

COMPARISON OF EFFICACY OF SHOCK-WAVE THERAPY VERSUS INJECTION THERAPY (CORTICOSTEROIDS & PLATELET-RICH PLASMA) IN TREATMENT OF PLANTAR FASCIITIS

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Abstract

Background: The argument on whether extracorporeal shock-wave therapy (ESWT) and exert an equivalent pain control or which is the better treatment for plantar fasciitis (PF) in adults remains to be resolved. It is important and necessary to conduct a meta-analysis to make a relatively more credible and overall assessment about which treatment method performs better pain control in treatment of PF in adults. **Methods:** The Embase, PubMed, Web of Science, and Cochrane Library electronic databases were searched for all relevant studies. Only randomized controlled trials (RCTs) focusing on comparing ESWT and CSI therapies in PF cases in adults were included. The primary outcome measure was visual analog scale (VAS) reduction, whereas the secondary outcomes included treatment success rate, recurrence rate, function scores, and adverse events. **Results:** In the present study, our analysis showed that high-intensity ESWT had superior pain relief and success rates relative to the CSI group within 3 months, but the ESWT with low intensity was slightly inferior to CSI for efficacy within 3 months. In addition, patients with CSI may tend to increase the need for the analgesic and more adverse events may be associated with the ESWT. However, the ESWT and CSI present similar recurrent rate and functional outcomes. **Conclusion:** Our analysis showed that the pain relief and success rates were related to energy intensity levels, with the high-intensity ESWT had the highest probability of being the best treatment within 3 months, followed by CSI, and low-intensity ESWT. More high-quality RCTs with long-term follow-up time are needed to further compare the differences of CSI and ESWT for adults with PF.

Key words: Shock wave therapy, Corticosteroids, Platelet-rich plasma, Plantar fasciitis.

Abbreviations: CSI = Corticosteroid Injection, ESWT = Extracorporeal Shock-Wave Therapy, PF = Plantar Fasciitis, RCTs = Randomized Controlled Trials, VAS = Visual Analog Scale, RCT = Randomized Controlled Trial.

INTRODUCTION

The question is always, which is the better treatment for plantar fasciitis in adults? It is important and necessary to perform studies on which treatment method achieves better results in controlling the pain of plantar fasciitis in adults. (1) Plantar fasciitis is one of the common causes of chronic foot pain in adults. It is a degenerative disorder, that may be due to the weakness of the foot biomechanics or the biomechanical overstress of the calcaneal tuberosity, obesity, using inappropriate footwear, and long periods of standing or walking, all are considered predisposing factors. (2) The majority of patients experience heel pain and calf muscle tightness earlier in the morning or after sitting for long periods of time. A burning pain is felt in the medial plantar calcaneal area (3,6). Plantar fasciitis is defined as a thickening of the plantar fascia by more than 4 mm and areas of hypo echogenicity, as well as a blurred edge on ultrasonography (USG) (3). Magnetic resonance imaging (MRI) is another available test that helps in the evaluation, and diagnosis of plantar fasciitis (7). Almost 80% of cases with plantar fasciitis improve with non-operative therapy. 80-90% of patients with plantar fasciitis usually recover within ten months (8-10). Non-surgical treatments like non-steroid anti-inflammatory drugs (NSAIDs), proper footwear, exercise therapy such as stretching & strengthening, or extracorporeal shockwave therapy (11-14) are all considered the first-line treatment of Plantar fasciitis (15). Shock wave therapy - SWT – is one of the modalities used for the treatment of plantar fasciitis, it's preferred because of is a noninvasive procedure, and they

found that it promotes tissue and bone regeneration (16,17). There are two kinds of shockwaves, radial and focal. Radial shockwaves are pneumatic waves generated by air compressors. These waves have lower penetrating ability into the tissue not more than 3 cm, and limited biological effect (18). Radial shockwaves are used for treating superficial musculoskeletal disorders, such as tendinopathy, tennis & golfer's elbow (19). Focal shockwaves are more effective in comparison with radial shockwaves. These shockwaves result in the disintegration of calcification, fibrosis and calcifications and an increase of the blood flow to the affected area resulting in healing and pain relief. Moreover, Shock wave therapy destroys sensory unmyelinated nerve fibers, and promotes collagen synthesis & neovascularization in the degenerated tissues. (20) Recent studies mentioned that both focused shock wave and radial shock wave therapies were chosen as good options for the treatment of plantar fasciitis. Radial shock wave therapy does not concentrate on the tissue as much as Focused shock waves (21). B- mode Sonography revealed that Extracorporeal shock wave therapy morphologically, reduces the thickness of the plantar fascia significantly (22,23). In addition to the morphological changes, it promotes the regeneration of the Plantar fascia and improves its elasticity. However, still no report on the long-term effects of ESWT. Intralesional injection of steroids has been used in the treatment of plantar fasciitis since the 1950s and is still widely used because of its lower cost and rapid effect on pain relief. It is usually practiced if conservative treatment fails [24]. Steroids have an anti-inflammatory property, taking into consideration complications such as atrophy of the fat pad of the heel, plantar fascia rupture (25), nerve injury including the lateral plantar nerve, and osteomyelitis of calcaneus [26]. In

