Japan Journal of Research

Original Article

# The Effect of Neurophysiological Modulation on Muscle Power and Pain Through Manual Therapy Over Electro- Physiotherapy for Athletes with Illio Tibial Band Syndrome (ITBS)

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- Received Date: 18 July 2024
- Accepted Date: 29 July 2024
- Publication Date: 31 July 2024

Keywords

Iliotibial Band Syndrome, Manual Therapy, Visual Analog Scale, Electro- physiotherapy. Hand-Held Dynamometer



## Abstract

***Introduction and Objectives:*** *Iliotibial Band Syndrome (ITBS) is a common overuse injury in athletes, primarily impacting the knee and hip due to repetitive friction of the iliotibial band against the femur, resulting in pain and restricted hip abduction and knee extension. Muscle power and pain associated with ITBS can be measured using Hand-held Dynamometer (HHD) and Visual-Analog-Scale scores (VAS) respectively. This study aimed to compare the efficacy of two treatment groups, Manual-Therapy (MT) and Electro-Physiotherapy (EPT), in determining the most effective approach for managing ITBS.*

***Materials and Methods:*** *A RCT was conducted at the Sports Medicine Clinic of the Teaching Hospital Karapitiya, enrolling twenty athletes in each group as controls and experimental subjects. The control group received EPT, NSAIDS, and paracetamol for one week, while the experimental group received MT, NSAIDS, and paracetamol for the same duration. Muscle power and pain measurements were assessed using HHD & VAS on D1 and D28. P-values for statistical significance were obtained using RM-ANOVA followed by Bonferroni test.*

***Results****: Mean ages for EPT and MT groups were 24.4±6.6 and 25.4±6.6years, respectively. Muscle power (N) for EPT group on D1, and D28 were 101.7±26.3 and 112.7±23 respectively. The same parameters for MT group were 98.1±26 and 186.8±25.3. The mean differences for muscle power of two groups on D1 and D28 were -3.600(P=0.666) and 74.050(P<0.001). VAS scores for EPT group on D1, and D28 were 8.2±0.9 and 7±1 respectively. The same parameters for MT group were 7.9±0.8 and1.8±0.8. The mean differences for pain of two groups on D1 and D28 were 0.250(P=0.395) and -5.200(P<0.001). Partial-Eta-Squared for the two groups were 0.355 and 0.758respectively. Manual-Therapy group's higher effectiveness was statistically significant (p<0.001) and a 35.5% variance in muscle power and 75.8% variance in VAS score was attributable to it.*

***Conclusion:****Manual-therapy is superior to electro-physiotherapy in improving muscle power and decreasing in VAS scores of athletes with ITBS.*

## Introduction

### Iliotibial band syndrome

According to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)-WHO Version for; 2016 Iliotibial band syndrome was classified as M76.3 (https://icd.who.int/browse10/2016/en#/M76.3). The 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].

**Citation**: Thebuwanaarachchi ST, Samarawickrama MB, Dissanayake A, Gunawardena S, Shishidara H. The Effect of Neurophysiological Modulation on Muscle Power and Pain Through Manual Therapy Over Electro- Physiotherapy for Athletes With Illio Tibial Band Syndrome (ITBS). Japan J Res. 2024;5(6):044.

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].

It should be emphasised that confirmative pathophysiological mechanisms that produce ITBS is controversial. There are hundreds of studies in which researches have analysed 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 ITBS. 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 ITBS. 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 the deceleration phase of running. In 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 localised 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.

## Treatment: Management strategies for this condition include

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

## Therapeutic efficacy of Manual therapy (MT)

Manual therapy techniques to release myo-fascial restrictions in the ITB and related structures are also frequently recommended.

Pedowitz reported on a single case that he treated effectively with strain–counter strain technique [13]. Hammer emphasizes the use of connective tissue treatment methods to release restrictions not only in the ITB but in the gluteal muscles and any other areas found to be restricted in the hip area, thigh, or lower extremity [14].

Conversely, of the scarce published data that has tested the efficacy of these measures, Ellis et al. found a single trial of deep transverse friction massage applied in the treatment of ITBFS. It was not found to confer any added benefit [15].

Level IV evidence were found where both the techniques, manual pressure release (MPR) alone and in combination with Kinesio taping(MPR-KT) effective in reducing pain caused by myofascial trigger points(MTRP), a condition in which a hyperexcitable muscle knot found within the muscle causing severe pain and loss of muscle strength [16].

