Transactions on Materials, Biotechnology and Life Sciences
ISSN: 2960-1932, eISSN: 2960-2319 | Volume 3
BLSME 2024

A Review of Common Interventions and Preventive Options Used in the Treatment of Plantar Fasciitis

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Abstract. Plantar fasciitis is a frequent, chronic ailment that significantly affects day-to-day functioning. This review takes a deep look at the different therapies and preventions used in the treatment of this condition to improve foot function, reduce pain, and improve patient outcomes. The efficacy of common treatment options such as physical therapy, medication, stretching, night splints, therapeutic ultrasound, and extracorporeal shock wave therapy has been mentioned again in this study. Moreover, the importance of injection treatment and surgery also play a significant role in the management of plantar fasciitis. In addition to conventional treatment, the health care professional also needs to pay attention to the prevention of this overuse foot injury. The available approaches involve stretching the particular posterior muscles of the low limbs. Eventually, the impact of interdisciplinary considerations, including physiological factors and strength training methods, on plantar fasciitis was explored in order to provide a certain theoretical basis for clinical practice.

Keywords: Intervention; prevention; strengthening; stretching; plantar fasciitis.

1. Introduction

Plantar fasciitis (PF) is one of the most common overuse injuries that induce heel pain, which may impact up to 10% of the general population at some point in their lives and significantly increase health care expenses [1, 2]. According to the study in recent years, approximately 1 million physician visits per year are diagnosed as this pathology, with about 60% of patients initially seeking related treatment from their primary care physicians [3]. The incidence of this condition among the patients is about 4.5% to 10.0%, with a high incidence in females aged 40 to 60 years [3]. The main sign and symptom of the injury includes a sharp and non-radiating pain on the plantar heel during the first few steps of the morning or after an extended period of standing [3]. Additionally, this foot lesion is very common in active people, with prevalence ranging from 5.2% to 17.5% in runners [3]. The related research found that recreational and elite runners are the two main groups of people suffering from such injuries [3]. The established risk factors for the syndrome include age, gender, and obesity. Foot biomechanical anomalies such as a tight Achilles tendon, pes cavus, and pes planus have also been linked to PF. An elevated risk of PF may exist in patients with gout and certain seronegative spondylarthropathies. The majority of PF cases can be resolved with conservative measures and time; however, approximately 1% of patients will need surgery, highlighting the vital role that a range of interventions and preventative techniques have in the management of this condition [4]. By presenting an overview of the most recent findings and recommended procedures for treating this degenerative foot issue, it aims to provide practitioners with a helpful tool for improving the care and outcomes of patients with this prevalent and debilitating condition.

2. Anatomy

A robust band of dense connective tissue called the plantar fascia is located just beneath the skin on the bottom of the foot [5]. It consists of three parts, including the plantar aponeurosis in the middle position, the lateral plantar fascia, and the medial plantar fascia on both sides [1]. By joining the metatarsal heads to the medial tubercle of the calcaneus, the plantar fascia serves as the primary structural support for the longer foot arch [1]. Furthermore, the plantar fascia is made to withstand

the severe strains and stresses that come with having to perform foot-weight-bearing exercises like jogging, walking, and other sports [6]. However, excessive load on the plantar fascia can also cause repetitive microtears on the fascial tissues that ultimately lead to PF [1].

3. Symptoms

The plantar anteromedial part of the heel hurts, and this is the most typical sign and symptom of PF [1]. In general, patients report their heel pain as non-radiating, throbbing, scorching, or piercing without paresthesia [7]. Other symptoms include pain and soreness in the heel after the first few steps after waking up in the morning or following an extended period of inactivity [3]. The abnormal feeling may sometimes subside after a few minutes of walking, but it will return at the end of the day [1]. Besides, it is significant to record if the patient feels pain in one or both feet. Only 30% of cases with PF involve both heels. PF is primarily expressed unilaterally [7]. Nonetheless, the report states that when bilateral presentation is evident, systemic arthropathies such as ankylosing spondylitis, reactive arthritis/Reiter's disease, and psoriatic arthritis should be considered [7].

