Turk J Phys Med Rehab 2023;69(1):8-14
DOI: 10.5606/tftrd.2023.9923
Available online at www.turkishjournalpmr.com

Original Article

Comparison of effects of low level laser therapy and local corticosteroid injection in the treatment of plantar fasciitis

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Received: October 06, 2021 **Accepted:** March 29, 2022 **Published online:** October 27, 2022

ABSTRACT

Objectives: The purpose of the study was to compare low-level laser therapy (LLLT) and local corticosteroid injection in the treatment of plantar fasciitis.

Patients and methods: This retrospective study was performed with 56 patients (6 males, 50 females; mean age: 44.7±10.1 years; range, 18 to 65 years) between January 2015 and March 2016. The patients were equally divided into two groups: Group 1, comprising patients who underwent a one-time local corticosteroid injection into the heel by the same physician, and Group 2, including patients who had gallium arsenide laser therapy at a wavelength of 904 nm lasting 10 sessions. Evaluations were done at pre-treatment, post-treatment, and two weeks, one month, and three months after the post-treatment evaluation. The post-treatment evaluation was accepted as the 10th day after the injection in Group 1 and as the time after the last session of the laser treatment in Group 2. Each visit was compared with the previous visit for within-group analysis. The Visual Analog Scale (VAS), Heel Tenderness Index (HTI), and Foot Function Index (FFI) were assessed.

Results: Pain scores in Group 1 and Group 2 were not associated with statistically significant differences ($p>0.05$). Within-groups analysis demonstrated statistically significant differences concerning VAS subgroups ($p<0.05$), except for Group 2's resting VAS values ($p=0.159$). No statistically significant differences were found between groups in the means of FFI scores ($p>0.05$). Statistically significant differences were observed regarding within-group analyses for all subscores ($p<0.001$). No statistically significant differences were observed between the two groups for all visits regarding HTI scores ($p>0.05$). Statistically significant differences were found between baseline and the first after-treatment visit in all groups ($p<0.05$). Statistically significant differences were found in the first ($p=0.020$) and third ($p=0.010$) months compared to the one-week follow-up in Group 2 regarding HTI scores.

Conclusion: Both LLLT and local corticosteroid injection for plantar fasciitis have positive effects for three months after treatment. However, LLLT is more effective than local corticosteroid injection at the end of the third month in local tenderness.

Keywords: Corticosteroid injection, low level laser treatment, plantar fasciitis.

Plantar fasciitis (PF) is reported as one of the most frequent causes in patients presenting with heel pain. The disorder nearly has a 10% prevalence in the general population.[1] It frequently occurs in individuals between 40 and 60 years. It is more common in those who stand for a long time and carry weight, such as women, soldiers, obese individuals, and athletes.[2,3]

Histological features of PF are unclear. Nonetheless, studies demonstrated degenerative changes mostly in the plantar fascia enthesis, including disruption of collagen filaments, secretion of essential substance proteins, focal areas of fibroblast increment, and enhanced vascularity.[4,5] Clinical findings are generally sufficient for the diagnosis of PF. Plain X-ray is the most common imaging technique and shows a

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Cite this article as:
Yetişir A, Kozanoğlu E, Kelle B. Comparison of effects of low level laser therapy and local corticosteroid injection in the treatment of plantar fasciitis. Turk J Phys Med Rehab 2023;69(1):8-14. doi: 10.5606/tftrd.2023.9923.

calcaneal spur in 50% of the cases.[6] The most typical symptom is heel pain, which usually occurs during the first step when the individual wakes up in the morning. This pain decreases during activity but aggravates by prolonged weight-bearing activity.[2]

Plantar fasciitis is usually a self-limiting condition.[7,8] In addition, medical treatment approaches are generally effective in the management of PF.[1] Nonsurgical treatment options include nonsteroidal anti-inflammatory drugs, oral analgesics, physical therapy modalities, exercise (particularly stretching), foot orthotics, platelet-rich plasma, and corticosteroid injections.[6,9-12] Although these conservative therapies provide pain relief in approximately 90% of patients, there is no specific recommended treatment option for PF.[1]

