

Comparative Effectiveness of Dry Needling versus Manual Therapy Combined with a Structured Exercise Programme on Functional Recovery in Athletes with Iliotibial Band Syndrome

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KEYWORDS <i>Iliotibial Band Syndrome; Lower Extremity Functional Scale; Dry Needling; Manual Therapy; Functional Recovery; Sports Rehabilitation; Exercise Therapy.</i> Article Info Received: 30.05.2026 Accepted: 19.06.2026 Published: 29.06.2026	Abstract Background Iliotibial Band Syndrome (ITBS) is a common overuse injury among athletes that frequently results in impaired lower-extremity function and reduced sports participation. Although structured exercise programmes remain the cornerstone of rehabilitation, adjunctive interventions such as Manual Therapy and Dry Needling are increasingly incorporated to improve rehabilitation outcomes. Evidence comparing their effectiveness in restoring lower-extremity function, however, remains limited. Objective To compare the effectiveness of Dry Needling combined with a structured exercise programme and Manual Therapy combined with the same exercise programme on lower-extremity functional recovery in athletes diagnosed with Iliotibial Band Syndrome. Methods A prospective comparative interventional study was conducted among sixty athletes aged 18–40 years with clinically diagnosed Iliotibial Band Syndrome. Participants were randomly allocated into two equal groups. Group A received Manual Therapy combined with a structured exercise programme, whereas Group B received Dry Needling combined with the identical exercise programme. Treatment was administered five sessions per week for six weeks. Functional status was evaluated using the Lower Extremity Functional Scale (LEFS) before and after the intervention. Statistical analysis was performed using paired and independent <i>t</i>-tests, with statistical significance established at $p < 0.05$. Results Both intervention groups demonstrated significant improvements in lower-extremity function following six weeks of rehabilitation ($p < 0.001$). The Manual Therapy group improved from 50.67 ± 3.93 to 57.47 ± 4.09, whereas the Dry Needling group improved from 51.67 ± 3.93 to 66.60 ± 6.12. Between-group analysis demonstrated significantly greater functional improvement in participants receiving Dry Needling combined with structured exercise compared with Manual Therapy combined with exercise ($p < 0.001$). Conclusion Both Manual Therapy and Dry Needling effectively improved lower-extremity function in athletes with Iliotibial Band Syndrome when combined with a structured exercise programme. However, Dry Needling produced significantly greater functional recovery and may represent the preferred adjunctive intervention for optimizing rehabilitation outcomes and facilitating return to sport.
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Aim

To compare the effectiveness of Dry Needling and Manual Therapy, each combined with a structured exercise programme, in improving lower-extremity

function among athletes with Iliotibial Band Syndrome.

Objectives

1. To evaluate the effect of Manual Therapy combined with a structured exercise programme on lower-extremity functional performance in athletes with Iliotibial Band Syndrome.
2. To evaluate the effect of Dry Needling combined with the same structured exercise programme on lower-extremity functional performance.
3. To compare post-treatment lower-extremity functional outcomes between both intervention groups using the Lower Extremity Functional Scale (LEFS).

Hypothesis

Null Hypothesis (H₀)

There is no significant difference between Manual Therapy combined with a structured exercise programme and Dry Needling combined with the same exercise programme in improving lower-extremity function among athletes with Iliotibial Band Syndrome.

Alternative Hypothesis (H₁)

Dry Needling combined with a structured exercise programme results in significantly greater improvement in lower-extremity function than Manual Therapy combined with the same exercise programme.

Perfect. Now we'll prepare the **Results** for **Manuscript 2**, keeping the emphasis exclusively on **functional recovery (LEFS)**. The structure is intentionally different from Manuscript 1 even though the participant characteristics are the same.

INTRODUCTION

Iliotibial Band Syndrome (ITBS) is one of the most common overuse injuries affecting athletes participating in repetitive lower-

limb activities such as running, cycling, football, and long-distance training. The condition is characterized by pain over the lateral aspect of the knee or distal thigh, frequently accompanied by limitations in movement efficiency, reduced athletic performance, and difficulty performing sport-specific activities. Because athletes depend on optimal lower-extremity function for successful participation in training and competition, restoration of functional performance has become a major goal of contemporary rehabilitation programmes.

