Iliotibial Band Syndrome

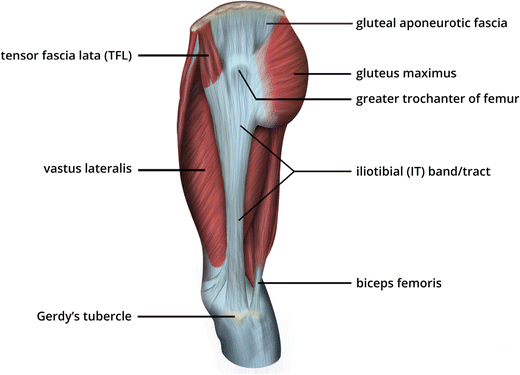
**Introduction**

Iliotibial band syndrome, also known as iliotibial band friction syndrome, is a condition that commonly causes lateral knee pain1,2 and pain in the lateral thigh.3 This condition was first described in 1975 by Lieutenant Commander James W. Renne4. Renne noted the occurrence of a “painful, disabling condition”4 in Marines undergoing intense physical training, which prompted him to undertake a research study to further investigate and describe the condition. Since the time of Renne’s first investigation, the prevalence of iliotibial band syndrome has increased, likely due to the increasing popularity of recreational running and cycling.1 Current research suggests that iliotibial band syndrome accounts for 22% of lower extremity injuries2, is the most common cause of lateral knee symptoms in runners1, and accounts for 15% of knee overuse injuries in cyclists.2  Since first being described by Renne in 1975 as a friction syndrome4, there are now other theories regarding the etiology of iliotibial band syndrome. Some groups of researchers believe that iliotibial band syndrome is related to compression of fat and connective tissue deep to the iliotibial band, while others suggest chronic inflammation of the iliotibial bursa.1 Unfortunately, the debate surrounding the etiology of iliotibial band syndrome has made the creation of a specific, evidence-based treatment model for iliotibial band syndrome elusive.3

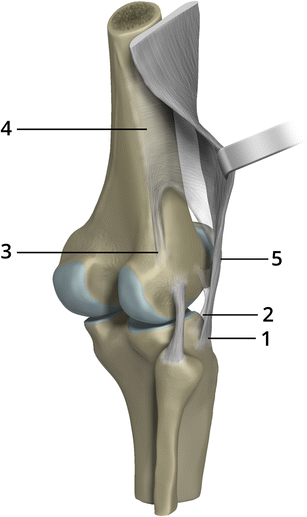
**Anatomy and Function**

The iliotibial band or iliotibilal tract is a very strong segment of the fascia lata, the deep fascia of the lateral thigh.5 The iliotibial band is comprised of portions of the tensor fascia lata (TFL), gluteus maximus, and gluteal aponeurotic fascia (Figure 1).5 It descends along the lateral aspect of the thigh and inserts around the lateral aspect of the knee joint, where it has at least five areas of insertion (Figure 2).5

**Figure 1: Iliotibial band anatomy**5



**Figure 2: Iliotibial band distal insertions**5



The iliotibial band is a unique structure in the human body and attempts to distinctly classify its anatomy remain “varied and inconsistent”5. The iliotibial band is comprised of deep connective tissue and has been described as muscular, ligamentous, tendinous, and aponeurotic.5  Although the specific structure of the iliotibial band is somewhat difficult to classify, we do know that it serves multiple functions in the human body. The iliotibial band contributes to lateral knee stability, it helps to extend and rotate the hip, and allows for asymmetrical standing.5,6 Interestingly, research into the anatomy of quadruped animals has found that these mammals have all have a tensor fascia lata or gluteus maximus muscle, however, they all lack an iliotibial band. This suggests that the iliotibial band is an essential stabilizer of the lateral knee joint and is necessary for erect posture.7