4. Groups and Activities at Risk

In most cases, PF progresses without a specific, identifiable reason [7]. There are, however, many risk factors that can make individuals more susceptible to the condition. The following parts will elaborate on those risk factors in two categories: high-risk groups and high-risk activities. Furthermore, some other risk factors are also provided in the report.

4.1. High-Risk Groups

Based on the previous research findings, PF is most common among people aged 45-64, with an increased incidence in women [1]. Using information from the National Health Insurance Research Database, a nationwide population-based study was carried out to determine 26,024 physicians, 127,455 nurses, and an equivalent number of people for comparison (the general population). Three groups had their risk of PF assessed between 2006 and 2012: doctors, the general population, nurses, and nurses alone. It also looked at the differences in PF risk among physician subgroups. In nurses, the prevalence of PF was 13.11% during the seven years, whereas in physicians, it was 8.14%. The odds ratio (OR) for PF was 0.660, with a 95% confidence interval (CI) of 0.622-0.699. In contrast to the general population, the risk was higher for nurses (OR: 1.035; 95% CI: 1.011-1.059) but lower for physicians (n = 26). Nursing professionals were shown to be at a higher risk than physicians, even after adjusting for age and sex (adjusted odds ratio [AOR]: 1.541; 95% CI: 1.399-1.701). Female doctors were more likely to experience PF than male doctors. [8]. Moreover, another group of individuals at risk includes those who are sedentary or obese [3]. An analysis of the sonographic results of plantar fascia in a normal population has examined the impact of age and body mass index (BMI). 148 healthy adults (94 females, 63.5%, and 54 males, 36.5%) had their plantar fascia thickness measured by ultrasound over the course of a year. It showed that the mean plantar fascia thickness was significantly higher ($p < .001$) in the group of individuals over 45 with a BMI above 25 than in the group of individuals under 45 with a BMI under 25 [9].

4.2. High-Risk Activities

As for the risk activities, numerous studies have noted that extended periods of time spent standing on hard surfaces increase the likelihood of developing the ailment since the plantar fascia stretches and contracts excessively [1, 3, 7]. One study has investigated the pain and difficulty level among working females who need prolonged standing. The survey included 150 respondents, who ranged in age from 30 to 50. 72% of participants reported some degree of pain and difficulty [10]. Furthermore, to ascertain the risk factors and frequency of PF in the population of a particular region, additional research has also been done (n = 695). It was reported that over one-third (39.3%) of the participants with PF stated that they had to walk or stand for a moderate amount of their work, compared to those

who only needed a slight amount of standing or walking (19.9%) [11]. In addition, recent increased weight-bearing activities also show a negative impact on the plantar fascia [3]. According to a prior study, the prevalence of PF in both recreational and elite runners range from 4.5% to 10%. This means that PF is the third most common musculoskeletal injury linked to running-related sudden excessive foot movement, after medial tibial stress syndrome (which has an incidence between 13.6% and 20%) and Achilles tendinopathy (which has an incidence between 9.1% and 10.9%) [12].

4.3. Other Risk Factors

Apart from those common factors, other risk factors include limited ankle dorsiflexion, flat feet or a high arch, increased body mass index, tight calf muscles, and recent modifications to shoe gear [1, 3, 13]. A systematic review comprised sixteen papers, whereas the meta-analysis contained eleven risk factors. A higher incidence of PF was linked to the following variables: weighted mean difference [MD] = 7.04°; 95% CI, 5.88-8.19; $P < 0.001$), body mass index (MD = 2.13 kg/m^2; 95% CI, 1.40-2.86; $P < 0.001$; $I^2 = 50\%$), and body mass (MD = 4.52 kg; 95% CI, 0.55-8.49; $P = 0.026$) [5]. Besides, another study has evaluated the association between gastrocnemius tightness and PF. Upon analyzing 105 data points, it was found that there was a significant correlation between gastrocnemius tightness and the 100-mm visual analog scale (VAS) for pain experienced during morning steps and $R = 0.757$ ($P <.001$) between gastrocnemius tightness and VAS for the worst pain experienced the week before. [14]. Additionally, research has compared the correlation between the incidence of PF and types of footwear (high heels and flat foot wear) in young females. The findings revealed that 20% of the 100 participants in the sample had plantar fascia stretching, and 27% of the population was at risk of developing PF, with 19% of the patients wearing high heels [15].

