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"COMPARATIVE EFFECTIVENESS OF DRY NEEDLING AND DYNAMIC CUPPING WITH INSTRUMENT-ASSISTED SOFT TISSUE MOBILISATION (IASTM) ON PAIN AND FUNCTIONAL DISABILITY IN PATIENTS WITH PLANTAR FASCIITIS: A RANDOMISED CONTROLLED TRIAL"

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ABSTRACT

Background: One of the most common causes of heel pain and functional limitation is plantar fasciitis, which can have a significant impact on mobility. Various conservative physiotherapy interventions have been suggested. However, there is limited evidence comparing Dry Needling (DN) and Dynamic Cupping along with IASTM.

Objective: To compare the effectiveness of Dry Needling and Dynamic Cupping with IASTM in reducing pain and improving functional disability among patients with plantar fasciitis.

Methods: As 66 clinically diagnosed participants with plantar fasciitis were randomized in a controlled trial. Initially, 70 participants were recruited, of whom, 4 dropped out when carrying out the study. Participants were randomly assigned either to the Dry Needling (ND) group (n = 33) and the Dynamic Cupping with IASTM (DC+IASTM) group (n = 33). For four weeks, both groups were treated three times per week. The VAS and FFI on an individual's pain intensity and functional disability were used in this study. The VAS and FFI estimate the severity of pain and its impact on functional ability, respectively. Statistical evaluation was accomplished using paired and independent samples t-tests with the standard for significance $p < .05$.

Results: Both interventions resulted in significant improvements in pain and functional disability ($p < .001$). The Dry Needling group demonstrated significant reductions in VAS scores (7.62 ± 0.84 to 4.82 ± 0.96) and FFI scores (73.85 ± 9.23 to 49.27 ± 9.08). The Dynamic Cupping with IASTM group showed greater improvements, with VAS scores decreasing from 7.35 ± 0.84 to 3.26 ± 1.11 and FFI scores decreasing from 73.94 ± 9.37 to 43.33 ± 13.08. Between-group analysis revealed significantly greater improvements in favour of Dynamic Cupping with IASTM for both pain and functional disability ($p < .001$).

Conclusion: Dynamic Cupping along with IASTM was more effective in reducing pain and improving recovery function than IASTM alone for the management of plantar fasciitis. Based on these findings, the use of the treatment can be considered an effective conservative physiotherapy intervention for patients with PF.

KEYWORDS: Plantar Fasciitis; Dry Needling; Dynamic Cupping; Instrument-Assisted Soft Tissue Mobilisation (IASTM); Foot Function Index.

INTRODUCTION

1.1 Overview of Plantar Fasciitis

One of the most common causes of heel pain in adults is the disabling condition of plantar fasciitis. It can be seen among the general population, mostly among middle-aged individuals, sports persons, and individuals whose jobs require standing for long hours, like teachers. This disorder is marked by pain at the medial calcaneal tubercle, especially with the first steps in the morning or after any rest periods. Continuous symptoms could weaken walking ability, balance, mobility, and quality of life. Plantar fasciitis is a degenerative fasciopathy rather than a solely inflammatory condition, and it recommends approaches that facilitate tissue healing and restoration of function (Shetty et al., 2019; Ribeiro & João, 2022; Kumar et al., 2024; Alnefaie et al., 2025).

1.2 Pathophysiology of Plantar Fasciitis

Many studies have shown that repetitive microtrauma, excessive tensile loading, abnormal foot biomechanics, obesity, limited ankle dorsiflexion, standing for long periods, and gastrocnemius tightness can lead to degeneration of the plantar fascia. The results of histopathological investigations show that there is no acute inflammation, but they do show collagen disorganisation, fibroblast proliferation, fascial thickening, and reduced vascularity. The changes observed lead to pain, poor force impaction, and incapacity. Foot posture and flexibility of the muscles are common biomechanical contributors to disease progression. Reference states that pronated foot posture, altered plantar pressure distribution, and reduced flexibility are also important biomechanical contributors to disease progression (Ribeiro & João, 2022; Gupta et al., 2023; Nadeem et al., 2023). IASTM treatment has also been known to provide benefits (Integrated Neuromuscular Inhibition Technique versus IASTM, 2024).

