Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1132039
J Health Sci Med 2022; 5(6): 1672-1675

Evaluation of iliotibial band volume with 3T MRI

Bünyamin Güney, Murat Yunus Özdemir, Emrah Doğan
Muğla Sıtkı Koçman University, Faculty of Medicine, Department of Radiology, Muğla, Turkey

Cite this article as: Güney B, Özdemir MY, Doğan E. Evaluation of iliotibial band volume with 3T MRI. J Health Sci Med 2022; 5(6): 1672-1675.

ABSTRACT

Aim: The aim of our study is to evaluate the iliotibial band thickness (ITBT) and volume (ITBV) according to age and gender with 3 T MRI in a healthy Turkish population.

Material and Method: In the current study, 150 patients who had knee MRI were retrospectively evaluated. They were divided into the following groups to examine the effects of age: group 1: 18–30 years old; group 2: 31–40 years old; group 3: 41–50 years old; and group 4: 51–60 years old. ITBV measurements were performed on axial T2-weighted knee MR images.

Results: The mean age was 42.2±29.6 (range 18-60) years. The mean ITBT was 1.76±0.22 mm and the mean ITBV was 20,24±1,44 mm3 in all patients. There was statistically significant difference in mean iliotibial band thickness and volume between genders (p=0.001; p=0.001). There were no statistically significant differences in mean iliotibial band thickness and volume values between the groups in the one-way ANOVA test (p >0.05).

Conclusion: Radiological studies on iliotibial band thickness and band area in healthy individuals are new in the literature. This study is the first radiological study in which the volume of the iliotibial band was measured in healthy individuals and was performed on a 3 tesla MR device. Also, it is the first study that is used artificial intelligence for iliotibial band evaluation and the technic is effective and more rapid according to our experience. ITBV and ITBT are statistically significantly higher in males than females. Most thick ITB was detected between the ages of 31-40. The values of our study, especially ITBT, differ from previous studies and the values are altered in a wide range. Therefore, standardization in the calculation is necessary. This topic is open to future research.

Keywords: Artificial intelligence, friction syndrome, iliotibial band, MRI scans

INTRODUCTION

The iliotibial band (ITB) is a lateral thickening of the fascia latae of the thigh. The ITB occurs proximally at the level of the greater trochanter, as the fascial junction of the tensor fascia latae, the gluteus maximus and gluteus medius muscles. It progresses distally, attaches to the supracondylar tubercle of the femoral condyle and distal to the knee joint, to the Gerdy tubercle on the anterolateral aspect of the proximal tibia (1). When the knee is in full extension and flexed 20° to 30°, the ITB lies anterior to the lateral femoral epicondyle and acts as an active knee extensor. At 20° to 30° flexion, the ITB takes a posterior position relative to the lateral femoral epicondyle and becomes an active knee flexor (2).

Friction syndrome occurs as a result of the compression and scouring of different tendon groups between bone and other tendon groups. It is often associated with overuse (3). Iliotibial band friction syndrome (ITBFS) is one of the rare causes of lateral knee pain. Pain is caused by inflammation of the distal portion of the ITB. This syndrome is seen especially in cyclists and runners due to overuse (4). Although the etiology of ITBFS is still unknown, some anatomical variations (limb length difference, genu varum, lower extremity malalignment) excessive pronation, hip adduction weakness, and myofascial restraint was blamed (5). The most accepted cause of ITBFS is, of ITB friction at the level of the lateral femoral epicondyle, it is the compression of the surrounding fat and connective tissue and accordingly the chronic inflammation of ITB (6).

The diagnosis of ITFBS is usually made by physical examination. Typical complaints of the patients are tenderness 1-2 cm above the lateral knee joint and pain that increases with movement in the lateral knee (7). MRI is used to rule out different possible causes and to make a definitive diagnosis. MRI findings are abnormal signal in the adipose tissue between ITB and lateral epicondyle, increased signal in ITB on T2-weighted images, and thickening of ITB (8).

