Original article

Extensions of lower end of iliotibial tract and its clinical significance

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Abstract:

Introduction: Iliotibial tract (ITT) is a combination of fascia, muscles and ligament. It is present only in human beings, it stabilizes the knee both in extension and in partial flexion; and is, therefore, used constantly during walking and running.

Aims & Objectives: Iliotibial Band Syndrome is a common thighinjury, associated with running. Clinical studies have emphasized the role of the ITT on knee mechanics. Anatomical and morphological study of the lower end of ITT may help in understanding its role to stabilize the knee joint during flexion and extension.

Looking to the applied significance of ITT in general and its lower end in particular; and added to this the fact that no such data is available for central Indian population. This work was undertaken to study the morphology and morphometry of the lower end of ITT and its various extensions.

Material & Methods: Thirty-four lower limbs (17right & 17 Left) for this study were obtained from the department of anatomy. ITT was identified on anterolateral aspect of thigh. Its distal attachments were dissected on to patella, tibia, fibula.

Observations & results: The width (2.7cm) and thickness (2.25 mm) of ITT were measured at the level of upper border of patella. We also measured width of the slips going towards patella (1.7cm) and Gerdy's tubercle (1.25 cm).

Conclusion: The findings of the present work, besides, enhancing anatomical knowledge of the region may be of help to orthopedicians and physiotherapists in the diagnosis and management of lateral knee pain.

Key words: Iliotibial band, Iliotibial tract, Gerdy's tubercle, Iliotibial BandSyndrome

Introduction:

The iliotibial tract or iliotibial band (Maissiat's band, IT Band) is a longitudinal fibrous reinforcement of the fascia lata. The iliotibial tract (ITT) is a combination of the fascia lata, tensor fascia femoris muscle (tensor fasciae latae), and gluteus maximus muscle.[1]

ITT is a lateral thickening of the fascia lata, originating from the iliac crest of the pelvis. The ITT continues down the outer third of the thigh, at the femur bone, passing over a protuberance called the greater trochanter. At the level of the greater trochanter, fibers from the gluteus maximus (G.Max) and Tensor fascia lata (TFL) merge with the ITT posteriorly and anteriorly, respectively.

The ITT lies superficial to the fascia of the vastus lateralis muscle, and through the intermuscular septum get attached to lateral lip of the linea aspera. As the ITT approaches the knee joint, it passes over a protuberance on the outer aspect of the femur, the lateral femoral epicondyle. As the ITT approaches the knee joint it splits into two structures, the iliopatellar band and a distal extension of the ITT, which crosses the knee joint and gets attached to Gerdy's tubercle, located on the proximal outer aspect of the tibia. The iliopatellar band migrates medially to join with the lateral patellar retinaculum, a sheath-like tissue that attaches to the outer aspect of the patella.[2]

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Distally, the ITT attaches to the patella, to the fibular head and to Gerdy's tubercle on the tibia and blends with, an aponeurotic expansion from vastus lateralis. When the knee is extended against resistance it stands out as a strong, visible ridge on the anterolateral aspect of thigh and knee.[3]The ITT attaches by its deeper aspect to the lateral intramuscular septum from the level of the lesser trochanter to the lateral condyle of femur.[1]

The ITT stabilizes the knee both in extension and in partial flexion; and is, therefore, used constantly during walking and running. In leaning forward with slightly flexed knees, the tract is the main support of the knee against gravity.

ITT is present only in human beings & appears to develop with the erect posture, probably helped the species to attain their bipedal gait. Maybe the pelvic slouch position of rest was also used by our ancestors as long ago as the bony expressions of the ITT exist.[4]

Aims & Objectives:

The anatomy of the posterolateral aspect of the knee is complex and remains controversial. Several descriptions have been contradictory or incomplete, owing in part to the anatomic variability and perhaps to the difficulty in dissection. Looking to the applied significance of ITT in general and its lower end in particular; and its relevance in certain clinical conditions such as: Runner's Knee (ITT Friction syndrome); its significance as a replacement in ACL tear, and its stabilizing effect on the patella and the knee and added to this the fact that no such data is available for central Indian population (Indian Population!!).This work was undertaken to study the morphology and morphometry of the lower end of ITT and its various extensions.

