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REVIEW PAPER

Ultrasound of iliotibial band syndrome

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Abstract
Iliotibial band syndrome or friction syndrome is an overuse disorder of the lateral knee. It is commonly reported in athletes, such as runners and cyclists, and refers to pain related to physical activity. The diagnosis is based on clinical history and physical assessment. Imaging, including ultrasound, is mainly performed in recurrent or refractory cases. The purpose of this paper is to review the etiology, diagnosis, and therapy of iliotibial band syndrome with a focus on ultrasound imaging and ultrasound-guided treatment. Ultrasound findings include soft-tissue edematous swelling or discrete fluid collection, suggestive of bursitis, between the iliotibial band and the lateral femoral epicondyle. The thickening of the iliotibial band has been inconsistently reported. Treatment varies according to the disease phase and, in the acute phase, consists of rest, physical therapy, and anti-inflammatory medications. Ultrasound-guided local steroid injections are effective in relieving symptoms.

Keywords Fascia lata · Gerdy tubercle · Iliotibial friction syndrome · Iliotibial tract · Knee · Sonography

Introduction

The iliotibial band is a portion of the fascia lata. It receives contributions from the tensor fascia lata and gluteus maximus muscles in the lateral thigh and terminates distally about the knee, having the main ribbon-shaped insertion into the Gerdy tubercle on the anterior aspect of the lateral tibial condyle [1]. The iliotibial band transmits forces from the hip to the knee, acts as a lateral stabilizer of the knee, and also serves an important postural function [2, 3].

Iliotibial band syndrome, also known as iliotibial band friction syndrome, is an overuse disorder of the lateral knee that refers to pain related to lower limb activity [4]. This syndrome is one of the most common knee injuries in runners and is also frequently encountered in other athletes, such as cyclists and basketball, soccer, or hockey players [5–7]. Particularly, it has been reported as a cause of knee pain in 62% and 38% of female and male runners, respectively [6], and in 24% of cyclists [7]. The diagnosis of iliotibial band syndrome is based on clinical assessment, and imaging is mostly performed in recurrent or refractory cases [4]. Both magnetic resonance imaging and ultrasound may be used to confirm the diagnosis. The role of magnetic resonance imaging has been well addressed in recent literature [8, 9] and is beyond the scope of this paper. As a cost-effective imaging modality that enables visualization of the superficial soft-tissue structures with high resolution, dynamic evaluation, and comparison with the contralateral healthy side [10–19], ultrasound is valuable for the assessment of iliotibial band syndrome. The purpose of this paper is to review the etiology, diagnosis, and therapy of iliotibial band syndrome, with a focus on ultrasound imaging and ultrasound-guided treatment.

Etiology and risk factors

Iliotibial band syndrome has several proposed causes, including friction of the iliotibial band against the lateral epicondyle of the femur [20] compression of the fat and connective tissue deep to the iliotibial band [21], and chronic inflammation of an adventitial bursa underneath the iliotibial

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band [22]. The first is linked to iliotibial band rubbing back and forth across the lateral femoral epicondyle during activities involving repetitive knee flexion and extension, thus resulting in friction of the iliotibial band and inflammation of the adjacent soft tissues [20]. This etiology has been debated over the years, particularly with regard to the direction and extent of the iliotibial band motion. However, an ultrasound study has demonstrated that the iliotibial band moves in an antero-posterior direction relative to the lateral femoral epicondyle during knee extension and flexion, thus supporting the central role of friction as an etiological factor [23]. Other proposed etiologies, such as fat compression [21] and soft-tissue irritation [24] deep to the iliotibial band, may coexist and explain why pathological changes primarily occur in the soft tissues rather than within the iliotibial band [25]. Particularly, chronic irritation can result in an adventitial or secondary bursitis underneath the iliotibial band, where no primary bursa has been consistently identified in cadaveric studies [22].