5. Diagnosis

5.1. Physical Examination

As regards physical examination, after the patient describes symptoms and clinical history, a detailed inspection of both lower extremities is necessary to determine the diagnosis of this foot injury [1]. At the beginning of the physical examination, any anatomic abnormalities of the feet, such as a high arch or flat foot, should be noted [3]. Following that, an area of tenderness on the anteromedial aspect of the heel will be palpated, which will further assist the physician in confirming the diagnosis of PF [3]. To provide a more precise diagnosis, a certain test could also be carried out. An effective diagnostic for PF, for instance, is the windlass test, which involves passively flexing the ankle and toes to replicate pain on the plantar anteromedial part of the heel [1]. Previous studies have shown that the sensitivity and specificity of the windlass test are 31.8% and 100%, respectively [16]. Besides, ankle range of motion and the patient's gait should be assessed [7]. A correlational study has claimed that active dorsiflexion less than 10 degrees beyond the neutral position suggests tight calf muscles [7]. A different body of research revealed that people with PF may exhibit antalgic gait in addition to reduced ankle range of motion as a result of compensatory motions favoring the unaffected foot [7].

5.2. Imaging Examination and Differential Diagnosis

To diagnose PF, clinical signs and a physical examination are usually sufficient. Nonetheless, ultrasonography, magnetic resonance imaging (MRI), or conventional radiography should be performed on patients with concomitant heel diseases. A review including six ultrasound investigations found that ultrasound is an efficient technique in the diagnosis of PF, with the mean thickness of patients' fascia ranging from 4.2 mm to 6.67 mm. It revealed that the primary sonographic findings for the diagnosis of PF were raised thickness of the plantar fascia and hypoechoic plantar fascia [17]. Furthermore, according to a study, T2-weighted pictures with intrafascial and perifascial edema, fusiform plantar fascial thickening, and marrow edema in the calcaneal tuberosity are typical MRI findings associated with PF [7]. Apart from those two imaging

examinations, X-rays can also be used to exclude bone lesions. It is generally agreed that patients with PF often have a calcaneal spur shown on lateral heel radiographs [7].

Additionally, health care professionals might also suggest imaging tests such as X-rays or MRIs to help determine whether there is an alternate diagnosis [3]. Based on the research, X-rays are useful diagnostic techniques for excluding acute osseous abnormalities, such as calcaneal stress fractures, that might cause heel discomfort [7]. Moreover, an MRI can help rule out other pathologies in cases with unusual or resistant heel pain, such as calcaneal edema, plantar fascia tears, or arteriovenous malformations [18]. Differential diagnosis of PF can be conducted from aspects of skeletal orign, soft tissue orign, and neurogenic orign [1].

6. Interventions

Though most occurrences of PF are assumed to resolve on their own, there are a number of treatment options available, including conservative non-invasive treatments, invasive conservative treatments, and surgical treatments.

6.1. Non-invasive Conservative Treatments

In non-surgical PF patients, improvement occurs in over 85% to 90% of cases. The use of ice packs and rest, over-the-counter (OTC) NSAIDs, stretching, physical therapy, orthotics and supportive shoes, night splints, ultrasound therapy, and ESWT are some of the methods implemented [1].

6.1.1. Rest, ice compress, and NSAIDs

The first course of treatment should involve adequate foot rest combined with careful non-operative therapeutic approaches [1]. Furthermore, compared to applying heat, people with PF appear to benefit from the occasional use of an ice compress [7]. NSAIDs are a proven, effective pain management strategy when used in conjunction with other forms of treatment [1, 3, 7]. One study found that combining NSAIDs with other conservative treatments led to a brief improvement in pain and disability in a small, randomized, placebo-controlled study on PF. It was reported that between baseline and six months, it was shown that the NSAID group had 5.2 times more pain and 3.8 times better disability than the placebo group, at 3.6 and 3.5 times, respectively [19]. Notwithstanding the consensus in clinical practice about the use of over-the-counter NSAIDs for PF, such analgesics have not been demonstrated to appreciably reduce the symptoms of the condition when taken as the only course of treatment.

