

Efficacy of Phonophoresis and Foam Roller Stretching along with Intrinsic Muscle Activities in Reducing Pain and Improving Function among Patients with Plantar Fasciitis

Subramani. T.; Kavith. K.; Usha Nandhini. M.

Abstract:-

BACKGROUND: Plantar fasciitis is a heel pain common in middle-aged persons due to inflammation of the plantar fascia. The calcification at the fascia's connection to the calcaneus is the result of recurrent microtrauma. It is imperative to intervene early. To manage the illness, physiotherapy is crucial, involving foam roller stretching and phonophoresis. The combination therapy known as phonophoresis combines workouts aimed at strengthening muscles and employs ultrasound to deliver medicines into tissues.

OUTCOME MEASURES: The Foot Function Index and Visual Analog Scale were used to assess pain severity and impact on duties and activities. A score of 10 indicated extreme pain or inability to function. Participants rated their pain on both scales.

METHODOLOGY: This study was conducted at Thangam Physiotherapy clinic in Perambalur, India, for 3 weeks. The population included patients aged 30 to 45 with plantar fasciitis for two months, free from psychological depression, and well-organized. 15 patients were selected and assessed using an ultrasound apparatus, diclofenal diethylamine, and Aquasonic gel.

PROCEDURE: The patient had phonophoresis, which is a continuous, ten-minute process that uses aquasonic gel and diclofenal diethylamine. The instructions given to the participants involved standing with the afflicted foot on a foam roller and pressing down on the roller until they experienced discomfort. In order to strengthen the feet and ankles, intrinsic foot workouts were carried out, such as toe curls and extensions.

RESULT: A three-week therapy trial for plantar fasciitis revealed a statistically significant difference in the patients' discomfort and function, indicating that these therapies can successfully lessen pain and enhance ankle joint function.

CONCLUSION: Patients with plantar fasciitis who received intrinsic foot exercises, foam roller stretching, and phonophoresis showed considerable improvements in function and pain reduction.

I. INTRODUCTION

The routine activity of locomotion is provided by the extremes of ground reactive forces associated with extremities. As we have seen, people are moving around quickly to meet their needs in daily life, which has made the world too busy looking and moving.

In ambulation, the lower extremities do the majority of the work, with the foot becoming nearly obsolete for smooth locomotion. It also acts as a powerful lever, propelling the body forward and providing good body stability by keeping the foot arches in place.

More than half of middle-aged people get plantar fasciitis as a result of this kind of recurrent stress. An aseptic infection of the plantar fascia is what this plantar fasciitis is. The most typical reason for heel pain is this. Plantar fasciitis is a medical term that refers to "the bottom of the foot, "fascia" is a kind of connective tissue, and it is denoted inflammation.

This is an overuse condition that, for unknown reasons, results in a localized inflammatory response to stressors resulting from repeated microtrauma. This syndrome develops when the tissue is overworked before it has had enough time to recover. Thus, the so-called "heel spur"—a calcification at the plantar fascia's attachment to the calcaneus—continues to cause pain and inflammation over time. The term "heel pain syndrome" is frequently used to describe this illness.

As it worsens, the discomfort could begin to interfere with everyday tasks. A lack of achilles tendon flexibility combined with a history of increased stress on the plantar fascia can result in plantar fasciitis, an inflammation of the fascia. Physiotherapy, through its preventive, therapeutic, and restorative functions, is an important part of this patient's overall management because it allows the patient to participate in daily activities more effectively.

There is a lot of literature that supports phonophoresis as a new upcoming technique in which medically useful drugs are driven into the tissues using ultrasound, which plays an important role in reducing pain in plantar fasciitis. Plantar fasciitis is a significant issue that interferes with daily activities. The importance of early intervention in regaining optimal function cannot be overstated.

Plantar Fasciitis can be treated in a variety of ways. The Outcomes of various therapy methods differ depending on the Clinical situation. Plantar fasciitis is routinely treated with Phonophoresis and foam roller stretching and intrinsic foot activities, are the techniques utilised by physiotherapists. It is impossible to say that one modality is preferable to another.

Foam rolling has recently gained popularity as a self-myofascial release (SMR) method. SMR is thought to operate on the same therapeutic mechanism as conventional "myofascial release." Nevertheless, the person must exert pressure on themselves by using their own body weight. The motion of the foam roller in relation to the tissue structure applies both direct and sweeping pressure to the soft tissues. By breaking adhesions, this generates an increase in tissue extensibility and lubrication of the fascial layer.

