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A Comparison of the Efficacy of Dry-Needling and Extracorporeal Shockwave Therapy for Plantar Fasciitis: A Randomized Clinical Trial

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Abstract

Background: Plantar fasciitis (PF) is the most common cause of metatarsus pain.
Objectives: The current study aimed at comparing the improvement of pain and function in patients with PF treated with extracorporeal shockwave (ESWT) and dry-needling therapy.
Methods: The current single-blinded, clinical study was conducted on 72 patients with PF selected from the outpatient and rehabilitation clinics of Tabriz University of Medical Sciences, Tabriz, Iran from August 2016 to March 2017. Patients were randomly divided into two groups, and the subjects in the first group were treated with ESWT, while the second group were treated with dry-needling. The performance was evaluated based on FFI (Foot Function Index), and the pain level according to VAS (Visual Analogue Scale); subjects were evaluated at baseline, as well as four and eight weeks after treatment and the obtained results were compared and analyzed using appropriate statistical methods.
Results: The subjects' VAS and FFI scores significantly decreased compared with those of the baseline in both dry-needling and ESWT groups four and eight weeks after treatment ($P < 0.005$). Based on the criteria, no statistically significant difference was observed between the two groups four weeks after the treatment ($P = 0.732$ for VAS and $P = 0.578$ for FFI). However, eight weeks after treatment, significant changes were observed in pain reduction and FFI in the dry-needling group compared with the ESWT group (VAS: 1.7 ± 0.9 vs. 2.9 ± 1.9, $P = 0.013$ and FFI: 31.4 ± 28.0 vs. 50.4 ± 33.1, $P = 0.008$, respectively).
Conclusions: Both extracorporeal shockwave and dry-needling therapies were effective in plantar fasciitis treatment; despite the fact that the results of the current study revealed that dry-needling therapy was more effective than extracorporeal shockwave, at eight weeks after treatment.

Keywords: Dry Needling Therapy, Extracorporeal Shockwave Therapy, Fasciitis, Foot Function Index, Plantar, Visual Analogue Pain Scale

1. Background

Plantar fasciitis, the most common cause of heel pain (1), is an overload disorder that leads to successive microscopic damage in the plantar fascia and at the site of its attachment to the calcaneus bone (2). About 10% of people experience plantar fasciitis globally during their lifetime, and 20% - 30% of cases have a bilateral involvement (3, 4).

The disease is multi-factorial. Risk factors that may contribute to the heel pain include flat foot, heave arched foot associated with non-flexible curvature, post-planus (excessive pronation of the leg), overweight and obesity, contraction of the Achilles' tendon, unsuitable shoes (which supports the arch of the foot), and frequent micro- traumas in the runners (5, 6).

As with most types of overload injuries, the initial treatment follows the principles of PRICEMM including protection, activity change, holding up, stretching of the foot fascia, ice massage, and night splint (2). Non-steroidal anti-inflammatory (NSAIDs) drugs alongside other therapeutic modalities (in-situ steroid injections and subsequent therapeutic options) are commonly used for its treatment (7). Pain does not improve with conservative measures in 10% of patients, and long periods of applying these methods result in dissatisfaction in the treatment of plantar fasciitis (8).

Extracorporeal shockwave therapy (ESWT) is widely used as an alternative therapy for plantar fasciitis and some particular diseases. This is used from a few decades ago due to its non-invasive nature, rapid recovery, and com-

fort for daily living (9-11). Several studies evaluated the effects of ESWT and its comparison with other therapeutic modalities to treat plantar fasciitis (2, 12, 13). In a study by Metzner et al. (12), ESWT improved the pain of patients with plantar fasciitis by 30% in 81% of patients in a follow-up period of six weeks. A clinical trial by Mogtaderi et al. (14), showed that ESWT by both methods, shock wave therapy only for heel as well as the other parts of the leg eight weeks after treatment, effectively reduced the pain in plantar fasciitis. However, this decrease in pain criteria was significantly higher in the second group than the first group (14). Meanwhile, the results of a review published in 2005 did not reveal promising results of shockwave treatment for plantar fasciitis (15).