Material and methods:

The Lower limbs for the present work were obtained from the Department of Anatomy, Sri Aurobindo Medical College and PG Institute, Indore. The study was carried out on 17 embalmed cadavers (age 60-65 years, Avr. height 167.50 cm) with no apparent pathology and 3 fetuses (age 5-9 months) obtained from the department of Gynecology and obstetrics. The dissection was carried out bilaterally on the fetal and adult cadavers. The skin and subcutaneous tissue were removed. Fascia lata (FL) was cleaned and ITT was identified on anterolateral aspect of thigh. The extensions of distal partof ITT were dissected to its sites of attachment on patella, tibia, fibula and its relation to biceps femoris muscle and its tendon**.** The lower end of ITT has been cut at the level of upper border of patella to measure the thickness of ITT and to ascertain relationship of fascia lata to ITT. The tendinous fibers forming lateral patellar retinaculum were dissected. Various measurements were recorded (width and thickness of ITT at the level of upper border of patella &width of the slips going towards patella, Gerdy's tubercle, and Ligamentum patellae.) with the help of Digital vernier caliper, Thread, Scale, & Measuring Tape.

Observations and Discussion:

At the lower end of ITT superficial fibers of FL are seen running horizontally & spreading out towards patella, ligamentum patellae, Gerdy's tubercle and posteriorly over biceps femoris (Fig. 1, 2). These finding were confirmed in fetal dissection also (Fig. 3). Average width of anterior slip of ITT to patella was 1.7 cm (R –1.8 cm/ L -1.6 cm). Average width of patellar retinaculum is 2 cm and at Gerdy's tubercle it was 1.2 cm on both the sides. (Table.1). As in the literature reviewed no comparable data was available.

The lower end of ITT was cut to expose an oval area deep to it which was occupied by fat. Tendinous fibers from ITT were seen running obliquely to the lateral femoral condyle (Fig.4, 5). Average width of ITT at upper border of Patella it was 2.7cm (R –2.5 cm/ L -2.9 cm). At the level of upper border of patella the ITT has been

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cut transversely to see the thick tendinous fibers and confirming a fibrous sheet enclosing ITT (Fig.7). Thickness of ITT at the level of upper border of patella was 2.2 mm (R –2.3 mm/ L -2.1 mm) (Table.1).

Wang et al (2006)[5] mentioned the width of ITT as 3.5 cm. They have not mentioned the level at which the width was measured. Findings in the present study clearly indicate that the ITT narrows when traced inferiorly up to the level of patella and the main bundle of fibers converges to be attached to Gerdy's tubercle. At the level of patella, from its anterior margin there is spreading of fibers to reach the patella and reinforcing the lateral patellar retinaculum, whereas from its posterior margin its expansion covers the tendon of biceps femoris to reach the head of fibula (Fig.1, 2 3).

Whiteside and Roy (2009)[6] have described trifurcation of ITT at its lower end in the form of distinct band attaching to (a) Patella; (b) Gerdy's tubercle; (c) Fibula and biceps femoris and have implicated them to play a role during various movements at the knee joint, viz. the anterior band tightened in flexion, central band in mid flexion and posterior band in full extension (Bryce 1923)[7], (Last 1954)[7], (Orava 1978)[8], (Lucas 1992)[9].

In the present study the thickness of the ITT was measured at the level of upper border of patella and it was found to be 2.2 mm. A transverse section of FL at this level shows that it was quite thin in contrast to the thickness of ITT which stands out very prominently (Fig. 7).

Lower fibers of VL and anterior expansion of ITT helps in forming lateral patellar retinaculum which is usually describe to be attached to lower lateral margin of patella and lateral edge of ligamentum patellae (Evans 1979)[4],(Fulkerson et al 1980)[10], (Birnabaum et al 2004)[11]. But in the present work it has been found that the retinaculum splits into two lamellae. One of which passes superficial to ligamentum patellae and by splitting this lamella the vertically directed tendinous fibers of ligamentum patellae are clearly exposed (Fig.6). The formation of sheath to surround ligamentum patellae will provide for freedom of force transmission between patella and tibial tuberosity through ligamentum patellae**.**

In the present study from the lower part of LIS, where it joins the ITT, a tendinous slip is seen to join the lateral condyle of femur. Below it and deep to the lower part of ITT there is a gap (Fig.4, 5) which is occupied by fibro fatty tissue. This is in agreement with that ofJohn Fairclough (2008)[12]. The nerves supplying adipose tissue may be responsible for production of pain inrunner's kneeas has been described byJohn Fairclough (2008)[12]**,** Bauer et al (2011)[13]. Between these tendinous attachments on femur and attachment to Gerdy's tubercle the ITT on the anterolateral aspect of knee is free and these two attachments and this buckle shaped ligament can have a stabilizing effect on the knee joint, as well as allow for the movement of tibia on femoralcondyle.

