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Corticosteroid vs Platelet Rich Plasma Injections in the Treatment of Chronic Plantar Fasciitis

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Abstract

Objective: To assess the effectiveness of platelet rich plasma (PRP) injections in the treatment of chronic plantar fasciitis compared to traditional corticosteroid injections. **Design:** Systematic literature review. **Methods:** A literature search was performed in Pubmed using the search terms “plantar fasciitis” and “platelet rich plasma”. Inclusion criteria included publication within 10 years, randomized control trial, human study, and containing the American Orthopedic Foot and Ankle Society (AOFAS) hindfoot scoring system. **Results:** Our literature search resulted in the review of three randomized- control trials. Mahindra et al. showed that PRP was superior to corticosteroid injections in the treatment of chronic plantar fasciitis at 3 months. Acosto-Olivo et al. found both treatments were equally effective at reducing symptoms of plantar fasciitis over a 16- week period. Similar to Mahindra et al., Monto found that PRP was a more effective treatment for maintaining remission of chronic plantar fasciitis over a 24- month period. **Conclusion:** PRP injections are shown to be as effective or more effective than corticosteroid injections in the treatment of chronic plantar fasciitis that has failed conservative treatment.

Introduction

Plantar fasciitis accounts for approximately one million healthcare visits per year and 11-15% of adult foot symptoms requiring medical care.[1,2] The deep plantar fascia is a thick tissue with longitudinal fibers that are intimately attached to the skin.[3] The fascia provides arch support during jumping, walking, and standing.[1] The causes of plantar fasciitis are multifactorial. Identifying an individual's risk factors are essential in order to create a successful treatment plan. Risk factors include obesity, flat fleet, overuse, trauma, and prolonged jumping or standing.[1, 4] Plantar fasciitis is typically diagnosed in those between the ages of 40 - 60 years old, but may be seen at younger ages especially in athletes.[1,4]

Plantar fasciitis typically presents as heel pain that is worse in the morning or after periods of inactivity. The pain initially decreases throughout the day, but then worsens with extended periods of walking or standing.[4] Patients may complain of localized tenderness over the medial aspect of the heel.[4] In addition, patients may complain of pain with dorsiflexion and standing on their toes.[3] A diagnosis of plantar fasciitis can be made clinically.[2,3]

Initial treatments for plantar fasciitis are conservative and include a combination of non-steroidal anti-inflammatory drugs (NSAIDS), orthopedic shoes and exercise therapy. However, 10% of patients do not improve with conservative measures and progress to have debilitating chronic plantar fasciitis.[7] Treatment of chronic plantar fasciitis includes a trial of corticosteroids injections along points of tenderness in the plantar fascia.[1] In a randomized control trail of 65 patients, pain was significantly reduced in those who received an injection of methylprednisolone compared to placebo injection.[5] Treatment with corticosteroid injections has significant drawbacks though, as repeated injections can cause heel pad atrophy and plantar fascia rupture.[6]

Local PRP injections are an emerging treatment modality in the management of chronic tendon and ligament pathologies, including plantar fasciitis.[7,8,9] The theory behind PRP treatment is that an injection of large doses of growth factors, cytokines and cellular contents into soft tissue will promote cellular proliferation and possibly regeneration.[4] An injection of PRP directly at the site of tenderness within the plantar fascia allows these contents to reach an area that is otherwise relatively inaccessible due to its hypovascularity.[7] The aim of this review is to determine whether PRP injections are more effective than corticosteroid injections in the treatment of chronic plantar fasciitis.

Methods

An initial literature search in Pubmed was performed in September of 2018 (Figure 1). The search terms “plantar fasciitis” and “platelet rich plasma” produced 63 results. Duplicate articles were removed yielding 63 results. Inclusion criteria included articles being published within the past 10 years,

randomized control trials, and human studies. Once inclusion criteria was assessed, 8 articles met the criteria for our research. Additional articles were excluded due to irrelevance and not using the AOFAS hindfoot scoring system to assess subjective and objective outcomes of treatment (Appendix 1). For example, studies that only used the visual analog scale (VAS) to assess outcomes of treatment were removed. Three studies were identified as suitable for our research.

