



Role of Platelet Rich Plasma in Chronic Plantar Fasciitis: A Prospective Study

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Abstract

Introduction Autologous platelet rich plasma (PRP) local injection has been recently proposed as a treatment of plantar fasciitis. The autologous PRP does not have much side effects compared to steroid injections. So far PRP injections have shown promising results in various studies. This study assessed the efficacy of a single local injection of PRP in chronic unilateral plantar fasciitis through a prospective case series.

Methodology A hospital-based prospective case series of 30 unilateral plantar fasciitis patients with symptom duration of 6 months or more were included in the study. All patients included in the study were assessed clinically and by visual analogue score for heel pain, AHS component of AOFAS and FADI scores before injection and at 6 and 12 week follow-up. USG measurement of plantar fascia thickness was done at pre-injection and at 12 weeks follow-up. All patients were observed for 12 weeks.

Results The mean age was 39 years (range 20–55 years). The pre-injection VAS score for heel pain was 6.5 ± 1.1 which improved to 2.7 ± 0.5 and 1.8 ± 0.8 at 6 and 12 week respectively and difference was significant ($p < 0.001$). The baseline FADI and AHS component of AOFAS scores were 53.1 ± 9.0 and 72.2 ± 5.7 which improved to 65.5 ± 5.3 and 76.1 ± 4.5 at 6 weeks and, 77.9 ± 4.4 and 85.7 ± 4.6 at 12 weeks respectively which was significant ($p < 0.001$). The baseline mean plantar fascia thickness was 4.9 ± 0.3 mm which was significantly ($p < 0.001$) reduced to 3.9 ± 0.3 mm at 12 weeks post PRP injection. All pairwise comparisons by the post-hoc Wilcoxon signed rank test with p -value adjustment were also significant.

Conclusion The short-term results of single dose PRP injections shows clinical and statistically significant improvements in VAS for heel pain, functional outcome scores and plantar fascia thickness measured by USG. This study concludes that local PRP injection is a viable management option for chronic plantar fasciitis.

Keywords Plantar fasciitis · Platelet rich plasma · Ultrasound · USG · Plantar fascia thickness

Introduction

Plantar fasciitis is one of the common aetiologies of foot and heel pain in adults. It is bilateral in 30% of patients [1–3]. The peak incidence is between 40 and 60 years, with

a younger peak in athletes [4]. The pathology involves the origin of the plantar fascia at the medial calcaneal tuberosity hence the pain is localized at that point. The aetiology is multifactorial and poorly understood. The known risk factors are obesity, poor foot and ankle biomechanics, flat

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feet, prolonged standing, jumping, running and ill-fitting footwear. Plantar fasciitis can be isolated or associated with other systemic diseases like seronegative spondyloarthropathies [5–9].

Various therapies have been reported, but the available evidence for a single modality of management is inadequate and conflicting. As of now there is no gold standard treatment for plantar fasciitis. Even though the corticosteroid injections have shown satisfactory short-term results, they were associated with various local and systemic adverse effects [10, 11]. These adversities have led to search for other options for the treatment of plantar fasciitis.