The predisposing factors associated with iliotibial band syndrome are both extrinsic and physical or intrinsic factors. The extrinsic factors include training errors, such as a rapid increase in mileage and downhill running [26, 27]. Particularly, in the latter case, knee flexion is reduced, and iliotibial band friction may be facilitated as this occurs around or slightly below 30° of flexion [27]. The main physical or intrinsic factors include genu varum, hip abduction weakness, and lower limb length discrepancy [27, 28]. Particularly, genu varum may favor the development of iliotibial band syndrome by increasing the strain of the iliotibial band during weight-bearing, as seen on sonoelastography in female athletes with genu varum in comparison with normal knee alignment [29].

Clinical presentation

Pain occurs at the level of the distal iliotibial band, between the lateral femoral epicondyle and its tibial insertion, and is associated with regular physical activity. Initially, lateral knee pain is often experienced late in or after completing a sporting activity. As the syndrome progresses, it begins earlier in the course of the activity [4]. On physical assessment, tenderness can be observed at the level of the lateral femoral epicondyle [4].

Ultrasound imaging

Ultrasound provides an excellent visualization of the superficial soft-tissue structures of the knee, including the iliotibial band, using linear high-frequency transducers [30, 31]. On ultrasound, the iliotibial band is assessed in the coronal plane on the lateral aspect of the knee. Under healthy conditions, it appears as a linear fibrillar structure that crosses over the lateral epicondyle of the femur and inserts distally into the Gerdy tubercle of the tibia [32]. The iliotibial band can also be easily depicted if the transducer is placed in the midline to visualize the patellar tendon along its longitudinal axis and then moved laterally. The iliotibial band is the first identifiable longitudinal structure that extends proximally from the lateral tibial condyle [33]. Additionally, the iliotibial band can be evaluated in the axial plane over the lateral femoral epicondyle. A dynamic assessment in the axial plane can reveal various degrees of snapping along the lateral femoral epicondyle [34].

In healthy individuals, iliotibial band mean thickness on ultrasound has been reported to be 1.1–1.9 mm at the level of the lateral femoral epicondyle [35, 36] and 3.4 mm at the level of the lateral tibial condyle [35]. A negative correlation has been found between iliotibial band thickness and age, i.e., mean thickness decreases with increasing age [35]. On the other hand, no association has been observed between iliotibial band thickness and height, weight, dominant limb, or the volume of training or sporting activity [35, 36].

The diagnosis of iliotibial band syndrome relies on clinical history and physical assessment [4]. Imaging, including ultrasound, is reserved for recurrent or refractory cases and requires correlation with clinical information [4]. Ultrasound findings of iliotibial band syndrome include soft-tissue edematous swelling (Fig. 1) and discrete fluid collection

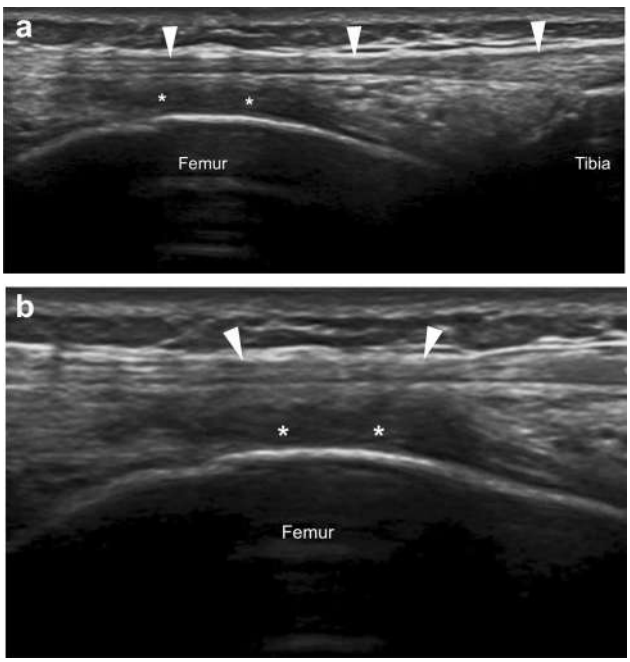


Fig. 1 On longitudinal (**a**) and axial (**b**) sonograms, soft-tissue hypoechoic edematous swelling (asterisks) is noted between the iliotibial band (arrowheads) and the lateral femoral epicondyle

