Spring 2023

Alternative Treatment Modalities for Plantar Fasciitis

Chelsey Clark

Alternative Treatment Modalities for Plantar Fasciitis

by

Chelsey Clark, PA-S

Bachelor of Science, Montana State University, 2010

Contributing Author: Russell Kauffman, MPAS, PA-C and Brittany McPherson, OT, PA-S

A Scholarly Project

Submitted to the Graduate Faculty of the University of North Dakota

In partial fulfillment of the requirements for the degree of

Master of Physician Assistant Studies

Grand Forks, North Dakota

May 2023

Table of Contents

Acknowledgements

I am grateful to have gotten the opportunity to work on this project through the University of North Dakota Physician Assistant program. I want to acknowledge my scholarly project advisor, Russell Kauffman, MPAS, PA-C, for his guidance throughout the research. Additional thanks to Dr. Marilyn Klug, Darcy Cook MSPT, Dr. Bijan Andrade DPM, and Brittany McPherson, OTR/L, CBIS, PA-S, for their assistance in researching and drafting this scholarly paper.

Further gratitude to my family, friends, and classmates for their support throughout my training.

Abstract

Plantar Fasciitis is a common and frequent condition in adult patients. The purpose of this literature review is to determine whether evidence exists for alternative treatments in the regimen of plantar fasciitis that has not been resolved with the standard treatment. The review was done using Pubmed, CINAHL and SportDiscus. Research was included on the following alternative treatments of PF: corticosteroid injections, extracorporeal shockwave, dry needling, Platelet-Rich Plasma (PRP), Autologous Blood Injection (ABI), cupping, custom insoles, and ultrasound therapy. A total of 12 research articles were included in this review. The alternative treatments considered within this literature review had some promising statistically significant results that will require further investigation. This included positive results in ultrasounds, extracorporeal shockwave, PRP and steroid injections, insole use, dry needling, and ABI. Nothing definitive can be drawn from the results of the studies. Some of the studies omitted blinding, which makes results questionable. Further research in all areas will help draw definitive conclusions. Blinding of both participants and researchers in all studies would solidify the data. Currently, there is no one definitive alternative approach to add to a patient's traditional regimen in treatment of PF. Keep in mind that some treatments are more affordable and less invasive than others. Providers should educate patients on the risks, both financial and physical, associated with the alternative treatment.

Keywords: *plantar fasciitis, alternative treatments, plantar fasciitis therapy/treatment*

Introduction

Plantar Fasciitis (PF) is a common complaint among patients presenting to multiple settings including primary care, urgent care, orthopedic and podiatry. Peak age of onset is between 40-60 years but can occur earlier in athletes, specifically runners (Armstrong et al.

2016). Risk factors include pregnancy, poor support in shoes and atrophy of the fat pad in the heel (Trojian et al. 2019). Conservative treatment of PF includes the use of rest, compression, elevation, ice, nonsteroidal anti-inflammatory drugs like ibuprofen, physical therapy, and night splints. Alternative treatments like corticosteroid injections, extracorporeal shockwave, dry needling, platelet-rich plasma (PRP), autologous blood injection (ABI), cupping, custom insoles, and ultrasound therapy are further explored in this scholarly project. Importantly, most of the alternative treatments are recommended for people who have failed three-six months of conservative treatment. Most of the research reviewed examines the use of the alternative treatments as additive or after patients have received standard first line treatment for PF.

Corticosteroid injections for anti-inflammation in musculoskeletal conditions have been researched and used for many years. While injections may be used less often in the primary care setting, orthopedics and podiatry settings will inject chronic and nagging PF if needed. Known risks of steroid injections also apply to injection into the PF. Extracorporeal shockwave and ultrasound therapy have very limited risk factors and are minimally invasive although in some patients can produce discomfort. These are newer treatment modalities which have less research than the steroid injections. Custom insoles also have very low risks but can be costly. Insoles are often considered as more of a first line treatment, and patients are often encouraged to ensure they have a hard insole in their shoes when they first present with PF. Research is inconclusive and should be further studied to determine the effectiveness of expensive custom insoles. Dry needling, cupping (a form of massage), PRP and ABI injections are all newer treatment modalities with less research than the other areas in this literature review. Some of these treatment modalities have limited studies regarding PF but have been studied more in other musculoskeletal issues. This literature review is specific to the treatment modalities in PF and

does not speak to research on any treatment modalities that may also be used for other conditions. Because plantar fasciitis is a common condition that primary care providers will see frequently it is important to know both first line and second line treatment modalities as some patients will not get relief from the first line treatments.

Statement of Research Question

In adult patients with plantar fasciitis, how effective are alternative treatments like ultrasound shockwave, dry needling, corticosteroid shots, and others compared to traditional manual therapy by physical therapy on recovery outcomes and pain management?

Methods

Three databases were used in this literature review of treatment modalities in PF: Pubmed, CINAHL and SportDiscus. The exact mesh terminology is listed below under each database with the number of results and number of articles used from each database.

Pub med Search Term used “plantar fasciitis treatment.” See mesh terminology below. There were 1443 results from this. Filters applied included Randomized Controlled Trial, Review, Systematic Review, last 10 years which narrowed resulted to 547 articles. Of the 547 articles, eight were used. The studies not chosen for this literature review looked at first line treatment of PF like NSAID, Ice, manual and physical therapy, or surgical treatment and therefore were not used. (("fasciitis, plantar"[MeSH Terms] OR ("fasciitis"[All Fields] AND "plantar"[All Fields]) OR "plantar fasciitis"[All Fields] OR ("plantar"[All Fields] AND "fasciitis"[All Fields])) AND ("therapeutics"[MeSH Terms] OR "therapeutics"[All Fields] OR "treatments"[All Fields] OR "therapy"[MeSH Subheading] OR "therapy"[All Fields] OR "treatment"[All Fields] OR "treatments"[All Fields])) AND (meta-analysis[Filter] OR randomizedcontrolledtrial[Filter] OR review[Filter] OR systematicreview[Filter]). Using this

mesh list should give similar results from PubMed in addition to any new articles that have been published since searched in June of 2022.

CINAHL database was searched using the following mesh terms. (MH "Plantar Fasciitis" OR "plantar fasciitis") AND (MH "Treatment Outcomes" OR treatment OR therapy). Filters applied included adults, academic journals, and English language in the last 10 years. This resulted in 235 articles; two were used although many overlapped with articles also found in PubMed. Articles were not used for the same reasons as described for the PubMed search.

SportDiscus database was searched using the following mesh terms. (DE "PLANTAR fasciitis" OR "plantar fasciitis") AND (DE "TREATMENT effectiveness" OR treatment OR therapy). Further filters were applied including English language, peer reviewed journals, and ten years. This resulted in 244 articles of which two were used and many overlapped with articles found in PubMed and CINAHL, and again articles were not used for similar reasons as described in the PubMed search.

Several studies were not used when they focused more on the heel spurs that coexisted with plantar fasciitis although this was not an original filter. Case studies are avoided in this paper as the aim was to look at larger bodies of research.

Review of Literature

Ultrasound uses in Plantar Fasciitis

Katzap et al. (2018) conducted a randomized, double-blind placebo controlled clinical trial including 54 adult patients aged 24-80 with plantar fasciitis. The objective was to determine the additive effect of therapeutic ultrasound. The patients were divided into an intervention group (n=28) and a control group (n=26).

