Impact of Graston Technique and Deep Friction Massage on Plantar Fasciitis Using the Foot Function Index: A Scoping Review

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Background: Plantar fasciitis (PF) is a common foot condition characterized by heel pain. Deep friction massage and Graston technique (GT) are manual therapy techniques used to manage PF. This scoping review aimed to assess the effectiveness of these techniques on pain, disability, and function in individuals with PF, as measured by the Foot Function Index (FFI).

Methods: A comprehensive literature search was conducted in electronic databases (PubMed, PEDro, EBSCOhost, Cochrane Library) using relevant keywords. Studies were included if they involved adult participants with PF, utilized deep friction massage and/or GT as the intervention, and employed the FFI as an outcome measure. Data were extracted on study characteristics, participants, interventions, and outcomes.

Results: Six studies (five randomized controlled trials and one quasi-experimental study) involving 299 participants were included. All studies indicated statistically significant changes or improvements in within-group FFI after deep friction massage or GT. Four studies showed absolute changes in FFI measure beyond the minimal clinically important difference (defined as ≥7 points for the total FFI), which indicates some clinical significance regarding a functional change. However, between-group differences varied, and some studies reported no difference between the two treatments.

Conclusion: The findings suggest that both deep friction massage and GT may be effective in managing PF. Further research with larger, well-designed studies is needed to assess long-term effects and optimize treatment for diverse patient characteristics. A multimodal approach, considering patient-specific factors, may be necessary to achieve optimal outcomes in PF management.

KEYWORDS: Adult; Graston technique; heel pain; friction massage; plantar fasciitis

INTRODUCTION

The robust and fibrous plantar fascia is an essential component that supports and preserves the medial longitudinal arch of the foot. Pathologically, the degradation and ongoing inflammation of the plantar fascia and its perifascial surrounds are the most common cause of plantar fasciitis (PF).[(1)] Historically, PF has been described by colloquial terms such as "tennis foot," "police foot," or "jogger's heel"; however, these are outdated and rarely used in modern clinical practice. Aseptic inflammation of the fascia or tendon of the foot causes PF, a common musculoskeletal condition of the foot.[(2)] It is characterized by an intense, sharp pain in the medial plantar heel in the morning or during post-inactivity steps that worsens with continued weight-bearing activities and is the most common cause of heel pain.[(3)]

The rising prevalence of foot disorders is a major public health problem, particularly in individuals engaged in prolonged standing or repetitive weight-bearing activities.[(4)] Specifically, 10% of the general population suffers from PF.[(5)] Previous literature suggests that conservative approaches combined with electrotherapeutic techniques can effectively treat PF.

Therapeutic ultrasound, extracorporeal shock wave therapy, laser therapy, and interferential current therapy are examples of such electrotherapeutic modalities. These techniques can aid in tissue healing, pain relief, and inflammation reduction.[6–8] By treating underlying causes and enhancing general foot function, conservative procedures may enhance the effectiveness of the electrotherapeutic treatments. Some of these include ice therapy,[9] exercise therapy, activity management, and manual therapy techniques,[10] such as deep friction massage (DFM)[11] and Graston technique (GT).[12]

In DFM, applying pressure to the traumatized areas helps lessen adhesions and scar formation. This technique facilitates the flow of blood and aids in the removal of substances by releasing histamine, which promotes healing.[13] Through the breakdown of adhesions and the stimulation of the production of new collagen fibers to replace immature collagen in tendinosis, this approach successfully resolves inflammatory tendon problems and aids in the healing process.[11]

The GT is an instrument-assisted soft-tissue mobilization (IASTM) approach that aids in the identification and treatment of scar tissue, tissue adhesions, and limits on mobility that cause discomfort and decreased function.[12,14] IASTM is a common manual therapy technique that evaluates and treats soft-tissue problems using stiff instruments composed of different materials. Specifically, the GT applies longitudinal pressure to tissue fibers, causing microtraumas that stimulate collagen synthesis and connective tissue remodeling, as well as the destruction of scar tissue and loosening of adhesions.[15–17]

DFM and GT are two common manual therapy methods that work on fascial adhesions and tissue dysfunction by distinct mechanisms, such as direct manual pressure in DFM and instrument-assisted tissue mobilization in GT. The comparison of these interventions is valuable since both are readily available, non-invasive, and widely applied in physiotherapy practice, but their relative benefits in enhancing pain and function in PF are not well established. Elucidating their comparative advantages will assist in evidence-based clinical decision-making.

