

Comparison of laser versus ultrasound therapy in management of chronic plantar fasciitis

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Abstract

The most common cause of heel pain is “plantar fasciitis” which is accountable for 80% of the cases. There are limitations in its treatment availability. The non-surgical treatments although have shown promising response and satisfactory outcomes. Such two treatments viz. laser and ultrasound therapy were studied and compared in plantar fasciitis patients. In the present study 100 plantar fasciitis patients recruited and divided into two groups with 50 patients each, one group was treated with laser therapy and the other with ultrasound therapy. The outcomes were reported in the form of Visual Analog Scale (VAS) and Foot Function Index (FFI) scores. There was a promising improvement noted in VAS score and FFI score when compared within the groups. The comparison of these scores between the groups revealed laser therapy to be more effective in reducing the symptoms than the ultrasound therapy, as the VAS and FFI scores were significantly improved in laser therapy group compared to ultrasound therapy. So here we conclude the laser therapy is more effective in relieving from the symptoms of plantar fasciitis as compared to ultrasound therapy.

Keywords: Plantar fasciitis, Heel pain, Heel spur, Laser therapy, Ultrasound therapy

Introduction

Plantar fasciitis is caused due to degenerative irritation which is at the attachment of the plantar fascia on the medial process of the calcaneal tuberosity. It can cause severe pain, which could impede daily activities. Typically, plantar fasciitis is exhibited by a piercing pain confined to the anterior aspect of the calcaneus. This condition is partially associated with a heel spur (exostosis); though, bony heel spurs may be witnessed in individuals without any plantar fasciitis symptoms, whereas numerous patients with plantar fasciitis do not have a spur⁽¹⁾.

Obesity, wear-out from prolonged standing and increased exercise are some of the risk factors for plantar fasciitis. Inward rolling of the foot, Achilles tendinitis, and a sedentary lifestyle are also some of the constituents^(2,3). Based on signs and symptoms essentially decide the diagnosis; ultrasound is known to

be beneficial⁽⁴⁾. Ankylosing spondylitis, heel pad syndrome, osteoarthritis and reactive arthritis are few other conditions with comparable symptoms⁽⁴⁻⁶⁾.

Generally extending the foot and toes upwards pointing to the tibia is known to induce pain, which mainly develops gradually, and affects both feet in roughly one-third of cases^(2,3,7). The existence of areas of hypervascularisation and hypovascularisation in the fascia has also been hypothesised^(8,9). Clinically local tenderness, pain and associated morning heel stiffness that improves as the patient perform daily activities are trademarks of this disorder. A series of interventional and conservative approaches have been proposed and are accepted based on individual experiences. However, no consensus is at hand with regards to reproducible conclusions. Many non-operative approaches include rest, sole inserts, contrast bath, braces, stretching and strengthening exercises, night

splints, physical therapy, non-steroidal and steroidal anti-inflammatory medication⁽¹⁰⁾.

There are currently various invasive and non-invasive management strategies for plantar fasciitis, such as oral analgesics, non-steroidal anti-inflammatory drugs, physical therapy, corticosteroid injection, stretch exercise, and foot orthotics, botulinum toxin injection and platelet-rich plasma injection^(11,12). In a short period of time corticosteroid injection might effectively relieve pain proclaimed by numerous studies⁽¹³⁾, serious negative situations may be promoted by plantar fasciitis rupture. As there are limited treatments available for plantar fasciitis, it can be quite challenging to treat the condition. Fortunately, most patients with this condition eventually responded well to non-surgical treatment with satisfactory outcomes⁽¹⁴⁾.

Intralesional autologous blood injection has more advantages in lowering pain and tenderness in chronic plantar fasciitis, but corticosteroid is far superior in terms of speed and in the extent of improvement⁽¹⁵⁾. Setting the highest tolerable energy output within medium intensity ranges is the ideal option when applying FSW therapy to plantar fasciitis. RSW therapy is considered an appropriate alternative because of its reduced price and probably better effectiveness⁽¹⁶⁾. The efficacy of low-intensity ESWT is worthy of recognition. The short-term pain relief and functional outcomes of this treatment are satisfactory. However, owing to the lack of a long-term follow-up, its long-term efficacy remains unknown⁽¹⁷⁾.

