

Conservative Treatment of Plantar Fasciitis and Posterior Heel Pain: A Review

Alessandro Bistolfi^{1*}, Jessica Zanollo¹, Andrea Vannicola¹, Lorenzo Morino², Walter Daghino², Elisa Lioce², Alessandro Masse² and Giuseppe Massazza¹

¹Department of Rehabilitation Medicine, University of Turin, Italy

²Department of Orthopaedics, Traumatology and Rehabilitation Orthopaedic and Trauma Centre, Hospital Città della Salute e della Scienza, Italy

*Corresponding author: Alessandro Bistolfi, Department of Rehabilitation Medicine, University of Turin, Italy, Tel: 390116933223; E-mail: abistolfi@cittadellasalute.to.it

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Abstract

This review focuses on the various techniques of conservative treatment of plantar fasciitis and posterior heel pain. Being the optimal therapy controversial, the intent is to drive surgeons and rehabilitation specialists in the choice of the strategies. The Data sources were MEDLINE, PubMed, CINAHL, EMBASE, and Psych INFO databases using the selected key words. Studies have been selected for review using as criteria English, adults, clinical population and intervention. Among several published studies about rehabilitation and fasciitis, only a few showed bases on scientific evidence. Moreover, many studies were heterogeneous and included different outcomes and evaluations. There is consensus that a specific rehabilitation program is necessary to avoid chronicity. However, the real efficacy of every specific treatment (orthoses, stretching, radiotherapy, botulin toxin, shock waves, corticosteroid therapy, and platelet rich plasma) is still questionable, and often related to the experience of the authors. In conclusion, patients undergoing physiotherapy obtain a better and faster outcome achievement than non-treated patients; however, evidence-based treatments, protocols and clinical trials are recommended.

Keywords: Rehabilitation; Fasciitis; Heel pain; Treatment

Introduction

Plantar fasciitis is a very common disease and it accounts for an estimated one million visits per year to office-based physicians and hospital department [1]. Although being one of the most common causes of heel pain, usually the disorder is prevalent in runners and people who are over-weight; it is also prevalent in patients with inflammatory arthritis [2]. Plantar fasciitis involves predominantly the proximal insertion of the aponeurosis (enthesis) which is specifically adapted to shearing and bending forces; also, entheses play a role in redistribution of compressive forces. The aetiology of plantar fasciitis is assumed to be due to excessive tensile loading, exacerbated by abnormal biomechanics of the legs such as pes planus, leg length discrepancy, and tightness of calf muscles [2,3].

The purpose of this review is to analyze the various techniques of conservative treatment of plantar fasciitis and to identify which one showed effectiveness and scientific validation.

Orthoses

Orthotics is used to relieve symptoms by reducing strain in the fascia: mechanical overloading is considered a dominant factor for the onset of the fasciitis. Orthoses are commonly thought to exert their therapeutic effect by reducing these tensile forces [4,5] during standing and walking by providing medial arch support. Most of these are made of rubber characterized by several densities and thickness. However, a systemic review has shown the effectiveness of orthoses in the treatment of plantar fasciitis to be poor [6].

Night Splint is a device that allows stretching of Achilles tendon and plantar fascia during the night incorporating ankle dorsiflexion and toe dorsiflexion. Among the orthotic therapies, a significant improvement was noted with the use of custom and prefabricated

