A Comparison of the Effect of Low-Level Laser Therapy versus Ultrasound Therapy in Patients with Chronic Plantar Fasciitis

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ABSTRACT

Objective: To compare the effects of low-level laser therapy and ultrasound therapy in subjects with chronic plantar fasciitis in reducing pain and improving function.

Methods: Experimental study design, Comparative study type. 30 subjects were selected and divided into 2 groups & each group consisted of 15 members assessed with Foot function index and Visual analogue scale.

Results: Statistical analysis was done by using paired ‘t’ test which showed significant improvement in both groups. Therefore, there is a significant difference between Group-A and Group-B, showing that low-level laser therapy (LLLT) is more effective than the ultrasound(US) therapy with exercises on chronic plantar fasciitis (p <0.05).

Conclusion: Low-level laser therapy has shown significant result in reduction of pain and improving function in subjects with chronic plantar fasciitis.

Keywords
Low-level laser therapy; Chronic plantar fasciitis

Introduction

The plantar fascia is a connective tissue made up of thick fibrous band. It gets originated from the calcaneal medial tubercle and lies in the sole of the foot and extends up to the base of the metatarsal heads and support the longitudinal arch and also assist with dynamic shock absorption [1]. The word ‘fasciitis’ denotes inflammation of the plantar fascia. It is also termed as “plantar fasciosis” [2]. Plantar fasciitis is a painful disorder in the plantar aspect of the foot characterized by structural deterioration of the plantar fascia along with inflammation. About 10% of the population affected with plantar fasciitis, at least once in a lifetime and non-athletic populations are affected more than the athletic population [3].

Normally, the plantar fascia does its function appropriately without damaging the fascia, but in the risk factors such as, excessive foot pronation (pes planus), obesity (body mass index greater than 30 kg per m²), prolonged standing or walking occupations (e.g., teachers, construction workers etc.), excessive running etc., may cause minimal tear in the plantar fascia. This repeated trauma exceeds the fascia’s power to recover and may lead to degenerative changes with a high risk of injury ultimately leading to calcification of the fascia and enthesopathy [4].

Clinical presentation is a pain in the medial plantar region of the heel with the initial steps taken in the morning or after a prolonged weight-bearing activity. Diagnosis of plantar fasciitis is usually made on the basis of history and
physical examination [5]. Pain and tenderness is increasing on movement like passive dorsiflexion of toes or active standing on toes by the patient. On physical examination it is concluded that calf muscle tightness limiting the dorsiflexion of the ankle and plantar fascia tightness restricting the toe extension [6-8].

Treatment of this condition is usually conservative. Several research studies using different conservative treatments both individually and in combination have concluded that conservative treatment yielded better response in terms of relief from the first step of morning pain. Invasive management such as fenestration and steroid injections are also available.

Laser therapy (low-level laser therapy L.L.L.T) is the use of red or infra-red light which aids in soft tissue healing and helps relief of pain [9]. The effect of the laser therapy is like photosynthesis i.e., it helps in production of ATP, gives more energy which makes the tissue to play its role in a natural healing process. Low-level laser therapy is to stimulate the tissue, which causes biochemical effect, doesn’t cause damage to living tissues [10]. Low-level laser therapy (LLLT) is also known as Low-intensity laser therapy(LILT), biostimulative therapy (BT), laser phototherapy (LPT).

The mechanism of reduction in the pain and swelling is that phototherapy relieves this both by increasing the local and systemic microcirculation. The synthesis of nitric oxide is associated with an increased blood flow [11]. It also been shown that there is a pain reduction by phototherapy acting on the inflammatory products [12,13]. The effect of laser on pain relief is because of the action of endorphins with endogenous pain relievers which was found with an evidence of phototherapy [14,15].