(Figs. 2, 3, 4), suggestive of adventitial bursitis, between the iliotibial band and the lateral femoral epicondyle [37–39]. The thickening of the iliotibial band has been reported inconsistently [40, 41], and researchers have questioned whether this finding occurs only in chronic cases [41]. Cortical irregularity of the adjacent femoral epicondyle can also be observed [33]. A common pitfall is the normal lateral recess of the knee joint as fluid is associated with the iliotibial band in a large number of asymptomatic runners, deep or anterior to it [42]. The lateral recess extends adjacent to the lateral femoral condyle, deep to the iliotibial band [24], and should not be mistaken for an adventitial bursitis. Continuity of the recess with the joint can be demonstrated with ultrasound (Figs. 5, 6) [43].

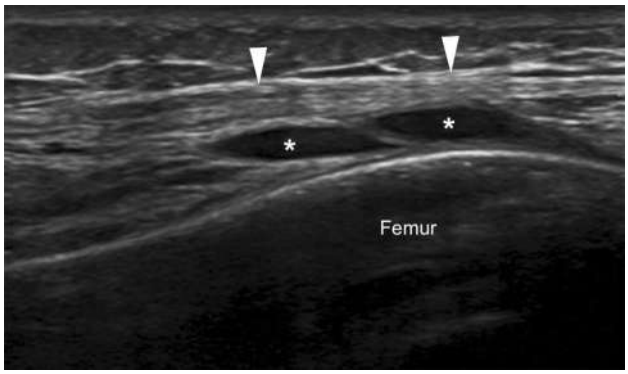
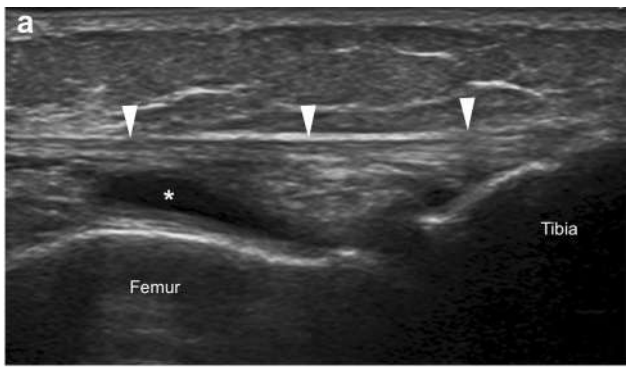


Fig. 3 On a longitudinal sonogram, a septated bursa (asterisks) is noted between the iliotibial band (arrowheads) and the lateral femoral epicondyle



