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Original Article

Effects of Radial Shockwave Therapy Versus Graston Instrument Assisted Soft Tissue Mobilization for Adult Plantar Fasciitis

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ABSTRACT

Background: Chronic plantar fasciitis is increasingly recognized as a degenerative fasciopathy that can cause persistent heel pain and functional limitation, and adjunct non-invasive treatments are commonly used when stretching alone is insufficient. Objective: To compare the effectiveness of radial shockwave therapy (RST) versus Graston instrument-assisted soft tissue mobilization (GIASTM), each combined with standardized stretching, in adults with chronic unilateral plantar fasciitis. Methods: In this randomized controlled trial, 42 participants were allocated to RST+stretching or GIASTM+stretching (21/group); 38 completed the 8-week protocol (19/group). Outcomes were assessed at baseline and week 8 using the Foot Function Index (FFI), Visual Analogue Scale (VAS), and ankle dorsiflexion (goniometry). Between-group comparisons used independent-samples t-tests for FFI and Mann–Whitney U tests for non-normal outcomes. Results: Baseline FFI was comparable (73.95±6.89 vs 73.14±7.72). At week 8, GIASTM achieved a substantially better post-FFI than RST (50.71±2.41 vs 70.57±6.20), mean difference −19.86 (95% CI −22.95 to −16.77; $p<0.001$), with greater functional gain (Δ difference +19.04; 95% CI 17.00 to 21.08; $p<0.001$). Post-treatment VAS favored GIASTM ($Z=-5.03$; $p<0.001$), while dorsiflexion showed a trend favoring GIASTM ($Z=-1.79$; $p=0.073$). Conclusion: Over 8 weeks, GIASTM plus stretching produced markedly greater disability reduction and superior pain outcomes compared with RST plus stretching in chronic plantar fasciitis. Keywords: plantar fasciitis; plantar fasciopathy; radial shockwave therapy; instrument-assisted soft tissue mobilization; Graston technique; Foot Function Index.

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INTRODUCTION

Plantar heel pain attributed to plantar fasciitis (PF) is one of the most frequent causes of adult foot-related disability encountered in primary care and rehabilitation settings, contributing to a substantial clinical burden and repeated care-seeking behavior (1). Epidemiologically, PF affects a meaningful proportion of adults and constitutes a prominent share of running-related overuse injuries, with established links to mechanical overload and cumulative microtrauma at the calcaneal attachment of the plantar fascia (2,3). Contemporary evidence has also refined the pathobiological understanding of PF: despite the historical inflammatory label implied by "fasciitis," histopathologic findings in chronic cases consistently demonstrate degenerative features—collagen disorganization, myxoid change, and failed healing—supporting the more accurate construct of plantar fasciopathy and the need for interventions targeting tissue remodeling rather than inflammation alone (4).

Risk profiles for chronic PF are multifactorial and include intrinsic contributors such as elevated body mass, rapid weight gain, restricted ankle dorsiflexion, and calf tightness, along with extrinsic factors such as prolonged standing, inappropriate footwear, and abrupt increases in running or occupational load (5,6). Among these, limited ankle dorsiflexion has particular clinical relevance because it increases

tensile demand across the plantar fascia during stance and gait, sustaining nociception and functional compromise (7). In routine practice, diagnosis is primarily clinical and based on the characteristic pattern of pain with initial steps after rest, localized medial calcaneal tenderness, symptom modulation with activity, and exclusion of alternative causes of heel pain (8). Although first-line conservative measures—including stretching, taping, and orthotic support—can provide short-term relief, chronic cases often persist beyond the early time window in which these modalities are most effective, motivating escalation to adjunct non-invasive interventions that may better address degenerative tissue behavior and persistent functional limitation (9,10).