most cases, injections of steroids can offer short-term relief, no longer than six months compared to a placebo (27). On the contrary, Platelet Rich Plasma (PRP) is known to have a strong anti-inflammatory effect almost no side effects on the plantar fascia. It has high levels of bioactive cytokines and growth factors, which in turn enhance the healing of the plantar fascia and the tendons by helping cellular migration, cellular proliferation, improving matrix deposition, and angiogenesis. It can also ameliorate degenerative conditions (28), prevent infections [29], and enhance wound healing, bone healing, and tendon healing (30). Therefore, PRP has been a biological option in treating the Plantar fasciitis (31, 32). Studies showed that both PRP and steroid injection can decrease inflammation, however, PRP could be superior over Corticosteroids as it may interfere with the degeneration of the plantar fascia. (32)

MATERIALS AND METHODS

Search strategy

The databases searched were Pubmed, Medline, Embase, the Cochrane Library, Springer Link, Clinical Trials.gov and OVID from inception to May 2018. The following search terms were used: plantar fasciitis or PF; Shock-wave or SW; Corticosteroid or CS; Platelet-rich plasma therapy or PRP, intra-articular injection or IA injection.

Data selection

Inclusion eligibility was independently performed by two investigators who screened the title and abstracts of all articles. Disagreements were resolved with discussion between the authors. A third researcher was the arbitrator when the two investigators did not reach agreement. The inclusion criteria were: (1) studies were designed as RCTs; (2) participants were at least 18 years old; (3) studies compared SW with CS; (4) articles were written in the English language. The level of evidence was assessed using the criteria from the Oxford Centre for Evidence-Based Medicine. The quality of the included randomized studies was assessed using the Cochrane Collaboration risk of bias tool. Studies were considered to have a low risk of bias when on every item of bias, a "low risk" was scored. Studies were considered to be moderate risk of bias when "high risk" or "unsure risk" on 1 or 2 items of bias were scored. Studies were considered to be high risk of bias when more than 2 items were scored as "high risk" or "unclear risk."

DISCUSSION

Shockwave therapy has been used to treat calcific tendonitis of the rotator cuff, bone fusion failure, chronic tennis elbow, and painful heel syndrome; the efficacy of this modality has been controversial in many studies. Xiong et al., 2018 (54) was the first meta-analysis study comparing the efficacy of SW with CS, SW was as effective as CS in the treatment of plantar fasciitis at 3 months, and was superior in pain relief. However, Porter *et al.* found that corticosteroid injections were more effective in terms of the cost and short term effect than SW in treating plantar fasciitis. The Xiong et al meta-analysis found no significant differences in the score of Mayo CSS, FFI, HFI and 100 Scoring System, however, the SW group had moderately better outcomes in terms of symptom control in these scoring systems. Treatment with corticosteroids was associated with a higher frequency of

relapses because intramuscular injections can cause permanent adverse changes within the fascial structures and the patients tend to overuse their legs as a result of direct pain relief immediately after the injection. The type of SW machine, energy level, injection volume, timing, and interval were nonuniform among the different studies.

Peerbooms *et al.* (30) found a positive effect of PRP injection into the common lateral epicondyle, this report describes the first comparison of autologous platelet concentrate versus corticosteroid injection for the treatment of resistant lateral epicondylitis. This report demonstrates that a single injection of concentrated platelets improves pain and function better than corticosteroid injections. These improvements were long lasting and no complications were reported.

Molloy *et al.* (55) reported that the injection of platelet-rich plasma (PRP) into the tissue promotes the healing process that reverses the degeneration at the base of the plantar fascia. Individual cytokines present in platelet alpha granules induce the healing of the chronic plantar fasciitis through induce fibroblast migration and proliferation, upregulate vascularization, and increase collagen deposition in a variety of in vitro and in vivo settings. Furthermore, many of these cytokines have been found to act in a dose-dependent manner. However, this difference was not statistically significant ($p>0.05$). Hurely et al (58) suggested that plantar fasciitis is primarily a degenerative condition, not purely inflammatory condition, this degeneration is thought to be due to microtrauma, which in turn contribute to a cycle of recurrent inflammation, and degenerative inflammation. Histologically, plantar fasciitis shows mucous degeneration, disorganization of collagen fibers, and collagen necrosis. Both PRP and CS decrease inflammation, but PRP has the potential to modulate plantar fascia degeneration because of its biological regenerative properties, favoring it over CS. PRP contains growth factors and bioactive cytokines that are thought to influence healing by enhancing cell migration, improving cell proliferation, promoting angiogenesis, and increasing matrix deposition. In contrast, CS has no such regenerative capacity and, as a result, its effects are only anti-inflammatory and thus its effects are short-lived.

