Current Physical Medicine and Rehabilitation Reports (2024) 12:193–199
https://doi.org/10.1007/s40141-024-00442-w

REVIEW

Iliotibial Band Syndrome Current Evidence

Marcus Bonoan[1] · Marjorie Morales[2] · Xiao Wei Liu[2] · Olutimilehin Oyeniran[2] · Kevin Zheng[2] · Eugene Palatulan[2]

Accepted: 5 February 2024 / Published online: 19 February 2024

Abstract

Purpose of Review The goal of this paper was to synthesize the most up-to-date information on iliotibial band syndrome (ITBS).

Recent Findings Progression of running volume was not more significantly associated with ITBS incidence than progression of running intensity. Functional motor control exercises may be superior to traditional exercise. ESWT (extracorporeal shockwave therapy) is shown to be an effective treatment for ITBS.

Summary ITBS has the second-highest incidence rate of all knee pathologies in runners. The pathophysiology of ITBS is still unknown as recent studies have shown the original theory that the disease is caused by friction between the ITB and lateral femoral epicondyle is unlikely. Conservative management continues to be the main course of treatment for ITBS. Different exercise programs may yield different results, but a consistent program typically results in improvement of symptoms. More studies are required to evaluate the effectiveness of alternative therapies. Recent studies support the use of ESWT for the treatment of ITBS.

Keywords Iliotibial band syndrome · Iliotibial band friction syndrome · Iliotibial band · Lateral knee pain · Runners' knee · Extracorporeal shockwave therapy

Introduction and Background

Iliotibial band syndrome (ITBS) is a common overuse injury that presents with lateral knee pain over Gerdy's tubercle or the lateral femoral epicondyle (LFE). This diagnosis was first described in 1975 as a pathology found in US Marine Corps recruits who were taking part in endurance training [1]. Since its first description, ITBS has been found to occur in many active individuals who take part in sports requiring repetitive cycles of knee flexion and extension, especially running. It is estimated to occur in 1.6 to 12% of runners [2]. According to the RUN CLEVER trial, ITBS had the second-highest incidence rate of all the knee pathologies [3]. In this article, the most current evidence on the pathophysiology, diagnosis, and treatment of ITBS is discussed.

Pathophysiology

The ITB is a longitudinal fibrous band that runs along the lateral thigh from the iliac crest to the anterolateral proximal tibia. Proximally, it receives fascial contributions from the tensor fascia lata (TFL) and gluteus maximus. Distally, the ITB passes over the LFE before inserting at Gerdy's tubercle. This structure functions as a hip extensor, hip abductor, and lateral hip rotator as well as knee flexor, extensor, and stabilizer. Near full extension, the ITB acts as a knee extensor. Beyond 30° of flexion, the ITB acts as a knee flexor. In addition, the ITB provides stability to the lateral side of the knee [4].

✉ Marcus Bonoan
marcus.bonoan@einsteinmed.edu

Marjorie Morales
mmorale1@montefiore.org

Xiao Wei Liu
xialiu@montefiore.org

Olutimilehin Oyeniran
ooyeniran@montefiore.org

Kevin Zheng
kevizheng@montefiore.org

Eugene Palatulan
eupalatu@montefiore.org

[1] Albert Einstein College of Medicine, Bronx, NY 10461, USA

[2] Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY 10461, USA

The exact pathophysiology of ITBS remains controversial but is thought to stem from dysfunction of the iliotibial band (ITB) with prolonged repetitive movements and irritation of nearby structures [5]. The original prevailing theory was that ITBS pain is generated by friction between the ITB and the LFE. This theory suggests that during knee flexion and extension, the ITB glides over the LFE along the sagittal plane [5]. However, anatomical studies have shown that the ITB is closely associated with the femur, including the LFE, by multiple fibrous connections which limit anterior and posterior movement over the LFE [6]. Another theory postulates that there is a subtendinous bursa at the LFE which becomes irritated in ITBS, but the presence of this bursa has not been reproducible in other anatomical studies. An MRI study states that ITBS pain is likely generated by irritation of a highly innervated fat pad which was found below the ITB in all cadavers included in the study [6]. Repetitive flexion of the knee past 30° has been postulated to compress this highly innervated fat pad and lead to pain.