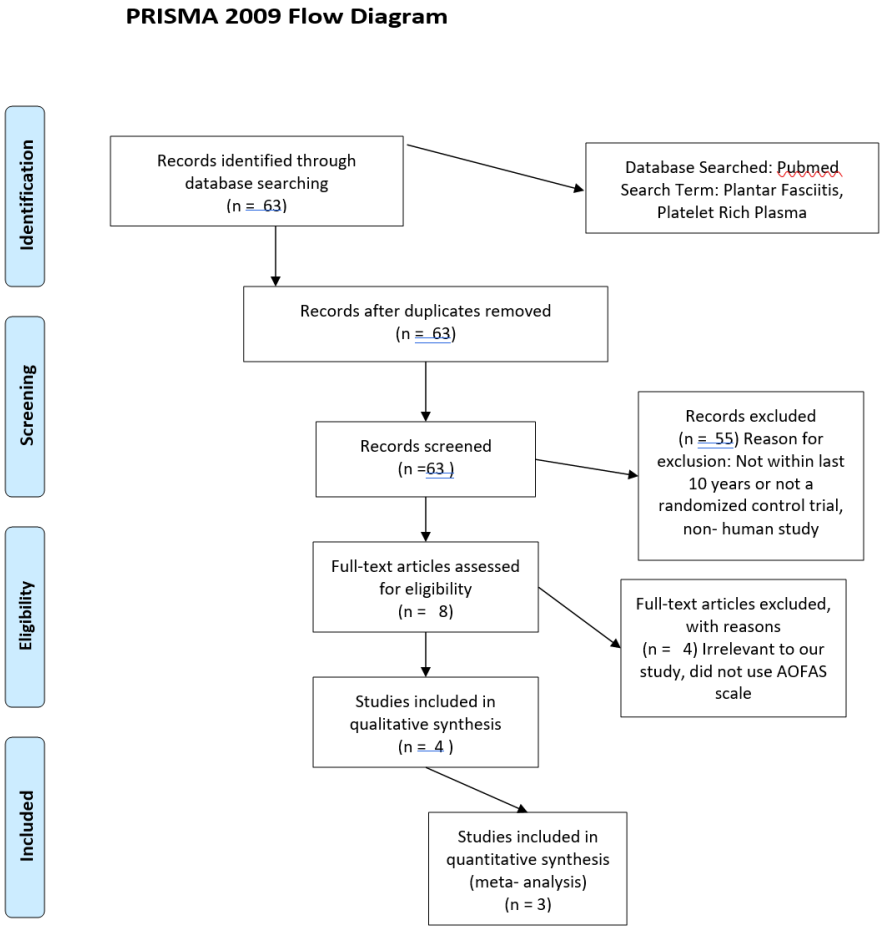

Figure 1. PRISMA diagram of search results including inclusion and exclusion criteria.

Results

Study #1: Chronic Plantar Fasciitis: Effect of Platelet Rich Plasma, Corticosteroid, and Placebo.

Study Objective: To compare the effectiveness of PRP and corticosteroid injections in the treatment of chronic plantar fasciitis.

Study Design: This was a prospective randomized double-blind placebo control study of 75 patients with clinically diagnosed chronic plantar fasciitis. Patients had no response to at least three months of conservative therapy including physical therapy, NSAIDS, bracing, and orthotics.

Patients were randomly divided by computer-derived random charts into three groups. Group A received 2.5 to 3 milliliters (mL) of PRP, group B received 2 mL of 40 mg of methylprednisolone, and group C received normal saline. There were 25 patients in each group.

Mean ages of patients in groups A, B, and C were 30.72, 33.92, and 35.48 years respectively with a p-value of 0.14 among the groups. Male to female ratios for group A, B, C were 8:17, 12:13, and 11:14 respectively.