Dry-needling is a relatively new therapeutic approach, along with other rehabilitation treatments, performed by physicians and rehabilitation practitioners worldwide (16). Dry-needling and acupuncture, as the alternative and less invasive methods, specifically targets myofascial trigger points (17, 18). It has been observed that dry-needling changes the biochemical environment around the mowing points and reduces spontaneous electrical activity in the musculature of the skeletal muscles (19). In a blinded clinical trial conducted on patients with plantar fasciitis, the employment of dry-needling resulted in significant improvement in pain. The pain level was measured with a visual analogue scale (VAS) after four weeks of intervention compared with the control group ($P < 0.001$). However, there was no significant difference between the two intervention and control groups with regards to the range of motion of the ankle joint in dorsiflexion (ROMDF) and that of the ankle joint in plantar extension (ROMPE) (20).

Since functional limitations may occur if the problem is not properly treated and that the duration of occupational and exercise activities for the individual could be reduced, the current study evaluated the effect of dry-needling in comparison with high-energy shockwave therapy to treat plantar fasciitis in terms of pain, function, and healing in a clinical trial design. Also, in case of the same efficacy or better effect of dry-needling, it is recommended to use this low-cost treatment method. According to the search made in related scientific literature and medical search engines, there was no study on comparing the effect of ESWT and dry-needling on pain relief, performance improvement, and recovery rates in patients with plantar fasciitis.

2. Objectives

The current study aimed at comparing the efficacy of two common methods to treat plantar fasciitis, and finding a method with higher efficacy along with the results of further studies that can help to treat these patients better and more effectively.

3. Methods

3.1. Ethical Considerations

The current single-blind, randomized clinical trial, approved by the Ethics Committee of Tabriz University of Medical Sciences and the Physical Medicine and Rehabilitation Research Center, was conducted from September 2016 to March 2017 (Ethical Code: IR.TBZMED.REC.1395.562) and was registered in the Iranian Registry of Clinical Trials (IRCT201610014104N6).

The study objectives, the reason for their selection and participation in the study, the benefits, risks, and possible side effects of the study were systematically explained to the subjects. The confidentiality of participants' information in the current study was guaranteed and subjects signed consent forms. The current study was in accordance with the Helsinki Declaration.

3.2. Sample Size

The current study mainly aimed at evaluating pain based on VAS criteria in both groups. Based on the findings of a similar study (21) the standard deviation of the intervention and control groups was 2.80 and 2.89, respectively, and two units reduction in VAS was considered as the effect size. With a significant level of 0.05, test power of 0.8, and using a two-way test, the sample size of the study was determined 31 subjects in each group. Applying a 15% dropouts to the current study, the sample size was set to 36 subjects in each group and 72 in total.

3.3. Study Participants

First, patients diagnosed with plantar fasciitis, resulting from palatal pain ailment lasting over a month were selected from the outpatient and rehabilitation clinics of Imam Reza, Shahid Madani, and Shohada Hospitals affiliated to Tabriz University of Medical Sciences from August 2016 to March 2017 using routine clinical examinations and radiological examination, if needed. Then, the patients were referred to the Outpatient Clinic of Tabriz Shohada Hospital for further examination regarding inclusion and exclusion criteria and eligibility for assigning to the intervention group.