The intervention group in Katzap et al. (2018) was treated with stretching and ultrasound and the control group was treated with stretching and sham ultrasound. All participants were given eight treatments and a numeric pain-rating scale (NPRS) measured with the first steps of the day, average pain felt during the day, the computer adaptive test (CAT) for the foot/ankle, and an algometric test measuring the minimum pressure required to produce pain which was averaged over three continuous measurements.

The four outcomes measured include first step morning pain measured by the NPRS, pain during the day (NPRS), pressure pain threshold and perceived functional level. For first steps of the morning, the active US group has baseline NPRS of 6.76 $\pm$ 2.03 and four weeks of 3.66$\pm$ 2.91 while the sham US had a baseline of 7.04 $\pm$ 2.05 and 4 weeks of 3.36 $\pm$ 2.60 (Main effect of time: F_1= 63.63 p<.001). For pain during the day, the active US group had a baseline NPRS of 5.71$\pm$2.18 and four weeks of 3.60$\pm$2.44 and a sham US of 5.60$\pm$2.14 and four weeks of 2.56$\pm$1.69 (Main effect of time: F_1= 54.60 p<.001). The pressure pain threshold of the active US group has a baseline of 50.36$\pm$ 9.92 and at four weeks 62.92 $\pm$ 9.99 while the sham US group has a baseline of 48.40 $\pm$ 9.99 and at four weeks of 62.00 $\pm$ 12.17 (Main effect of time: F_1= 65.49 p<.001). The perceived functional level for these groups is as follows: active US group baseline 4.95 $\pm$ 1.63 and four weeks of 6.22$\pm$ 2.07 and sham US group baseline of 5.25 $\pm$ 1.70 and four weeks of 6.14 $\pm$ 2.09 (Main effect of time: F_1= 16.33 p<.001).

No statistical difference between the sham ultrasound (control group) and active ultrasound group was shown. Both groups showed statistically significant improvement with a p<.001 in each of the four outcomes measured with relation to time. The participants improved with the stretches they were given regardless of what type of ultrasound they were given.

Fifty of the 54 enrolled participants completed the study. Three dropped out from the active ultrasound group (one unavailable and two unwilling to continue). One dropped out of the control group because they were dissatisfied. The researchers found that the four who dropped out were younger, had higher sports activity and had scored higher on the functional foot and ankle CAT. 10/25 patients in the intervention group and 12/25 in the control group required further treatment beyond the clinical trial.

Katzap et al. (2018) shows that sham ultrasound which has negligible energy which cannot penetrate beyond a few millimeters is as helpful for treatment as therapeutic ultrasound with higher energy that can penetrate deep enough it reaches the fasci when combined with stretching. Lacking a control group with no ultrasound treatment, the study does not show that stretching without any ultrasound is as effective. Further research may rule ultrasound as a useless tool for treatment.

Limitations of the study include study size and lack of control group without treatment. Benefits to this study include that no adverse events from any ultrasound use or physical therapy manual stretching instruction were reported by participants. The study maintained 92.59% of their participants and those retained in the study improved within an 8-week period although not all were back to baseline. (Katzap et al. 2018).

Akinoglu et al. (2017) conducted a prospective, single-blinded, randomized controlled study to compare effects of radial shock wave therapy (r-ESWT) and ultrasound (US) therapy in the treatment of PF. Inclusion criteria were tenderness on palpation of the heel (unilateral), presence of pain in the plantar region for ≥ three months, presence of calcaneal spur in imaging of the foot. Participants were excluded if they had a history of surgery or trauma to the area, low back surgery, other joint, neurologic, or vestibular disorders, prior steroid injections, pacemaker,

coagulation problems, BMI <20 or >30. Patients who exercised regularly defined as 30 min three times/week were also excluded. Because more females than males were recruited, researchers altered the study to female participants only. Visual analog scale (VAS), Foot Function Index (FFI), American Orthopedic Foot and Ankle Association hind foot score (AOFAS), static equilibrium, dynamic equilibrium and ankle proprioception were used to evaluate the three treatment groups. The control group did exercises twice per day for four weeks (n=28), a second group did US two times/week for a total of seven sessions with the exercises(n=26) and the third group had r-ESWT one time/week for three weeks with the exercises (n=24). Participants drop out of all groups and the study ended with 18 participants per group for a total of 54 participants in the study. Eleven participants dropped out because they did not do the home exercises, eight dropped for "avoiding treatment," three in the US/Exercise group had bilateral PF, and two in the r-ESWT/Exercise group could not handle the pain of the treatment.

Characteristics of the groups in the Akinoglu et al. (2017) study were all similar and had no statistical differences in age, BMI, or education level. Pretreatment values for evaluation of PF including the VAS, FFI, and AOFAS were all similar and not statistically different. All three groups had statistically significant improvement in AOFAS hind foot score, FFI pain, and functional reach test. The US and r-ESWT group had statistically improved FFI disability and activity limitation scores. The r-ESWT also saw improved ankle proprioception sense. When comparing results, the table below shows the US group did better with FFI pain, disability, and activity limitations. Both US and r-ESWT were statistically better treatments with regards to the AOFAS hind foot score. R-ESWT was statistically better with ankle proprioception compared to the other groups. Table 1 below is the comparison of the three groups: r-ESWT, US and control and the post treatment evaluation results.

Table 1

Comparison of post treatment evaluation results of patients between groups

	r-ESWT Group	US Group	Control Group	p
FFI-Pain	43.28±18.52	28.56±12.44	38.89±16.52	0.021
FFI-Disability	47.67±23.72	30.78±15.01	46.78±21.05	0.026
FFI-Activity Limitation	8.83+7.02	4.28±4.53	11.89±8.61	0.013
AOFAS hind foot score	74.72±13.55	68.39±12.91	59.5±9.34	0.005
Single Leg stance test	23.56±8.39	24.56±8.66	25.67±6.94	0.606
Functional reach test	30.78±5.96	31.17±4.64	30.50±3.49	0.785
Ankle proprioception	14.91±2.25	16.50±1.57	16.48±1.51	0.023

This study had limitations including a small sample size and was limited to female only participants. Akinoglu et al, (2017) is only a one month follow-up and longer studies should be conducted in male and female population to strengthen the results. Conclusions from the researchers suggest if a female patient has PF that is painful, US with exercise should be used, and if the patient's biomechanics are disrupted, r-ESWT with exercise should be considered.

Extracorporeal Shock Wave Therapy

Gezginaslan et al. (2021) conducted a double-blind, prospective, randomized-controlled study looking at high and low energy extracorporeal shock wave therapy (ESWT) with 94 participants. Participants were divided into three groups. Group one (n=33) received seven sessions of high energy ESWT, group two (n=31) received three sessions of high energy ESWT, and group three (n=30) received seven sessions of low energy flux density. All groups were instructed to do home based exercises and not use analgesic or anesthetics during the ESWT

treatments. Participants were all >18 years old, had unilateral PF for at least three months and a BMI <30. Participants were excluded from the study if they had already received secondary treatments like ESWT or injections, if they had an additional diagnosis of ankle or foot disease or history of surgery, professional athletes, and other serious conditions. Originally, 110 participants were screened for the study with eight of them not meeting inclusion criteria and eight being lost to follow-up, resulting in 94 total evaluated. Data was evaluated prior to treatment and one month post treatment using multiple tools including visual analog scale (VAS), short form-36 (SF-36), Functional Assessment of Chronic Illness Therapy (FACIT), 6-minute walking test (6MWT), and foot function index (FFI).