6.1.2. Stretching

Since PF is normally considered to be associated with a lack of ankle dorsiflexion, stretching protocols previously prioritized stretching the Achilles tendon [3]. However, it has also been shown that targeted stretching of other muscles and ligaments, such as the gastroc-soleal complex, plantar fascia, and intrinsic foot muscles, reduces pain [7]. Eighty-two patients were randomized to either Achilles tendon or plantar fascia stretching in a single randomized controlled trial (RCT). Nonsteroidal anti-inflammatory medications and insoles were given to both groups. When compared to the Achilles tendon group, the plantar fascia group experienced a 52% improvement in heel pain after eight weeks [3]. Additionally, after 8 weeks, 52% of patients in one study who had only stretched their plantar fascia and 22% of patients who had only stretched their gastroc-soleal complex exhibited improvement [3]. Although the optimal length of time to stretch each day is not predetermined, stretching for longer periods of time is often linked to improved symptom relief [7].

6.1.3. Physical therapy

Physical therapy has been shown to be one of the most successful strategies for the treatment of PF. Some medical professionals might advise massaging the heel with ice. For example, a patient could use a massage ball or a frozen water bottle laced with frosting at home to massage the affected area [7]. For additional therapeutic benefit, physical therapy exercises like stretching and strengthening

may be considered in addition to the standard regimens that the physical therapist often uses in sessions. Eighty-four patients were randomized in a RCT to receive either a strengthening or stretching program; both groups demonstrated a substantial improvement in the gait pattern and a reduction in discomfort for patients suffering from PF ($p<0.001$) [20]. Moreover, one related piece of literature mentioned that osteopathic manipulative treatment methods such as counterstrain might alleviate PF symptoms instantly. In relation to this treatment, the plantar fascia should be placed in a position of least resistance by using plantar flexion of the ankle and toes and passive flexion of the knee. While maintaining this position, the tender point, which is often located at the plantar fascial insertion on the medial calcaneus, should be observed for roughly ninety seconds. After that, the foot needs to be returned to its neutral position and checked once more [1].

6.1.4. Supportive shoes and orthotics

Many shoe modification techniques are available for managing PF, with the use of shoe inserts being regarded as one of the most prevalent approaches. Research has shown that the combination of stretching exercises and shoe inserts, such as rubber heel cups, felt pads, and silicone heel pads, significantly reduces heel discomfort in the short term [7]. In addition, it is believed that by lessening the strain on the fascia, foot orthoses can also help decrease the symptoms of PF because they can prevent foot pronation and support the medial arch [3]. In a preliminary trial, 135 individuals received a prefabricated orthosis, a personalized orthosis, or a sham orthosis. When compared to sham orthoses, both patient groups reported improved function and discomfort after three months, with no discernible difference in pain between those using prefabricated and bespoke orthoses [3]. Furthermore, a recent systematic review and meta-analysis found that people with plantar heel discomfort experienced pain reduction with foot orthoses for seven to twelve weeks when compared with sham orthoses. However, long-term pain improvement was not consistently observed [3].

6.1.5. Night splints

The use of posterior-tension night splints has also shown promise for treating individuals with recurrent PF. These devices prevent the gastrocnemius-soleus complex from contracting as the patient sleeps by maintaining the ankle in a neutral or dorsiflexed position [3]. According to studies on the effectiveness of night splints, all of the patients in the trial get significant alleviation, with an average resolution time of 12.5 weeks [7]. Nevertheless, when used in conjunction with other therapeutic approaches, the efficacy of night splints in treating PF has been shown to vary. An RCT ($N = 116$) found that Achilles tendon stretching and NSAIDs were ineffective in treating symptoms when combined with a night splint [3]. Another RCT ($N = 28$), on the other hand, revealed that using night splints in addition to orthotic insoles at two and eight weeks reduced pain [3]. As a result, additional research is needed to determine whether night splints are beneficial in treating PF due to their ambiguous use.