A systemic review on the effect of physical therapy approaches for the treatment of Iliotibial Band Syndrome show that trigger point release results showed a significant decrease in pain

and an improvement in function ability. Kinesio taping treatment had an additional benefit of improving night pain [17].

Researchers have observed that even modified MFR manoeuvres termed self-myo-facial release (SMFR) could significantly increase the joint ROM [18].

Dating back to as early as 400 BC, manual therapy has played a crucial role in physical rehabilitation programs. Throughout the years, a multitude of manual therapy techniques have been created and advocated [19].

The annual expenditure on manual therapies in the United States alone, which includes chiropractic/osteopathic manipulation and massage, exceeds $8.1 billion [20].

## Electrotherapy

Electrotherapy, also known as electromagnetic therapy, utilizes electrical energy for medical treatment. One common application is diathermy, which involves generating electrically induced heat to relax muscles. This technique heats deep tissue either electromagnetically or ultrasonically for therapeutic purposes. Electrotherapy serves various functions, including alleviating muscle spasms, preventing and slowing down disuse atrophy, enhancing local blood circulation, and aiding in muscle rehabilitation and reeducation through electrical muscle stimulation. It also helps in maintaining and increasing the range of motion, managing chronic and severe pain, alleviating post-traumatic and post-surgical acute pain, stimulating muscles immediately after surgery to prevent venous thrombosis, promoting wound healing, and facilitating drug delivery [21].

### Short-wave diathermy

Short-wave diathermy current is a high frequency AC. The heat energy obtained from the wave is used for giving relief to the patient.

### Ultrasound

Ultrasound is an electromagnetic wave different from sound waves. The frequencies of waves employed for medical purposes are between 500 000 and 3 000 000 Hz. Ultrasonic waves are generated by vibration of a crystal mounted on a special head.

### Transcutaneous electrical nerve stimulation

Transcutaneous electrical nerve stimulation (TENS) is the use of electric current produced by a device to stimulate the nerves for therapeutic purposes. TENS by definition covers the complete range of transcutaneously applied currents used for nerve excitation.

### Interferential current

Interferential current (IFC) therapy is a unique use of kilohertz AC waveform. IFC is an endogenous production from interference of two medium frequency ACs within the tissues

Electro therapy session- Includes Infra-Red Heat (IRH) for 15 min and Ultrasound (US) for 30 min or Short Wave (SW) for 15 mins.

According to Bret, electro therapy, exercise therapy, KT and massaging (MFR) considered as most common physical therapy treatments and modalities. Those modalities could be used either individually or in combination [21].

## Neurophysiology of manual therapy

Ongoing research indicates that a neurophysiological response to manual therapy is accountable for clinically significant reductions in pain according to current findings [22]. Included in the neurophysiological response is the descending pain modulation circuit, which may be a principle mechanism in the analgesic effect of manual therapies.

### Descending Modulation of Pain

In 1965, Melzack & Wall were the first to explain the potential mechanisms of a central pain modulatory system. They described the gate control theory of pain, which simply states that non-noxious input suppresses painful output by inhibiting dorsal root nociceptors. Numerous neurotransmitters, including serotonin (5-HT), endocannabinoids, and endogenous opioids (EO), have been shown to act on the rostral ventromedial medulla (RVM) and periaqueductal grey (PAG) to modulate nociceptive circuits and pain output [23,24]. EO peptides such as β-endorphins have not only been demonstrated to have a comparable analgesic effect to morphine but are 18 to 33 times more potent [25]. Diffuse noxious inhibitory control (DNIC) is the process by which afferent noxious signals are inhibited from the peripheral nervous system (PNS). Using a rat model, Le Bars et al. [26]; found that neurons were inhibited by noxious stimuli (a hot bath), therein coining the term DNIC. Since then, multiple studies have suggested that EO are an underlying mechanism of DNIC [27]. Being that the analgesic effects of both human touch [28] and placebo [29] are mediated by an EO response, it is imperative that a placebo control group be utilized in research examining the neurochemical response to manual therapy, as placebo and touch alone are confounding variables. Previous reviews have noted potential descending modulatory mechanisms – an endogenous opioid response – in both physical therapy [30] and physical medicine; however, the neurochemical response to manual therapy and its implications for descending pain modulation, to the authors' knowledge, have not yet been thoroughly reviewed.