3.4. Inclusion and Exclusion Criteria

The trial recruited subjects meeting the subsequent inclusion criteria: age over 18 years, ability to understand instructions or complete the questionnaire, diagnosis of plantar fasciitis through the application of clinical guidelines of the International Classification of Function, Disability, and Health from the Orthopedic Section of the American Physical Therapy Association by an experienced physiatrist (22) for more than a month, heel pain in the first step during the last week with a severity of at least 20

mm in the VAS, referring to the Outpatient Clinic of Tabriz Shohada Hospital for initial evaluation and no analgesic, NSAIDs, or paracetamol use for at least 14 days before the initial assessment and during the intervention. The exclusion criteria were needling refusal, history of systemic inflammatory diseases such as rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis, coagulopathy detection or anticoagulant administration, except for ASA, at a maximum dose of 325 mg/day, history of plantar fascia surgery, pregnancy, dermatologic disease at needling place, history of direct trauma with or without foot fracture, history of local injections or physiotherapy during the past three months, history of peripheral arterial disease, heel pain associated with Achilles bursitis, and sensitivity to metals.

Finally, 72 patients clinically diagnosed with plantar fasciitis were enrolled in the current single-blind, randomized, clinical trial after signing the informed consent form.

3.5. Study Design

Simple randomization was performed using the random number generation function in a commercially available software program (Excel; Microsoft, Redmond, WA, USA) by a third party. A demographic questionnaire was completed for all patients including general characteristics such as age, gender, and history of previous illnesses. In the dry-needling group, 18-gauge needle was used, which was shaken slowly at the mowing point (medial plantar fascia) until the muscle was contracted. The mowing point is usually located on the medial side of the foot, which has maximum pain and tenderness. This point was diagnosed by experienced physicians and physiotherapists. Treatment was performed in a 30-minute timeline. The subjects were placed in a supine position to facilitate needle entering. Then, the needle was taken out a little and re-entered to produce the appropriate response. In case of the inadequacy of this process to reduce painful stimulus, the manipulation was stopped, and the needle remained in place until the patient tolerated and created an appropriate response. This procedure is based on the patient's response. The movement of the needle was repeated until the muscular twitch stopped. As soon as the muscular twitch stopped, the needle was kept in place for five minutes. A dry-needling treatment was given for one session, and in case of failure, a maximum of three sessions was performed.

In the shockwave therapy, ESWT was used as a radial method with high energy intensity and impulse intensity of 2000, an energy flux of 0.25 and frequency of 10 Hz for three sessions; one session weekly. The probe of the device was placed in the thighs (medial fascia or heel). All patients received conservative treatments including floor, shoes, and stretching exercises such as heel stretch and rotator cuff muscles. Patients were prohibited to use non-steroidal anti-inflammatory medications during their contribution in the current study due to their repressive properties on recovery procedure. Acetaminophen 500 mg was prescribed for pain relief in this period.

The effects of the interventions were evaluated three times (at baseline as well as after four and eight weeks of intervention) by experienced physicians and physiotherapists, and the data were compared and analyzed by statistical analysis. None of the participants were lost to follow-up or excluded during the trial period.

3.6. Study Evaluation

Patients scored their pain according to VAS using an 11-point scale based on the intensity of perceived pain (23). The intensity of the patients pain was marked on the scale and the severity of the pain was evaluated and compared with the pain observed and recorded at the intervention baseline, then at four and eight weeks after intervention, respectively.

In order to assess foot performance, a foot functional index (FFI) was used that consisted of a 17-item questionnaire, including five questions on pain and 12 questions regarding disability (24). The evaluator and analyst at the beginning and the end of the study were blind to the assignment of reviewers to the groups and used modalities.

The current study was single-blind; patients were conscious of being involved in the study and the group they were in at the time of intervention. Patients in each group were unaware of the other treatment groups. The investigators that assessed the study outcomes were blind to the allocated interventions. Also, the analyst was informed about the type of treatment in the groups. All evaluations were repeated at baseline as well as four and eight weeks after treatment by the same investigator.

