Standard of Care: Iliotibial Band Syndrome

ICD 9 Codes: 726.69 (enthesopathy of knee NOS)

Secondary diagnoses may be added as applicable: 719.46 (knee pain), 719.45 (pelvic/ thigh pain), 719.55 (pelvic/ thigh stiffness) or 719.7 (difficulty walking).

Case Type / Diagnosis:

Iliotibial band (ITB) syndrome is the second most common knee injury next to patellofemoral pain syndrome[1] and is considered an overuse injury often associated with lateral knee pain, lateral femoral condyle pain, hip pain or lateral thigh pain. Typically, a patient with ITB syndrome has more pain when the knee is flexed to 30 degrees than with full knee extension or knee flexion.[2] ITB syndrome was initially considered to be a result of constant friction of the ITB during knee flexion and extension over the lateral femoral condyle as would occur with running[3] or cycling[2]. More recently, it has been suggested that ITB symptoms may develop more from the compression of the fat and connective tissue between the iliotibial band and the lateral femoral condyle or from imbalances of the hip musculature.[4] Other authors[5, 6] propose that ITB syndrome may be related to strain rate as opposed to the degree of strain. Strain is the change in length during running divided by resting length, while strain rate is the change in strain divided by time.[5, 6] Further, evidence based on MRI demonstrates chronic inflammation and pathological changes between the distal ITB and the lateral femoral condyle[7] although there is no evidence of an actual inflamed lateral bursa.[2, 8] These newer findings challenge the medical management and physical therapy interventions for ITB syndrome.

The ITB is a fascial structure and extends from the tendinous portion of the tensor fascia lata (TFL) and the gluteus maximus muscle along the lateral thigh to the knee. At the knee it separates into two components and attaches first at the lateral femoral condyle on the femur and second on the tibia at Gerdy's tubercle (lateral tibial tubercle). At the lateral femoral condyle it is a tendinous attachment with a layer of adipose tissue containing pacinian corpuscles and is highly vascular. Inflammation at this site may cause pain during compression. At Gerdy's tubercle it is a ligamentous attachment which is tensed during tibia internal rotation as the knee flexes during weight acceptance in gait.[6, 9, 10] There is a broad fibrous expansion which anchors the ITB to the femur and the patella.[11] Anatomic studies have not shown the presence of a lateral bursa between the distal ITB and the lateral femoral condyle and report low magnitude of strain during stretching of the ITB. The function of the ITB is to stabilize the lateral hip and knee to resist hip adduction and knee internal rotation[9, 12] and control varus forces at the knee.[13]

Indications for Treatment:

Incidence:
ITB syndrome is common cause of lateral knee pain in 22% of lower extremity injuries.[14] There is a 1.6-12% incidence in runners[14] especially in marathon runners[1] and 22% in military recruits.[2] It can also occur in cycling (15% of overuse injuries at the knee)[14], dancing, volleyball, tennis, football, skiing, weight lifting, and aerobics[2, 14] as well as in soccer, basketball and field hockey in female college athletes and in competitive rowers.[14] Men (28%) and women (62%)[1] can develop ITB syndrome. Men less than 34 years old may be more susceptible[1] but no other age differences were found.

Biomechanical Factors:
Researchers have proposed several biomechanical factors leading to ITB syndrome but there remains limited, well conducted, scientific studies to support these factors.[2] Most authors suggest it may be a combination of factors that likely leads to the development of ITB symptoms some of which include improper training techniques, biomechanical abnormalities, increased running mileage and muscle imbalance.[12, 15, 16]