Intrinsic muscle strengthening exercises include short foot exercises, heel raises, toe curls, and toe extensions. The Foot Function Index comprises 17 questions regarding the impact of pain on various duties and activities. Using the same scale as the patient assessment, the questionnaire's pain severity was determined; a score of 10 indicated extreme pain or an inability to function.

Visual Analog Scale: Participants were asked to rate their level of pain on a horizontal scale ranging from 1 to 10, as well as on a 10 cm scale with 0 to 10 markings. They were then asked to indicate which mark on the scale best described their level of pain.

Therefore, the goal of this study was to ascertain which combination of phonophoresis and exercise routine would be the most successful course of treatment. Phonophoresis is the term for the drug's passage through the skin and into the subcutaneous tissue while sound waves are present. Due to the fact that it combines medication with ultrasonic therapy, it falls under the category of combination therapy. Any movement, skill, or manoeuvre that requires the use of muscles and is repeated in order to develop or strengthen the body or any of its parts. Therefore, the goal of this study was to assess the effects of phonophoresis, foam rolling, stretching, and intrinsic foot exercises on individuals with plantar fasciitis' range of motion and discomfort.

II. DESIGN AND METHODOLOGY

A. Study Design

Experimental study design was selected to conduct this study.

B. Study Setting

The study took place at Thangam Physiotherapy clinic, Perambalur.

C. Study Duration

The study was conducted for about total of 3 weeks.

D. Sampling Method

The population under research consisted of all subjects who met the inclusion criteria and were between the ages of 30 and 45 for both sexes.

E. Selection Criteria

➤ Inclusion Criteria

- Age range: 30 to 45 years
- Both sexes
- The patient who has had plantar fasciitis for two months.
- Free from psychological depression and well-organized.

➤ Criteria For Exclusion

- Patients with plantar fascia rupture,
- Diabetic mellitus,
- leprosy,
- tarsal tunnel syndrome,
- fat pad syndrome,
- calcaneal spur.

III. METHODOLOGY

Using a practical selection technique, 15 patients with plantar fasciitis were selected, and they completed an assessment proforma with subjective ratings of the type, degree, and medical history of their pain. An explanation of each participant's ailment and the intended treatment plan was provided. Test pain scores were gathered using a visual analog scale, and data was documented.

A. Materials Used

- Ultrasound apparatus
- Diclofenal diethylamine (Voveran)
- Coupling medium (Aquasonic gel)

B. Phonophoresis

The patient received the phonophoresis at first. The patient was lying prone. The foot was raised by placing the pillow on the ankle. On the heel, diclofenal diethylamine and the coupling media aquasonic gel were administered. After the transducer was positioned, it was turned in tiny, concentric circles.

- Mode: Continuous
- Intensity : 0.25 watt/cm².
- Duration : 10 minutes.
- Frequency : 1MHz

C. Foam Roller Stretching

Standing with the injured foot on the foam roller and the unaffected foot on the floor was the recommended position for the participants. The next step was to tell them to keep pushing against the foam roller while moving their foot repeatedly from heel to toe. When they reached their point of greatest discomfort, they were instructed to halt. The participants foam-rolled for 45 seconds, took a 15-second break, and then repeated five times.

D. Intrinsic Foot Activities

Foot exercises involve pressing the tip into the ground, lifting heels, and holding the upper position for 5 seconds. Toe curls involve scrunching toes on a towel, while toe extensions involve lifting toes and spreading them apart to achieve the same height. These exercises help strengthen the muscles in the feet and ankles.

