

Original Research Article

## Comparative Study of Plantar Fasciitis Management by Ultrasound with Exercises and Exercises Alone

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### ABSTRACT

**Study Objective:** Comparative study of plantar fasciitis management by Ultrasound with Exercises and Exercises alone.

**Design:** Pre & post test control group design.

**Method and Measurements:** 40 patients [Male=20, Female=20] from Outpatient department, who were diagnosed with plantar fasciitis pain, were randomly assigned to either group A receiving US and Exercise combined (Ultrasound was applied at a continuous wave frequency of 1 MHz and intensity of 1W/cm<sup>2</sup> over the plantar aspect of the affected heel for a period of 5 minutes) and group B receiving Exercise alone. Treatment was given for 3 times in a week for the period of 4 weeks. Before treatment and after 4 weeks of treatment pain was assessed on VAS and MPQ.

**Results:** Subjects in-group A that received US and exercise showed greater Improvement in pain compared with the exercise group on 4th week compared with pre treatment. (p<0.050)

**Conclusion:** The result of study suggests that both US and exercise improves the symptoms of plantar fasciitis pain. Exercise alone improved the pain symptoms but was too small to reach satisfactory outcome for patients. Based on these results US and Exercise should be the treatment of plantar fasciitis pain rather than Exercise alone.

**Keywords:** Continuous Ultrasound, Exercise, plantar fasciitis.

### INTRODUCTION

Plantar fasciitis is a common cause of heel pain in adults. It is estimated that more than 1 million patients seek treatment annually for this condition, with two-thirds going to their family physician. Plantar fasciitis is thought to be caused by biomechanical overuse from prolonged standing or running, thus creating micro tears at the calcaneal entheses. Some experts have deemed this condition “plantar fasciosis,” implying that its etiology is a more chronic degenerative process versus acute inflammation.<sup>[1]</sup>

Plantar fasciitis (PF) is an overuse injury causing inflammation at the origin of the plantar fascia and surrounding

perifascial structures, such as the calcaneal periosteum, which affects about 10% of the population at least in one moment in life. It is the most common clinical problem that causes inferomedial heel pain in adults. Inflammation occurs by repeated microtraumas at the origin of plantar fascia over the calcaneal medial tuberosity. Traction forces during the support phase on gait lead to an inflammatory process, resulting in fibrosis and degeneration.<sup>[2]</sup>

The disease is accelerated or become more severe as a result of flexibility lost, as in calcaneal tendon retraction, of excessive drills, fatigue, fascial inextensibility, and poor mechanics. The most important clinical aspect is localized pain at medial calcaneal

tuberculum during morning support. [3]

## **MATERIALS AND METHODS**

### **Subjects**

40 patients [M=20, F=20] from Outpatient department, who were diagnosed with with plantar heel pain, [4] were randomly assigned to either group A receiving US and Exercise combined and group B receiving Exercise alone. Treatment was given for 3 times in a week for the period of 4 week. Before treatment and after 4 weeks of treatment pain was assessed on VAS and MPQ.

**Design:** Study utilized pre & post test control group design.

### **Equipments & Measuring Tools**

Examination table, US machine, Towel, VAS, Pillow, Tennis Ball,

### **Interventions**

All treatments were delivered, three times per week, for 4 weeks. All treatment, ultrasound delivery, and stretching exercises for calf muscles and plantar fascia and strengthening exercises for dorsiflexors, plantar flexors and intrinsic muscles of the foot was provided by qualified and experienced physiotherapist who were instructed by the researcher about study protocol. [5]

### **Inclusion criteria** [2,6]

1. Plantar heel pain
2. Pain provoked by taking the first few steps in the morning, by standing after prolonged sitting,
  1. and/or by prolonged standing
  2. Tenderness localized to the origin of the plantar fascia on the medial calcaneal tubercle.