The iliotibial band is a thickened longitudinal portion of the fascia lata extending from the iliac crest to Gerdy's tubercle on the proximal tibia. Through its anatomical connections with the tensor fasciae latae and gluteus maximus muscles, it contributes to force transmission, lateral stability of the hip and knee, and efficient control of lower-limb movement during dynamic activities. Repetitive loading associated with running and jumping can increase compressive forces around the distal iliotibial band, particularly during approximately 20–30 degrees of knee flexion. When combined with altered movement mechanics, this repetitive stress may contribute to persistent symptoms and progressive impairment of functional performance.

Current evidence suggests that ITBS should not be considered solely a localized soft tissue disorder. Functional deficits involving hip abductor weakness, impaired neuromuscular control, altered pelvic stability, reduced eccentric muscle performance, and abnormal lower-extremity biomechanics have been identified in athletes with the condition. These impairments may compromise movement quality during running, stair negotiation, squatting, hopping, and sport-specific activities. Consequently, successful rehabilitation requires not only reduction of symptoms but also restoration of efficient

movement patterns and lower-extremity function.

Functional recovery is increasingly recognized as a more clinically meaningful outcome than pain reduction alone in sports rehabilitation. Athletes frequently report the ability to tolerate less pain during daily activities while continuing to experience limitations during higher-demand functional tasks such as sprinting, cutting, jumping, or prolonged running. Therefore, rehabilitation strategies should be evaluated according to their ability to improve activity performance and facilitate a safe return to sport rather than solely their capacity to reduce pain intensity.

Exercise therapy remains the foundation of conservative management for ITBS because it addresses many of the biomechanical impairments associated with the condition. Progressive strengthening of the hip abductors, gluteal musculature, and core stabilizers, together with flexibility exercises and neuromuscular retraining, aims to restore lower-limb alignment, improve dynamic stability, and enhance movement efficiency during athletic activities. Appropriate exercise progression also prepares athletes for return-to-sport by gradually increasing tissue loading and functional capacity.

Manual Therapy is frequently incorporated into rehabilitation programmes to complement exercise interventions. Techniques such as myofascial release, soft tissue mobilisation, and joint mobilisation may improve tissue extensibility, restore movement quality, reduce muscular restrictions, and facilitate normal joint mechanics. Beyond their mechanical effects, these interventions may enhance proprioceptive input, improve sensorimotor integration, and create favourable conditions for subsequent exercise performance. By reducing movement restrictions and improving tissue mobility, Manual Therapy may contribute to

restoration of functional activities during rehabilitation.

Dry Needling has become an increasingly accepted physiotherapy intervention for treating myofascial dysfunction associated with musculoskeletal disorders. The technique targets myofascial trigger points and dysfunctional muscle tissue using sterile monofilament needles with the objective of restoring normal muscle function. Proposed physiological effects include normalization of muscle activation patterns, reduction of abnormal motor end-plate activity, improvement in local circulation, and optimization of neuromuscular performance. These responses may improve muscle recruitment and movement efficiency, allowing athletes to perform rehabilitation exercises with greater effectiveness.

Athletes with ITBS commonly exhibit trigger points and muscular dysfunction involving the tensor fasciae latae, gluteal muscles, and vastus lateralis. Dysfunction within these muscles may impair hip stability, alter lower-limb kinematics, and reduce functional performance during dynamic activities. Consequently, interventions that improve neuromuscular function may contribute not only to symptom resolution but also to meaningful improvements in functional ability and readiness for return to sport.

Lower-extremity function can be evaluated using the Lower Extremity Functional Scale (LEFS), a reliable and valid patient-reported outcome measure that assesses difficulty experienced during everyday and sport-related activities. Unlike isolated pain measures, the LEFS provides a broader assessment of functional performance by evaluating activities such as walking, stair climbing, squatting, running, and recreational participation. Improvements in LEFS scores therefore reflect meaningful recovery from the patient's perspective and provide clinically relevant information regarding rehabilitation progress.