1.3 Conservative Management of Plantar Fasciitis

The first-line treatment for plantar fasciitis is conservative. Research in the beginning looked at injection therapy. According to Peerbooms et al. (2019), platelet-rich plasma promotes improved long-term outcomes as compared to corticosteroid injections. In contrast, Shetty et al (2019) note sustained improvements in pain and function due to PRP. Later, Naruseviciute and Kubilius (2020) showed that symptoms were reduced by high-intensity and low-level laser therapy. Through the work of Ribeiro and João (2022), it has been shown that insoles that are customised and minimalist footwear can improve pain, foot health and plantar loading. The systematic reviews of Guimarães et al. (2023) and Li et al. (2006) further confirmed that a plethora of conservative modalities (e.g., stretching, laser therapy, manual therapy, taping, and dry needling) effectively reduce pain and disability.

1.4 Dry Needling in Plantar Fasciitis

Over the years, dry needling has become increasingly popular. According to Llurda-Almuzara et al. (2021), trigger-point dry needling effectively minimized pain and disability over both short- and long-term follow-up. The study by Wheeler et al. (2022) showed that dry needling produced clinically meaningful changes and that adding an autologous blood injection did not produce additional clinical benefit. According to the research by Moosaei Saein et al. (2022), the pain intensity and thickness of the plantar fascia decreased after dry needling intervention. According to Salehi et al. (2023), dry needling performed better with stretching exercises. Dede et al. (2024) found results that were as good or better than ESWT. In other meta-analyses by Yang et al. (2024), Li et al. (2026), and Mokhtari et al. (2026), dry needling was found to be effective in reducing pain, improving function, and decreasing plantar fascia thickness. Although there were positive findings, the variability of treatment protocols and comparison groups is a limitation.

1.5 Dynamic Cupping and Instrument-Assisted Soft Tissue Mobilisation (IASTM)

Evidence for soft tissue mobilisation techniques has also grown. Dynamic cupping therapy immediately reduces pain, as shown by Jani and Tank, 2020. Stephens and colleagues (2022) noted that there was significant clinical use of cupping for musculoskeletal pain. According to Gupta et al. (2023), IASTM could significantly improve flexibility, foot posture, function, and balance. Nadeem et al. (2023) noted significant reductions in pain and increased strength and ankle range of motion with Ergon IASTM. According to Mohammed et al. (2024) and Maira Sarfaraz et al. (2025), IASTM-based interventions proved more functionally advantageous. Ranjan et al. (2025) illustrated that dynamic cupping lowered gastrocnemius thickness and pain amongst plantar fasciitis patients. The systematic reviews conducted by Tedeschi (2024) and Jawade et al. (2026) found that soft-tissue mobilization techniques may be effective as adjunctive treatment, especially when used alongside stretching and strengthening exercises.

1.6 Rationale for Comparing the Interventions

Much evidence exists independently for dry needling and soft tissue mobilisation approaches, but direct comparisons remain rare. The majority of studies so far have compared dry needling to stretching, shockwave therapy, kinesio taping, and injection therapies, whereas IASTM and cupping were primarily assessed against conventional rehabilitation programmes. Moreover, current systematic reviews demonstrate variations in methodology and a lack of substantial evidence for quality comparative evidence. It remains clinically important to know which intervention better reduces pain and improves function. A direct comparison of dry needling and dynamic cupping in conjunction with IASTM may help identify the most effective conservative treatment option in patients with plantar fasciitis and provide evidence-based guidance for physiotherapy.

1.7 Aim of the Study

This study aimed to compare the effectiveness of Dry Needling and Dynamic Cupping combined with Instrument-Assisted Soft Tissue Mobilisation (IASTM) in reducing pain and improving functional disability among patients with plantar fasciitis, and to determine which intervention provides superior clinical outcomes in conservative physiotherapy management.