The literature that is now accessible indicates that it is imperative to determine the most beneficial practices, advantages, and health risks related to various methods of therapy available for the treatment of patients with PF. Despite their widespread use as the primary choice of treatment in clinical practice, robust evidence supporting their effectiveness is limited. There is a lack of high-quality evidence, particularly from well-designed randomized controlled trials (RCTs), which hinders the ability to draw definitive conclusions about the effectiveness of these interventions in improving patient-reported outcomes, such as the Foot Function Index (FFI). Therefore, this scoping review intends to comprehensively synthesize the available evidence on the effectiveness of DFM and GT on FFI in patients with PF. This will help in identifying key methodological limitations and highlighting critical areas for future research to inform clinical practice and guide evidence-based treatment decisions.

Research Question

Are DFM and GT effective in improving pain, disability, and activity modification in patients with PF, as assessed by the FFI?

METHODS

This study used a scoping review methodology to investigate the current state of knowledge about the use of DFM and GT in addressing PF, as determined by the FFI. A scoping review was chosen as they are an effective way to map the existing knowledge base, identify research gaps, and guide future research objectives.[18] The protocol was registered in the Open Science Register database with registration number: 10.17605/OSF.IO/Q6TW5.

Information Sources

Electronic databases, including Cochrane Library, PEDro, EMBASE, EBSCO, and MEDLINE, were comprehensively searched for the available literature published from inception until September 2024.

Search Strategies

Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) principles were followed in the literature search and identification process to ensure a transparent and rigorous technique for finding pertinent studies and synthesizing the available information. The PRISMA-ScR checklist guided the transparent reporting of the information sources, eligibility criteria, study selection, search results, screening, and data charting to ensure reproducibility and minimize selection bias.[19] The search terms included combinations of "deep friction massage," "Graston technique," "physical therapy," "plantar fasciitis," and "Foot Function Index." The search was expanded and refined using Boolean operators like AND/OR. Articles in languages other than English and gray literature, such as theses, conference papers, and dissertations, were not included (Table 1). There was no search for unpublished studies. Only full-text, published, peer-reviewed articles were included in the search.

Study Selection

Following the retrieval of articles from the databases, search findings were combined, and duplicates were removed using the Rayyan software (Rayyan Systems Inc., Cambridge, Massachusetts, USA).[20] Subsequently, two independent reviewers screened the titles and abstracts of the remaining articles to determine their eligibility based on predefined inclusion and exclusion criteria. Full-text screening was then conducted for the selected articles to ensure they met all inclusion criteria and were of sufficient quality. Any reviewer discrepancies were resolved through discussion or consultation with a third reviewer.

Eligibility Criteria

The eligibility criteria for study inclusion were based on the PICOS (Participants, Intervention, Comparator, Outcome measures, Study design) framework.[21] Studies were included if they involved adult participants (aged 18–70 years) diagnosed with PF, utilized DFM and/or GT as the primary intervention, and employed the FFI as a primary or secondary outcome measure. RCTs, quasi-experimental, and pilot clinical trials were considered for inclusion. Studies focusing on other foot pathologies, using pharmacological or surgical interventions without subsequent physiotherapy, or employing outcome measures other than the FFI were excluded. Additionally, unpublished studies and non-English language articles were not considered.

Data Extraction

Three reviewers (SP, SS, and SM) were involved in data extraction from the retrieved studies. The extracted data included a comprehensive range of methodological and technical details, encompassing study design, participant characteristics, intervention details, control group information, outcome measures, key findings, limitations, and clinical implications.

