

# Normative Value of Patellar Tendon Thickness in Indian Young Adult Population - A Cross Sectional Study

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### ABSTRACT

**Purpose:** *Patellar Tendinopathy (PT) is a highly prevalent condition in lower extremity. Ultrasonography is used as diagnostic tool and outcome measure in clinical trials on PT. As the thickness of the tendon increases in tendinopathy conditions, it is important to establish a normal value of the tendon thickness. Therefore, normal and pathological tendon can be differentiated from each other. Though normal tendon thickness was established for western country population, it is important to have a normal reference value for Indian population as Indians belong to different race and ethnic background. So, the purpose of the study was to establish a normative data of patellar tendon thickness in young Indian adult population.*

**Methodology:** *A total of 48 subjects, 28 males and 20 females were included based on inclusion and exclusion criteria. The inclusion criteria were subjects aged between 18 and 35 years of age, both male and female, currently not suffering from any of the musculoskeletal pain in the lower extremity. Included subjects were positioned supine with mild knee flexion and undergone ultrasound measurement of patellar tendon thickness at both 0.5 centimetres proximal to the tibial tuberosity and 0.5 centimetres distal to the apex of the patellar tendon of both the extremities by an experienced radiologist. The measurements were recorded in centimetres.*

**Results:** *Patellar tendon thickness of the recruited subjects for right and left side with geometric mean and 95% confidence was calculated. The overall Proximal thickness geometrical mean and confidence interval were. 0.35 (CI 0.34 to 0.37). Meanwhile, the mid and distal thickness were 0.33 (CI 0.32 to 0.35) and 0.35 (CI 0.33 to 0.36) respectively.*

**Original value:** *This is a primary study established a normative value of patellar tendon thickness for young Indian adult population.*

**Paper type:** *A cross sectional study*

**Keywords:** Patellar tendinopathy, Tendon thickness, Ultrasonography, Normative values, Indian young adults.

### 1. INTRODUCTION :

Tendinopathies are prevalent in both lower and upper extremities. The incidence of lower extremity tendinopathies are higher than osteoarthritis [1]. Among all lower extremity tendinopathies, patellar tendinopathy (PT) is highly prevalent in younger adults, with prevalence rate of 32 to 45% in sports involves jumping like basketball and volley ball [2]. The incidence of PT is also high in young elite level athletes [3]. Nearly 53% of the athletes suffering from PT quit their sports career due to recalcitrant and debilitating nature of the symptoms [4]. PT is also prevalent among people who squat and does stair climbing often [5]. The main complaint of the PT patient is anterior knee pain especially in the lower pole of the patella while eccentric loading and tenderness in the same region [6]. Though various clinical tests are available for diagnosis of PT, it is impractical to figure out PT just based on clinical examination due to various other clinical symptoms that are overlapping PT. Those conditions are fat pad syndrome, deep infrapatellar bursitis, synovial plica and patellofemoral pain syndrome

(PFPS) [7]. Hence, it's important to use imaging techniques to confirm the diagnosis of PT or exclude other possible causes of anterior knee pain [8, 9, 10].

Various imaging techniques are commonly used to diagnose knee pathologies such as X ray, Magnetic Resonance Imaging (MRI), multiple detector computed topography, and colour Doppler ultrasound (US) [11]. Among all, MRI considered to be a gold standard in knee imaging. But US can be used for immediate correlation of knee joint structures and/or pathology in one knee with the other knee joint. US has another added advantage of being non-invasive, widely available, easy to administer and less expensive than MRI [10].

In order to confirm the pathological patellar tendon, the hypoechoic area and the thickness of the tendon are usually measured either at 5 centimetres distal to the apex of the patella or 5centimetres proximal to the tibial tuberosity [12]. But, various factors such as age, body weight, gender, ethnicity, and habitual physical activity would determine patellar tendon size in healthy individual [11].

As there is no normative data of patellar tendon thickness established in Indian young adult population, it is imperative to know the normal value of it especially antero-posterior thickness. Then, the values can be used as reference standard to differentiate between normal tendon and pathological tendon among young Indian adult population. Therefore, the aim of the study was to find out the normal value of patellar tendon thickness among young healthy Indian adult population.

