

## Effectiveness of Thera-Band Exercise Program and Electro- physiotherapy on Abductor Strength of the Iliotibial Band in Athletes with Iliotibial Band Syndrome

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### Abstract

**Objectives:** The iliotibial band (ITB) is a thick fascial band formed near the hip by merging the fascia of the gluteus maximus, gluteus medius, and tensor fasciae latae muscles. Iliotibial band syndrome (ITBS) is a common overuse injury, manifests as pain on the outer side of the knee and hip due to ITB friction with the femur. Athletes may experience reduced hip and knee mobility, potentially impacting performance. This study aims to compare the efficacy of two ITBS treatments: Thera-Band Exercise Program (TBEP) as the experimental group and Electro-Physiotherapy (EPT) as the control group.

**Methods:** A randomized controlled trial carried out at the Teaching Hospital Karapitiya, with thirty athletes in each group. The control group received EPT, and medications, for two weeks, the experimental group received TBEP and medications for the same duration. Abductor Muscle strength assessment was conducted on Day 01 and Day 28 using handheld dynamometer (HHD)

**Results:** The mean ages in the control and experimental groups were 24.33±6.40 years and 24.97±6.87 years, respectively. Muscle strength (N) for the control group on Day 1 and Day 28 were 99.77± 24.81 and 108.83±22.36, respectively. In the experimental group, the corresponding values were 102.50±26.71 and 147.00±29.92, respectively. The mean differences for muscle strength of two groups in D1 and D28 were 2.733(P>0.683) and 38.167(P<0.001) (RM-ANOVA). TBEP had a statistically significant effect (p=0.000), and it explained 16.8% of the variance in muscle strength. The Partial Eta Squared was 0.168.

**Conclusions:** The Thera band program works better in improving abductor muscle strength of the athletes with ITBS compared to electro- physiotherapy.

**Keywords:** Iliotibial Band Syndrome, Thera band, Muscle Strength, Electro- physiotherapy. Hand-Held Dynamometer

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## **Introduction**

### *Iliotibial band syndrome*

According to Nguyen, Iliotibial band syndrome (ITBS) is one of the highly affected causes for lateral knee pain. It was first revealed in the United States Marine Corps recruits during their training in 1975 (Renne), and since then it has been diagnosed frequently in athletes including long-distance runners, cyclists, skiers and participants of hockey and basketball (1).

Latest updates published by Balachandar showed that ITBS is the most common injury of the lateral side of the knee in runners, with an incidence estimated to be 5% to 14% (2).

Fredericson and Weir illustrated that in the United States, the incidence of ITBS was around 4.3-7.5% in athletes who participate in long-distance running. But studies have indicated, that ITBS is less prevalence in short-distance or sprint-distance runners. The higher rate in long-distance runners is virtual because of the enhanced stance phase during longer-distance running. ITBS has also been documented in military recruits, cyclists, and tennis players. The prevalence of ITBS is also grown in adolescents undergoing the rapid growth phase (3).

Some researchers depicted that the popularity of running and other sports is still growing and as participation increases, the incidence of running-related injuries also rise. As such an increased prevalence in ITBS was noted over the past few decades and might be associated with the increasing number of athletes worldwide (4,5).

### *What is ITBS?*

It should be emphasized that confirmative pathophysiological mechanisms that produce ITBS is controversial. There are hundreds of studies in which researchers have analyzed the pathophysiology of ITBS. Nevertheless, the exact mechanism is still controversial.

Once the concept of ITBS was first invented, the postulated model was that during activities necessitating repetitive knee flexion (such as running), the iliotibial band shifted forward and backward repetitively over the lateral femoral condyle, triggering friction and hence inflammation of the ITB.

Numerous studies elaborated, the pathogenesis of Iliotibial band friction syndrome (ITBFS). It comprises of inflammation and irritation of the lateral synovial recess (6,7), as well as sustained irritation of the posterior fibres of the ITB and inflammation of the periosteum of the lateral femoral epicondyle, all of which explains the pathogenesis of ITBFS. Kirk et al., proposed, that with repetitive soft tissue irritation there is merely not adequate time for the body to repair these injured tissues. This might lead to further irritation and damage, which, in theory, would extend the area of the impingement zone and increase the risk of irritation (8,9).