Conclusion:

The various parameters that have been studied in the present work in central Indian population have not been carried out in such great details in Indian context. Hence, these values can be utilize for ascertaining the normalcy or otherwise of this whole ITT complex in cases of contractures, ruptures and repairs, Iliotibial band friction syndrome, poliomyelitis or as a replacement for anterior cruciate ligament rupture.

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Table: 1 (R- right, L- left)

Observations	Width of ITT at upper border of Patella (cm)	Width of anterior slip of ITT to patella (cm)	Width of lateral patellar retinaculum (cm)	Width at Gerdy's tubercle (cm)	Thickness of ITT at the level of upper border of patella (mm)
Maximum	**R-** 3.4 **L-** 3.5	**R-** 2.4 **L-** 2	**R-** 3 **L-** 3	**R-** 2 **L-** 2	**R-** 2.99 **L-** 2.56
minimum	**R-** 2 **L-** 2.5	**R-** 1 **L-** 1	**R-** 1.6 **L-** 1.5	**R-** 1 **L-** 1	**R-** 1 **L-** 0.95
Average	**R-** 2.5 **L-** 2.9	**R-** 1.8 **L-** 1.6	**R-** 2.08 **L-** 2.04	**R-** 1.2 **L-** 1.3	**R-** 2.31 **L-** 2.1

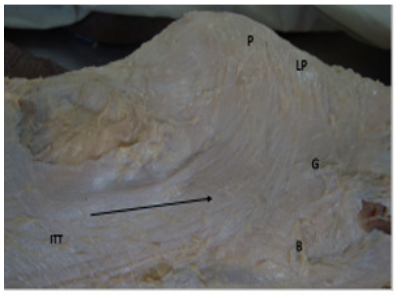

Fig.1. Right knee lateral view showing: lower end of ITT. Superficial fibers are seen running horizontally and are spreading out towards patella (p), ligamentum patellae (LP), Gerdy's tubercle (G) and posteriorly over biceps femoris (B)

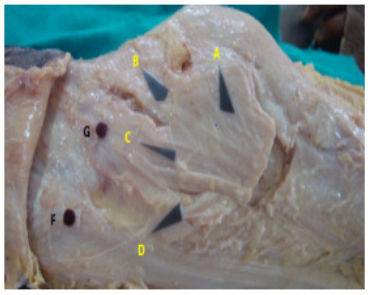

Fig.2. Left knee lateral view showing: lower end of ITT with bands of fibers which are artificially separated to show the divergence of fibers of ITT to patella (A), ligamentum patellae (B), Gerdy's tubercle (C), and over the biceps femoris (D). Also marked are Gerdy's tubercle (G) and head of fibula (F)

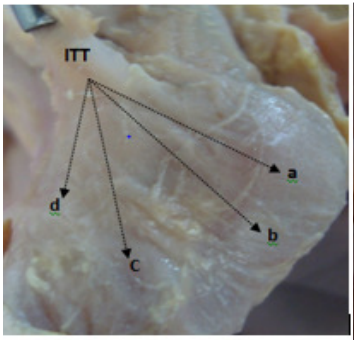

Fig.3.Fetal material- Lower end of ITT showing spreading of fibers to reach: (a) patella, (b) patellar retinaculum, (c) Gerdy's tubercle, (d) tendon of biceps femoris

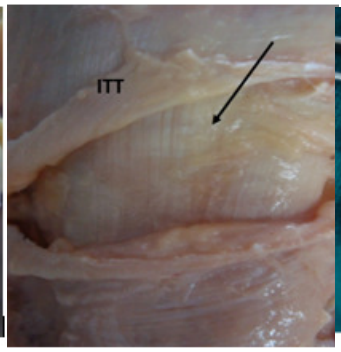

Fig.6.The tendinous fibers of ligamentum patellae (Black arrow) have been exposed by transversely splitting the fibers of ITT which form patellar retinacula that pass superficial to ligamentum patellae

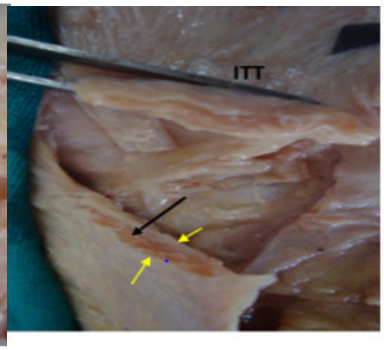

Fig.7. The ITT has been cut transversely at the level of upper border of patella to show the thick tendinous fibers (Black arrow) and also seen is a fibrous sheet enclosing ITT (Yellow arrows)