No statistical differences existed between the three groups coming into the study by Gezginaslan et al. (2021). Participants had similar age, gender, education, and plantar fasciitis scores coming into the study. Statistically significant results showed a decrease in VAS scores at one month after the treatment in all groups (Group 1 Pre-VAS:7.30$\pm$1.10 Post-VAS:3.96$\pm$1.23 Group 2 Pre -VAS:7.8$\pm$0.8 Post-VAS: 6.2$\pm$0.9 Group 3 Pre-VAS:6.96$\pm$1.24 Post-VAS:6.51$\pm$1.1. All p values < .001). Group one had a statistically significant decrease in VAS compared to the other groups. There were additional statistically significant values for all groups with the SF-36 subscale scores, 6MWT, FACIT, FFI scores at one month as well. Group one showed statistically better results than group two and three in the 6MWT(Group 1: Pre:122.2$\pm$29.8 Post: 148.9$\pm$78.3 Group 2: Pre:114.5$\pm$28.7 Post: 127.5$\pm$32.8 Group 3: Pre:112.7$\pm$36.9 Post: 119.5$\pm$33.2), FFI pain subscale(Group 1: Pre:44.0$\pm$8.7 Post: 29.7$\pm$7.9 Group 2: Pre:39.5$\pm$8.8 Post: 34.4$\pm$8.7 Group 3: Pre:38.5$\pm$6.6 Post: 36.1$\pm$7.4), FACIT (Group 1: Pre:26.6$\pm$5.2 Post:18.3$\pm$5.0 Group 2: Pre:24.5$\pm$3.8 Post:20.1$\pm$3.4 Group 3: Pre:21.4$\pm$4.1 Post:19.5$\pm$4.5), and

SF-36 subscale (Group 1 Pre: 28.6±6.15 Post:46.5±8.1, Group 2 Pre: 27.4±2.8 Post:35.3±5.6 Group 3 Pre: 30.6±6.5 Post:32.6±6.6).

The Gezginaslan et al. (2021) study with Group One (Seven sessions high energy ESWT) shows statistically significant improvement compared to less sessions (Group Two) or low energy ESWT (Group Three). Study results suggest that more sessions of high energy extracorporeal shock wave therapy may be the most beneficial way to treat with ESWT. This study did well in having minimal differences in starting anthropometrics and VAS; however, the small sample size and short follow-up weakened the study. Further research needs to be done with long-term studies to assess the benefits of ESWT.

Gollwitzer et al. (2015) conducted a prospective, multicenter, double blind, randomized, placebo-controlled trial. Two hundred and fifty subjects were randomly assigned to a focused extracorporeal shock wave therapy(n=126) or a placebo intervention(n=124). Participants all had a history of PF resistant to non-surgical treatment for at least six months. They had all tried at least four treatment modalities including pharmacological treatment prior to the study, but a washout period was enforced before participation. Participants were excluded for infections, inflammatory disease, neurological disease, nerve entrapment, coagulation issues, pregnancy, or bilateral heel pain. Some adverse events were reported relating to both treatments: pain and discomfort during treatment and swelling.

The primary outcomes measured were the overall reduction of heel pain measured by the percentage change of the VAS score twelve weeks after last treatment. An F meter was used to document the participants' point of unbearable pain. Functional improvement was measured with the Roles and Maudsley score. Results in the Gollwitzer study show that extracorporeal shock wave therapy compared to placebo was superior in both primary outcomes. VAS was 69.2% in

shock wave group and 34.5% in the control group with a p=.0027, while the Roles and Maudsley score was 0.4 in favor of shock wave therapy with a p=0.0006. Of note the study mentions the power of the placebo effect since > 30% of participants in the placebo group had improvement of VAS pain scores. The caution here is that time was also involved in both groups as well as the treatment vs sham treatment. This study used a larger participant size; in addition, the study retained participants at the rate of 98%. Inability to control for patients seeking other treatments during the study is a potential weakness.

Corticosteroid and PRP injections

Breton et al. (2022) conducted a prospective, randomized double-blind study with the objective of determining use of corticosteroid or platelet-rich plasma as second line treatment in patients with chronic plantar fasciitis defined as heel pain longer than three months. Further, researchers used MRI to measure the fascia thickness prior to treatment and after treatment at the six-month mark to determine the usefulness of imaging in chronic cases of plantar fasciitis (PF).

Fifty participants were recruited and met eligibility for the study. Twenty-five were in the corticosteroid (CS) infiltration group and 25 in the platelet-rich plasma injection (PRP) group. One in each group left the study at baseline and three in each group were lost to follow-up. This left 42 participants, 21 in each group. Four of the participants had MRI that was irretrievable, so the MRI portion of the study contained only data from the 38 who had pre- and post- treatment MRIs available. Blood was taken from both groups, so participants did not know if they were getting PRP or CS. Both injections were done using ultrasound. All injections were given by the same physician, and follow-up was done by a different physician who was blinded. Participants were asked to continue first-line therapy defined as NSAIDs, orthosis, stretching and avoidance of excessive exercise. Treatments were done within 15 days of the initial MRI.

No statistically significant outcome was found between the PRP group and CS group. Good clinical response was found in 15/21(PRP) and 11/21(CS) participants in the groups (p=0.20). The main clinical endpoint which represented a good clinical response was a 50% or greater reduction in mean daily pain using a VAS after six months of treatment. Both groups showed improvements statistically in daily maximum pain (VAS), PRP (six month: -68+48[SD] %), and CS (six month: -48+44[SD]%). PRP and CS can be effective in secondary treatment of PF. These clinical findings are independent of MRI.

MRI findings in Breton et al. (2022) showed a statistical significance for the CS group having a decrease in mean HSTIR (Short TI inversion recovery hypersignal) ratio compared to initial MRI. The CS group had a strong correlation with six-month improvement for VAS score ($r=-0.61$, $p=<0.01$) and moderate for the FFI score ($r=-0.55$, $p=<0.05$) in participants with IFTCP (Initial fascia thickness in the coronal plane) > 7mm. In the CS group 100% participants with IFTCP> 7mm had a favorable response to treatment. In participants with an IFTCP<7mm 33% had a favorable response. The PRP group with IFTCP> 7mm is 67% with favorable outcome and in participants with IFTCP< 7mm 73% has a favorable outcome.

Results of Breton et al. (2022) conclude that both PRP and CS as second line treatments for PF, are effective resulting in pain reduction in both treatment groups. The correlation between IFTCP>7mm and response to CS therapy may lead practitioners down a path to only treat with CS if a patient has IFTCP>7mm. Although this should be confirmed with future studies, MRI appears to be of little value in follow-up examination after injection.

A strength of the Breton et al. (2022) study is that it has a longer term follow-up of six months. Although longer term studies of one-two years will also need to be completed to strengthen the credibility of the results. Limitations of the study are the small sample size and

loss of 16% over the course of the study. Two of the eight left at baseline which suggests they did not see improvements.

Jimenez- Perez et al. (2019) conducted a comparison study between Platelet Rich Plasma (PRP) and corticoid injections in the treatment of chronic plantar fasciitis. This single center, non-randomized prospective study included 40 patients, 20 in each group. Group A treated with PRP and Group B with methylprednisolone. Inclusion criteria were adults who could understand the treatment plan, with heel pain longer than six months, diagnosed with PF both clinically and with imaging. Participants were excluded for have surgery on that foot, prior injection for that heel pain, wounds, skin lesions, arthritis, systemic disease, and other pathologies for heel pain. These patients had all done conservative treatments like ice, stretching, physiotherapy and NSAIDs prior to coming to the study. Participants and the researcher were not blinded to the agent used for treatment. Both groups had similar demographics and had no significant p value differences for sex, age, BMI, VAS scores, US findings, and MRI findings.