In clinics the Therapeutic ultrasound (US), which is the high-frequency mechanical wave, which is through vibration transmits the energy. There is a delivering of energy by ultrasonic generators in two modalities: continuous mode or pulsed mode. In the continuous mode, the wave power (W/cm²) remains steady, and it aids in pain relief, it acts on termination of fibrosis [16,17]. Thus, for a potential indication for chronic plantar fascia treatment, the use of high-power continuous ultrasound is chosen. Since the shockwave therapy which has the same effects and also gives good results and ultrasound is a low cost equipment that is widely available.

Methodology

This study received Institutional Ethical approval from SRM college of Physiotherapy, SRM University. 30 subjects were conveniently selected for the study. Both men and women with age group between 20 to 35 years with unilateral heel pain for at least three months of ongoing heel pain were included in the study. Study was conducted in the Outpatient Department of Physiotherapy, SRM Medical College Hospital and Research Centre. Subjects with trauma to the heel, Foot deformities, Pregnant and lactating women, Previous diagnosis of neuropathy of lower extremity, Vascular diseases and those who suffer from skin ulceration (infection or wound) on the heel and surrounding areas were excluded from the study.

Procedure

The informed consent was obtained from the subjects. The subjects were selected based on the inclusion and exclusion criteria. The procedure was clearly explained to the subjects.

Windlass test was done in sitting position by stabilizing the position of the ankle in neutral with one hand just proximal to the first head of the metatarsal. Then, passively extended 1st phalanx while allowing the flexion of the interphalangeal joint. A positive test is considered if the pain is reproduced to the patient.

Foot function index (FFI) was used for the functional evaluation of the foot both pre-and post-treatment and Pain was assessed using visual analogue scale (VAS) during rest, pre-and post-treatment. The patient was instructed to simply mark the line to indicate pain intensity.

Both men and women subjects was taken with fifteen subjects in each group with physiotherapy referral by a physician or orthopedic surgeon.

The subjects with unilateral symptomatic chronic plantar fasciitis (3 months or more) were randomly divided into two groups. i.e. Group-A and B; Group-A treated with low-level laser therapy with conventional physiotherapy exercises. Group-B treated with ultrasound therapy with conventional physiotherapy exercises. Each group consisted of 15 subjects. Pre-test and post-test were conducted on both groups by using VAS for pain assessment, and foot function index (FFI) for assessing pain intensity and disability.
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Over a period of four weeks, a total of 12 treatment sessions were given on alternate days. The subjects were positioned in prone lying with a pillow supporting the anterior aspect of ankle for the both modalities.

Low-Level Laser Therapy: The scanning method, Intensity of 6 J/cm² for 10 minutes, thrice/week for 4 weeks. Ultrasound Therapy: Frequency of 1 MHz & Intensity of 2 W/cm² with continuous mode for 3 Minutes, thrice/week for 4 weeks (Graphs 1 and 2).

Conventional physiotherapy exercises
  - Tennis ball stretching exercise
    A tennis ball was kept under the sole of the foot and the subjects were instructed to roll it from behind the metatarsal heads to the heel concentrating on the medial arch. Repeated at least 3 times a day and the duration of 2 minutes.
  - Achilles tendon and plantar fascia stretch
    Subjects were advised to loop a towel around the forefoot and, keep the knee straight, pull the foot towards the knee. Hold it for 30 seconds and repeat 3 times for each foot.
  - Intrinsic muscle stretch
    Sitting and pulling up the ankles and toes until a stretch is felt with legs crossed. Hold for 30 seconds and 3 repetitions, 3 times per day.
  - Dynamic stretches for plantar fascia
    In standing (holding the back of a chair for support) or sitting allowing the foot and ankle to move in all directions over a rolling pin, or a tennis ball etc. few minutes with twice a day repetition, this can also be done using a cool drink can.

Results

Therefore, there is a significant difference between Group-A and Group-B, showing that low-level laser therapy (LLLT) is more effective than the ultrasound (US) therapy with exercises on chronic plantar fasciitis (p<0.05).

