

## Morphometric Sexual Dimorphism of Tibial Tuberosity in Maharashtra

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### Abstract

*Introduction:* The revolutionary changes in the surgical treatment of unicompartmental and total knee arthroplasty make it important for surgeons and radiologists to acquaint themselves with relevant knowledge pertaining to the morphometry of tibial tuberosity and its clinical significance. *Material and Methods:* This study was undertaken on 122 normal dry adult human tibia of known sex and side (62 males & 60 females) in terms of Distance of tibial tuberosity from anterior border of inter condylar area, length and breadth in upper smooth part and lower rough part of tibial tuberosity. *Result:* Different parameters in male and female bones were taken on right and left side, the differences among them are significant. *Conclusions:* Sound knowledge of tibial tuberosity morphometry and variability helps orthopaedic surgeon in carrying out surgical procedures

**Keywords:** Sexual Dimorphism; Tibial Tuberosity; Knee Arthroplasty.

### Introduction

According to Hughes ES et al (1946) [1] tibial tuberosity varies from a faint elevation to a prominent part of bone which instigates 2cm below the anterior margin of tibial plateau. Shape size and position of Tibial tuberosity are particularly essential in extension of knee joint. Weight bearing is mainly related to extended knee joint.

Tibial tuberosity develops from secondary ossification centre at the upper end of tibia. Tibial tuberosity is apophysis ossifies in traction [2]. Fusion of proximal tibial epiphysis with apophysis may leave behind a mechanically vulnerable area which predisposes the tuberosity to avulsion injury. Also an accurate and repeatable morphometric system of tibial tuberosity aids in definition of tibial deformity,

improvement of prosthesis design which requires adequate sizing specific to population in knee arthroplasty [3].

Non-union between epiphyseal part of tibial tuberosity and diaphysis is common in tibial tuberosity fracture. Hence, it is important for surgeons and radiologists to acquaint themselves with relevant knowledge pertaining to the morphometry of tibial tuberosity and its clinical significance [4].

### Material & Methods

With prior approval of the ethical committee, study was carried out over 122 normal dry adult human tibia of known sex and side. They were grouped side and sex wise. All measurements recorded with Digital Vernier Calliper (Min. count 0.01mm).

Length and breadth of both upper smooth and lower rough part were measured. Also the distance of tibial tuberosity from anterior border of inter condylar area was taken at its maximum measurement as shown in Figure 1.

1. *Distance of tibial tuberosity from anterior border of inter condylar area (CD)* distance taken from anterior border of inter condylar area to upper smooth part of tibial tuberosity Figure 2.

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2) Upper Smooth Part

- i. Length (EF) vertical distance taken from highest point on upper smooth part of tibial tuberosity to horizontal ridge separating upper smooth and lower rough part of tibial tuberosity Figure 3(i).
- ii. Breadth (GH) taken at maximum width of upper smooth part of tibial tuberosity Figure 3(ii).

3. Lower Rough Part

- i. Length (FG) vertical distance taken from horizontal ridge separating upper smooth and lower rough part of tibial tuberosity to the point where lower end of rough part of tibial tuberosity where it continue as anterior border of tibia Figure 4(i).
- ii. Breadth (JK) taken at maximum width of lower rough part of tibial tuberosity Figure 4(ii).

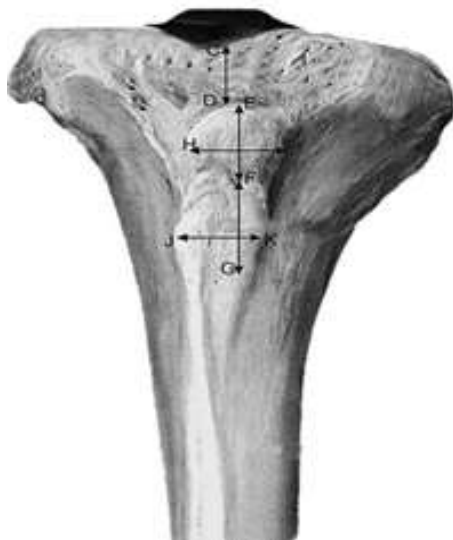


Fig. 1: Measurement of all parameters of tibial tuberosity



Fig. 3(i): Length of upper smooth part



Fig. 3(ii): Breadth of upper smooth part



Fig. 2: Distance of tibial tuberosity from anterior border of intercondylar area



Fig. 4(i): Length of lower rough part



Fig. 4(ii): Breadth of lower rough part

done. Data expressed as (Mean ± Standard Deviation). A paired t-test was applied and p-value yielded. The statistical analysis was done by using SPSS (20).

**Results**

The measurement of different dimensions of tibial tuberosity viz. Distance of tibial tuberosity from anterior border of inter condylar area, length and breadth in upper smooth part and lower rough part are taken and shown age-wise, gender-wise and side-wise in tabulated form. The study sample includes 122 normal dry adult human tibia in which 62 were males (50.8%) and 60 (49.2%) females. Collected data was compared with previous studies

*Statistical Analysis*

Statistical analysis of different parameters were

*Study Group*

**Table 1:** Sex and Side Distribution

Sex	Right	Left	Total
Male	31	31	62
Female	30	30	60

*Distance of Tibial Tuberosity from Anterior Border of Inter Condylar Area (CD)*

Mean values of Distance of tibial tuberosity from anterior border of inter condylar area (CD) were compared sex and side wise. In sex wise comparison the difference between male and female found

significant on left side whereas, male had higher values on right side but difference was insignificant Table 2 (a). While, sidewise comparison among right and left side shown significant difference in female whereas, male had higher values on left side but difference was insignificant Table 2(b).