Table 1. Search Strategy

Keyword Combinations	*MEDLINE*	*Cochrane Library*	*PEDro*	*EMBASE*	*EBSCOhost*
"Plantar fasciitis"	2,034	973	212	0	1,449
"Plantar fasciitis" AND "physical therapy"	237	84	35	0	179
"Plantar fasciitis" AND "FFI"	100	106	30	0	71
"Plantar fasciitis" AND "Graston technique" AND "FFI"	1	0	0	0	1
"Plantar fasciitis" AND "Graston technique"	5	10	1	0	4
"Plantar fasciitis" AND "deep friction massage technique" AND "FFI"	0	0	0	0	0
"Plantar fasciitis" AND "deep friction massage technique"	4	0	0	0	0
"Plantar fasciitis" AND "FFI" AND "Graston technique" OR "deep friction massage technique"	0	0	0	0	0

FFI = Foot Function Index.

RESULTS

Literature Search

The initial literature search yielded 5,536 results. After primary screening and removing duplicates, 142 articles were screened based on their titles and abstracts. Subsequently, 17 full-text articles were assessed for eligibility, and 6 studies ultimately met the inclusion criteria. The PRISMA-ScR flow diagram visually represents the study selection process (Figure 1).

Results Synthesis

Level of evidence

The included studies primarily consisted of five RCTs, considered to be the gold standard for clinical research. One of the studies was a quasi-experimental design, which offers a lower level of evidence compared to RCTs. Thus, according to the Oxford Centre for Evidence-Based Medicine Levels of Evidence framework, all six studies were classified as level II evidence, indicating moderate-quality evidence.[22]

Sample characteristics

A total of 299 participants were included in the review, with 161 receiving a DFM or GT. While the gender distribution was not reported in two studies, the remaining studies included 111 females and 73 males. The age range of the participants was 18–50 years.

Outcome measures

FFI, the primary outcome measure considered for the scoping review, was utilized across all six studies, which assessed the functional limitations and pain associated

