

Research Article

Digital analysis of the placement of the tibial tuberosity

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ABSTRACT

Background: The tibial tuberosity is a roughened prominence that serves as the attachment site for the ligamentum patellae and typically varies in size and shape. The objective was to determine the vertical and horizontal position of the tibial tuberosity (TT) and determine the side and the gender differences in 170 adult dry tibias.

Methods: 170 randomly collected tibiae of unknown sex were analysed to evaluate the position and the gender differences in the tibia. Horizontal position was assessed using 2 digital photographs of the upper end of the tibia, one being end on view and the other frontal view. The picture thus taken was transferred to the computer and analysed using adobe photoshop version 5.0 software.

Results: There was a significant difference (p value = 0.013) in the horizontal position of TT in end on view. The horizontal position of TT (frontal view) was more laterally placed on the right side than the left which was statistically significant (p value= 0.017, nonparametric test). The horizontal position of TT (end on view) was more laterally placed on the left side than right which was not statistically significant. There was no difference in the vertical position of TT.

Conclusion: From the results, it can be inferred that, the TT is placed more laterally and occupies approximately 6% of the total length of the tibia in all 170 bones.

Keywords: Tibia, Tibial tuberosity, Horizontal- vertical position

INTRODUCTION

Understanding variation as it is expressed at the individual and population level as well as for the time and space is essential for the biological reconstruction. The study of human variation is typically employed to discern and comprehend the nature of this variation in respect to age, sex, and group affiliation. The tibial tuberosity is a roughened prominence that serves as the attachment site for the ligamentum patellae and typically varies in size and shape.¹ A literature search revealed limited documentation of normal, variant morphological and morphometric measurements and there was no validation of the tibial tuberosity. The size, shape and the position of

the tibial tuberosity is essential in the extension of the knee joint.² The central tenet of anatomic reconstruction is that a closer replication of the natural anatomy can better restore the knee joint function, and is less likely to cause impingement on or iatrogenic injury to adjacent structures.³⁻⁷

The main objective of the present study was to determine the vertical and horizontal position of the TT and determine the side and the gender differences in 170 adult dry tibias. The present study will provide valuable parameters which would help forensic experts, anthropologists and the orthopaedecians.

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. Horizontal position was assessed using 2 digital photographs of the upper end of the tibia, one being end on view and the other frontal view. The picture thus taken was transferred to the computer and analysed using adobe photoshop version 5.0 software (Figure 1).



Figure 1: Method of taking end on view photograph of upper end of tibia.



Figure 2: Analysis of the end on view photograph using adobe photoshop.

Analysis; A horizontal line was drawn touching the most prominent point of the TT. Then 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. In the above photograph the prominence of TT was also assessed by drawing a horizontal line across the base of the TT (Figure 2 and 3).

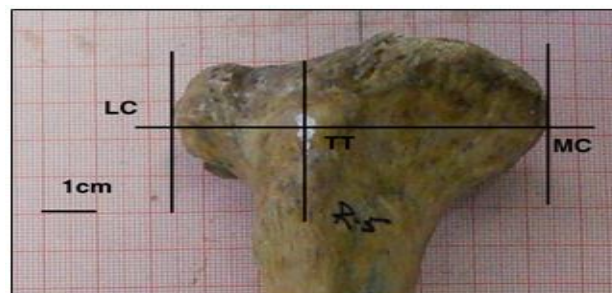


Figure 3: Analysis of the frontal view photograph using adobe photoshop.

RESULTS

There was a significant difference (p value = 0.013) in the horizontal position of TT in end on view. The horizontal position of TT (end on view) was more laterally placed on the left side than right which was statistically significant (p value= 0.013, nonparametric test).The horizontal position of TT (frontal view) was more laterally placed on the left side than right which was not statistically significant. There was no difference in the vertical position of TT.

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Table 1: Differences in the vertical and horizontal position of TT between right and left sides.

Parameter		n (r+l)	Mean difference 95 %CI of mean difference	P value
Horizontal position	Mc/lc ratio end on view	101 +69	-0.1 -0.19 – -0.01	0.0132
	Mc/lc ratio end on view	101 +69	0.12 -0.09 – 0.32	0.4432
Vertical position TT/L		101 +69	0.002 -0.002 – 0.006	0.311

There were no significant differences between males and females in the vertical and horizontal position of TT.

There was no statistically significant difference in the vertical and horizontal position of TT of right tibiae between males and females. The horizontal position of

TT was more laterally placed in males than females in frontal view which was statistically significant (p value= 0.04, non-parametric test). There was no statistically significant difference in horizontal position (end on view) and vertical position of TT. To assess which view was more appropriate to determine the horizontal position of TT, Pearson's correlation was done on a, b and a/b (vide supra). It was noted that there was a significant difference of a and b in both views (p value= 0.004 & 0.017

respectively). However, there was no statistical difference in a/b.

Further paired sample test was done over the above values in both views and was found that the difference was statistically significant (p value<0.001). Thus, it indicates that end on view is more accurate than the frontal view to determine the horizontal position of TT (Table 2).

Table 2: Differences in the vertical and horizontal position of TT between males and females.

Parameter	n (r+l)	Mean difference 95%CI of mean difference	P value (Independent sample test)
Horizontal position Mc/lc ratio end on view	75+95	0.043 -0.05 – 0.14	0.268 ²
	75+95	-0.05 -0.25 – 0.16	0.886 ²
Vertical position TT/L	75+95	-0.002 0.006 – 0.003	0.464 ¹

DISCUSSION

From the results, it can be inferred that, the TT is placed more laterally and occupies approximately 6% of the total length of the tibia in all 170 bones. When the horizontal position was analysed for side differences, TT was more laterally placed on the left than on the right probably indicating that the stronger and powerful attachment of vastus medialis on right side when compared to left, thus placing TT more medially on right when compared to the left side. The position of TT is further influenced by the dominance of the limbs which in general is the right lower limb, thus making it more powerful when compared to left. TT occupies approximately 6% of the total length of the tibia on both right and left sides.

Further the vertical and horizontal position of TT was analysed for gender differences. It was noted that there was no significant gender differences. It's of interest to note that in an Indian study done on live subjects, it was concluded that the TT is more laterally placed in females than in males.⁹ One possible reason for the above difference in the opinion might be, in the former study live volunteers were used and the present study involved the assessment of position of TT on actual bones. When palpating the TT on live subjects the part of the TT which is palpable is the distal half of the TT, i.e the subcutaneous area. Whereas, in the present study the most prominent point of TT used to ascertain the position of TT was usually located in the proximal part of the TT, the site of attachment of patellar tendon. This may one of the reasons for difference in opinion. Another factor which must be considered is, in live subjects, apart from the bony architecture, there are other dynamic factors governing the palpable position of TT. Thus, resulting in

difference in opinions in studies using live volunteers and dry bones.

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