### *Clinical Features & Diagnosis*

In a study done by Sutker et al., the main complaint of patients was lateral knee pain accompanying repetitive knee flexion and extension while doing exercise under a load, as manifested in deceleration phase of running. The next study, Sutker et al., diagnosed forty-

eight subjects of ITBS after being evaluated of 1030 runners complaining of lower extremity pain. Diagnosis of the forty-eight cases of ITBS was confirmed according to the pain consistent with the patient's history and localized tenderness over the lateral femoral epicondyle. However, there was no pain associated with hop and squat (10).

A study done by Khaund and Flynn elaborated a clinical presentation of diffuse lateral thigh pain with sharp discomfort of the lateral femoral epicondyle and lateral tibial tubercle. They gave further details about this by affirming that patients may experience pain at the end of a run or even a few minutes after commencing a run and throughout a run irritation will progressively increase. Therefore patients experienced an exacerbation of their symptoms while lengthening their step or sitting for extensive periods of time with their knees in flexion (11). They also complain of pain while running down hill and in severe cases, pain while walking or going down stairs (12).

There is a frequently practiced test which objectively assess a patient. The Noble compression test in which the examiner should be able to reproduce the symptoms with compression just proximal to the lateral femoral epicondyle while the knee is bent at thirty degrees and then extending the knee.

### Clinical and functional anatomy of the ITB

The ITB is a fascial structure which consists of thick connective tissue that supports and assists stance, stability at the knee. It resists large varus torques at the knee efficiently, (13). The tensor fascia lata and gluteus maximus

muscles are inserted to the ITB proximally (14). Based on anatomical dissections of one orangutan, three chimpanzees, one gorilla, one bear, and other four-legged animals, Kaplan (14) concluded that, although all quadruped animals have tensor fascia latae or gluteus maximus muscles, they all do not have an ITB. The investigator then proposes that the ITB is essential for erect posture and an independent stabilizer of the lateral knee joint. It has two significant attachments distally, including the lateral epicondyle and the Gerdy tubercle (Figure 1) (15). The band passes distally down the lateral aspect of the pelvis and femur to distal to the distal femur at the upper edge of the lateral epicondyle (16). The histopathologic makeup is consistent with tendon and includes a layer of adipose tissue beneath the ITB insertion area. The adipose tissue consists of Pacinian corpuscles, is extremely vascular and might be the site of the inflammation that elicits pain during compression.



**Figure 1: Anatomy of the Iliotibial Band**  
(Represented with the permission, adopted <http://www.tihcij.com/Articles/Etiology-of-ITB-Syndrome>)

The second distal attachment of the ITB is significantly important biomechanically and it passes most distally to make the insertion into the Gerdy tubercle of the tibia and serves as a ligament in structure and function. The Gerdy tubercle attachment is tensed and tight during internal rotation of tibia as the knee flexes during the weight-acceptance phase of gait (17). Internal rotation of tibia interprets the sporadic connection between toeing in and ITB strain. It spreads to many other distal attachments, namely, the biceps femoris, vastus lateralis, lateral patellar retinaculum, patella (by way of epicondylopatellar ligament and patellar retinaculum), and patellar tendon (17). Together, these anterior and lateral insertions construct a horseshoe shape or inverted U shape structure which is well established and positioned for anterolateral support to the knee. The site of injury is frequently related to the insertion at the lateral epicondyle, but it is highly associated with the forces produced by the numerous attachments above and below the lateral epicondyle (Figure 01). Fairclough et al (15) elucidate a mechanism of compression of the ITB against the lateral epicondyle that happens at 30° of knee flexion. Their anatomic clarification comprises of observation that compression of the adipose tissue at the lateral epicondyle of the femur triggered pain and inflammation however, there is no anterior-posterior movement of the band moving over the epicondyle occurs. It is merely an approximation of the ITB into the lateral epicondyle as the knee internally rotates during flexion from an extended position. The researchers present an anatomical standpoint that denies the commonly held theory of a

friction syndrome. Fairclough et al., (15) defined friction as an implausible cause of ITBS because the band inserts deeply and strongly into the femur. The functional anatomy might be related to the reason that a fat pad and Pacinian corpuscle compression mechanism may have diverse mechanoreceptor inferences compared with a friction syndrome, even if inflammation remains the primary concern.