## Aim of the study

This study aimed to compare the efficacy of two treatment groups, Manual-Therapy (MT) and Electro-Physiotherapy (EPT), in determining the most effective approach for managing ITBS.

# Materials and Methods

## Subjects and study design

A randomized controlled trial (RCT) conducted at the Sports Medicine Clinic of the Teaching Hospital Karapitiya, enrolling twenty athletes in each group as controls (n=20) and experimental subjects (n=20). 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 Physio Therapy (EPT) along with medications, while the experimental group received manual therapy in addition to medications. The duration of the interventions for both groups was two weeks. Before participating in the study, all patients gave their written informed consent. The Ethics Committee approval was obtained from the Ethical review committee of the Faculty of Medicine, University of Ruhuna (No. 2021.P.001 (12/01/2021).

## Abductor muscle strength measurements using Handheld Dynamometer (HHD)

The testing was performed in sports and exercise medicine clinical examination room. The testing set-up was comprised of a portable HHD (Figure 1) and a physiotherapy table. Hip abductor strength was assessed at day 01 and 28. The examiner wase advised to use the Micro FET 2™ (Hoggan Health Inc., UT, USA) wireless digital handheld manual muscle testing dynamometer. The device, which is factory-standardized, also includes three substitutable contact pads for athlete comfort. Test–retest reliability of hand-held dynamometer muscle analysis in the lower extremities has been demonstrated by Agre et al. [31]. An examiner with prior experience operating the HHD performed all the assessment at day 01 and 28, for all athletes.


***Figure 1.*** *Digital hand-held dynamometer - with the permission of Hoggan Health Co.ltd US*

The assessment position for measuring bilateral hip abduction strength would be in the supine position .The anatomical landmark for the HHD placement was five centimetres proximal to the proximal edge of the lateral malleolus .Each participant was completed 3 consecutive trials with a 30-second rest in between each trial as per previously described methods [32]. The examiner put on resistance in a stable position as the athlete exerted five seconds of isometric maximum voluntary contraction (MVC) against the HHD and the examiner. All HHD measurements was recorded in Newtons (N) (Figure 2).

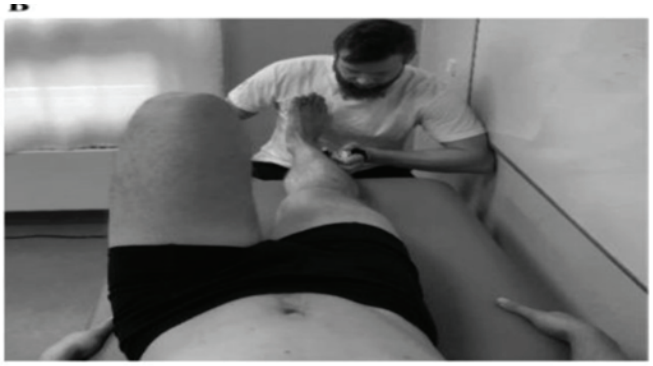

***Figure 2.*** *Hip Abduction Strength, Supine Position (With the permission, adopted from page https://www.researchgate.net/figure/Hip-abduction-measurement-with-a-HHD*

## Pain measurements using visual analogue scale

Pain was recorded according to the visual analogue scale for pain (100 mm VAS) prior commencing each therapy session (0 to 10) and after four weeks. (Figure 3)

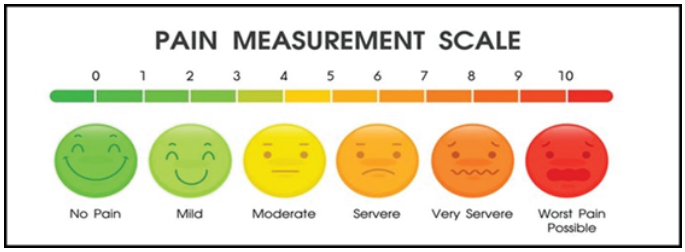


***Figure 3.*** *Visual Analogue Scale (100mm VAS) for pain measurements*

## Statistical analysis

All statistical analysis was performed using SPSS 26.0 for Windows. $P < 0.01$ and 0.05 were considered statistically significant.

