Chettinad Health City Medical Journal
Volume 11, Issue 4 - 2022, Pg. No. 79-85
Peer Reviewed & Open Access Journal

Review Article

Effect of Extracorporeal Shock Wave Therapy on Pain in Plantar Fasciitis: A Review Study

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DOI: https://doi.org/10.24321/2278.2044.202243

I N F O

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How to cite this article:
Gangani K, Chauhan P, Kaur A. Effect of Extracorporeal Shock Wave Therapy on Pain in Plantar Fasciitis: A Review Study. Chettinad Health City Med J. 2022;11(4):79-85.

Date of Submission: 2022-05-10
Date of Acceptance: 2022-11-24

A B S T R A C T

Background: The most frequent cause of discomfort in the inferior heel is plantar fasciitis, and Extracorporeal Shock Wave Therapy (ESWT) is one of the most effective therapy for plantar fasciitis. It was aimed to determine how extracorporeal shock wave therapy would affect plantar fasciitis.

Method: Studies were searched on Google Scholar and PubMed over the last 10 years. Randomised Control Trials (RCT), meta-analysis, cohort, and observational studies which used extracorporeal shock wave therapy for the treatment of plantar fasciitis were included and the primary outcome of this study is variation in pain relief.

Results: Patients with persistent plantar fasciitis who had extracorporeal shock wave therapy showed a moderately positive correlation with reduced pain and improved foot function of individuals.

Conclusion: Extracorporeal shock wave therapy is effective in decreasing pain in patients with plantar fasciitis.

Keywords: Extracorporeal Shock Wave Therapy, Plantar Fasciitis, Pain

Introduction

In early 1990, Extracorporeal Shock Wave Therapy (ESWT) has been started to be utilised for effectiveness in treating a patient with musculoskeletal conditions such as shoulder calcific tendinosis, chronic plantar fasciitis, and painful tendinosis.[1,3] Treatment of extracorporeal shock wave therapy has been proposed as a possible treatment for a patient with a chronic condition.[2] A high-energy sound wave that ends in a burst of energy resembling a mini-explosion is referred to as a "shock wave".[4] Extracorporeal shock wave therapy has been advanced from extracorporeal shock wave lithotripsy. Adverse effects can be explained, for instance, pain during the use of extracorporeal shock wave therapy itself. In addition to a slight skin reddening, petechial bleeding may also occur in the skin when high energy or high contact pressure of the tool on the muscle tissue. Extracorporeal shock wave therapy can increase the rate of the healing of tissue, however fundamentals like immobilisation during bone healing must still be followed; otherwise, regenerative tissue would be damaged during each movement of the fracture gap. It is very impressive to emphasise to the patient that recovery takes time.[5]

The most effective conventional treatment for heel pain, including plantar fasciitis and Achilles tendon insertion

tendinopathy, has been extracorporeal shock wave therapy. Extracorporeal shock wave therapy is a safe treatment that has very few side effects, such as pain during therapy and minor hematoma, but it has no other severe complications. So it is performed as recommended in clinical activities.[5] It utilises 5 to 130 Mpa high peak pressure, with a broad frequency of 14 Hz to 120 MHz.[1] Extracorporeal shock wave therapy provides a long-lasting analgesic effect and promotes the healing process.[4,5]

The term "Plantar fasciitis" is typically a self-limiting inflammatory condition and a prevalent cause of inferior heel pain, which affects 10% of the population, often seen in athletes and sedentary individuals.[6,7] It is caused by damage to the origin of the plantar fascia or because of bio-mechanical abnormalities of the foot.[3,6] Although the suffix "-it is" suggested an inflammatory condition, it is also associated with non-inflammatory changes.[8] A patient who suffers from plantar fasciitis may experience inferior heel pain with the first few steps in the morning or after a prolonged period of standing, sitting, or rest, and may report a gradual onset of pain.[6] The condition is seen highest between the age group of 40 and 60 years.[9] Due to the poor quality of the method used in previous studies, the effectiveness of extracorporeal shock wave therapy in treating plantar fasciitis cannot be determined. Therefore, in this review, we have evaluated the effect of extracorporeal shock wave therapy on plantar fasciitis.