Adil *et al.* (2013) (56) have shown improved pain scores with the use of ESWT in the short term and was maintained for a time, Eslamian et al, 2016 (35) reported that 60% of patients in the ESWT group were successfully treated, superior to the 40% corticosteroid injection group. This group difference was not statistically significant as the sample size for each group was too small to reach a meaningful difference, further research is needed to determine the long-term effectiveness of ESWT 35.

ESWT is a series of single sonic pulses characterized by high peak pressure and short duration, transmitted to the affected area by an appropriate generator with energy density ranging from 0.003 to 0.89 mJ/mm². Although the mechanism of action of shock waves is not fully understood, it has been suggested that ESWT may affect local pain factors by inducing overexcitation of axons. Subsequently, reflex analgesia occurs and pain is reduced by disrupting unmyelinated sensory fibers. Several recent studies suggest that nitric oxide production induced by ESWT plays an important role in the inhibition of inflammatory processes. In addition, direct stimulation of healing and promotion of neovascularization have also been

reported. Radial “shock waves,” unlike “focused” shock waves, can be delivered to tissue without local anesthesia or nerve block anesthesia. In general, radial ESWT is better tolerated than focused SWT because the highest pressure and highest energy flux density of radial shock waves are at the tip of the applicator and therefore outside the tissue. In contrast, focused shock waves have their highest pressure and highest EFD at the center of the focus, which is located within the treated tissue 59. Porter and Shadbolt observed better VAS scores for pain in the corticosteroid injection group compared with the ESWT group after 3 and 12 months of treatment (55). Yucel and colleagues also observed significant improvements in VAS scores for pain and heel tenderness index scores in both treatments, but there were no significant differences between groups. However, the authors preferred corticosteroid injections because of their lower cost and easier availability (37). Both treatments showed improvement in pain and functional capacity after 2 months of treatment. Although the difference between groups was not significant, FFI improved more with ESWT, and patients were more satisfied with ESWT. Thus, shock wave therapy appears to be a safe alternative for the management of chronic plantar fasciitis (35). Limitations of the study were the lack of a control group to exclude placebo effects, the relatively small number of subjects in each group and the sample consisted primarily of women. In addition, the short follow-up period limited any definitive conclusions regarding long-term efficacy. Future studies are needed to overcome these limitations.

In addition, the short follow-up period limits any definitive conclusions regarding long-term effectiveness. Future studies are needed to overcome these limitations. The inclusion of studies reported in other languages may have affected heterogeneity and influenced the results. In addition, variability in population, duration of disease, and outcome scores resulted in high heterogeneity and diverse clinical outcomes. All these discrepancies complicated the integration of data and increased the risk of erroneous results. Furthermore, follow-up periods were inconsistent across studies; more rigorously designed RCTs with larger sample sizes are needed to provide greater certainty about the efficacy of the different modalities.

CONCLUSION

The clinical relevance of the present study is that both SW and injection therapy were effective and successful in relieving pain and improving self-reported function in the treatment of plantar fasciitis at 3 months post treatment. Both interventions caused improvement in pain and functional ability 2 months after treatment. Although inter-group differences were not significant, the FFI was improved more with ESWT and patients were more satisfied with ESWT, thus shockwave therapy seems a safe alternative for management of chronic plantar fasciitis. In patients with chronic plantar fasciitis, the current clinical evidence suggests that PRP may lead to a greater improvement in pain and functional outcome as compared with CS injections. Also, inter-group differences were not significant, the VAS score showed higher improvement in the SW group, thus shock-wave therapy appears to be a better alternative for the management of chronic plantar fasciitis. Both PRP injection and ESWT are very effective methods to improve pain and reduce plantar fascia thickness in patients with chronic plantar fasciitis nonresponsive to other conservative measures. The ESWT

group showed good initial benefit over the PRP group, but the effect hit a plateau after a couple of months, whereas the PRP group showed improvement after a few weeks from the injection. PRP injection is more effective over a longer duration, though the actual length or duration of its effect is not clear from our study. Both modalities have very good safety profiles and patient compliance. The patient population receiving PRP injections is most frequently in the fifth or sixth decade of life, although late adolescents and young adults are also being treated with PRP for various musculoskeletal disorders. Although large comparative studies have identified lateral epicondylitis as the only condition with convincing clinical improvement after PRP injection when compared with controls or comparison treatments, we found most patients receive PRP therapy for conditions involving the knee meniscus and shoulder (including rotator cuff injuries) despite a lack of high-quality evidence to support its use. The number of sessions of ESWT and PRP can be altered and studied in the future to find out the algorithms of these interventions that provide a better outcome. Further studies are needed to compare the efficacy of SW and injection therapy on long-term follow-up patients.

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