CORPUS PUBLISHERS

Advance Research in Dermatology & Cosmetics (ARDC)

Volume 2 Issue 1, 2023

Article Information
Received date : February 13, 2023
Published date: March 31, 2023

*Corresponding author
Formosa Cynthia, Faculty of Health Sciences, University of Malta, Europe

DOI: 10.54026/ARDC/1006

Keywords
Chronic planter heel pain; Laser therapy; Stretching; Pain

Research article

The Use of Laser Therapy in the Management of Chronic Plantar Heel Pain

Abela Maria, Gatt Alfred and Formosa Cynthia*
Faculty of Health Sciences, University of Malta

Abstract

Purpose: To compare the efficacy of laser therapy versus conventional treatment (stretching exercises and silicone heel cups) for the short-term management of CPHP.

Methods: A case-control study was carried including 18 participants with 26 symptomatic limbs with CPHP. Each participant received one of two treatments; laser therapy or conventional treatment Progress was monitored using two pain scales; VAS pain scale and the Foot Function Index where participants were asked to rate their pain at the start of the study (Time 0) and after 3 weeks (Time 1).

Results: Both treatment options showed a significant reduction in pain scores ($p<0.05$) however, when comparing both treatment options, a significant difference ($p<0.05$) in mean pain score was found with the laser therapy being more effective treatment option for the short-term management of CPHP.

Conclusion: Laser therapy, when compared to conventional treatment, is a better short-term treatment option for the management of CPHP. Further research in this area is warranted to ensure best patient care, to further clarify long-term efficacy and optimal treatment parameters of Laser Therapy.

Introduction

Chronic plantar heel pain (CPHP) has become a generalized term used to describe a number of undifferentiated conditions affecting the heel with the commonest being plantar fasciitis [1]. It is one of the commonest disorders affecting the foot. One in ten people are affected at some point in their life [2] with 2 million people globally, most commonly those between the age of 40 and 60, seeking medical advice and receiving treatment annually [3].

Commonest complaint of CPHP is burning and aching pain at the plantar fascia origin, in the morning and after a period of non-weight bearing [2] which eases by activity [3]. Irving et al. [4] report that aetiology for CPHP is still unclear thus has multiple risk factors associated with it including increased BMI, increasing age, limited ankle dorsiflexion, leg length discrepancy, heel pad thickness, foot type, limited first metatarsophalangeal joint range of motion, improper shoes and previous injuries. Rosenbaum et al. [5] outlines a number of conservative treatment options for the management of CPHP including stretching exercises, nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, heel pads, orthoses, night splints, and extracorporeal shockwave therapy amongst others. Although most cases can be treated conservatively, those who fail to improve could be referred for surgical options.

Stretching exercises aimed at stretching the plantar fascia and Achilles tendon are deemed to be the most effective conservative care for CPHP [6]. Laser therapy (LT) is another conservative non-invasive option which has been reported to be able to treat multiple disorders including acute and chronic pain including CPHP, nerve degeneration and ligamentous injuries. LT employs the principles of photochemistry which by the use of a wavelength of light, photoreceptor protein is stimulated; protein capable of absorbing light, to start signal transduction cascades [7].

Despite a number of trials, lack of agreement on the most effective treatment for CPHP is present, thus leaving clinicians uncertain on which treatment to prescribe [5]. Gatt et al. [1] states that although a number of treatment options have been identified, there is little evidence on their effectiveness in clinical practice thus indicating that further research is warranted. This study aimed to investigate the difference in the management of CPHP between stretching exercises and silicone heel cup and laser-therapy. The conventional treatment chosen for this study was chosen according to Wolgin et al. [8] and Davis et al. [9] who concluded that stretching exercises and cushioned insoles were the most effective conservative treatments in the management of CPHP. Rosenbaum et al. [5], also highlights that stretching programmes are usually the first-line treatment for the short-term management of CPHP. Up to the authors knowledge, this study is novel since no studies compared these treatment modalities together.

Research Design and Methods

A prospective experimental study was conducted amongst 18 participants with 26 symptomatic limbs with CPHP. This study was approved by the University Research Ethics Committee. All investigations were carried out in accordance with the Declaration of Helsinki as revised in 2000.