Diagnosis

History

Patients can describe ITBS as a burning or sharp pain with or without snapping sensation over the lateral femoral epicondyle as the ITB traverses over it following the foot strike phase during the dynamic walking and running gait cycle [6]. Patients with ITBS often will report transient pain during exercises prone to injuries due to overuse of knee extension or a foot strike such as running and cycling; as such, symptoms frequently return in the next run. A common factor that these exercises share is a history of training which includes distances that the body is not otherwise used to training. Common exercise examples include unrestricted running on a downhill slope or flat surface such as a track field. Speed is an important factor as biomechanical studies found slower jogging pace aggravates the pain more than quick strides or running [3]. Once symptoms of ITBS are present, there is a chance they are reproduced when keeping the knee flexed for extended periods of time. When reproduced, it can persist throughout the exercise and last up to days [7].

Clinical Screening and Evaluation

Screening patients should include localization of knee pain, with the common complaint being burning or shooting pain in the lateral knee. Secondly, time of onset differentiates ITBS from other injuries as the pain starts after a reproducible distance or time, with no pain at the beginning or end of the run [3]. One of the first initial screening maneuvers for evaluation of the IT band is eliciting the reproduction of symptoms during knee flexion at 30° as this is the maximal zone of impingement. When the knee is flexed, the ITB slides posteriorly to the lateral femoral epicondyle, and as the knee flexes, it moves anteriorly but tightens in both locations. This tension causes the posterior surface of the ITB to compress on the femur and create the impingement zone [6]. Screening should tease out which phase of running causes the most pain as ITBS pain is right after a foot strike. Pain with palpation over the lateral collateral ligament, lateral fat pad, or popliteal tendon may suggest other causes for injury.

Physical Examination

Inspection starts with assessing an individual's gait and looking for the lateral gluteal muscles for tightness or weakness which can be confirmed through manual motor testing and special tests [7]. There may be the presence of occasional swelling [7]. Weakness can be assessed with a single-leg balance test with overhead reach; if the torso flexes laterally, this suggests tight lateral gluteal muscles. If weakness is elicited, muscle activation can be elicited through manual stimulation at the origin and insertion, and partial restoration of strength can confirm lateral gluteal muscle inhibition as the cause of injury to the ITB. Palpation over the lateral knee occasionally elicits tenderness and discomfort or pain, which can radiate along the ITB length. Findings on palpation such as crepitus, mild pitting edema, or snapping are common but nonspecific. Special tests for ITBS include the Noble compression test, Thomas test, and Ober test (OT) [4]. The Noble compression test is done with the patient lying on the unaffected side and flexing the affected knee to 90° as the examiner presses the ITB over the lateral femoral epicondyle and extends the knee to 30° of flexion; a positive test is a reproduction of the pain at this juncture. OT is performed to assess for decreased range of motion in the ITB and tensor fascia lata (TFL). Of note, these tests have not yielded a satisfactory sensitivity or specificity for the identification and diagnosis of ITBS. Studies have confirmed the method and reliability of OT; however, most recently, the reliability of the OT and modified Ober's test has come into question. One study on lightly embalmed cadavers found OT and MOT to be more significantly correlated to the assessment of tight gluteus medius and minimus muscles and hip joint capsule rather than the ITB, making it an unreliable test for ITBS [8].

Physical exam maneuvers uncover hip abductor muscle deficits which cause burning pain due to muscle inactivity. A combination of hip abductor muscle inhibition and trigger points can facilitate the development of adhesions of the fascia which can be felt on palpation along the border of the fibrous band [2]. The diagnosis can be further solidified by physical exam maneuvers that elicit temporary symptomatic relief, such as lateral trunk flexion, and further confirmed by

coupling it with an extension of the arm overhead. Although this causes a temporary change in length across the ITB complex, it opens up a wide range of injury etiologies as this maneuver also extends other muscles such as tensor fascia lata, vastus lateralis, and gluteus maximus [7].

Imaging

ITBS is a clinical diagnosis, and imaging work-up is not routinely required. Imaging is typically only obtained in refractory or recurrent bases of ITBS [9]. Plain radiographs are typically not useful in the diagnosis of ITBS, but they can be used to help detect other causes of lateral knee pain, such as degenerative joint disease, patellar maltracking, and stress fractures [3]. MRI may demonstrate increased T2 signal intensity in the soft tissues lateral to the femoral epicondyle suggestive of fluid and edema. A thickened iliotibial band may indicate chronic pathology [10]. There may also be tendinopathic changes to the gluteus medius or minimus tendons. Musculoskeletal ultrasound can be utilized to identify acute inflammatory changes suggestive of bursitis between the iliotibial band and lateral femoral epicondyle, characterized by soft tissue hypoechoic edematous swelling or discrete fluid collections [9].