1.8 Research Hypothesis

H_1: There will be a significant reduction in pain intensity, as measured by the Visual Analogue Scale (VAS), following both Dry Needling and Dynamic Cupping with Instrument-Assisted Soft Tissue Mobilisation (IASTM) interventions in patients with plantar fasciitis.

H_2: Dynamic Cupping combined with Instrument-Assisted Soft Tissue Mobilisation (IASTM) will demonstrate significantly greater improvement in functional disability, as measured by the Foot Function Index (FFI), compared to Dry Needling in patients with plantar fasciitis.

2. MATERIALS AND METHODS

2.1 Study Design

A subsequent randomized controlled trial, with a prospective design and parallel group structure, was performed to compare the effectiveness of Dry Needling (DN) combined with Dynamic Cupping and Instrument-Assisted Soft Tissue Mobilisation (IASTM) in patients with plantar fasciitis in terms of pain and functional disability. The study design was developed according to CONSORT guidelines and based on methodologies adopted in previous trials of plantar fasciitis interventions (Peerbooms et al., 2019; Salehi et al., 2023).

2.2 Study Setting

The research took place at the Department of Physiotherapy_____ of a named tertiary healthcare and rehabilitation centre_____. All assessments and treatment sessions were performed by a qualified physiotherapist in a clinical environment.

2.3 Participants

Inclusion Criteria

- Adults aged 19–60 years.
- Clinically diagnosed plantar fasciitis.
- Heel pain persisting for more than four weeks.
- Pain during the first steps in the morning.
- Baseline Visual Analogue Scale (VAS) score ≥4.

Exclusion Criteria

- Previous foot or ankle surgery.
- Corticosteroid injection within the previous three months.
- Neurological or systemic inflammatory disorders.
- Pregnancy.
- Contraindications to dry needling or cupping therapy.

2.4 Sample Size Calculation

G*Power software (Version 3.1) was used with an alpha level of 0.05, statistical power of 80% (β = 0.20), and a moderate effect size in reference to previous studies on plantar fasciitis intervention (Moosaei Saein et al., 2022; Salehi et al., 2023). Initially, 70 participants were recruited, but 4 participants dropped out due to personal issues and non-compliance with the intervention protocol. Subsequently, SPSS-V27 Code allocated the remaining participants to the study groups. Final statistical analysis revealed that there were 66 participants available.

2.5 Recruitment Procedure

Participants meeting the eligibility criteria were recruited from the referrals of the OPD of orthopaedics and physiotherapy. The participant was enrolled after getting consent.

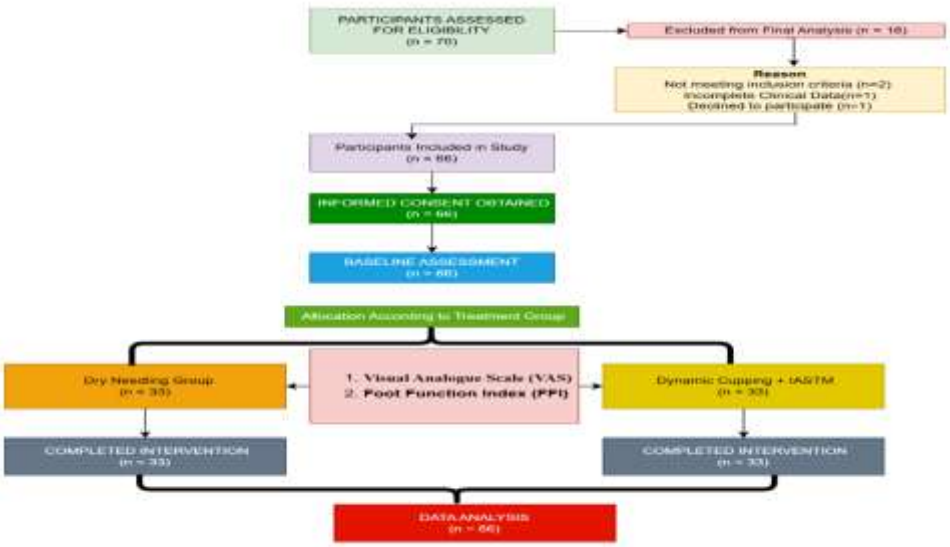

Figure 1 CONSORT flow diagram illustrating participant recruitment, randomisation, allocation, follow-up, and final analysis of patients with plantar fasciitis receiving Dry Needling or Dynamic Cupping combined with Instrument-Assisted Soft Tissue Mobilisation (IASTM).