**Table 2 (a):** Sex wise comparison

Side	Sex	(Mean ± SD) in mm	P value
Right	M	17.48 ± 2.26	>0.05 Non significant
	F	16.78 ± 2.25	
Left	M	18.26 ± 3.25	<0.01 Significant
	F	13.35 ± 2.98	

**Table 2 (b):** Side wise comparison

Sex	Side	P value
M	Right	>0.05 Non significant
	Left	
F	Right	<0.01 Significant
	Left	

*Length of Upper Smooth and Lower Rough Part*

Mean values of Length were compared sex and side wise in upper smooth and lower rough part of tibial tuberosity. In sex and side wise comparison the

difference was significant in upper and lower part of tibial tuberosity except, in female where right side had little higher values in lower part of tibial tuberosity Table 3 (a and b).

**Table 3 (a):** Sex wise comparison

Length	Side	Sex	(Mean ± SD) in mm	P value
Upper part	Right	M	<b>17.07± 3.24</b>	<0.01
		F	14.79 ± 3.04	<b>Significant</b>
Lower part	Left	M	19.11 ± 3.24	<0.01
		F	12.024 ± 3.45	<b>Significant</b>
	Right	M	<b>31.90± 5.09</b>	<0.01
		F	25.80± 4.87	<b>Significant</b>
Left	M	38.33± 6.20	<0.01	
	F	25.67± 6.00	<b>Significant</b>	

**Table 3 (b):** Side wise comparison

Length	Sex	Side	P value
Upper part	M	Right	<0.01
		Left	<b>Significant</b>
	F	Right	<0.01
		Left	<b>Significant</b>
Lower part	M	Right	<0.01
		Left	<b>Significant</b>
	F	Right	>0.05
		Left	Non significant

*Breadth of Upper Smooth and Lower Rough Part*

Mean values of Breadth were compared sex and side wise in upper smooth and lower rough part of tibial tuberosity. In sex and side wise comparison the difference was significant in upper and lower part of

tibial tuberosity except; in male, where left side had higher values in upper part of tibial tuberosity and on right side, where male had higher values in upper part of tibial tuberosity Table 4 (a and b).

**Table. 4 (a):** Sex wise comparison

Length	Side	Sex	(Mean ± SD) in mm	P value
Upper part	Right	M	<b>16.97 ±2.39</b>	>0.05
		F	16.26 ±1.84	Non significant
	Left	M	17.51 ± 1.66	<0.01
		F	12.86 ± 3.22	Significant
Lower part	Right	M	<b>17.44 ± 3.70</b>	<0.05
		F	15.39 ± 2.20	Significant
	Left	M	19.21 ± 2.63	<0.01
		F	13.95 ± 3.89	Significant

**Table. 4 (b):** Side wise comparison

Length	Sex	Side	P value
Upper part	M	Right	>0.05
		Left	Non significant
	F	Right	<0.01
		Left	Significant
Lower part	M	Right	<0.05
		Left	Significant
	F	Right	<0.05
		Left	Significant

**Discussion**

The present study demonstrates various dimensions of tibial tuberosity. Series of observations revealed previously unreported anatomic study of tibial tuberosity. Morphometric study of tibial

tuberosity is an important tibial component to observe proper postoperative alignment of prosthesis. Ultimately it determines success of arthroplasty and present a challenge to the operating orthopaedic surgeon [5].

Earlier Hughes ES and Sunderland S (1946) [1] had measured the distance of tibial tuberosity from anterior border of inter condylar area to be 20 mm in Australian population but irrespective of side and sex but, in present study values are towards lower side. This distance could be of great significance in case of intramedullary nailing in tibial fracture.

In present study, the mean difference in different parameters of tibial tuberosity is towards lower side as compared to study carried by Swati G, et al. (2015) [4]. This variation could be due to different ethnic origins of samples.

In India one of the commonest mode of sitting is squatting. Extensive flexion of knee joint in squatting position brings about some adaptations in upper end of tibia due to friction of quadriceps tendon [6,7].

### Conclusion

The literature search revealed limited documentation of morphometric study of tibial tuberosity in Maharashtrian population. So, this study will be helpful to anatomists, arthropologists and radiologists.

Sound knowledge of tibial tuberosity morphometry and variability helps orthopaedic surgeon in carrying out surgical procedures like unicompartmental and total knee arthroplasty. Also this study will give basis for designing the optimal tibial component during arthroplasty.

Finally, we had made an attempt to study mean differences of different sex and side compared gender and side wise.

### List of Abbreviations

- F – Female
- M – Male
- mm – Millimeter
- SD – Standard Deviation

*Conflict of Interests:* None

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