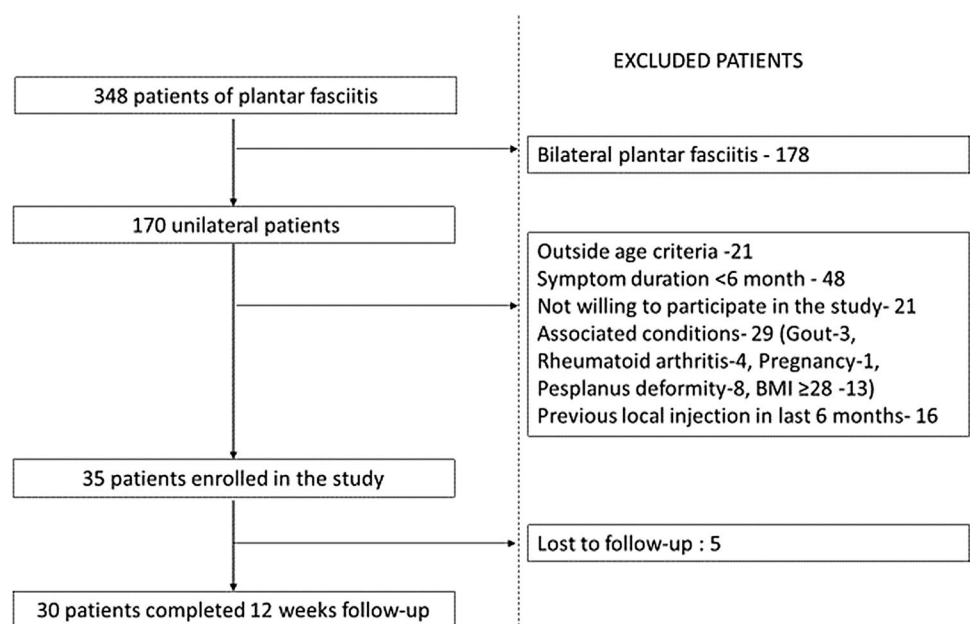
Injection of autologous platelet rich plasma (PRP) has been recently proposed as a treatment for plantar fasciitis on the evidence that it contains various growth factors and cytokines that may induce local factors to accelerate healing process [12]. The autologous PRP does not have side effects compared to steroid injections. So far, PRP injections have shown promising results in various studies. This prospective case series makes use of the VAS score for heel pain, functional outcome scores and ultrasonographic (USG) measurement of plantar fascia thickness as an outcome measure to study the actual role of single local injection of PRP in the management of plantar fasciitis. Literature utilising USG measurement of plantar fascia thickness as an outcome measure to study the effectiveness of PRP injection are very few which makes this study unique. The null hypothesis is that PRP injection has no effect in the outcome of plantar fasciitis management.

Methodology

This is a hospital-based prospective case series, conducted between January 2018 and January 2019. Patients aged between 20 and 60 years, presented with unilateral heel pain or pain on first step in the morning relieved by unloading and diagnosed as a case of unilateral plantar fasciitis of at least 6 months duration in whom symptoms did not improve despite conservative treatment were included. Patients with BMI ≥ 28 , bilateral disease, nerve related pathologies, Achilles tendinitis or tendinosis, Rheumatoid arthritis, ankylosing spondylitis, local infection, Gout, pregnant or breastfeeding, metastatic disease, complex regional pain syndrome, bony spur on plain radiograph, Previous intra-lesional injection in the last 6 months for the same condition, Previous foot surgery and those not willing for consent or follow-up were excluded from the study (Flowchart showing the scheme of patient enrolment shown in Fig. 1).

After fulfilling the inclusion and exclusion criteria, 30 patients were enrolled in the study. After ethical clearance, all patients were informed about the methodology. Informed and written consent were taken. All patients were assessed by pain and disability measurement of the foot through questionnaires (visual analogue pain score, AHS component of American Orthopaedic Foot and Ankle Society clinical rating system and the Foot and Ankle Disability Index) were taken before injection and at 6 and 12 week post injection to monitor the functional status. Thickness of plantar fascia at its origin was measured by USG at pre-injection and at 12 weeks post-injection to assess the response of plantar fascia to the PRP injection. PRP was prepared by centrifuging