One study of female runners attributed ITB strain to greater hip adduction angle and greater peak knee internal rotation angle compared to controls which lead to increased tensile stress at the hip in the frontal plane, internal rotation stress at the knee and greater rearfoot inversion moments.[12] Findings from another study of female runners state that biomechanical factors are: greater peak hip adduction, greater peak knee internal rotation angle, lower tibial internal rotation (by 2.2^{o}, not significant) and femoral external rotation. It was noted that subjects in this study landed in greater hip adduction and knee internal rotation.[17] Similar findings were demonstrated with hip abductor weakness in long distance male runners with less hip adduction.[11] Further studies are warranted to explore these biomechanical factors of greater hip adduction, knee internal rotation and hip external rotation in runners.[6] Studies have shown over-pronation in those with ITB syndrome but other studies have shown reduced rearfoot pronation in runners with ITB syndrome.[13, 14, 18] Long distance runners with greater foot inversion, knee flexion at heel strike and greater knee internal rotation velocity have reported symptoms with ITB syndrome.[6, 19] Further research is needed to more fully understand the relationship of these findings in runners and non-runners.[6]

As mentioned above strain rate has been shown to be a statistically significant factor in the development of ITB syndrome. A study by Taunton et al[1] noted an increase in knee varus alignment in 33% of runners, increased knee valgus alignment in 15% and leg length discrepancies (anterior superior iliac spine to medial malleolus) of greater than 0.5 cm difference in 10% as etiologic factors. Other factors leading to ITB syndrome may be associated with ground reaction forces in normal single limb stance causing a varus torque at the knee. With excessive hip adduction during the stance phase of gait, leg stance and a concomitant Trendelenberg sign, the ground reaction vector is more medial than normal as the perpendicular distance to the knee is longer than normal. Consequently, the result is an increased varus torque at the knee and elongated lateral hip musculature placing increased stress on the ITB.[6, 11] Calcaneal eversion with tibial internal rotation can also lead to ITB syndrome[6, 17] when there is an increase strain to the ITB tissues with biomechanical malalignment.

Muscular Factors:
Strength, endurance, flexibility and coordination of the muscles and structures at the hip can be contributing factors of ITB syndrome. The TFL can be tight and strong leading to increased hip flexion in stance and internal rotation at the hip. The gluteus maximus and gluteus medius muscles can be lengthened and weak. The combination of these two factors can lead to a postural pattern with a Trendelenberg sign or compensated Trendelenberg sign. Poor muscle control at the hip additionally causes increased hip adduction and knee varus or valgus placing added strain to the ITB tissues.[6] It is not clearly understood if hip abductor weakness is the direct cause of ITB syndrome or if the timing/performance of the hip abductor muscles affects the amount of hip adduction during the stance phase of gait leading to a strain of the tissues.[14] A study by Fredericson et al,[9] demonstrated significant decreases in gluteus medius muscle strength on the affected limb for long distance runners with a significant increase in gluteus medius muscle strength and painfree running after a six week training program. Lavine[14] explores the possibility of a low hamstring to quadriceps muscle strength ratio associated with ITB syndrome.

Other contributing factors:
Other factors such as improper training methods, footwear, and bicycle fit can lead to ITB syndrome. Repetitive activities at 30^{o} of knee flexion in a closed chain and weight bearing position can cause impingement of the ITB causing pain at the knee.[6] Running downhill with a greater degree of knee flexion at heel strike may also be a factor but studies have shown no difference in the angle of knee flexion in runners with or without ITB syndrome.[14] In cyclists and runners, the amount of time in the impingement zone, the intensity of the loading, an increase in mileage especially in the context of strength deficits or biomechanical malalignment, or hill training can lead to ITB syndrome in runners. Some studies support long distance running versus sprinting as a factor in causing less impact on the impingement zone of the ITB although another study showed increased knee flexion at heel strike in runners following an exhaustive run to be the causal factor.[6]

Contraindications / Precautions for Treatment:

- Patients with active signs/symptoms of infection (fever, chills, prolonged and obvious redness or swelling at hip or knee joint)
- Avoid increases in pain with chosen exercises and activities
- Refer to appropriate modality procedures for contraindications and precautions for modality use.

Evaluation:

Medical History: Review PMH and pertinent diagnostic tests including any imaging. MRI results can show inflammation if present and have shown thickening over the lateral femoral condyle and fluid located deep to that region.[6, 8] Radiographs may have been obtained to rule out fracture or bone spur and may reveal a prominent femoral condyle.[20]

History of Present Illness: Note the length of time symptoms have been present and severity of symptoms, history of previous problems and any recent change in activity such as increasing running mileage, as well as other possible contributing factors such as running surfaces, type of footwear, orthotic use, cycling routine, recent growth spurt, overall health.