Subject selection

This study made use of convenience sampling including subjects over18 years. Participants presenting with heel pain for at least 3 months and had not received any treatment before were eligible to participate. Participants with full sensation on the plantar aspect of the foot and willing to abstain from any other medications and treatments that were not part of the study during participation were recruited. Participants were excluded from participation if they were undergoing other treatment for the condition, had a history of trauma to the heel, presented with other conditions leading to heel pain including

arthritic and neurological heel pain, diabetic neuropathic pain, fibromyalgia, sciatic pain, ulcerations on the heel or the surrounding area. Participants with history of heel surgery or with benign and malignant tumours, acute infection of the bone or soft tissue such as osteomyelitis or with metabolic disorders including Paget's disease, Osteomalacia and Sickle cell disease, peripheral vascular disease or autoimmune disease, pregnant or lactating participants and those presenting with photosensitivity disorders were excluded.

Matching criteria

Frequency distribution control and precision control were used, with participants being matched for variables that could affect treatment outcomes. These included gender, age, BMI, occupation status: sedentary versus active, footwear: trainers versus formal shoes, Ankle Joint Range of Motion: adequate versus limited, foot type: pronated versus supinated or neutral.

Methods

Upon informed consent, participants were interviewed at the beginning of the study. Interview included demographic data; gender, age, weight, height, BMI, occupation, footwear and type of lifestyle. Medical history was recorded including general areas of foot pain and duration of pain. Weight and height were measured using medical scales. Height was recorded on the point perpendicular to the superior aspect of the skull [2]. BMI, was calculated by dividing the weight in kilograms (kg) by the height squared in meters (m^2) (kg/m^2). Ankle joint range of motion [10] was measured together with the Foot Posture Index (FPI) [11] in order to establish foot type of the study group. Participants were asked to rate CPHP at Time 0 before the commencement of any treatment during the first morning steps using the VAS pain scale [12] as well as the Foot Function Index (FFI) [13].

Participants were divided into two groups and matched for variables outlined above. First participant was assigned to Group A (Laser Therapy) and the matching participant was assigned to Group B (Conventional Treatment). This process was repeated until a total of 13 symptomatic limbs were recruited in each group. Participants recruited in Group A were asked to visit the clinic twice a week for three weeks in order to receive Laser treatment. Participants recruited in Group B were seen once at the start of the study and were instructed on stretching exercises and the use of silicone heel cups and were seen again after 3 weeks at the end of the study (Time 1). Both participant groups were asked to rate their pain using the VAS pain scale and the FFI at the start of the study (Time 0) and at the end of the study after 3 weeks of treatment (Time 1).

Treatment Protocol - Laser Therapy: Group A versus Conventional Treatment: Group B

Group A, were provided with medical LT using LASERCURE Medical Diode Laser System, a Class 4 laser [14]. Diodes are made out of GaAIAs semiconductor material which convert electric energy into laser radiation with a wavelength of 980nm +/-10nm [14]. Medical Laser therapy is the application of red and near infrared light over an injured site to reduce inflammation, accelerate tissue healing and reduce pain. Medical Laser therapy offers a painless, non-invasive, side-effect free alternative to relieve the debilitating pain of various musculoskeletal problems including CPHP.

After demographic data was obtained and pain was rated using the VAS as well as the FFI, laser was applied over three to five points of pain areas including plantar fascia insertion and plantar fascia origin. LT was applied using a handheld probe perpendicular to the skin. The contact method, with the handpiece held directly onto the skin, was used in order to ensure deep penetration. Area was treated using a slow movement. In line with the device manual, participants received a total of six sessions for three weeks, two sessions per week spaced one day apart with a power of 10 watts emitting 6,000J. Pulsed laser, where laser pulses have OFF times followed by ON times, was utilized since it penetrates deeper than continuous laser without overheating the tissue thus reducing participant discomfort.

