

Effectiveness of High Load Plantar Fascia Resistance Training among Athletes with Plantar Fasciitis

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Abstract

Background: Plantar fasciitis is a common condition characterized by pain and inflammation in the plantar fascia, a thick band of tissue that runs along the bottom of the feet, connecting the heel to the toes. It is particularly prevalent among athletes who engage in activities that involve repetitive impact, such as running, jumping. Athletes with plantar fasciitis often undergo a structured rehabilitation program that incorporates high load resistance training alongside other interventions such as stretching, massage, orthotic devices, and modifications in training and footwear.

Purpose: To compare the effectiveness of High Load Plantar Fascia Resistance Training with ultrasound and Intrinsic Muscle strengthening with ultrasound among athletes with Plantar Fasciitis.

Materials and Methods: Total of 60 subjects were selected from Sri Sai Ortho General Clinic based on the selection criteria and randomly divided into two groups; High load plantar fascia resistance training (HLST) with ultrasound (n=30) and Intrinsic muscle strengthening with ultrasound (n=30). The subjects were assessed for pain intensity using NPRS and using LEFS, for pre and post-test values. The interventions were given for 2 weeks. Study period : November 2022 to March 2023

Result: The result of the study revealed that both exercises are effective but (HLST) with ultrasound was more effective and significant in terms of decreasing pain and improving functional mobility.

Conclusion: Hence the study concludes that HLST was more effective in managing plantar fasciitis in terms of both relieving pain as well as functional mobility among athletes with plantar fasciitis.

Keywords: Heel pain, Resistance training, Intrinsic foot muscle, disability Scale.

Introduction

The strong, fibrous band that runs from the calcaneus and extends distally to the phalanges is called the plantar fascia, and plantar fasciitis is an inflammation of this band.¹ It affects both elderly and

athletic populations and is assumed to be brought on by chronic overload from either lifestyle choices or exercises.²

It makes up to 8% of all injuries related to running among runners, making it one of the most

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frequent injuries. Long-term running, which results in biomechanical overuse and minute tears at the calcaneus seems to be the cause of PF.³

The origin and insertion of the IFM are located inside the feet. During walking and other strenuous exercises, the foot intrinsic muscles actively resist the arch bending. They essentially provide the foot's arch with active support, this is notably evident during the propulsion phase of walking, running, and jumping.⁴

In each phase of gait it provides support, helps to store and release energy. The intrinsic Muscles are the primary source of the basic stability that is necessary for all actions.⁵

The heel strikes the ground as one is walking. The tibia rotates inward and the foot pronates immediately after this contact, both the arch and the plantar fascia are stretched. As a result, the foot can absorb shock and account for differences in the walking surface.⁶

Risk factors include- a sudden increase in running volume or intensity, running on hard surfaces, tight calf muscle, and prolonged standing or walking.⁷ Other risk factors are shortening of the Achilles tendon, and weakness of the plantar flexor and inappropriate footwear.⁸

Symptoms include stabbing pain in the heel at the base of foot, pain worsens in the morning when taking the first few steps. Standing for a long time can also increase the pain.^{9,10}

Athletes may experience a typical kind of morning discomfort that manifests itself due to more intense exercise. They may experience foot stiffness, pain and swelling in the heel.¹¹

Physiotherapy treatment like radiation therapy, stretching, ESWT, Cryotherapy, ultrasound, lasers, and tapes are used, as well as surgical techniques like partial or complete plantar fascia release.^{12,13,14}

Therapeutic Ultrasound uses high-frequency acoustic energy to create thermal or non-thermal effects and helps in reduction of pain.¹⁵

Some studies have shown that intrinsic foot exercise routine helped recreational long-distance runners improve their forward running propulsive forces and enhance the volume of the foot's intrinsic muscle.¹⁶

Studies have shown that a basic progressive exercise routine followed every other day produces better results than plantar-specific. Hence the high-load strength training may help subjects with plantar fasciitis experience quicker pain relief and functional benefits.¹⁷

Thus, the purpose of the study was to compare the effects of High load strength training with ultrasound and Intrinsic muscle strengthening with ultrasound among athletes with Plantar fasciitis.