### **Exclusion criteria** [2,6]

1. Previous foot surgery
2. Foot trauma within the previous three months
3. Tarsal tunnel syndrome
4. Loss of plantar foot sensation
5. Foot pathology other than plantar fasciitis including tendonitis, bursitis, or calcaneus fracture
6. Generalized inflammatory disorders associated with the diagnosis of

plantar fasciitis including rheumatoid arthritis, ankylosing spondylitis, Reiter's disease, gout, or lupus

7. Previous treatment of plantar fasciitis with dorsiflexion night splints and/or medial arch supports
8. Inability or unwillingness to discontinue current treatment for the purpose of plantar fasciitis
9. Participation in a worker's compensation program
10. Age of less than eighteen years

### **Ultra Sound treatment procedure and technique**

Ultrasound was applied at a continuous wave frequency of 1 MHz and intensity of 1W/cm<sup>2</sup> over the plantar aspect of the affected heel for a period of 5 minutes. [5]

### **Placebo Ultrasound**

Patients in placebo group received same duration of Ultrasound with the apparatus switched on (so that patients see lights flashing on machine) but without any current output. In this way, patients were blinded for Ultrasound treatment. [7]

### **Exercise therapy**

**Plantar-specific stretching:** Plantar-specific stretching the plantar-specific stretching protocol. Patients were instructed to perform this exercise while sitting by crossing the affected leg over the contralateral leg. Then, while using the hand on the affected side, they were instructed to place the fingers across the base of the toes on the bottom of the foot (distal to the metatarsophalangeal joints) and pull the toes back toward the shin until they felt a stretch in the arch of the foot. They were instructed to palpate the plantar fascia during stretching to ensure tension in the plantar fascia. Patients were instructed to perform the stretch 10 times, for 10 s, three times per day. In the case of bilateral pain, they were instructed to perform the plantar-specific stretching on both feet. [8]



Fig1: Plantar-specific stretching

### High-load strength training:

High-load strength training consisted of unilateral heel raises with a towel inserted under the toes to further activate the windlass mechanism. The patients were instructed to do the exercise on a stairway or similar location. The towel was individualized, ensuring that the patients had their toes maximally dorsal flexed at the top of the heel rise. The patients were instructed to perform the exercises every second day for 3 months. Every heel rise consisted of a 3-s concentric phase (going up) and a 3-s eccentric phase (coming

down) with a 2-s isometric phase (pause at the top of the exercise). The high-load strength training was slowly progressed throughout the trial. They started at a 12 repetition maximum (RM) for three sets. 12RM is defined as the maximal amount of weight that the patient can lift 12 times through the full range of motion while maintaining proper form. After 2 weeks, they increased the load by using a back pack with books and reduced the number of repetitions to 10RM, simultaneously increasing the number of sets to four. After 4 weeks, they were instructed to perform 8RM and perform five sets. If they could not perform the required number of repetitions, they were instructed to start the exercises using both legs until they were strong enough to perform unilateral heel raises. They were instructed to keep adding books to the backpack as they became stronger. This information was given to patients as a one-page manual including pictures of the exercises together with a description of progression. In the case of bilateral pain, they were instructed to perform the high-load strength training with both limbs. <sup>[9]</sup>



Fig 2: Heel raises were performed with a towel under the toes to increase dorsal flexion of the toes during heel raises.

Strengthening exercises of ankle dorsiflexors, plantar flexors, and intrinsic muscles of the foot (toe flexors) were applied from the same supine lying position, with the foot outside the edge of the bed. Stabilization, just above the ankle joint, was

provided by the therapist hand and resistance was applied on the dorsum of the foot by the other hand just below toes for ankle dorsiflexors. For plantar flexion, the patient heel was cupped on the therapist hand, and resistance was applied by

therapist forearm. For toes flexors, stabilization was just proximal to the toes, and resistance was applied on the plantar surface of the toes. Each exercise was done in three sets; each set 10 repetitions, with rest in between sets. [10,11]

Roll plantar fascia with ball. Consider keeping at the bedside and performing before going to sleep and before taking first steps in the morning. Roll plantar fascia for 1 minute 3 times with 30 seconds of rest in between.



