

Comparing High-Load Strength Training with Plantar-Specific Stretch and Manual Therapy for Plantar Fasciitis Pain

Divya Bharathy R¹, Kamalakannan M², Ramana K³, Anitha A⁴

¹Postgraduate, ²Associate Professor, ^{3,4}Assistant Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

How to cite this article: Divya Bharathy R, Kamalakannan M, Ramana K et. al. Comparing High-Load Strength Training with Plantar-Specific Stretch and Manual Therapy for Plantar Fasciitis Pain. Indian Journal of Physiotherapy and Occupational Therapy / Volume 18 Special Issue 2024

Abstract

Background: The plantar fascia, a substantial band of tissue running along the bottom of the foot from the heel bone to the toes, is involved in the inflammation and irritation of the condition. One in ten people will experience plantar fasciitis at some point in their lives, making it a prevalent condition.

Purpose: To compare the effectiveness of High-load strength training with plantar stretch and manual therapy on pain and functional recovery in subjects with plantar fasciitis.

Materials and Methods: Thirty participants were randomly assigned to experimental (High-load strength training with plantar stretch) and conventional (manual therapy) groups. The numerical pain rating scale (NPRS), and foot and ankle ability measure (FAAM) were used to evaluate the pre-test. The same test was used to determine post-treatment values after six weeks of treatment.

Results: A significant difference was observed between the experimental and control groups ($P = <0.0001$). High-load strength training and plantar stretching play an important role in patients with plantar fasciitis.

Conclusion: The combination of specific plantar stretches and high-load strength-training activities produce significant functional benefits and rapid reduction of pain.

Key Words: Plantar fasciitis, cross-friction massage, mobilization, high-load strength training exercise, plantar stretch.

Introduction

Many people frequently experience heel discomfort owing to plantar fasciitis. It affects approximately 10% of the population¹. The word "fasciitis" refers to inflammation; however, the fundamental phase of this disorder is degenerative, with no inflammatory cells. It can be identified by soreness at the calcaneal origin of the plantar fascia

and thicker plantar fascia, regardless of whether the condition is known as plantar heel discomfort or plantar fasciitis. Risk factors include a restricted range of ankle dorsiflexion, elevated BMI, and prolonged duration of painful or uncomfortable standing².

The human foot complex is composed of a solid mechanical structure comprising 26 bones, 33 joints, 19 muscles, and 107 ligaments. Heel pain, frequently

Corresponding Author: Divya Bharathy R, Postgraduate, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

E-mail: divyabharathy99@gmail.com

characterized as a stabbing sensation felt in the arch and heel regions of the foot, is one of the most typical symptoms of plantar fasciitis³. Being overweight or obese, being over 40, having high arches or flat feet, and all increase the risk of developing a condition called plantar fasciitis. It can have a considerable impact on our everyday lives given the complexity and crucial function of the foot plays in sustaining our body weight and enabling movement⁴.

Although studies suggest degenerative changes in the plantar fascia, including collagen fibre breakdown, increased production of ground substance protein, concentrated fibroblast proliferation sites, and enhanced vascularity, the histology of plantar fasciitis is unknown⁵

The main issue with PF is heel pain when performing weight-bearing movements, particularly walking, which is the most crucial daily activity. Patients with walking issues may experience limitations in function, employment, social engagement, and quality of life (QoL). Patients with PF who experience painful episodes in the heel frequently avoid putting weight on the foot that is exhibiting symptoms and run the risk of developing antalgic gait.⁶

Combined with Achilles tendon loading, the windlass device applied controlled high-load tensile forces to the plantar fascia. When the metatarsophalangeal joints are flexed to the dorsal position, the windlass mechanism promotes the plantar fascia to tighten⁷. Furthermore, it is possible that a sizable amount of Achilles tendon loading is transferred to the plantar fascia given the close anatomical connections between the Achilles tendon, para-tendon, and plantar fascia. This could imply that considerable tensile strains across the plantar fascia are brought on by the windlass mechanism being activated and strong loading of the Achilles tendon⁸.