orthoses and with the night splint in medium term follow-up. Landorf et al. [7] showed a significant improvement in the level of pain in 3 months of use of orthoses (prefabricated and custom) but found no improvement at 12 months. Prolonged use has not however shown significant improvements in studies conducted by Landorf et al. [6], and McPoil et al. [8]. Martin and colleagues [9] randomly assigned 193 patients with chronic plantar heel tenderness to receive custom orthoses, prefabricated orthoses or a night splint. At three months follow-up, there were no statistically differences in pain reduction between the three groups: the results suggested that custom orthoses, prefabricated orthoses and night splints all have similar outcomes for patients with plantar fasciitis. Pfeffer et al. [10] showed that the prefabricated orthoses get a positive result in the medium term, while McPoil et al. have identified an improvement in the case in which they are associated to stretching [8]. Crawford et al. [11] and Roos et al. [12] have presented the results of improvement obtained with the use of night-splint in medium and long-term. The night splint should be considered as a treatment for symptoms that last more than six months [8]. The prefabricated orthoses have shown positive results in short-term period, with a relative improvement in pain and function [8]. However, there is no evidence that rely on the use of prefabricated and customized orthoses for the long-term period, longer one year [13].

Stretching

Stretching is frequently utilized as a conservative treatment for plantar heel pain [14,15] and systematic reviews and studies investigating the efficacy of conservative treatments for plantar fascia published different findings [16-18]. Di Giovanni et al. found that exercise program focused on distension of the plantar fascia resulted in less pain, better patient satisfaction, and a higher functional status than exercise focusing on distension of the Achilles tendon and plantar fascia [19,20]. The plantar fascia stretching exercise was performed with seated patient, crossing the affected leg over the contralateral leg; while placing the fingers across the base of the toes, the patient pulled

the toes back toward the shin until he felt a stretch in the arch of plantar fascia. To confirm that they were stretching the fascia, patients were instructed to use the opposite hand to palpate the tension of the fascia on the bottom of the foot. They were instructed to hold each stretch for a count of 10, repeat the stretch 10 times and perform the stretch 3 times per day. However, none of the reviews have focused specifically upon stretching, but they believe that is an important component of plantar fascia treatment.

Radiotherapy

The anti-inflammatory effect of radiation therapy for the painful heel spur is known since a long time [21]. However, the exact mechanism of therapy remains still undetermined and only hypothesis tried to explain it: improvement of blood perfusion due to an influence of radiation to the endothelium, a release of some cytokines and enzymes, modification of the pH of the tissues, influence of radiation on some parts of the local nervous system [12].

Hildebradt et al. have shown the effects of low dose radiation on molecular mechanisms and on inflammatory mediators [22-24]. Numerous retrospective studies, treating the painful heel, have revealed good analgesic effect of the low dose radiotherapy. A significant therapeutic improvement has been evidenced in 65-90% of patients [12]. Seegenschmiedt et al. [25] have evidenced that patients previously unsuccessfully treated with conservative therapy, could positively respond to radiotherapy. Thus, according to these authors the radiotherapy should not be considered as the ultimate possible treatment due to its high efficacy at low radiation doses, and low costs. According to Schafer, the radiotherapy should be started during the first 6 months of painful symptoms [26].

Prospective clinical studies are necessary to assess the optimal dose and fractionation scheme of the radiotherapy [27]. Alternatively, Heyd et al. recommend that a total dose of radiotherapy should not exceed 3 Gy [28]. Analyzing the results achieved in literature it could be concluded that low dose radiotherapy (3-12 Gy) is the effective treatment in majority of patients and the side effects are insignificant. However, a placebo effect cannot be totally excluded [12]. In according to literature, Miszczyk et al. [29] considered that there are no acute or late toxicity in cases of plantar fasciitis patient irradiation [24,30,31]. Surenkok et al. [32] valued a low risk of secondary cancer after irradiation therapy, and conclude that radiotherapy is an effective therapy solution for relieving pain in calcaneal spur patients. As well, according to Micke et al. [30] an overall treatment risk appears to be very small.

Botulinum Toxin A

Huang et al. [33] have evidenced the anti-nociceptive and analgesic effect of botulin toxin A (BoNT-A) in the treatment of foot pain and plantar fasciitis. BoNT-A was found to show effects such as inhibiting inflammatory pain and releasing neurotransmitters from primary sensory neurons in a rat formalin model. It inhibits peripheral sensitization, which lead to an indirect reduction in central sensitization [34]. The plantar fascia is a profound tissue, deficiently vascularized. Physical therapy modalities, e.g. ultrasounds, or analgesic drugs (NSAIL) are usually non-efficient in the therapy of plantar fasciitis due to reduced vascularization; the painful symptoms can recur frequently [31].