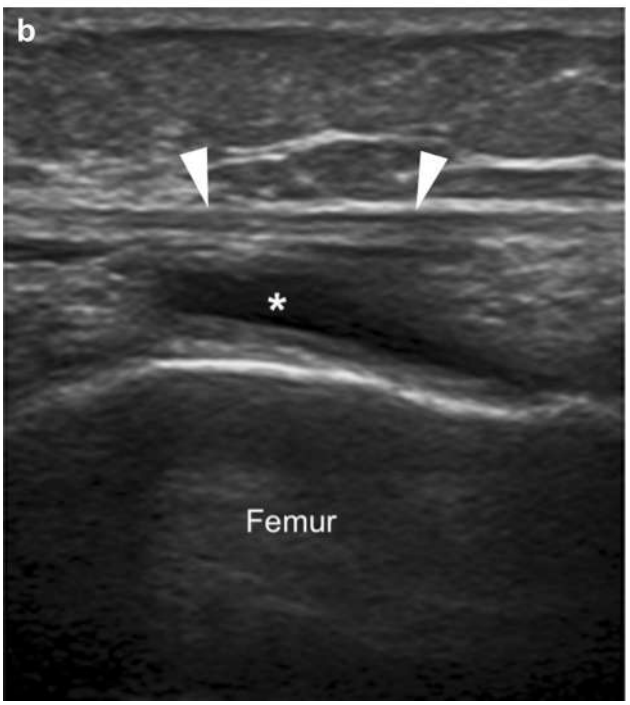
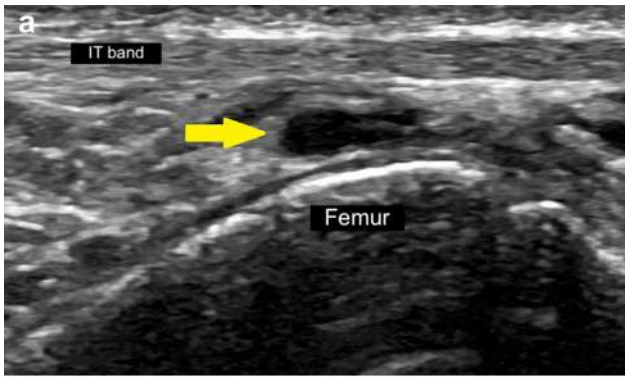


Fig. 2 On longitudinal (**a**) and axial (**b**) sonograms, a discrete fluid collection suggestive of bursitis (asterisk) is noted between the iliotibial band (arrowheads) and the lateral femoral epicondyle

Therapy

Iliotibial band syndrome is mainly managed non-operatively, and Fredericson et al. have proposed different treatment strategies according to three disease phases, such as the acute, subacute, and recovery strengthening phases [44]. The path to recovery involves the correction of facilitating



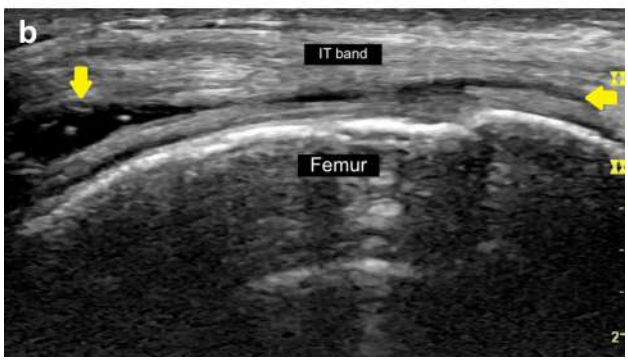


Fig. 4 On longitudinal sonograms in different patients (**a**, **b**), bursae (arrows) are noted between the iliotibial band (IT band) and the lateral femoral epicondyle

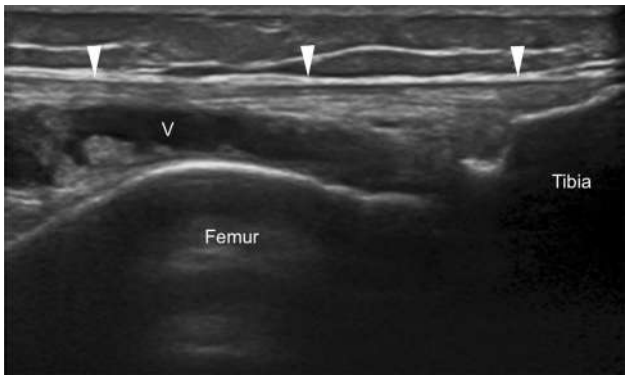


Fig. 5 On a longitudinal sonogram, knee joint effusion (V) and synovial hypertrophy are noted in the lateral recess of the joint, adjacent to the lateral femoral condyle and deep to the iliotibial band (arrowheads). Continuity of the effusion with the knee joint is demonstrated

