The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 7, 2025

EFFECTIVENESS OF THERAPEUTIC ULTRASOUND IN THE TREATMENT OF PLANTAR FASCIITIS: A SYSTEMATIC REVIEW

Zakir Ullah[*1], Sehrish Khan[2], Muhammad Atif[3], Rooh Ullah[4], Mariam Shehzadi[5], Shah Faisal Wazir[6]

[*1]*Assistant Professor School of Health Sciences Peshawar*
[2,3,4,5]*Lecturer at school of health sciences Peshawar*
[6]*Physiotherapist At Franklin Autism Diagnostic and research Center Peshawar*

[*1]zakirbaryal.9777@gmail.com, [2]sehrishdr696@gmail.com, [3]atif64091@gmail.com, [4]roohullahhanfi@outlook.com, [5]shehzadimariam0@gmail.com, [6]faisalxyz911@gmail.com

DOI:https://doi.org/10.5281/zenodo.15862251

Keywords:
Plantar Fasciitis, Therapeutic Ultrasound, Shockwave Therapy, Pain, Physical Therapy, Systematic Review

Article History
Received: 06 April, 2025
Accepted: 26 June, 2025
Published: 11 July, 2025

Corresponding Author: *
Sehrish khan

Abstract

Background: *Plantar fasciitis is a common cause of heel pain, often managed conservatively with therapeutic ultrasound (US), though its effectiveness remains unclear.*

Objective: *To evaluate the effectiveness of therapeutic US in reducing pain and improving function in plantar fasciitis.*

Methods: *A systematic review of randomized controlled trials (RCTs) was conducted. Studies comparing US with placebo, no treatment, or alternatives (e.g., rESWT, dry needling) were included. Outcomes assessed included pain (VAS), function (FFI, AOFAS), mobility (PFPS), and satisfaction. Risk of bias was evaluated using the Cochrane RoB 1 tool.*

Results: *Eight RCTs (418 participants) were included. Most showed significant pain reduction and functional improvement with US, especially when combined with exercise. However, US was generally less effective than rESWT. Risk of bias was moderate to high due to methodological limitations.*

Conclusion: *Therapeutic ultrasound may modestly improve pain and function in plantar fasciitis, particularly alongside exercise, but appears less effective than shockwave therapy. More rigorous, long-term studies are needed.*

INTRODUCTION

Plantar fasciitis (PF) is very common condition presenting as pain at the anterior and medial prominence of calcaneum or heel bone(1)Plantar fasciitis is one among the feet pathologies, the prevalence of Plantar fasciitis is reported about 0.5% to 8% and almost one out of 10 adult will have this condition in their lifespan.(2-4)**.** Plantar fasciitis is also identified by other names such as painful heel syndrome, heel spurs, runner's heels, sub-calcaneal discomfort, joggers' heel, heel spur syndrome calcaneodynia, and calcaneal periostitis(9)The incidence of plantar fasciitis is reported 3.83 cases per one thousand patient per year, little higher in females than males. In most of the cases PF is reported unilaterally, but may present bilaterally in one third of the reported cases (5, 6)**.** This disorder

most commonly affects athletes affecting about 17.4% of the runners and soldierly employees, although this may affect all other population, particularly women of middle-age ranges from 40 to 60 (10).

Over 10 Lac patients with PF visit physician annually in the United State. Despite the name of the condition, plantar fasciitis is degenerative pathology rather than an inflammatory condition The capacity of lengthening of the plantar fascia is about 4%, failure in lengthening requires a force of 1000 N2 approximately(4)(7, 8).

PF was originally thought to be an acute inflammatory disease, but histologic findings of samples from patients undergoing surgery showed myxoid degeneration with fragmentation and degeneration of the plantar fascia, reflecting a chronic degenerative process without inflammation. The most common complaint of plantar fasciitis is pain in heel, especially during the first few steps in the morning or after rest, that's why PF is known as first-step pain The pain may worsen due to long standing and walking but sometime the pain decreases with movement(2, 12)

The risk factors of plantar fasciitis are decreased ankle dorsiflexion, increased body mass index or obese adults, and ergonomic weight-bearing. Among these, the reduced range of motion at the ankle joint, specifically ankle dorsiflexion, is found to be the most significant. Despite these, other risk factors may also contribute, including pesplanus or flat feet, pescavus or high-arched feet, excessive running, and leg length difference or discrepancies (LLD). PF is also found mostly in patients with autoimmune disorders, such as rheumatoid arthritis (13, 14).