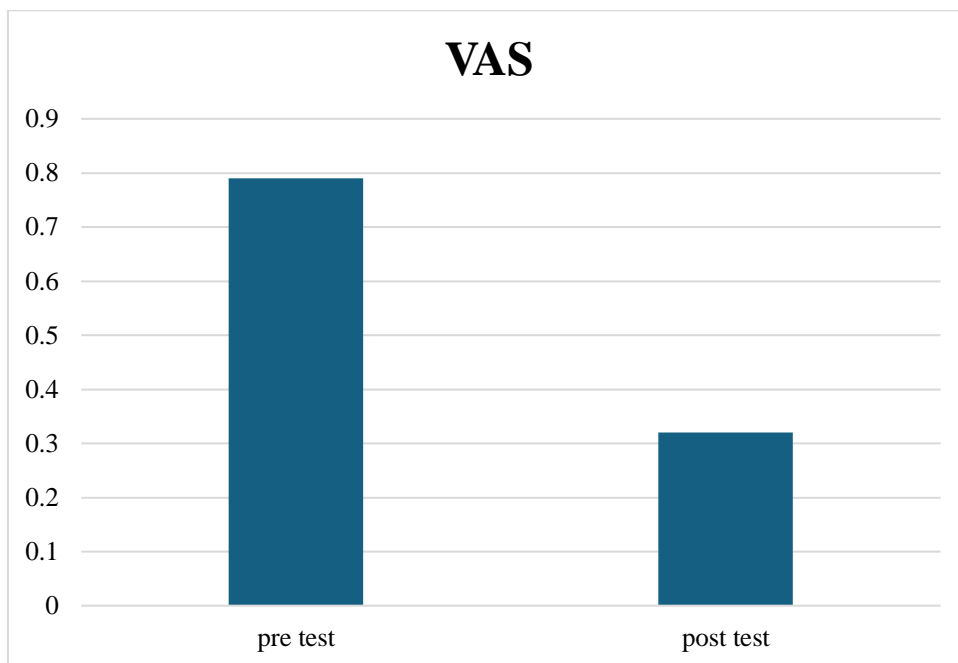
E. Statistic Analysis

Each patient had a three-week course of treatment. The pre and post intervention ratings were recorded on a unique proforma for each and every individual subject.

The investigation's end measures were the ankle joint's range of motion and discomfort. We measured pain and function using the visual analog scale (VAS) and the foot function index (FFI).

Table 1: Pre test and Post test value of Visual analog scale (VAS)

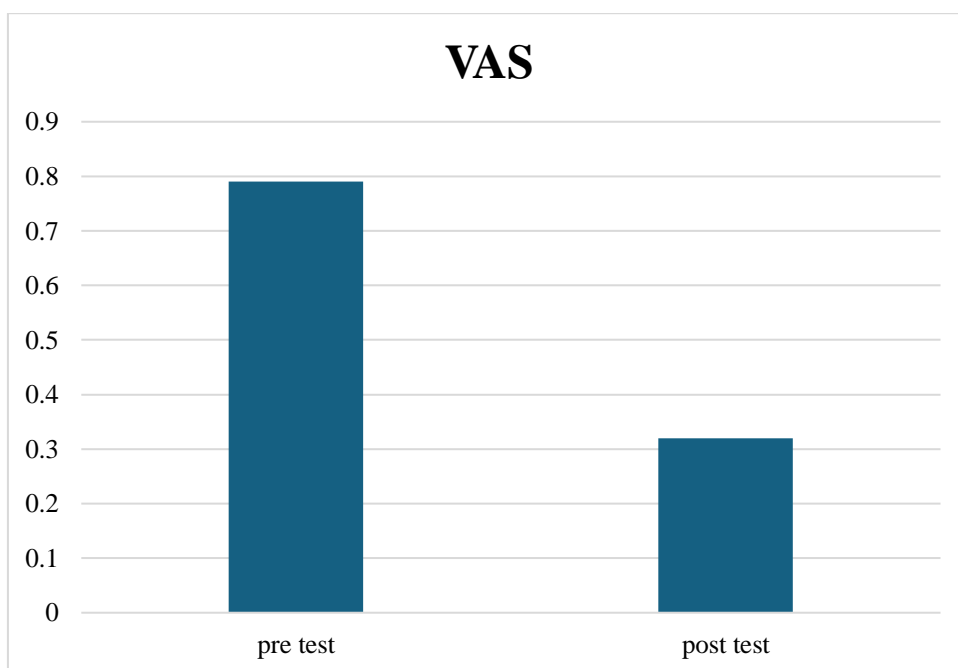
Pre test	Post test	P value
8.32	3.2	<0.001



Graph 1: Comparison of pre test and Post test core of Visual analog scale (VAS)

Table 2: Pre test and Post test value of foot function index (FFI)

Pre test	Post test	P value
0.79	0.32	<0.001



Graph 2: Comparison of pre test and Post test of foot function index (FFI)

IV. RESULT

Patients with plantar fasciitis who underwent phonophoresis, foam roller stretching, and intrinsic foot exercises showed a statistically significant difference ($p < 0.001$) in all the outcome measures in terms of pain relief and function.

V. DISCUSSION

The following are the notable reductions in pain that the various therapy approaches have brought about.

Rather than being a direct result of ultrasound, the penetration of hydrocortisone is caused by the skin being heated by conduction from the warm ultrasound head.