3.7. Statistical Analysis

The data were analyzed with SPSS Statistics Software for Windows, version 16.0 (SPSS Inc. Chicago, ILL., USA). Descriptive statistics were employed including frequency distribution, mean $\pm$ standard deviation (SD), and minimum and maximum amounts. The Kolmogorov-Smirnov test was used to check the normal distribution of data. According to the results of this test, parametric and non-parametric tests were employed. Independent-samples *t*-test was used to compare the quantitative variables of the two groups. Chi-square and the Fisher exact test were employed to compare qualitative variables. A general linear model (GLM) for two factors, treatment (fixed) and time of evaluation as repeated measures, was run to determine whether any changes in the dependent variables were the results of the interaction between the type of treatment and time. The Mauchly sphericity test indicated that the assumption of sphericity was violated for both;

the Greenhouse-Geisser corrections were applied to the degrees of freedom (df). The pairwise comparisons were corrected using a Bonferroni adjustment. The principled approach to handling missing data was per protocol analysis. The GraphPad Prism version 6.04 for Windows, (GraphPad Software, La Jolla California, USA) was applied to draw the graphs. The type one error was $\alpha = 0.05$ and the study power was 80% with a type β error of 0.2.

4. Results

In the current study, 97 subjects were assessed out of which 85 were qualified to participate in the study. However, only 72 of them were randomly selected and assigned into two equal groups; 36 patients underwent ESWT, while the other 36 patients participated in the dry-needling process (see CONSORT flow-diagram in Figure 1).

Among the studied subjects, 18 patients (eight in the ESWT and 10 in the dry-needling groups) were male and 54 patients (28 in the ESWT and 26 in the dry-needling groups) were female. The qualitative analysis did not show a significant difference between the two groups (P = 0.786).

A total of 72 patients participated in the study, with an age range of 23 to 65 years old. The mean $\pm$ SD age of the patients was 44.1 $\pm$ 9.4 years; 43.2 $\pm$ 9.2 and 45.1 $\pm$ 9.69 years in the ESWT and dry-needling groups, respectively. The quantitative analysis did not show any significant difference between the two groups using independent samples *t*-test (P = 0.494). There was no significant difference in terms of other demographic variables (gender, education, employment, marriage, body mass index (BMI), etc. between the two groups (Table 1).

The comparisons between the two treatment groups in the same moment showed that in the baseline evaluation, there were no differences between the groups in terms of VAS value (P = 0.204) and FFI (P = 0.379) in the morning, indicating the homogeneity of the groups. Results of the baseline, as well as four- and eight-week follow-up sessions are listed in Table 2.

4.1. Intragroup Comparisons

In the four-week follow-up, the dry-needling treatment showed a significant improvement for both measured parameters compared with baseline values (P < 0.001). Improvement appeared to carry over to the eight-week follow-up (P < 0.001) (results not presented in the table).

In the ESWT group, a significant short-term improvement was observed in both measured parameters (P < 0.001). Apparent lasting benefits of shockwave therapy was identified in both measured parameters (P < 0.001) (results not presented in the table, as well as Figures 2 and 3).

4.2. Intergroup Comparisons

The patients in the dry-needling group had a significantly lower pain score based on VAS scale compared with those of the ESWT group (P = 0.013) in the eight-week follow-up; however, pain intensity did not differ significantly between dry-needling and ESWT groups in the four-week follow-up evaluation (P = 0.732) (Table 2 and Figure 2). The dry-needling group significantly performed better than the ESWT group in the last week of follow-up (P = 0.08) based on FFI, but there were no differences between the groups in the four-week follow-up (P = 0.578) (Table 2 and Figure 3).

No significant side effects were observed in the two groups except mild soreness in a number of patients in the dry-needling group.

5. Discussion

In the current study, 72 patients with plantar fasciitis were referred to physical and rehabilitation clinics of Tabriz Shohada Hospitals. Positive results were obtained on the efficacy of both dry-needling and ESWT methods in the short-term treatment of plantar fasciitis. This means that both methods of ESWT and dry-needling therapy were effective. However, eight weeks after treatment, the effect of dry-needling therapy on pain relief and improvement of patient function was significantly improved.

Plantar fasciitis is a musculoskeletal condition that is mostly observed on feet and mainly involves plantar fascia (25, 26). Despite the high prevalence of plantar fasciitis and its negative effects on the quality of life (22, 27, 28), the applied conservative therapies are pending treatments; optimal treatment for this disease is not clearly suggested (22).