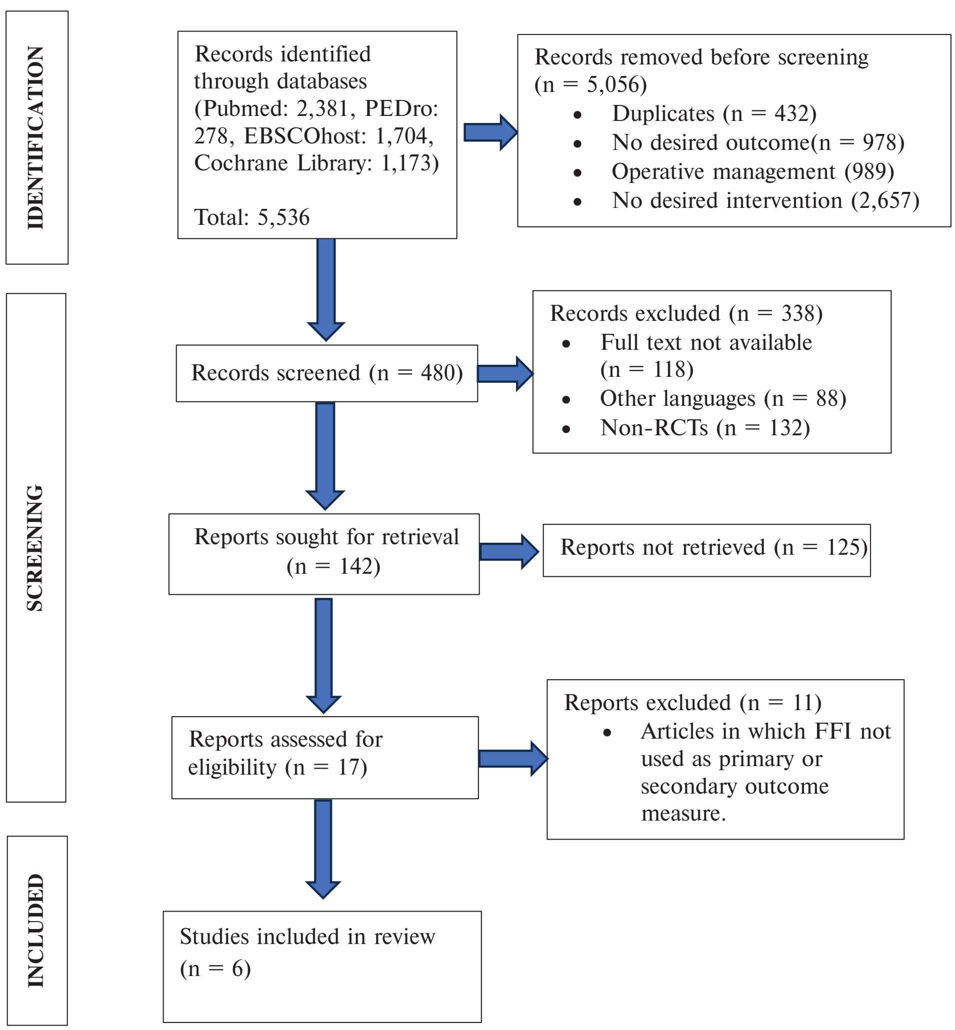

FIGURE 1. PRISMA flowchart. FFI = Foot Function Index; RCT = randomized controlled trials.

with PF. In one of the included studies, the Short-Form Health Survey was also used along with FFI to further evaluate pain, disability, and quality of life among PF patients. In addition to the FFI, other outcome measures such as the Visual Analog Scale (VAS), Numerical Pain Rating Scale, and McGill Pain Questionnaire to assess pain intensity were employed in four, one, and one study, respectively. The Tampa Scale was used in one of the studies to measure kinesiophobia, the excessive and debilitating fear of movement and physical activities.

Protocol characteristics

The reviewed studies primarily explored the efficacy of DFM and GT by comparing them to other therapeutic interventions. Four studies compared friction massage to various physiotherapy interventions, such as calf muscle stretching, dry cupping, manual therapy, and corticosteroid injections in patients with PF. The remaining two studies evaluated the efficacy of GT, alone or combined with stretching, against extracorporeal shockwave therapy and the active release technique. Table 2 provides a summary of the general characteristics of the included studies.

All six studies noted statistically significant within-group improvements in FFI for both GT and DFM. Yelverton et al. found significant improvements in all three treatment groups, with the stretching and friction massage group showing the greatest improvements.[11] Mohammed et al. found a statistically significant between-group difference, with GT having a greater improvement than the active release technique ($p < 0.001$).[26] Pisirici et al. noted statistically significant improvements for both GT, along with stretching, and extracorporeal shockwave therapy with stretching at both post-treatment and follow-up assessment.[16] In contrast, Kamran et al. and Farooq et al. found no statistically significant between-group difference, while there were clear within-group improvements.[23,25] Moshrif et al. reported a statistically significant advantage for local steroid injection over DFM at both 2- and 6-week follow-up assessments ($p < 0.001$).[24] These findings are presented in Table 3.

Most of these included studies that reported statistically significant improvements in pain and function. However, at least one included RCT explicitly reported the minimal clinically important difference (MCID) and demonstrated improvements exceeding this threshold. Pisirici et al. (2022) stated that the MCID for chronic plantar heel pain is 13 mm for VAS, 12 points for FFI pain, 7 for FFI disability, and 7 for total FFI, and found that both groups exceeded these thresholds at post-treatment and follow-up, indicating clinically meaningful improvement.[16] Similarly, Farooq et al. (2019) reported a significant decrease in mean FFI scores after 3 months, representing a >50% improvement, which exceeds the MCID and is considered clinically significant.[23] Mohammed et al. (2024) also found significant within-group improvements in both VAS and FFI after 4 weeks of treatment, with the GT group showing greater improvements than the active release technique group, again suggesting a clinically relevant benefit.[26] However, not all studies explicitly reported MCID values, and some focused only on statistical significance without discussing clinical relevance.[11,24,25]

DISCUSSION

This scoping review aimed to illustrate the literature suggesting the effectiveness of DFM and GT in managing pain and functional limitations associated with PF, as assessed by FFI. While the available evidence is limited by number and methodological quality, like small sample sizes and short follow-up periods, the findings suggest that both techniques have the potential to alleviate pain, improve function, and reduce impairment in individuals with PF.