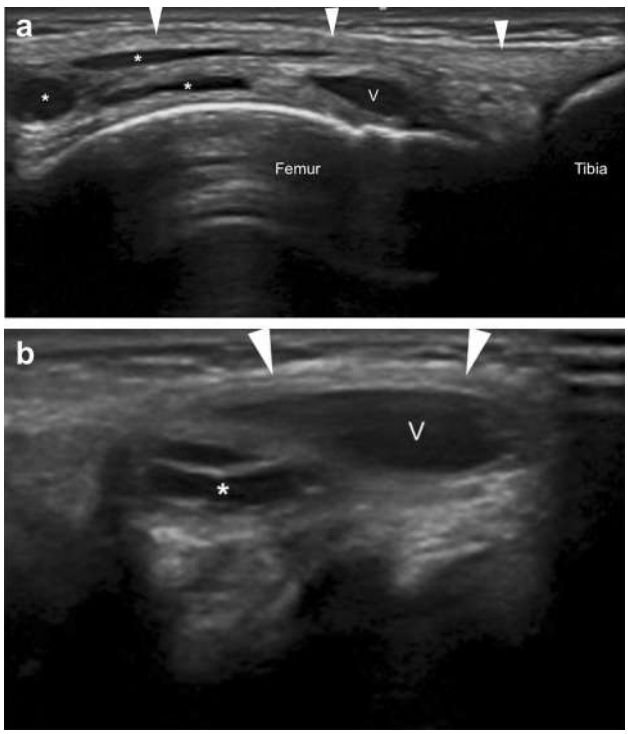


Fig. 6 On longitudinal (**a**) and axial (**b**) sonograms, knee joint effusion (V) and multiple bursae (asterisks) are noted deep to the iliotibial band (arrowheads) and superficial to the lateral femoral epicondyle

factors, such as the weakness of the gluteus medius, the excessive adduction of the hip and internal rotation of the knee, the varus alignment of the knee, and lower limb length discrepancy [45].

In the acute phase, treatment is aimed at reducing local inflammation. Rest from physical activities such as running and cycling is a mainstay of treatment. In severe cases, patients should also avoid any activity involving repetitive flexion or extension of the knee and swim using only their arms and a pool buoy [45]. Concurrent therapies such as ice, phonophoresis, and iontophoresis play additional roles [46]. Both oral nonsteroidal anti-inflammatory medications and local corticosteroid injections can be used [46]. Local corticosteroid injections are considered in severe cases where physical therapies and oral medications fail to relieve symptoms [47–52]. They have been shown to effectively decrease pain in patients with recent onset of iliotibial band syndrome [53]. The response to corticosteroid injections helps diagnose iliotibial band syndrome as well [54]. Ultrasound is valuable in providing needle guidance throughout the procedure [55–62]. The procedure is performed with a sterile and local anesthetic technique. The transducer is positioned in the longitudinal or axial plane. Either an out-of-plane or an in-plane approach (Figs. 7, 8), such as distal to proximal [63] and medial to lateral [64], can be used. The tip of the needle is placed at the deep surface of the iliotibial band. Fluid aspiration can be performed if a focal fluid collection