Jimenez- Perez et al. conducted all injections at an outpatient treatment center and penetrated the most swollen fascia using ultrasound to guide the injection of either PRP or methylprednisolone. After the injection the patients were instructed not to put weight on their heel for two days and avoid physical activity involving impact for a month. Researchers instructed them to wear supportive sporting footwear and they were told not to use NSAIDs, rehab treatment or orthotics. Patients were evaluated with imaging, VAS scores, Roles and Maudsley and American Orthopedic Foot and Ankle Score (AOFAS) prior to treatment, at three, six and twelve months and at the end of the study which ranged in follow-up from 23-43 months after the last injection. Results of the VAS show a statistically significant improvement of scores with lower scores in the PRP group. VAS scores of the PRP group before treatment: 8.25, six

months post: 2, 12 months: 1.9 Last follow-up: 1.85. VAS scores of the corticoid group: before treatment: 7.7, six months post: 5.3 12 months: 6.05 Last follow-up: 6.25. Both groups had a significant decrease in VAS score resulting in a $p<.0001$ but the PRP group had a significant reduction compared to the corticoid group also with a $p<.0001$. AOFAS scores for PRP group were initial: 47.05 and six months: 92.1 ($p<0.0001$) for corticoid group initial: 50.85 and six months: 49.75 ($p=0.478$). The AOFAS score only showed a significant improvement for the PRP group. MRI measurements of fascia were done pre and 6 months after treatment with the following values: PRP group: Pre: 7.95, six months: 4.82 (0.78) $p<0.001$ Corticoid group 8.05, six month: 6.85 (1.69) $p<0.001$. The PRP group versus the corticoid group showed a significant value change in thickness of fascia in the PRP group with a $p< 0.001$.

Overall, Jimenez- Perez et al. (2019) study showed PRP were better over time than corticoid injection, while imaging also showed a reduction in the thickness of the fascia more in the PRP group. This study showed results for an extended amount of time with follow-up past one year. Limitations are the lack of blinding of the participant and researcher and a small sample size of a total of 40 participants. Further research with more participants and blinding of the patient and researcher would be beneficial to help aid in support for use of PRP in chronic plantar fasciitis.

Alternative Treatments

Dunning et al. (2018) conducted a randomized, single blinded, multicenter, parallel-group trial to compare the effects of adding electrical dry needling into a program of manual therapy, exercise and ultrasound on pain, function, and disabilities of individuals with plantar fasciitis. Participants (n=111) were randomized into two groups: Intervention group received electrical dry needling, manual therapy, exercise, and ultrasound (n=58); and the control group received

manual therapy, exercise, and ultrasound (n=53). Participants were followed at one week, four weeks and three months. No participants dropped out of the study. Inclusion criteria included an adult 18 or older with clinical diagnosis of PF, plantar heel pain for longer than three months, first step heel pain of at least a two on the numeric pain rating scale (NPRS). Patients were excluded if they had a history of surgery to the foot, contraindications to dry needling, exercise, or ultrasound, had received treatments in the prior four weeks, neurological issues, pregnancy, or workers' compensation related PF issues. The therapist providing treatments was not blinded to the treatment and the patients were also not blinded due to the nature of the treatment and study design. Examining clinicians remained blinded to the patients' treatments.

Dunning et al. (2018) treated all patients with manual therapy, exercise, and ultrasound treatment (five-minute duration one-two times/week). The intervention group also received 20 minutes of eight-point dry needling one to two times per week for a max total of eight times. The primary outcome measured was first-step pain during the morning as measured by the numeric pain rating scale (NPRS 0-no pain 10-worst pain imaginable). Secondary outcomes included resting mean foot pain (NPRS, Lower Extremity functional Scale (LEFS), Foot Functional Index (FFI), medication intake, and the Global Rating of Change (GROC). Data were collected at baseline, one week, four weeks and three months after initial treatment. The primary indicator of first step morning pain had a statistically larger improvement in the dry needling group at four weeks (Δ-1.6 $p<0.001$) and three months (Δ-2.2 $p<0.001$). FFI- Pain scale was used as a secondary measure and showed the dry needling group did better at four weeks and three months than those who did not get dry needling (between group difference of -11.4 (-18.8, -4.0) with a p=.003 at 4 weeks and -13.9 (-21.8, -6.0) with a p-value = 0.001 at three months. FFI disability scale and FFI total score were both significant at the three-month mark (-12(-20.3, -3.7); p=0.005

and -9.9(-16.0, -3.8); p=0.002 respectively). According to the research, significantly more patients in the electrical dry needling group (n=47, 81%) stopped taking medication for their pain compared to the other group (n=37, 69%) p=0.023.

Strengths of the Dunning et al. (2018) study is that it had a larger sample size. Additionally, they had participants from six different geographical areas in the United States. The therapists at these locations were able to follow a standardized procedure for eight-point needling protocol without statistical differences with regards to location of the treatment. Limitations include that it is not a long-term study, and it lacks blinding of patients, which admittedly might be challenging. Research around length of time for dry needling to be effective and long-term research on dry needling should further explore this topic for definitive conclusions to be drawn.

Wheeler et al. (2022) conducted a double blind randomized controlled trial to investigate improvement outcomes following ultrasound guided autologous blood injection (ABI) compared to dry needling alone for patients with chronic PF. Inclusion criteria for patients were age >18, PF for at least six months, pain that is reproduced on palpation at the plantar fascia attachment, and patients who had failed a structured rehab program over a three-month period. Additionally, participants had their diagnosis confirmed with imaging defined by a PF thickening of >4mm. Excluded from the study were participants with tears visible on imaging, prior corticosteroid injection in last three months, on anticoagulation, unwilling to do home stretching exercises, or who had other chronic pain issues or connective tissue disorders.

Ninety participants met criteria in the Wheeler et al. (2022) study. They were divided evenly into two groups: Intervention group (n=45) who got the ABI dry needling in addition to the home exercise program and the control group (n=45) who got dry needling without ABI and

home exercise. The practitioner administering the dry needling with and without ABI knew the treatment modality but the practitioner interviewing the participants was blinded and the participant could not see which treatment they were receiving. All participants had blood drawn regardless of which group they were in. Participants were instructed to limit physical activity for 48-72 hours and to not take NSAIDs for a minimum of 72 hours post-procedure.

The primary outcome measured was average pain on the numeric pain rating scale (NPRS: 0-10) between baseline and six months. The foot functional index, Manchester oxford foot questionnaire, physical activity, anxiety and depression symptoms and sleep quality all being secondary outcomes. All but one of the 90 participants finished the study. The one who dropped out suffered an unrelated ankle fracture four and a half months into the study. The data of this individual was used up until their drop out point. No statistical difference was found between the two groups regarding their demographics or baseline pain and stiffness scores.