**Etiology**

The etiology of iliotibial band syndrome as first described by Renne4, is a friction syndrome whereby the distal portion of the iliotibial band becomes inflamed due to a repetitive anterior-posterior motion of the IT band over the lateral femoral epicondyle.1,4 Some supporters of the friction-based etiology theory suggest the existence of an impingement zone for the iliotibial band, that occurs at approximately 30 degrees of knee flexion.1,8  Conversely, other researchers call this theory into question based on recent studies indicating that anterior-posterior movement of the iliotibial band does not occur.1,9 These researchers propose that the iliotibial band is not a distinct structure, but rather a thickened area within the lateral fascia. This lateral fascia is connected to the linea aspera by an intermuscular septum, making anterior-posterior movement impossible. These authors go on to suggest that, rather than anterior-posterior movement, there are cycles of tightening of the lateral fascia. These cycles of tightening cause compression, and thereby pain and inflammation, in the underlying tissues.2,9  A third theory suggests that iliotibial band syndrome is cause by inflammation of bursa and tendon over the lateral epicondyle of the femur. This theory is supported by cadaver studies that demonstrate a potential fluid filled space. This “potential space” is consistent with magnetic resonance imaging (MRI) findings in live patients who present with symptoms of iliotibial band syndrome.1,2 This theory is also supported by the positive outcomes noted with bursectomy in sub-iliotibial band space.1

Clearly, the exact etiology of iliotibial band syndrome remains uncertain. One author suggests that there may be several different subtypes of iliotibial band syndrome with various biomechanical factors that contribute to pain and dysfunction.2 Regardless of the cause of iliotibial band syndrome, one thing is clear: patients with this diagnosis exhibit significant inflammation in the tissue located between the distal iliotibial band and the lateral femoral condyle.Surgical studies involving histological examination of the tissues in this area have demonstrated macroscopic changes that are consistent with chronic inflammation.3 Thus, it stands to reason that the primary goal of intervention to address iliotibial band syndrome is to reduce inflammation and address each patients’ individual biomechanical factors that are contributing to this inflammation.

**Risk Factors**

The lack of a clearly defined etiology of iliotibial band syndrome makes it difficult to establish clear risk factors related to this diagnosis. However, research involving runners with and without iliotibial band syndrome, does point to some information about risk factors that can guide clinical decisions. One risk factor is hip abduction weakness, especially in longer distance runners10  It is theorized that weak hip abductors and/or lack of neuromuscular control of the hip abductors can create a greater adduction moment which in turn creates strain in the distal iliotibial band.11  Another study found that runners with iliotibial band syndrome were more likely to have increased hip adduction and increased knee internal rotation during the stance phase of running.11 Internal rotation at the knee creates a medial movement of the attachment of the iliotibial band at Gerdy’s tubercle; it is postulated that this medial movement creates further compression of the iliotibial band in the area of the lateral femoral condyle.11 This research provides evidence that improving strength and neuromuscular control of the hip is critical for managing or preventing iliotibial band syndrome in runners.

**Differential Diagnosis**

Iliotibial band syndrome generally presents as pain in the lateral aspect of the knee, and may also include lateral thigh pain. There is a high prevalence of iliotibial band syndrome among both professional and recreational athletes.1,2 Symptoms of iliotibial band syndrome typically present as pain that occurs in the lateral knee after an exercise activity involving repetitive flexion and extension of the knee. Eventually as the condition progresses, symptoms begin earlier in the activity and can also occur at rest. In addition, patients may experience significant point tenderness upon palpation of the area near the lateral femoral condyle.1  Differential diagnosis is an essential component in assessment of lateral thigh and knee pain, since there are numerous other pathologies both malignant and benign that can present with symptoms that are similar to iliotibial band syndrome.

During the patient evaluation, it is of utmost importance for the physical therapist to attempt to rule out pathologies such as bony fracture or cancerous lesions. While these may be rare and unlikely diagnoses, they have been found to present in patients complaining of lateral thigh and knee pain, even in younger and middle aged patients where a more nefarious source of pain is not as likely to be suspected.12,13 Red flags for cancer include: a previous history of cancer, unexplained weight loss, fever, and night pain. Patients may also complain of severe pain and have symptoms that are unrelieved by position or previous courses of treatment.13  Red flags for fracture include trauma or accident, advanced age, history of prolonged use of corticosteroid medication, and the presence of a contusion or abrasion.14 However, these symptoms may not be present in all patients. Current evidence supports the use of sound clinical judgment and a thorough evaluation scheme to assess for sources of pain that are outside the scope of physical therapy intervention.13

After ruling out the more nefarious sources of pain, it is important clear other areas of the body as contributors to the patient’s pain. It is prudent to begin with a thorough assessment of the lumbar spine since etiologies involving the lumbar spine may present with radicular pain and parasthesia into the lateral hip and thigh.12 This pain can mimic the symptoms of iliotibial band syndrome, making differential diagnosis of lateral thigh and knee pain challenging.12 The physical therapist should perform a thorough clearing exam of the lumbar spine to rule out involvement of the spine in the patient’s painful symptoms.