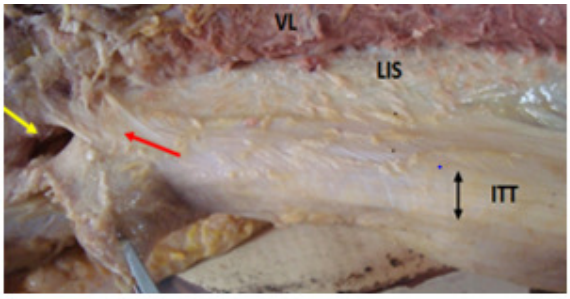

Fig.4 Showing LIS which shows obliquely running tendinous fibers. The fibers of VL arising from its surface which have been cut and retracted producing a shaggy surface of LIS. ITT is distinctly seen to become continues with LIS. The lower end of ITT has been cut (retracted by forcep) to expose an oval area (Yellow arrow) deep to it which was occupied by fat. Also seen obliquely running tendinous fibers from ITT (Red arrow) to the lateral femoral condyle.

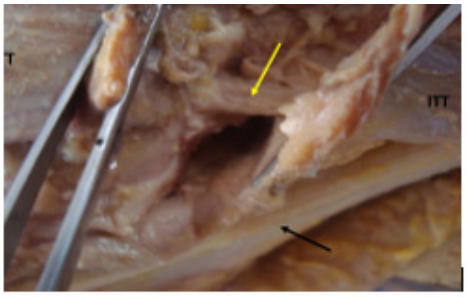

Fig.5 Showing the tendon of biceps femoris (Black arrow), the ITT. Which has been cut transversely and its thick edges turned with the help of forcep to expose the thick tendinous band (Yellow Arrow) which goes to lateral femoral condyle.

References:

1. Rodney k. beal. The iliotibial band a review. current orthopaeic practice volume 20 No 1 Jan/ Feb 2009
2. DC Joshua Dubin. Evidence Based Treatment for Iliotibial Band Friction SyndromeBioMechanics,- Dubin Chiropractic, 2006
3. Standring Susan, Neil R. Borley, Patricia Collins, Alan R Crossman, Michael A Gatzoulis, Jeremiah C Healy, David Johnson, Vishy Mahadevan, Richard LM Newell, Caroline B Wigley. Neck muscle – Iliotibial tract In Gray's Anatomy: The anatomical basis of clinical practice. 40th edition. Section Section 9, pages 1349-1350, 2008
4. Philip Evans. The postural function of the iliotibial tract. Annals of the Royal College of surgeons of England Vol 61, 1979

5. Wang C, Yu D, Cong H. Primary repair of tissue defects of achilles tendon and skin by free grafting of anterolateral femoral skin flap and iliotibial tract. ZhongguoXiu Fu Chong Jian Wai KeZa Zhi.,20(10):1037-9; Oct 2006
6. Leo A. Whiteside and Marcel E. Roy. Anatomy, Function, and surgical access of the iliotibial band in total knee arthroplasty, J Bone Joint surg Am. 2009
7. Emanuel B. Kaplan. The iliotibial tract Clinical and morphological significance. The Journal of bone and joint surgery vol. 40A No 4 July 1958
8. S. Orava, iliotibial tract friction syndrome in athletes - an uncommon exertion syndrome on the lateral side of the knee Brit. J. Sports Med. - Vol. 12, No. 2, pp. 69-73, June 1978
9. Carrie Ann Lucas. The iliotibial band friction syndrome as exhibited in athletes. Journal ofAthletic training Vol 27 No 3, 1992
10. Débora Bevilaqua-Grossi1, et al, Contribution to the anatomical study of the oblique portion of the Vastus lateralismuscle.Braz. J. morphol. Sci. 21(1), 47-52, 2004
11. Birnbaum K., Siebert CH, Pandorf T, Schopphoff E., Prescher A., Niethard FU. Anatomical and Biomechanical investigations of the Iliotibial tract, Surgical and Radiological Anatomy, Vol 26(6), pp 433- 446, Dec 2004
12. John Fairclough, Koji Hayashi, HechmiToumiKathleen Lyons, Graeme Bydder, Nicola Phillips,Thomas M. Best and Mike Benjamin. The functional anatomy of the iliotibial band during flexion and extension of the knee: implications for understanding iliotibial band syndrome. J. Anat. 208, Pp309–316, 2006
13. Jeffrey A. Bauer and Lara M. Duck. Examining Biomechanical and Anthropometrical factors as contributors to Iliotibial band friction Syndrome, sport science review, Vol xx, No. 1-2, 2011