Risk Factors and Prevention

In addition to repetitive flexion and extension of the knees, there are multiple non-modifiable and modifiable risk factors that predispose patients to ITBS. Non-modifiable risk factors include anatomical characteristics that affect lower extremity alignment. These include weak hip abductors, more prominent lateral femoral epicondyle, and genu varum [11–13]. Modifiable risk factors include running excessively on horizontal or downhill surfaces and sudden increase in running distance or frequency [12]. It is also important to note that risk factors for ITBS may differ depending on a patient's sex. A recent meta-analysis demonstrated that transverse plane hip motion and hip abductor weakness are more associated with female runners with ITBS than male runners [14•].

It has been hypothesized that different schedules of progression in running predispose individuals to different groups of injuries [15]. More specifically, a sudden increase in running distance increases the risk of knee injuries, including ITBS and patellofemoral pain syndrome. In contrast, a sudden increase in running intensity increases the risk of calf, ankle, and foot injuries [15]. However, the recent Run Clever trial did not show significant evidence to support the aforementioned hypothesis. There were no significant differences in injury incidence between the two groups [15]. These results do not support a different injury risk for different running schedules, but sudden drastic changes in exercise distance or intensity are overall discouraged. Gradual increase in distance or intensity should be practiced to avoid ITBS and other lower extremity injuries.

Treatment

Introduction

ITBS is typically treated with a conservative approach. In the acute phase of injury, patients are instructed to avoid the activity that led to the development of their symptoms and to apply ice to the area of pain [12]. Oral pain medications, such as nonsteroidal anti-inflammatories and acetaminophen, can also be used in the acute phase. As symptoms improve, patients can gradually increase their physical activity [12]. Patients should undergo physical therapy with a focus on ITB stretching and strengthening of hip abductors [12]. Most patients fully recover by 6 weeks with conservative management alone [7]. If symptoms persist despite conservative management, additional treatment options can be explored. Corticosteroid injections have been shown to provide short-term pain relief in patients with ITBS, but there is a paucity of studies that quantify the long-term benefit [16]. Other treatment options for knee tendinopathies, such as percutaneous needle tenotomy, platelet-rich plasma injection, prolotherapy, topical nitroglycerin, and extracorporeal shockwave therapy, may be considered. However, there is minimal evidence to support the use of these therapies specifically for the treatment of ITBS. Since the pathophysiology of ITBS remains unclear, the indication for these therapies also remains unclear. Surgery is very rarely used in the treatment of ITBS. Most patients will respond to conservative management and will be able to return to their sport gradually [12].

Exercise Therapy

Exercise therapy is key to the management of ITBS. Exercise therapy aims to adjust musculoskeletal imbalances that increase the strain of the ITB [12]. In the acute phase of the disease, patients are advised to avoid activities that aggravate their symptoms. During the period of 1 week to several weeks after onset or the subacute phase, exercise is started gradually with stretching of the ITB, hip flexors, and gluteus maximus. Patients are then progressed to exercises for strengthening the hip abductors, gluteus maximus, and TFL [12]. A biomechanical approach is recommended to address muscle imbalances in the lateral hip muscles with deep tissue massage and strengthening exercises that emphasize tri-planar motions and integrated movement patterns [17]. Myofascial restrictions can be addressed through trigger point therapy, which involves applying pressure to specific points in the muscle to release tension and improve blood flow [17]. Ultimately, patients who experience symptom relief are slowly allowed to return to sports. Methods of achieving these goals vary, and research on the most effective methods is ongoing.

More recent evidence continues to support the claim that consistent adherence to an exercise program improves outcomes in patients with ITBS. In a recent study, female runners placed in three different exercise programs all had improvement in function and pain. There were no significant differences in outcomes among the groups [18]. However, other studies demonstrate that different exercise programs may yield different benefits. A recent study evaluated the effectiveness of a functional motor control (FMC) exercise program in Greco-Roman wrestlers. This exercise program included progression from double-leg squats to single-leg squats in order to improve the patients' control of knee kinematics. When compared to a traditional therapeutic exercise (TE) program, which included myofascial release, stretching, and strengthening exercises, FMC was more effective in improving pain, function, and muscle strength but less effective in increasing range of motion [19].