The basic diagnostic criteria for PF comprise pain and discomfort at the inferior or medial heel, and stiffness with pain during the first few steps early in the morning. Pain usually decreases after activities but mostly increases at the end of the day. Tenderness may also be felt at the medial heel. The Windlass test is widely used for the diagnostic purpose of PF during physical examination, with high specificity of 100% but very low sensitivity of 32% (5).

The first choice of treatment approach for this condition in the acute stage, used worldwide, is based on conservative measures. These include rest, cryotherapy, anti-inflammatory drugs (NSAIDs), especially celecoxib, shoe insoles, Kinesio taping, soft tissue release, dry needling, and exercises to strengthen the muscles of the leg—particularly the gastrocnemius and soleus—to reduce mechanical stress on the plantar fascia. Contrast baths with hot and cold water are also used as an option for treatment and pain relief (7, 15). Stretching or strengthening exercises have been found helpful in decreasing pain and improving gait patterns in patients with plantar fasciitis. High-load strength training may reduce pain more quickly (5, 16, 17).

Corticosteroid injections are another intervention aimed at decreasing inflammation and providing pain relief. However, the effectiveness of corticosteroid injections is not fully known, and their benefits are limited in long-term treatment, making corticosteroids a short-term option for pain relief rather than a cure for plantar fasciitis (4, 7, 15). In chronic or severe conditions, physical therapy with night splints is recommended to support healing. Research on night splints remains contradictory. One study concluded that night splints do not provide benefits in terms of pain, function, or flexibility [26], and one randomized controlled trial (RCT) found no improvement in symptoms when night splints were added to NSAIDs and Achilles tendon stretching. However, another RCT reported that using certain lower limb orthoses along with adjustable dorsiflexion night splints was more effective than orthoses alone (5, 18).

Extracorporeal shock wave therapy (ESWT) is also considered a conservative treatment option for plantar fasciitis. A meta-analysis showed that ESWT had higher improvement rates compared to placebo. Another meta-analysis including 19 trials revealed that ESWT significantly reduced pain compared to placebo (19, 20). Low-level laser therapy (LLLT), which involves the application of laser light without heat, is used in a range of treatments for inflammation and pain reduction. A 2022 meta-analysis found that low-level LLLT may improve pain within six weeks (21).

Therapeutic ultrasound (US) is widely used to reduce pain and promote soft tissue healing. It is believed to facilitate tissue repair through thermal and non-thermal effects, including increased local blood flow, enhanced collagen synthesis, and pain modulation.

Despite its routine use in physiotherapy, the clinical effectiveness of ultrasound therapy for managing plantar fasciitis remains controversial. One RCT comparing therapeutic ultrasound with sham ultrasound concluded that both were equally effective (22), while another found therapeutic ultrasound to be more effective than sham. A separate RCT reported that therapeutic ultrasound and stretching exercises resulted in similar outcomes in treating plantar fasciitis (23). When compared to ESWT, a systematic review and meta-analysis of five RCTs concluded that ESWT is more effective than therapeutic ultrasound in reducing pain and improving function (5, 24–26).

Research Question

"In patients with plantar fasciitis, how effective is therapeutic ultrasound compared to placebo or other conservative treatments in reducing pain and improving function?"

Protocol and registration

The PRISMA protocol was followed for the current systematic review and was registered with PROSPERO (www.crd.york.ac.uk/PROSPERO) under the registration number CRD420251026760.

Inclusion

the following requirements had to be met to include studies in the systematic review: studies involving patients with plantar fasciitis; prospective randomized controlled trials (RCTs); free full-text articles published in the English language; participants aged 18 years or older; inclusion of both male and female subjects; presence of a comparison group; and use of pain and functional improvement as outcome measures.