Both thermal and non-thermal impacts of ultrasound can alter the stratum corneum's permeability. Because the stratum corneum contracts differently on either side of the skin, the medication will spread across it when its permeability is enhanced. The tissue absorbs the ultrasonic frequencies and transforms them into heat. The insonate tissues' circulation is aided by this heat. Consequently, the pain-relieving chemical is removed from the affected area. Exercises help to stop the pain from returning, and stretching early on maintains blood flow while reducing discomfort.

Bomana claims that phonophoresis causes a rise in local temperature, which raises the cell membrane's permeability. Nancy N. Byl states that phonophoresis enhances circulation to the sonicated area, dilates entry points like sweat glands and hair follicles, and raises the kinetic energy of molecules in the medication and the cell membrane. Drug molecules have a higher chance of diffusing beyond the stratum corneum and gathering by the dermal capillary network as a result of these physiological changes. Because sound waves are mechanical, they can cause fast vibrations in cells, change the resting potential of the cell membrane, and even break the cell membranes of nearby cells, all of which can aid in the diffusion of drugs.

For this investigation, a small sample size is required in order to draw a reliable result. The study cannot be generalized because it was only conducted for the 30- to 40-year-old age range.

In our study, foam rolling made a statistically significant difference in pain. These findings could be the result of physiological, neurological, or biomechanical mechanisms. Increased blood flow, which removes waste materials, and activation of cutaneous receptors, which reduces nociceptive stimulation, can both contribute to pain relief.

Following soft tissue release, there has been evidence of decreased cortisol levels and increased dopamine and serotonin levels, resulting in pain relief. Furthermore, foam rolling reduces muscle stiffness and tissue adhesion, increasing muscle tendon compliance and soft tissue flexibility.

For subjects who will be in the research longer than two months, a comparable investigation may be conducted. A larger sample size could be used for a comparable investigation. A comparable investigation might be carried out for the age range of under thirty to over forty-five years. Future research might examine the comparative and long-term effects of intrinsic foot exercises, foam rolling, and phonophoresis in the treatment of plantar fasciitis.

VI. CONCLUSION

Plantar fasciitis patients who received phonophoresis, foam roller stretching, and intrinsic foot exercises improved significantly in terms of pain relief and improvement in function.

- **Conflicts Of Interest:** We have no conflict of interest to declare.
- **Source of Fundings:** We did not receive support from any organization for the submitted work.
- **Ethical Clearance:** Approval was obtained from local ethics committee.

REFERENCES

- [1]. Radford JA, Landorf KB, Buchbinder R, Cook C. Effectiveness of low-dye taping for the short-term treatment of plantar heel pain: a randomised trial *BMC Musculoskelet. Disord.* 2006 7(1):1-7
- [2]. Osborne HR, Allison GT. Treatment of plantar fasciitis by LowDye taping and iontophoresis: Short term results of a double blinded, randomised, Placebo controlled clinical trial of dexamethasone and acetic acid. *Br J Sports Med* 2006;40(6):545-9.
- [3]. Orter D, Barrill E, Oneacre K, May BD. The Effects of duration and frequency of Achilles tendon stretching on dorsiflexion and outcome in painful Heel syndrome: A randomized, blinded, controlled trial. *DiGiovanni BF, Nawoczenski DA, Lintal ME, Moore EA, Murray JC, Wilding GE, Baumhauer JF. Tissue-specific plantar fascia-stretching exercise enhances outcomes in patients with chronic Heel pain: A prospective, randomized study. J Bone joint Surg Am* 2003;85(7):1270-7.
- [4]. Tsai CT, Chang WD, Lee JP. Effects of short-term treatment with kinesiotaping for plantar fasciitis. *J Musculoskeletal Pain.* 2010;18(1):71-80.
- [5]. Hyland MR, Webber-Gaffney A, Cohen L, Lichtman SW. Randomized controlled trial of calcaneal taping, sham taping, and plantar fascia stretching for the short-term management of plantar heel pain. *J Orthop Sports Phys Ther.* 2006;36(6):364-371.
- [6]. Lemont H, Ammirati KM, Usen N. Plantar fasciitis: a Degenerative process (fasciosis) without inflammation. *J Am Podiatr Med Assoc* 2003;93:234-7.
- [7]. Kavitha K, Usha Nandhini M, Kalpana K, Priyanka N, H. M., Deepanbabu M. The effectiveness of conventional therapy with intrinsic foot muscle exercise versus conventional therapy with gluteal muscles strengthening exercise on pain and improving balance among pes planus