Group B were instructed on a self-stretching protocol which included calf muscles stretching and plantar fascia stretching [15]. Participants were instructed to perform stretching exercises twice daily for 20 seconds followed by 20 seconds of rest and repeated for a total of three minutes per stretch making the stretching protocol last nine minutes in total [15]. Participants were instructed on the following stretching exercises

Calf muscles stretching in standing -with the affected foot furthest away from the wall, the participant leaned forward while making sure the heel was on the floor. Inorder to focus on the stretching of the soleus muscle, the participant was instructed to bend the knee of the affected foot while keeping the heel on the ground. For the gastrocnemius muscle, the participant was instructed to keep the knee of the affected foot in full extension while keeping the heel on the ground. Both stretches were done until a stretch in the calf and Achilles region were felt [15].

Plantar Fascia-Specific Stretching - While sitting, participants were instructed to cross the affected foot over the contralateral thigh. They were instructed to grasp the toes and dorsiflex until a stretch in the plantar fascia was felt. Participants were instructed to start gently and increase intensity as tolerated [15].

Heel Cups - Group B were also provided with dual-density heel cups and instructed to wear them regularly. The heel cups were hypoallergenic in nature made out of medical grade silicone.

After completion of the above mentioned treatment modalities (3 weeks - Time 1), participants were asked to rate pain again using the VAS pain scale and the FFI. The IBM SPSS (Statistical Package for Social Sciences) (Version 25) program was utilized for the statistical analysis. The paired sample t-test was employed to evaluate difference in mean pain reduction for both treatments separately [Time 0 versus Time 1]. The independent sample t-test was used to compare difference in pain scores between treatments at the start and end of the study.

Results

Demographics

Eighteen participants with 26 symptomatic limbs diagnosed with CPHP were included in the study; twelve males and six females, mean age of 48.67 years. mean weight - 84.94kilos, mean height – 1.66metres, BMI – 30.99. Duration of pain in weeks was 29.28. Pain was most common at the plantar fascia insertion (n=11) and least common at the plantar fascia insertion together with the medial longitudinal arch (n=6). Nine limbs experienced pain on the whole plantar aspect of the heel. Most of the participants had a standing/active occupation (n=15) with only a few reported a sedentary occupation (n=3). Participants reported to wear trainers (n=13) whilst others wore formal shoes (n=5). With reference to the ankle joint range of motion of the affected limbs 14 participants exhibited adequate ankle joint range of motion whilst 12 participants demonstrated limited ankle joint range of motion. The most common foot type was a neutral foot [n=19] and the least common foot type was pronated [n=3]. Some limbs also showed a supinated foot type [n=4].

Statistical analysis

Comparing CPHP before and after treatment for each study group

The paired sample t-test was carried out to compare mean pain score before and after treatment for both the VAS pain scale as well as the Foot Function Index. Table 1 demonstrates that all p-values do not exceed the 0.05 level of significance. It can be concluded that there was a significant pain reduction in pain scores with both the VAS pain scale as well as the Foot Function Index implying that pain reduction was experienced with both treatment modalities.

Table 1: Comparing CPHP Before and After Treatment for each Study Group – Paired Sample T-Test.

		Mean	Sample Size	Std. Deviation	P-value
Laser Therapy only	VAS Before	81.54	13	8.263	0.000
	VAS After	32.69	13	17.514	
	FFI Before	94.00	13	18.899	0.000
	FFI After	49.77	13	12.975	
Conventional only	VAS Before	82.31	13	7.804	0.000
	VAS After	56.77	13	8.054	
	FFI Before	111.77	13	15.605	0.000
	FFI After	71.54	13	12.607	

Comparing the effects of Laser Therapy versus Conventional Care on CPHP

The Independent Sample T-Test was used to determine differences in pain between conventional treatment versus laser therapy for the management of CPHP. As shown in table 2 when looking at the VAS pain scale, the p-value before treatment exceeds the 0.05 level of significance. This indicates no significant difference in pain levels between both groups before treatment at the start of the study (Time 0). However, the p-value after treatment for the VAS pain scale is smaller than the 0.05 level of significance. Therefore, it can be concluded that there was a significant difference in the reduction of pain between the two groups.