Taping/Orthosis/Braces

Appropriate shoe adjustments, including potential orthoses, may be considered as part of a customized regimen to address any compensatory patterns or movement asymmetries due to previous injuries or inherent skeletal muscular biomechanics. Therefore, orthotics may be considered as part of a comprehensive treatment plan for ITBS. [18]. A recent study also demonstrated that Kinesio Taping may help prevent ITBS by addressing the kinetic chain in ways of increasing hip flexion, peak hip abduction, and hip external rotation [20].

Injection Treatments

Corticosteroid injections may be used to treat ITBS when activity modification and oral pain medications are inadequate [9, 16, 21]. Gunter et al. have also shown it to be effective in decreasing pain of ITBS during the first 2 weeks of symptom onset [16]. Injections should be performed with ultrasound guidance for increased accuracy. There are different target sites for injection, between ITB and LFE, or enthesopathy of the tendon at Gerdy's tubercle with different techniques and approaches [22, 23]. There is a need for more studies to evaluate the long-term benefits of corticosteroid injections. In addition, there have been case reports of other injection treatments which include the ultrasound-guided hydrodissection of ITB and injection of ITB with hyaluronic acid and botulinum toxin [24, 25].

Extracorporeal Shockwave Therapy

Extracorporeal shockwave therapy (ESWT) is an emergent therapy for soft tissue conditions. Originally introduced in lithotripsy for the treatment of kidney stones in 1980, the procedure has since expanded to the treatment of musculoskeletal overuse injuries of the tendon and fascia [26••]. Current evidence supports its usage in plantar fasciitis, rotator cuff tendinopathy, lateral elbow epicondylopathy, proximal hamstring tendinopathy, patellar tendinopathy, and Achilles tendinopathy [26••]. Limited case studies have additionally demonstrated quicker recovery with bone stress injuries [26••].

The exact mechanism by which ESWT treats musculoskeletal pathologies is unclear. There are multiple theoretical mechanisms, including the promotion of neovascularization, collagen synthesis, cellular proliferation, and pain modulation [26••]. Furthermore, the effect of ESWT may depend on the type of tissue and the type of ESWT. Currently, there are two major forms of ESWT. Focused shockwave therapy (F-SWT) applies a wider field of pressure, allowing for sites further from the site of application to be affected. Radial shockwave therapy (R-SWT) applies a narrower field of pressure. R-SWT tends to have more superficial effects than F-SWT because R-SWT pressure waves have lower speeds and lower peak pressures [26••].

ESWT is a promising treatment modality of ITBS, especially for in-season athletes. ESWT has been shown to be a low-risk treatment modality that can accelerate the return to sport. Compared to more invasive procedures, such as platelet-rich plasma injections and surgery, ESWT has a shorter post-treatment recovery time, allowing athletes to stay active after treatment [27••]. Focused evidence on the treatment of ITBS is limited and often grouped with other running disorders with varied study protocols. A meta-analysis on the use of ESWT on knee soft tissue disorders, including ITBS, showed that ESWT improves function and pain [28]. A randomized controlled trial comparing R-SWT to manual therapy for the treatment of ITBS demonstrated improved pain in both the R-SWT and manual therapy groups. However, the benefit of ESWT was not significantly different from that of manual therapy [29]. In another clinical randomized controlled trial of 40 participants comparing the effectiveness of shockwave therapy (SWT) with dry needling (DN) for the management of ITBS, SWT and DN were both found to be equally effective in reducing pain and improving function in patients with ITBS after 4 weeks of intervention [30]. Those who underwent DN treatment experienced less pain in the 4-week follow-up after cessation of intervention compared to SWT. However, SWT was found to be more effective than DN in improving hip flexion range of motion. This study provides valuable insights into the effectiveness of alternative treatment options for ITBS. More studies are required to further quantify the benefit of ESWT in treating ITBS and to determine what ESWT protocol is optimal for treatment.

Surgery

With a comprehensive approach to the treatment of ITBS, surgery is rarely required. The prognosis of ITBS is favorable as the majority respond positively to conservative therapy and refractory cases are in the minority. When pain is refractory to stretching, strengthening, and muscle activation therapy, patients may consider surgical lengthening of the posterior ITB by releasing the portion that is tense over the lateral femoral epicondyle [31, 32]. The release is either a Z-lengthening or a triangular-shaped resection, both accomplished when the knee is at the maximal impingement zone at 30°. Traditionally, this is performed with open release or endoscopic release; however, recently, a more minimally invasive technique of ultrasound-guided release has been emerging [31, 32].