Although both Manual Therapy and Dry Needling are widely used alongside exercise-based rehabilitation, evidence directly comparing their influence on functional recovery in athletes with ITBS remains limited. Most published studies have focused primarily on pain outcomes, while comparatively fewer investigations have evaluated their relative effectiveness in restoring lower-extremity function. This gap limits clinicians' ability to select the most appropriate adjunctive intervention when the primary rehabilitation goal is recovery of functional performance.

Accordingly, the present study was designed to compare the effectiveness of Manual Therapy and Dry Needling, each combined with an identical structured exercise programme, in improving lower-extremity function among athletes diagnosed with Iliotibial Band Syndrome. Functional recovery was assessed using the Lower Extremity Functional Scale (LEFS). By focusing specifically on rehabilitation outcomes rather than pain alone, this study seeks to provide clinically relevant evidence to guide physiotherapists in selecting interventions that optimize movement quality, functional independence, and return-to-sport readiness.

MATERIALS AND METHODS

Study Design

A prospective comparative interventional study with a pre-test and post-test parallel-group design was conducted to compare the effectiveness of Manual Therapy (MT) and Dry Needling (DN), each combined with a structured exercise programme, on lower-extremity functional recovery in athletes diagnosed with Iliotibial Band Syndrome (ITBS).

Study Setting

The study was conducted in the Department of Physiotherapy, Pacific Medical College

and Hospital, Udaipur, Rajasthan, India. Participant recruitment, intervention, and outcome assessments were completed during the study period following approval from the Institutional Ethics Committee.

Participants

Sixty athletes with clinically diagnosed Iliotibial Band Syndrome were recruited according to predefined eligibility criteria. Participants were randomly allocated into two equal groups (n = 30 each).

- **Group A:** Manual Therapy combined with a structured exercise programme.
- **Group B:** Dry Needling combined with the same structured exercise programme.

Baseline demographic characteristics, including age, sex, body mass index (BMI), sporting discipline, and dominant limb, were recorded prior to intervention. Both groups were comparable with respect to demographic and baseline clinical characteristics.

Eligibility Criteria

Inclusion Criteria

Participants were included if they met all of the following criteria:

- Male or female athletes aged 18–40 years.
- Clinical diagnosis of Iliotibial Band Syndrome presenting with lateral knee or lateral thigh pain.
- Symptoms aggravated during activities such as running, stair climbing, squatting, jumping, prolonged sitting, or cycling.
- Ability to participate in a six-week supervised rehabilitation programme.

- Willingness to provide written informed consent.

Exclusion Criteria

Participants were excluded if they had:

- Previous surgery involving the affected knee.
- Ligamentous or meniscal injury.
- Patellar instability or recurrent subluxation.
- Neurological disorders affecting lower-limb function.
- Other musculoskeletal conditions that could influence rehabilitation outcomes or functional assessment.

Intervention Protocol

Both groups received supervised physiotherapy five sessions per week for six consecutive weeks. Each session lasted approximately 45–60 minutes.

Group A: Manual Therapy with Structured Exercise Programme

Participants received Manual Therapy directed towards the iliotibial band and associated musculature. Treatment included soft tissue mobilisation, myofascial release, and joint mobilisation techniques based on clinical findings.

Following Manual Therapy, participants performed a standardized exercise programme comprising:

- Iliotibial band stretching
- Tensor fasciae latae stretching
- Hip abductor strengthening
- Gluteus medius and gluteus maximus strengthening
- Core stabilisation exercises
- Progressive lower-limb strengthening

- Functional rehabilitation and sport-specific movement retraining

Exercise intensity was progressively increased according to individual tolerance and rehabilitation goals.