### Pathophysiology of ITBS

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extend the area of the impingement zone and increase the risk of irritation (8,9).

Though, this interpretation has been impeached in several ways Fairclough and others rationalized that the ITB is not a well-defined anatomical structure but simply a condensed zone within the lateral fascia, which furthermore is firmly attached to the linea aspera by an intermuscular septum (18). According to these anatomical clarifications, it is impossible to have an anterior–posterior glide of the ITB, and they assumed that a friction syndrome could not be in the region exactly. Alternatively, they proposed that a misinterpretation of anterior–posterior movement of the ITB caused by sustained repetitive cycles of tightening; with each and every cycle of tightening the lateral fascia creates a repetitive compression effect on connective tissues beneath the ITB.

#### Management of ITBS

Management strategies include,

- Nonsteroidal anti-inflammatory drugs (NSAIDs)
- Injections of steroids
- Platelet Rich Plasma Injection (PRP)
- Surgical procedures
- Physical therapy
  - i. Electrotherapy methods, such as Ultrasound therapy, Transcutaneous Electrical Nerve Stimulation (TENS), Shock-wave therapy, and Infra-Red (IR) heating
  - ii. Exercise therapy, incorporating stretches and strength training with Thera Bands

#### Therapeutic efficacy of Thera -band exercise

Isokinetic exercises, bridging exercises, sling exercises, squats, and Thera-band (TB) exercises are utilized to develop the hip muscles (19). Among these exercises, the TB is capable of exercising level adjustments. If the elasticity of the band is gradually enhanced and the band is applied to a proper location, it may be believed as a suitable strengthening exercise. Thus, the muscles and joints are not overloaded by this exercise. The intensification in flexibility, strength and endurance as a result of an increase in ROM is constantly stated in several types of research. Subsequently, exercises with an elastic band are comparatively affordable portable, simple, and used for multiple purposes compared to machine resistant programs. They are at present frequently applied in rehabilitation programs (20). Currently, resistance exercise utilizing a TB is generally applied in strength training, sports rehabilitation, and disability rehabilitation. It is stated that at least four weeks of TB exercise enhanced muscle strength up to 14%–26% (21). In an advanced study, it is described that not only strength, balance, proprioception, and function are improved but it also has preventative effects on chronic pain and damage (22). Even though, there are several advanced studies about TBs, the researchers do not compare flexion and abduction hip joint exercises using a TB. A study was done by Uchida et al., in 2016 to determine the tension of the different-coloured TBs (Figure 2) (colour corresponds to the resistance level). The tension force (kilogram-force units) of eight color-coded elastic bands (tan, yellow, red, green, blue, black, silver, and gold) with different resistance levels was

measured at 10 different percentages of elongation and compared the values found with the reference values elaborated by the producer. The mean tension force values acquired in this study, as well as the positive slopes in their linear regression analysis, confirmed the relationship that, their values were less than those expected by the producer for virtually all of the eight different-coloured bands tested (23).



**Figure 2: Thera-band colours sequence resistance levels**

## Materials and Methods

A randomized controlled trial (RCT) conducted at the Teaching Hospital Karapitiya involving two groups of athletes. The study aimed to compare the effectiveness of two different interventions on abductor muscle strength over a period of two weeks. The control group was administered Electro Physiotherapy (EPT) along with medications, while the experimental group received Thera band Exercise program (TBEP) (Table 1) in

addition to medications. The duration of the interventions for both groups was two weeks.