Exclusion

The exclusion criteria included studies investigating other conservative interventions such as Kinesio-taping or dry needling, studies that were not peer-reviewed, studies without full text, studies lacking complete methodology or results, and publications other than randomized controlled trials (RCTs), such as systematic reviews, dissertations, conference abstracts, and posters.

Search Strategy

Three databases PubMed, Cochrane library and PEDro were searched on (27th June 2025) using the following key words:

(Plantar fasciitis) OR (plantar heel pain) OR (heel spur syndrome) OR (heel insertion pain) OR (calcaneal pain) OR (inferior heel pain) OR (inferior heel pain)) AND (Ultrasonic Therapy) OR (Ultrasound Therapy) OR (therapeutic ultrasound)) OR (ultrasound physiothepy) OR (non-invasive thermal therapy) AND ((controlled clinical trial) OR (randomized control trial)

Table of Research Questions

P	**Patients diagnosed with plantar fasciitis**
I	**Therapeutic ultrasound(both pulsed and continues)**
C	**Any other modalities other than ultrasound or placebo**
O	**Pain reduction and functional improvement**
S	**Study design systematic review of randomized control trial**

Data extraction

The data from the selected studies were extracted by primary researcher through identifying the articles that met the eligibility criteria. Subsequently, further data was extracted based on the outcomes. Discrepancies if any were resolved. Data was extracted through Covidence via a standardized table including author, year of publication sample size, number of patients or individuals included (containing gender and age) intervention specific to each included study, study design, outcome measures, results and conclusion.

Selection of the studies

A total, 395 articles were identified through three databases. Including 126 articles from PubMed.

Articles identified through Cochrane library were 255, while 14 articles were identified through PEDro database. Of these,112 were removed as duplicates identified by Covidence and 02 duplicated studies were removed manually. Of the 281studies left, 250 were excluded in title and abstract screening. 31 studies were identified for full text screening. 23 articles were excluded i.e wrong intervention (n=8), wrong study design (n=7), wrong population (n=2) and wrong comparator (n=1), full text not available (n=3) duplicate found after full text review were (n=2).The final 8 studies which examined therapeutic ultrasound for the management of PF were selected for this review.