The preparation of PRP involved drawing 27 mL of blood from the cubital vein of group A and placing it in a glass tube containing 3 mL of citrate dextrose solution to prevent clotting. The blood was centrifuged at 32000 rpm for 12 minutes resulting in 2.5 to 3 mL of PRP. Group B and C had 5 mL of blood drawn.

The injection was given at the point of maximum tenderness with a 22-gauge needle. During the injection, a screen was placed between the patient's face and the injection, so they could not see the contents of the syringe. After injection the patients were advised to not use NSAIDS for one month and to apply ice as needed. All patients received physical therapy.

Patients were assessed before injection and during follow up at three weeks and three months by a blinded observer. The patients were assessed using the AOFAS Ankle and Hindfoot score which is a common scale used to measure treatment outcomes in patients with plantar fasciitis (Appendix 1). This scale measures pain, function, and alignment for a total of 100 points. A higher score indicates greater improvement in symptoms and function.[10]

Study Results: Mean AOFAS score before injection in groups A, B, and C were 51.56, 55.72, and 50.28 respectively. These scores improved to 83.92, 86.60, and 53.88 at 3 weeks follow up and 88.24, 81.32, and 50.84 at 3 months (Table 1). Group A experienced a 63% increase at three weeks and a 71 % increase in AOFAS score at three months compared to pretreatment. Group B experienced a 55.4% increase at three weeks and a 46% increase at three months, when compared to pretreatment values.

AOFAS scores in group A and B improved significantly at three weeks (P=0) and three months (P=0). In group C, no significant difference was seen in AOFAS score at 3 weeks (P=0.06) or 3 months (P=0.39)

Comparison of groups A and B showed no significant difference in AOFAS score before injection (P=0.20). At three weeks follow up, group B had a better outcome when compared to group A, but difference was not significant (P=0.33). At three months group A had significantly higher AOFAS score compared to group B (P=0.00). A p-value less than 0.05 was considered statistically significant.

The authors concluded that local injection of PRP is as effective or more effective than corticosteroid at three-month follow up.

Table 1. AOFAS scores prior to injection, at three weeks and three months for group A, group B and group C.

	Prior to Injection	**3 Weeks**	**3 Months**	**% Increase from pretreatment to 3 months**
Group A (PRP)	51.56	83.92	88.24	71%
Group B (Corticosteroid)	55.72	86.60	81.32	46%
Group C (Saline)	50.28	53.88	50.84	0

Study Critique: Limitations of this study include a small sample size of 75 participants and short length of follow-up (three months). In addition, other limitations include clinical diagnosis of plantar fasciitis without the utilization of plain x-ray or MRI to confirm diagnosis. While plantar fasciitis is a clinical diagnosis these studies provide extra support and comparisons for diagnosis and research purposes as well as confirming no other foot pathologies are present (i.e. stress fractures). Strengths included double blinded study, utilization of computer randomized with equal subjects in each group, and a comparison placebo group.

Study #2: Plantar Fasciitis- A Comparison of Treatment with Intralesional Steroids versus Platelet Rich Plasma A Randomized, Blinded Study

Study Objective: Compare the use of intralesional steroids to intralesional PRP, using pain scales and functional evaluation, in patients with plantar fasciitis who did not respond to conservative treatment.

Study Design: This was a controlled, randomized, blinded clinical assay of 32 patients who were diagnosed with plantar fasciitis in the outpatient clinic by the same orthopedist. X-ray and MRI were completed to rule out stress fractures in all patients. Inclusion criteria included skeletally mature patients with heel pain at the insertion of the plantar fascia, failure of conservative treat for three months such as orthotics and NSAIDS and no previous infiltrations. Exclusion criteria included patients with associated pathologies such as alterations in ipsilateral ankle and knee, osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, Reiter's syndrome, neurological abnormalities, skin infections, or history of infection at the application site in the previous three months (Table 2).

