



EFFECTIVENESS OF ACTIVE RELEASE TECHNIQUE WITH LOWER LIMB STRENGTHENING FOR THE TREATMENT OF PLANTAR FASCITIS

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Abstract

Introduction: Plantar fasciitis (PF) is a common musculoskeletal disorder characterized by degenerative changes in the plantar fascia, leading to significant heel pain and functional impairment. Conventional treatments often fail to address both the soft tissue restrictions and biomechanical deficiencies that contribute to the condition. Active Release Technique (ART), a manual therapy targeting myofascial adhesions, and lower limb strengthening exercises have individually shown efficacy, but their combined effects are underexplored.

Objectives: This study aimed to evaluate the effectiveness of combining Active Release Technique (ART) with lower limb strengthening (LLS) in reducing pain and improving foot function in patients with plantar fasciitis, compared to ART alone.

Methods: This was an Experimental Study. Thirty participants aged 30–40 years with clinically diagnosed plantar fasciitis were randomly assigned to two groups: Group A (ART + LLS) and Group B (ART only). Both groups received therapeutic ultrasound as an adjunct. The interventions were administered 4 times per week for 4 weeks. Pain and function were assessed using the Numeric Pain Rating Scale (NPRS) and Foot Function Index (FFI), respectively. Data were analyzed using paired and independent sample t-tests.

Results: Both groups showed significant improvements in NPRS and FFI scores ($p < 0.05$). However, Group A (ART + LLS) demonstrated superior results. Group A's NPRS score decreased from 9.13 ± 0.63 to 1.46 ± 0.51 , and FFI decreased from 84.25 ± 8.04 to 24.53 ± 5.15 . Between-group comparison confirmed statistically greater improvements in Group A (NPRS: $p = 0.0035$; FFI: $p = 0.0078$).

Conclusion: The combined intervention of Active Release Technique with lower limb strengthening significantly enhances pain relief and functional recovery in plantar fasciitis patients compared to ART alone. This multimodal approach addresses both soft tissue restrictions and muscular imbalances, supporting its clinical application in conservative PF management.

Keywords: Plantar fasciitis, Active Release Technique (ART), Lower limb strengthening (LLS), Manual therapy, Foot Function Index (FFI), Pain relief, Therapeutic ultrasound.

1. Introduction

Plantar fasciitis (PF) is one of the most prevalent causes of heel pain, affecting nearly 10% of individuals at some point in their lives. It is a syndrome resulting from repeated trauma to the plantar fascia at its origin on the calcaneus. The most accepted theory posits that the plantar fascia's insertion on the medial tubercle of the calcaneus undergoes partial tearing and inflammation due to repetitive stress, which is fundamentally a degenerative process.

Patients typically report sharp, stabbing pain in the medial aspect of the heel, especially during the first steps in the morning or after prolonged inactivity or extended standing on hard surfaces. Research indicates that poor biomechanics are a primary cause of PF, with individuals with excessively high or low foot arches being at greater risk. The plantar fascia, a thick fibrous connective tissue, supports the longitudinal arch statically and absorbs shock dynamically. Dysfunction, particularly in the Windlass mechanism, increases tensile stress on the fascia. Biomechanical risk factors include overpronation, high arch, tight Achilles tendon, weak intrinsic foot muscles, obesity, and prolonged standing.

While conservative treatments like rest, ice, stretching, orthotics, and NSAIDs are common, they often provide only temporary relief and may not address the underlying biomechanical issues. Recent studies have highlighted the role of manual therapy. Active Release Technique (ART) is a patented soft tissue therapy that focuses on identifying and releasing adhesions, fibrosis, and restrictions within myofascial structures by applying precise tension while the patient actively moves the tissue through its range of motion. ART has shown promising results in treating chronic soft tissue injuries, including PF, by targeting fascial restrictions.

Additionally, lower limb strengthening exercises are proposed as an effective adjunct therapy. Strengthening the intrinsic and extrinsic muscles of the foot, such as the flexor digitorum brevis, abductor hallucis, and tibialis posterior, can improve arch support and reduce strain on the plantar fascia. Studies suggest that combining strengthening exercises with traditional therapy yields superior outcomes in pain reduction and functional recovery.

Therapeutic ultrasound (US) has been used as a valuable adjunct modality to enhance the effects of manual therapy and exercise. The high-frequency sound waves in continuous mode (1 MHz, 1.5 W/cm²) cause thermal and non-thermal effects, promoting healing, increasing blood flow, and improving collagen extensibility, thus reducing inflammation and pain.