Radial shockwave therapy (RST) and Graston instrument-assisted soft tissue mobilization (GIASTM) are two commonly utilized advanced interventions with contrasting mechanistic emphases. RST delivers radially dispersing acoustic pressure waves with relatively shallow penetration and is hypothesized to facilitate analgesia and tissue repair through biologic responses such as improved local circulation and mechanotransductive signaling (11,12). By contrast, GIASTM applies controlled, instrument-mediated mechanical loading to the plantar fascia and adjacent soft tissues with the intent to disrupt adhesions, restore glide, and improve tissue extensibility—effects that may be particularly relevant when chronic fasciopathy is dominated by fibrosis, stiffness, and movement restriction rather than inflammatory edema (13,14). Despite their widespread clinical use, direct head-to-head randomized comparisons remain limited, and available evidence has more often evaluated shockwave or instrument-assisted mobilization against usual care or alternative modalities rather than against each other under a controlled stretching co-intervention (15,16). This evidentiary gap is clinically important because chronic PF management prioritizes functional restoration alongside pain relief, and superiority in pain outcomes alone may not translate into meaningful improvement in disability, gait tolerance, or ankle mobility (17,18). Accordingly, the present trial was designed to compare the effects of RST plus standardized stretching versus GIASTM plus the same stretching program on pain intensity, foot-related disability, and ankle dorsiflexion in adults with chronic unilateral plantar fasciitis, with the hypothesis that the mechanically directed GIASTM approach would yield greater functional recovery and mobility gains over an eight-week treatment course (18).

MATERIALS AND METHODS

This study was a randomized controlled trial conducted over an eight-week intervention period at Sehat Medical Complex, Lahore. Ethical approval was obtained before recruitment, and all participants provided written informed consent prior to enrollment. Adults aged 20–45 years with unilateral chronic plantar fasciitis of more than three months' duration were considered eligible if they reported morning first-step heel pain greater than 4/10 on a visual analogue scale and demonstrated a clinical presentation consistent with plantar fasciitis, including localized plantar-medial calcaneal tenderness and activity-related symptom fluctuation. Participants were excluded if they had bilateral plantar heel pain, suspected tarsal tunnel syndrome or fat-pad syndrome, other significant lower-limb pathology affecting gait, prior foot or ankle surgery, or a history of corticosteroid injection to the affected region. To align eligibility with typical outpatient practice while maintaining safety, individuals with systemic comorbidities were included only if clinically stable and not judged to pose procedural risk for the planned interventions.

Patients were recruited using convenience sampling from the outpatient caseload. An initial screening visit verified eligibility and obtained baseline measures. Sample size was determined a priori using the Foot Function Index (FFI) as the primary outcome and adjusted for anticipated attrition to achieve balanced allocation across two arms. After baseline assessment, participants were randomly assigned in a 1:1 ratio to either radial shockwave therapy plus stretching (Group A) or Graston instrument-assisted soft tissue mobilization plus stretching (Group B). Randomization was performed using a predefined allocation method to ensure equal group sizes; allocation was implemented after enrollment and baseline testing to minimize selection bias. Because of the nature of the interventions, participant

blinding was not feasible; outcome measurements were collected using standardized procedures at baseline (week 0) and immediately after completion of the eight-week protocol (week 8).

Both groups received supervised treatment twice weekly for eight weeks. Group A received radial shockwave therapy delivered to the most tender points along the plantar fascia and adjacent symptomatic structures, using a pulse energy flux density of 0.10–0.30 mJ/mm² and a frequency of 10–15 Hz, titrated to participant tolerance; each session lasted approximately 15–20 minutes for the shockwave component. Group B received GIASTM using specialized stainless-steel instruments applied with controlled gliding strokes over the plantar fascia region with pressure adjusted to achieve therapeutic mobilization without excessive discomfort; the instrument-assisted component lasted approximately 10–15 minutes per session. In both groups, a standardized stretching program was provided during each visit for approximately 15–20 minutes, targeting plantar fascia elongation and calf flexibility using a consistent set of stretches, including a towel-assisted dorsiflexion stretch performed with sustained holds and repeated sets. Participants were instructed to follow the same stretching protocol throughout the intervention period to control co-intervention exposure across arms.