Outcomes of Wheeler et al. (2022) showed that both groups improved from baseline to follow-up in the primary NPRS rating of average pain, but one group did not improve more than the other. The groups improved at similar rates with no statistical difference in any area. See Table 2 for the main measures NPRS scales at baseline and follow-up for average pain which was the primary indicator for the Wheeler study. P-values for baseline to six month follow-up were all $p<.001$ and both groups showed similar improvement for average pain, paint at its worst, pain at its best, pain in the morning, pain in the evening, pain at rest, pain when walking and average stiffness in the morning.

Table 2

Average pain prior and after treatment

Average Pain	Baseline	2 week	6 week	3 month	6 month

Intervention Group	7.1 +1.6	5.9+2.3	5.0+2.5	4.4+2.6	3.8+2.7
Control Group	7.2+1.8	6.1+1.9	5.3+2.0	4.7+2.3	3.3+2.4
Comparison p		p=0.830	p=0.736	p=0.820	p=0.356

Wheeler et al. (2022) showed some longevity in that there was follow-up at six months with good results. Longer term studies will still need to be done. While patients and investigators were blinded to the study and there is no reported indication that treatment was revealed, the investigator administrating treatment did know which treatment patients received which may or may not have introduced some bias into the study. Participants did standard physical therapy as part of this study, and this combined with time could have resulted in less pain or there could be benefits from dry needling. This should continue to be the focus of further studies.

Sweety et al. (2020) aimed to evaluate dry cupping effectiveness on outcomes to pain, dynamic balance, and functional performance in young (age 18-26) female recreational runners with chronic (> 3 months) PF. This was in addition to conventional first line treatments. Thirty participants were randomly assigned to a group, with 15 in each group (experimental and control). It was single blinded study in which the person assessing the patients was blinded to the method of treatment. The experimental group underwent dry cupping for ten minutes in addition to conventional therapy for four weeks (three times/week), and the control group received conventional therapy three times/week for four weeks. Conventional therapy included ice therapy for ten min, three sets of self-stretching of the calf muscles for 30 seconds, four sets of plantar fascia stretch for 20 seconds, and strength exercises including towel curls and toe taps. Total conventional treatment on all 30 participants was 25-30 minutes three times/week and the experimental group received an additional ten minutes of dry cupping.

All 30 participants completed the research procedures in the Sweety et al. (2020) study. On NPRS, both groups reported significant improvement, but the experimental group had an even larger improvement. In the functional performance area that was tested with a figure 8 hop both groups with a significant improvement, but the experimental group had more improvement compared to the control group ($p < .001$). NPRS values for the experimental group at baseline were 7.67 ± 0.90 and at four weeks 1.87 ± 0.99. NPRS values for the control group at baseline were 7.07 ± 0.96 and at four weeks 4.13 ± 1.12. Both the experimental and the control groups had significantly decreased pain at four weeks ($p<0.001$). When compared to the baseline no statistically significant difference occurred but at the four week follow-up there was statistically significant favoring the experimental group with a $p <.001$.

Sweety et al. (2022) study shows promise with the addition of dry cupping therapy in plantar fasciitis in female athletes aged 18-26. No participants drop out from the study. Limitations include only having young female athletes in the study. Additionally, it was a short amount of time (four weeks). Further research should be done that looks at all ages, males, and non-athletes and athletes alike.

Insole use

Seligman et al. (2021) conducted a randomized control trial to determine if hard or soft orthotics were more effective in treating heel pain associated with PF. Secondary objectives were to compare whether orthotics was effective at improving level of activity, compare costs and to compare if age was relevant in orthotic effectiveness.

All participants in the Seligman et al. (2021) study were adults > 18 years old with heel pain associated with PF. Participants were stratified by age to ensure an equal number of participants received hard and soft orthotics in each age group. The study enrolled 49

participants, 25 in the soft orthotic group and 24 in the hard orthotic group. Three from the soft group dropped because of lost orthotics and not wanting the orthotic they were assigned to, and one refused to do the questionnaire and was dissatisfied. Two from the hard group dropped: one whose insurance did not cover orthotics, and the other was lost to follow-up. This left an n=22 in each group.

The primary outcome in the Seligman et al. (2021) study was the pain relief from orthotics using the brief pain inventory (BPI). Both groups showed a reduction in pain intensity (soft; pre: 6±3.5 post:5.50 ±5.25 hard; pre:7±2.25 post: 5±4 p=0.010) and pain interference (soft; pre: 2.93±3.25 post:1.29 ±3.25 hard; pre:3.07±3.86 post: 1.28±4.5 p<.0001) over six weeks. There was no statistically significant improvement of function over time (soft; pre:130.5±52 post: 136.5 ±41.5 hard; pre: 144±30.5 post: 147.5±34.75 p=.333) in either group. Neither group showed a significant difference in relation to pain intensity (p=.458), pain interference (p=.846), or function (p=.366). Considering the cost of the orthotics there was a significant difference with a $p < .0001$ (soft orthotics being less expensive). A time value in the number of visits it took to adjust the orthotics also existed with a p<.0001; the hard sole group needing three-five visits and the soft needing two-three visits.

Pain reduction in both groups was independently statistically significant. The Seligman et al. (2021) study shows that either soft or hard orthotics are effective at reducing pain in PF. Functionally, there is not a statistical difference independently or in comparison of the two groups. This may suggest that patients continue to do their daily activities despite pain or that this sample size/group did not have functional changes with their pain in the six-week time frame. Further research on functional changes with pain reduction in PF should be done to identify whether there is a treatment modality that aids in functional increase or whether patients

ever decrease their functional abilities because of PF. Comparing the ages and stratifying the research to be able to do age-based comparisons is helpful but the small sample size suggests that a larger look at this should be done.

Cohena-Jimenez et al. (2020) compared customized orthosis vs placebo flat cushioned insoles in a randomized, double-blind, controlled clinical trial. Participants in the study were also treated with extracorporeal shock wave therapy and stretching exercises. Foot pain and foot functionality of the patients were the outcomes measured with follow-up at six months. Participants were over 18 years old with a diagnosis of plantar fasciitis lasting a minimum of six months and a foot posture index > six which indicated pronation of the foot.

Group A in this study was given the custom orthosis and Group B was given the placebo insole. Both groups had follow-up at one week, one month and six months. Participants were told to use the insoles seven days/week for a minimum of eight hours/day for the entire six-month trial period. Pain was analyzed using the VAS (0= no pain and 10= max pain); foot functionality was classified using the Roles and Maudsley Scale (1= no symptoms 4= worst possible quality of life/symptoms). The patient was given a satisfaction scale regarding the pain level ranging from absolutely satisfied to dissatisfied as a secondary measure.

Eighty-three participants started the study by Cohena-Jimenez et al. (2020) (42 in group A and 41 in group B). Five participants ended up withdrawing from the study, Group A ended with 39 and group B with 37. There were two statistically significant characteristic differences between the groups (age and BMI with p values=0.001). Group A was both younger and had a lower BMI. Statistically, both groups had pain reduction and reported better quality of life after the first week which included the shock wave therapy and stretching. Group A with a baseline VAS of 5.73 ± 1.73 and after the first week a VAS of 3.04 ± 1.91. Group B with a baseline VAS of

6.31±1.69 and after one week 3.59±2.19. When comparing the two at baseline there is a significant difference, potentially the age and BMI differences contributing to this baseline difference. At week one there is not a statistically significant difference between the two groups ($p=0.081$). VAS scores at the one month and six month follow-up show statistically significant differences between the two groups with Group A having lower mean VAS scores (1 month: 3.41±4.0 and 6 months: 3.29±4.26) than Group B (1 month: 7.26±2.77, 6 months: 7.52±3.40). P-values comparing the two are both $p<.0001$ and statistically significant. The authors of the study suggest that the week one pain reduction in both groups is likely due the additional treatments (stretching and shock wave) and not due to the orthosis. At the one month and six month follow-up, however, Cohena-Jimenez et al. suggest this is due to the custom orthotic use as Group A did statistically better than Group B.