Social History: Note any pertinent information regarding home, work, recreational or athletic activities.

Medications: NSAIDS are most often prescribed. NSAIDS combined with analgesics may be beneficial. If symptoms have been present less than 14 days (acute stage) runners may benefit from a corticosteroid injection before returning to running.[21]

Examination (Physical / Cognitive / applicable tests and measures / other)
This section is intended to capture the most commonly used assessment tools for this case type/diagnosis. It is not intended to be either inclusive or exclusive of assessment tools.

Pain: Obtain pain information from patient using descriptors and VAS or VRS pain scale. Note location, description and aggravating factors. Typically the area just above the lateral joint line or at Gerdy's tubercle is painful or tender.
Palpation: Palpate area of patient's knee. Note any trigger points/tender areas in lower extremity musculature including vastus lateralis, gluteus medius, piriformis, and distal biceps femoris muscles[20] and at proximal gastrocnemius. Also palpate for change in tissue density of the IT Band.
ROM: Take goniometric measurements of active and passive motion at hip, knee and ankle.
Muscle length: Test flexibility with Ober test, Thomas test/hip flexor muscle test, 90/90 hamstring test and Ely test. Ober test is performed with the knee in flexion and in extension.[22] Note also the length of gastrocnemius[20] and piriformis muscles.
Joint Play: Assess patellofemoral joint especially medial tilt and medial glide.[23]
Strength: Perform manual muscle test of lower extremity muscles including gluteus maximus, gluteus medius, gluteus minimus, hip external rotators, quadriceps/VMO and hamstrings.[24] Decreased gluteus medius strength is common in long distance runners with ITB syndrome.[9] Individuals may also have hip extension, and knee extension or flexion weakness.[18, 20]
Sensation: Assess in lower extremities
Posture/alignment: Perform standing postural assessment. Note if genu valgum or varum, increased Q angle, genu recurvatum and foot pronation. Note any other biomechanical abnormalities. Measure leg lengths.
Special Tests: Test for distal ITB syndrome with Noble compression test. The Noble compression test is performed with the patient lying on the unaffected side with the knee flexed to 90 degrees. Apply pressure to the ITB over the femoral condyle and bring the knee into extension. If pain occurs as the knee approaches

30 degrees of flexion the test is positive, [20, 22, 25] Test for hip abductor weakness with Trendelenberg test.
Gait and Running: Observe gait and note exacerbation of postural dysfunction including foot pronation, genu valgum or varum, and hip internal rotation. If possible observe patient running and note any further exacerbations.
Functional Outcomes: Have patient fill out Lower Extremity Functional Scale.[26]
Functional Tests: Perform single leg balance, Star Test[27] and eccentric step test.[22]

Differential Diagnosis[20, 25]

- Knee osteoarthritis, early mild degenerative joint disease
- Lateral meniscus tear
- Lumbar spine dysfunction
- Sacroiliac dysfunction
- Muscle strain
- Patello-femoral stress syndrome
- Superior tibiofibular joint sprain
- Medial collateral ligament or lateral collateral ligament injury
- Biceps femoris tendonitis
- Popliteal tendonitis
- Common peroneal nerve injury
- Myofascial pain
- Knee synovial cyst[28]
- Synovial sarcoma[29]
- Greater Trochanteric bursitis

Assessment:

Problem List

1. Decreased strength
2. Decreased range of motion
3. Impaired joint play
4. Decreased muscle length
5. Pain
6. Postural dysfunction
7. Decreased function and recreation
8. Altered biomechanics (including foot mechanics and leg length discrepancy)

Prognosis: Good if compliant with program, makes changes in activity level as needed and biomechanical alignment is addressed. If the problem is chronic the prognosis may be more guarded.