2.6 Group Allocation
Eligible participants were allocated to either Group A (Dry Needling) or Group B (Dynamic Cupping with IASTM) using a computer-generated sequence.

2.7 Blinding Procedures
Assessor Blinding: Outcome assessors were blinded to group allocation.

2.8 Intervention Protocols
Group A: Dry Needling
- **Treatment Procedure:** Sterile disposable needles were inserted into identified myofascial trigger points of the gastrocnemius, soleus, and plantar fascia region following protocols reported by Llurda-Almuzara et al. (2021) and Salehi et al. (2023).
- **Needle Specifications:** Single-use stainless-steel needles (0.25 × 40 mm) were utilised.
- **Frequency and Duration:** Three sessions per week for four consecutive weeks.

Group B: Dynamic Cupping with IASTM
- **Dynamic Cupping Procedure:** Moving silicone cups were applied over the plantar fascia and calf musculature using negative pressure and gliding movements as described by Jani and Tank (2020).
- **IASTM Procedure:** Instrument-assisted soft tissue mobilisation was performed using stainless-steel instruments targeting plantar fascia adhesions and calf musculature according to protocols reported by Nadeem et al. (2023).
- **Frequency and Duration:** Three sessions per week for four consecutive weeks.

2.9 Outcome Measures
Primary Outcome Measures
- **Visual Analogue Scale (VAS):** Pain intensity was assessed using a 10-cm Visual Analogue Scale.
- **Foot Function Index (FFI):** Functional disability was evaluated using the Foot Function Index.
- **Secondary Outcome Measures:** Plantar fascia thickness and ankle dorsiflexion range of motion were assessed where applicable.

2.10 Data Collection Procedure
A blinded assessor recorded the outcome measurements at baseline and after the completion of the intervention period. To monitor compliance with the treatment, attendance registers and treatment logs were maintained. Throughout the study, the participants were monitored for adverse reactions like soreness, bruising, discomfort, skin irritation, or bleeding.

2.11 Statistical Analysis
Mean, standard deviation, frequency, and percentage, paired t-tests were used to analyse pre- and post-intervention changes, independent t-tests or ANCOVA were applied to compare treatment effects between groups. Also, Statistical significance was established at $p < 0.05$.

3. RESULTS

Table 1: Descriptive Statistics of Demographic and Outcome Variables (N = 66)

Variable	Minimum	Maximum	Mean	SD
Age (years)	22	58	40.80	11.07
VAS Pre	6.0	8.9	7.49	0.84
VAS Post	1.4	6.0	4.04	1.30
FFI Pre	60	90	73.89	9.23
FFI Post	21	72	46.30	11.57
VAS Change	2.10	5.00	3.45	0.83
FFI Change	15.00	40.00	27.59	7.13

Table 2: Within-Group Comparison of Pain Intensity and Functional Disability Before and After Dry Needling Intervention (n = 33)

Outcome Measure	Pre-Test M ± SD	Post-Test M ± SD	Mean Diff	t	p	Cohen's d
VAS	7.62 ± 0.84	4.82 ± 0.96	2.80	32.89	< .001**	5.73
FFI	73.85 ± 9.23	49.27 ± 9.08	24.58	22.46	< .001**	3.91

**p < .001.

Table 3 Within-Group Comparison of Pain Intensity and Functional Disability Following Dynamic Cupping with Instrument-Assisted Soft Tissue Mobilisation (IASTM) Intervention (n = 33)