Methodology

We have looked for all English articles using the following databases: PubMed and Google Scholar, which were added to search articles such as English articles, and articles from the past 10 years (from 2012 to 2022). The following keywords have been used in the searches extracorporeal shock wave therapy, plantar fasciitis, the effect of extracorporeal shock wave therapy in plantar fasciitis, and after which articles were searched by abstract and title. An observational study, meta-analysis, and randomised controlled multicentre trial were included, and articles not relevant to the topic and do not show any relation between extracorporeal shock wave therapy and plantar fasciitis were excluded. We identified 186 records from the searches after the removal of duplicate data. There were no other statistics from different data sources that were found. We intentionally removed 160 records after reviewing the titles and abstracts, because they dealt with the effect of extracorporeal shock wave therapy on different diseases, were ongoing trials, and retrospective studies were published in languages other than English, and were completely unrelated articles. Following more evaluation, 20 research studies had been considered to meet the appropriate review criteria. We also manually screened reference lists of previous randomised control trials, meta-analyses, cohorts, and observational studies of plantar fasciitis. The outlining of the process of study methodology is seen in the flowchart (Figure 1).

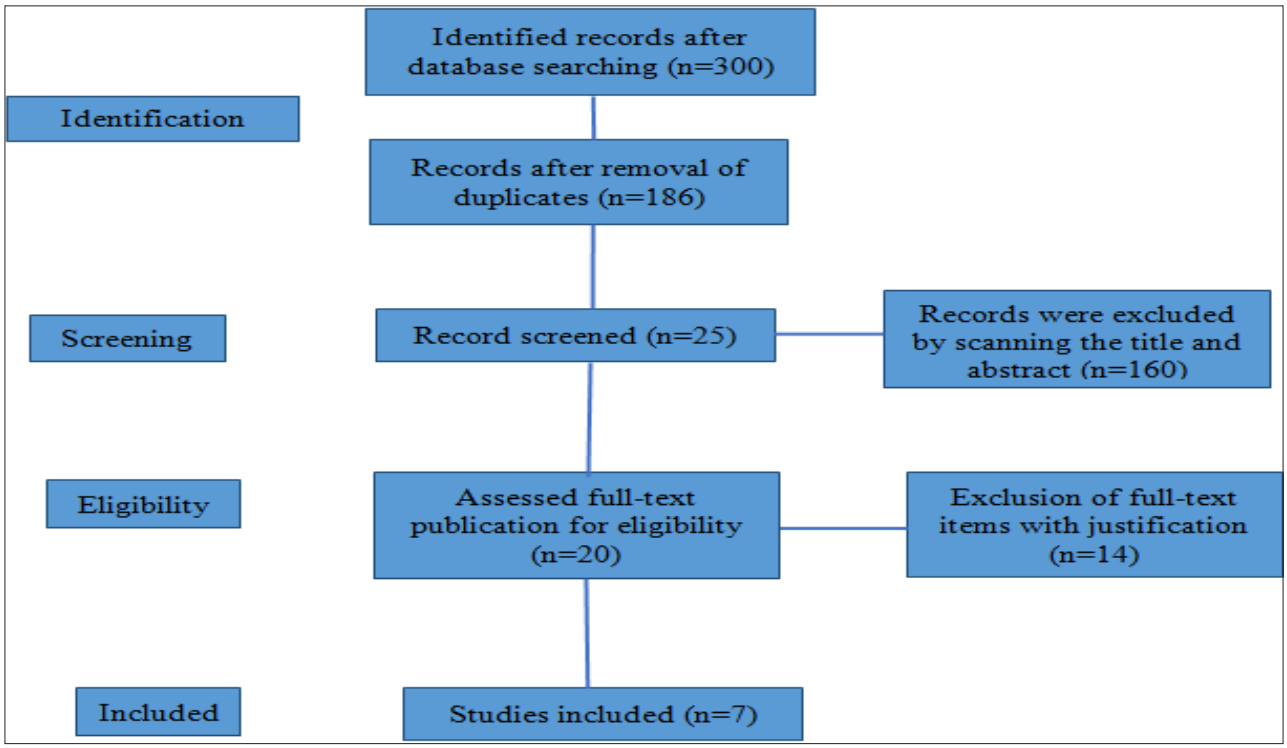

Figure 1.Flowchart Illustrating the Process of the Research, Identification, Inclusion, Eligibility and Exclusion, and Screening

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202243

Table 1.Key Characteristics of Studies

Characteristics of the Included Studies											
Outcomes (Mean ± SD) (VAS)											