Existing Gaps in Knowledge and Future Directions

The exact pathophysiology of ITBS requires further study. Understanding this process may help refine the treatment and prevention of ITBS. A new wave of studies using visual gait acquisition systems can better monitor biomechanics and quantify the effectiveness of exercise therapy.

There is a need for more treatment options for ITBS that are refractory to conservative management and for patients who would like to avoid surgical interventions. Treatment options used for the treatment of chronic tendinosis such as percutaneous tenotomy, platelet-rich plasma injection, prolotherapy, and topical nitroglycerin could potentially be used to treat ITBS. However, currently, there have not been many randomized controlled studies of these treatment options specifically for ITBS.

Conclusion

Iliotibial band syndrome is a common cause of lateral knee pain, especially in runners and cyclists. It is known that the pathology is related to repetitive extension and flexion of the knee, but the exact pathophysiology of ITBS is still up for debate [5]. Originally, the disease was thought to be caused by friction between the iliotibial band and the lateral femoral epicondyle [6]. However, recent studies have shown that the iliotibial band is closely associated with the femur, which prevents significant movement of the IT band over the LFE during flexion and extension. The mechanism of pain is more likely related to the compression of a highly innervated fat pad deep into the IT band [7].

ITBS is typically diagnosed clinically. Patients describe burning, lateral knee pain located over the lateral femoral epicondyle or Gerdy's tubercle. The pain is associated with an activity such as running that requires repetitive knee flexion near 30°. ITBS has traditionally been thought to be more associated with increasing running volume rather than intensity. However, the recent Run Clever trial did not show significant differences in ITBS risk between runners who progressed their running volume and runners who progressed their running intensity [15]. In addition to a thorough history, physical examination can support the diagnosis and uncover musculoskeletal imbalances contributing to ITBS. Patients may have reproducible pain on the Noble compression test [17]. They may also have decreased ITB and TFL range of motion during the modified Thomas and Ober tests [17]. Imaging is not required for the diagnosis of ITBS [9].

ITBS is managed with a conservative approach. In the acute stage of the injury, patients are instructed to rest and manage pain and swelling with icing and oral analgesics, such as NSAIDs or acetaminophen. As symptoms resolve, patients should undergo a physical therapy program that focuses on addressing kinetic chain impairment, stretching the ITB, and strengthening the hip abductors, gluteus maximus, and TFL [12]. Consistent adherence to an exercise program improves pain and function. The exercise program can be further adjusted to achieve specific goals. A recent study on wrestlers with ITBS showed that a functional motor control exercise program was superior to a traditional exercise program in improving pain, function, and strength but inferior in increasing range of motion [19]. After symptoms continue to improve, patients can gradually return to their sport of choice. Avoidance of running downhill as well as increasing the pace of running may help prevent aggravation of ITBS as it decreases the frequency that individuals run at 30° of knee flexion [12].

For patients who are resistant to conservative management, alternative therapies are available. Glucocorticoid injections have been shown to provide significant pain relief for at least 2 weeks [16]. Recent studies have also reported that extracorporeal shockwave therapy may be an effective treatment option for ITBS. A meta-analysis demonstrated that ESWT was an effective treatment for a number of soft tissue knee injuries, including ITBS [28]. A randomized control trial also reported that ESWT provided patients with more pain relief and increased hip flexion than dry needling [30]. However, another trial showed that ESWT did not provide significantly more improvement in pain reduction than manual therapy [31]. Biologic injections such as autologous whole blood, platelet-rich plasma concentrates, processed lipoaspirate concentrates, and bone marrow aspirate concentrates have been used for other tendon-associated pathologies. However, there have not been any studies on the effectiveness of these treatments for ITBS.

Author contributions M.B., M.M., X.L., O.O., and K.Z. wrote the main manuscript text. K.Z. and E.P. reviewed the manuscript.

Declarations

Competing interests The authors declare no competing interests.