To assess the impact of these interventions, abductor muscle strength of ITB was measured on two occasions: on Day 01 and Day 28. The assessment was conducted using a hand-held dynamometer (HHD) (Figure 3). A hand-held dynamometer is a portable device that measures muscle strength by quantifying the force applied during muscle contraction. In this context, it was likely used to evaluate the abductor strength of ITB, which are responsible for moving a limb away from the body.

The choice of Day 01 and Day 28 for assessments suggests a before-and-after design, allowing the researchers to compare the baseline muscle strength with the strength after the two-week intervention period. This design helps determine the effectiveness of the interventions in influencing abductor muscle strength of ITB over the specified timeframe.



**Figure 3: Digital hand-held dynamometer (Represented with the permission of Hoggan Health Co. Ltd USA)**

**Table 1: Thera band strengthening (TBS) program**

Strengthening Procedure	Progression # 1 Supine Bridge with Thera band	Progression # 2 Lateral Monster Walk	Progression # 3 Monster X walk	Progression # 4 TKE
				
<b>Start position</b>	Begin in the supine position with your knees bent and feet flat on the floor. Place your feet hip width apart	Place feet together and tie the TB around the ankles	Place both feet shoulder-width apart inside a TB. Cross the band to form an X and press your arms overhead. Assume a quarter squat position	Wrap a TB around your stance leg as shown so that it is pulling the knee across the front of your body
<b>Execution</b>	While lying on back, tighten lower abdominals, squeeze buttocks and then raise buttocks off the floor/bed as creating a "Bridge" with body.	Take a step to the right with the right leg and follow with the left leg. Take the prescribed number of steps to the right and then repeat on the opposite side	Take a step to the right with the right leg and follow with the left leg. Take the prescribed number of steps to the right and then repeat on the opposite side.	Bend your stance knee and lower your body towards the floor. Return to a standing position. Your stance knee should bend in line with the 2nd toe and not pass the front of the foot. Repeat prescribed number of repetitions
<b>Coaching keys</b>	Keep the core tight throughout the movement	Maintain the quarter squat position throughout the entire exercise. Avoid that the knees move inward. Keep the knee well aligned between hip and ankle. Keep the toes pointed forward. Keep your feet at least shoulder-width apart, so there is always tension on the TB. Maintain a level pelvis through set	Maintain the quarter squat position throughout the entire exercise. Avoid knees moving inward. Keep the knee well aligned between hip and ankle. Keep the toes pointed forward. Keep feet at least shoulder-width apart, so there is always tension on the TB	Bend the stance leg-knee to about 45 degrees
<b>Duration</b>	Week 1-2, reps 15x3	Each direction	Each direction	Each leg
<b>Weeks and Reps x Sets</b>	Medium TB	Week 1-2, reps 15x3 Medium TB	Week 1-2, reps 15x3 Medium TB	Week 1-2, reps 12x3 Medium TB
<b>Frequency</b>	3x/week	3x/week	3x/week	3x/week

TKE: Terminal Knee Extension with Thera band-Hip Abduction

## Results

In the presented results, the mean ages of participants in the control and experimental groups were comparable, with the control group having a mean age of  $24.33 \pm 6.40$  years and the experimental group having a slightly higher mean age of  $24.97 \pm 6.87$  years. The focus of the study was on abductor strength, measured in Newtons (N), and assessments were conducted on Day 1 and Day 28.

For the control group, the abductor strength on Day 1 was  $99.77 \pm 24.81$  N, and it increased to  $108.83 \pm 22.36$  N by Day 28. In contrast, the experimental group exhibited a more significant change, with abductor strength values of  $102.50 \pm 26.71$  N on Day 1 and a substantial increase to  $147.00 \pm 29.92$  N by Day 28.

Statistical analyses, including repeated-measures analysis of variance (RM-ANOVA), revealed that the mean differences in abductor strength between the two groups were not significant on Day 1 (2.733,  $P > 0.683$ ). However, by Day 28, the difference became highly significant ( $38.167$ ,  $P < 0.001$ ), (fig-04 and 05) indicating that the experimental group, receiving TBEP, experienced a more pronounced improvement in abductor strength compared to the control group.