This study aimed to determine whether the high-load strength training with plantar stretch and manual therapy were effective in treating plantar fasciitis.

Aim

To compare the effectiveness of High-load strength training with plantar stretch and manual therapy on pain and functional recovery in subjects with plantar fasciitis.

Material and Method

It was an experimental study conducted on 30 subjects with plantar fasciitis, age between 18-35 yrs was taken from Saveetha Medical College and Hospital, Chennai. Convenient sampling Technique using closed- envelope method. The total study duration was 6 weeks from July 2022 to August 2022

Inclusion Criteria:

- Both genders were represented, and the plantar fascia thickness is 4.0 mm or more.
- Pain when the proximal plantar fascia or medial calcaneal tubercle was palpated.
- A minimum of three months prior to enrollment, a history of inferior heel pain.
- Present with heel pain, which is noted as being higher in the morning and reducing while walking continues.

Exclusion Criteria:

- History of systemic diseases.
- Injection of steroids for plantar fasciitis within the last six months.
- Pregnant women (because of changes in weight and potential pedal edema which may result in heel pain).
- People below the age of 18
- The participant's medical history form, including any concerns about their health (cancer, tumor, fracture).

Outcome Measure:

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

- NPRS - Numerical Pain Rating Scale.
- FAAM- Foot and Ankle Ability Measure.

Procedure

Thirty respondents were chosen using a convenient sampling technique, based on the inclusion and exclusion criteria. All individuals provided written informed consent before beginning the study. patients were visiting the physiotherapy OPD for treatment protocol. Assessment of all the included participants was done according to the assessment form. A numerical pain rating scale, and foot and ankle ability measure were used to evaluate

the pre-test and post-test. Using the closed-envelope method, participants were randomly assigned to one of two groups.

Group A: (High-Load Strength Training with Plantar Stretch)

High-load strength training:

The activity was performed in a stairwell or similar area. To ensure that the patient's toes were fully dorsally flexed at the peak of heel rise, the towel was customized. The clients who finished every heel rise include a 2-second isometric stop at the end of a 3-second concentric phase (moving up) and a 3-second eccentric phase (moving down). They started with three sets of 12 maximum repetitions (RM). 12RM is defined as the maximum weight a patient can lift 12 times while using the proper technique and a full range of motion. After two weeks, they decreased the number of repetitions to 10 RM and increased the load by carrying books in a rucksack. Increasing the number of sets to four simultaneously.

Plantar-specific stretch:

Gastrocnemius Muscle stretch:

The individual was advised to lean against a wall with both hands shoulder-width apart. The healthy limb was moved forward, while the injured leg was moved backward. The front leg's knee was flexed, but the back leg's knee remained extended. Throughout the stretch, the heels of both feet remained on the ground. The participant then leaned forward until a maximum stretch in the calf area was felt. The protocol for each participant was a 30-second stretch three times per day for three weeks.

Soleus Muscle stretch:

The individual was told to lean against a wall, hands shoulder-width apart. The healthy limb was moved forward, while the injured leg was moved rearward. Both legs' knees were slightly flexed. Throughout the stretch, the heels of both feet were held on the ground. The participant then leaned forward until a maximum stretch in the calf area was felt. The procedure for each participant was a 30-second stretch three times a day for three weeks.

Group B: (Manual therapy)

Manipulation technique:

Mortise shear: Participants receive only the

eccentric exercise for a single session per day in the total of 5 weeks. The participants used dumbbells as resistance to eccentric exercise (weight 10 RM).