Corresponding Author: Emrah Doğan, dr_e_dogan@hotmail.com
Received: 16.06.2022 **Accepted:** 12.10.2022

In the studies carried out so far, the thickness of the most hypertrophic part of the ITB has been measured. There is still no clear study on the normal values of ITB. The aim of this study is to measure the volume of the part of the ITB distal to the lateral femoral epicondyle and its thickness at the level of the lateral femoral condyle, where it is most compressed, using 3T MRI, and evaluate it according to age and gender in the normal population.

MATERIAL AND METHOD

The study was carried out with the permission of Muğla Sıtkı Koçman University Noninvasive Clinical Resarches Ethics Committee (Date: 06.05.2021, Decision No:178). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This retrospective study was performed in Radiology department. Individuals with any disease (trauma, previous knee surgery, meniscal tear, cruciate ligament tear, collateral ligament tear, those with neurological disease etc.) were excluded from the study. Patient files and imaging findings formed the basis of the study. Generally, patients with nonspecific knee pain were present. Patients with nonspecific symptoms and without pathology who underwent MRI were included in the study. These patients were not diagnosed with any disease during file scans. In the current study, 150 patients who had knee MRIs were retrospectively evaluated. Patients who had knee MRIs in the first 6 months of 2021 were included in the study. Those with poor image quality were excluded from the study.

75 males and 75 females were included in the study. They were divided into groups according to their age and gender: group 1: 18–30 years old; group 2: 31–40 years old; group 3: 41–50 years old; group 4: 51–60 years old; group 5: > 60 years old; group A consisting of 75 men; group B consisting of 75 women. This study was carried out according to the bases of the Declaration of Helsinki. ITBT and ITBV measurements were performed on axial T2-weighted knee MR images. MR images were obtained with a 3 T scanner (Siemens Skyra, Berlin, Germany). Images were obtained with a protocol of 256 × 320 matrix and a 17-cm field of view, repetition time=4200 ms (TR 4200 ms), echo time=43 ms (TE 43 ms), number of excitations=2 (NEX2) and a 2-mm slice thickness.

Volumetric measurement of ITBV was made using 3D Slicer software (3D Slicer software ver. 10.4.2, http://www.slicer.org). The Slicer volumetric measurement program is a free open-source software package developed by Harvard University and approved for medical research. Region of interest (ROI) was adjusted to not exceed the anatomical contours of the band. After dividing the iliotibial band into sections with appropriate threshold values in the axial image, separate MRI numbers were assigned to each image with the slicer software. After each slice containing the relevant iliotibial band sections was revealed and volume calculation was made. Intra-observer variability was set at less than 5% (**Figure 1, 2**).

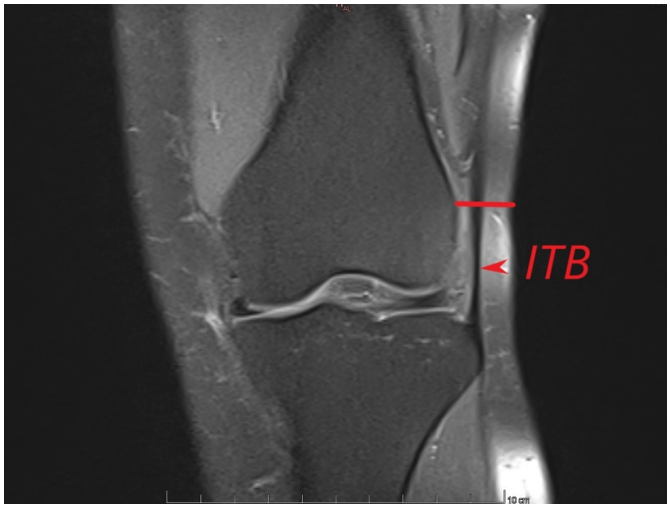

Figure 1. The software calculated ITBV from the proximal point of the tendon, where the lateral condyle makes an angle with the distal metaphysis, to the insertion point.