Corticosteroid (CS) injections are one of the most preferred and popular treatment techniques for clinicians. It has been shown that local CS injections reduce pain, particularly in the short term. However, it has severe side effects, such as rupture of the plantar fascia.[2,13,14] Corticosteroid injections enable the suppression of fibroblasts and ground substance protein accumulation, which are thought to be the potential mechanisms in the pathophysiology of PF.[13]

Laser application is a recently popular treatment modality in the management of various musculoskeletal disorders and is a noninvasive method that has a nonionizing, monochromatic, and electromagnetic light beam. It has analgesic, anti-inflammatory, and biomodulatory effects. It is thought that laser therapy enhances tissue renewal and suppresses pain by increasing collagen production, wound healing, tensile strength, and mast cell count.[15]

Despite the increasing popularity of low-level laser therapy (LLLT) and CS injections in the medical treatment of PF, there are a few trials comparing LLLT and CS injection therapies in PF. The purpose of this study was to compare the efficacy of these two treatment methods in the management of PF.

PATIENTS AND METHODS

This retrospective study was conducted with 56 PF patients (6 males, 50 females; mean age: 44.7±10.1 years; range, 18 to 65 years) who underwent LLLT or CS injection therapy at the Cukurova University Faculty of Medicine, Department of Physical Medicine and Rehabilitation between January 2015 and March 2016. Inclusion criteria for the study were having a diagnosis of plantar fasciitis for more than one month and a minimal Visual Analog Scale (VAS) score ≥4/10. Exclusion criteria were having incomplete data in the hospital records concerning specific follow-up visits during the PF treatment in the last six months, a heel spur >2 mm, undergoing a rheumatological, neurological, neoplastic disease, or neoplastic disease treatment, and having diabetes mellitus, a foot surgery, or general musculoskeletal pain. Data were extracted from the patient files. Initial physical examination and laboratory tests were noted. Patients who met the inclusion criteria and had complete data in their files (pre-treatment and post-treatment control visits) were included. The patients who met the inclusion criteria were determined from 168 patients who were diagnosed

TABLE 1
Patients' characteristics

	Group 1				Group 2				
	n	Mean±SD	Median	Min-Max	n	Mean±SD	Median	Min-Max	*p*
Age (year)		43.1±9.9				45.0±10.2			0.467**
Sex									0.669*
Female	24				26				
Male	4				2				
Body mass index		28.0±5.2				27.7±4.8			0.754**
Symptom duration (month)		14.1±23.4	6	1-120		22.7±27.7	10	1-96	0.292***
Spur length (mm)		1.7±0.4	1.87	0.47-2.00		1.5±0.4	1.60	0.90-2.00	0.169***
Symptomatic foot									0.787*
Right	13				11				
Left	15				17				

SD: Standard deviation; * Chi-square test; ** T test; *** Mann Whitney U test.

TABLE 2
Changes in VAS scores over time between and within groups

VAS		Group 1 Mean±SD	Group 2 Mean±SD	p^*
Palpation	T_0	7.6±2.1	6.8±2.2	
	T_1	2.4±2.5	2.5±3.2	
	T_2	2.3±3.1	2.6±3.4	0.199
	T_3	2.0±3.0	2.4±3.3	
	T_4	1.3±2.6	1.9±3.4	
p^{**}		<0.001	<0.001	
Resting	T_0	3.9±2.9	2.5±2.9	
	T_1	1.2±2.1	1.6±2.8	
	T_2	1.6±2.9	1.9±3.2	0.106
	T_3	1.2±2.5	1.5±2.7	
	T_4	0.6±1.6	1.0±2.4	
p^{**}		<0.001	0.159	
Walking	T_0	6.2±2.7	5.0±3.0	
	T_1	2.4±2.5	2.5±3.2	
	T_2	2.3±3.1	2.6±3.4	0.199
	T_3	2.0±3.0	2.4±3.3	
	T_4	1.3±2.6	1.9±3.4	
p^{**}		<0.001	<0.00	
Activity	T_0	8.1±1.8	6.8±2.9	
	T_1	2.9±2.5	2.8±3.1	
	T_2	2.9±3.1	2.8±3.3	0.135
	T_3	2.3±2.6	2.5±3.0	
	T_4	1.3±2.2	2.0±3.5	
p^{**}		<0.001	<0.001	