The reviewed studies consistently demonstrated the effectiveness of DFM in managing PF. It was found to be a valuable tool in reducing pain, improving functional limitations, and enhancing the overall quality of life for individuals with this condition. Kamran et al.[25] and Farooq et al.[23] reported no statistically significant differences, even though there were between-group improvements. Farooq et al. (2019) in their study found that when applied to the flexor digitorum brevis muscle, DFM was equally effective as calf muscle stretching in improving pain, function, and disability in patients with PF.[23] In contrast, Yelverton et al. (2019) demonstrated that combining DFM with calf muscle stretching produced the most significant therapeutic benefits compared to massage with ankle and

TABLE 2. Study Characteristics

Authors and Year	*Objectives*	*Participants*	*Outcome Measures*	*Intervention Duration*	*Findings*
Yelverton et al. (2019)[11]	Cross friction massage (deep friction massage) combined with complicated stretching, foot and ankle manipulation, and a combination of all three treatments were compared in this study for PF.	45 – Cross friction massage group: 15 – Cross friction massage and stretching group: 15 – Aforementioned protocols group: 15	FFI scale	Cross friction massage versus cross friction massage and stretching of plantar fasciitis and gastrosoleus versus aforementioned protocols	All three protocols had a positive effect on the ROM and pain perception to patients with PF.
Farooq et al. (2019)[23]	To compare the effects of calf muscle stretching and transverse friction massage (deep friction massage) on the FFI scale in patients with PF.	26 – Experimental group: 12 – Control group: 14	FFI scale	Calf muscle stretching and transverse friction massage (deep friction massage)	Stretching the calf muscles and applying transverse friction massage to the flexor digitorum brevis are two equally effective treatments for PF.
Moshrif et al. (2020)[24]	The objective was to assess this physical modality's effectiveness in treating PF in contrast to local steroid injection.	60 – Local steroid injection group: 30 – Deep friction massage group: 30	FFI scale	Deep friction massage versus local steroid injection (40 mg local triamcinolone injection)	According to this study, deep friction massage is ineffective when used as the only treatment for plantar fasciitis. It is, nevertheless, a physical adjuvant modality.
Pisirici et al. (2022)[16]	To compare the impact of stretching exercises (SEs) and Graston technique (GT) on patients with PF.	66 – ESWT + SEs group: 23 – GT + SEs group: 23 – SEs group: 20	FFI scale	ESWT and GT	While GT + SEs was found to be most successful in improving functional status at 6 months, ESWT + SEs and GT + SEs appeared to have similar benefits on initial step pain post-treatment at an 8-week follow-up.
Kamran et al. (2023)[25]	To examine the impact of dry cupping and transverse friction massage (deep friction massage) on patients' pain, PF disability, and activity limits.	32 – Dry cupping group: 16 – Transverse friction massage group: 16	FFI scale	Transverse friction massage (deep friction massage) and dry cupping	Dry cupping and transverse friction massage had similar results in lowering pain, activity restrictions, and handicap in individuals with PF.
Mohammed et al. (2024)[26]	To compare the effects of GT and the active release technique on pain and function in patients with PF.	70 – Active release group: 35 – GT group: 35	FFI scale	GT versus active release	Both GT and the active release technique have demonstrated statistical significance in lowering pain and enhancing function.

ESWT = extracorporeal shockwave therapy; FFI = Foot Function Index; PF = plantar fasciitis; ROM = range of motion.