6.1.6. Ultrasound

There was contradictory data regarding therapeutic ultrasonography's efficacy in treating PF. In one RCT, the group that received therapeutic ultrasound treatment showed a noteworthy decrease in pain as compared to the control group. In comparison with baseline, the treatment group reported a substantial decrease in average pain (–26%, –33%, –43%) and hypoechoic lesion volume (–33%, –53%, –68%) at weeks 4, 8, and 12. Treating patients reported significantly more daily living activities (+28%, +42%, +47%, +40%) compared to the sham/control group (+0.12%, +12%, +3%, +21%) [21]. However, in terms of pain reduction and functional improvement, a meta-analysis comprising five RCTs found that ESWT is superior to therapeutic ultrasound ($MD = −1.36$, $P = 0.005$) [22]. In individuals with chronic PF, a recent RTC compared and evaluated the efficaciousness of ESWT and corticosteroid injection (CSI), followed by therapeutic ultrasound (TUS). It found that, at the 12-week follow-up, ESWT provided more pain relief ($p = 0.004$). However, using CSI in conjunction with TUS is a quick and efficient way to relieve PF pain [23]. Overall, studies indicate that, despite the lack of current evidence to support ultrasound efficacy, this treatment method is comparatively safe.

Furthermore, a more thorough investigation is required to confirm that therapeutic ultrasound treatment for PF is successful.

6.1.7. Extracorporeal shock wave therapy

Another often-mentioned non-invasive treatment option for PF is extracorporeal shock wave therapy (ESWT), which comes in two modalities: radial and focused [3]. Originally prescribed to treat insertional tendinopathies, this therapy was first made available in the early 1990s [3]. Because they create vibrations that promote blood flow, shock waves aid in healing. It is hypothesized to degrade unmyelinated nerve fibers (substance P fibers), boost growth factors, and promote neovascularization [3]. Although there is disagreement about the best shock wave intensity, modality, and pulse cycle sequence for treating PF, recent studies have shown growth-positive results after using ESWT [3]. A meta-analysis of nine RCTs showed that ESWT significantly raised the success rate in alleviating heel pain overall when compared with a placebo. After using a pressure meter, heel pain was reduced to excellent or good, and the visual analog scale (VAS) score was lowered by 60% throughout everyday activities and the first step of the morning [24]. In addition, a network meta-analysis comprising 19 trials demonstrated that ESWT significantly reduced pain in the short term (<6 weeks) and intermediate term (2-4 months) when compared to placebo [18]. According to another recent RCT, patients with thinner plantar fascia reported less pain following ESWT, and both the high-intensity (0.56 mJ/mm2) and low-intensity (0.12 mJ/mm2) groups showed comparable improvements in pain and function [18]. Nevertheless, additional research is still required to determine the ideal ESWT regimen for treating PF because of the significant heterogeneity in pertinent studies.

6.2. Invasive Conservative Treatments

Health care professionals may recommend other invasive treatment procedures if symptoms are still maintained after several months of non-invasive conservative treatments [3]. Those treatments include corticosteroid injection, autologous blood-derived injection, and botulinum toxin injection [13].