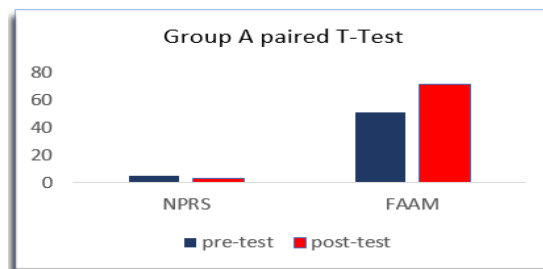
Figure eight foot: The participant was supine, with one hand on the lateral portion of the ankle and calcaneus, held from underneath. The other hand of therapist was put on the midfoot medial aspect, with the thumb on the sole and the fingers on the dorsum. The ankle was kept steady while the forefoot and midfoot were manipulated using a mixture of inversion, abduction, and eversion. The motion is oriented medial to lateral (figure of eight).

Metatarsal shear: The individual was supine at the time of the metatarsal shear. Then the therapist grasped on either side with the thumbs placed on the metatarsal head on the sole of foot. Each affected foot's metatarsal head was translated back and forth.

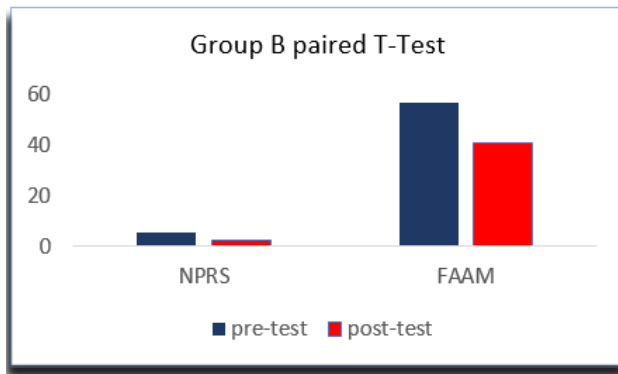
Mobilization techniques:

Hallux mobilization technique: The participant was supine, and the researcher was at the foot of the table, one hand stabilising the foot and the other grasping the patient's hallux, moving it in all directions with a medial shove.

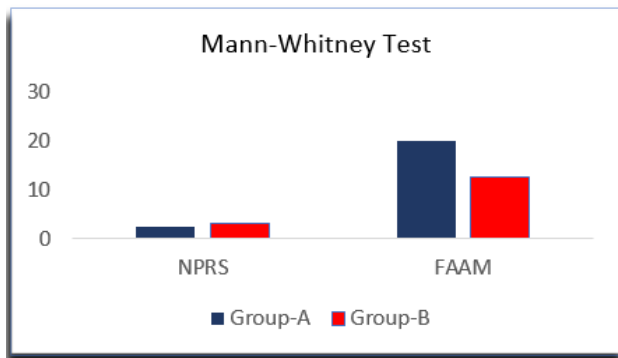
Cross Frictional Massage: For this intervention, participants were positioned supine. Because no lubricant was used, the finger (typically one, but sometimes two) doing the massage did not slide across the skin, but rather took the skin with it, allowing the force to be conveyed straight to the deep tissue being treated. The most painful point of the plantar fascia insertion was identified, and the foot was dorsiflexed to allow the plantar fascia to stretch. A strengthened index finger was then used to perform deep friction massage at the insertion of the plantar fascia. Back and forth 'across the grain' of the tissue, the motion was restricted to about an inch.



INTERPRETATION: Fig.1 shows that the values are extremely statistically significant.



INTERPRETATION: Fig.2 shows that the values are extremely statistically significant.



INTERPRETATION: Fig.3 shows that the values are extremely statistically significant.

Result

- The study was conducted on 30 subjects. Both the groups had 15 subjects each.
- The mean for NPRS of experimental group was 2.3 and for conventional group was 3.1, with p value is <0.0001 and indicating that the results were extremely statistically significant.
- The mean for FAAM of the experimental group was 20.05 and for the conventional group was 12.49, with p value $=<0.0001$ and indicating that the results were extremely statistically significant.