VAS: Visual Analog Scale (0-10 cm); SD: Standard deviation; *: Statistically significance of the comparison of mean VAS between groups; **: Statistically significance of the comparison of mean VAS within groups; T0: Pre-treatment visit; T1: Second week visit after treatment; T3: First month visit after treatment; T4: Third month visit after treatment.

with PF in the hospital records. The patients were equally divided into two groups: Group 1, comprising patients who underwent a one-time local CS injection into the heel by the same physician, and Group 2, including patients who had gallium arsenide laser therapy at a wavelength of 904 nm lasting 10 sessions.

In Group 1, 1 mL of triamcinolone hexacetonide and 1 mL of lidocaine hydrochloride were applied to the most painful site of the affected heel. After the sterilization of the area to be injected, the CS and lidocaine were administered using a 23-gauge syringe into the most painful site of PF (usually the medial side of PF) only once.

The patients in Group 2 received gallium arsenide laser treatment with a wavelength of 90 nm for 150 sec onto five points (2J/cm^2, 3500 Hz) for 10 sessions. The laser device (Intelect mobile laser, 2015, Chattanooga®, UK) was used with a right angle directly onto the painful heel areas. The therapist and the patient used protective glasses during the treatment. The injection and laser treatment were applied by the same physician and the same therapist, respectively.

Assessments of pre-treatment, post-treatment, and two weeks, one month, and three months after the post-treatment evaluation were extracted from the hospital records. The post-treatment evaluation was accepted as the 10th day after the injection in Group 1 and as the time after the last session of the laser treatment in Group 2. Each visit was compared with the previous visit for within-group analyses.

TABLE 2
Continued (Post Hoc pairwise comparisons for Table 2)

	VAS palpation		VAS resting		VAS walking		VAS activity	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
T_0 *vs.* T_1	**<0.001**	**<0.001**	**<0.001**	0.999	**<0.001**	**0.018**	**<0.001**	**<0.001**
T_0 *vs.* T_2	**<0.001**	**<0.001**	**0.041**	0.999	**<0.001**	**0.021**	**<0.001**	**<0.001**
T_0 *vs.* T_3	**<0.001**	**<0.001**	**0.003**	0.999	**<0.001**	**0.013**	**<0.001**	**<0.001**
T_0 *vs.* T_4	**<0.001**	**<0.001**	**<0.001**	0.533	**<0.001**	**0.006**	**<0.001**	**<0.001**
T_1 *vs.* T_2	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
T_1 *vs.* T_3	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
T_1 *vs.* T_4	0.977	0.999	0.475	0.999	0.206	0.999	**0.008**	0.888
T_2 *vs.* T_3	0.999	0.200	0.999	0.999	0.999	0.999	0.936	0.945
T_2 *vs.* T_4	0.999	0.999	0.170	0.345	0.999	0.896	**0.033**	0.466
T_3 *vs.* T_4	0.402	0.999	0.570	0.999	0.999	0.999	0.128	0.999

VAS: Visual Analog Scale.