6.2.1. Corticosteroid injection

It is common practice to use corticosteroids to reduce inflammation and pain [3]. Despite the fact that PF is a degenerative condition rather than an inflammatory process, corticosteroids seem to offer a transient therapeutic advantage [3]. According to research, corticosteroids have been found in histologic examinations of patients with persistent PF to be effective in treating the condition by inhibiting fibroblast growth and the production of ground substance proteins. [13]. The plantar fascial injection typically entails injecting a mixture of local anesthetic and corticosteroid into the heel at the most tender spot, which is often medially or occasionally under the plantar [7]. Regarding the therapeutic effect of corticosteroid injection, an RCT that was published in the BMJ enrolled eighty-two PF patients for ultrasound-guided dexamethasone or normal saline injections. The results showed that, in comparison to a placebo, a single injection of dexamethasone guided by ultrasonography could more effectively ease pain and minimize plantar fascia swelling for up to three months. The dexamethasone group's level of discomfort decreased by 10.9 points (95% confidence interval 1.4 to 20.4, P = 0.03) after four weeks [25]. Additionally, based on a meta-analysis comparing steroid injections to four different noninvasive treatment types, steroid injections are generally more effective than noninvasive treatments for reducing pain within three months. Regarding the reduction in the VAS score at specific months (mean difference (MD), 1.67; 95% confidence interval (CI) = 0.58–2.76; P = 0.003), the study found a tendency in favor of steroid injections as opposed to non-invasive therapies. Comparing physical therapy to steroid injections at the 1.5-month follow-up, the former was associated with a lower VAS score (MD, 2.5; 95% CI = 0.1–4.9; P = 0.04) [26]. Concerning the injection site, studies suggest that a deeper injection into the fascia, as opposed to a superficial one, may result in a greater reduction in plantar fascia thickness, discomfort, and disability, as well as an increase in the quality of life associated with the foot [7]. While corticosteroid injections have certain benefits, they may also raise the risk of atrophy of the plantar fat pad and rupture of the plantar fascia.

6.2.2. Autologous blood-derived injections

Autologous blood-derived injections have gained popularity recently as a treatment for chronic PF. Platelet-rich plasma (PRP) and whole blood are two autologous blood-derived products that may promote tissue regeneration [3]. Since PF does not involve inflammation, these injections may, in theory, be more effective than corticosteroid injections for treating the condition [3]. With increasing evidence of its effectiveness in the last 30 years, PRP, which has been used extensively in sports medicine, dentistry, wound healing, and alopecia, contains a high concentration of growth factors that encourage proliferation, migration, cell differentiation, and angiogenesis [17]. In a meta-analysis, VAS scores were compared before and three months after receiving ESWT, corticosteroid injections, or autologous blood-derived products. According to subgroup analysis, PRP produced the best immediate results. At the last follow-up, the mean VAS scores for the PRP groups dropped from 7.44 at pre-injection to 3.64 [27]. By contrast, autologous whole-blood injection, which is also identified as platelet-poor plasma (PPP) therapy, involves a similar treatment process compared to PRP apart from the different injected substances [17]. When comparing those two injections, an RCT conducted in 2022 revealed that patients with PF showed a considerable improvement after receiving either of those two injections, with no discernible differences between the two groups. [17]. However, as opposed to platelet-rich plasma, which can be costly, whole blood does not need further processing, so the cost of the injections may be the only expense associated with using whole blood [17].

6.2.3. Botulinum toxin injection

Botulinum toxin (BTX) is a gram-positive bacterium that is a member of the clostridium genus of anaerobic spore-forming bacteria, producing strong neurotoxins that lead to botulism [28]. Since then, many forms of chronic pain have been treated with botulinum toxin [28]. Botulinum toxin type A, or BoNT-A, has gained a lot of popularity because of its potent binding, stability, and superior clinical application results [28]. Numerous conditions can benefit from the use of BoNT-A, such as esthetic dermatology, ophthalmic diseases, curological conditions, neurological disorders, muscle diseases, and maxillofacial disorders [28]. It functions by inhibiting the production of pain peptides from nerve terminals and sensory ganglia, reducing sympathetic neural discharge, and having anti-inflammatory and ant glutaminergic properties [3]. Emerging data suggests that BoNT-A is effective in treating PF as well. According to a 2022 meta-analysis that only included RCTs, BoNT-A injections significantly reduced pain (mean difference, −2.07 [95% CI, −3.21 to −0.93]; P=.0004; I^2=97%) and improved function (standardized mean difference, 1.15 [95% CI, 0.39-1.91]; P=.003; I^2=87%) [29]. Furthermore, another RCT indicates that the combination of BoNT-A and plantar fascia stretching exercises produced a more rapid and long-lasting improvement over a 6-month period when compared to other treatments [30]. In contrast, BoNT-A did not produce superior pain relief when compared to ESWT in a different RCT. Following their initial steps, the patients receiving ESWT in that trial had a VAS of pain of 2 (1–4) points, while the patients receiving BoNT-A had a VAS of pain of 1 (0–2) points (p = 0.009). These outcomes were comparable [31].