In addition to a thorough examination of the spine, the patient’s hip and knee should be examined for other possible sources of pain. A simple clearing examination of the hip should be sufficient to rule out the involvement of hip structures. However the clinician should be aware that the patient might also have a concurrent diagnosis of greater trochanteric bursitis. The mechanism behind the development of greater trochanteric bursitis is similar in nature to the contraction/compression theory explaining the development of iliotibial band syndrome. Greater trochanteric bursitis may occur due to the contraction of lateral hip muscles including the tensor fascia lata and the gluteus medius. The contraction of these muscles can create compression in the greater trochanteric bursa leading to the development of greater trochanteric bursitis.12 It is not uncommon for patients to present with both greater trochanteric bursitis and iliotibial band syndrome concurrently, especially those patients who are middle aged or beyond.15

Finally, when examining for iliotibial band syndrome, a thorough investigation of the knee is paramount. An exhaustive list of all etiologies that may present with lateral knee pain is beyond the scope of this paper. However, it is worth noting some of the more likely causes of lateral knee pain in patients who present for physical therapy treatment. These sources of lateral knee pain include: lateral meniscus tear, degenerative joint disease, stress fracture, patellofemoral pain syndrome (PFPS), lateral collateral ligament pathology, and biceps femoris tendinopathy.1 Once the examiner has ruled out other possible etiologies of lateral knee pain, further special testing can be utilized to rule in (or out) iliotibial band syndrome. Commonly used special tests for iliotibial band syndrome include the Nobel compression test, the Trendelenburg test for gluteus medius weakness/hip muscle imbalance, Ober’s test and the modified Thomas test to assess for iliotibial band tightness.7,16

***Nobel’s Test***

This test is utilized to help distinguish iliotibial band pain from other sources of lateral knee pain. The test is performed with the patient in a side lying position. The clinician applies pressure over the lateral condyle of the femur while bending the knee back and forth in a 0-90 degree range of motion. A positive test is indicated by popping, snapping, or creaking sensation or by increased pain with the application of pressure over the lateral femoral condyle. Unfortunately, there have not been any studies performed to indicate the reliability and validity of Nobel’s test.17

***Trendelenburg Test***

The Trendelenburg test is used to identify weakness of the hip abductors. This test is performed by having the patient stand, facing away from the physical therapist. The physical therapist asks the patient to raise one leg off the ground and maintain a single leg stance for 30 seconds. The physical therapist watches for evidence of hip abductor weakness. A positive test is indicated by the patient’s pelvis dropping toward the unsupported side.18

***Ober’s Test***

Ober’s test is used to assess for contracted or inflamed tissue in the tensor fascia lata and/or iliotibial band. The test is performed with the patient lying in side lying with the painful side up. The patient bends the bottom leg to stabilize the lumbar spine and pelvis. The clinician grasps the distal portion of the top leg, bends the knee to a 90-degree angle, extends the hip, and then adducts the thigh toward the table. Care must be taken by the clinician to stabilize the pelvis and avoid hip flexion and rotation during the test. A positive test is indicated by the patient’s leg remaining in the abducted position and the patient experiencing lateral knee pain with attempted adduction.19

***Modified Thomas Test***

The modified Thomas test is used to assess the flexibility of the hip flexors and tensor fascia lata. The modified Thomas test is performed by having the patient lie supine on the edge of a table with both legs hanging off the end. The patient attempts to flex the knee and use both arms to pull the knee as close to the chest as possible while keeping the lumbar spine in contact with the table during the entire test. A positive test is indicated if the patient cannot keep the lumbar spine in contact with the table, or is unable to flex the knee beyond 80 degrees.20

**Concurrent Diagnoses**

As noted above, greater trochanteric bursitis is fairly common diagnosis occurring alongside iliotibial band syndrome. Unfortunately this is not the only diagnosis that may be related to iliotibial band syndrome. Several studies support a contributing role of the iliotibial band in patellofemoral pain syndrome, likely due to tightness in the iliotibial band causing increased lateral deviation or lateral rotation of the patella.21,22 Research also indicates a link between knee osteoarthritis and iliotibial band syndrome, specifically in patients who have osteoarthritis of the medial compartment of the knee. One study of 128 patients with advanced osteoarthritis in the medial compartment of the knee found that a whopping 74.2% had moderated to advanced MRI evidence of iliotibial band syndrome.23