Group B: Dry Needling with Structured Exercise Programme

Participants allocated to Group B received Dry Needling using sterile disposable monofilament needles inserted into clinically identified myofascial trigger points involving the tensor fasciae latae, gluteal muscles, vastus lateralis, and other muscles associated with the iliotibial band complex.

Immediately following Dry Needling, participants completed the same standardized structured exercise programme administered to Group A.

Using an identical exercise programme for both groups ensured that any observed differences in functional recovery could be attributed primarily to the adjunctive intervention rather than variations in exercise prescription.

Outcome Measure

Primary Outcome

Lower Extremity Functional Scale (LEFS)

Lower-extremity functional performance was assessed using the **Lower Extremity Functional Scale (LEFS)**.

The LEFS is a validated patient-reported outcome measure consisting of **20 items**, each scored on a **5-point scale (0–4)**, yielding a total score ranging from **0 to 80**, with higher scores indicating better lower-extremity function.

The questionnaire evaluates activities including:

- Walking
- Climbing stairs

- Squatting
- Running
- Hopping
- Recreational and sporting activities
- Functional mobility during daily living

LEFS assessments were performed at:

- **Baseline (Week 0)**
- **Post-intervention (Week 6)**

The primary outcome of the study was the change in LEFS score following completion of the rehabilitation programme.

Appendix 1

LOWER EXTREMITY FUNCTIONAL SCALE

We are interested in knowing whether you are having any difficulty at all with the activities listed below because of your lower limb problem for which you are currently seeking attention. Please provide an answer for **each** activity.

Today, do you or would you have any difficulty at all with:

(Circle one number on each line)

ACTIVITIES	Extreme Difficulty or Unable to Perform Activity	Quite a bit of Difficulty	Moderate Difficulty	A Little bit of Difficulty	No Difficulty
a. Any of your usual work, housework or school activities.	0	1	2	3	4
b. Your usual hobbies, recreational or sporting activities.	0	1	2	3	4
c. Getting into or out of the bath.	0	1	2	3	4
d. Walking between rooms.	0	1	2	3	4
e. Putting on your shoes or socks.	0	1	2	3	4
f. Squatting.	0	1	2	3	4
g. Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
h. Performing light activities around your home.	0	1	2	3	4
i. Performing heavy activities around your home.	0	1	2	3	4
j. Getting into or out of a car.	0	1	2	3	4
k. Walking 2 blocks.	0	1	2	3	4
l. Walking a mile.	0	1	2	3	4
m. Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
n. Standing for 1 hour.	0	1	2	3	4
o. Sitting for 1 hour.	0	1	2	3	4
p. Running on even ground.	0	1	2	3	4
q. Running on uneven ground.	0	1	2	3	4
r. Making sharp turns while running fast.	0	1	2	3	4
s. Hopping.	0	1	2	3	4
t. Rolling over in bed.	0	1	2	3	4
Column Totals:					

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Data Collection

Demographic data and baseline clinical characteristics were recorded before treatment.

The LEFS questionnaire was administered prior to the first treatment session and repeated after completion of the six-week intervention by the same assessment procedure to ensure consistency.

Completed questionnaires were reviewed for completeness before data entry into Microsoft Excel. Statistical analysis was

subsequently performed using IBM SPSS Statistics Version 26.0.

Statistical Analysis

Data were analysed using **IBM SPSS Statistics Version 26.0** (IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as **mean ± standard deviation (SD)**, whereas categorical variables were summarized using frequencies and percentages.

Normality of the data distribution was assessed before inferential statistical testing.

Within-group improvements in LEFS scores were analysed using the **paired *t*-test**.

Between-group comparisons of post-treatment LEFS scores and mean functional improvement were performed using the **independent *t*-test**.

The level of statistical significance was set at **$p < 0.05$** .

To enhance interpretation of treatment effectiveness, effect sizes (Cohen's *d*) and 95% confidence intervals should be reported where applicable.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of Pacific Medical University, Udaipur, Rajasthan.

Written informed consent was obtained from all participants prior to enrolment.