TABLE 3
Changes in FFI scores over time between and within groups

		Group 1	Group 2	
		Mean±SD	Mean±SD	p^*
FFI pain	T_0	59.1±11.8	56.6±14.6	
	T_1	28.6±22.3	26.7±24.4	
	T_2	25.0±25.7	23.8±24.9	0.596
	T_3	19.8±21.9	21.1±24.6	
	T_4	11.9±17.6	15.8±25.5	
p^{**}		**<0.001**	**<0.001**	
FFI disability	T_0	68.9±18.4	63.6±16.5	
	T_1	32.9±27.1	30.7±29.0	
	T_2	28.4±28.8	26.4±29.8	0.418
	T_3	23.0±27.7	23.2±29.7	
	T_4	12.4±20.5	17.9±31.0	
p^{**}		**<0.001**	**<0.001**	
FFI activity limitation	T_0	22.8±5.0	22.1±4.9	
	T_1	10.3±8.5	9.6±8.3	
	T_2	8.3±9.0	7.1±8.9	0.592
	T_3	7.0±8.5	6.5±8.8	
	T_4	3.6±6.7	5.1±9.8	
p^{**}		**<0.001**	**<0.001**	
FFI total	T_0	150.8±31.3	142.3±32.1	
	T_1	71.8±56.3	67.1±59.7	
	T_2	61.6±62.2	57.2±61.8	0.492
	T_3	49.8±56.8	50.8±61.3	
	T_4	27.8±44.2	38.8±65.4	
p^{**}		**<0.001**	**<0.001**	

FFI: Foot function index; SD: Standard deviation; *: Statistically significance of the comparison of mean FFI subscale between groups; **: Statistically significance of the comparison of mean FFI subscale within groups; T_0: Pre-treatment visit; T_1: Second week visit after treatment; T_3: First month visit after treatment; T_4: Third month visit after treatment.

The Visual Analog Scale (VAS), Heel Tenderness Index (HTI), and Foot Function Index (FFI) were evaluated at all control visits. Maximum pain in different situations (palpation, resting, walking on heels, and activity) was assessed by a subjective, 10-cm VAS, ranging from no pain (0) to maximum pain.[10] The FFI is a self-administered survey that measures the impact of foot pain on the quality of life of the patient. Turkish translation and adaptation of the FFI in patients with plantar fasciitis are available.[16] The FFI has three distinct subscales that assess pain, disability, activity restriction, and the sum of the subscales and consists of 23 questions in total. Patients are asked to score the severity of their complaints on a scale of 0 to 10. The physician's assessment of heel pain on palpation was done using the HTI (0= no pain; 1= painful; 2= painful and winces; 3= painful, winces, and withdraws).

Statistical analysis

Data were analyzed using IBM SPSS version 20.0 software (IBM Corp., Armonk, NY, USA). Quantitative data are summarized as mean ± standard deviation or median (range), and qualitative data are expressed as numbers (percentages). The Kolmogorov-Smirnov test was used for the normal distribution analysis. Student's t-test or the Mann-Whitney U test was used for comparing continuous variables between two groups. The chi-square test was used for the comparison of categorical variables. The repeated-measures analysis followed by the Bonferroni post hoc test was used to evaluate the change between baseline and follow-up measurements. A p value of <0.05 was considered statistically significant.

TABLE 3
Continued (Post Hoc pairwise comparisons for Table 3)

	FFI pain		FFI disability		FFI activity		FFI total	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
T_0 *vs.* T_1	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
T_0 *vs.* T_2	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
T_0 *vs.* T_3	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
T_0 *vs.* T_4	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
T_1 *vs.* T_2	0.999	0.995	0.878	0.999	**0.024**	0.063	0.921	0.567
T_1 *vs.* T_3	0.093	0.081	0.125	0.306	**0.031**	**0.011**	0.064	0.076
T_1 *vs.* T_4	**<0.001**	0.084	**0.001**	0.135	**0.001**	0.124	**<0.001**	0.089
T_2 *vs.* T_3	0.990	0.514	0.999	0.852	0.999	0.999	0.999	0.698
T_2 *vs.* T_4	**0.033**	0.129	**0.022**	0.098	0.047	0.999	**0.023**	0.153
T_3 *vs.* T_4	**0.007**	0.512	**0.022**	0.553	0.018	0.999	**0.008**	0.652

There were statistically significance between T_0 and T_1, T_2, T_3, T_4 in Group 1 and 2 for FFI pain, disability, activity limitation and total. There were statistically significance between T_1 and T_4, T_2 and T_4, T_3 and T_4 in Group 1 for FFI pain, disability and total. There were statistically significance for FFI activity limitation in Group 1 between T_1 and T_2, T_3, T_4 and in Group 2 between T_1 and T_3.