Treatment Dose	**Average Age (years)**	**No. of Patients**	**0-6 Weeks**	**2-4 Months**	**6-12 Months**	**Author**	**Year of Publication**	**Type of Study**	**Duration of Condition (Months)**	**Intervention**	**Method**
ESWT 1 Therapy per week for 3 weeks (30 minutes)	60-65	10	5.30 ± 0.82	3.80 ± 0.78	NA	Kim TG et al.[11]	2015	Observational	≥ 6	ESWT	15 mm depth vertically 1500 times, at 4 Hz, 00089 mJ/mm^2
ESWT once a week for 5 weeks KT repeated every five days for five weeks	40-55	80	5.5 ± 1.1 5.6 ± 1.0	NA	NA	Ordahan B et al.[12]	2017	RCT	-	ESWT KT	12-15 Hz frequency, 2500 pulses KT application from calcaneus bone to metatarsal joints
Weight-bearing exercise for 4 weeks and apply ice after ESWT application after 6 weeks	42	76	2.5 ± 2	NA	NA	Richard L. Purcell et al.[8]	2017	Cohort	≥ 6	ESWT	24 kV for 2000 shocks without local anaesthesia
ESWT at 1 session per week and CFO at least 6 hours per day for 4 weeks	30-60	83	3.9 ± 1.7 4.1 ± 1.8	NA	NA	Caglar Okur S et al.[13]	2019	RCT	6	ESWT CFO (Custom Foot orthosis)	2000 pulses at 12 Hz frequency 1 mm thick polyethylene thermoplastic insole used for CFO

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202243

ESWT gave for 12 weeks	> 18	60	5.74 ± 2.81	5.08 ± 3.24	NA	Renan Goncalves Lea et al.[7]	2020	Meta-analysis	≥ 6	ESWT	900 pulses of 2% lidocaine hydrochloride in 5 ml of an anaesthetic block with 0.13 J/mm^2 frequency of 4 pulses/s
KT was left for 1 week for 3 weeks and ESWT for 3 weeks	18-65	45	8.3 ± 1.5 7.8 ± 2.0 7.6 ± 1.6	NA	NA	Yeliz Bahar-Ozdemir et al.[10]	2020	Single-centred, double-blinded RCT	6	ESWT& Low-dye taping ESWT& Sham taping ESWT	5 sessions at 11 Hz frequency, 3000 shock waves, and 2.5 density of KT with 50% tension (low-dye and sham)
Under local anaesthetic, every two weeks plus or minus two days (3 × 4000 impulses) for ESWT and placebo therapy	53	272	3.1 ± 2.4 2.7 ± 2.5	2.4 ± 2.6 2.4 ± 2.5	NA	Michael Haake et al.[4]	2022	Multicentre trial RCT	> 6	ESWT Placebo	4000 impulses of 0.08 mJ/mm^2 with 2 ml anaesthesia 7.5 MHz linear array ultrasound