## Results

In the presented results, the mean ages of participants in the control (n=20) and experimental groups (n=20) were comparable, with the control group having a mean age of 24.4±6.6 (M=45%, FM=55%) years and the experimental group having a slightly higher mean age of 25.4±6.6 (M=60%, FM=40%) 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 101.7±26.3 N, and it increased to 112.7±23 N by Day 28. In contrast, the experimental group exhibited a more significant change, with abductor strength values of 98.1±26 N on Day 1 and a substantial increase to 186.8±25.3 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 -3.600 (P=0.666) However, by Day 28, the difference became highly significant 74.050 (P<0.001) (Table 1 and Figure 4) indicating that the experimental group, receiving MT, experienced a more pronounced improvement in abductor strength compared to the control group.

The other focus of the study was pain, measured using Visual Analog Scale, and assessments were conducted on Day 1 and Day 28.

For the control group, Pain score on Day 1 was 8.2±0.9, and it reduced to 7.1±1.0. by Day 28. In contrast, the experimental group exhibited a more significant change, with pain score values of 7.9±0.8 on Day 1 and a substantial reduction to 1.8±0.8. by Day 28.

Statistical analyses, including repeated-measures analysis of variance (RM-ANOVA), revealed that the mean differences pain score between the two groups were not significant on Day 1 -0.250 (P=0.395). However, by Day 28, the difference became highly significant -5.200 (P<0.001) (Table 2 and Fig 5) indicating that the experimental group, receiving MT, experienced a more pronounced improvement in abductor strength and pain compared to the control group.

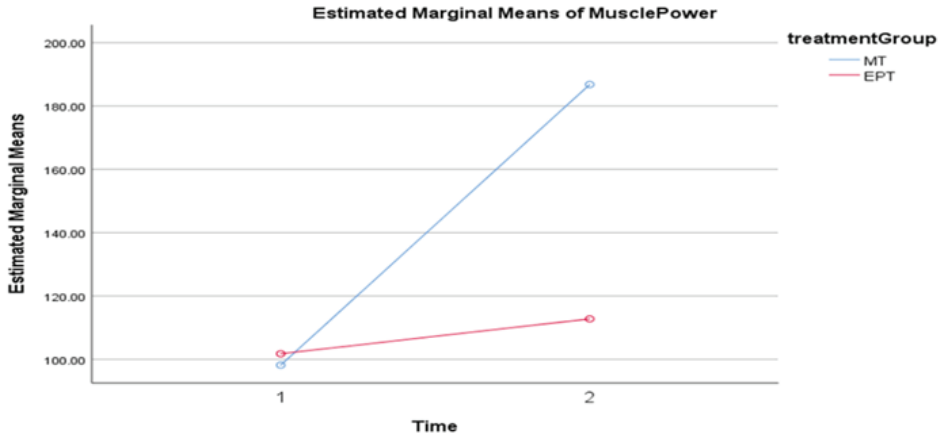


***Figure 4.*** *Graphical presentation Out Come Measure: Muscle Power – Pairwise Comparisons of Mean Difference in Muscle Power between Day 1 and Day 28 in each group ( In the graph; 1- Day 01, 2 -Day 28)*

***Table 1.*** *Out Come Measure: Muscle Power - Pairwise Comparisons of Mean Difference in Muscle Power (Hand Held Dynamometer Readings N) between Day 1 and Day 28 in each group*

| Pairwise Comparisons of mean difference in muscle power between control vs experimental groups on each day | | | | | |
|---|---|---|---|---|---|
| Measure: Muscle Power(N) By Hand Held Dynamometer | | | | | |
| Time | Mean (MT) | Mean (EPT) | Mean Difference (MT-EPT) | Std. Error | Sig.[b] |
| DAY 1 | Medication with MT (experiment) | Medication with EPT (Control) | | | |
| | 98.150 | 101.750 | -3.600 | 8.282 | 0.666 |
| DAY 28 | Medication with MT (experiment) | Medication with EPT(Control) | | | |
| | 186.800 | 112.750 | 74.050* | 7.661 | 0.000 |
| Based on estimated marginal means<br>*. The mean difference is significant at the .05 level.<br>b. Adjustment for multiple comparisons: Bonferroni.MT (Manual Therapy), EPT (Electro Physio Therapy) | | | | | |