While corticosteroid injection can cause complications [35], Huang et al. [33] have evidenced that an injection treatment of botulin toxin,

ultrasonography guided, does not cause fat pad atrophy. It can provide dynamic images that allow injections that are more precise. Plazcek et al. [36] refer that a single application of 200 units of botulin toxin could lead towards a significant improvement of symptoms. Babcock et al. [37] Evidenced a significant improvement of painful symptoms after short-term botulin toxin therapy, approximately 3 and 8 weeks after treatment.

Shock Waves

The therapy with shock waves has been introduced for the treatment of painful tallodinia calcifying, as an excellent alternative to surgical therapy, allowing a quick rehabilitation, and without need for immobilization post treatment [38]. Gerdesmeyer et al. [38] have demonstrated the safety and efficacy of the treatment protocol, consisting of three treatments (3 × 2000 impulses of shock waves, 0.16 mJ/mm²), applied without the use of anesthesia on the precise point of greatest pain. Chronic plantar fasciitis (symptoms lasting for more than three months) responds better to shockwave treatment than the acute form (less than three months symptoms) [39]. According Gerdesmeyer et al. [38] a treatment with radial shockwaves may be indicated for patients with plantar fasciitis resistant to prior therapies. Heinz Lohrer demonstrated that focused extracorporeal shock wave therapy might be superior compared to radial extracorporeal shock wave therapy in plantar fasciitis using the same low intensity energy flux densities [40]. A reduced pain level was reported for patients who additionally stretching exercised three times or more each week [41]. Rompe et al. [42] and Labek et al. [43] showed that the use of anesthesia can reduce the efficacy of the shockwaves. It was also demonstrated as the high-energy shock waves decreased the painful symptoms [44-46]. On the contrary, Buchbinder et al. [45], in patients with plantar fasciitis (ultrasound confirmed after a treatment of 6-12 weeks) show that there is no evidence of efficacy for pain, function, and quality of life compared with placebo. Buchbinder's result, are different from the results arrived by previous studies [47-49] placebo-controlled. Earlier trials revealed no beneficial effect of extracorporeal shock wave therapy compared to placebo [45,50]. D'Andrea showed that after six months there was no difference between treatment of plantar fasciitis using application of ultrasound and stretching, than application of radial shockwaves and stretching: both treatments were effective in the reduction of pain. There was no difference in the efficacy of two treatments, but the immediate effect of shockwave therapy provided faster relief from pain [51]. Orsi et al. [52] noticed that the treatment with low energy shock waves appear to be an effective therapy for painful heel and may help the patient to avoid surgery for recalcitrant heel pain. The surgical therapy, according to Davies et al. [53] and Weil et al. [54] may be associated with prolonged treatment times and the surgical therapy does not show better results than shockwaves. Finally, it's important remember that the shock waves show really different results because the therapy depends significantly from several factors such as the intensity of the waves, the number of pulses, low or high energy, use or less of anaesthesia.

Corticosteroid Therapy

Corticosteroid injection has shown the significant results in a short-term treatment (during the first month of therapy) of plantar fasciitis; like evidenced by Crawford et al. and Gudeman et al. [55-57]. The corticosteroid injection therapy could incite complications; in the case of injection, after a long-term period it could cause a rupture of plantar fascia, fat pad atrophy, lesion of plantar lateral nerve or osteomyelitis of

heel bone [35]. The local anesthesia did not evidence improvements of painful heel symptoms.