Discussion

This study compares the effectiveness of low-level laser therapy (LLLT) and ultrasound (US) therapy in subjects with chronic plantar fasciitis.

The subjects who fell into the age group of 20-35 years, of both genders and who were suffering from plantar fasciitis were selected but the study was analyzed only on 24 subjects due to 6 drop outs (due to personal and transport reasons). 12 subjects from Group-A were treated with low-level laser therapy (LLLT) along with conventional physiotherapy exercises. While 12 subjects from Group-B were treated with ultrasound (US) therapy along with conventional physiotherapy exercises.

On comparing the pre-test and post-test values of the present study, it revealed that there was a statistically significant difference (p<0.05) in both the groups in terms of pain intensity and improve function, but there was more improvement in Group-A than Group-B.

Regarding Occupation, plantar fasciitis seemed to be slightly more common in those with heavy duty than those of light duty that alters the nerve transmission due to increase tension on plantar fascia [18].

Low-level laser effects are non-thermal and photochemical and are causing no cell damage, and there is stimulation of the body’s own processes in healing tissue by the light [18-20]. The mechanism of reduction in the pain and swelling is that phototherapy relieves...
this both by increasing the local and systemic microcirculation. The synthesis of nitric oxide is associated with an increased blood flow [11]. It has also been shown that there is a pain reduction by phototherapy modulating the mediators of inflammation. There is an alteration in the pain threshold of nociceptors due to modulation in the transmission of nerve which is induced by photostimulation.

Ultrasonic therapy a very high-frequency sound waves, between 800,000 Hz and 2,000,000 Hz is a method of stimulating the tissue beneath the skin’s surface. There is a generation of waves by the piezoelectric effect which causes vibration of crystals within probe/wand head. There is a vibration of local tissues which passes through the skin caused by the sound waves. The sound waves that pass through the skin cause a vibration of the local tissues. Usually, no sensation of heat will be felt by the patient when cavitation or vibration can cause a deep heating locally. It has been shown to cause increases in tissue relaxation, local blood flow, and scar tissue breakdown. The effect of the increase in local blood flow can be used to help reduce local swelling and chronic inflammation. It is suggested that the application of ultrasound to injured tissues will, amongst other things, speed the rate of healing & enhance the quality of the repair (Watson 2006). These physiological aspects clearly explain the reason for the reduction of pain following ultrasound management for a period of four weeks.

According to DiGiovanni et al. (2003) stretching reduces the tension in the fascia which becomes tight in plantar fasciitis. A study performed to determine the effectiveness of plantar fascia stretching versus calf stretching concluded that the plantar fascia stretching group had greater improvement in functional outcome compared to calf stretching group. Plantar fascia stretching recreates windlass mechanism which limits micro trauma repetitively and associated inflammation by performing exercise after any prolonged sitting or inactivity prior to the first step in the morning. Poor intrinsic muscle strength is often attributable to plantar fasciitis that the strengthening the intrinsic foot muscles helps in supporting the arches of the foot [21].

The post-test mean value of Pain (VAS), Foot Function Index (FFI) score of group-A treated with low-level laser therapy(LLLTT) was 1.41 and 17.01 and group B treated with ultrasound (US) therapy was 2.33 and 20.55 at the end of 4 weeks simultaneously. Hence the recovery is faster, pain-free and effective in group-A subjects treated with Low-level laser therapy. Thus, these statistical findings could be attributed to the fact that low-level laser therapy (LLLTT) works more statistically over ultrasound therapy.

**Conclusion**

The present study concludes that application of four weeks’ treatment of low-level laser therapy (LLLTT) along with conventional physotherapy exercises had decreased the pain and improved function through reduction of muscle tension and strengthening of the weakened muscles of subjects with plantar fasciitis.

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**References**

16. Hong CZ, Chen YC, Pon CH, et al. Immediate effects of various physical medicine
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