Baseline Demographic Characteristics

Table 1. Baseline Characteristics of Study Participants

Variable	Overall (N=60)
Age (years), Mean $\pm$ SD	28.78 $\pm$ 6.54
BMI (kg/m ²), Mean $\pm$ SD	23.43 $\pm$ 1.96
Male, n (%)	30 (50.0)
Female, n (%)	30 (50.0)
Running, n (%)	40 (66.7)
Cycling, n (%)	14 (23.3)
Football, n (%)	6 (10.0)

Running was the predominant sporting activity among participants, followed by cycling and football. Age, BMI, and sex

Participant confidentiality was maintained throughout the study, and all procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

Participant Characteristics

A total of **60 athletes** diagnosed with Iliotibial Band Syndrome met the eligibility criteria and completed the study. Participants were randomly allocated into two intervention groups comprising **30 athletes each**. All participants completed the six-week rehabilitation programme, and no dropouts or protocol deviations were recorded. Consequently, data from all participants were included in the final statistical analysis.

The two groups were comparable with respect to baseline demographic and clinical characteristics, minimizing the likelihood of confounding due to participant-related variables.

distribution were similar across both intervention groups.

Baseline Functional Status

Lower-extremity function was assessed using the Lower Extremity Functional Scale (LEFS). Baseline LEFS scores were

comparable between the two intervention groups, indicating similar levels of functional impairment before treatment.

Table 2. Baseline Comparison of LEFS Scores

Group	Mean $\pm$ SD	<i>p</i> value
Manual Therapy + Exercise	50.67 $\pm$ 3.93	
Dry Needling + Exercise	51.67 $\pm$ 3.93	0.32 (NS)

There was no statistically significant difference in baseline LEFS scores between the groups ($p > 0.05$), confirming comparability prior to intervention.

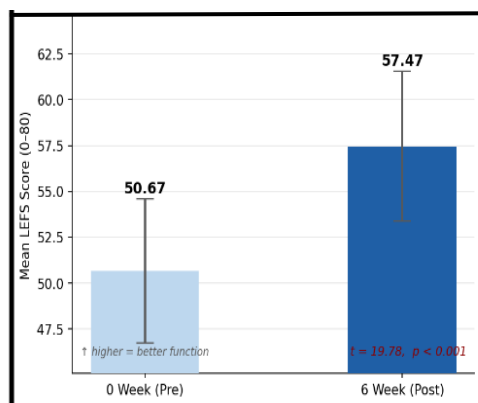
Within-Group Functional Improvement

Both intervention groups demonstrated significant improvements in lower-extremity function following six weeks of treatment.

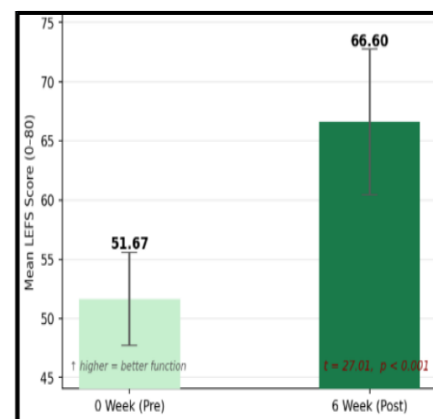
Table 3. Within-Group Comparison of LEFS Scores

Group	Baseline	Week 6	Mean Improvement	<i>p</i> value
A. Manual Therapy + Exercise	50.67 $\pm$ 3.93	57.47 $\pm$ 4.09	+6.80	<0.001
B. Dry Needling + Exercise	51.67 $\pm$ 3.93	66.60 $\pm$ 6.12	+14.93	<0.001

Statistically significant improvements in LEFS scores were observed in both groups following intervention. However, participants receiving Dry Needling demonstrated a substantially greater increase in functional performance than those receiving Manual Therapy.