When looking at the FFI, the p-value indicated a significant difference in pain scores before treatment with participants in the conventional therapy group experiencing greater pain at the start of the study (111.77 versus 94.00). Furthermore, when considering the p-value after treatment for the FFI, it can be concluded that there was a significant reduction in pain between LT and conventional treatment. However, the reduction in mean pain scores varied marginally between the two treatment options; 44.23 mean reduction of pain for LT and 40.23 mean reduction of pain for conventional therapy. This, similar to the VAS pain scale, also implies that LT is a better treatment option when compared to conventional therapy in the management of CPHP.

Table 2: Comparing the effects of Laser Therapy versus Conventional Care on CPHP - Independent Samples.

	Group	N	Mean	Std. Deviation	P-value
VAS Before	Laser	13	81.54	8.263	0.809
(Time 0)	Conventional	13	82.31	7.804	
VAS After	Laser	13	32.69	17.514	0.000
(Time 1)	Conventional	13	56.77	8.054	
FFI Before	Laser	13	94.00	18.899	0.015
(Time 0)	Conventional	13	111.77	15.605	
FFI After	Laser	13	49.77	12.975	0.000
(Time 1)	Conventional	13	71.54	12.607	

Discussion

The study results demonstrate that when looked at independently both treatment modalities showed a significant reduction in pain scores ($p<0.05$) after 3 weeks however, when comparing the reduction in pain between both treatment options, a significant difference ($p<0.05$) in mean pain score was found with the laser therapy showing to be more effective in pain reduction for the short-term management of CPHP.

A number of research papers [7,16,17] which have looked at pain reduction when utilizing one of these two treatment options separately are available, however, up to the authors knowledge no study has yet to date compared these two treatment options together, making this study novel.

Stretching exercises together with the use of silicone heel cups are considered to be the usual initial treatment for CPHP [5,17] thus the choice for this study to compare this treatment to a rather innovative treatment option for the management of CPHP – laser therapy. However, although patients are instructed on how to perform their stretching exercises at home daily usually both verbally and pictorially by various healthcare professionals who manage CPHP, it could be possible that such stretching protocols are not always adhered to due to time constraints or are just not carried out as instructed thus rendering them ineffective by patients. LT has no reported side effects with no pain associated with treatment. Unlike other treatment options such as casting, LT does not affect patient morbidity or daily activities but rather encourage patients to resume their usual activities [16]. Although the optimal dose, frequency and wavelength of laser treatment is not known yet [18] with multiple studies suggesting different treatment regimens for the purpose of this study the device -LASERCURE Medical Diode Laser System -manual protocol was utilized. In view of the positive outcome of this study the authors thus are confident that utilizing laser therapy in the treatment for CPHP could be a better treatment option for both patient compliance and also treatment outcome and reduction in pain. This is due to the fact, that a patient would only be required to attend a few sessions per week for a few minutes, thus ensuring better patient compliance by adhering to the recommended treatment plan.

Furthermore, issues related to the treatment of the presenting pain itself which is known to be brought about by CPHP; various pharmacological treatment modalities have been suggested in literature for pain management, ranging from steroid infiltration to NSAIDs amongst others however, none have proven to be totally effective in eradicating this type of pain not to mention the detrimental side effects that these long-term pharmacological drugs carry with them which could be circumvented through the use of laser therapy [1].

Limitations of the Study

A possible limitation of this study could be the sample size [n=26 symptomatic limbs]. For this reason, this study could be considered as a pilot study. Future research comparing these two modalities should recruit a larger number of participants to improve statistical power. Furthermore, this study, in order to examine the determine the efficacy of different treatment modalities on the management of CPHP made use of the VAS pain scale and the FFI, which are both general pain scales widely used in research studies. Further clinical and imaging modalities could have provided more reliable and accurate results. Such modalities could have included the measurement of plantar fascia thickness using diagnostic ultrasound. Unfortunately, participants were not followed up beyond the 3-week period in order to determine whether complete eradication of the pain had occurred which would have provided additional valuable data. Participant follow-up period could have been extended to a longer period of time in order to be able to understand the long-term effects and efficacy of treatment rather than following short-term effects only, however in view that significant pain reduction was achieved in a 3 week period, this implies that a positive outcome was reached [19].