- patients.ijdsr.org. October 2023,volume 8, issue 10:527-538
- [8]. Petraglia F, Ramazzina I, Costantino C. Plantar fasciitis In athletes: diagnostic and treatment strategies. A Systematic review. *Muscles Ligaments Tendons J* 2017;7:107-118.
- [9]. McKeon PO, Hertel J, Bramble D, Davis I. The foot core system: A new paradigm for understanding intrinsic foot muscleFunction. *Br J Sports Med* 2015; 49(5):290
- [10]. Tahririan MA, Motififard M, Tahmasebi MN, Siavashi B. Plantar fasciitis. *J.Res Med Sci* 2012;17:799-804.
- [11]. Bommanan D, Mennon GK, Okuyama H, Elias PM, GuyRH. Sonophoresis: II. Examination of the mechanism (s) of Ultrasound enhanced transdermal drug delivery, *Pharm. Res* 1992;9:1043-1047.
- [12]. Daniel P. Moore, Rakesh Parikh, Sanford H.Vernick, Gregory F. Petroski, William H. Pryor,Steven C. Kazmierczak. "Topical morphine in a Canine model: A pilot study", *Archives of Physical Medicine and Rehabilitation*, 1998.
- [13]. Headlee DL, Leonard JL, Hart JM, Ingersoll CD, Hertel J. Fatigue of the plantar intrinsic foot muscles increases navicular drop. *J ElectromyogrKinesiology* 2008; 18(3):420-5.
- [14]. Siddharth Singh, Vilas Sabale, PrabhavAgarwal, Shambhavi Ghotankar. "Outcomes of Percutaneous Nephrostomy vs. Double J stenting in the Treatment of Infectious Hydronephrosis", *Indian Journal of Surgery*,2023.
- [15]. Nancy N. Byl. The use of Ultrasound as an Enhancer for transcutaneous Drug Delivery: Phonophoresis. *PhysicalTherapy* 1995, 75(6)
- [16]. Tae- HO k, Eun -Kyung K, DO - YOUNG J. The effect of arch support taping on plantar pressure and navicular drop inHeight subjects with excessive pronated foot during 6 weeks. *J. Korean Socphys Med* 2011; 6(4); 489-96
- [17]. Laura A. Molloy. "Managing chronic plantar Fasciitis: When conservative strategies fail", *Journal of the American Academy of Physician Assistants*, 2012
- [18]. Ciccone CD, Leggin BG, Callamaro JJ. Effects of Ultrasound and trolamine salicylate phonophoresis on Delayed-onset muscle soreness. *Physical therapy* 1991;71(9):666-75.
- [19]. Kuhar S, Subhas K, Chithra J. Effectiveness of Myofascial release in Treatment of Plantar fasciitis A RCT 2009, 1(3).
- [20]. Jason C. Senkbeil, Kathleen Sherman-Morris Walker Skeeter, Cole Vaughn. "Tornado Radar images and Path Directions: An Assessment of Public Knowledge in the Southeastern United States", *Bulletin of the American Meteorological Society*, 2022
- [21]. Davis PF, Severud E, Baxter DE. Painful heel syndrome:Results of nonoperative treatment. *Foot Ankle Int* 1994;15:531-535.
- [22]. Joshua Dublin. Evidence based treatment of plantar fasciitis - Review of literature. *Sports therapy*, March 2007.
- [23]. *Foot and Ankle Disorders*", Springer SciencAnd Business Media LLC, 2022.
- [24]. Sunny Yadav, Shikha Malik, Saru Bansal."Effect of Foam Rolling along with Selfstretching on Pain and Range of Motion inPlantar Fasciitis Patient- A Quasi-experimentalStudy", *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*, 2022.
- [25]. Anat Shashua, Shlomo Flechter, Liat Avidan,Dani Ofir, Alex Melayev, Leonid Kalichman."The Effect of Additional Ankle and MidfootMobilizations on Plantar Fasciitis: ARandomized Controlled Trial", *Journal ofOrthopaedic & Sports Physical Therapy*, 2015.
- [26]. James Dunning, Raymond Butts, NathanHenry, Firas Mourad et al. "Electrical dryNeedling as an adjunct to exercise, manual Therapy and ultrasound for plantar fasciitis: A Multi-center randomized clinical trial", *PLOS ONE*, 2018.