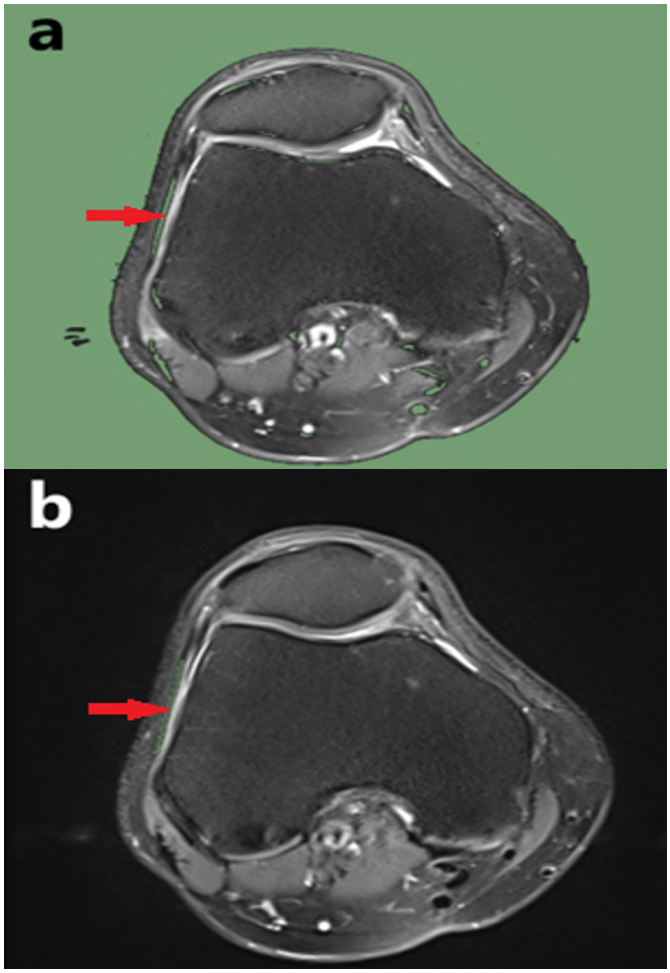

Figure 2. Demonstration of 3D Slicer software a. The software automatically detects tissues in the selected density range, including tendon (marked green). b. Then only the tendon is selected and the tissues outside the tendon are deleted (green part is ITB) so that only ITB can be measured.

Statistical Analysis

Statistical evaluation was performed using IBM SPSS version 20.0 software (IBM Corp, Armonk, NY, USA). The presence of a normal distribution was checked with the Kolmogorov-Smirnov test. Descriptive data are shown as the mean± standard deviation. The independent samples t-test was used to evaluate the significant differences between sexes. One-way ANOVA was used to evaluate the significant differences among age groups. Multiple comparisons were made with the Tukey test. A p value less than 0.05 was accepted as statistically significant.

RESULTS

A total of 150 patients (75 males, 75 females) were included in the study. The interobserver variability was determined at less than 5% for ITBT and ITBV. The mean age was 42,2±29,6 (range 18-60) years. The mean ITBT was 1,76±0,22 mm. The mean ITBV was 20,24±1,44 mm3 in all patients. There was statistically significant difference in mean iliotibial band thickness and volume between sexes (p=0.001; p=0.001). There were no statistically significant differences in mean iliotibial band thickness and volume values between the groups in the one-way ANOVA test (p >0.05).