ISSN: 2278-2044
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Results

According to observational, randomised control trials, meta-analysis, and cohort studies different interventions were used, such as extracorporeal shock wave therapy, Kinesio taping (sham taping and low-dye taping), and custom foot orthosis in the treatment of plantar fasciitis. The studies taken for this study were between 2012 and 2022. The subjects were taken for all the studies over 18 years and all the participants showed the symptoms from the last 6 months or more than 6 months. The frequency used in extracorporeal shock wave therapy was between 12 to 15 Hz in one study that was 7.5 MHz, and the shock waves were used between 900-3000 pulses. The treatment dose was different for each study, i.e. between 3 weeks to 12 weeks, the treatment session was given once a week.

The outcome measure was based on a pain grading scale (i.e. visual analogue scale), and for that mean and standard deviation were calculated. The outcome means for all the studies for 0-6 weeks, 2-4 months, and 6-12 months follow-up duration have been mentioned in Table 1. The results showed there was a statistically significant improvement in pain scale after treatment of extracorporeal shock wave therapy compared to other interventions, like Kinesio taping (sham taping and low-dye taping), placebo effect, and custom foot orthosis. The outcome of RCT studies, mean ± SD of ESWT and KT was 5.5 ± 1.1 and 5.6 ± 1.0; ESWT and CFO were 3.9 ± 1.7 and 4.1 ± 1.8; ESWT + low-dye taping, ESWT + sham taping and ESWT were 8.3 ± 1.5, 7.8 ± 2.0 and 7.6 ± 1.6, and ESWT and placebo were 3.1 ± 2.4 and 2.7 ± 2.5 for 0-6 weeks. The result of the study is shown in the table. All in all, extracorporeal shock wave therapy is a more effective treatment for reducing pain in plantar fasciitis.

Discussion

Heel pain is one of the most common symptoms of plantar fasciitis. Whereas standing and walking made the symptoms worse. The aetiology and mechanisms do not clear, however, studies have found that this inflammatory condition is closely associated with strain and bone degeneration. The treatment of heel pain is mainly analgesic. The treatment strategies encompass two categories: conservative treatment and surgical treatment. Conservative treatment is local physical therapy, local blocking, activating blood circulation, and so on. Surgical treatment can be taken into consideration whereas conservative treatment is ineffective. The surgery is selected according to the cause of the condition. Lateral nerve transactions may help improve symptoms. In calcaneal bone spurs, spur resection is used, however, sometimes bone spurs grow again or get worsen.

We found that 2-3 weeks makes extracorporeal shock wave therapy an attractive alternative to the treatment of chronic plantar fasciitis as opposed to ineffective treatment. These comparisons might have some valid limitations as a result of the extracorporeal shock wave therapy follow-up being statistically totally different from our all studies. Plantar fasciitis is often successfully treated in an exceedingly conservative way in most cases. Patients with recalcitrant symptoms, who have received a full program of treatment for 6 months, or patients who have had this inflammatory condition for over 12 months are less likely to respond to maintenance measures.

The result of Kim TG et al.'s[11] study suggests that the application of extracorporeal shock wave therapy to hemiplegic patients with plantar fasciitis has a sensible impact on the thickness of the plantar fascia, spasticity, reduction of pain, and gait performance. So they can consider that extracorporeal shock wave therapy helps in improving expansibility in the plantar fascia and spasticity and helps to alleviate pain and enhance gait ability.

Ordahan B et al.[12] concluded that both extracorporeal shock wave therapy and Kinesio taping treatments improved pain grades and performance and quality of life in everyone with plantar fasciitis. Both methods are equally effective in treating plantar fasciitis. In addition, case-control studies showing the long-term effects of both treatments should be conducted.

The other study by Purcell RL et al.[8] shows the result, that extracorporeal shock wave therapy is both effective and lasting for the management of plantar fascia pain in active patients. Extracorporeal shock wave therapy might heighten its appeal for those who desire to quickly resume activity with minimal associated morbidity. Other prospective randomised controlled trial studies are secured to clarify the precise treatment modality for chronic plantar fasciitis within the active versus non-active population.