Goals (Measurable parameters and specific timelines to be included on evaluation form)

1. Increase strength, including core stabilization and hip musculature
2. Increase ROM
3. Increase flexibility
4. Decrease pain
5. Improve posture
6. Improve function including gait pattern and stair ability
7. Return to work
8. Return to sport
9. Improved endurance
10. Prevent re-injury
11. Improve biomechanics during functional activities, if needed with use of an orthotic or heel lift

Treatment Planning / Interventions

Established Pathway	___ Yes, see attached.	_X_ No
Established Protocol	___ Yes, see attached.	_X_ No

Interventions most commonly used for this case type/diagnosis.
This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

While authors differ in best practices for managing ITB syndrome the following treatment plan is offered based on information available.

Treatment generally includes control of inflammation, strengthening, stretching, improving neuromuscular control, and soft tissue mobilization techniques.[14]

Acute Phase: [6, 25]

There is not strong evidence for effectively treating inflammation in the acute phase but individuals who received anti-inflammatory agents (NSAIDs, corticosteroids through phonophoresis or injection) showed significant improvement compared to controls.[14]

Address pain and inflammation at the lateral femoral condyle:

- Modalities: Ice, phonophoresis, iontophoresis[14, 20]
- Patient education and activity modification: Encourage rest from running and cycling. Avoid activities with repetitive knee flexion-extension. Gradual return to running or cycling.

Subacute Phase:

Modalities: can include use of iontophoresis, ultrasound, and ice or ice massage to decrease inflammation but there is little research data to support this specifically for ITB syndrome. A 2007 review concluded that physical therapy with a combination of NSAID's and analgesics can effectively manage symptoms and that phonophoresis with anti-inflammatory medication can lead to a quicker recovery as compared to knee immobilization.[21]

Manual techniques: Joint mobilization may be needed for an altered position of the patella, typically altered medial glide and medial tilt as fibers of the lateral retinaculum are associated with the ITB but not the actual length of ITB.[23] Deep transverse friction massage of the ITB is commonly used; however studies and systematic reviews show no statistical difference in improvement of pain in runners. Soft tissue mobilization can be used for myofascial restrictions at the hip and thigh.[20, 21, 30]

Taping: Trial of Kinesiotaping[31]and McConnell taping (for patellofemoral symptoms if present) may be tried although specific evidence related to ITBS was not found.[6, 32]

Therapeutic exercise:

> Stretching: Start after acute inflammation and pain has decreased.[20, 25] Modified Ober (knee in extension) stretch may be more effective than Ober (knee flexed to 90 degrees) stretch in stretching the iliotibial tract. The modified Ober stretch allows less interference from the TFL, can be more specific for the iliotibial tract, and places less stress on the medial knee.[10] Overhead arm extension during the standing iliotibial band stretch may increase effectiveness of this typical stretch.[20, 33] The patient can also reach downward and diagonally across to contralateral side with clasped hands to achieve a greater angle of adduction. Foam roll mobilization can help with stretching and reduce myofascial restrictions.[20] Hip flexor, hamstring, gastrocnemius, and soleus stretches are included as needed.
>
> Some studies do not support role of stretching the ITB in managing ITB syndrome[14] as lengthening of the ITB may actually be an apparent lengthening due to the lengthening of the TFL during stretching. As the muscular component of the ITB/ TFL complex has important role in tensioning the ITB, treatment should be directed at the TFL and gluteus maximus.[2] Hence, the need for stretching is determined at the discretion of the treating therapist.
>
> Strengthening: Strengthening exercises should focus on gluteal muscles, especially gluteus medius, which are needed to control femoral abduction and stabilize the pelvis during support phase of gait and running.[20] Exercises should include eccentric muscle contractions, triplanar movements, closed chain and integrated movement patterns. Participation in a strengthening program has been

shown to be beneficial especially with exercises aimed at increasing hip abductor strength.[9,34]

Typical exercises which target the gluteus maximus and gluteus medius can include:[6, 34]