Table 1. The distribution of age, mean iliotibial band thickness and volume in according to gender

	Males (n=75)	Females (n=75)	P value
Age (years)	39.71±12.7	41.4±11.7	0.371
ITBV (mm3)	21.55±2.08	18.82±1.80	0.001
ITBT (mm)	1.84±0.21	1.70±0.20	0.001

Table 2. The distribution of mean iliotibial band thickness and volume in according to age groups

	18-30 (n=26)	31-40 (n=34)	41-50 (n=44)	51-60 (n=46)
Age (years)	23.33±3.77	36.00±2.47	45.50±2.82	55.07±3.18
ITBV (mm3)	19.99±2.50	20.40±2.49	20.31±2.31	19.58±2.12
ITBT (mm)	1.78±0.23	1.78±0.20	1.77±0.24	1.73±0.21

DISCUSSION

There was statistically significant difference in mean iliotibial band thickness and volume between genders. ITBV and ITBT of males were statistically significant than females. There were no statistically significant differences in mean iliotibial band thickness and volume values between the groups in the one-way ANOVA test (p >0.05). As a measurement, volume and thickness can be alternatives to each other. Instead of manual measurement, automatic measurement parameters can be used as in our study.

There is no statistical difference between age groups. But ITB is thickest between the ages of 31-40. After the age of 40, the numerical values of ITBV and ITBT decrease. ITB's ageing process is similar to other tendons and muscles (9).

Ucpinar et al. (10) found ITB thickness of 2.07+-0.51 in the asymptomatic control group in their study. This study differs from our study in two aspects. First, this is not a volume study. Secondly, the results obtained are different from each other. The reason for this difference is that Ucpinar et al. made measurements while the knee was flexed at 30 degrees. In our study, we performed our measurements while the knee was in full extension in accordance with routine knee MRI protocols. In their study, they also found an average of 2.78± 0.51 ITB thickness in the patient group with friction.

Park et al. (11) average ITBT they measured 1.9±0.4 mm in the normal group and 2.6±0.5 mm in the ITBFS group. They also measured the ITB area in their study and found the mean ITB area was 25.2±6.6 mm2 in the normal group and 38.8±9.1 mm2 in the group with ITBFS. They showed that patients in the ITBFS group had significantly higher ITBCSA and ITBT than those in the normal group. The results of this study are approximately similar to ours. The slight difference between the two studies may be due to the smaller number of patients in their study than ours.

Ekman et al. (12) measured the iliotibial band thickness as 5.49±2.12 mm in the patient group and 2.52±1.56 mm in the control group and showed that the difference was statistically significant. There are differences between the results obtained in our study and the results of this study. Different results between the two studies may be due to two reasons. First, in the study by Ekman et al., the number of patients in the control group was quite low (only 10 patients, 5 females and 5 males). The second is that 8 of these 10 patients have regular athletic activity. Considering the past studies, it is seen that the numerical values are different from each other. This is due to racial differences as well as differences in measurement methods. As far as we know, there is no standard technique for iliotibial band measurement. There is a requirement for standardization in this regard.

ITFBS is one of the important causes of lateral knee pain, which is common in athletes, especially runners. The incidence in athletes is between 1.6% and 12% (13). Although the etiology of ITFBS is still unclear, one of the most accepted theories argues that repetitive friction of the ITB and lateral epicondyle during flexion and extension of the knee joint causes inflammation of the contact area of the ITB. ITB secondary to inflammation becomes edematous and increases in thickness (14). In

our study, we evaluated ITB thickness and volume based on images of patients who did not do any sports, who underwent MRI for nonspecific knee pain and were reported as normal.

Different modalities (US, MRI, stress radiography, computed tomography) can be used in the diagnosis of ITFBS. In cases where ITBFS is considered, MRI is generally used as a diagnostic tool. ITBFS can be diagnosed by the appearance of a high-intensity signal on the T2-weighted image seen at the lateral epicondyle level of the ITB and marked thickening of the distal ITB (15). Ultrasonography can also be used as a diagnostic tool; it shows increased echogenicity in favor of edema at the level of the lateral epicondyle and thickening of ITB. Gyran et al. found a normal ITB thickness of approximately 1.1±0.2 mm in healthy volunteers in their sonographic study (16).

This study has some limitations. Our study is retrospective All the patient's information, physical examination findings and curriculum vitae were obtained through the hospital system. Another there was no equal number of patients in the distribution among age groups.