**Medical Management**

Medical management of iliotibial band syndrome generally includes a referral for physical therapy treatment and prescription of any combination of anti-inflammatory medication, analgesic medication, and corticosteroid delivered orally or by injection.24,25 Research supports the use of steroid therapy as a conservative treatment to reduce pain and improve function. Unfortunately, this research is focused on short term outcomes occurring in the first 1-2 weeks of treatment and does not include long term results.24,26 Other research, unrelated to iliotibial band syndrome specifically, indicates that the use of corticosteroids for the treatment of connective tissue injury can lead to slower and poorer healing of these tissues. It is this author’s educated opinion that steroid therapy should be avoided as a first line treatment for iliotibial band syndrome.

Longer term studies support the use of physical therapy interventions aimed at hip strengthening, activity modification (including rest), and modalities such as ice.24 If these methods are unsuccessful and the patient has recurrent or intractable episodes of pain and dysfunction, surgical intervention may be recommended. There are various surgical interventions that may be used to address pain and dysfunction related to iliotibial band syndrome. One method of surgical intervention involves the transection of the posterior aspect of the iliotibial band, in the area where it passes over the lateral condyle of the femur. This intervention has demonstrates good results with one study indicating 84.4% of patients reporting excellent or good results.27 Another method of surgical intervention involves an arthroscopic resection of the lateral synovial recess. A study of 36 athletes demonstrated good to excellent results in 88.9% of patients, with all patients being able to return to sports activity.28  Good results have also been demonstrated in patients who undergo an iliotibial bursectomy, although evidence related to this approach is quite limited. A recent study examined the post surgical outcomes of iliotibial band bursectomy after a single surgeon performed the procedure on eleven patients. Favorable post surgical outcomes were noted and all patients were able to return to pre-injury level of activity.29

**Evidence-Based Physical Therapy Intervention**

The first line of defense against iliotibial band syndrome is activity modification. Patients should be educated to rest from the inciting activity and may require other activity modifications such as change of foot wear, use of orthotics, change in seat position or handlebar position on bicycle. As pain decreases, patients should be encouraged to resume activity gradually to avoid potential aggravation of symptoms.1-3,5,7  The following table presented by Fredricson30, outlines evidence-based phases of rehabilitation for iliotibial band syndrome.

**Table 1: Fredricson’s phases of rehabilitation for iliotibial band syndrome**30

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| **Acute Phase** |
| Goal: Reduce inflammation of the iliotibial band at the lateral femoral epicondyle  Control extrinsic factors, such as rest from running and cycling   1. In severe cases patients should avoid any activities with repetitive knee flexion-extension and swim using only their arms and a pool buoy 2. The use of concurrent therapies is advised (i.e., ice, phonophoresis, or iontophoresis) 3. Oral, nonsteroidal anti-inflammatory medication is recommended 4. Corticosteroid injection, if no response to the above methods 5. Up to 2 pain-free weeks before return to running or cycling in a graded progression |
| **Sub-acute Phase** |
| Goal: Achieve flexibility in the iliotibial band as a foundation to strength training without pain   1. Iliotibial band stretching 2. Soft tissue mobilization to reduce myofascial adhesions |
| **Recovery Strengthening Phase** |
| Goal: Strengthen the gluteus medius muscle including multiplanar closed chain exercises   1. Exercises should be pain free 2. Repetitions and sets of exercises are 8-15 repetitions and 2-3 sets 3. Recommend the exercises of side lying hip abduction, single leg activities, pelvic drops, and multiplanar lunges |

In the first phase of recovery, the goal is to decrease inflammation and pain with the application of activity modification, modalities, and anti-inflammatory medication. If these methods are not successful in reducing the patient’s inflammation and painful symptoms, Fredricson recommends the patient have corticosteroid injection administered.7 Unfortunately much of the research regarding iliotibial band syndrome is focused on the administration of anti-inflammatory and steroid medications as a conservative means of treatment.1,2,7,24 Physical therapy is advocated in research and clinical practice guidelines, however, it is almost uniformly recommended that physical therapy be prescribed in conjunction with steroid therapy. Certainly, more research is needed to investigate true conservative measures of treatment and the long-term effects of steroid therapy.