Patients were randomly assigned to two groups by selecting a sealed envelope. All procedures were performed by the same researcher, who was blinded to the application via covered syringes. Further assessments were performed by a different investigator who was also blinded to the treatment.

Patient demographics included 32 patients divided into two groups of 16 patients. Two patients in each group (four total) were excluded for failure to follow up, resulting in a total of 28 (14 per group). Average age of participants was 44.8 (24-61) years and 80% of participants were female.

The steroid treatment group received 8 mg of dexamethasone plus 2 mL of lidocaine. Medication was injected in the anteromedial zone of calcaneus. The PRP treatment group had 40 mL of whole blood drawn from basilic or antecubital vein into a vacuum sealed tube with 3.8% sodium citrate as an anticoagulant. The blood was centrifuged for ten minutes. The upper plasma layer was removed leaving 3 mL in which the platelets were re-suspended. Prior to administration, platelets were activated by adding 0.45 mL of 10% calcium gluconate. The activated PRP was aspirated with a 5 mL syringe and injected into the patient.

Patients were evaluated prior to treatment and at 2, 4, 12, and 16 weeks post treatment with the AOFAS scale.

Table 2. Exclusion criteria for Acosta-Olivo et al. Study

- Other associated pathologies (alterations in ipsilateral ankle and knee, osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, Reiter's syndrome)
- Neurological abnormalities
- Skin infections
- History of infection at the application site (within the previous three months)

Study Results: AOFAS scores for the steroid group at pretreatment, 2, 4, 8, 12, and 16 weeks were 67.6, 82.6, 86.8, 91.4, 96.8, 97.2 respectively (Table 3). AOFAS score increased by 43.2% between pretreatment and 16 weeks (Table 3). AOFAS scores for PRP group at pretreatment, 2, 4, 8, 12, and 16 weeks were 72.3, 80.8, 85.9, 96.1, 94.4, 96.2 respectively. P-values of the steroid group versus the PRP group at pretreatment, 2, 4, 8, 12, 16 weeks were 0.22, 0.54, 0.76, 0.21, 0.25, 0.73 respectively (Table 3).

There was a 33% increase in AOFAS scores between pretreatment and 16 weeks. Little difference in AOFAS scores were displayed between the study groups prior to treatment and all patients showed improvement in symptoms over the course of the study. No significant differences were observed between the 2 groups. A p-value of less than 0.05 was considered statistically significant.

The authors conclude that use of PRP is an effective treatment method for patients with plantar fasciitis who have failed conservative treatment and has equal efficacy as steroids, without the associated complications.

Table 3. Results of steroid group vs PRP group at pretreatment, 2, 4, 8, 12 and 16 weeks

	Pretreatment	**2 Weeks**	**4 Weeks**	**8 Weeks**	**12 Weeks**	**16 Weeks**
Steroid Group	67.6	82.6	86.8	91.4	96.8	97.2
PRP Group	72.3	80.8	85.9	96.1	94.4	96.2
P-values	0.22	0.54	0.76	0.21	0.25	0.73

Study Critique

Strengths of this study include use of standardized scales and the absence of complications with either of the two types of injections. Weakness of this study included a small sample size, short follow up period, and inclusion of more epidemiological data. In addition, a majority (80%) of patients in this study were female and four patients failed to follow up.

Study #3: Platelet- Rich Plasma Efficacy Versus Corticosteroid Injection Treatment for Chronic Severe Plantar Fasciitis

Study Objective: To compare the efficacy of PRP to corticosteroid injection in the treatment of chronic plantar fasciitis that failed traditional nonoperative management.

Study Design: This study was a single-blinded, prospective, randomized comparative study of 40 patients who were diagnosed with chronic unilateral plantar fasciitis and failed traditional non- operative treatments including rest, physical therapy, silicone heel lifts, CAM walker bracing, cast immobilization,

night splinting, and non-steroidal medication. Prior to the start of the study diagnosis of plantar fasciitis was confirmed via plain radiographs and MRI. Inclusion criteria included a four-month minimum of standard treatment with little to no relief of symptoms. Exclusion criteria was not reported by the researchers.