Outcome Measure	Pre-Test M ± SD	Post-Test M ± SD	Mean Diff	t	p	Cohen's d
VAS	7.35 ± 0.84	3.26 ± 1.11	4.09	42.66	< .001**	7.43
FFI	73.94 ± 9.37	43.33 ± 13.08	30.61	26.23	< .001**	4.57

**p < .001.

Table 4 Between-Group Comparison of Changes in Pain Intensity and Functional Disability Following Dry Needling and Dynamic Cupping with Instrument-Assisted Soft Tissue Mobilisation (IASTM) (N = 66)

Outcome Measure	Dry Needling (n = 33) M ± SD	Dynamic Cupping + IASTM (n = 33) M ± SD	Mean Diff	t	p	Cohen's d
VAS Change	2.80 ± 0.49	4.09 ± 0.55	-1.28	-10.02	< .001**	-2.47
FFI Change	24.58 ± 6.29	30.61 ± 6.70	-6.03	-3.77	< .001**	-0.93

**p < .001.

4. DISCUSSION

The present RCT compared the effectiveness of Dry Needling (DN) and Dynamic Cupping combined with Instrument-Assisted Soft Tissue Mobilisation (IASTM) in patients with plantar fasciitis. Both interventions produced statistically significant improvements in pain intensity and functional disability. Both interventions significantly improved pain intensity and functional disability. On the other hand, VAS and FFI scores improved significantly more in the Dynamic Cupping with IASTM group than in the Dry Needling group. Findings from the between-group analysis showed a significantly greater reduction in pain (VAS changed 4.09 versus 2.80) and improvement in function (FFI changed 30.61 versus 24.58) with Dynamic Cupping with IASTM as compared to the control group. The Dry Needling group showed a significant drop in pain intensity after treatment. The results align with those of Llurda-Almuzara et al.(2021), whose study found that dry needling significantly improved plantar heel pain in both short- and long-term follow-up. In a study by Moosaei Saein et al. (2022), there were significant drops in VAS scores and plantar fascia thicknesses after dry needling intervention. According to Salehi et al. (2023), when dry needling was combined with stretching exercises, outstanding outcomes were reported. The recent papers by Yang et al. (2024), Dede et al. (2024), Mokhtari et al. (2026), and Li et al. (2026) also showed the effectiveness of dry needling in reducing pain and improving the clinical outcomes of plantar fasciitis. The dynamic cupping with IASTM reduced pain more significantly than the dry needling did. The result is in accordance with Jani and Tank (2020), who noted that dynamic cupping resulted in immediate pain relief. As per Ranjan et al. (2025), there was a noticeable reduction in the intensity of pain after dynamic cupping. A study by Akil et al. (2025) revealed that the combination of cupping therapy with rehabilitation worked better to relieve pain than rehabilitation alone. Nadeem et al. (2023), Mohammed et al. (2024), Maira Sarfaraz et al. (2025) study and Jawade et al. (2026) studies showed significant reduction in pain after IASTM interventions. The current findings certainly corroborate that pain outcomes in the study were superior. The Dry Needling group showed significant improvements in their functional disability. Wheeler et al. (2022) also supported these results, showing a significant improvement in the Foot Function Index after dry needling treatment. Reports surfaced from Salehi et al. (2023), Dede et al. (2024), Yang et al. (2024), Mokhtari et al. (2026), and Li et al. (2026) that dry needling arguably improved foot-related function and performance of daily activities in patients with plantar fasciitis. The functional improvement in the Dynamic Cupping with IASTM group was better than that of Dry Needling. The findings match those of Gupta et al. (2023), who reported a significant improvement in the Foot Function Index score and dynamic balance after IASTM. Nadeem et al. (2023) noted an improvement in strength and functional mobility after Ergon IASTM. Mohammed et al. (2024), Maira Sarfaraz et al. (2025), and Jawade et al. (2026) additionally reported better functional recovery after using IASTM in rehabilitation programmes. Further, Ranjan et al. (2025) reported improvement in functional capacity after dynamic cupping therapy. The current findings are highly supported by previous studies that found dry needling and soft tissue mobilisation techniques to be effective in plantar fasciitis. Research on pain and function improvement after these treatment methods was conducted by Llurda-Almuzara et al. (2021), Moosaei Saein et al. (2022), Salehi et al. (2023), Yang et al. (2024), Dede et al. (2024), Mokhtari et al. (2026), Gupta et al. (2023), Nadeem et al. (2023), Mohammed et al. (2024), Maira Sarfaraz et al. (2025), Jawade et al. (2026). Some studies showed non-inferior outcomes for IASTM. The systematic review and meta-analysis conducted by Nazari et al. (2023) shows that the current evidence does not support that IASTM improves pain or function clinically. The authors reported that the studies reviewed are limited methodologically and are heterogeneous. According to Naruseviciute and Kubilius (2020), neither treatment group experienced significant differences despite overall clinical improvement. The differences between these two findings indicate the need for further high-quality comparative trials. Dry needling may lower pain levels by deactivating trigger points, normalizing muscle activity, and modulating noxious pain pathways. At the same time, IASTM may enhance neuromuscular function through greater tissue extensibility and return of normal movement (Moosaei Saein et al., 2022; Gupta et al., 2023). Dynamic cupping increases the local blood flow through the application of negative pressure by using specialized cups. It reduces blockages, increases microcirculation, improves oxygen delivery, and improves metabolic waste removal. As reported by Jani and Tank (2020), Prudêncio et al. (2025), and Ranjan et al. (2025), similar phenomena took place. These physiological responses can help in healing the tissues faster and alleviate pain. IASTM might enhance fascial mobility by breaking up adhesions, stimulating collagen remodelling, releasing fascial restrictions, and restoring normal tissue gliding. Soft tissue mobilisation showed improvements in flexibility, range of motion, and foot functioning as per the findings of Nadeem et al. (2023), Mohammed et al. (2024), Tedeschi (2024), Maira Sarfaraz et al. (2025), and Jawade et al. (2026).