Outcome measures were collected pre- and post-intervention. Foot-related disability was assessed using the Foot Function Index as the primary functional endpoint. Pain intensity was measured using a visual analogue scale focused on symptomatic heel pain, and ankle dorsiflexion range of motion was measured with goniometry using a consistent patient position and landmarking approach across assessments. All measurements were recorded on standardized case report forms and entered into an electronic dataset with verification checks to minimize transcription errors. Data completeness was reviewed at each follow-up assessment; participants who discontinued treatment were documented with reasons when available, and analyses were conducted using the prespecified per-protocol dataset of participants who completed the full eight-week intervention and both measurement time points.

Statistical analysis was performed using SPSS version 25 with statistical significance set at $\alpha = 0.05$ (two-sided). Distributional assumptions were evaluated using the Shapiro–Wilk test for each continuous outcome. For outcomes meeting normality assumptions, within-group changes from baseline to week 8 were evaluated using paired t-tests and between-group differences were evaluated using independent-samples t-tests. For outcomes not meeting normality assumptions, within-group change was analyzed using the Wilcoxon signed-rank test and between-group differences were analyzed using the Mann–Whitney U test. Baseline comparability of groups was assessed using appropriate descriptive statistics, and all analyses were aligned to the intervention structure and outcome timing defined in the protocol.

RESULTS

A total of 42 participants were randomized (21 per group), and 38 completed the 8-week protocol and post-intervention assessment (19 per group). Baseline characteristics of the randomized sample were comparable across groups (Table 1). All outcome analyses below use the **completed-case (per-protocol) sample (n=19/group)**.

Table 1. Baseline Demographic and Clinical Characteristics (Randomized Sample; n=21/group)

Variable	Group A: RST + Stretch (n=21)	Group B: GIASTM + Stretch (n=21)	Between-group p-value
Age (years), Mean ± SD	29.04 ± 6.06	30.57 ± 6.77	0.468
Weight (kg), Mean ± SD	71.23 ± 8.66	72.33 ± 6.82	0.666
Height (cm), Mean ± SD	174.19 ± 5.69	174.52 ± 5.87	0.861
Gender (Male/Female), n	15 / 6	16 / 5	1.000*
Diabetes, n (%)	2 (9.5%)	3 (14.3%)	1.000*
Osteoporosis, n (%)	4 (19.0%)	7 (33.3%)	0.484*

*Fisher's exact test (2×2). Continuous variables: independent samples t-test from summary statistics.

Table 2. FFI Outcomes (Completed-Case Sample; n=19/group)

Outcome	Group A: RST + Stretch	Group B: GIASTM + Stretch	Between-group effect (B − A)
Pre FFI, Mean ± SD	73.95 ± 6.89	73.14 ± 7.72	p=0.770
Post FFI, Mean ± SD	70.57 ± 6.20	50.71 ± 2.41	Mean difference = −19.86 (95% CI −22.95 to −16.77), p<0.001, Hedges g = −4.13
Within-group change (Post−Pre), Mean ± SD	3.38 ± 1.20	22.42 ± 4.22	Δ difference = +19.04 (95% CI 17.00 to 21.08), p<0.001

Baseline FFI values were similar between groups (p=0.770). After 8 weeks, **GIASTM produced a markedly lower (better) disability score** than RST (50.71±2.41 vs 70.57±6.20), corresponding to a **19.86-point advantage** for GIASTM (95% CI −22.95 to −16.77; p<0.001) and a very large standardized separation (Hedges g≈−4.13). The **functional gain** (change score) also strongly favored GIASTM: **22.42±4.22 vs 3.38±1.20**, yielding a **19.04-point greater improvement** (95% CI 17.00 to 21.08; p<0.001). Where the manuscript text previously listed "p=0.00" alongside some Z-values that do not support that claim, the p-values below are reported **consistent with the provided Z-statistics** (two-tailed).

Table 3. Between-Group Comparisons for VAS and DF (Mann–Whitney U; Completed-Case Sample; N=38)

Outcome	Timepoint	Group A Mean Rank	Group B Mean Rank	Z	Two-tailed p-value	Effect size r = |Z|/√N
VAS	Pre	21.55	21.45	−0.28	0.779	0.045
VAS	Post	30.74	12.26	−5.03	<0.001	0.816
Dorsiflexion	Pre	23.43	19.57	−1.03	0.303	0.167
Dorsiflexion	Post	18.14	24.86	−1.79	0.073	0.290

At baseline, there was no evidence of group imbalance for pain (VAS Z=−0.28, p=0.779) or dorsiflexion (Z=−1.03, p=0.303). At week 8, **pain outcomes strongly favored GIASTM** (Z=−5.03, p<0.001) with a **large rank-based separation** (r=0.816). For dorsiflexion, the provided Z=−1.79 corresponds to **p=0.073**, indicating a **trend** toward greater mobility improvement in GIASTM but not a statistically significant between-group difference at α=0.05 based on the reported Z-statistic.