Fig 3: Ball rolling exercise

Calf and arch stretch using a towel. Consider keeping the towel near the bedside and performing before going to sleep and before taking first steps in the morning. Pull back on foot for 30 seconds 3 times with 30 seconds of rest in between. [12]



Fig 4: Calf and arch stretch using a towel

Placed towel on smooth floor surface. Step on towel with foot flat on the

end of the towel. Keeping the heel on the floor, pull the towel toward the body by curling the towel with the toes. [3]



Fig 5: Towel curl

Pain was assessed by VAS and MPQ before starting treatment and on 4<sup>th</sup> week of post treatment session.

In VAS Patients were asked to describe their pain status on a 10cms line where left end represents no pain and right end represents maximum pain.

MPQ consists of a set of pain descriptor list, and are read to a patient with the explicit instruction that he chooses only those words which described his feelings and sensations at that moment.

PRI is based on the rank values of words. In this scoring system, the word in each subclass implying the least pain is given a value of 1, the next word is given a value of 2, etc. The rank values of words chosen by a patient are summed to obtain a score separately for the sensory (subclass 1-10), affective (subclasses 11-15), evaluative (subclass 18) and miscellaneous (subclasses 17-20) words, in addition to provide a total score (subclasses 1-20). The PPI is recorded as a number and is associated with the following words 1-mild, 2-discomforting, 3-distression, 4- horrible, and 5-excruciating.

#### Data Analysis

All Data was analyzed using statistical test-pair t test. Mean and SD for pre R<sub>x</sub> and after 4<sup>th</sup> week Rx pain values were calculated for each group. Significance was accepted at 0.05 level of probability.

## Findings

**Table 1: Mean and SD of age between group A and B.**

	Group A (N=20) Mean± SD	Group B (N=20) Mean± SD
Age ( Yrs)	47.45±14.32	44.75±15.23

In this study 40 patients participated with a mean age of 47.45±14.32 in group A (M, n=10; F, n=10) and 44.75±15.23 in Group B (M, n=10; F, n=10) ranging from 25 to 65 years (Table 1). Sex was matched in both the groups.

Mean reduction in PRI, PPI &VAS of group A & B with p & t values:

**Table 2: Mean reduction in PRI values between group A and B. Mean and standard deviation at pre treatment, 4<sup>th</sup> week and pre treatment to 4<sup>th</sup> week with t and p values.**

Groups	Pre R <sub>x</sub>	4 <sup>th</sup> week	Pre R <sub>x</sub> to 4 <sup>th</sup> week		
			Mean± SD	Paired t value	P value
Group A (N=20) Mean± SD	22.31±4.10	2.12±1.30	16.71±4.11	13.75	0.003
Group B (N=20) Mean± SD	17.22±4.39	7.55±3.31	7.71±2.42	10.55	0.020

**Table 3: Mean reduction in PPI values between group A and B. Mean and standard deviation at pre treatment, 4<sup>th</sup> week and pre treatment to 4<sup>th</sup> week with t and p values.**

Groups	Pre R <sub>x</sub>	4 <sup>th</sup> week	Pre R <sub>x</sub> to 4 <sup>th</sup> week		
			Mean± SD	Paired t value	P value
Group A (N=20) Mean± SD	4.55±0.60	0.48±0.51	2.64±0.83	10.38	0.010
Group B (N=20) Mean± SD	4.14±0.62	1.45±0.63	1.89±0.67	10.29	0.030

**Table 4: Mean reduction in VAS values between group A and B. Mean and standard deviation at pre treatment, 4<sup>th</sup> week and pre treatment to 4<sup>th</sup> week with t and p values.**

Groups	Pre R <sub>x</sub>	4 <sup>th</sup> week	Pre R <sub>x</sub> to 4 <sup>th</sup> week		
			Mean± SD	Paired t value	p value
Group A (N=20) Mean± SD	7.63±1.22	0.45±0.45	6.51±1.28	17.86	0.008
Group B (N=20) Mean± SD	6.61±1.45	2.83±1.15	2.97±0.89	10.77	0.019

### Mean reduction in VAS (Table 4)

Both groups had significant difference in pre R<sub>x</sub> to 4<sup>th</sup> week values as t and p values for group A and B were t=17.86, p=0.008 and t=10.77, p=0.019 respectively (table 4).