Aim

The goal is to address both the underlying causes of plantar fasciitis and the associated biomechanical factors that contribute to the condition.

Material and Method

Total of 60 subjects were selected based on the selection criteria and randomly divided into two groups; High load plantar fascia resistance training (HLST) with ultrasound (n=30) and Intrinsic muscle strengthening with ultrasound (n=30). The subjects were assessed for pain intensity using NPRS and using LEFS, for pre and post-test values. Study period : November 2022 to March 2023

Inclusion Criteria

- Age between 25-44 years
- Both gender
- Heel pain in the morning.
- No history of rest pain in heel
- Palpable pain over the medial tubercle of the proximal fascia

Exclusion Criteria

- History of systemic disease
- Rheumatoid arthritis
- Osteoporosis
- Diabetes mellitus
- Bursitis in and around the ankle joint

Outcome Measures

Assessment was performed at baseline (before starting of treatment) and after two weeks of study.

- Numerical Pain Rating Scale (NPRS)
- Lower Extremity Functional Scale (LEFS)

Procedure

Subjects were selected based on the selection criteria, the subjects were explained about the safety and simplicity of the study and informed consent was obtained. As a pre-test measurement the baseline for pain and functional mobility using NPRS and Lower extremity functional scale were used respectively and the same as post-test measurements were measured after 2 weeks of intervention.

High Load Plantar Fascia Resistance Training With Ultrasound : (HLST Group)

The subject was first treated with Ultrasound therapy and then the HLST exercises were initiated.

Ultrasound Protocol: The subjects was positioned in prone lying. Using ultrasound on the skin in a circular motion for approximately 10 minutes, per session for two weeks, with a frequency of 1MHz with 1W/cm² in a pulsed mode with a 1:4 ratio of duty cycle was applied over the plantar fascia.

HLST Exercises:

Patient position: Standing

Procedure:

Set up instruction:

Step 1: The towel should be rolled into a cylinder about 2 cm in diameter; the size should be adjusted to fit your particular foot size.

Step 2: The injured foot toes should be put on the towel about 5 cm away from the foot stool edge as a result of which can enclose the cylinder.

Step 3: Make sure the corner of the foot stool is at the midpoint of the foot; Placing a chair provides support which reduces the risk of fall.

Instruction:

Step 1: Carry out a heel rise in concentric phase for at least 5 seconds while (moving up), isometric phase for 3 seconds (pause at the top of exercise), followed by eccentric phase for 5 seconds (moving down)

Step 2: Raise the heel of the other leg up in the air, if it is possible. Heel lifts can be performed with both feet simultaneously if this is impossible or if both legs are injured.

Week 1 (1-7 days): Perform 3 sets of 12 repetitions using body weight, perform as many repetitions as you can at the beginning of the program.

Week 2 (8-14 days): lowering the repetitions to 10 and increasing the set to 4, by utilizing a backpack filled with books.

Intrinsic Muscle Strengthening With Ultrasound: (IMS Group)

The subject was first treated with Ultrasound therapy and then the IMS exercises were initiated.

Strengthening exercises for the Intrinsic Muscle:

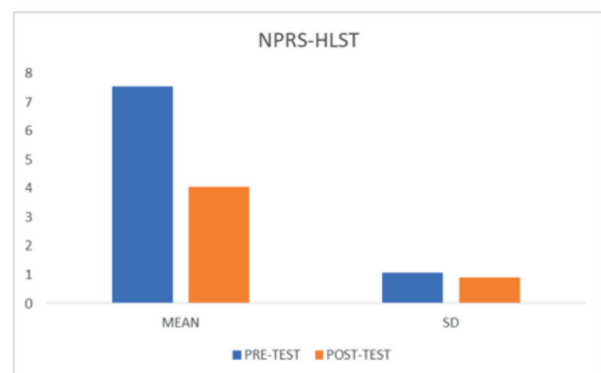
Active Ankle Exercises: Subjects position: Supine lying. Procedure: Active involvement of the subjects, performs ankle movements such as Plantar Flexion, Dorsiflexion, Eversion and Inversion 3 sets, 10 repetition for two weeks.