Fig. 1 Flowchart showing the scheme of patient enrolment in the study



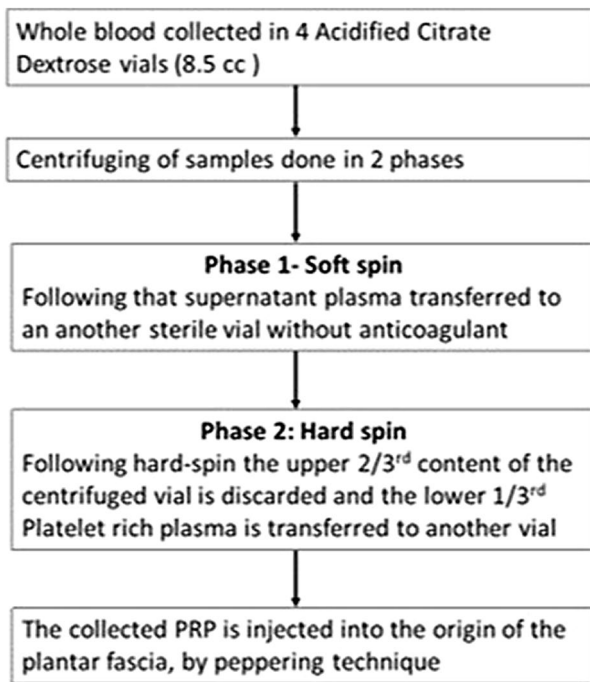


Fig. 2 Flowchart showing the method of preparation of PRP

30–35 ml of patient’s blood collected by sterile venepuncture (Method shown in Fig. 2). Under aseptic precautions all patients received 3 cc autologous PRP injection into the origin of the plantar fascia, by peppering technique for expansive zone of delivery. All injections were administered by a single orthopaedic surgeon. After injection all patients were monitored for 30 min for any adverse reaction. Following which they were allowed weight bearing as tolerated. After 2 weeks, plantar fascia stretching exercises were initiated. Foot inversion exercises, tip toe and heel walking were permitted after 6 weeks. All patients were followed up for 12 weeks.

Statistics Descriptive statistics were used initially. The Shapiro–Wilk test was performed on each variable to assess for Normality. Since VAS, FADI and AHS were found to violate Normality at one or more of the assessed weeks, Friedman’s test for repeated measures was used to assess the significance of differences between the assessments at 0, 6 and 12 weeks. A significant Friedman test was followed up by post-hoc tests using Wilcoxon signed rank test with *p*-value adjustment by the Holm’s method [13, 14]. Since the USG measurements of plantar fascia thickness did not show significant departure from Normality, a paired *t*-test was used to test the difference between the USG measurements at 12 weeks to the USG measurements at baseline.

For all assessments of the significance tests, a *p*-value of 0.05 or less was considered to be statistically significant. All tests were done using R statistical software [15] version 3.6.0 along with the add-on “Rcmdr.EZR” [14].

Results

The mean age of the study cohort was 39 years (SD 8.8 year) with a range of 20–55 year. Females were predominantly affected and right foot was more commonly involved. The mean symptom duration was 19 weeks (SD 4.9 weeks) (Demographic profile shown in Table 1).

The pre-injection VAS score for heel pain was 6.5 ± 1.1 which improved to 2.7 ± 0.5 and 1.8 ± 0.8 at 6 and 12 week respectively which was statistically significant ($p < 0.001$). The baseline FADI and AHS scores were 53.1 ± 9.0 and 72.2 ± 5.7 which post PRP injection improved to 65.5 ± 5.3 and 76.1 ± 4.5 at 6 weeks and, 77.9 ± 4.4 and 85.7 ± 4.6 at 12 weeks respectively. The improvement in all the scores were statistically significant at both 6 weeks and 12 weeks post PRP injection ($p < 0.001$ by the Friedman test). All pairwise comparisons by the post-hoc Wilcoxon signed rank test with *p*-value adjustment were also significant. For each outcome, the median and range are summarized in Table 2.

The mean thickness of plantar fascia of the affected foot assessed by USG at baseline was 4.9 mm with a standard deviation (SD) of 0.4 mm which was significantly ($p < 0.001$ by the paired *t*-test) reduced to a mean of 3.9 mm and SD of 0.3 mm at 12 weeks post PRP injection (Table 3). The study also showed that the mean thickness of plantar fascia of the normal foot to be 3.5 mm with a SD of 0.3 mm. USG images showing the thickness of plantar fascia of normal and affected foot are shown in Figs. 3, 4 respectively.

Discussion

Plantar fasciitis is often a self-limiting condition. In nearly 80% of the patients, the symptoms resolves spontaneously by 1 year from the onset [16], while in some patients it takes a chronic course and seriously affecting their day to day activities and quality of living in addition to a heavy health care burden [17, 18]. The aetiology and management of Plantar fasciitis is not fully understood [19, 20]. Contrary to the name, plantar fasciitis is not an inflammatory but a degenerative pathology due to repetitive microtrauma leading to wear of the plantar fascia at its origin [21, 22].

Table 1 Demographic profile

	Mean \pm SD
Age	39.0 \pm 8.8 years (range 20–55 years)
Symptom duration	19.1 \pm 5 weeks (range 12–28 weeks)
Gender	Male = 4; female = 26
Side affected	Right = 18; left = 12

Table 2 Summarizing the baseline and post-intervention outcome measures

	Pre-intervention median (range)	6 weeks median (range)	12 weeks median (range)	p value	
				Pre vs. 6 weeks	Pre vs. 12 weeks
VAS score	7 (4–8)	2 (1–5)	2 (1–4)	$p < 0.001$	$p < 0.001$
FADI score	52.4 (27.0–66.3)	67.3 (44.0–71.0)	78.9 (67.9–84.8)	$p < 0.001$	$p < 0.001$
AHS score	72.0 (59.0–83.0)	75.0 (64.0–84.0)	84.0 (74.0–96.0)	$p < 0.001$	$p < 0.001$