Caglar Okur S et al.[13] found that the use of custom foot orthosis was as effective as extracorporeal shock wave therapy treatment. There are several conservative treatment modalities for plantar fasciitis because it is rather common within the general population, incorporates a tendency to persist for months, and could be a condition that provokes significant disability in a number of the cases found that extracorporeal shock wave therapy and custom foot orthosis were effective modalities in reducing foot pain, improving foot functions and maintaining foot health within the treatment of plantar fasciitis.

Moreover, after they compared the two methods with one another, there was no superiority between the two ways in terms of short and mid-term effects. However, custom foot orthosis was more effective than extracorporeal shock wave therapy in alleviating pain, improving foot functions, and maintaining foot health for the long term.

ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202243

Leao RG et al.[7] concluded that shock wave therapy was helpful in plantar fasciitis treatment, which is taken into the result of improvement in pain grades, function, and quality of life. They might not establish an association between body mass index and therefore the response to the planned treatment.

Bahar-Ozdemir Y and Atan T[10] stated that application with adjuvant low-dye Kinesio taping and extracorporeal shock wave therapy did not provide any vital benefit on pain and tenderness in heel, it was found to be superior to adjuvant sham-taping and extracorporeal shock wave therapy alone in rising foot function because of plantar fasciitis within the 4 weeks follow-up. Extracorporeal shock wave therapy is likewise associated with useful treatment within the treatment of plantar fasciitis, however, the utilisation of combined treatments with taping, which is an easily applicable method for this patient population, might provide long-term relief. Studies involving larger sample sizes with follow-up periods longer than 3 months are required to evaluate this additional accurately. The result of Haake M et al.'s[4] study is valid for therapeutic variables applied. As the variables they examined replicate the real setup of extracorporeal shock wave therapy, that does not show the limitation of the study. The overall energy of shock waves was higher in their trial correlated to the previous studies. Although the use of various treatment interventions may cause different results, the evidence for this might simplest be acquired from clinical trials with adequate study designs. They cannot advocate specific applications of extracorporeal shock wave therapy to be tested in further clinical analysis as a result of all fundamental trials, using different shockwave variables and kinds of lithotripters, which showed negative consequences.

Extracorporeal shock wave therapy provides a safe and reliable effect in easing the pain related to plantar fasciitis. Maintenance measures of at least 6 months must be completed before extracorporeal shock wave therapy use. Due to its high level of success and lack of risk and complications, extracorporeal shock wave therapy may be used in the future as a line of treatment. Further research will be needed to evaluate the physiological and anatomical effects on the plantar fascia following extracorporeal shock wave therapy. A large number of patients and follow-up for six months or longer will help to determine the "treatment results" of extracorporeal shock wave therapy in plantar fasciitis.

Conclusion

The results of this review provide evidence of extracorporeal shock wave therapy's effectiveness in decreasing pain in patients with chronic plantar fasciitis. This promising intervention could alleviate the risk of surgery. Even though pain may occur after the use of extracorporeal shock wave therapy, it has been recognised that it is tolerable and quickly resolved. It might be fascinating to determine the lowest and most effective intensity and also the short duration length and frequency of extracorporeal shock wave therapy to produce the pain relief that may be utilised in clinical activities. There is additionally a requirement to determine the result of extracorporeal shock wave therapy in acute plantar fasciitis. The overall pooled effects of shock waves and dosage levels of chronic plantar fasciitis require further investigation.

Abbreviations: ESWT (Extracorporeal Shock Wave Therapy), RCT (Randomised Control Trial), CFO (Custom Foot Orthosis), KT (Kinesio Taping), VAS (Visual Analogue Scale).

Source of Funding: None

Conflict of Interest: None

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ISSN: 2278-2044
DOI: https://doi.org/10.24321/2278.2044.202243