Table 3. Summary of Foot Function Index Outcomes Across Included Studies

Author (Year)	*Pre-Treatment FFI (Mean ± SD)*	*Post-Treatment FFI (Mean ± SD)*	*Statistical Significance*
Yelverton et al. (2019)[11]	Chiropractic manipulation group: 31.73 Deep friction massage group: 26.73 Stretching group: 29.94	Chiropractic manipulation group: 16.92 Deep friction massage group: 6.94 Stretching group: 14.03	Significant within-group improvement ($p < 0.05$); the greatest gains were in the deep transverse friction group
Farooq et al. (2019)[23]	Stretching group: 94.0 ± 24.8 Deep friction massage group: 115.4 ± 32.9	Stretching group: 36.6 ± 16.0 Deep friction massage group: 37.8 ± 13.1	Significant within-group improvement ($p < 0.05$); no significant between-group difference
Moshrif et al. (2020)[24]	Corticosteroid group: 27.61 ± 3.32 Deep friction massage group: 26.52 ± 3.80	Corticosteroid group: 12.00 ± 3.39 Deep friction massage group: 24.3 ± 2.1	Significant between-group difference favoring steroid injection at 2 and 6 weeks ($p = 0.001$)
Pisirici et al. (2022)[16]	Stretching and extracorporeal shortwave therapy group: 50.63 ± 16.81 Stretching and GT group: 48.60 ± 18.82 Stretching group: 58.24 ± 16.84	Stretching and extracorporeal shortwave therapy group: 35.26 ± 18.31 Stretching and GT group: 30.69 ± 18.76 Stretching group: 42.41 ± 16.87	Significant within-group improvement; GT + stretching > stretching at the 6-month follow-up ($p = 0.003$)
Kamran et al. (2023)[25]	Deep friction massage group: 64.18 ± 7.40 Dry cupping group: 63.18 ± 7.70	Deep friction massage group: 21.12 ± 9.26 Dry cupping group: 23.12 ± 8.24	Significant within-group improvement ($p < 0.001$); no significant between-group difference
Mohammed et al. (2024)[26]	Active release technique group: 95.94 ± 2.43 GT group: 96.20 ± 1.99	Active release technique group: 80.97 ± 3.53 GT group: 55.88 ± 5.79	Significant within-group ($p < 0.001$); GT group significantly better than the active release technique group ($p < 0.001$)

FFI = Foot Function Index; GT = Graston technique; SD = standard deviation.

foot manipulation or a combination of all interventions.[11] A similar outcome was observed when comparing DFM to dry cupping on the flexor digitorum brevis, with massage demonstrating superior short-term pain relief and thus better improvement in function.[25] Such findings also aligned with the outcomes from the study by Moshrif et al. (2020), who suggested that, on comparing local steroid injection and DFM to the plantar fascia, while steroid injections offered rapid pain relief, particularly by addressing inflammation, their effects tend to be transient, often leading to recurrences. In contrast, DFM, by targeting tissue dysfunction, promoted gradual and sustained pain relief through mechanisms such as reducing fascial adhesions and encouraging collagen remodeling. They demonstrated statistically significant differences favoring local steroid injection over the DFM technique at 2 and 6 weeks of follow-up phases ($p < 0.001$) as well.[24] In addition, the mechanical pressure promotes localized hyperemia, increases histamine and prostaglandin release, and modulates nociceptive activity through the gate control mechanism, thereby reducing pain perception.[27]

Likewise, GT of IASTM has also shown promise in managing PF, demonstrating notable improvements in functional outcomes and pain reduction. While effective in addressing myofascial restrictions, GT's strengths lie in its ability to reduce fascial stiffness and promote long-term tissue remodeling. This makes it particularly beneficial for managing chronic fascial limitations. Pisirici et al. demonstrated statistically significant improvement in both the GT along with stretching group and the extracorporeal shockwave therapy along with stretching group at both post-treatment and follow-up phases. When compared to extracorporeal shockwave therapy, which excels in providing immediate pain relief through mechanical stimulation, GT demonstrated a greater capacity for progressive tissue repair, leading to more sustained pain reduction and increased flexibility over time.[16] Mohammed et al. determined a statistically significant between-group difference, in which the active release technique had less statistically significant improvement than GT ($p < 0.001$). While techniques such as the active release technique may offer more immediate pain relief for acute symptoms, GT's focus on the mechanical shear forces generated by stainless-steel instruments produce controlled microtrauma in the fascia, which in turn stimulates a localized inflammatory response, fibroblast activation, and angiogenesis, positioning it as a valuable option for the management of chronic PF.[26] These changes enhance collagen turnover, restore tissue extensibility, and reduce myofascial stiffness. Importantly, the use of instruments allows deeper penetration and a more uniform application of force compared to manual massage, thereby facilitating the release of chronic adhesions.[15,28]