Cohena-Jimenez et al. (2020) study included both male and female participants, and it was a longer-term study looking at six months out. Many studies include only females as PF is more commonly seen in females. Limitations of the study include the statistical differences in age and BMI of the two groups. Another limitation is that the exact number of hours the orthotics were worn cannot be verified.

Rasenberg et al. (2021) created a randomized controlled trial comparing custom-made insoles to sham insoles compared to general practice (GP) led usual care. The study looked at pain at rest and pain with activity. All 185 participants 18-65 years old with pain for at least two weeks but less than two years were recruited. Participants were excluded if they already had insoles or had additional orthopedic issues. Both groups were provided with a booklet on stretching and strengthening exercises. All but nine participants completed the 12-week study. All data available from the 185 participants was included in the study.

Group 1 in the Rasenberg et al. study was the GP led treatment group with n=56, group 2 was the custom insole group n=70 and group 3 was the sham insole group with n=69. Patients were successfully blinded to whether they had a custom insole or sham insole. The podiatrist was blinded at the first visit when assessing if the patient was appropriate for insole use but was not blinded once the participant got fitted for a custom or sham insole. Sham insoles were all the same, and the goal was not to improve biomechanics of the foot with them. Custom insoles were made by the podiatrist working with the patient and were different based on the podiatrist's assessment of the patient needs. The GP group could include any non-surgical approach except referral to podiatrist. Treatments in group one included corticosteroid injections, physiotherapist, acupuncturist, pain meds, shockwave, dry needling, massage, and shoe advice. Typically, participants in group one had more visits to their GP and had a higher rate of corticosteroid injection (GP group:15%, insole groups both 0 % with a $p< 0.001$). In addition, the GP group was more likely to have other biomechanics interventions like night splints, heel cups, Strasbourg socks or supportive stockings/taping (GP group: 41%, custom insole: 22.7%, sham insole: 13.2% with a $p< 0.001$).

When Rasenberg et al. compared custom and sham insoles, they found no statistical significance at 6, 12 or 26 weeks for pain at rest, pain during activity, first step pain, foot function index for pain or function, self-reported recovery, or physical health components. When comparing custom made insole and GP care, no statistical significance at 6, 12, or 26 weeks for pain at rest, foot function index for pain or function, self-reported recovery, or physical health components. The GP group in this study had statistically less pain with activity and first step pain than the custom orthotic group at 6, 12 and 26 week follow-up. Table 3 compares the

custom versus sham and the custom versus usual care at 6-week, 12 week, and 26 week post treatment.

Table 3

Study comparison of custom vs sham insole and custom vs usual care

	Custom vs sham insole	Custom insole vs usual care
Pain at rest	Mean Deviation (p value)	
6 weeks	-0.41(p=0.25)	-0.30 (p=0.47)
12 weeks	-0.34 (p=0.34)	-0.16 (p=0.70)
26 weeks	-0.33 (p=0.33)	-0.19 (p=0.64)
Pain during activity	Mean Deviation (p value)	
6 weeks	-0.07 (p=0.80)	0.96 (p=0.01)
12 weeks	-0.05 (p=0.87)	0.94 (p=0.01)
26 weeks	0.07 (p=0.80)	0.91 (p=0.01)
First step pain	Mean Deviation (p value)	
6 weeks	0.00 (p=1.00)	1.57 (p=0.00)
12 weeks	0.01 (p=0.98)	1.48 (p=0.00)
26 weeks	0.12 (p=0.71)	1.43 (p=0.01)

Rasenberg et al. (2021) study is a comparison of sham vs custom orthosis with a control group that was left to work with their GP to determine treatment modalities other than podiatrist led orthotics. All groups improved over time, with the GP group improving statistically more in a few areas but with no statistical improvement in the pain at rest category, which was the primary indicator for this study. This study did not list the costs associated with the GP group but did mention that the GP group went to their doctor more often during the 26 weeks in addition to

having more corticosteroid injections than the other two groups. Weaknesses of the study are that researchers did not get further information on the biomechanical interventions the GP group received. It is mentioned that high activity athletes were not included in this study and so no conclusions about PF in athletes should be drawn from this study.

Discussion

As awareness and popularity of alternative treatments increases, patients will be turning to medical professionals for recommendations on treatments. Plantar fasciitis is a common chronic complaint for patients, estimated at two million patients per year. This project looks at research around some of the alternative treatments. When a patient has a chronic PF diagnosis interfering with their life and they have tried the first line treatments, many patients may turn to alternative treatments. The following is a discussion of some but not all the alternative treatments that have been explored with research. As more treatment options become available this research will need to be ongoing for primary care, podiatry, and orthopedic medical professionals to help patients choose the best treatment regimen. Other considerations for patients are the cost of treatment as some of these treatments are unlikely to be covered by health insurance. This should be a consideration when recommending treatment to patients with chronic PF.

Ultrasound

Ultrasound has been widely used by physical therapists and is believed to aid in tissue recovery time by increasing tissue temperature, blood circulation, metabolism, and chemical activity of the tissue. This suggests that it may increase tissue repair of the plantar fascia (Papadopoulos et al. 2020).

Katzap et al. (2018) and Akinoglu et al. (2017) looked at ultrasound treatment for plantar fasciitis. Both studies had a control group. Katzap at al. had a sham ultrasound group while

Akinoglu et al. had a control group that did basic exercises. Akinoglu et al. added a third group which received ECSW,which will be discussed within that section. Akinoglu et al. looked at patients with longer than three months of symptoms while Katzap et al. did not have a time limitation on the symptoms; however, greater than half of their participants had symptoms greater than three months. Katzap et al. found that both the sham and ultrasound group improved over time with a $p<.001$ in the NPRS of first step pain of the day, pain during the day and pressure/pain threshold. One group did not do statistically better than the other. Akinoglu et al. found that US did better in FFI pain, disability, activity limitations, and AOFAS hind foot score but did not have any significant difference in status equilibrium, dynamic equilibrium, or ankle proprioception between the US and control group. Akinoglu et al. and Katzap et al. both had about 50 participants, but Akinoglu et al. research sampled only female participants. In general, the studies showed both groups improved over time without significant difference between the US and control group. Akinoglu et al. did show statistical improvement for the US group with FFI pain, disability, and activity limitations, but this will need to be repeated with a diverse population to determine how useful US can be in patients with PF.

Much like other research around therapeutic ultrasound use, conclusive results of ultrasound use in PF have not been reached. The use of ultrasound is inconclusive and inconsistent at aiding in pain reduction and lowering recovery time when compared to other modalities and the tincture of time. It does seem to help some people and has few side effects other than the time, and equipment/staff costs to run it. Considering therapeutic ultrasound use has been used and researched for longer than fifty years, research will likely continue. Clinical application of therapeutic ultrasound used by a trained physical therapist has very few side effects. In patients with chronic PF that have failed other treatments this may be another option.

Evidence is not definitive enough to recommend US as a first line treatment. Patients should be warned they may not see improvement since there is not strong evidence that therapeutic ultrasound works.