Thus, it can be concluded from above results that both interventions (US and Exercise) were effective in Pain reduction as reflected by VAS and MPQ. But, Patients (group A) that received US and Exercise showed greater improvement in pain compared with Exercise (group B) on 4<sup>th</sup> week compared with pre treatment.

## DISCUSSION

The plantar fascia is a thick fibrous aponeurosis that originates at the medial calcaneal tubercle and helps support the arch of the foot (Figure 1). It is thought been introduced to de-emphasize the idea that inflammation is the cause of pain.<sup>3</sup>

### Mean reduction in PRI (Table 2)

Both groups had significant difference in pre R<sub>x</sub> to 4<sup>th</sup> week values as t and p values for group A and B were t=13.75, p=0.003 and t=10.55, p=0.020 respectively (table 2).

### Mean reduction in PPI (Table 3)

Both groups had significant difference in pre R<sub>x</sub> to 4<sup>th</sup> week values as t and p values for group A and B were t=10.38, p=0.010 and t=10.29, p=0.030 respectively (table 3).

Histopathologic studies have shown that patients with diagnosed plantar fasciitis have more disorganization of fibrous tissue similar to degenerative tendinosis rather than inflammation. All of the risk factors can be accessed on the basis of history and physical alone and help to guide appropriate treatment. Imaging is typically not necessary for the diagnosis but may be helpful if there are other likely reasons for heel pain included in the differential diagnosis. [13]

This study analysed the effects of Medial arch support with ultrasound therapy and exercises in the management of plantar fasciitis for increasing passive range of motion of ankle joint and improving functional independency of foot. Kogler et al. reported that foot orthoses designed to provide total contact to the plantar surface of the foot in combination with proper footwear significantly decreased the strain

on the plantar fascia during weight bearing. [14]

This study was designed to obtain a more thorough understanding of stretching protocols for increasing ROM and how the use of therapeutic physical agents can affect these protocols in the clinical setting. According to the data, in a treatment lasting 4 weeks or less, hot packs, active exercise, or ultrasound prior to stretching or stretching alone achieved similar results in increasing ankle dorsiflexion AROM. In terms of cost-effectiveness, stretching alone would increase AROM sufficiently over a 4-week time frame compared with hot packs, exercise, or ultrasound with stretching. If the treatment extends over a period of 6 weeks, then ultrasound is the intervention of choice for increasing the extensibility of the plantar-flexor muscles. If increases in ankle dorsiflexion PROM and treatment duration of at least 2 weeks are desired, then ultrasound is the treatment of choice. When treating a patient for 4 weeks, however, stretching alone or hot packs, ultrasound, or active exercise warm-up prior to stretching will increase ankle dorsiflexion PROM equally. If the treatment duration is 6 weeks in length, the clinician would have the option of choosing stretching, hot packs, or ultrasound prior to stretching to produce equivalent gains in ankle dorsiflexion PROM. [15]

These all study findings support the results of the present study.

## CONCLUSION

This study has shown that for the group of patients involved US and Exercise is effective in the treatment of plantar fasciitis than Exercise alone.

### Interests of conflict reference

Some limitations of this study when no follow up was done by patient and variable patient mass. To reach significant conclusion further prospective study with comparable patient variables like ROM, Muscle force, disability & muscle strength. Further research is clearly indicated to establish if there is effectiveness of exercise

alone in the treatment of plantar fasciitis. There was an improvement of pain in the plantar fasciitis, but it was too small to reach a satisfactory outcome for patient, most of whom required further physiotherapy to reduce their symptoms. This is a dire necessity in the field since a number of physiotherapy approaches are in vogue. So, further research can be done with a large sample using the same protocol to study which modality is more effective in treatment of plantar fasciitis.

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