Platelet Rich Plasma

Platelet rich plasma (PRP) is defined as a sample of autologous blood with supraphysiological concentrations of platelets. Once activated, the platelets release bioactive proteins and growth factors stored in alpha-granules that are thought to aid and promote healing stimulating tissue regeneration from mesenchyme cells [58]. Platelet-rich plasma injection delivers platelets and growth factors in high concentrations directly to the site of injury, which otherwise is inaccessible to growth factors because of hypo vascularity and hypo cellularity [59]. Ragab and Othman [60] examined 25 patients who have been injected with PRP and were then followed up for an average of 10.3 months after treatment. VAS scores and functional limitations improved after treatment. Furthermore, ultrasonography, completed before and after PRP treatment, demonstrated decreased plantar fascia thickening. In a randomized controlled single-blinded study, Monto et al. [61] found that platelet-rich plasma injection was more effective and durable than corticosteroid injection at 2 years of follow-up. Mahindra et al. [62] found that platelet-rich plasma injection had significantly better outcomes compared with corticosteroid injection, based on AOFAS score (American Orthopedic Foot and Ankle Score), at 3 months of follow-up.

Other studies that compared intraregional corticosteroid and platelet-rich plasma injections did not find any significant difference between the two treatments in terms of efficacy, as shown by Shetty et al. [63] and Aksahin et al. [64]. There is no evidence of side effects of PRP treatment in literature. However, further high-quality research must be undertaken to define the optimal preparation of PRP (ideal volume, content of leukocytes and growth factors) and the timing of the intervention to maximize any benefit it may have.

Discussion

This study presents the results of literature analysis aimed at comparison between main groups of conservative therapies for heel pain (physical therapies, orthoses, and infiltrations). Collected data show a higher variability in results regarding physical therapies. Infiltrative therapies show greater percentage of success in a short-term period (follow-up < 1 month) versus a long-term period.

Orthotics therapies show best results in a medium term period (follow-up between 2 and 6 months) [4,5,8,10,51-54]. Among orthotics therapies, custom made or prefabricated orthoses with silicone inset and with night support, gave greater improvements for medium term follow-up. Landorf et al. [7] showed significant improvements in level of pain during 3 months of orthoses use (custom made or prefabricated). Also Pfeffer et al. [10] demonstrated that prefabricated orthoses achieved positive results in medium term period. Several research studies evaluated the effectiveness of orthoses for plantar fasciitis, nevertheless there is still a lack of scientific evidence. Designing controlled randomized trials is difficult because these orthoses are usually a first-step treatment and are usually associated with other treatments. Orthoses have a role as initial management strategy in the treatment of plantar fasciitis, nevertheless it is not clear which one has to be preferred between prefabricated or customized orthoses.

Other physical therapies showed efficacy, especially stretching of plantar fascia (medium and long-term period) [19,20,56]. Di Giovanni

et al. noticed significant improvements both in level of pain and in functionality after two years of follow-up [19,20]. Again, too few studies investigated the effectiveness of stretching compared to other interventions. In general, it is accepted that specific plantar fascia stretching may be more effective than Achilles tendon stretching alone in the short-term. McPoil et al. [8] identified an improvement with the association of stretching and orthoses, while Crawford et al. [11] and Roos et al. [12] showed positive results with night support splint in medium and long-term period.

Low dose radiotherapy (3-12 Gy) represents an effective treatment in the majority of examined patients and side effects are negligible: Miszczyk et al. [29], affirm that there are no side effects, neither acute nor delayed. Therefore, radiotherapy may be considered as a possible treatment. Nevertheless, the studies did not report the effects at very long term and, although very low, a risk of cancer cannot be excluded for sure.

From literature analysis, arises the fact that this high variability in results regarding physical therapies is due to singular therapies; this is especially true concerning ESWT, which positive or negative result depends on treatment modalities (waves intensity, number of impulses, low or high energy...) and on duration of pathology. As a matter of fact Haake et al. [50] demonstrated that ESWT does not achieve positive results in treatment of chronic plantar fasciitis, while Orsi et al. [52] noticed improvements in pain and functionality, in short and long term period.