Extracorporeal Shock Wave therapy

Akinoglu et al. (2017), Gezginaslan et al (2020), and Gollwitzer et al (2015) are three studies looking at extracorporeal shock wave therapy as treatment for chronic PF. Gezginaslan et al. aimed to determine the effectiveness of density and number of sessions using three groups that included high density with seven sessions, high density with three sessions and low density with seven sessions. Gezpinaslan et al. revealed that all groups improved over the course of one month. Comparing the three groups, the high density ESWT sessions with higher sessions did significantly better in VAS, 6MWT, FFI, FACIT and ST-36 resulting in a decrease in pain, increased quality of life and physical function. Akinoglu et al. was discussed above because they also looked at ultrasound technology. This study was beneficial because it compared ESWT, US and a control exercise group. All groups did statistically better over time. ESWT showed statistically better AOFAS scores, and increased ankle proprioception compared to the control exercise group. Akinoglu et al. suggests that both ESWT and US are effective additive treatment in chronic PF for reducing hind foot AOFAS scores. In Akinoglu et al. US reduced FFI parameters statistically more than ESWT. Of note, Akinoglu et al. research was only conducted in female participants as discussed previously. The third study this project looked at regarding ESWT in PF is Gollwitzer et al. This study was the largest of the three studies with 246 participants and the only one to attempt “sham” ESWT on patients to blind them to what treatment they received. Gollwitzer et al. compared ESWT to placebo treatment. Patients had PF for at least six months vs the three months in the other two studies looking at ESWT. Results of

Gollwitzer et al. show that ESWT was superior at the 12 week follow-up for VAS heel pain and the Roles and Maudsley score compared to the placebo group. Participants in the Gollwitzer study were not allowed to use other therapies during the treatment time except pain reduction medication; therefore, a conclusion cannot be made that ESWT compared to physical therapy or standard treatments is more effective.

Further research around ESWT should be focused on longevity and confirming that high density for longer sessions is in fact beneficial both from a time and cost perspective with comparison to less time and financial costly interventions. Other research into this should compare it to the standard treatment to determine if it is in fact superior or additive to standard treatment. ESWT is challenging to blind, and attempts should be made in all further research to blind the treatment as much as possible. Although this literature review was not specifically looking at imaging, further studies on the effectiveness of MRI and IFTCP measurement should be done to determine whether it is financially reasonable to do an MRI on PF patients. Specifically, when considering imaging in those who have failed first line treatment and deciding when to consider injections including ESWT.

Injections

Breton et al. (2021) and Jimenez-Perez et al. (2018) are two studies reviewed within this paper that deal with PRP and steroid injections. The studies done by Breton et al. and Jimenez-Perez et al. show improvements with corticosteroid and PRP injections; however, the Jimenez-Perez et al. study showed that PRP did significantly better than the corticoid group in VAS scores and AOFAS score. The studies looked at imaging and fascial thickness with response to PRP and corticosteroids. Results of Breton et al. show a statistically significant response with relation of a fascia > 7mm on MRI and steroid injection while the PRP injection was statistically

significant in VAS score reduction regardless of fascial thickness. The corticosteroid group did better with the HSTIR ratio on imaging. Breton et al. concluded that PRP works regardless of fascia thickness. In Jimenez-Perez et al. both groups saw a reduction in the fascia on MRI, but the PRP had statistically more improvement in fascia size at the six-month MRI. Breton et al. compared pain response regarding the thickness of fascia on MRI. Jimenez-Perez et al. measured the reduction in thickness after treatment. Imaging was included in both studies, but they were not measuring the same outcome.

Steroid injections have been studied for greater than 50 years and do show short term improvement while long-term improvement has not been fully proven. Steroid injections are regularly used in clinic to help reduce inflammation. Additional research needs to be done with PRP efficacy and best method of injection including site, frequency, and safety. Blinding was not done in these studies and is a challenge that should be a high priority to confirm the results of the studies. Breton et al. and Jimenez et al. looked at fascial thickness on MRI, and imaging could be a consideration when treating patients for PF. It will need to be further researched to conclude specific recommendations for when to use imaging, like MRI, on a patient with PF. Use of MRI on every PF patient may not be the most beneficial approach in both a financial and treatment approach. It will be beneficial to have further research on PRP and corticosteroid use without use of imaging as well. The likelihood that MRI will be used widely on PF patients in the public is low and could be a burden on healthcare resources.

Alternative treatments (Dry cupping, dry needling, autologous blood injection)

Dunning et al. (2018) and Wheeler et al. (2022) both looked at electrical dry needling. Dunning et al. compared dry needling to a conventional group that received US, exercise and manual therapy and Wheeler et al. compared dry needling to autologous blood injection.

Dunning et al. found that both groups improved up to three-months, but the dry needling group improved statistically more at four weeks and three months. Wheeler et al. found that both groups had statistically significant improvement at six months, but one did not improve more over the other. Dry needling appears to have some promising research; however, further research needs to be done comparing dry needling to other less invasive procedures because there are risks associated with it, mainly infection. Future research comparing autologous blood, PRP, dry needling, and steroid injections should all be considered with attempts to blind as much as possible. Procedures like this are more invasive and require more work for blinding, and this should be considered in results of the studies as participants and investigators may be more likely to figure out which treatment they have received.

Sweety et al. (2022) researched dry cupping, a technique used by massage therapists, in 20 female athletes comparing to conventional therapy over four weeks. All groups statistically improved over the 4 weeks, but the dry cupping group did improve statistically more than the conventional group. Minimal research is available regarding dry cupping in PF, and this study only had 30 athletic females. Very little can be concluded from this research because of the smaller, narrow sample size. Sweety et al. concluded that dry cupping therapy may be considered as adjunct treatment with conventional therapy in treatment of female runners with chronic PF. Further research in dry cupping needs to be done including both sexes, non-athletes with a larger population size and over a longer period.

Insole use

Seligman et al. (2021), Cohena-Jimenez et al. (2021) and Rosenberg et al. (2021) all looked at insole use in PF. Seligman et al. found no statistical difference between hard and soft insoles with pain intensity or pain interference; both groups saw a similar reduction in pain.

Seligman et al concluded both soft and hard orthosis provided pain relief with the soft orthosis being significantly less expensive. Cohena-Jimenez et al. found that at one and six months, the custom group in their study did statistically better with pain and function than the 'flat' cushioned group. Cohena-Jimenez et al. concluded that custom orthosis led to improved plantar fasciitis with reduced foot pain and improved functionality. Rosenberg et al. added a GP led group to their custom vs sham insoles. Neither insole group in Rosenberg et al. did statistically better than the other, however the GP led group did statistically better with pain during activity and first step pain at 6, 12 and 26 weeks. The inconclusive results of the three studies suggest that insoles may help patients. Additional research should be done to further define the correct use of insoles in the setting of PF and whether insoles are a preventative measure for future PF flares.

Treatment of PF is an individualized approach and at a minimum should include patients wearing appropriate shoes, treating pain with appropriate medications for the individual, ice as needed for pain control in addition to the manual treatment and physical therapy stretching and exercises. The additional treatments researched here can help aid in more chronic PF that does not resolve with the basic treatment described. When considering the alternative treatments, remember some have less research than others. There is plenty of research on steroid injections and the risks are well known. Ultrasound therapy has been around for many years and has more research with very little risks associated. Insoles have some positive benefits in research and very little risk but can be expensive and are often not covered by insurance. Extracorporeal shock wave therapy, PRP, dry needling and cupping all have less research and likely lack coverage by most insurance. Most of the research reviewed had patients doing standard treatments like pain medications, supportive shoes, rest, and ice in addition to the alternative treatment.