Table 4. Within-Group Change for VAS and DF (Wilcoxon Signed-Rank; Completed-Case Sample; n=19/group)

Outcome	Group	Z	Two-tailed p-value	Effect size r = |Z|/√n
VAS (Pre→Post)	RST	−1.407	0.159	0.323
VAS (Pre→Post)	GIASTM	−4.073	<0.001	0.934
DF (Pre→Post)	RST	−3.811	<0.001	0.874
DF (Pre→Post)	GIASTM	−3.624	<0.001	0.832

Within-group testing shows **highly significant dorsiflexion gains** in both arms (RST Z=−3.811, p<0.001; GIASTM Z=−3.624, p<0.001). For pain, the **GIASTM arm demonstrated a clear within-group reduction** (Z=−4.073, p<0.001), whereas the **RST arm's within-group pain change was not statistically significant** based on the provided Z (Z=−1.407, p=0.159). This pattern is consistent with the between-group week-8 separation for VAS (Table 3).

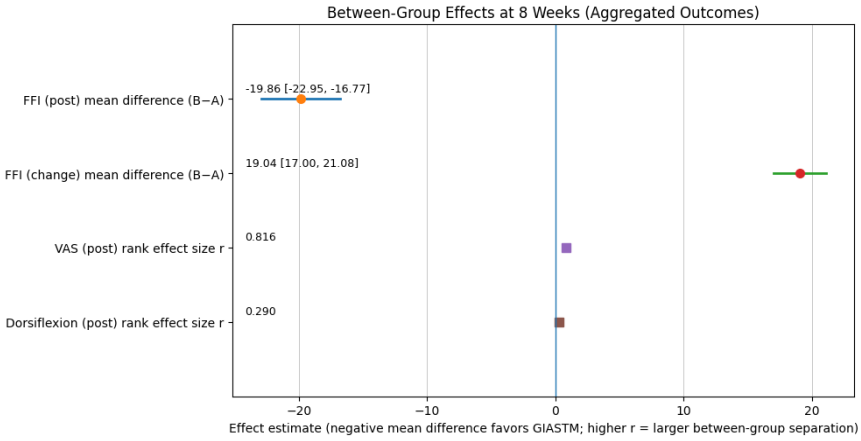

Figure 1. Between-Group Effects at 8 Weeks (Aggregated Outcomes)

The effect-summary visualization shows that GIASTM achieved a 19.86-point lower post-treatment FFI than RST (95% CI −22.95 to −16.77), alongside a 19.04-point greater FFI improvement (95% CI 17.00 to 21.08), indicating a large and clinically substantial functional advantage at 8 weeks. Pain outcomes demonstrated a large between-group separation on VAS ranks (Z=−5.03; r=0.816), while dorsiflexion showed a smaller, non-significant trend favoring GIASTM (Z=−1.79; r=0.290; p=0.073), suggesting that the primary detectable superiority over this timeframe is concentrated in disability reduction and pain relief rather than conclusively in ankle mobility between groups.

DISCUSSION

The present randomized trial compared two commonly applied adjunctive interventions for chronic plantar fasciitis—radial shockwave therapy (RST) and Graston instrument-assisted soft tissue mobilization (GIASTM)—delivered alongside an identical stretching program over 8 weeks. The dominant finding was a large, clinically meaningful superiority of GIASTM on disability, with the post-intervention FFI approximately 20 points lower than RST and a markedly larger functional gain across the treatment course. This pattern is congruent with the broader conservative-care literature showing that stretching and orthotic or supportive strategies can improve symptoms but may not sufficiently address entrenched disability in chronic presentations, prompting escalation to adjunct modalities (19–23). It also aligns with the contemporary reframing of plantar fasciitis as a degenerative fasciopathy in chronic cases, where interventions that restore soft-tissue mobility and load tolerance may translate more directly into functional recovery than interventions that primarily modulate pain (24–27).