From the mid-nineties, shockwave is employed to treat some musculoskeletal diseases such as lateral epicondylitis, calcification in the shoulder, and heel thorns. ESWT probably has a role to treat patients with chronic plantar fasciitis before considering more aggressive treatments. ESWT uses non-intrusive and high-energy audio waves produced from an external device on the skin and through the layers of the tissue and appears to promote repair (29). In the ESWT, electromagnetic, piezoelectric, and electro-hydrolysis methods are employed to generate waves. Two mechanisms are proposed for its effectiveness. First, transmitted waves affect the physiology of pain receptors. Secondly, the transmitted waves result in tissue repair through the formation of microtrauma and release molecular and growth factors (30).

A review study on the evidence of the ESWT used in plantar fasciitis showed that shockwave treatment worked more efficiently than placebo or manipulated shockwave (31, 32) and botulinum toxin injection (33) to treat pain. However, its effect was lower than that of corticosteroid

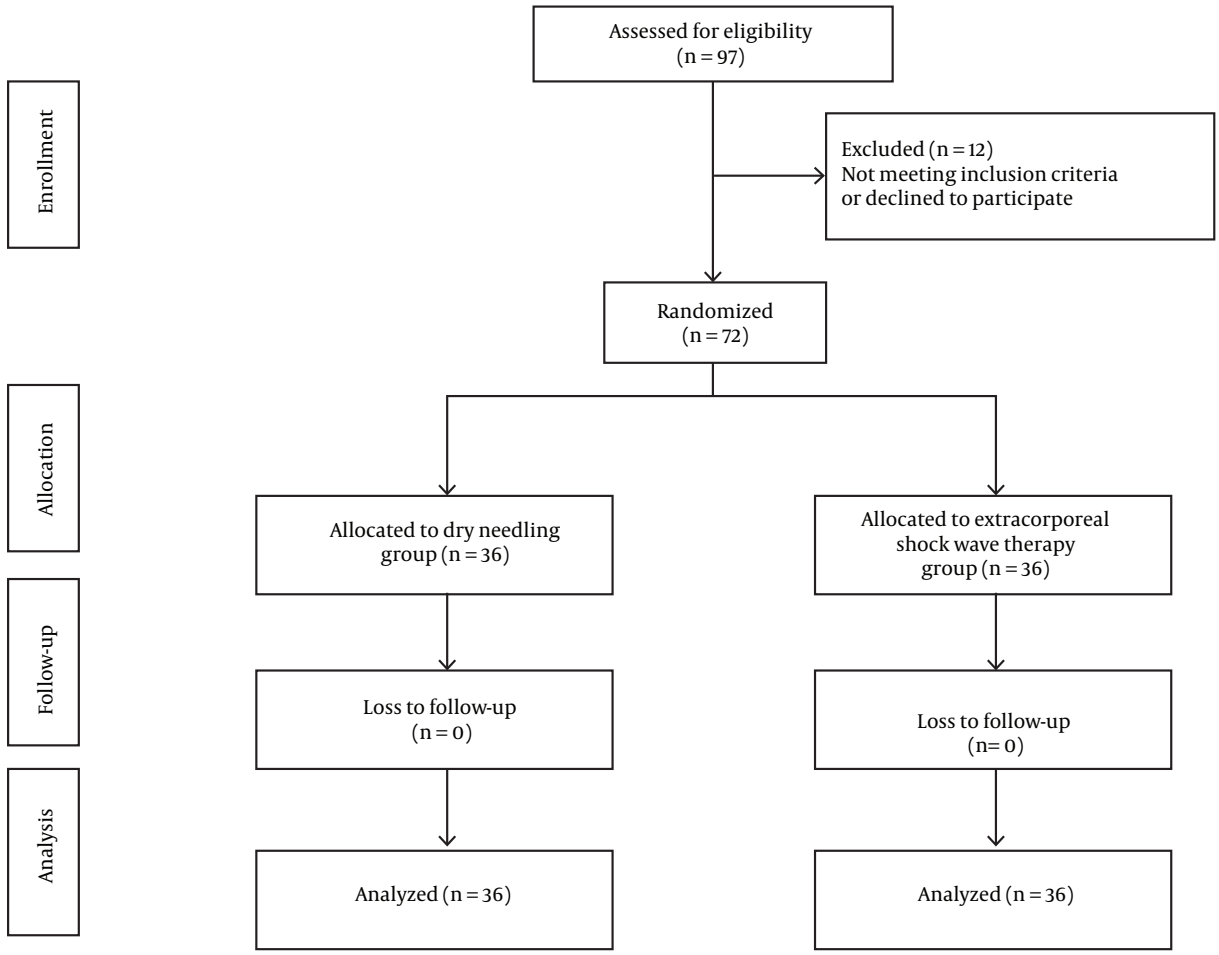

Figure 1. CONSORT 2010 flow-diagram for the randomized clinical trial of the efficacy of dry-needling and extracorporeal shockwave therapy for plantar fasciitis

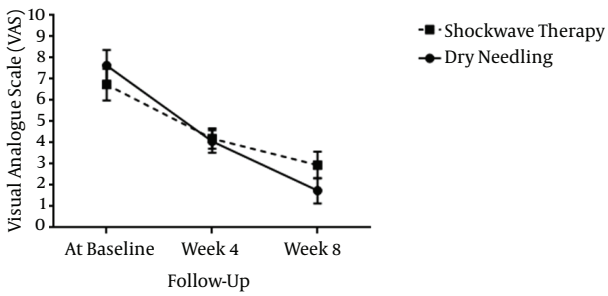

Figure 2. Trend of changes in visual analogue scale throughout the study

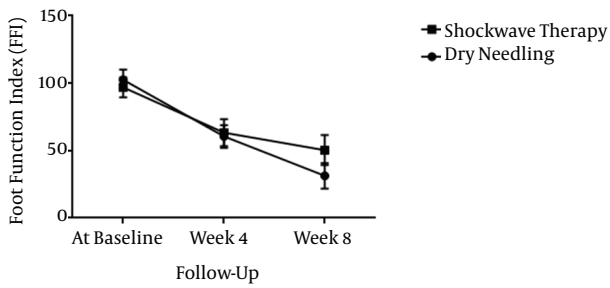