- Sidelying hip abduction
- Clamshell with resistance band
- Resisted hip abduction with bridging with resistance band
- Quadruped hip extension with knee in flexion with resistance band
- Quadruped hip extension, abduction and external rotation with knee in flexion with resistance band
- Standing hip abduction with resistance band on unaffected leg
- Single leg stance
- Lateral band walk
- Step downs

<u>Return to Sport/Activity:</u>

As patient starts to return to sport and higher levels of function exercises can be progressed to:[6]

- Contralateral pelvic drop
- Bilateral squat with resistance band for hip abduction
- Bilateral squat with single leg emphasis with resistance band for hip abduction and external rotation
- Staggered squat with resistance band for hip abduction
- Single limb squat

Trunk flexion and vertical tibia position are important in performing squats to facilitate gluteal recruitment.[6]

Exercises can be further progressed to more complex triplanar exercises such as:

- modified matrix
- wall banger
- frontal plane lunges[6, 20]

Exercises for quadriceps and hamstring strengthening as well as core stabilization should also be included in the exercise program. Balance and proprioception exercises, including plyometrics, are added as patient transitions back to high level athletics and running activities.

Gait: Evaluate biomechanics in walking, running and other activities and make changes/modifications accordingly.

Footwear and Orthotics: Make recommendations as needed for altered biomechanics of the foot. Use a heel lift for actual leg length discrepancies as indicated.[18, 20]

Activity Modification:
Individuals are instructed to decrease activities until painful symptoms subside and to avoid activities which involve repetitive knee flexion and extension including swimming.[6]

> Runners: Patients are encouraged to decrease running or other provocative activities; and to avoid hills and crowned running surfaces. After symptoms resolve they can return to activity, cross training and resistance training. They should begin with longer distance walking, and then increase activity to light jogging before attempting to run. When resuming running, they should start at a faster pace and shorter distances.[15] Runners can return to running on level ground every other day for the first week with easy sprints on level ground and gradually increase distance and frequency for 3-4 weeks. Downhill running should be avoided for several weeks. If running on slanted or crowned roads, runners should change the side of the street that they run on to even out the time spent on the "downhill leg." When running long distances on a track, the patient should change directions every mile to even out the time spent on "inside" and "outside" legs.[20]
>
> Cyclists: As symptoms resolve cyclists can train on level ground every other day. Positioning on the bike needs to be considered and corrected as needed.[35] The bike seat can be lowered below typical height to decrease knee extension and ITB stress. Handlebars can be more upright and the seat more forward to decrease the stretch on the gluteus maximus and the ITB. Orthotics (wedges) and adjusting the cleat position can control tibial internal rotation and foot hyperpronation.[6, 36]
>
> Cross Training: should not involve activities which require repeated knee flexion and extension.[6]

Frequency & Duration: typically 1-2x/week for 4-6 weeks

Patient / family education:
- Use of NSAIDS or ice as indicated
- Home exercise program and importance of adhering to the program
- Modification of exercise, running or training program or other sport activity as indicated
- Importance of adhering to activity and training modifications
- Importance of adhering to proper training techniques
- Return to sports when exercises can be performed with proper form and without pain[6]
- Proper footwear
- Change running shoes every 300-500 miles. In non-runners supportive athletic shoes should be replaced at 6 months, maximum 1 year.

Recommendations and referrals to other providers:
Return to referring MD if no improvement upon which they may be sent to orthopedist for further intervention such as surgery or injection. Patient may also benefit from an orthotist referral for orthotics to control foot motion.

Re-evaluation

- Standard Time Frame – every 30 days or less as appropriate
- If significant worsening of symptoms or lack of progress.

Discharge Planning

Commonly expectations at discharge:
- Improved hip abductor strength in long distance runners corresponds with successful return to previous training program.[9]
- Improved muscle length
- Resolution or lessening of pain at lateral knee
- Patient more knowledgeable about self-management and preventing recurrence of symptoms, patient consistently carries out recommended exercise program.
- Return to running when performing open and closed chain exercises properly and with no pain.[25]

Transfer of Care
Typically patients are discharged with an independent home exercise program

Patient's discharge instructions
Activity modifications as noted above, continue exercises, progress activities as tolerated

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