GROUP A LEFS (0 vs 6 weeks)



GROUP B LEFS (0 vs 6 weeks)

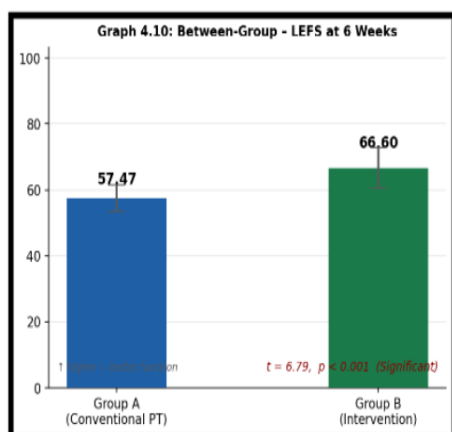
Between-Group Comparison of Functional Recovery

Comparison of post-treatment LEFS scores revealed significantly superior functional outcomes in the Dry Needling group.

Table 4. Between-Group Comparison of Post-treatment LEFS Scores

Outcome	Manual Therapy Dry Needling <i>p</i> value		
Week 6 LEFS	57.47 ± 4.09	66.60 ± 6.12	<0.001
Mean Functional Gain	+6.80	+14.93	<0.001

Participants treated with Dry Needling exhibited more than twice the improvement in functional performance compared with those receiving Manual Therapy.



Magnitude of Functional Improvement

To determine the clinical significance of rehabilitation outcomes, the magnitude of change in LEFS scores was evaluated.

Table 5. Clinical Interpretation of Functional Recovery

Parameter	Manual Therapy	Dry Needling
Mean LEFS Improvement	+6.80	+14.93
Percentage Improvement	13.4%	28.9%
Functional Interpretation	Moderate improvement	Marked improvement

The greater increase in LEFS scores observed in the Dry Needling group indicates enhanced restoration of lower-extremity function and suggests improved readiness for progressive rehabilitation and return to sporting activities.

Summary of Findings

The principal findings of the present study were:

- Both Manual Therapy and Dry Needling, when combined with a

structured exercise programme, resulted in significant improvements in lower-extremity function after six weeks of rehabilitation.

- Baseline LEFS scores were comparable between intervention groups, indicating similar functional limitations before treatment.
- Participants receiving Dry Needling achieved significantly greater

functional improvement than those treated with Manual Therapy.

- The mean improvement in LEFS score in the Dry Needling group was more than twice that observed in the Manual Therapy group.
- These findings suggest that Dry Needling, when integrated with structured exercise, may facilitate superior restoration of lower-extremity function in athletes with Iliotibial Band Syndrome.

DISCUSSION

The present study compared the effectiveness of Manual Therapy and Dry Needling, each combined with a structured exercise programme, on lower-extremity functional recovery in athletes with Iliotibial Band Syndrome (ITBS). Functional performance was evaluated using the Lower Extremity Functional Scale (LEFS) before and after a six-week rehabilitation programme. Both intervention groups demonstrated statistically significant improvements in functional status; however, participants who received Dry Needling in combination with structured exercise achieved significantly greater improvements than those treated with Manual Therapy combined with the same exercise programme.

Restoration of lower-extremity function is a primary objective in the rehabilitation of athletes with ITBS because successful return to sport depends not only on pain reduction but also on the recovery of movement efficiency, muscular performance, and dynamic stability. Athletes may report reduced pain during daily activities while continuing to experience deficits in running, jumping, cutting, and prolonged training sessions. Consequently, functional outcome measures such as the LEFS provide a broader assessment of rehabilitation

success by evaluating activity limitations relevant to both daily living and sports participation.

The significant improvement observed in both intervention groups highlights the effectiveness of comprehensive exercise-based rehabilitation for ITBS. Progressive strengthening of the hip abductors, gluteal musculature, and core stabilizers, together with flexibility exercises and functional retraining, addresses key biomechanical impairments associated with the condition. These interventions contribute to improved pelvic stability, enhanced lower-limb alignment, and more efficient force transmission during dynamic activities. The improvements observed in LEFS scores suggest that both rehabilitation protocols successfully enhanced participants' ability to perform functional tasks over the six-week intervention period.