Further analysis demonstrated that TBEP had a statistically significant effect ( $p = 0.000$ ), explaining 16.8% of the variance in muscle strength. The Partial Eta Squared, a measure of effect size, was calculated as 0.168, indicating a moderate-sized effect. These findings suggest that the experimental intervention had a substantial and statistically significant

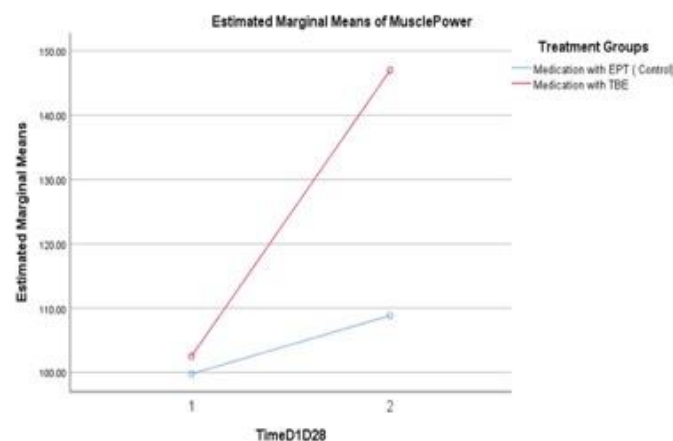
impact on abductor muscle strength, as evidenced by the observed differences between the groups on Day 28.

Time	HHD READINGS		Mean Difference (I-J)	Sig. <sup>b</sup>
DAY 1	Medication with MT (Experiment)	Medication with EPT (Control)	2.733	0.683
DAY 28	Medication with MT (Experiment)	Medication with EPT (Control)	38.167 <sup>*</sup>	0.000

\*Mean difference significant at .05 level

<sup>b</sup>Adjustments for multiple comparisons: Bonferroni

**Figure 4:** Out Come Measure: Muscle Power - Pairwise Comparisons of Mean Difference in Muscle Power between Day 1 and Day 28 in each group



**Figure 5:** Graphical presentation Out Come Measure: Muscle Power – Pairwise Comparisons of Mean Difference in Muscle Power between Day 1 and Day 28 in each group

## Discussion

The rehabilitation of iliotibial band syndrome (ITBS) poses a tough challenge for sports physicians and physiotherapists, given its resistance to many conventional treatments. This condition proves debilitating, significantly impairing the performance of athletes, particularly long-distance runners. The diverse spectrum of External and internal factors may be the primary influence contributing to the complexity of managing ITBS. Notably, the condition is predominantly addressed through practices based on expertise rather than evidence-based methodologies. The reliance on eminence-based approaches accentuates the gaps in established, evidence-driven strategies for effectively addressing ITBS, emphasizing the need for further research and development in this area of sports medicine. The presented results shed light on the effectiveness of two interventions, Thera-Band Exercise Program (TBEP) and electro-physiotherapy (EPT), in improving abductor muscle strength among athletes with iliotibial band syndrome (ITBS). Notably, the participants in the TBEP group exhibited a substantial and statistically significant increase in muscle strength from Day 1 to Day 28, surpassing the improvements seen in the EPT group. The mean differences between the two groups became highly significant by Day 28, with TBEP accounting for a remarkable 38.167 N increase in muscle strength compared to the control group.

The statistical analyses, particularly the repeated-measures analysis of variance (RM-ANOVA), emphasized the significant impact of TBEP, with a p-value of 0.000, indicating

the intervention's efficacy in enhancing abductor muscle strength. The effect size, measured by Partial Eta Squared at 0.168, further substantiates the practical significance of TBEP, signifying a moderate-sized effect.

In conclusion, the findings suggest that the Thera-Band Exercise Program is more effective than electro-physiotherapy in improving abductor muscle strength among athletes with ITBS. The study emphasizes the importance of targeted exercise interventions like TBEP in rehabilitation strategies for athletes experiencing iliotibial band syndrome, offering a valuable contribution to the optimization of treatment protocols in sports medicine. Further studies are warranted to delve into the precise mechanism through which these improvements occurred.

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