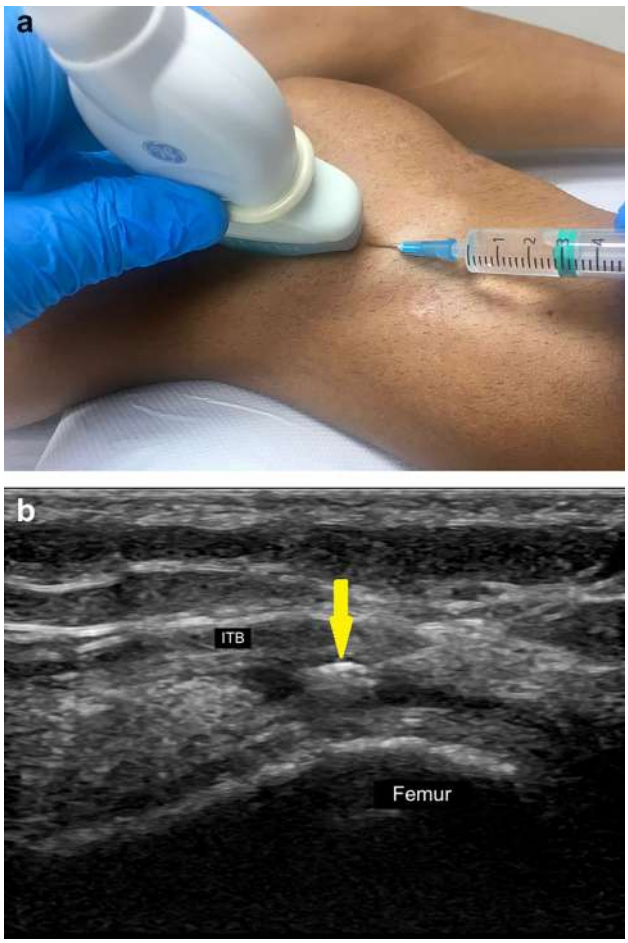


Fig. 7 In a patient with iliotibial band syndrome (**a**), ultrasound-guided injection is performed using a distal-to-proximal in-plane approach. On a longitudinal sonogram (**b**), the tip of the needle is placed deep to the iliotibial band (ITB), superficial to the lateral femoral epicondyle, and the injectant flow (arrow) is noted

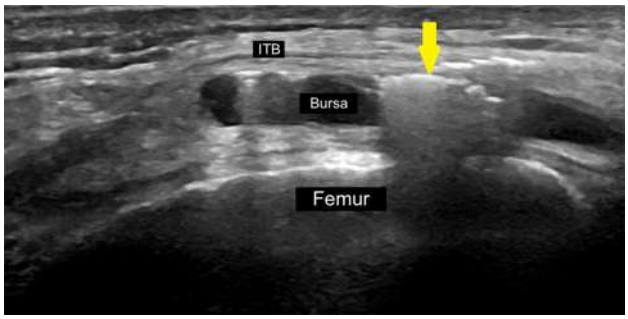


Fig. 8 On a longitudinal sonogram, a bursitis is seen deep to the iliotibial band (ITB) and superficial to the lateral femoral epicondyle. An ultrasound-guided injection is performed using an out-of-plane approach, and the injectant flow (arrow) is noted

or bursitis is present. A combination of corticosteroid and anesthetic is injected [63, 64]. Up to 2 pain-free weeks are advised before returning to usual activity in a graded progression [45].

Once acute inflammation is under control, stretching exercises can be started. Thus, in the subacute phase, treatment focuses on achieving flexibility in the iliotibial band as a foundation to strength training. Iliotibial band stretching and soft-tissue mobilization aimed at reducing myofascial adhesions are performed [65].

Eliminating myofascial adhesions precedes strengthening and muscle reeducation. Hence, the recovery strengthening phase focuses on a series of exercises to improve gluteus medius strength. Exercises should be pain-free and include side-lying hip abduction, single-leg activities, pelvic drops, and multiplanar lunges [65].

Recalcitrant cases of iliotibial band syndrome require surgery. Surgical options include the release of the iliotibial band, iliotibial band bursectomy, and the resection of the lateral synovial recess [66–68].

Conclusions

Iliotibial band syndrome is a common source of pain in active individuals. Ultrasound is an effective imaging modality for the assessment of iliotibial band syndrome and proves a valuable aid in recalcitrant or refractory cases. A clear understanding of the anatomy, etiology, and clinical presentation is needed to achieve the correct diagnosis on ultrasound. Treatment varies according to the phase of the disease and, in the acute phase, may include ultrasound-guided local steroid injections.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interest.

Ethical approval All performed procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Not applicable.

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