Table 3 Summarizing plantar fascia thickness assessed by USG at baseline and at 12 weeks post PRP injection

USG (Mean ± SD)			
	Pre-intervention (0 weeks) mm	Post-intervention (12 weeks) mm	p value
Affected foot	4.9 ± 0.4	3.9 ± 0.3	$p < 0.001$

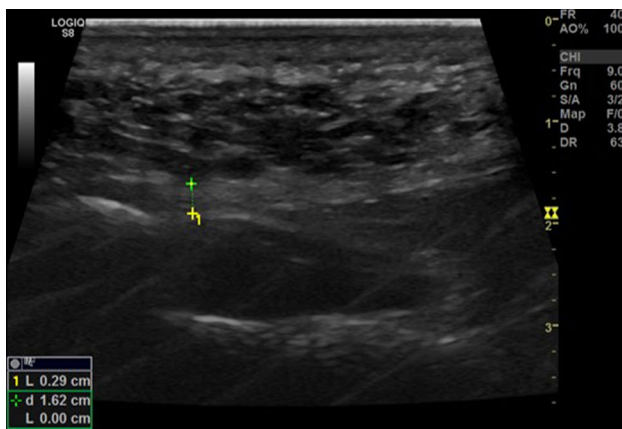


Fig. 3 Plantar fascia thickness measured by ultrasonogram in an asymptomatic foot

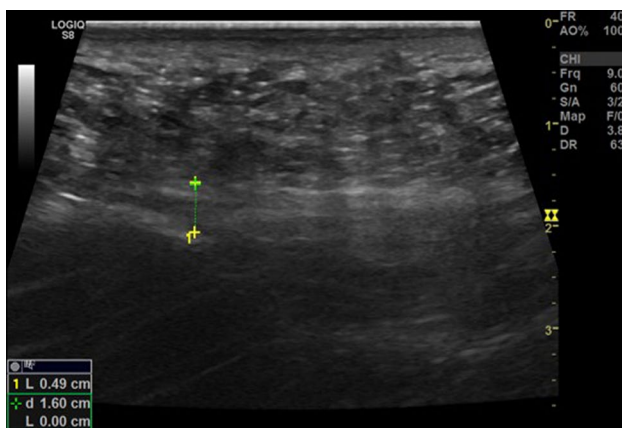


Fig. 4 Plantar fascia thickness measured by ultrasonogram in a symptomatic foot

The treatment of plantar fasciitis is mainly aimed at alleviating pain and functional improvement. Plantar fasciitis is mainly treated by conservative therapies including activity modification, NSAID’s, ice application, arch support, splinting/strapping, deep tissue massage, plantar fascia stretching exercises and physical therapy to alleviate the symptoms [23, 24]. RCT by Gupta et al. reported that plantar fascia stretching exercises provide significant symptomatic relief than heat, silicone heel pad or calf stretching exercises [9]. Despite the conservative treatment, in around 10% patients, the symptoms persist and leads to chronic plantar fasciitis. Currently local corticosteroid injections are the mainstay in the treatment of chronic plantar fasciitis as they provide satisfactory short-term outcomes. The anti-inflammatory property of corticosteroids are effective in reducing the heel pain [25, 26]. They also inhibit the proliferation of fibroblasts and ground substance proteins [27]. Although the advantages are significant, multiple injections are often required and are associated with rupture or tear of plantar fascia, abscesses, osteomyelitis and infection, depigmentation of skin, nerve and muscle injury, post-injection flare, and heel fat pad atrophy [10, 11, 28].

Local injection of PRP is a recently introduced treatment of plantar fasciitis. PRP is rich in growth factors (TGF, VEGF, PDGF), cytokines and interleukins [29]. In plantar fasciitis, the growth factors and anti-inflammatory cytokines in the PRP initiate the healing process at the site of degeneration of plantar fascia and alleviates the symptoms [29, 30]. PRP injection is ideally infiltrated at the point of maximum tenderness of the affected heel.