Figure 3. Trend of changes in foot function index throughout the study

injection (34), endoscopic surgery (13), and possibly a rehabilitation program (in the early stages of the disease) (35) alone. Pain is the primary symptom complaint of patients with plantar fasciitis. Pain perceived on medial calcaneal tubercle is commonly intolerable in the first step in the morning, and this pain diminishes slightly after a few steps and augmented again after long-lasting activity and also before bedtime at nights (36). Also, it appears

Table 1. Baseline Comparison of Demographic and Anthropometric Characteristics of the Participants[a]

Variable	Dry-Needling Group	ESWT Group	P Value[b]
Age, y	45.08 ± 9.61	43.22 ± 9.20	0.605
Gender		8 (22.22)	0.589
Male	10 (27.77)		
Female	26 (72.22)	28 (77.77)	
Education level			0.955
Illiterate	1 (2.77)	0 (0.00)	
Under diploma	11 (30.55)	15 (41.66)	
High school diploma	22 (61.11)	15 (41.66)	
Academic education	2 (5.55)	6 (16.66)	
Employment			0.456
Unemployed	22 (61.11)	19 (52.77)	
Employed	12 (33.33)	14 (38.88)	
Retired	2 (5.55)	3 (8.33)	
Marital status			0.944
Single	2 (5.55)	4 (11.11)	
Married	27 (75)	23 (63.88)	
Divorced and other	7 (19.44)	9 (25)	
History of chronic diseases			0.854
No	25	24	
DM	3	3	
HTN	3	5	
Hypothyroidism	4	3	
Others	1	1	
SBP, mmHg	130.00 ± 11.46	134.86 ± 8.90	0.137
DBP, mmHg	75.41 ± 13.00	69.72 ± 14.03	0.806
Weight, Kg	69.17 ± 7.01	73.39 ± 6.37	0.787
Height, m	1.65 ± 0.06	1.63 ± 0.05	0.852
BMI, Kg/m^2	25.10 ± 1.84	27.62 ± 2.43	0.512

Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; ESWL, Extracorporeal Shockwave Therapy; SBP, systolic blood pressure.
[a] Numeric scales are expressed as mean ± SD, and categorical measures are reported as No. (%).
[b] P value less than 0.05 was considered significant.

that the ESWT is a better modality after the initial period of other therapies. However, according to a study by Eslamian et al. (21), patient satisfaction and recovery rates were higher in ESWT than the local corticosteroid injection. A recent study suggested ESWT as a safe and effective treatment with desirable outcomes in the alleviation of pain and improvement of function of the foot. Acceptable reductions in magnetic resonance imaging (MRI) results including thickening of the plantar fascia, soft-tissue edema, and bone marrow edema were observed after ESWT (37). In a study by Vahdatpour et al. (38), both fictitious and real ESWT treatment significantly reduced pain criteria; however, this reduction was significantly higher in the ESWT group. Also, sonographic findings showed an increase in plantar fascia thickness in the control group and a decrease in that of the intervention group. In the study, the selection of a group of patients as the control group could demonstrate the actual effectiveness of ESWT. The efficacy of ESWT in long-term treatment of plantar fasciitis with that of the radiofrequency thermal lesioning (RTL) was also compared. Based on the results, pain and function criteria improved in the ESWT group, one, three, and six months after treatment (39).

The effects of ESWT on foot function improvement in

Table 2. Comparison of the Variables in the Two Groups at Different Intervals[a]

Variables and Time Points	Dry-Needling	ESWT	Total	Test Result	Pairwise Comparisons	
					Dry-Needling vs. ESWT	P Value[b]
Visual Analogue scale in the morning						
At baseline	7.6 ± 2.2	6.7 ± 2.1	7.2 ± 1.5	$F_{(time)}$ (1.65, 108.70) = 111.551, P < 0.001	At baseline	0.204
Week 4	4.1 ± 1.5	4.2 ± 1.5	4.1 ± 1.0		Week 4	0.732
Week 8	1.7 ± 1.7	2.9 ± 1.9	2.3 ± 1.3		Week 8	0.013
Total	4.5 ± 1.0	4.6 ± 0.9				
Test result	$F_{(group)}$ (1, 66) = 0.375, P = 0.542			$F_{(group\ time)}$ (1.65, 108.70) = 4.59, P = 0.018[b]		
Foot function index						
At baseline	102.5 ± 29.7	96.9 ± 21.5	99.72 ± 15.67	$F_{(time)}$ (1.63, 113.84) =106.82, P < 0.001	At baseline	0.379
Week 4	60.6 ± 24.9	63.3 ± 29.7	61.94 ± 18.3		Week 4	0.578
Week 8	31.4 ± 28.0	50.4 ± 33.1	40.86 ± 21.12		Week 8	0.008
Total	64.81 ± 17.64	70.21 ± 16.72				
Test result	$F_{(group)}$ (1, 70) = 2.084, P = 0.153			$F_{(group\ time)}$ (1.63, 113.84) = 4.67, P = 0.017[b]		

Abbreviation: ESWL, extracorporeal shockwave therapy.
[a] All values are expressed as Mean ± SD.
[b] P value less than 0.05 was considered significant.

patients with plantar fasciitis was also observed in previous studies (21, 29, 39). However, FFI reduction was significantly higher in the ultrasound treatment group. Foot sensation also increased in the ESWT-treated group (40). In the current study, the effectiveness of ESWT eight weeks after treatment on FFI was less than that of the dry-needling therapy.