Fredricson’s next phase of rehabilitation involves improving flexibility of the iliotibial band to prepare for safe and pain-free strength training. This phase includes iliotibial band stretching and myofascial release techniques. The final phase focuses on strengthening of the gluteus medius in various planes of motion.7  Activities aimed at muscular strengthening, neuromuscular re-education, and iliotibial band stretching are important components of rehabilitation for iliotibial band syndrome. A study of 806 west point cadets found that patients with greater than ten percent difference in strength between limbs had a greater likelihood of injury.31 This illuminates the role that muscle weakness plays in the acquisition of injury. Specifically, researchers have found weakness in the knee flexors and extensors32, and the hip abductors of patients with iliotibial band syndrome.15 The evidence presented in current research outcomes and relevant EMG studies support the important role of strengthening the gluteus medius1,2,7 and gluteus maximus7,30 muscles in the treatment of iliotibial band syndrome. In addition to these strengthening activities, it is beneficial to stretch the iliotibial band as tightness of the iliotibial band has been found to contribute to iliotibial band syndrome.7 Exercise should be progressed to include double leg and single leg closed chain activities according to patient tolerance.7 Based on current evidence, Baker presents the following progression of therapeutic exercise7 to address iliotibial band syndrome.

**Table 2: Baker’s Exercises for iliotibial band syndrome**7

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| Beginning Level Exercises |
| Standing iliotibial band stretch |
| Resisted clamshell in side lying |
| Hip abduction bridge |
| Resisted hip extension and knee flexion in quadruped |
| Resisted hip extension, external rotation, and abduction in quadruped |

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| Intermediate Level Exercises |
| Contralateral pelvic drop off step |
| Resisted squat (theraband around knees to recruit abductors) |
| Resisted staggered squat (theraband around knees to recruit abductors) |

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| Vigorous Exercises |
| Resisted squat with single leg emphasis (theraband around knees to recruit abductors) |
| Posterior lunge |
| Single leg deadlift |

There is limited evidence to support the use of any therapeutic modalities in the treatment of iliotibial band syndrome, with the exception of ice. The use of ice is cited repeatedly in the research as a modality utilized to decrease pain and inflammation.1,2,7,24,25 Some authors also site the use of phonophoresis and iontophoresis in the treatment of iliotibial band syndrome,24,30 however, the outcomes related to these treatments are not well documented. As noted earlier in this paper, it is well known that utilizing steroid therapy to address connective tissue injury can lead to slower and poorer tissue healing,33 thus steroid treatment of iliotibial band syndrome should be avoided when possible.

**Conclusion**

Iliotibial band syndrome is a complex problem with an unclear etiology. Anatomically, the iliotibial band is a dense connective tissue with structural changes as it moves from its origin in the area of the distal tensor fascia lata to the multiple distal insertions surrounding the knee joint. The biomechanical properties and actions of the iliotibial band are not clearly understood with three prevailing theories as to the etiology of iliotibial band syndrome. The original theory of iliotibial band syndrome suggests that pain and inflammation is secondary to a friction created by rubbing of the iliotibial band at the lateral femoral condyle during knee flexion and extension activities. Other research suggests a compression of structures underlying the iliotibial band during contraction of tissues. While still another theory suggests that pain is due to the inflammation of an iliotibial bursa. All of these theories support a common thread of inflammation in the area of the distal iliotibial band as it goes over the lateral femoral condyle. Due to the unclear etiology of iliotibial band syndrome, there is no one biomechanical abnormality that can be attributed as causing iliotibial band syndrome. Despite this, research does seem to indicate some common threads among patients with iliotibial band syndrome, specifically tightness of the iliotibial band and weakness of the hip abductors.

Unfortunately iliotibial band does tend to present alongside other diagnoses related to hip and knee pain: patellofemoral pain syndrome, knee osteoarthritis, and greater trochanteric bursitis. Because of this it is important to address iliotibial band syndrome early so that it does not contribute to the development of other painful syndromes. Treatment aimed at reducing inflammation, stretching the iliotibial band, improving neuromuscular control and strength in the hip are all effective methods in reducing the pain and disability associated the iliotibial band syndrome. Fortunately conservative treatment is typically effective and surgical intervention is generally not necessary. The implementation of a physical therapy program aimed at reducing inflammation, restoration of strength, and improvement of body mechanics can help patients to have a successful recovery from iliotibial band syndrome.

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