatomy SPMC(W) SVIMS, Tirupati, SV medical college, Tirupati, Narayana medical college and also from the Department of Anthropology, SV university, Tirupati Measurements were taken on both sides of upper end of tibia, using digital vernier caliper with accuracy of 0.1 mm.

The following parameters were measured :

1. Anteroposterior diameter of superior articular surface of medial condyle : It represents the maximum distance between anterior and posterior edges of superior articular surface of medial condyle. [ Table 1/ Fig 1]
2. Transverse diameter of superior articular surface of medial condyle : The maximum transverse diameter of superior articular surface of medial condyle. [Table 1]
3. Anteroposterior diameter of superior articular surface of lateral condyle : The maximum distance between the anterior and posterior borders of superior articular surface of lateral condyle.
4. Transverse diameter of superior articular surface of lateral condyle : The maximum transverse diameter of superior articular surface of lateral condyle. [Table 1]
5. Anteroposterior diameter of intercondylar area : The maximum distance between anterior and posterior borders.
6. Transverse diameter of intercondylar area: The maximum transverse diameter at following three levels: [Table 2]
  - a) Anterior part
  - b) Middle narrow part - at the level of intercondylar eminence.
  - c) Posterior part
7. Anteroposterior diameter of anterior intercondylar area : The maximum distance between anterior borders to a line joining intercondylar eminence.
8. Anteroposterior measurement of posterior intercondylar area : The maximum distance between a line joining intercondylar eminence and posterior border.
9. Proximal epiphyseal breadth : Distance between the two most laterally projecting points on the medial and lateral condyles on the proximal articular region. [Table 4]

### Statistical Analysis :

The morphometric measurements are taken by using a digital vernier caliper and are tabulated and statistical analysis is done by using SPSS software. [Fig 1]

### III. RESULTS :

This morphometric study conducted on adult human tibiae of Indian population revealed the under-mentioned important observations.

N= 100	Diameter (mm)	side	Max(mm)	Min (mm)	Standard deviation	P value
MEDIAL	Antero posterior	Right	49.5	29.5	43.56±3.43	0.48
		Left	49.64	39.08	43.54±2.45	
	Transverse	Right	32.43	24.04	28.20±2.06	0.38
		Left	32.68	24.20	28.12±2.38	
LATERAL	Antero posterior	Right	38.62	26.84	32.25±3.57	4.99
		Left	42.91	33.42	37.96±2.37	
	Transverse	Right	32.64	23.45	27.41±2.43	0.25
		Left	32.74	23.61	27.61±2.26	

**Table 1. AP and Transverse Measurements of Medial & Lateral Tibial Condyle**

N= 100	Diameter (mm)	side	Max(mm)	Min (mm)	Standard deviation	P value
Inter condylar area	Antero posterior	Right	48.92	24.62	43.87±4.76	0.01
		Left	49.89	41.04	45.84±2.72	
Intercondylar Transverse	Anterior	Right	25.02	20.69	23.35±1.07	0.01
		Left	28.31	20.34	23.77±1.57	
	Middle Narrow	Right	8.42	6.24	7.13±0.62	0.38
		Left	7.97	6.05	7.11±0.57	
	Posterior	Right	8.56	7.14	7.62±0.32	2.10
		Left	6.98	6.12	6.53±0.27	

**Table 2. AP & Transverse Measurement of Intercondylar Area at the Levels of Anterior, Middle Narrow Part, & Posterior part**

N= 100	Diameter (mm)	side	Max(mm)	Min (mm)	Standarddeviation	P value
Anteroposterior	Anterior Intercondylararea	Right	24.01	15.62	23.80±1.97	0.01
		Left	27.27	17.38	23.21±1.93	
	Posterior Intercondylararea	Right	24.01	15.62	20.00±1.97	3.14
		Left	27.67	17.38	22.60±1.97	

**Table 3. The table showing comparison of anteroposterior measurement of anteriorintercondylar area between right and left sides.**

N= 100	side	Max(mm)	Min (mm)	Standarde deviation	P value
Proximal epiphyseal breadth	Right	79.7	62.33	69.28±4.17	0.16
	Left	79.75	36.2	68.57±6.33	

**Table 4. Comparison of proximal epiphyseal breadth between right and left sides.**

In the present study out of 100 bones, The mean anteroposterior and transverse diameters of medial condyles were more on right than left side, and the difference was statistically insignificant (P value = 0.38 & 4.99). In this study, there was a statistically insignificant left side increase in AP & transverse diameters of both lateral condyles. The anteroposterior measurement of intercondylar area is more on left than right side, which was statistically significant (P value = 0.01). The Transverse measurement of anterior intercondylar area is more on left than right side, which was statistically significant (P value = 0.01) while the intercondylar transverse diameters of middle narrow and posterior borders were insignificant with a slight shift to the right side. (P value = 0.38 & 2.1). On comparison of AP diameter of the Anterior & posterior intercondylar area there was a significant shift to the right side in the anterior border (P value = 0.01). The comparison of the proximal epiphyseal breadth of both sides was not significant (P value = 0.16).