5.1 Clinical Implications for Physiotherapy Practice

Results provide support for the use of Dry Needling and Dynamic Cupping with IASTM as effective conservative treatment interventions for plantar fasciitis. However, combining Dynamic Cupping with IASTM produced greater

improvements in pain and function. These findings support the addition of these interventions into physiotherapy rehabilitation programmes to facilitate better clinical outcomes and quicker functional recovery.

5.2 Strengths of the Study

The current research adopted a randomized controlled design for higher methodological rigor and less selection bias. Following standardized measure methods, we used the Visual Analogue Scale and Foot Function Index. The direct comparison of Dry Needling and Dynamic Cupping with IASTM fills an important gap in the plantar fasciitis literature.

5.3 Recommendations for Future Research

Future studies should have larger multicentre samples and longer follow-up periods for long-term effectiveness. There is a need to establish dynamic cupping and IASTM outcomes against other evidence-based interventions with further investigation. In the future, it is imperative to add biomechanical, ultrasonographic, and patient-reported outcomes.

6. CONCLUSION

The current study has shown that Dry Needling and Dynamic Cupping along with Instrument-Assisted Soft Tissue Mobilisation (IASTM) are effective in reducing pain and functional disability in patients with plantar fasciitis. Yet, Dynamic Cupping plus IASTM showed much bigger improvements in pain intensity and foot function than Dry Needling. The results underscored the clinical usefulness of soft tissue mobilisation as an effective form of conservative treatment in physiotherapy. Further investigations should study long-term outcomes in a larger multicentre population and also the underlying biomechanical mechanism of plantar fasciitis.

Declarations

Ethics Approval and Consent to Participate

Ethical approval for the study was obtained from the Institutional Ethics Committee prior to data collection. Written informed consent was obtained from all participants before enrolment in the study.

Consent for Publication

All participants provided consent for the use and publication of anonymised research data for academic and scientific purposes.

Availability of Data and Materials

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

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All authors contributed to the conception, design, data collection, analysis, interpretation of data, manuscript preparation, and final approval of the submitted version.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Ethical Approval

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and was approved by the Institutional Ethics Committee of the respective institution.

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