## **2. OBJECTIVES :**

The main objective of the study was to find out the normal value of patellar tendon thickness among young healthy Indian adult population.

## **3. METHODS :**

It's a cross sectional study. The study was presented before institutional research committee and ethical committee for their approval. After the approval was sought, the data collection was commenced. The subjects were included based on inclusion and exclusion criteria. The inclusion criteria were subjects aged between 18 and 35 years of age, both male and female, currently not suffering from any of the musculoskeletal pain in the lower extremity.

Exclusion criteria were subjects had a history of knee pain within 6 months, history of fractures around the knee in the past 6 months, had a history of surgeries around the knee joint, anybody involved in intense physical activity for at least for the past 6 months were excluded.

A total of 48 subjects, 28 males and 20 females were included in the study. Subjects' age, hand dominance, height, weight and Body Mass Index (BMI) were collected. The subjects were positioned supine with knee in mild flexion and undergone ultrasound measurement of antero-posterior patellar tendon thickness at both 0.5 centimetres proximal to the tibial tuberosity and 0.5 centimetres distal to the apex of the patellar tendon by an experienced radiologist [13] [fig 1]. Mid portion of the antero-posterior tendon thickness also measured in our study according to the previous study [14].

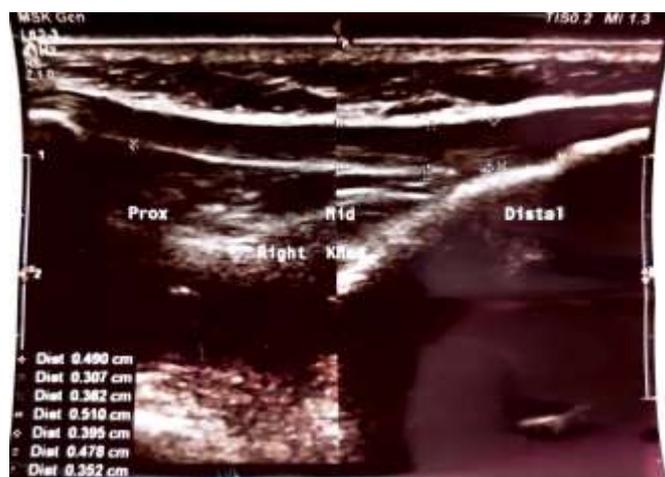
The Philips ultrasonography was used to measure the tendon thickness. Affinity 90 scanner™ with a 14 MHz linear array transducer was used to look for the tendon thickness on both right and left sides. The measurements were recorded in millimetres.

Sample size calculation for estimating means,  $n = [(Z\alpha \times \sigma)/d]^2 d = 0.02 \sigma = 0.07 n = [(1.96 \times 0.07) / 0.02]^2 n = (1.96 \times 3.5)^2 n = (6.86)^2 n = 47.1$  number = 48. All the data from the recruited subjects were verified for the normal distribution using Shapiro-Wilk test. As the data deviate from the normal distribution, descriptive statistics were reported using geometric mean with 95% confidence interval for the demographic parameters and the outcome scores. In addition to the above, minimum and maximum value of demographic parameters were expressed as range. Wilcoxon Signed Rank test was used as inferential non-parametric statistics to highlight the difference between left and right patellar tendon thickness. For all the statistical analyses, the level of significance was set at  $p < 0.05$ . This would limit Type-I error to less than 5%. Data were analysed using the statistical software, statistical package for the social sciences (SPSS) version 20.0 (Armonk, NY: IBM Corp.) for Windows 10.

## **4. RESULTS :**

The demographic parameters of the recruited samples were tabulated in Table 1. Patellar tendon thickness of the recruited subjects between left and right side with geometric mean with 95% confidence were tabulated in Table 2 and Table 3 tabulates the normative data of Patellar tendon thickness of recruited subjects (n=48& 96 knees). There exists positive correlation between weight and

BMI with patellar tendon thickness at proximal level with  $\rho=0.381$  ( $p=0.020$ ) and  $\rho=0.559$  ( $p<0.001$ ) respectively. While no correlation was exist at other levels.