In terms of side effects, ESWT, especially newer musculoskeletal devices have a good performance and few side effects are reported. However, there are reports of a possible migraine or faint trigger (41). However, no significant side effects were observed in the current study.

Dry-needling is another medical treatment employed to treat plantar fasciitis in recent years, and it is increasingly used by physical medicine and rehabilitation specialists. In this method, the myofascial trigger point (MTP) stimulation is used to treat musculoskeletal pain (42). Based on the results of a meta-analysis of clinical trials, dry-needling and acupuncture MTP were slightly more advantageous over placebo to treat musculoskeletal pain (43). Cotchett et al. (44), described substantial heel pain alleviation in subjects undergoing real dry-needling compared with patients undergoing sham dry-needling. At the same time, Eftekharsadat et al. (20), showed that dry-needling therapy improved both pain and performance criteria in comparison with placebo four weeks after treatment. The author described the dry-needling as a good alternative to the aggressive treatment. Furthermore, the efficacy of mini scalpel-needle (MSN), a new medical device to manage plantar fasciitis, is recently experienced. According to the results, MSN pain alleviation was higher than that of the steroid injection (45). Rastegar et al. (46), compared the potency of dry-needling and corticosteroid injection in pain alleviation in plantar fasciitis. Steroid injection, compared with dry-needling, diminished pain scores rapidly until few weeks after baseline. However, subjects undergoing dry-needling stated lower pain scores after 12 months of follow-up compared with the ones undergoing the steroid injection.

In the current study, despite a significant improvement in the pain of patients treated with ESWT, the dry-needling therapy was effective compared with ESWT four weeks after treatment and more effective eight weeks after treatment.

In line with the results of the current study, Chew et al. (47), showed that both autologous conditioned plasma (ACP) and ESWT treatment with concomitant treatment compared with conventional therapy that only improved one, three, and six months after treatment, improved pain and function criteria. Although there was no significant difference between the pain and functional scales of the two groups, the reduction of plantar thickness was lower in the ESWT group.

Little is proposed about the potential pathways of dry-needling for pain decrement, though several mechanisms of action are suggested for acupuncture therapy of acute

or chronic pain. Central excretion of opioid peptides, augmented local blood flow, and anti-inflammatory properties of this treatment were suggested previously (48).

Mild treatment soreness and fainting are reported as side effects of dry-needling in few studies (49, 50). No safety problems are reported in other studies (51). Mild soreness applies to a number of the current study patients, which resolved spontaneously within 12 - 24 hours of needling. None of the participants experienced fainting during the treatment period.

The current study had some limitations including non-random sampling, using subjective assessments, no control group, and no evaluation of long-term effects. The pain of plantar fasciitis focused on the medial plantar region of the heel; therefore, it was used as the location for dry-needling. Ultrasonography or other imaging techniques were not employed to guide needles. In addition, outcome evaluations such as walking distances, flexor muscle performances, and fatigue levels can complete the assessment of patients.

It is recommended that longer follow-up clinical trials be designed to find out long-term outcomes using different performance domains.

5.1. Conclusions

The results of the current study indicated that both ESWT and dry-needling therapy methods significantly reduced the pain score at four and eight weeks after treatment by VAS and FFI score in comparison with the baseline. There was no significant difference between the two groups four weeks after treatment in terms of these two criteria. However, eight weeks after treatment, pain reduction and FFI were significantly higher in the dry-needling group.

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Footnotes

Authors' Contribution: Mohammad Rahbar and Ali Kargar contributed to research conduct and reporting. Fatemeh Jahanjoo contributed in data collection as well as drafting or reviewing the manuscript. Fariba Eslamian contributed in clinical examinations and data collection as well as drafting or reviewing the manuscript. Vahideh Toopchizadeh contributed in clinical examinations and data collection and drafting or reviewing the manuscript. Neda Dolatkhah contributed of research conduct and reporting.

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