Towel Curl Up: Subjects position: Sitting in the chair. Procedure: Place the feet flat on the end of the towel, when placing the heel on the ground by curling the towel within the toes for ten minutes per day for two weeks.

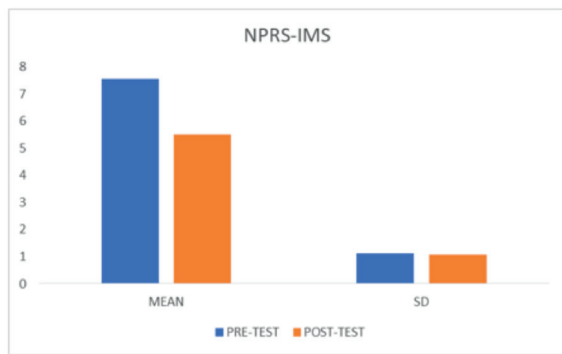
Achilles Tendon Stretching: Subjects position: Walk standing position. Procedure: Place the hands at eye level, against the wall. Keeping the leg back that you want to stretch. Point your toes straight ahead while keeping your back heel on the ground. Actively bend the other leg knee towards the wall, the leg which is behind is kept straight. Bend forward towards the wall, till a stretch is felt in the calf muscle. Perform 5 sets and hold each stretch for 1 min, for two weeks.

Tennis Ball- Plantar Fascia Stretch: Subjects position: Sitting in a chair. Procedure: Tennis ball is used to stretch the plantar fascia. Place the tennis ball under the arch of the affected foot. Roll the ball from heel to toe. Perform it for 10 minutes per day for two weeks.

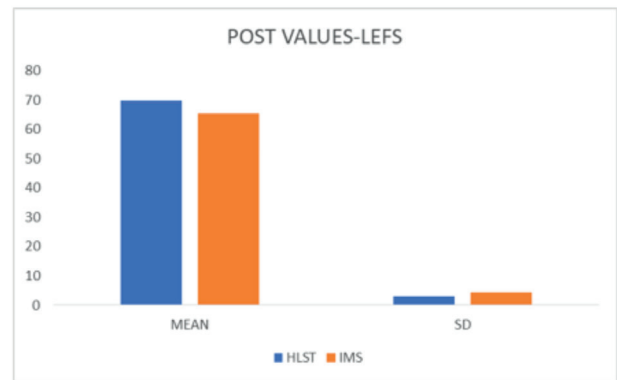
Data Analysis



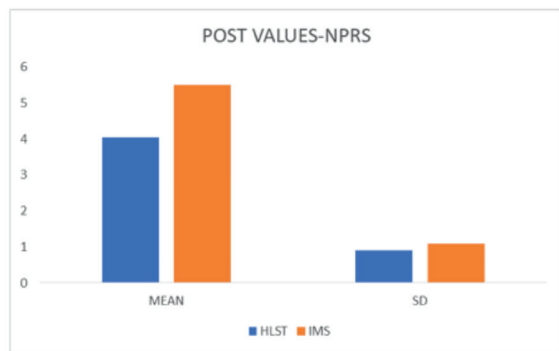
Graph - 1 Pre-test and Post-test values of NPRS of HLST



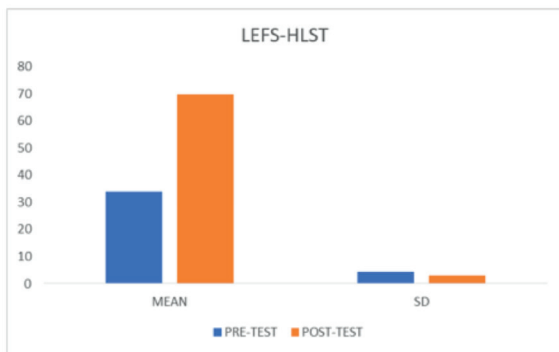
Graph - 2 Pre-test and Post-test values of NPRS of IMS