Among infiltrative therapies, the injection of corticosteroids showed significant results in treatment of plantar fasciitis in short term period, within the first month, according to Crawford et al., Gudeman et al. [55,57,58]. However, corticosteroids injections could have complications: in case of long-term injections, for example, we can observe rupture of plantar fascia, atrophy of adipose tissue, lesion of lateral plantar nerve, calcaneal osteomyelitis. The best method of injection of corticosteroids is not confirmed yet: possibilities are iontophoresis or injection. The platelet-rich plasma (PRP) injections got similar results to the corticosteroids injections, according to the studies of Shetty et al. [63] and Aksahin et al. [64]. Mahindra et al. [62] and Monto et al. [61] even showed better outcomes than those obtained with the corticosteroids injection at a mean follow-up of 3 months and 2 years, respectively. Furthermore, there are no evidence of side effects for platelet-rich plasma injection, even if more studies are necessary to optimize the treatment. On the contrary, evidence for the use of PRP in plantar fasciitis support positive results. Since this treatment has been proposed only recently, limited studies are available and randomized placebo-controlled studies are necessary to characterize the procedures and to optimize the treatment [65,66]. Nevertheless, controversies still exist on the real efficacy of injecting PRP around tendinous tissues: a recent metanalysis underlined that there is strong evidence against the efficacy of PRP injections for chronic lateral elbow tendinopathy [67], while other studies sustained some superior analgesic effect of radiation therapy compared to mean PG steroid injection [65]. It was also observed that botulin toxin has analgesic and nociceptive effects and its efficacy in treatment of plantar fasciitis was showed by Huang et al. [33]. Babcock et al. [37] showed that injections of botulin toxin cause important improvements in short term period, after 3 and 8 weeks from treatment.

Conclusion

Many techniques and methods of rehabilitation seem to give a real benefit to the patient despite the missing of scientific evidence. There are conflicting results in the short and long term, probably because the exact etiology of plantar fasciitis and the subjective component of the pain do not allow a proper standardization of results. Frequently there is the simultaneous use of physical or minimally invasive therapy and physiotherapy exercises; therefore, it is difficult using this type of review to identify which is actually the best treatment during various stages of plantar fasciitis. Moreover, physical therapies showed the highest percentage of success in association with orthoses and infiltrative therapies.

In summary, foot orthoses must be considered as the first step of treatment for plantar fasciitis, due to the effectiveness at short term, the reduced costs and the safety of the procedure. Must be considered that they can be not effective at long term and that other treatments must be associated. More complicated therapies such as radiations and PRP injections rely on the experience and on the feasibility in the specific cases. Appropriately, powered randomized controlled trials, utilizing validated outcome measures, blinded assessors and long-term follow-up are needed to assess the efficacy of the procedures.

Clinical Message

Most of the current studies did not clarify the results of the physical treatment for posterior and plantar heel pain. However, there is no doubt about the benefits of rehabilitation in the short and medium term. The key point concerns patient satisfaction and patient perception: these are the aims to be achieved as soon as possible for ethical and economic reasons.

For clinical practice, orthoses and stretching must be the first-step treatment because they are effective, safe and cheap. A program of standard rehabilitation exercises must be associated. Second-level approaches can lie on ESWT and steroid injections, which are simple procedure, safe in the majority of the cases and again easy to manage. More complex therapies, such as radiation and PRP injections can be considered in the persistent pain.

For the future, it is desirable the identification of scientifically validated procedures and standardized guidelines for each type of treatment. When preparing a new study in this field, well designed, case-control blinded studies and randomized controlled trials must be preferred. The outcomes must correspond to those used in the literature and a single specific treatment must be compared with a control group of conventional rehabilitation.

Conflict of Interest Statement

The authors declare that there is no conflict of interest and that this research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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