



Analysis of Tibial Tuberosity: Variations in Prominences and Morphometry

KEYWORDS

Tibial Tuberosity, Prominense, Morphometry

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ABSTRACT *Objective: The main objective of the present study was to determine the prominence of Tibial Tuberosity (TT) and the morphometry and analyse the side and gender differences Methods: 170 randomly collected tibia of unknown sex was analyzed to evaluate the measurements of the TT. All the bones selected were dry and showed normal anatomical features.*

Results: The length and breadth were more in males than females which was statistically significant except for the proximal breadth. There were no side and gender differences in the prominence of TT.

Conclusion: This is a baseline data on the osteometric characteristics of the TT. The statistically significant differences in these dimensions in males and females are important in interpreting diagnostic images. The osteological characteristics and mean morphometric tibial parameters may be considered to be important determinants of sex, race and identity for forensic investigation.

INTRODUCTION:

The tibia, popularly known as the shinbone, is situated in the antero-medial aspect of the leg parallel to the medial side of the fibula¹. It is the second largest bone in the body, with its length exceeded by that of the femur². The tibial tuberosity is a bony projection seen in the upper end of the tibia. A literature search revealed limited documentation of normal, variant morphological and morphometric measurements and there was no validation of the tibial tuberosity. The main objective of the present study was to estimate the prominence of TT along with the Morphometry and determine the side and the gender differences in 170 adult dry tibias to evaluate the various parameters of the TT.

MATERIALS AND METHODS:

The material for the present study comprised of one hundred and seventy adult human tibia bones. The tibias were collected from the department of Anatomy from various Medical colleges. The Images of the proximal end of the tibia was analysed using Adobe Photoshop version 5. 3 vertical lines were drawn. The first line just touching the edge of the medial condyle, 2nd line passing through the prominence of TT and the third line just touching the edge of the lateral condyle. A horizontal line was drawn touching the most prominent point of the TT. The prominence of TT was assessed by drawing a horizontal line across the base of the TT.



Fig 1: Analysis Of The End On View Photograph Using Adobe Photoshop

The Morphometry of TT was assessed using digital calipers. The Total length was measured in midline from the point where TT begins to the point where it continues as the anterior border of tibia. Then, separate measurements for proximal and distal parts of TT were done in midline. The maximum breadth of the entire TT was measured. Then, maximum breadth of proximal and distal parts was separately measured



Fig 2 : Measurement Of Total Length Of TT

RESULTS:

Parameter	n (r+l)	Mean difference 95%CI of mean difference	P value
Whole length	101+69	-3.26 -5.74 – -0.78	0.01 ¹
Proximal length	73+52	-0.02 -1.45 – 1.41	0.98 ¹
Distal length	73+52	-3.6 -5.94 – -1.25	0.004 ²

Maximum breadth	101+69	1.03 0.25 – 1.82	0.01 ¹
Proximal breadth	73+52	0.76 -0.14 – 1.68	0.1 ¹
Distal breadth	73+52	-0.53 -1.51 – 0.44	0.283 ¹

Table 1: Differences in morphometry of TT between right and left sides

The whole length of TT was more on left side than right which was statistically significant. The distal length of TT was more on left side than right which was statistically significant. The maximum breadth of TT was more on the right side than on the left with a statistical significance of 0.01.

Parameter	n (males + females)	Mean difference 95%CI of mean difference	P value
Whole length	75+95	5.48 3.12 – 7.84	<0.001 ¹
Proximal length	56+69	1.42 0.02 – 2.82	0.047 ¹
Distal length	56+69	3.58 1.25 – 5.91	0.002 ²
Maximum breadth	75+95	2.10 1.38 – 2.82	<0.001 ¹
Proximal breadth	56+69	0.58 -0.33 – 1.49	0.209 ¹
Distal breadth	56+69	2.44 1.56 – 3.31	<0.001 ¹

Table 2 : Differences in morphometry of TT between males and females

The length and breadth were more in males than females which was statistically significant except for the proximal breadth.



Fig 3: demonstrates the most, intermediate and the least prominence of TT

	Mean difference (cm)	95% CI of the mean difference	P value (non parametric test-Mann Whitney U test)
Right vs left	-0.045	-0.105 – 0.014	0.143
Males vs females	0.025	-0.035 – 0.08	0.554

Table 3: Differences in the prominence of TT between right and left sides and males and females

There were no statistically significant differences between the sides or gender. The prominence of TT was more on the left side than the right. However it was not statistically significant. The prominence of TT was more in females than males on the right side. However it was not statistically significant. In the left side the prominence of TT was more in males than females. However it was not statistically significant.

DISCUSSION AND CONCLUSION

The size, shape and position of tibial tuberosity are particularly essential in the extension of the knee joint³. According to Hughes ES et al (1946) the tibial tuberosity varies from a faint elevation to a prominent part of bone which instigates 2cm below the anterior margin of tibial plateau⁴ (2). According to our study the most prominent point of TT was 6.8mm from the surface of the tibia. This point as stated above was usually located in the proximal part of the TT, the site of attachment of patellar tendon. Hence, confirming the concept of traction apophysis of TT caused by the amount of force transmitted by the ligamentum patella.

There were no side or gender differences in prominence of TT. This could be due to the fact that the study was not powered to analyse the differences in the prominence of TT. Hence larger sample may be required to find out whether there is side or gender difference in prominence of TT. From the results it was noticed that the proximal length was less than distal length and the proximal breadth was more than distal breadth of TT. This explains the insertion of the Patellar tendon into the proximal part of the TT.

The morphometry of TT was analysed for side differences. It was noted that the whole and distal length of TT was more on left side than on right which indicates that the vertical extent of the attachment of the fibres of patellar tendon is less on left than right. This is further strengthened by the point that the maximum breadth of TT is more on right side than left side, i.e. wider and firm attachment of patellar tendon on right side. Further morphometry of TT was analysed for gender differences. It was found that all the parameters measured for the morphometry of TT except for the proximal breadth was more in males than females indicating the increased amount of force transmitted by the patellar tendon in males thus increasing the dimensions of TT. This is further supported by the fact that TT is a traction apophysis.⁵

In Conclusion the analysis of the prominences and the morphometry of the TT observed in this study should be taken into account especially by Surgeons, Orthopaedecians and Radiologists. The details obtained will also be helpful for the morphologists and clinical anatomists. The values noted during the present study are more consistent with the study conducted by Swathi G⁶. The difference seen between the values of present study and that of other workers could be explained on the basis of ethnic and racial variations.

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