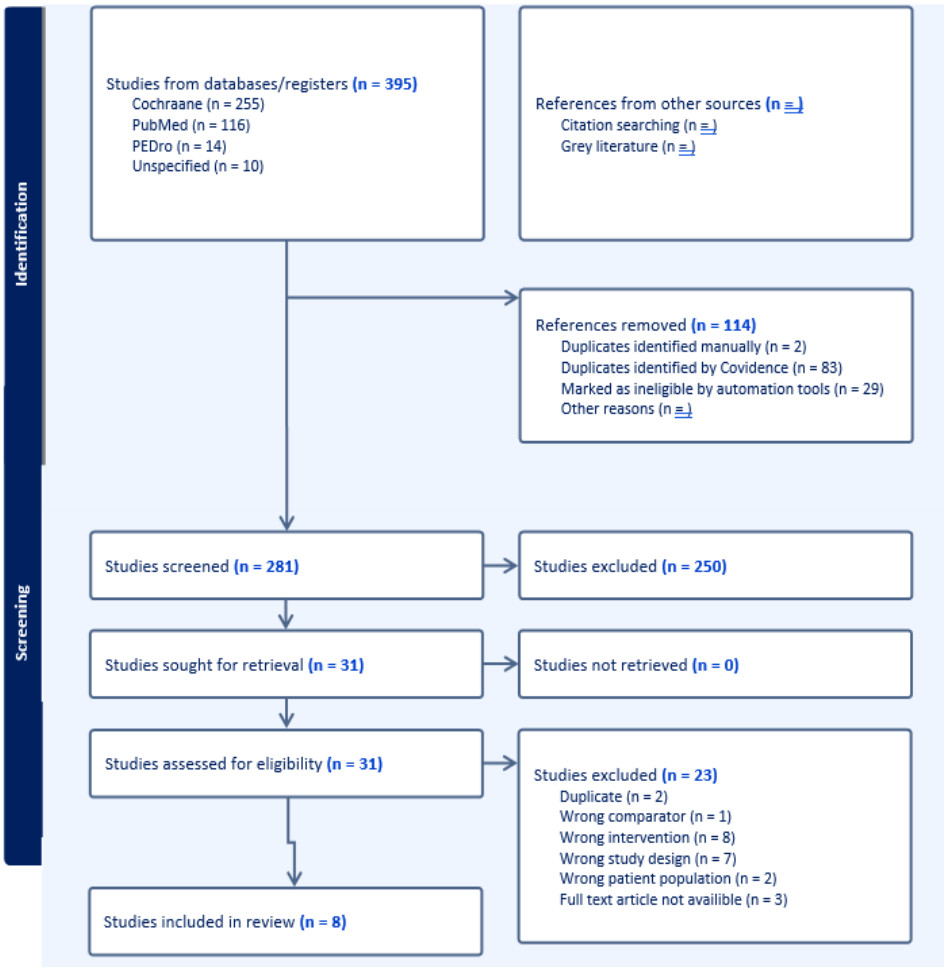
Results

A total of **395 articles** were identified from three databases: **PubMed (n = 126)**, **Cochrane Library (n = 255)**, and **PEDro (n = 14)**. After removing **114 duplicates** (112 via Covidence, 2 manually), **281 articles** remained for screening.

Following title and abstract screening, **250 articles** were excluded. **31 full-text articles** were assessed for eligibility, with **23 excluded** for the following reasons: wrong intervention **(n = 8)**, wrong study design **(n = 7)**, wrong population **(n = 2)**, wrong comparator **(n = 1)**, full text not available **(n = 3)**, and duplicates **(n = 2)**.

Eight studies on therapeutic ultrasound for managing plantar fasciitis were included in the final review. **Study selection is summarized in Figure.**

PRISMA Flowchart



Studies Characteristics

The table below summarizes the eight randomized controlled trials (RCTs) reviewed, conducted between 1995 and 2025, focusing on physiotherapeutic interventions for plantar fasciitis. Sample sizes ranged from 26 to 159, with intervention durations of 2 to 26 weeks. Treatments included radial extracorporeal shock wave therapy (rESWT), ultrasound therapy (US), dry needling; exercise/stretching programs, and intense therapeutic ultrasound (ITU).

Most studies assessed outcomes related to pain (e.g., NPRS, VAS), function (e.g., FFI, AOFAS, PFPS, FAAM), ankle range of motion, and quality of life. rESWT was the most frequently studied and often outperformed ultrasound in improving pain and function. Both sham-controlled and comparative designs were included. While the inclusion of short- and long-term studies allowed broader insight, variations in outcome tools and follow-up periods limited comparability.

Study	Country	Sample Size	Interventions	Treatment Duration	Outcomes Assessed
Katzap et al. (2018)	Israel	n = 54	Stretching + Ultrasound vs. Stretching + Sham	4 weeks	NPRS (pain), CAT (function), Algometry (tenderness)
Crawford &Snaith (1996)	UK	n = 26	Therapeutic Ultrasound vs. Sham Ultrasound	4 weeks	VAS (pain)
Akınoglu et al. (2017)	Turkey	n = 54	Radial ESWT vs. Ultrasound vs. Exercise	6 weeks	FFI (function), AOFAS (foot/ankle), Proprioception
Dedes et al. (2019)	Greece	n = 159	Radial ESWT vs. Ultrasound vs. Control	3 sessions (1/week)	Pain, Functional Impairment, Quality of Life (Likert scale)
Jain &Jothilingam (2024)	India	n = 50	Dry Needling vs. Ultrasound Therapy	2 weeks	NPRS (pain), Ankle Range of Motion
Slayton et al. (2019)	USA	n = 74	Intense Therapeutic Ultrasound (ITU) vs. Sham	26 weeks	VAS (pain), FAAM (activities of daily living),
KingChulalongkorn (2016)	Thailand	n = 30	Radial ESWT vs. Ultrasound	6 weeks	VAS (pain), PFPS (Plantar Fasciitis Pain Score),

NPRS: Numeric Pain Rating Scale
VAS: Visual Analogue Scale
FFI: Foot Function Index
AOFAS: American Orthopaedic Foot & Ankle Society Score
CAT: Computerized Adaptive Testing
FAAM: Foot and Ankle Ability Measure
rESWT: Radial Extracorporeal Shock Wave Therapy
PFPS: Plantar Fasciitis Pain Score

Outcomes

Pain Reduction

All RCTs showed significant pain reduction post-intervention. rESWT consistently outperformed ultrasound ($p < 0.001$) (29). Dry needling was also more effective than US ($p < 0.05$) (30). Ultrasound alone showed no significant benefit in some studies (27, 28).