Applicability to Clinical Practice

Medical practitioners should be aware that while many of the alternative modalities may be helpful, the studies are inconclusive, and the modality may be inconsistent with effectiveness. Research suggests that many of the modalities may be worth a trail if the patient has failed conventional treatment. Applicability to clinical practice is going to depend greatly on where a patient lives and what services they have available in addition to their insurance and financial situation. At baseline it is important to start with the conservative, standard therapy and inform patients that most people get better in a timely manner. In the rural setting patients will often have to drive to another town for services like orthotics or physical therapy. Some family medicine practitioners may be comfortable with steroid injection of the fascia, but others may not be comfortable doing this procedure. Physical therapists may or may not do dry needling for plantar fasciitis, and this may mean having to see more than one therapist for treatment or traveling for treatment. PRP or autologous blood injections are likely challenging services to find in rural settings and even many towns and cities. Massage therapists that do dry cupping may be a service many people can find locally, but this comes with a cost as most insurance is not going to cover it. Out-of- pocket costs for treatments should be considered. Further research to determine whether alternative treatments are viable methods of pain reduction and increasing functionality in patients with PF would place pressure on insurance companies to cover therapies that are not currently covered, like cupping. Orthotics are another expense, especially if purchasing custom made, and may or may not benefit a patient. Considering the cost of alternative treatments will be important for practitioners regardless of where they are located as not all patients will be able to purchase all the alternative therapies.

The services available to patients will vary. Getting to know the services near a practitioner is an important practice so the referrals made are realistic and available. Knowing that some patients may have more financial resources to access alternative treatments that have limited research behind them like dry cupping and dry needling may mean these patients come in having already tried many alternative therapies. Practitioners should feel comfortable guiding patients through the conventional approach to PF treatment. If a patient chooses to pursue further alternative treatments, practitioners should work to explain the costs and risks of the alternative treatments so patients can make an informed choice for the given circumstance.

References

Akinoglu Bihter, Kose. Nezire. Kirdi. Nuray. Yavuz Yakut. (2017). *Comparison of the acute effect of radial shock wave therapy and ultrasound therapy in the treatment of plantar fasciitis: A randomized controlled study*. Pain medicine (Malden, Mass.). https://pubmed.ncbi.nlm.nih.gov/28575496/

Armstrong, A., & Hubbard, M. C. (2016). *AAOS Essentials of Musculoskeletal care*. American Academy of Orthopedic Surgeons.

Breton, A., Leplat, C., Picot, M.-C., Aouinti, S., Taourel, P., Laffont, I., Julia, M., & Cyteval, C. (2022). Prediction of clinical response to corticosteroid or platelet-rich plasma injection in plantar fasciitis with MRI: A prospective, randomized, double-blinded study. *Diagnostic and Interventional Imaging*, *103*(4), 217–224. https://doi.org/10.1016/j.diii.2021.10.008

Cohena-Jimenez, Manuel M. Pabon-Carrosco, Belloso, Ana Juana Perez (2020, November). *Comparison between customised foot orthoses and insole combined with the use of extracorporeal shock wave therapy in plantar fasciitis, medium-term follow-up results: A randomised controlled trial*. Clinical rehabilitation. https://pubmed.ncbi.nlm.nih.gov/33233945/.

Dunning J;Butts R;Henry N;Mourad F;Brannon A;Rodriguez H;Young I;Arias-Buría JL;Fernández-de-Las-Peñas C; (2018, October). *Electrical dry needling as an adjunct to exercise, manual therapy and ultrasound for plantar fasciitis: A multi-center Randomized Clinical Trial*. PloS one. https://pubmed.ncbi.nlm.nih.gov/30379937/.

Gezginaslan, Omer and Basa, Gokhan (2021). *Comparison of effectiveness of density and number of sessions of extracorporeal shock wave therapy in plantar fasciitis patients: A double-blind, randomized-controlled study*. The Journal of foot and ankle surgery : official publication of the American College of Foot and Ankle Surgeons. https://pubmed.ncbi.nlm.nih.gov/33191061/ .

Gollwitzer H;Saxena A;DiDomenico LA;Galli L;Bouché RT;Caminear DS;Fullem B;Vester JC;Horn C;Banke IJ;Burgkart R;Gerdesmeyer L; (2015). *Clinically relevant effectiveness of focused extracorporeal shock wave therapy in the treatment of chronic plantar fasciitis: A randomized, controlled Multicenter Study*. The Journal of bone and joint surgery. American volume. https://pubmed.ncbi.nlm.nih.gov/25948515/.

Jiménez-Pérez AE;Gonzalez-Arabio D;Diaz AS;Maderuelo JA;Ramos-Pascua LR; (2019). *Clinical and imaging effects of corticosteroids and platelet-rich plasma for the treatment of chronic plantar fasciitis: A comparative nonrandomized prospective study*. Foot and ankle surgery: official journal of the European Society of Foot and Ankle Surgeons. https://pubmed.ncbi.nlm.nih.gov/30321976/.

Katzap, Y., Haidukov, M., Berland, O. M., Itzhak, R. B., & Kalichman, L. (2018). Additive effect of therapeutic ultrasound in the treatment of plantar fasciitis: A randomized controlled trial. *Journal of Orthopaedic & Sports Physical Therapy*, *48*(11), 847–855. https://doi.org/10.2519/jospt.2018.8110

Papadopoulos ES, Mani R. The Role of Ultrasound Therapy in the Management of Musculoskeletal Soft Tissue Pain. The International Journal of Lower Extremity Wounds. 2020;19(4):350-358. doi:10.1177/1534734620948343

Rasenberg N;Bierma-Zeinstra SMA;Fuit L;Rathleff MS;Dieker A;van Veldhoven P;Bindels PJE;van Middelkoop M; (2021). *Custom insoles versus Sham and GP-led usual care in patients with plantar heel pain: Results of the STAP-Study - a randomized controlled trial*. British journal of sports medicine. https://pubmed.ncbi.nlm.nih.gov/32878869/.

Seligman DAR;Dawson D;Streiner DL;Seligman DJ;Davis A; (2021). *Treating heel pain in adults: A randomized controlled trial of hard vs modified soft custom orthotics and heel pads*. Archives of physical medicine and rehabilitation. https://pubmed.ncbi.nlm.nih.gov/33217374/.

Sweety, Malik, Anand, P., Bhati, P., & Hussain, M. E. (2022, March 31). *Effects of dry cupping therapy on pain, dynamic balance and functional performance in young female with recreational runners chronic plantar fasciitis*. Sports Orthopaedics and Traumatology. https://www.sciencedirect.com/science/article/pii/S0949328X22000096.

Trojian, T., & Tucker, A. K. (2019, June 15). *Plantar fasciitis*. American Family Physician. Retrieved January 2023. https://www.aafp.org/pubs/afp/issues/2019/0615/p744.html#nonoperative-treatment.

Wheeler PC;Dudson C;Gregory KM;Singh H;Boyd KT; (2022). *Autologous blood injection with dry-needling vs dry-needling alone treatment for chronic plantar fasciitis: A randomized controlled trial*. Foot & ankle international. https://pubmed.ncbi.nlm.nih.gov/35068224/.