Although both treatment alternatives appear to be more effective than placebos in easing plantar heel pain, the most potent treatment is currently uncertain. Therapeutic ultrasound is one of the most extensively used electrical devices among physical therapists globally. Therapeutic ultrasound increases tissue metabolism and temperature, increases blood circulation, softens the tissues, increases the permeability of the cell membranes, increases the chemical activity of the tissues, and modulates the molecular structures and the rate of protein production and pulsation - all conceivably influencing the rate of tissue recovery⁽¹⁸⁾.

Intense therapeutic ultrasound (ITU) is a recently developed ultrasound-based therapy in which sound waves are directed towards selected musculoskeletal tissue. Clinical researches have exhibited that more than 85% of patients receiving the treatment on subcutaneous tissue, showed promising improvement in skin lifting with little to no pain, inflammation, erythema or scarring⁽¹⁹⁾. Histologically, it has been demonstrated that ITU encourages the generation of dermal collagen with thickening of the dermis and straightening of the elastic fibers in the reticular dermis⁽²⁰⁾.

Photochemistry principles based therapy i.e. laser therapy (LT) that militate via nonthermal or photochemical effects on cells. Considerable studies have reported that LT could cure various diseases, including subacromial impingement syndrome, acute and chronic pain, oral mucositis, stroke, temporomandibular disorder, lymphedema and carpal tunnel syndrome. In recent years, LT has been used to relieve pain caused by plantar fasciitis. Cinar et al. reported that LT could remarkably improve walking distance and walking surface⁽²¹⁾. In addition to that, ultrasound imaging results proposed that after LT intervention, Plantar Fascia thickness was significantly reduced when compared with that in the placebo group⁽²²⁾.

Hence the present prospective comparative study was done at our tertiary care center to compare the management of plantar fasciitis by ultrasound therapy and laser therapy and assess and compare the improvement in symptoms and functional capacity in patients treated by ultrasound therapy and laser therapy.

Material and methods

The present prospective randomized clinical study was carried out between the period of 1st September 2018 to 31st July 2020, in Department of Orthopaedics and Physiotherapy, Bharati Vidyapeeth (DTU) Medical College, Pune, to compare the efficacy of Laser Vs ultrasonic therapy as treatment of plantar fasciitis. The study was approved by institutional ethics committee.

Total of 100 Patients with plantar fasciitis attending OPD during this period after taking informed consent

form were recruited from the department of Orthopaedics and department of physiotherapy. Fifty patients were treated for plantar fasciitis by laser (TECHNOMED with 655nm wavelength) therapy and other 50 were treated with ultrasound (TECHNOMED with 3MHz frequency) therapy.

All symptomatic patients since 4-6 weeks who have failed to respond to drug therapy reporting to Orthopaedics Department of Bharati Hospital were recruited for the study. While the patients with neurological condition, systemic diseases, local skin condition/infection, lower limb fractures and pregnancy were excluded from the study.

After ethical committee approval and informed consent, patients fulfilling both inclusion and exclusion criteria were included in the study. Patient distribution was done alternatively after diagnosis by a senior consultant, 50 patients were treated with Laser therapy with exercises and 50 were with ultrasonic therapy with exercises.

Laser therapy

For Laser therapy 12 min scanning with wavelength 655nm and 5 min probe with infra-red rays with wavelength 655nm were used for 5-7 sessions with special glasses for protection from laser rays.

were assessed at the time of diagnosis, 4 weeks, 8 weeks and 12 weeks after the treatment with Laser or ultrasonic therapy for pain relief and function. Assessment was done on basis of function foot index on a scale 0 to 10 for pain, difficulty in walking and activity limitation. The FFI is a self-administered index consisting of 23 items divided into three sub-scales. Lowest number suggesting excellent pain relief, no disability and no limitation of activity.