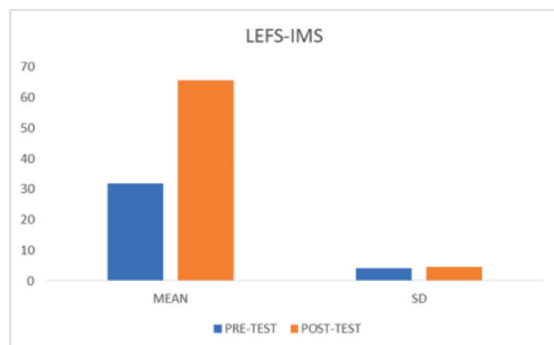
Graph-6 Post-test values of HLST-IMS of LEFS



Graph - 3 Post-test values of HLST-IMS of NPRS



Graph - 4 Pre-test and Post-test values of LEFS -HLST



Graph - 5 Pre-test and Post-test values of LEFS - IMS

Result

In HLST group pre-intervention mean of NPRS was 7.53 and LEFS was 33.90. After treating the subject with HLST with ultrasound, the mean value of NPRS and LEFS is 4.03 and 69.73, which shows statistically significant differences between the groups.

In IMS group pre-intervention mean of NPRS was 7.53 and LEFS was 31.70. After treating the subject with IMS with ultrasound, the mean value of NPRS and LEFS is 5.50 and 65.40, which shows statistically significant differences between the groups.

Based on the statistical analysis, both groups showed improvement in NPRS and LEFS. However, subjects in HLST groups who received HLST with ultrasound showed better improvement in NPRS and LEFS than the subjects in the IMS groups who received IMS with ultrasound.

Discussion

The current study compares the efficacy of HLST with ultrasound and IMS with ultrasound among athletes with plantar fasciitis. Additionally, the focus is to evaluate the efficiency in reducing pain and improving functional outcome. Before and after treatment, the outcomes were evaluated using the NPRS and LEFS. When the responses from the two groups were compared, the result showed a significant difference in High load plantar fascia resistance training with ultrasound group's than the Intrinsic muscle strengthening with ultrasound group.

Douglas L. Miller, et al. states that ultrasound can have an impact not just through thermal but also

through non heating mechanisms such as mechanical stress, gas body activation. Physiotherapy treatment, for instance, the use of misdirected heating can be controlled to treat highly absorbent tissues like bone or tendon without causing damage.¹⁸

Valma J Robertson, et al. states that the therapeutic uses of ultrasound in Physical Therapy Based on Heating, the first clinical use of ultrasound for physical therapy dates back to the 1950s and is frequently referred to as simply “therapeutic ultrasound.”¹⁹ L Machet, et al. states that Physical therapist, applies coupling gel to the handheld transducer and move it around the area of pain in circular motion to treat diseases like inflammation of tendon and bursa in shoulder. Which increases circulation and hastens recovery.²⁰ Rathleff MS, et al. shows that for individuals with plantar fasciitis, this is the first randomized experiment to contrast high-load strength training with plantar-specific stretching. The subjects with HLST was related with a bigger improvement in FFI.²¹ Lynn, et al. states that, it is not able to determine the degree to which strengthening therapies that enhance IFM may assist symptom less or at-risk groups for Plantar Fasciitis/heel discomfort.²² Daeyeol Kim, et al. states that a similar increase in muscle growth with LL and HL and maximum strength readings increased somewhat after high load.²³ Brittany R. Counts, et al. states that muscle contractions alone could activate the muscle enough to stimulate growth of the muscle like High Load training.²⁴ Scott K. Lynn, et al. stated that training the IFM had no effect on the results of the navicular height and static balancing tests.²⁵ Therefore, our study states the HLST is effective for managing Plantar fasciitis symptoms.

Conclusion

Hence the study concludes that both exercises are effective but (HLST) with Ultrasound was more effectual and significant in terms of decreasing pain and improving functional mobility, in managing plantar fasciitis.

Ethical clearance: The ISRB committee of a private hospital and institution in Chennai has provided its clearance for the conduct of human research that complies with all applicable national laws, institutional regulations. ISRB number-03/066/2022/ISRB/SR/SCPT.

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Conflict of interest: The authors state that there is no conflict of interest.

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