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent. This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Renne JW. The iliotibial band friction syndrome. J Bone Joint Surg Am. 1975;57(8):1110–1.
2. Strauss EJ, Kim S, Calcei JG, Park D. Iliotibial band syndrome: evaluation and management. J Am Acad Orthop Surg. 2011;19(12):728–36. https://doi.org/10.5435/00124635-201112000-00003.
3. Mulvad B, Nielsen RO, Lind M, Ramskov D. Diagnoses and time to recovery among injured recreational runners in the RUN CLEVER trial. PLoS One. 2018;13(10):e0204742. https://doi.org/10.1371/journal.pone.0204742.
4. Cuccurullo SJ. Physical medicine and rehabilitation board review. (4th ed., pp239–240). Desmos Medical. 2019.
5. Orava S. Iliotibial tract friction syndrome in athletes–an uncommon exertion syndrome on the lateral side of the knee. Br J Sports Med. 1978;12(2):69–73. https://doi.org/10.1136/bjsm.12.2.69.
6. Fairclough J, Hayashi K, Toumi H, Lyons K, Bydder G, Phillips N, Best TM, Benjamin M. The functional anatomy of the iliotibial band during flexion and extension of the knee: implications for understanding iliotibial band syndrome. J Anat. 2006;208(3):309–16. https://doi.org/10.1111/j.1469-7580.2006.00531.x.
7. Fredericson M, Wolf C. Iliotibial band syndrome in runners: innovations in treatment. Sports Med. 2005;35(5):451–9. https://doi.org/10.2165/00007256-200535050-00005.
8. Willett Gilbert M, Kleim Sarah A, Shostrom Valerie K, Lomneth CS. An anatomic investigation of the Ober test. Am J Sports Med. 2016;44(3):696–701. https://doi.org/10.1177/0363546515621762.
9. Jiménez Díaz F, Gitto S, Sconfienza LM, Draghi F. Ultrasound of iliotibial band syndrome. J Ultrasound. 2020;23(3):379–85. https://doi.org/10.1007/s40477-020-00478-3.
10. Flato R, Passanante GJ, Skalski MR, et al. The iliotibial tract: imaging, anatomy, injuries, and other pathology. Skelet Radiol. 2017;46:605–22. https://doi.org/10.1007/s00256-017-2604-y.
11. Everhart JS, Kirven JC, Higgins J, Hair A, Chaudhari AAMW, Flanigan DC. The relationship between lateral epicondyle morphology and iliotibial band friction syndrome: a matched case-control study. Knee. 2019;26(6):1198–203. https://doi.org/10.1016/j.knee.2019.07.015. (Erratum. In: Knee. 2020 Aug; 27(4):1291).
12. Fredericson M, Weir A. Practical management of iliotibial band friction syndrome in runners. Clin J Sport Med. 2006;16(3):261–8. https://doi.org/10.1097/00042752-200605000-00013.
13. Stickley CD, Presuto MM, Radzak KN, Bourbeau CM, Hetzler RK. Dynamic Varus and the development of iliotibial band syndrome. J Athl Train. 2018;53(2):128–34. https://doi.org/10.4085/1062-6050-122-16.
14.• Foch E, Brindle RA, Pohl MB. Lower extremity kinematics during running and hip abductor strength in iliotibial band syndrome: a systematic review and meta-analysis. Gait Posture. 2023;101:73–81. https://doi.org/10.1016/j.gaitpost.2023.02.001. **Findings from this study highlight the importance of addressing kinetic chain deficits in runners, which vary due to anatomical differences across genders.**
15. Ramskov D, Rasmussen S, Sørensen H, Parner ET, Lind M, Nielsen R. Progression in running intensity or running volume and the development of specific injuries in recreational runners: run clever, a randomized trial using competing risks. J Orthop Sports Phys Ther. 2018;48(10):740–8. https://doi.org/10.2519/jospt.2018.8062.
16. Gunter P, Schwellnus MP. Local corticosteroid injection in iliotibial band friction syndrome in runners: a randomised controlled trial. Br J Sports Med. 2004;38(3):269–72. https://doi.org/10.1136/bjsm.2003.000283.
17. Baker RL, Fredericson M. Iliotibial band syndrome in runners: biomechanical implications and exercise interventions. Phys Med Rehabil Clin N Am. 2016;27(1):53–77. https://doi.org/10.1016/j.pmr.2015.08.001.
18. McKay MJ, Baldwin JN, Ferreira P, Simic M, Vanicek N, Wojciechowski E. Rehabilitation of iliotibial band syndromein female runners: a randomized controlled trial. J Orthop Surg Res. 2020;15(1):188. https://doi.org/10.1186/s13018-020-01713-7.
19. Jahanshahi M, Nasermelli MH, Baker RL, Rabiei P, Moen M, Fredericson M. Comparing functional motor control exercises with therapeutic exercise in wrestlers with iliotibial band syndrome. J Sport Rehabil. 2022;31(8):1006–15. https://doi.org/10.1123/jsr.2020-0541.
20. Watcharakhueankhan P, Chapman GJ, Sinsurin K, Jaysrichai T, Richards J. The immediate effects of Kinesio Taping on running biomechanics, muscle activity, and perceived changes in comfort, stability and running performance in healthy runners, and the implications to the management of iliotibial band syndrome. Gait Posture. 2022;91:179–85. https://doi.org/10.1016/j.gaitpost.2021.10.025.
21. Hong JH, Kim JS. Diagnosis of iliotibial band friction syndrome and ultrasound guided steroid injection. Korean J Pain. 2013;26(4):387–91. https://doi.org/10.3344/kjp.2013.26.4.387.
22. Hackel J, Hayano T, Pitts J, Jerome M, 21 - Knee injection techniques, Editor(s): Christopher J. Williams, Walter. L Sussman, John Pitts, Atlas of Interventional Orthopedics Procedures, Elsevier, 2022, Pages 366–427 https://doi.org/10.1016/B978-0-323-75514-6.00021-2.