#### IV. DISCUSSION :

Although many studies were done on Morphometric parameters of the upper end of tibia, the data of comparison of measurements of Indian population with the rest of the world & emphasis on regional differences in India has been limited. Hence this study attempts to appraise and compare the morphometric parameters of the upper end of tibia in south Indian population.

In current study the mean value of anteroposterior measurement of medial condyle on right side is 43.56mm and on left side is 43.54 mm. A study done by Srivastava et al.[3] in North india in 2014, observed values in Right & Left side were 38.63mm & 39.94mm, and the values are much lower than the present study. In the Work done by Ugochukwu et al.[4] in Nigerian Population in 2016, the AP diameters of medial & lateral condyle were 46.1 mm & 48 mm and the values are higher than present study. In a study done by Muralimanju et al. [5] in south Indian population in 2016, the values are lower than the present study. In a study done by Zalawadia et al [6] in Gujarat Population in 2018, the values were much closer to the present study. On comparison with a study done by Gandhi et al [7] the AP & transverse diameters of medial and lateral condyles were much higher than the present study. The comparisons of the anteroposterior, transverse measurements of medial & Lateral condyles of present study with between various studies from within India and different ethnicities are depicted in table 5.

Study & Year	Right Side				Left side			
	AP diameter of Medial condyle	Transverse diameter of Medial condyle	AP diameter of lateral condyle	Transverse diameter of Lateral condyle	AP diameter of Medial condyle	Transverse diameter of Medial condyle	AP diameter of lateral condyle	Transverse diameter of Lateral condyle
Srivastava Aet al. [3] (2014)	38.63 mm	29.73 mm	36.47 mm	29.21 mm	39.94 mm	27.5 mm	36.94 mm	29.77 mm
Zalawadia et al [6] (2018)	44.27 mm	28.3 mm	38.2 mm	27.1 mm	44.57 mm	28.3 mm	38.5 mm	27.3 mm
Ugochukwu et al [4] (2016)	46.1 mm	30.3 mm	48 mm	29.6 mm	45.1 mm	31.5 mm	49.2 mm	31.3 mm
Gandhi S et al [7] (2014)	48.45 mm	30.18 mm	40.86 mm	28.6 mm	47.73 mm	29.38 mm	40.69 mm	28.8 mm
Muralimanju BVet al[5] (2016)	40.6 mm	26.9 mm	34.8 mm	26.5 mm	39.2 mm	26.6 mm	32.6 mm	25.7 mm
Zhang et al [8] (2019)	46.5 mm		41.95 mm					
Present study	43.56 mm	28.2 mm	32.25 mm	27.41 mm	43.54 mm	28.12 mm	37.96 mm	27.61 mm

**Table 5 : Showing anteroposterior, transverse measurements of medial & Lateral condyles of both sides**

Study & Year	Right Side				Left side			
	Antero Posterior	Transverse (anterior end)	Transverse (middle narrow part)	Transverse (posterior end)	Antero Posterior	Transverse (anterior end)	Transverse (middle narrow part)	Transverse (posterior end)
Kwak et al [10] korean	47.3 mm				47.3 mm			
Gandhi et al [7]Northindian	47.1 mm	24.8 mm	7.1 mm	7.1 mm	49.1 mm	25.4 mm	7.4 mm	7.4 mm
Jacobsen [11] Danish		35 mm	11 mm	16 mm				
Reeti et al[12] Bihar	47.2 mm	24.71 mm	7.21 mm	14.14 mm	49.06 mm	26.13 mm	7.85 mm	13.24 mm
Present study	43.8 mm	23.35 mm	7.13 mm	7.6 mm	45.8 mm	23.7 mm	7.11 mm	6.5 mm

**Table 6 : Comparison of measurements of intercondylar area**

The anteroposterior measurement of intercondylar area in Korean population done by Kwak et al, irrespective of side and sex were 47.3+3.8mm which were higher than the observations from our study. In a study in Danish population by Jacobsen [11] transverse diameters of intercondylar area at different levels irrespective of sex and side, the values depicted in table5, were higher when compared to our parameters. In a study done by Gandhi etal [7] & Reetiet al [12] in North Indian population the transverse measurements of the intercondylar area were comparable to the present study done in south Indian population.

Jacobsen [11] in a study in Danish stated that the shape of posterior contours of the tuberculum mediale and laterale can serve as landmark which was corroborated by the Gonylaxometry radiological measurements of Kennedy and Fowler [13]. As revealed in multiple studies the incongruence of medial and lateral plateau may play a pivotal role in unicompartmental knee arthroplasty [14] and we hope that the morphometric analysis of the proximal articular surface of tibia of present study and others might be beneficial in designing befitting knee prosthesis for unicompartmental and total knee replacements in Indian population.

## V. CONCLUSION :

The current study in anyway has no claim to comprehensiveness much less to exhaustiveness, but a modest attempt to cast a light on the morphometric attributes of upper end of tibia in Indian population and to validate ethnic and regional differences in measurements. Even though many studies were conducted on the data of Tibial condylar measurements, the comparative studies within different ethnic groups and races are minimal. The data obtained in the present study would ostensibly provide a scientific basis for designing the optimal tibial component for partial and total knee arthroplasty for Indian population.

## VI. LIMITATION :

A limitation of the present study is the lack of parameters for comparison between genders

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