Despite the availability of various treatment options, PF remains a challenging and recurrent condition. Limited research has evaluated the synergistic effects of combining ART (targeting soft tissue restrictions) and lower limb strengthening (improving muscular support). This study aims to determine the efficacy of this integrated approach.

The **Null Hypothesis (H0)** is that there is no significant effectiveness of Active Release Technique with lower limb strengthening for the treatment of plantar fasciitis.

Alternate Hypothesis (H1) is that there is a significant effectiveness.

2. Materials and Methods

Study Design and Setting

This was an Experimental Study. Participants were included from Faridabad, with a total intervention duration of 4 weeks per patient.

Participants and Criteria

A total of 30 plantar fasciitis patients were included from Faridabad.

- **Inclusion Criteria:** Subjects aged 30 years or more and less than 40 years, both males and females, who had a prolonged standing history, and presented with tenderness over the heel and plantar fascia.

- **Exclusion Criteria:** Age below 30 or above 40 years, pregnant women, those without a prolonged standing history, history of heel fractures or surgical interventions on the foot, and patients with post-traumatic or neurological disorders.

Intervention Groups

Participants were randomly divided into two groups of 15 patients each:

1. **Group A (Experimental Group):** Received Active Release Technique (ART) + Lower Limb Strengthening (LLS) protocols, along with Ultrasonic therapy.
2. **Group B (Control Group):** Received Active Release Technique (ART) alone protocols, along with Ultrasonic therapy.

Intervention Protocol (4 weeks, 4 sessions/week)

All subjects provided written informed consent. Interventions were given 4 times in a week for 4 weeks.

- **Active Release Technique (ART):** The patient was placed prone with feet hanging off the edge of the treatment table. The therapist palpated the plantar fascia, heel, and calf muscles to locate adhesions. Deep, targeted pressure was applied to the restricted areas using the thumb, fingers, or elbow, with pressure gradually increased to a tolerable intensity. The patient was instructed to actively move the foot and toes, often involving dorsiflexion and toe extension, while the pressure was maintained. Each movement was repeated 3–5 times per affected area, with total session time lasting 10–15 minutes.
- **Lower Limb Strengthening (LLS) (Group A only):** This structured protocol consisted of exercises for the knee and ankle joints, performed with a 30-second interval between sets. Exercises progressed weekly in terms of resistance, repetitions, and balance challenge, including exercises like Towel Curls, Marble Pickups, Seated Ankle Dorsiflexion/Plantarflexion with resistance band, Heel Raises (progressing to singleleg), Knee Extensions, Straight Leg Raises, Wall Sits, Step-Ups, Bridges, Toe Walking, and Heel-to-Toe Walking.
- **Therapeutic Ultrasound (Both Groups):**
 - **Mode:** Continuous mode
 - **Frequency:** 1 MHz □ **Intensity:** 1.5 watt/cm²
 - **Duration:** 5 minutes
 - **Application Area:** Medial calcaneal tubercle and arch of the foot
 - **Frequency:** 4 sessions/week

Outcome Measures

The subjects underwent pre- and post-testing using two outcome measures:

1. **Numeric Pain Rating Scale (NPRS):** A self-reported, one-dimensional indicator of pain intensity rated on a scale of 0 (no pain) to 10 (worst imaginable pain).
2. **Foot Function Index (FFI):** A validated self-reported questionnaire assessing how foot pathology affects activity limitation, pain, and disability, with higher scores indicating greater impairment (scored as a percentage).

Statistical Analysis

Descriptive statistics (mean $\pm$ standard deviation, SD) were used to summarize baseline characteristics and group changes. Comparative analysis utilized parametric tests with a significance level of $p < 0.05$:

- **Paired sample t-test:** Used for within-group comparison (pre-intervention vs. postintervention).
- **Independent sample t-test:** Used for between-group comparison (Group A vs. Group B post-intervention).

3. Results

The study included 30 participants, with 15 in Group A (ART + LLS) and 15 in Group B (ART only).

Within-Group Analysis

Both groups showed statistically significant improvements ($p < 0.05$) in both pain and function from pre- to post-treatment.