23. Malanga G, & Mautner K (2014). Atlas of ultrasound-guided musculoskeletal injections. McGraw-Hill Education/Medical
24. Lai LP, Patibanda V, Hwang GE, Stitik TP, Foye PM, Chen B. 2071378 Ultrasound-guided hydrodissection of the iliotibial band after total knee arthoplasty: case report. Ultrasound Med Biol. 2015;41(4):S113. https://doi.org/10.1016/j.ultrasmedbio.2014.12.458.
25. Petrella R, Decruze A. JSAT0603 An innovative treatment modality for acute ilio-tibial band syndrome in runners: local hyaluronate + botulinum toxin in a prospective cohort of 45 athletes. Ann Rheum Dis. 2017;76:1002–3.
26.•• Tenforde AS, Borgstrom HE, DeLuca S, McCormack M, Singh M, Hoo JS, Yun PH. Best practices for extracorporeal shockwave therapy in musculoskeletal medicine: clinical application and training consideration. PM R. 2022;14(5):611–9. https://doi.org/10.1002/pmrj.12790. **Findings from this study suggest that shockwave therapy plays a role in the therapy of various musculoskeletal overuse injuries, including ITBS.**
27.•• Rhim HC, Borg-Stein J, Sampson S, Tenforde AS. Utilizing extracorporeal shockwave therapy for in-season athletes. Healthcare (Basel). 2023;11(7):1006. https://doi.org/10.3390/healthcare11071006. **Findings from this study suggest that shockwave therapy is a treatment modality comparable to more invasive procedures with greater benefits in accelerated return to activity.**
28. Liao CD, Xie GM, Tsauo JY, Chen HC, Liou TH. Efficacy of extracorporeal shock wave therapy for knee tendinopathies and other soft tissue disorders: a meta-analysis of randomized controlled trials. BMC Musculoskelet Disord. 2018;19(1):278. https://doi.org/10.1186/s12891-018-2204-6.
29. Weckström K, Söderström J. Radial extracorporeal shockwave therapy compared with manual therapy in runners with iliotibial band syndrome. J Back Musculoskelet Rehabil. 2016;29(1):161–70. https://doi.org/10.3233/BMR-150612.
30. Maghroori R, Khorrami M, Ebrahimi S. SWT Vs. DN for the treatment of ITBS. GMJ. 2021;10:e2174. https://doi.org/10.31661/gmj.v10i0.2174
31. Boettcher BJ, Hollman JH, Stuart MJ, Finnoff JT. Ultrasound-guided cutting wire release of the posterior iliotibial band: a feasibility study. PM R. 2020;12(11):1113–9. https://doi.org/10.1002/pmrj.12340.
32. Villanueva M, Iborra Á, Sanz-Ruiz P, Noriega C. Ultrasound-guided release for iliotibial band syndrome: a novel ultraminimally invasive surgical procedure. Knee. 2021Jun;30:9–17. https://doi.org/10.1016/j.knee.2021.02.021.