Discussion

The purpose of this study was to compare the effectiveness of high-load strength training with plantar-specific stretch and manual therapy on pain and functional recovery in patients with plantar fasciitis. The study involved 30 people aged 18 to 35. Patients with dominant sides were impacted more than patients with non-dominant sides. Random

group allocation separated the groupings in half. The experimental group did high-load strength training with plantar-specific stretch, while the control group did manual therapy. The trial lasted 6 weeks. During the treatment, there is no drop-out.

When data from the experimental group, which received high-load strength training with plantar-specific stretch, were analysed using paired t-tests within the study population for NPRS, and FAAM, there was a statistical difference in all two measures of outcome, namely pain, and function. Activating the windlass mechanism in the plantar fascia gives proximal stability and helps to minimize tension at the heel, limiting pain stimulation of receptors and reducing pain by neurotransmitters in affected tissue. Decreased pain aids in the improvement of performance and the reduction of impairment. The fair distribution of kinetic energy in the kinetic chain also aids in performance⁹.

When data was analysed using paired t-testing within the group for NPRS, and FAAM for conventional groups that only received manual therapy, there was a statistical difference in all two outcome measures, which are pain, function. As shown in the study by Jarde, enhanced collagen production may assist restore tendon structure and improve patient outcomes in individuals with plantar fasciitis who have degenerative alterations at the plantar fascia. However, the thickness of the plantar fascia was significantly reduced in both groups. However, the majority of patients still demonstrated significant plantar fascial thickening compared to the amount of around 2.2-4.0 mm reported in pain-free individuals¹⁰.

In all situations, the Mann-Whitney test was employed to look for significant differences in post-test results between the control and experimental groups. The experimental and control groups have a considerable difference. As a result, the mean values of the experimental and usual groups diverge substantially. This difference is statistically significant, according to convenient criteria. The positive benefits were clearly greater in the experimental group than in the control group.

According to Yelverton in 2019, the stretching procedure included a dorsiflexion stretch to treat

potential stiffness in the gastrocnemius and soleus muscles. By altering the muscle-tendon unit, passive stretching has been proven to increase ankle ROM. As a result, higher ROM in the direction of passive stretch would be expected. In terms of the overall effect, the combination of stretching and cross-friction appears to be the most beneficial to the patient^{10,11}.

According to Ashley Aisle's research, traumatic hyperaemia increases blood supply to the location, which reduces pain by boosting the rate of Lewis P substance breakdown. Lewis P substance is a neuropeptide that works as a pain transmission mediator in the CNS. As a result, its destruction may have resulted in a reduction in pain, and the following reduction in pain intensity may have aided in the improvement of function. The therapies provided in the reviewed research differ significantly in their approaches to treating plantar fasciitis and enhancing intrinsic foot musculature strength^(12,13).

Dean Huffer and Wayne Hing in 2016. The objective was to critically assess the research on strength training methods for the management of plantar fasciitis and strengthening of the intrinsic foot musculature. Seven articles met the requirements for inclusion. All of the articles displayed a moderate to high level of quality, although their external validity was poor. Comparing the therapy reveals significant differences in the strength training regimens used to treat plantar fasciitis and improve intrinsic strength. The strength of the intrinsic foot muscles and the symptoms of plantar fasciitis should be evaluated in future studies using standardized outcome measures⁽¹⁴⁾. Taping has a benefit of reducing tension and the symptoms of plantar fascia⁽¹⁵⁾.

All outcome indicators in both groups showed significant improvement. There was a slight improvement in pain score, and functional recovery in the experimental group, which was statistically significant. This study concluded that the high-load strength training with plantar-specific stretch significantly improved the function, and pain reduction in patients with plantar fasciitis⁽¹⁶⁾. After four weeks, high-load strength training was associated with better short-term benefits. This could be attributed to adherence to the intervention. We expect that patients will eventually reduce performing their workouts when they reach a pain threshold they

find acceptable. This question was answered by using valid data on long-term compliance.