Observations and results

Among 100 plantar fasciitis patients the results of management by ultrasound therapy and laser therapy were compared. The patients were divided in the following two groups of 50 patients each: **Laser therapy group:** 50 patients were treated with laser and exercises; **Ultrasound therapy group:** 50 patients were treated with ultrasonography and exercises

The mean age of patients in Laser Group was 34.04 ± 13.56 years and in USG group was 33.92 ± 13.16 years with no significant difference in the means between the groups ($p > 0.05$). 62% and 58% of patients in laser therapy and ultrasound therapy group were females while 38% and 42% were males respectively. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Table 1: Demographic parameters and duration of symptoms in patients with plantar fasciitis

	Laser Group		USG Group		p Value	
	N	%	N	%		
Age (years) Mean \pm SD	34.04 ± 13.56		33.92 ± 13.16		>0.05	
Gender	Male	19	38%	21	42%	>0.05
	Females	31	62%	29	58%	
Duration of symptoms	2.06 ± 0.77		1.90 ± 0.76		>0.05	

Ultrasound therapy

For Ultrasound therapy 3 MHz frequency was used for 7-8 min for 5-7 sessions.

Both procedures were carried out in association with stretching and strengthening exercises. All patients

In Laser Group (2.06 ± 0.77) as compared to USG Group (1.90 ± 0.76 months) was the mean symptoms duration. As per students 't' test between the groups there was no statistically significant difference noted ($p > 0.05$).

The mean pre-treatment VAS score in Laser Group was 7.12 ± 0.43 which decreased to 5.50 ± 0.61 in post

treatment 4 weeks. The mean VAS scores at post treatment 8 weeks and post treatment 12 weeks were 4.21 ± 0.96 and 2.97 ± 0.68 respectively. There was significant reduction in VAS score at follow-up period than at diagnosis as per ANOVA test ($p < 0.05$). The mean pre-treatment VAS score in USG Group was 7.37 ± 0.70 which decreased to 6.24 ± 0.56 in post treatment 4 weeks. The mean VAS scores at post treatment 8 weeks and post treatment 12 weeks were 5.54 ± 0.50

($p < 0.05$). The mean pre-treatment Foot Function Index (FFI) score in USG Group was 75.14 ± 22.41 which decreased to 40.46 ± 27.01 in post treatment 4 weeks. The mean FFI scores at post treatment 8 weeks and post treatment 12 weeks were 34.86 ± 29.32 and 33.68 ± 27.92 respectively. There was significant reduction in FFI score at follow-up period as per ANOVA test ($p < 0.05$). The comparison of FFI score between the groups as per Student t-test no significant ($p > 0.05$) difference in the means between the two study groups at

Table 2: Comparison of VAS Score within Laser Group and ultrasound group and between the two study groups during Follow-up Period

VAS Score	Laser Group (Mean \pm SD)	USG Group (Mean \pm SD)	p Value
At Diagnosis	7.12 ± 0.43	7.37 ± 0.70	>0.05
At 4 weeks	5.50 ± 0.61	6.24 ± 0.56	$<0.05^*$
At 8 weeks	4.21 ± 0.96	5.54 ± 0.50	$<0.05^*$
At 12 weeks	2.97 ± 0.68	4.40 ± 0.49	$<0.05^*$
P value within the group	$<0.05^*$	$<0.05^*$	

and 4.40 ± 0.49 respectively. There was significant reduction in VAS score at follow-up period as per ANOVA test ($p < 0.05$). The pretreatment VAS was comparable between the groups as per Student t-test (7.12 ± 0.43 vs. 7.37 ± 0.70). The VAS score improved significantly in Laser Group compared to USG Group at post treatment 4 weeks (5.50 ± 0.61 vs. 6.24 ± 0.56), 8 weeks (4.21 ± 0.96 vs. 5.54 ± 0.50) and 12 weeks (2.97 ± 0.68 vs. 4.40 ± 0.49) as per Student t-test ($p < 0.05$). The results of VAS score pre and post-treatment are shown in table no. 2 in the patients of plantar fasciitis treated with laser and ultrasound therapy.

The mean pre-treatment Foot Function Index (FFI) score in Laser Group was 76.92 ± 22.48 which decreased to 24.76 ± 24.58 in post treatment 4 weeks. The mean FFI scores at post treatment 8 weeks and post treatment 12 weeks were 20.72 ± 23.27 and 21.14 ± 24.77 respectively. There was significant reduction in FFI score at follow-up period as per ANOVA test

the time of diagnosis. The FFI score improved significantly in Laser Group compared to USG Group at post treatment 4 weeks (24.76 ± 24.58 vs. 40.46 ± 27.01), 8 weeks (20.72 ± 23.27 vs. 34.86 ± 29.32) and 12 weeks (21.14 ± 24.77 vs. 33.68 ± 27.92) as per Student t-test ($p < 0.05$). The results of FFI score pre and post-treatment are shown in table no. 3 in the patients of plantar fasciitis treated with laser and ultrasound therapy.