Demographics for the study included 23 females and 17 males. The male and female participants between the PRP and corticosteroid groups had varying heights and body mass indexes (BMI). Males in the PRP had a higher average BMI than males in the corticosteroid group. Females in the PRP group were, on average, taller and had a lower BMI than the females in the corticosteroid group. The authors reported that although differences were noted in in height, weight and BMI among the patient groups, they were not statistically significant

Patients were randomized into two groups of 20 patients per group. Group 1 was treated with 40 mg of methylprednisolone via ultrasound guidance. Group 2 was treated with autologous PRP. To prepare the PRP 27 mL of venous blood was obtained from each participant and mixed with 3 mL of anticoagulant citrate. The blood was centrifuged for 12 minutes. 3 mL of PRP was obtained from the "buffy coat" for injection. For both groups, the injection site was cleansed prior to injection with 2% chlorhexidine gluconate/70% isopropyl alcohol and a local anesthetic field block was performed using 6 mL of 0.5% bupivacaine.

Upon completion of injections, participants were placed in a CAM walker brace for two weeks. In addition, patients were given an exercise regimen consisting of calf/arch stretching and the Swedish heel drop program. Participants were not to use NSAIDs in the first two weeks after their injection and were discouraged from using them throughout the length of the entire study.

Study Results: The corticosteroid group consisted of 9 males and 11 females with an average age of 59. The average AOFAS score of the corticosteroid group prior to treatment was 52. At 3 months this score increased to 81, but then decreased at 6 and 12 months to 74 and 58 and then ultimately returned to near baseline at a score of 56 at 24 months (Table 4).

The PRP group consisted of 8 males and 12 females with an average age of 51. The average AOFAS score of the PRP group was 37 prior to beginning treatment. At 3 months this score increased to 95 and remained elevated at 6, 12 and 24 months with scores of 94, 94 and 92 respectively (Table 4).

Results showed a clinically significant difference between AOFAS scores of the corticosteroid and PRP groups at 3, 6, 12, and 24 months (P=.001, 95% confidence interval). The authors concluded that the use

of local PRP injection was more successful in the long-term management of plantar fasciitis than corticosteroid injections.

A p-value of less than 0.05 was considered statistically significant with a confidence interval of 95% for all tests.

Table 4. Comparison of AOFAS scores of corticosteroid group vs PRP group

	Prior to Treatment	**3 Months**	**6 Months**	**12 Months**	**24 Months**
Corticosteroid Group	52	81	74	58	56
PRP Group	37	95	94	94	92

Study Critique: Limitations of this study included small sample size, unclear exclusion criteria of the study participants, and single-blinded only. Furthermore, there was a difference in volume of injection between the 2 groups which the authors note to be of unknown significance. Strengths include randomization, long length of follow-up, high patient retention, similar injection techniques, and the investigation of the statistical significance of confounding variables such as differences in height and weight.

Discussion

Plantar fasciitis is one of the most common causes of heel pain. It typically presents with localized tenderness over the medial calcaneal tubercle and is initially treated with conservative methods such as stretching, orthotics, and NSAIDS. For persistent chronic plantar fasciitis, injection of corticosteroid is the preferred non-surgical treatment. Although corticosteroids are effective in reducing pain associated with plantar fasciitis their use comes with a significant risk fascia rupture.[11]

In recent years, the use of PRP injections to treat chronic plantar fasciitis that has failed traditional therapy has gained interest due to its presumed ability to reduce pain presumably without the risk of plantar fascia rupture.[8] Relatively few studies have been done to analyze the effectiveness of PRP compared to steroids injections and those completed studies have produced mixed results. However, a majority of these studies show promising data that PRP is as effective, if not more effective than steroids in the treatment of plantar fasciitis.[7,8,9]

The results of this review revealed that PRP injections are as efficacious as steroid injections in the treatment of plantar fasciitis that does not respond to conservative treatment, but not necessarily superior. All three studies used a statistical significance cut off of ($p = 0.05$). An overview of the three studies is provided in Table 5.