RESULTS

No significant differences were found between the groups in terms of patient demographics or clinical characteristics (Table 1). Statistically significant differences were not found between Group 1 and Group 2 pain values during palpation, rest, activity, and walking (p>0.05; Table 2). There were statistically significant differences in the within-group analyses of VAS subgroups (p<0.05; Table 2), except for the Group 2 resting VAS value (p=0.159; Table 2).

Statistically significant differences were not found between groups regarding the four subscores of the FFI (p>0.05; Table 3). At the same time, statistically significant differences were observed within groups for all subscores (p<0.001; Table 3). However, the decrease in score for all subgroups of FFI was greater in Group 1 compared to Group 2 (Table 3).

There were no statistically significant differences between groups for all visits regarding HTI scores (p>0.05; Table 4). Statistically significant differences were found at the post-treatment visit compared to pre-treatment in both groups (p=0.290 for Group 1; p<0.010 for Group 2; Table 4). Clinical improvement was observed in the comparison of subsequent visits for Group 1. Statistically significant differences were not found in post-treatment two weeks (pT1-pT2=0.999) in two groups, one month (pT2-T3=0.630) and three months (pT3-T4=0.530) in Group 1 compared to respective previous visits in the HTI values (Table 4). Although there were no statistically significant differences between the two-week post-treatment visit compared to the previous visit (p=0.999), statistically significant differences were found in the first month (p=0.020) and the third month (p=0.010) compared to previous visits in the assessment of HTI in Group 2 (Table 4).

TABLE 4
Quantitative change in patients over time between and within groups regarding HTI scores

		Group 1	Group 2	
	HTI	n	n	*p*
T_0	0*	1	5	0.080
	1*	12	15	
	2*	13	5	
	3*	2	3	
T_1	0*	16	18	0.310
	1*	10	5	
	2*	1	4	
	3*	1	1	
$P_{T0\text{-}T1}$		**0.290**	**0.010**	
T_2	0*	16	15	0.589
	1*	10	8	
	2*	2	4	
	3*	0	1	
$P_{T1\text{-}T2}$		0.999	0.999	
T_3	0*	14	18	0.144
	1*	13	6	
	2*	1	2	
	3*	0	2	
$P_{T2\text{-}T3}$		0.630	**0.020**	
T_4	0*	20	22	0.053
	1*	8	2	
	2*	0	2	
	3*	0	2	
$P_{T3\text{-}T4}$		0.530	**0.010**	

HTI: Heel tenderness index; T_0: Pre-treatment visit; T_1: Second week visit after treatment; T_3: First month visit after treatment; T_4: Third month visit after treatment; $P_{T0\text{-}T1}$: Statistically significance of the comparison of change of number between T_0 and T_1 within groups; $P_{T1\text{-}T2}$: Statistically significance of the comparison of change of number between T_1 and T_2 within groups; $P_{T2\text{-}T3}$: Statistically significance of the comparison of change of number between T_2 and T_3 within groups; $P_{T3\text{-}T4}$: Statistically significance of the comparison of change of number between T_3 and T_4 within groups; 0*: No pain; 1*: Painful; 2*: Painful and winces; 3*: Painful, winces and withdraws.

DISCUSSION

In this study, LLLT and local CS injection therapies used for the treatment of PF were compared. It was suggested that both types of treatment provide positive results on PF; however, LLLT seemed more effective at the end of the third month.