Conclusion

The study concludes that high-load strength training along with plantar-specific stretch has significant effects in reducing pain and improving function in subjects with plantar fasciitis.

Ethical clearance: The study was approved by the committee of institutional scientific review board. All study participants were informed about the study objectives, and those who agreed to Participate signed informed consent forms.

Funding: This study was a self-funded study.

Conflicts of interest: The authors declare that they have no conflicts of interest.

References

1. Latt LD, Jaffe DE, Tang Y, Taljanovic MS. Evaluation and treatment of chronic plantar fasciitis. *Foot & ankle orthopaedics*. 2020 Feb 5;5(1):2473011419896763.
2. Carek PJ, Edenfield KM, Michaudet C, Nicolette GW. Foot and Ankle Conditions: Plantar Fasciitis. *FP essentials*. 2018 Feb 1;465:11-7.
3. Kamalakannan M, Dass EP. Efficacy of Bare foot Exercise Versus Common Footwear Exercise in Subjects with Plantar Fasciitis. *Research Journal of Pharmacy and Technology*. 2019 Mar 1;12(3):1039-43.
4. Buchanan BK, Kushner D. Plantar Fasciitis. 2022 May 30. *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing. 2023.
5. Goff JD, Crawford R. Diagnosis and treatment of plantar fasciitis. *American family physician*. 2011 Sep 15;84(6):676-82.
6. Viel E, Esnault M. The effect of increased tension in the plantar fascia: a biomechanical analysis. *Physiother Theory Pract*. 1989;5(2):69-73.
7. Fuller EA. The windlass mechanism of the foot. A mechanical model to explain pathology. *Journal of the American Podiatric Medical Association*. 2000 Jan 1;90(1):35-46.
8. Bandara EM, Kularathne WN. Physical Therapy Interventions for Plantar Fasciitis: A Review Article. *International Research Journal of Advanced Engineering and Science*. 2019;4:176-87.

9. Budiman-Mak E, Conrad KJ, Roach KE. The Foot Function Index: a measure of foot pain and disability. *Journal of clinical epidemiology*. 1991 Jan 1;44(6):561-70.
10. Kowal A, Spozowski K. Effectiveness of stretching exercises in conservative therapy of plantar fasciitis (PF). *Journal of Education, Health and Sport*. 2022 Sep 9;12(9):621-31.
11. Caratun R, Rutkowski NA, Finestone HM. Stubborn heel pain: Treatment of plantar fasciitis using high-load strength training. *Canadian Family Physician*. 2018 Jan 1;64(1):44-6.
12. Sarkar B, Mangalam AK, Sahay P. Efficacy of muscle energy technique as compared to myofascial trigger point release in chronic plantar fasciitis: a double blind randomized clinical trial. *Int J Health Sci Res*. 2018;8(6):128-36.
13. Huffer D, Hing W, Newton R, Clair M. Strength training for plantar fasciitis and the intrinsic foot musculature: A systematic review. *Physical Therapy in Sport*. 2017 Mar 1;24:44-52.
14. Sankhe AJ, Shukla G, Rathod VJ, Alagesan J, Manickavasagam I, Kamalakannan M. The effect of Calcaneal taping versus Low dye taping in treating patients with plantar fasciitis-Randomized Clinical Trial. *International Journal of Therapies and Rehabilitation Research*. 2016;5(3):41.
15. Cole C, Seto C, Gazewood J. Plantar fasciitis: evidence-based review of diagnosis and therapy. *American family physician*. 2005 Dec 1;72(11):2237-42.
16. Jarde O, Diebold P, Havet E, Boulu G, Vernois J. Degenerative lesions of the plantar fascia: surgical treatment by fasciectomy and excision of the heel spur. A report on 38 cases. *Acta orthopaedica belgica*. 2003 Jun 1;69(3):267-74.