Of the three studies, study 1 and study 3 showed that PRP was superior to corticosteroids in the long-term treatment of plantar fasciitis (p= 0.00, 0.01 respectively). Study 2 concluded that the two treatments had no statistically significant difference in efficacy at 16 weeks (p= 0.73). Interestingly, study 1 showed that the steroid group had higher AOFAS scores at 3 weeks, but PRP had higher scores at 3 months. Study 3 revealed a similar pattern of findings as the steroid group had improved scores at 3 months but at 24 months scores had returned to pretreatment findings. Conversely, PRP scores steadily increased over the course of treatment and remained elevated at 24 months. These findings suggest that PRP could be superior to steroids in providing long term relief of plantar fasciitis.

Table 5. Comparison of Mahindra et al., Acosto- Olivo et al. and Monto

	Mahindra et al. (study 1)	**Acosto- Olivo et al. (study 2)**	**Monto (study 3)**
Study Design	Prospective randomized double- blind placebo control study	controlled, randomized, blinded study	single- blinded, prospective, randomized comparative study
Assessment Method	AOFAS	AOFAS	AOFAS
Patients, N	75	32	40
Age	~33.37	44.8	~55
Gender	44F: 31M	25.6F: 6.4M	23F: 17M
AOFAS Score Timing	Pretreatment, 3 weeks, 3 months	Pretreatment, 2, 4, 8, 12, 16 weeks	Pretreatment 3, 6, 12, 24 months
Diagnosis	Clinical	Clinical, MRI, X-ray	Clinical, MRI, X-ray
Definition of Chronic Plantar Fasciitis	3 months	3 months	4 months
P- Values	P= 0.00	P= 0.73	P= 0.01
Study Conclusion	PRP superior to corticosteroids	Equal efficacy	PRP superior to corticosteroids

Of the three studies, Study 1 had the largest sample size of 75 patients. Study 2 and 3 had similar sample sizes of 32 and 40 participants. Study 1, 2, and 3 had more women than men (Table 5). Study 2 had the largest difference in genders, with a ratio of 25.6 females to 6.4 males. Study 3 had the longest follow of 24 months. Study 1 had the shortest follow up time of 3 months and the least frequent follow up with two reassessments of AOFAS scores at 3 weeks and 3 months.

All three studies examined patients with chronic plantar fasciitis. Study 3 defined patients with chronic plantar fasciitis as those who experienced symptoms for at least four months despite conservative treatment. Conservative treatment was defined as rest, physical therapy, silicone heel lifts, CAM walker bracing, cast immobilization, night splinting, and NSAIDS. Plantar fasciitis diagnosis was confirmed with X-ray and MRI. Study 2 defined chronic plantar fasciitis as failure of conservative treatment for 3 months. They defined conservative treatments as orthotics and NSAIDS. Similar to study 3, X-ray and MRI was utilized to confirm diagnosis. Study 1 defined failure of conservative treatment as 3 months similarly to study 2. Study 1 defined conservative treatment as physical therapy, NSAIDS, bracing and orthotics. Unlike study 3 and study 1, imaging techniques (X-ray, MRI) were not utilized.

Adverse effects of PRP therapy, such as plantar fascia rupture, were not mentioned or reported in all three studies. In the future, more long-term prospective studies should be done to examine the adverse effects of PRP injections.

Strengths of this review include utilization of a standardized scale to evaluate the results from all three studies (AOFAS scale). The use of the AOFAS scale allows for comparisons and accurate conclusions to be drawn about the patient's subjective and objective responses to the PRP injections, corticosteroid injections, or placebo injections across all three studies.[10] Study 1 provided the use of a placebo group, which has not been part of the methodology of any other study. The placebo group allows for further support of both corticosteroid and PRP as treatment for plantar fasciitis. Other strengths included that all three studies were published within the last 4 years and the long follow up period (24 months) of study 3.