The underlying mechanism of PF is unclear. Although it is thought to be an inflammatory process, cardinal clinical signs of inflammation, such as heat, redness, and swelling, are generally not observed. However, classic histological signs are encountered.[5] Nonsurgical treatment options are frequently preferred, and CS injections are widely used in daily practice. As PF is an inflammatory process, it can be presumed that the mechanism of action of CS is due to its potent anti-inflammatory effect. Corticosteroids inhibit the synthesis of arachidonic acid from membrane phospholipids and suppress prostaglandin-related pain and inflammation.[8] One of the most important aspects of CS injections is to select the agent. It is recommended to use an agent with a high tissue resolution to avoid fluorinated compounds. Although the use of methylprednisolone and dexamethasone is recommended,[8] there are also studies using triamcinolone and betamethasone.[17,18]

In a meta-analysis, the effectiveness of CS injection has been compared with noninvasive treatment methods for PF.[13] These included shock wave therapy, physical therapy methods (e.g., exercise and subtalar traction), insole application, and oral nonsteroidal anti-inflammatory drugs. Authors reported that CS injection was more effective in first three months, especially in 1.5 months than other non invasive methods. The results of our study were similar to this study in pain (resting and palpation) and FFI scores. We have observed positive results at the third month in both groups; however, patients in the LLLT group have demonstrated better HTI scores at three months.

Laser has been used for the treatment of various musculoskeletal conditions, including subacromial impingement syndrome,[15] temporomandibular disorder,[19] and carpal tunnel syndrome,[20] and has been used for the treatment of PF in recent years. Çınar et al.[21] evaluated the effectiveness of LLLT in patients with PF. Authors stated that the LLLT group had lower pain scores. In addition, they reported that the effect of LLLT lasted up to three months when combinated with limb care. The parameters of laser therapy were similar to our study. Nevertheless, outcome measures used in Çınar et al.'s study were the American Orthopedic Foot and Ankle Society Score and a 12-min walking test, while FFI and HTI were used as outcome measures in the current study.

In a meta-analysis comparing various treatment modalities for PF, radial extracorporeal shock wave therapy, ultrasound, and focused extracorporeal shock wave therapy were suggested as alternative methods.[1] Furthermore, it was proposed that LLLT needs new evidence, particularly for the long-term use of 6 to 12 months, and suggested that LLLT had beneficial effects for two to four months. In our study, we followed patients for three months.

There are a few studies comparing CS injections and laser application in the treatment of various musculoskeletal disorders. In two of these studies concerning PF therapy, similar effects were reported.[22,23] Additionally, in a study on carpal tunnel syndrome, it was reported that LLLT, CS injections, and steroid phonophoresis had similar positive effects.[24]

We used the FFI and the HTI as the outcome measures in the current study and did not find any significant differences in FFI scores. Nevertheless, HTI scores were better in the LLLT group than in the CS injection group at the end of three months. This suggests that LLLT and CS injection both have positive effects on pain and function, but LLLT appears superior for heel tenderness, particularly in a relatively short period of three months in patients with PF.

There are two major limitations to this study. First, our study was not prospective in design, and although the study was retrospective, we tried to minimize this limitation by evaluating more follow-ups from the records. The other limitation was the low sample size due to the lack of complete data on files.

In conclusion, both LLLT and local CS injection therapies have positive effects for three months following treatment for PF. However, LLLT appears more effective than a local CS injection at the end of the third month in tenderness. Thus, LLLT is a noninvasive and relatively cheap treatment option, and it may be preferable in the nonpharmacological therapy of PF.

Ethics Committee Approval: The study protocol was approved by the Çukurova University Faculty of Medicine Local Ethics Committee (date: 13.06.2016, no: 4/53). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, design, analysis and/or interpretation: E.K., A.Y., B.K.; Control/supervision: E.K.; Data collection and/or processing: A.Y., B.K.; Literature review, writing the article, materials: A.Y., B.K.; Critical review: E.K., B.K.; References and fundings: A.Y.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

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