Participants receiving Manual Therapy combined with structured exercise demonstrated meaningful improvement in functional performance. Manual Therapy may facilitate functional recovery by improving soft tissue mobility, reducing fascial restrictions, restoring joint mobility, and enhancing movement quality. In addition to these mechanical effects, Manual Therapy has been proposed to improve proprioceptive input and sensorimotor integration, potentially allowing athletes to perform strengthening and neuromuscular exercises more effectively. Improved tissue mobility may also reduce compensatory movement patterns, thereby contributing to better functional outcomes during rehabilitation.

The Dry Needling group demonstrated significantly greater improvements in LEFS scores than the Manual Therapy group. This finding suggests that Dry Needling may provide additional benefits beyond pain reduction by improving neuromuscular function and movement efficiency. Trigger point dysfunction within the tensor fasciae latae, gluteus medius,

gluteus maximus, and vastus lateralis has been associated with altered muscle activation, impaired pelvic control, and abnormal lower-limb biomechanics in individuals with ITBS. By targeting these dysfunctional muscles, Dry Needling may facilitate more efficient muscle recruitment, reduce excessive muscular inhibition, and improve coordination during dynamic activities. These physiological responses may explain the greater functional gains observed in the present study.

The superior functional recovery observed in the Dry Needling group is clinically important because rehabilitation outcomes in athletic populations are ultimately determined by the ability to resume sport-specific activities safely and efficiently. Improved LEFS scores indicate better performance in activities such as walking, stair negotiation, squatting, running, hopping, and recreational participation. Enhancing these abilities is essential for reducing the risk of recurrent injury and supporting a graded return-to-sport programme. Therefore, the greater functional improvement associated with Dry Needling may have practical implications for physiotherapists managing athletes during the later stages of rehabilitation.

The findings of the present study are consistent with previous research demonstrating that multimodal rehabilitation programmes incorporating therapeutic exercise and adjunctive physiotherapy interventions improve functional outcomes in lower-extremity overuse injuries. Studies evaluating Dry Needling have reported improvements in muscle performance, movement quality, and patient-reported function when the technique is integrated with exercise-based rehabilitation. Likewise, Manual Therapy has been shown to improve mobility and facilitate exercise performance, although its functional effects may be influenced by treatment duration, intervention techniques, and patient characteristics. The current

study contributes additional evidence by directly comparing these two commonly used interventions under standardized rehabilitation conditions.

An important strength of this study is that both intervention groups completed an identical structured exercise programme. This standardized approach minimizes variability in rehabilitation and increases confidence that the observed differences in functional outcomes were attributable primarily to the adjunctive intervention rather than differences in exercise prescription. Furthermore, the use of the Lower Extremity Functional Scale provided a patient-centered assessment of functional recovery, enabling evaluation of changes that are meaningful to athletes during rehabilitation.

Several limitations should be acknowledged. The study was conducted at a single centre with a relatively small sample size, which may limit the generalizability of the findings. Functional outcomes were assessed only over a six-week intervention period, and long-term maintenance of improvements was not evaluated. Although the LEFS is a reliable and valid instrument, objective performance-based measures such as gait analysis, muscle strength testing, hop tests, or biomechanical assessments were not included. Future research incorporating these objective measures, together with longer follow-up periods and multicentre recruitment, would provide a more comprehensive understanding of rehabilitation outcomes in athletes with ITBS.

Overall, the findings indicate that both Manual Therapy and Dry Needling, when combined with a structured exercise programme, effectively improve lower-extremity function in athletes with Iliotibial Band Syndrome. However, the significantly greater improvement observed following Dry Needling suggests that it may be the more effective adjunctive intervention for

enhancing functional recovery and supporting progression toward unrestricted sports participation.

CONCLUSION

The present study compared the effectiveness of Manual Therapy and Dry Needling, each combined with a structured exercise programme, in improving lower-extremity function among athletes with Iliotibial Band Syndrome. Both interventions resulted in statistically significant improvements in functional performance following six weeks of supervised rehabilitation. However, athletes who received Dry Needling in combination with the structured exercise programme demonstrated significantly greater improvements in Lower Extremity Functional Scale (LEFS) scores than those treated with Manual Therapy combined with the same exercise programme.