Conclusion

Laser therapy, when compared to conventional treatment, is a better short-term treatment option for the management of chronic plantar heel pain. Additionally, it reduces the need for the administration of prolonged pharmacological interventions and their associated side effects. Further research in this area is warranted to ensure best patient care that may effectively relieve the heel pain of patients with CPHP, at least in the short term (i.e. 3 weeks). More large-scale, well-designed studies are needed urgently to further clarify long-term efficacy and optimal treatment parameters of LT.

References

1. Gatt A, Grech M, Chockalingam N, Formosa C (2018) A Preliminary Study on the Effect of Computer-Aided Designed and Manufactured Orthoses on Chronic Plantar Heel Pain. Foot & ankle specialist 11(2): 112-116.
2. Irving DB, Cook JL, Young MA, Menz HB (2008) Impact of chronic plantar heel pain on health-related quality of life. Journal of the American Podiatric Medical Association 98(4): 283-289.
3. Toomey E (2009) Plantar heel pain. Foot and ankle clinics 14(2): 229-245.
4. Irving DB, Cook J, Menz HB (2006) Factors associated with chronic plantar heel pain: a systematic review. Journal of science and medicine in sport 9(1-2): 11-22.
5. Rosenbaum AJ, DiPreta JA, Misener D (2014) Plantar heel pain. Medical Clinics 98(2): 339-352.
6. Barrett DSL (2009) Heel pain: healing the heel. Author House.
7. Macias DM, Coughlin MJ, Zang K, Stevens FR, Jastifer JR, et al. (2015) Low-level laser therapy at 635 nm for treatment of chronic plantar fasciitis: a placebo-controlled, randomized study. The Journal of Foot and Ankle Surgery 54(5): 768-772.
8. Wolgin M, Cook C, Graham C, Mauldin D (1994) Conservative treatment of plantar heel pain: long-term follow-up. Foot & ankle international 15(3): 97-102.
9. Davis PF, Severud E, Baxter DE (1994) Painful heel syndrome: results of nonoperative treatment. Foot & Ankle International 15(10): 531-535.
10. Cejudo A, De Baranda PS, Ayala F, Santonja F (2014) A simplified version of the weight-bearing ankle lunge test: Description and test–retest reliability. Manual therapy 19(4): 355-359.
11. Redmond AC, Crane YZ, Menz HB (2008) Normative values for the foot posture index. Journal of Foot and Ankle research 1(1): 1-9.
12. Crichton N (2001) Visual analogue scale (VAS). J Clin Nurs 10(5): 697-706.
13. Budiman ME, Conrad J, Roach KE (1991) The Foot Function Index: a measure of foot pain and disability. Journal of clinical epidemiology 44(6): 561-570.
14. Applied Laser Systems (2019) Laser Cure Series: Operating Manual. China: Wuhan Gigaa Optronics Technology Co., Ltd
15. Renan OR, Alburquerque SF, Rodrigues De Souza DP, Cleland JA, Fernández DLPC (2011) Effectiveness of myofascial trigger point manual therapy combined with a self-stretching protocol for the management of plantar heel pain: a randomized controlled trial. Journal of orthopaedic & sports physical therapy 41(2): 43-50.
16. Jastifer JR, Catena F, Doty JF, Stevens F, Coughlin MJ (2014) Low-level laser therapy for the treatment of chronic plantar fasciitis: a prospective study. Foot & ankle international 35(6): 566-571.
17. Li L, Yang L, Yu F, Shi J, Zhu L, et al. (2018) 3D printing individualized heel cup for improving the self-reported pain of plantar fasciitis. Journal of translational medicine 16(1): 1-11.
18. Cinar E, Saxena S, Uygur F (2018) Low-level laser therapy in the management of plantar fasciitis: a randomized controlled trial. Lasers in medical science 33(5): 949-958.
19. Nygaard HA (2008) Measuring body mass index (BMI) in nursing home residents: the usefulness of measurement of arm span. Scandinavian journal of primary health care 26(1): 46-49.