6.3. Surgical Treatment

Patients who have not shown any discernible improvement following a prolonged nonsurgical course of treatment are typically candidates for surgery [3]. Plantar fasciotomy is a common surgical technique in which the plantar fascia is partially or completely removed to release tension in the tissue [1]. Only the medial and central bands of the plantar fascia are normally loosened, leaving the lateral band intact. The primary recommended surgical procedures are open or endoscopic plantar fasciotomies without inferior calcaneal exostectomy [3].

6.3.1. Open plantar fasciotomy

When using an open approach, an incision is often made around the distal origin of the plantar fascia on the calcaneal tubercle, along the plantar medial portion of the heel [7]. Following surgery, patients must remain immobile for three weeks, and it might take up to three months to resume regular activities [7]. Plantar arch collapse and incision site scarring are possible side effects [7]. Moreover,

there are other dangers associated with open surgery, including the potential for an over-release of fascia leading to a flat foot and about 1/4 of patients still having pain after the procedure [7]. Nonetheless, one advantage of open surgery is the removal of a calcaneal spur, if one exists [7].

6.3.2. Endoscopic plantar fasciotomy

Due to its minimally invasiveness and ability to visualize plantar fascial bands, endoscopic plantar fasciotomy has become the current gold standard for surgical treatment [3]. A study published in the literature discovered that, in comparison to open procedures, people who undergo endoscopic procedures recover more quickly from their discomfort and may resume their normal activities sooner [3]. Additionally, seven days following endoscopic plantar fasciotomy surgery, 77% of patients returned to wearing their regular shoes, and 97% of patients experienced pain reduction, according to a different study that followed 652 patients [3]. Although endoscopic fasciotomy appeared to have positive results, according to a systematic review and meta-analysis, the grade of recommendation was low (Grade C) because there were insufficient RCTs [32]. Regarding the potential complications of endoscopic surgery, sural neuritis at the lateral port is one of the most frequent clinical complaints following the surgical procedure [7]. Therefore, this crucial neural structure must be avoided with caution during surgery.

7. Prevention

It is possible to prevent PF before symptoms emerge, and certain preventive measures can be implemented to reduce the incidence of this condition. Many texts have referred to the importance of stretching that targets particular soft tissues such as the Achilles tendon, calf muscle, and plantar fascia itself [1, 13]. Based on recent research, it has been shown that PF pain in people who need long-term standing has been found to be significantly reduced by engaging in active stretching exercises ($p < 0.05$) [33]. Apart from that, another study reported that exercises such as wall stretching can help flag-raising troops with their PF ($p < 0.05$) [34]. However, despite the benefits of stretching exercises for PF, the pretest-posttest method was used to conduct those investigations. Hence, in order to confirm the reliability of stretching exercises in preventing PF, more thorough RCT research is required.

In addition, there is a growing body of evidence pointing out that stretching the hamstring muscle might also have a positive outcome for the prevention of PF [13]. One prospective cohort study found that hamstring tightness is a significant contributing factor to the diagnosis of PF, and stretching of this muscle should be addressed during treatment. It was reported that individuals who had tight hamstrings were 8.7 times more likely to develop PF [13]. Furthermore, according to another comparative study, patients with PF exhibited tightness (39.13%) in the posterior muscles, including the hamstring and calf muscles of the lower limb, but the unaffected individuals exhibited a low percentage (12.50%) [35]. The findings of this research indicate that therapists should check for stiffness in the hamstrings and triceps surae while implementing a stretching strategy to treat PF [35].

Besides, other preventive methods such as weight loss, avoidance of high-impact activities, ice, modifying footwear, foot orthoses, and supportive taping are also essential for the prevention of this foot syndrome [1, 3].