CONCLUSION

Radiological studies on iliotibial band thickness and band area in healthy individuals are new in the literature. This study is the first radiological study in which the volume of the iliotibial band was measured in healthy individuals and was performed on a 3 tesla MR device. Also, it is the first study that is used artificial intelligence for iliotibial band evaluation and the technic is effective and more rapid according to our experience. ITBV and ITBT are statistically significantly higher in males than females. Most thick ITB was detected between the ages of 31-40. The values of our study, especially ITBT, differ from previous studies and the values are altered in a wide range. Therefore, standardization in the calculation is necessary. This topic is open to future research..

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Muğla Sıtkı Koçman University, Noninvasive Clinical Researches Ethics Committee (Date: 06.05.2021, Decision No:178)

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Flato R, Passanante GJ, Skalski MR, Patel DB, White EA, Matcuk GR Jr. The iliotibial tract: imaging, anatomy, injuries and other pathology. Skeletal Radiol 2017: 605-22.
2. Kaplan EB. Some aspects of functional anatomy of the human knee joint. Clin Orthop 1962; 23: 18-29.
3. Khaund R, Flynn, S. Iliotibial band syndrome: a common source of knee pain. Am Fam Physician 2005; 71: 1545-50.
4. Güney B, Doğan E, Özdemir MY. Osteochondroma as a cause of ischiofemoral impingement- first case series. Acta Med Litu 2021; 28: 189-94.
5. Bankaoglu M, Soydan Mahmutoglu A, Celebi I, et al. Association of iliotibial band friction syndrome with patellar height and facets variations: a magnetic resonance imaging study. Iran J Radiol 2018; 15: e63459.
6. Hong JH, Kim JS. Diagnosis of iliotibial band friction syndrome and ultrasound guided steroid injection. Korean J Pain 2013; 26: 387-91.
7. Yan R, Huang Z, Wang L, Zhang X. MR manifestations and clinical significance of iliotibial band friction syndrome. Zhonghua Yi Xue Za Zhi 2014; 94: 1473-5.
8. Ellis R, Hing W, Reid D. Iliotibial band friction syndrome--a systematic review. Man Ther 2007; 12: 200-8.
9. Seeber GH, Wilhelm MP, Sizer PS Jr, et al. The tensile behaviors of the iliotibial band - a cadaveric investigation. Int J Sports Phys Ther 2020; 15: 451-9.
10. Agridag Ucpinar B, Bankaoglu M, Eren OT, Erturk SM. Measurement of iliotibial band diameter in iliotibial band friction syndrome and comparison with an asymptomatic population. Acta Radiol 2021; 62: 1188-92.
11. Park J, Cho HR, Kang KN, et al. The role of the iliotibial band cross-sectional area as a morphological parameter of the iliotibial band friction syndrome: a retrospective pilot study. Korean J Pain 2021; 34: 229-33.
12. Ekman EF, Pope T, Martin DF, Curl WW. Magnetic resonance imaging of iliotibial band syndrome. Am J Sports Med 1994; 22: 851-4.
13. Strauss EJ, Kim S, Calcei JG, Park D. Iliotibial band syndrome: evaluation and management. J Am Acad Orthop Surg 2011; 19: 728-36.
14. Ferber R, Noehren B, Hamill J, Davis IS. Competitive female runners with a history of iliotibial band syndrome demonstrate atypical hip and knee kinematics. J Orthop Sports Phys Ther 2010; 40: 52-8.
15. Vasilevska V, Szeimies U, Stäbler A. Magnetic resonance imaging signs of iliotibial band friction in patients with isolated medial compartment osteoarthritis of the knee. Skeletal Radiol 2009; 38: 871-5.
16. Gyaran IA, Spiezia F, Hudson Z, Maffulli N. Sonographic measurement of iliotibial band thickness: an observational study in healthy adult volunteers. Knee Surg Sports Traumatol Arthrosc 2011; 19: 458-61.