These findings indicate that although both interventions effectively support functional recovery, Dry Needling provides superior improvements in lower-extremity function when incorporated into an exercise-based rehabilitation programme. Enhanced functional performance may facilitate progression to advanced rehabilitation, improve readiness for sport-specific activities, and support a safe and efficient return to athletic participation.

Accordingly, Dry Needling may be considered a valuable adjunctive intervention for optimizing functional rehabilitation in athletes with Iliotibial Band Syndrome.

Clinical Implications

The findings of the present study have direct implications for sports physiotherapy and rehabilitation practice.

- Dry Needling may be integrated with structured exercise programmes to achieve greater

improvements in lower-extremity functional performance in athletes with ITBS.

- Improved functional recovery may allow earlier progression to advanced strengthening, neuromuscular retraining, and sport-specific rehabilitation.
- Manual Therapy remains an effective conservative intervention and may be particularly appropriate for athletes with contraindications to Dry Needling or those preferring non-invasive treatment.
- Rehabilitation programmes should prioritize restoration of movement quality and functional capacity in addition to symptom management.
- Functional outcome measures such as the LEFS should be routinely incorporated into rehabilitation to monitor patient progress and guide return-to-sport decisions.

Strengths of the Study

The present study has several methodological strengths.

- A prospective comparative interventional design was employed.
- Both intervention groups received an identical structured exercise programme, reducing variability in rehabilitation.
- Functional recovery was evaluated using the validated Lower Extremity Functional Scale, a patient-centred measure of lower-limb performance.
- Equal allocation of participants ensured comparable baseline characteristics.
- The study directly compared two widely used physiotherapy interventions in an athletic

population, providing clinically relevant evidence for rehabilitation practice.

Limitations

The findings should be interpreted in light of several limitations.

- The study was conducted at a single institution with a relatively small sample size.
- Functional outcomes were evaluated only over a six-week intervention period, without long-term follow-up.
- Objective performance measures such as isokinetic strength testing, gait analysis, hop tests, or motion analysis were not included.
- Blinding of participants and therapists was not feasible because of the nature of the interventions.
- The results may not be generalizable to recreationally active individuals or non-athletic populations with ITBS.

Recommendations for Future Research

Future studies should consider:

- multicentre randomized controlled trials with larger and more diverse athletic populations;
- long-term follow-up to evaluate maintenance of functional improvements and return-to-sport outcomes;
- inclusion of objective biomechanical assessments, muscle strength testing, gait analysis, and functional performance tests;
- comparison of Dry Needling with emerging physiotherapy interventions such as extracorporeal shockwave therapy, blood flow restriction training, or instrument-assisted soft tissue mobilization;
- investigation of rehabilitation programmes tailored to different sports and competitive levels.

Abbreviations

Abbreviation Full Form

ITBS	Iliotibial Band Syndrome
ITB	Iliotibial Band
LEFS	Lower Extremity Functional Scale
DN	Dry Needling
MT	Manual Therapy
BMI	Body Mass Index
SD	Standard Deviation
ROM	Range of Motion

Abbreviation Full Form

TFL	Tensor Fasciae Latae
IEC	Institutional Ethics Committee

Declarations

Ethics Approval

Ethical approval was obtained from the Institutional Ethics Committee of Pacific Medical University, Udaipur, Rajasthan, India. Written informed consent was obtained from all participants prior to enrolment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

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Competing Interests

The authors declare that they have no competing interests.

Author Contributions

Anushka Bajaj contributed to the conception and design of the study, participant recruitment, intervention delivery, data collection, statistical analysis, interpretation of findings, and manuscript preparation.

Dr. Farukh Mohammad Pinjara supervised the research, contributed to the

study methodology, critically reviewed the manuscript, and approved the final version.

Dr. Jafar Khan provided academic guidance, reviewed the scientific content, and approved the final manuscript.

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