Together, these findings highlight that while both DFM and GT improve pain and function in PF, their physiological mechanisms differ. DFM primarily exerts its benefits through modulation of local circulation, nociception, and collagen fiber realignment, making it useful in acute and subacute stages. In contrast, GT's instrument-assisted approach enhances tissue extensibility and promotes long-term fascial remodeling, offering sustained benefits in chronic cases.

From a clinical standpoint, DFM is an inexpensive, manual method that involves no equipment, and it can be delivered in most physiotherapy environments. Nonetheless, it can be time-consuming and relies heavily upon therapist skill, as proper pressure, direction, and duration directly impact outcomes.[29] Alternatively, GT, necessitates the use of stainless-steel instruments and formal certification of practitioners. This could raise the cost of initial usage and is likely to decrease accessibility, especially in resource-poor environments.[15] However, GT offers mechanical advantage that facilitates greater penetration into deep-restricted soft tissues with reduced physical effort by the therapist, thus potentially decreasing practitioner fatigue and risk of musculoskeletal injury upon repeated use. It also facilitates more reproducible force application than manual techniques. These practical factors like cost, accessibility, therapist expertise, and physical demands are of utmost importance when choosing a proper treatment modality, especially in hectic outpatient clinics where efficiency and sustainability of care provision matter.

One notable aspect of this review is the fact that pain and function improvements observed were mainly established using the FFI, since it was the primary outcome measure in all the included studies. FFI is a validated and popular questionnaire that assesses pain, disability, and activity limitation in PF patients.[30] Its advantages are in its patient-based design, simplicity of administration, and capacity to mirror the subjective impact of foot impairment, making it useful both for clinical use and trials. While the FFI may not capture every subtle or objective change in function, it remains a practical and reliable outcome measure, making it suitable for both clinical and research contexts.

This scoping review's study limitations were limited sample sizes and short follow-up periods. Variations in intervention regimens and outcome measures were among the methodological variability issues that made the reporting challenging. Additionally, the results may have been impacted by the failure to consider comorbidities, age, and the severity of PF. Moreover, since this was a scoping review, a formal risk of bias or quality of methodological assessment of included studies was not conducted. This is a limitation recognized that could impact the strength and interpretation of the findings.

While these findings provide valuable insights, further research is needed to determine the best treatment for PF. Larger studies with longer follow-up periods to see how long the effects of different treatments last are needed. It is also crucial to understand how factors like age, other health conditions, and the severity of the pain impact treatment outcomes. To achieve this, well-designed research studies comparing different treatment options and considering how these factors affect individual patients are warranted. By carefully studying them, long-term outcomes can be improved for people with PF.

CONCLUSION

This scoping review concludes that both DFM and GT demonstrate potential benefits of pain alleviation and functional gain for PF. The evidence, however, is restricted by small sample sizes, methodological heterogeneity, and short follow-up times. These results should therefore be interpreted with caution, and no clear recommendations for clinical practice can yet be established.

Future studies should emphasize well-designed RCTs with larger sample sizes, standardized intervention protocols, and extended follow-up. Comparative studies determining therapeutic efficacy, cost-effectiveness, therapist training needs, and patient compliance would also provide more clinical relevance. Also, the use of diverse outcome measures other than the FFI would offer a broader perspective on treatment outcomes.

CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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AUTHOR CONTRIBUTIONS

SM conceptualized the study, conducted the literature search, screened articles, extracted data, and drafted the manuscript. SP contributed to study design, data interpretation, manuscript review, and critical revision of the article. SS supervised the review process, resolved discrepancies during study selection, and provided final approval of the manuscript. All authors read and approved the final version of the manuscript.

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