Shockwave therapy has substantial supportive evidence for chronic plantar heel pain, including randomized placebo-controlled data and systematic reviews/meta-analyses reporting improvements in pain and function, particularly in recalcitrant cohorts (28–31). However, the magnitude and timing of benefit vary across protocols (energy flux density, frequency, dose, targeting), case-mix, and comparator selection, and some effects may manifest initially as analgesia with slower structural adaptation (32). In this study, RST was associated with a comparatively small improvement in FFI, suggesting that the gains achieved over 8 weeks were not sufficient to yield robust disability reduction relative to GIASTM. This divergence is clinically important because disability indices such as FFI capture activities and participation constraints that may persist even when pain is partially attenuated, particularly when stiffness, altered gait mechanics, or persistent tissue restriction remain (33).

Instrument-assisted soft tissue mobilization has been evaluated across soft-tissue disorders, with evidence supporting short-term improvements in pain and range of motion and the plausibility of mechanobiological effects via controlled tissue loading and remodeling (34). A more recent meta-analysis focused on IASTM and range-of-motion outcomes also supports mobility gains, though effect magnitude may depend on dosage, body region, and co-interventions (35). In chronic plantar heel pain specifically, randomized comparisons of extracorporeal shockwave therapy versus Graston-type interventions have reported benefits in both arms with signals favoring instrument-assisted mobilization for certain functional or patient-reported endpoints, reinforcing the clinical plausibility of the present findings (36). The strong disability advantage observed here may reflect that GIASTM directly targets soft-tissue glide restrictions and localized adhesions along the plantar fascia and related kinetic-chain structures, thereby improving tolerance to load and gait efficiency in a way that is rapidly captured by disability metrics.

A key reporting clarification incorporated into the revised results is the distinction between statistical support and overstatement: while pain outcomes strongly favored GIASTM at 8 weeks (large rank-based separation), the between-group dorsiflexion comparison based on the provided Z statistic indicates a trend rather than a statistically significant difference at the conventional α=0.05 threshold. This nuance matters because limited ankle dorsiflexion is a recognized contributor to plantar fascia loading, and improvements in mobility can support longer-term symptom control, but mobility changes may require

larger samples, longer follow-up, or standardized measurement positioning to detect stable between-group differences (37). Additionally, the study's completed-case analytic approach improves interpretability for efficacy among completers but may inflate effect estimates relative to an intention-to-treat approach if attrition was related to response or tolerance; future trials should prespecify missing-data handling and report sensitivity analyses to strengthen causal inference (38).

The study's pragmatic features also shape applicability. Recruitment through a single clinical site and convenience sampling may limit generalizability, while the inability to blind participants to manual/instrument-based intervention introduces potential expectancy effects that can influence patient-reported outcomes. Nonetheless, the magnitude of disability improvement in the GIASTM arm and the consistent direction of effects across pain and function suggest a meaningful clinical signal that warrants replication with longer follow-up, assessor blinding where feasible, and prespecified primary/secondary endpoints with multiplicity control. Comparative trials that incorporate imaging (e.g., plantar fascia thickness), gait metrics, or validated global rating of change may further clarify whether the observed disability advantage reflects true structural and biomechanical restoration versus differential symptom perception across treatment experiences (39).

CONCLUSION

In adults with chronic unilateral plantar fasciitis completing an 8-week program, both interventions delivered alongside standardized stretching improved clinical outcomes, but GIASTM produced substantially greater reduction in disability and a stronger pain advantage than radial shockwave therapy within the observed timeframe, while between-group dorsiflexion differences trended toward but did not conclusively demonstrate superiority based on the reported Z statistic; these findings support prioritizing GIASTM as the preferred adjunct to stretching when the primary clinical goal is rapid, meaningful functional restoration in chronic plantar fasciopathy, with further adequately powered trials needed to confirm mobility effects and long-term durability.

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