Group	Measure	Pre-Intervention (Mean $\pm$ SD)	Post-Intervention (Mean $\pm$ SD)	<i>T</i> value	<i>P</i> value
Group A (ART + LLS)	NPRS	9.13 $\pm$ 0.63	1.46 $\pm$ 0.51	15.02	0.00016
	FFI	84.25 $\pm$ 8.04	24.53 $\pm$ 5.15	14.73	0.00018
Group B (ART only)	NPRS	8.06 $\pm$ 0.70	2.40 $\pm$ 0.50	15.23	0.00020
	FFI	75.40 $\pm$ 5.70	30.46 $\pm$ 5.81	13.85	0.00015

Between-Group Analysis (Post-Intervention)

The comparison of post-intervention scores using the independent samples *t*-test revealed statistically significant differences, with Group A demonstrating superior outcomes.

Measure	<i>T</i> value	<i>P</i> value	Interpretation
NPRS	3.155	0.0035	Group A showed significantly greater pain reduction.
FFI	2.837	0.0078	Group A showed significantly greater functional improvement.

The superior results in Group A allowed the rejection of the null hypothesis and supported the alternative hypothesis.

4. Discussion

This study demonstrated that while both interventions significantly improved pain and function in plantar fasciitis patients, the combined approach of Active Release Technique with lower limb strengthening yielded superior clinical outcomes compared to ART alone.

Role of Therapeutic Modalities

Therapeutic ultrasound was effectively utilized in both groups as an adjunct modality in continuous mode (1 MHz, 1.5 W/cm²) to promote tissue healing, reduce inflammation, and enhance collagen extensibility, thus preparing the tissues for more effective manual therapy. The significant improvement in the ART-only group supports the efficacy of ART in resolving myofascial adhesions and restoring normal tissue mobility in plantar fasciitis.

Superiority of the Combined Intervention (Group A)

The greater reduction in NPRS scores in Group A suggests an enhanced analgesic effect from combining ART and LLS. While ART addresses localized fascial dysfunctions, the addition of lower limb strengthening is believed to provide longer-term neuromuscular support by improving the mechanical resilience of the foot arch

structures. This synergistic effect is crucial because plantar fasciitis is recognized as a biomechanical dysfunction involving chronic overload. Strengthening exercises—targeting intrinsic foot and ankle stabilizers—improves load distribution, reduces plantar strain during gait, and offloads the plantar fascia.

Similarly, the significantly better FFI scores in Group A indicate that functional capacity and daily mobility were more effectively restored with the combined protocol. Strengthening the foot and ankle muscles restores arch stability and improves shock attenuation, which is essential for improved gait mechanics and functional capacity. The findings reinforce the importance of not relying solely on

passive modalities but integrating muscle re-education and foot stability enhancement for better long-term outcomes.

Clinical Implications

The results validate the use of ART for plantar fasciitis and strongly emphasize the added value of lower limb strengthening. Clinically, integrating strengthening exercises into standard therapy protocols is recommended to address the underlying biomechanical factors, promoting sustainable recovery and reducing the risk of recurrence.

5. Conclusion and Recommendations

Conclusion

The present study concludes that while Active Release Technique alone is effective in reducing pain and improving foot function in patients with plantar fasciitis, the combination of Active Release Technique with lower limb strengthening exercises offers superior clinical benefits. This multimodal approach effectively addresses both soft tissue restrictions and muscular imbalances, supporting its application as a comprehensive rehabilitation strategy for the conservative management of plantar fasciitis.

Limitations of the Study

- **Small sample size:** This restricts the statistical power and limits the generalizability of the results to broader populations.
- **Short duration and lack of long-term follow-up:** The 4-week intervention duration and absence of follow-up may not adequately capture the sustainability of therapeutic benefits or the recurrence rate.
- **Lack of objective biomechanical assessments:** The absence of tools like gait analysis or plantar pressure distribution restricts a deeper understanding of the observed functional improvements.
- **Absence of a placebo control group:** This limits the ability to fully differentiate the true physiological effects from potential placebo or expectation-driven responses.

Future Recommendations

Future studies should:

- Incorporate a larger and more diverse sample population.
- Implement long-term follow-up assessments to determine the sustainability of effects and potential for recurrence.
- Utilize objective biomechanical tools such as gait analysis, plantar pressure mapping, and electromyography (EMG) to gain deeper insights into neuromuscular and structural changes.
- Include a placebo or sham therapy group to help distinguish true treatment effects from placebo responses.

6. References

Note: The references below are selectively formatted from the provided sources. When transferring to a word document, a unified citation style (e.g., APA, Vancouver) should be applied.

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