Limitations of this review include a small sample size, short length of follow up, use of different types and amounts of steroids, method of injection, and sample selection. Small sample size and length of follow are a major limitation of our review and show the need for larger scale studies. The three studies use different types and amounts of steroids. In addition, injections were administered either by ultrasound guided injections or at the point of maximal tenderness. Each study had differing exclusion and inclusion criteria. Specifically, only study 2 excluded for other conditions that may cause pain in the area of the plantar fascia. Lastly, the use of more female subjects than male subjects in each group is a further limitation.

The AOFAS ankle score is a survey that includes a mixture of subjective and objective questions and involves participation of both the patient and the provider. However, since its creation, it has raised some concerns with regards to its validity and reliability.[10] The use of this score to compare our studies poses a limitation due to the subjective nature of the questionnaire.

Potential bias was noted in study 3 as the author is a consultant for Exactech Inc. (Gainesville, Fl), which is the company that develops the preparation system used in his study (Accelerate Sport Platelet Concentration System). Study 1 and study 2 reported no conflicts of interest.

Conclusion

The use of PRP injections have shown to be as effective and, in some cases, more effective than corticosteroid injections in the treatment of chronic plantar fasciitis. The results of this review show exciting potential advancements in the treatment of chronic plantar fasciitis without the risk of plantar fascia rupture as seen in corticosteroids treatment. In addition, this review reveals that the positive effects of treatment with PRP may not wane as they do with corticosteroid injections (study 2). While PRP may be as efficacious as corticosteroid injections there are several factors that complicate its implications as a treatment including price of injections and lengthy time to prepare.[9]

Further research is necessary to understand the full spectrum of treatment implications and complications of the use of PRP injections. Future research studies should include larger sample sizes with longer lengths of follow-up to fully assess the utilization of PRP in plantar fasciitis treatment. In addition, future research should control for and differentiate between conditions that could contribute to or complicate plantar fasciitis such as obesity.

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Appendix 1. Outcomes measured using the AOFAS ankle and hindfoot scoring system.[10]

AOFAS Ankle and Hindfoot Scale (100 Points Total)
Pain (40 Points) - None **(40)** - Mild, Occasional **(30)** - Moderate, daily **(20)** - Severe, almost always present **(0)**
Function (50 Points) *Activity limitations, Support requirement* - No limitations, no support **(10)** - No limitations of daily activities, limitation of recreational activities, no support **(7)** - Limited daily and recreational activities, cane **(4)** - Severe limitation of daily and recreational activities, walker, crutches, wheelchair, brace **(0)** *Maximum walking distance, blocks* - Greater than 6 **(5)** - 4-6 **(4)** - 1-3 **(2)** - Less than 1 **(0)** *Walking surfaces* - No difficulty on any surface **(5)** - Some difficulty on uneven terrain, stairs, inclines, ladders **(3)** - Severe difficulty on uneven terrain, stairs, inclines, ladders **(0)** *Gait abnormality* - None, slight **(8)** - Obvious **(4)** - Marked **(0)** *Sagittal motion (flexion plus extension)* - Normal or mild restriction (30° or more) **(8)** - Moderate restriction (15° - 29°) **(4)** - Severe restriction (less than 150°) **(0)** *Hindfoot motion (inversion vs eversion)* - Normal or mild restriction (75%- 100% normal) **(6)** - Moderate restriction (25%- 74%) **(3)** - Marked restriction (less than 25% normal) **(0)** *Ankle- hindfoot stability (anteroposterior, varus- valgus)* - Stable **(8)** - Unstable **(0)**
Alignment (10 Points) - Good, plantigrade foot, midfoot well aligned **(15)** - Fair, plantigrade foot, some degree of midfoot malalignment observed, no symptoms **(8)** - Poor, nonplantigrade foot, severe malalignment, symptoms **(0)**
Total = 100