Discussion

The comparison of clinical and functional results of Laser and ultrasound therapy using function foot index and VAS score was the aim of the present study. This study suggests that laser therapy showed significant improvement in pain relief with the help of the VAS and FFI scores. Plantar fasciitis is a common condition affecting major population especially working population which could impede daily activities. It is the

Table 3: Comparison of FFI Score within Laser Group and ultrasound group and between the two study groups during Follow-up Period

FFI	Laser Group (Mean ± SD)	USG Group (Mean ± SD)	p Value between the groups
At Diagnosis	76.92 ± 22.48	75.14 ± 22.41	>0.05
At 4 weeks	24.76 ± 24.58	40.46 ± 27.01	<0.05*
At 8 weeks	20.72 ± 23.27	34.86 ± 29.32	<0.05*
At 12 weeks	21.14 ± 24.77	33.68 ± 27.92	<0.05*
P value within the group	<0.05*	<0.05*	

most common diagnosis in cases of heel pain at plantar aspect without any history of trauma. There are many treatments available for this condition like anti-inflammatory drugs, physiotherapy such as stretching exercises, corticosteroid injection, Laser therapy, ultrasound therapy etc. Most of the cases resolve with conservative treatment. Both of these modality (Ultrasound and Laser therapy) used in this study have been used in the past.

Ultrasound therapy is a modality in which piezoelectric crystals use high frequency alternative current to transform electric energy to mechanical oscillation energy. Many studies in the past like Katzap Y et al.⁽²³⁾ concluded that ultrasound doesn't improve the pain relief in patients with plantar fasciitis. Slayton et al.⁽²⁴⁾ concluded in their study that intense therapeutic ultrasound therapy (ITU) has shown the effectiveness for pain relief of patients suffering from chronic plantar fasciitis which is refractory to conservative or minimally invasive treatment. There is a controversy in its use in plantar fasciitis. There are many studies still going on to prove its efficacy for therapeutic uses. There is a need to prove its role in the management of plantar fasciitis at different dosage of frequency.

Laser therapy is the other modality used in this study. It works on the principle of photochemistry which uses a different wavelength of light to initiate a signal transduction cascade by stimulating a protein, photoreceptor protein. Laser therapy has been found effective over other modality of conservative treatment of plantar fasciitis. Some studies like Wang Wei et al.⁽²⁵⁾ did a meta-analysis in which patients with plantar

fasciitis, laser therapy relieves better heel pain and with efficacy for 3 months. In both these modality stretching and strengthening exercises were included along with either of this therapy. The stretching exercises proved to be efficient in plantar fasciitis. This is supported by a study done by Kent Stuber et al.⁽²⁶⁾. Conservative treatment in plantar fasciitis, it states that stretching relieves the tension put on the plantar fascia by either the plantar fasciitis self being tensed or the fascia being tensioned by a tight Achilles tendon, providing pain relief. James et al.⁽²⁷⁾ in their study proved that there was significant improvement in reduction of VAS score and FFI score after 12 months post procedure. Many studies concluded superiority of Laser therapy over ultrasound therapy.

In this study Laser therapy (655nm) showed statistically significant improvement in pain relief based on VAS score and FFI score. Studies like Macias et al.⁽²⁸⁾ support this data of superiority of Laser over ultrasound therapy, and concluded that low level Laser therapy (635nm) is a promising therapy in plantar fasciitis in reduction of heel pain. This study showed significant reduction ($p < 0.01$) in mean score in VAS score and FFI score. Kiritsi et al.⁽²²⁾ used 904nm gallium arsenide infrared laser therapy and their study reported a significant difference in VAS pain scores and decrease plantar fascia thickness post therapy between their study groups.

Conclusion

This study concludes that LASER therapy is a better treatment modality in patients with plantar fasciitis as

compared with Ultrasound therapy on the basis of results obtained from VAS score and Functional Foot Index score.

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Conflict of interest: Nil

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