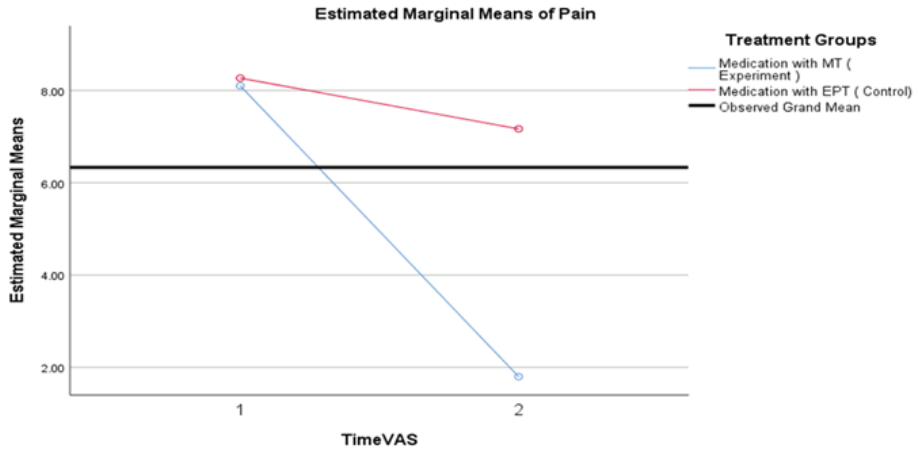


***Figure 5.*** *Graphical presentation Out Come Measure: Pain– Pairwise Comparisons of Mean Difference in Pain Score between Day 1 and Day 28 in each group (In the graph; 1- Day 01, 2 -Day 28)*

***Table 2.*** *Out Come Measure: Pain - Pairwise Comparisons of Mean Difference in Pain Score (Visual Analog Scale Readings) between Day 1 and Day 28 in each group*

| **Pairwise Comparisons of mean difference in pain score between Control vs Experimental groups on each day** | | | | | |
|---|---|---|---|---|---|
| **Measure: Pain score By Visual Analog Scale(VAS)** | | | | | |
| **Time** | **Mean (MT)** | **Mean (EPT)** | **Mean Difference (MT-EPT)** | **Std. Error** | **Sig.[b]** |
| DAY 1 | Medication with MT (experiment) | Medication with EPT (Control) | | | |
| | 7.950 | 8.200 | -0.250 | 0.291 | 0.395 |
| DAY 28 | Medication with MT (experiment) | Medication with EPT (Control) | | | |
| | 1.800 | 7.000 | -5.200* | 0.296 | 0.000 |
| Based on estimated marginal means<br>*. The mean difference is significant at the .05 level.<br>b. Adjustment for multiple comparisons: Bonferroni.MT (Manual Therapy), EPT (Electro Physio Therapy) | | | | | |

Further analysis demonstrated that MT had a statistically significant effect ($p<0.000$). Partial Eta Squared for the two groups were 0.355 and 0.758 respectively. MT's higher effectiveness was statistically significant ($p<0.001$) and a 35.5% variance in muscle power and 75.8% variance in VAS was attributable to it. These findings suggest that the experimental intervention had a substantial and statistically significant impact on abductor muscle strength and pain as evidenced by the observed differences between the groups on Day 28.

## 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, Manual Therapy (MT) and electro-physiotherapy (EPT), in improving abductor muscle strength and pain among athletes with iliotibial band syndrome (ITBS). Notably, the participants in the MT group exhibited a substantial and statistically significant increase in muscle strength and reduction pain score 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 MT accounting for a remarkable 74.05 N increase in muscle strength and substantial reduction in Pain score -5.2 compared to the control group.

The statistical analyses, particularly the repeated-measures analysis of variance (RM-ANOVA), emphasized the significant impact of MT, with a p-value of 0.000, indicating the intervention's efficacy in enhancing abductor muscle strength and reducing Pain score. The effect size, measured by Partial Eta Squared at 0.355 and 0.758 respectively, further substantiates the practical significance of MT, 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 and reducing pain score among athletes with ITBS. The study emphasizes the importance of MT like 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.

## Conclusion

Manual-therapy is superior to electro-physiotherapy in improving muscle power and decreasing in VAS scores of athletes with ITBS.

## Acknowledgement

I would also like to acknowledge the dedicated efforts of the Professors, Doctors, physiotherapists, masseurs, and clinical staff of the Sports Medicine Unit whose collaboration and support were integral to the success of this study. Last but not least, my heartfelt appreciation goes to all the participants whose participation and commitment made this research possible

## Ethical approval

Approved by the Institutional Ethics Committee Letter No. 2021.P.001 (12/01/2021).

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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