8. Interdisciplinary Considerations

8.1. Psychological Factors

There is evidence suggesting that emotional stress can increase the opportunity of developing PF [36]. The result of the research demonstrates that mental problems such as anxiety can certainly develop chronic pain from PF [37]. The study involved 277 Thai novice conscripts who were free of musculoskeletal pain and who underwent 10 weeks of military training. The subjects also had a baseline assessment of their ankle range of motion, ankle strength, and the quality of their lower

extremity movement from a physical therapist. After completing the short version of the mental stress scale, the subjects experienced 71 episodes of painful PF [37]. The findings show that following the 10-week military training, conscripts with anxiety (B = 0.13; 95% CI, 0.06–0.20; $p < 0.01$) and poor lower extremity mobility quality (B = 0.87; 95% CI, 0.28–1.47; $p = 0.01$) at baseline experienced higher levels of pain intensity from PF compared to those without these characteristics [37].

Apart from that, other research suggests that for individuals with chronic PF, physical treatment should be combined with a biopsychosocial approach [38]. In particular, the goal of this case series was to demonstrate the advantages of a biopsychosocial approach that incorporates pain neuroscience education (PNE) into physical therapy for patients who have persistent PF with respect to pain, psychosocial factors, and foot and ankle function. Seven females (mean [SD] age = 49.0 [11.4] years) obtaining physical therapy for chronic syndrome were included. Along with standard physical therapy, patients received six 15-minute PNE treatments. By the end of the trial, patients had attended an average of 8.7 (7–12) physical therapy sessions across a mean (range) of 46.7 (42–56) days. Six (86%) of the patients showed improved pain neuroscience knowledge following PNE. At twelve weeks, six (86%) of the patients had pain and ankle function that reached or surpassed the minimum clinically relevant difference (MCID). For pain catastrophizing and mobility phobia, five (71%) individuals met or surpassed MCID. Six individuals (86%) showed decreased sensitivity to local discomfort [38]. Therefore, it is concluded that patients with chronic PF may benefit from physical treatment that incorporates PNE.

8.2. High Load Strength Training

Although stretching is a common method that helps people recover from PF, another often overlooked component for the management of the condition is strengthening [39]. High-load strength training, which has been demonstrated to be effective in treating a variety of tendinopathies, was discovered to be applicable to PF as well because the pathophysiology of this ailment, which resembles a degenerative tendon disorder, is now better understood [39]. Previous investigations have found that high-load strengthening programs can help restore the penitent's plantar fascia to wellness faster than stretching [40]. That study involved randomly assigning 48 people with PF verified by ultrasonography to two groups: the stretch group, which received daily plantar-specific stretching and shoe inserts, and the strength group, which received twice-weekly progressive high-load strength training. The foot function index (FFI) served as the main result. In comparison to the stretch group, the strength group's FFI was 29 points lower [95% CI: 6–52, $P = 0.016$] at the primary endpoint, which occurred at three months. Between groups, there were no differences at 1, 6, and 12 months ($P > 0.34$). After a year, the stretch group's FFI was 16 points (95% CI: 0–32), while the strength groups were 22 points (95% CI: 9–36) [40].

Calf raises are the best type of high-load exercise for the plantar fascia. It involves raising the heel unilaterally while keeping a towel beneath the toes [40]. Early research has given the protocol for this exercise. It indicates that the heel rise movement should include a two-second isometric phase (stop at the peak of the exercise), followed by a three-second concentric and eccentric phase (moving up and down). The whole process of the exercise needs to be completed in a very slow manner. The exercise program begins with three sets at the 12-repetition maximum (12RM), which is the most weight the patient could lift for 12 repetitions across their whole range of motion while keeping perfect form. Following two weeks, patients upped the workload, decreased the repetition count to 10RM, and raised the number of sets to four. After four weeks, five sets of eight repetitions were required. In case the patients could not perform the required number of repetitions, they were advised to start the exercises bilaterally until they developed the strength to perform unilateral heel lifts [40].

9. Conclusion

PF is frequently stubborn, causing discomfort to last for years in some situations. In the literature, a great deal of research has been done on intervention and prevention measures. Some of these

strategies have shown promising results when compared to standard treatment procedures in RCTs, whereas others have produced contradictory or inconsistent results. Therefore, for future research, more investigations are needed to determine which treatment and prevention approach is the most effective one.

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