**Fig. 1:** Measurement of patellar tendon thickness at proximal, mid and distal portion

**Table 1:** Demographic parameters of the sample recruited (n=48&96 knees)

Demographic parameters	Geometric mean (95% CI)	Range
Age (Years)	27.7 (18.6 to 34.3)	18 to 35
Height (cm)	163.5 (160.4 to 167.1)	144 to 180
Weight (kg)	58.4 (55.1 to 64.7)	40 to 100
BMI (Kg/m <sup>2</sup> )	21.8 (20.9 to 23.4)	16.1 to 31.6

**Table 2:** Patellar tendon thickness between the right and left side (n=48&96 knees)

Patellar tendon thickness	Right side	Left side	p-value
Proximal-level	0.35 (0.34 to 0.38)	0.35 (0.33 to 0.37)	0.809
Mid-level	0.33 (0.32 to 0.35)	0.33 (0.31 to 0.36)	0.426
Distal-level	0.35 (0.34 to 0.37)	0.34 (0.32 to 0.36)	0.110

\* - Wilcoxon Signed Ranks Test

**Table 3:** Patellar tendon thickness among the sample recruited (n=48&96 knees)

Patellar tendon thickness	Geometric mean (95% CI)	Range
Proximal-level	0.35 (0.34 to 0.37)	0.28 to 0.49
Mid-level	0.33 (0.32 to 0.35)	0.23 to 0.51
Distal-level	0.35 (0.33 to 0.36)	0.25 to 0.43

## 5. DISCUSSION :

This is the first study found the average normal antero-posterior thickness of the patellar tendon among healthy young Indian adult population. In order to differentiate between the normal tendon and pathological tendon, it is important to look for the tendon thickness other than presence of hypoechoic area on ultrasonography [15].

US has been used as one of the inclusion criteria in clinical trials for the diagnosis of patellar tendinopathy [16, 17]. The significance of US in the diagnosis of patellar tendinopathy (PT) is that it helps to rule out other pathological conditions, such as fat pad syndrome, patella femoral pain syndrome (PFPS), plica syndrome causing anterior knee pain. Meanwhile, it reveals the presence of hypoechoic area in the patellar tendon [10].

Other than part of an inclusion criteria, US has also been used as one of the outcome measures in clinical trials exploring the effectiveness of various treatment for PT [16, 17, 18]. As anthropometric variability is observed among different race and ethnicity, it is imperative to establish a normative value of the patellar tendon thickness in people living in different geographical location. So, the values can be used

as reference standard to compare the pre and post intervention values in order to quantify the treatment efficacy in that specific population [11].

According to the previous study, the patellar tendon thickness is more in pathological tendon compared to normal tendon. It has been documented that the average normal tendon thickness was 4 mm whereas pathological tendon thickness was 8mm in western population [19]. The reason for increased thickness was attributed to haphazard arrangement of tendon collagen against the normal parallel arrangement. A study on Nigerian population established a cut-off value of 6mm to differentiate between normal tendon and pathological tendon [11]. Another study done on elite university level athletes in Japan found that 7mm was the cut off value to differentiate between normal and pathological patellar tendon. Whereas, in our study the average value of 3.5 mm (0.35 cms) was considered as normal value and cut off score to differentiate between normal tendon and pathological tendon at proximal and distal measurement sites [20].

Our study results (3.5 mm) are almost similar (3.8 mm) to the Japanese population study the 0.35 cms or 3.5 mm value may be used as reference values in future studies to compare the efficacy of treatment on PT among young Indian adults. Moreover, our study positive correlation exists between weight and BMI only at proximal level. Therefore, body weight and BMI may not be the factors to influence the tendon thickness in healthy Indian adults.

The reason for finding the normative values only for young Indian adults was that PT is more prevalent on young adult population than elderly people. In addition to that, due to high prevalence of patellar tendinopathy among males and frequently observed patellar tendon abnormality among males are the reasons for adding male subjects more than females in this study [21].

This study has its own limitation. The sample size of 48 may not be sufficient enough to represent the whole Indian population. Therefore, future study is warranted with larger sample size.

## 6. CONCLUSION :

This study has established a normative value of patellar tendon antero-posterior thickness among young Indian adults.

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