Functional Improvement

rESWT groups showed greater improvements in AOFAS and FFI scores. Akinoglu et al. reported better balance and proprioception with rESWT.

Ultrasound offered no added benefit over stretching in CAT scores (28).

Quality of Life:
rESWT improved QoL more than US or control (Dedes et al.). ITU improved satisfaction and activity (Slayton et al.), though with high risk of bias.

Dropouts:
- Slayton et al.: 35% attrition (48/74 retained).
- Akinoglu et al.: 31% attrition (54/78 completed).
- Katzap et al.: 7% dropout, reasons provided.
- Jain &Jothilingam, Dedes et al., Crawford &Snaith: No dropouts reported; early studies lacked full CONSORT reporting.

DISCUSSION

The objective of this study was to look at the effectiveness of therapeutic ultrasound in the management and treatment of plantar fasciitis The studies reviewed onthis topic were not in burden, so retrieval and inclusion led to 08 study being therapeutic ultrasound based. This review synthesizes the available evidences on the effectiveness of therapeutic ultrasound-based treatments for plantar fasciitis. The findings suggest that radial extracorporeal shock wave therapy (rESWT) is more effective than ultrasound therapy in reducing pain, improving function, and enhancing quality of life in the short-term management. These findings are supported by studies with low risk of bias and consistent outcomes across multiple domains.

Ultrasound therapy, despite its widespread use, does not appear to provide significant benefit over placebo or sham treatments when used alone. High-quality trials such as those by Katzap et al. (2018) and Crawford &Snaith (1996) found no additive benefit oftherapeutic ultrasound over stretching or sham therapy. These findings call into question the clinical utility of ultrasound as a standalone intervention for plantar fasciitis.Emerging technologies like Intense Therapeutic Ultrasound (ITU) show potential decrease in pain and functional improvements; however, the high risk of bias (industry involvement, attrition, lack of registration) in these studies necessitates cautious interpretation.

The efficacy of dry needling, as shown by Jain &Jothilingam (2024), demonstrates potential, though replication in larger, blinded, and registered studies is required. The superiority of rESWT over US was most consistently demonstrated across studies, especially when measuring outcomes like pain reduction, proprioception, and mobility, with statistical significance in nearly all comparisons.

This review highlights key gaps in the literature: Many studies had uncleared or high risk of bias, especially in blinding and allocation concealment. Standardization of ultrasound parameters (frequency, intensity, pulse mode) is lacking. Most studies had short follow-up durations (4–12 weeks), limiting conclusions on long-term efficacy.

Conclusion

Therapeutic ultrasound (US) shows moderate short-term effectiveness in managing plantar fasciitis, particularly for pain relief and functional improvement. Studies like Katzap et al. (2018) and Slayton et al. (2019) suggest enhanced benefits when US is combined with stretching. However, radial extracorporeal shock wave therapy (rESWT) consistently outperformed US in pain reduction and proprioception.

Earlier evidence (e.g., Crawford &Snaith, 1996) questioned US efficacy, reflecting inconsistencies likely due to varying protocols and study quality. Some recent studies also showed risk of bias, especially in blinding and allocation.

Overall, US may serve as a useful adjunct but is not superior to rESWT. Further high-quality, standardized trials are needed to confirm its role in clinical practice.

Limitations

Several limitations were identified across the included studies. Common issues included small sample sizes, short follow-up durations, and methodological flaws such as inadequate blinding, poor allocation concealment, and inconsistent outcome reporting. Variability in ultrasound protocols and assessment tools limited comparability. Some studies included only female participants or lacked proper sham controls, reducing generalizability. Potential publication bias may also have affected results. These factors underscore the

need for larger, well-designed, and standardized trials to validate the effectiveness of therapeutic ultrasound for plantar fasciitis.

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