Several case series and RCT’s were published in the literature reporting the effectiveness of PRP injection in plantar fasciitis. Martinelli et al. [30] reported a case series of 14 patients of plantar fasciitis treated with three doses of PRP injection, in their study the VAS scores had reduced from 7.1 pre-treatment to 1.9 at the 12-month follow-up. Another case series by Ragab and Othman [31] reported a complete alleviation of pain with a single dose PRP injection in 88% of their patients ($n = 25$) at 12 month follow-up. Kumar et al. [32] in their cases series of 44 patients (50heels) treated with single PRP injection reported that at 6 month post-injection, baseline RM score, VAS score and AOFAS improved from mean 4 to 2 ($p < 0.001$), 7.7 to 4.2 ($p < 0.001$) and 60.6 to 81.9 ($p < 0.001$) respectively. All the three studies concluded

Table 4 Summarizing various case series that studied the efficacy of PRP injection in plantar fasciitis

Study	Type of case series	No of patients	No of PRP injections	Outcome measures	Final follow-up	Study conclusion (effectiveness of PRP injection)
Ragab and Othman [26] (2012)	Prospective	25	1	VAS, Ultrasound	12 months	Effective
Martinelli et al. [25] (2013)	Prospective	14	3	VAS, RM score	12 months	Effective
Kumar et al. [27] (2013)	Prospective	44 (50 heels)	1	VAS, AOFAS score, RM score	6 months	Effective
Wilson et al. [35] (2014)	Prospective	12 (24 heels)	1	FAAM, Foot-SANE score, SF-12v2	12 months	Effective

VAS, visual analogue scale, AOFAS score, The American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Score, RM-Roles and Maudsley score, FAAM- Foot and Ankle Ability Measure Score, SANE- Single Assessment Numeric Evaluation, SF-12v2- Short Form 12 item (version 2)

that PRP injection is very much effective in the treatment of plantar fasciitis.

RCT by Jain et al. [33], comparing PRP with steroid injections reported that the mean VAS, AOFAS, and RM scores in the PRP group was 3.3, 88.5, and 1.9 respectively and in the steroid group was 5.3, 75, and 2.6 respectively at the 12 month follow-up and the difference was significant. Similar study by Say et al. [34] reported that the mean AOFAS in PRP group was 85.5 ± 4.2 and 90.6 ± 2.6 , compared with 75.3 ± 4.8 and 80.3 ± 4.7 in the steroid group, respectively at 6 weeks and 6 months of follow-up. The difference in the scores were statistically significant ($p < 0.001$) at both the follow-up. Changes in AOFAS and VAS scores were significantly higher in the PRP group ($p < 0.001$). Another similar study by Shetty et al. [35] reported that at the 3-month follow-up, VAS, AOFAS and Foot and Ankle Disability Index (FADI) scores were significantly improved in both steroid and PRP groups. The study concluded that PRP injection gives a better outcome than that of the steroid injections.

All the three studies that compared the outcomes of PRP with steroid injection concluded that PRP injection had better patient related outcome measures than steroids. (Various case series that studied the efficacy of PRP injection in plantar fasciitis is summarized in Table 4). The results obtained in this study shown that PRP injection definitely reduces pain and improves the VAS score for heel pain and functional scores (FADI and AHS) in patients with plantar fasciitis. The difference from the baseline was statistically significant at both 6 and 12-week follow-up ($p < 0.001$).

Plantar fasciitis causes abnormal thickening of the plantar fascia (> 4.0 mm) in almost all cases [36]. This change in plantar fascia thickness can be easily assessed by ultrasonography (USG) [37]. These measurements can be used to monitor response to the treatment. Several studies reported that both the corticosteroid and PRP injections are effective in reducing the plantar fascia thickness [25, 38, 39]. Study

by Jain et al. [33] reported that the thickness of plantar fascia was reduced significantly following the steroid injection than that of PRP injection at 1 and 3 month follow-up ($p = 0.004$ and $p = 0.011$ respectively) but the difference at the 6-month follow-up was not significant ($P = 0.148$). They concluded that corticosteroid injection provides rapid reduction in the plantar fascia thickness in the first 3 months of injection but the results are comparable at 6 months. In this study, at 12 week follow-up, the thickness of plantar fascia was reduced to 3.9 ± 0.3 mm from 4.9 ± 0.3 mm at preintervention which was statistically significant ($p < 0.001$).

All patients in the study tolerated the local PRP injection without any significant local or systemic adverse events. Limitations of this study were small study population, a short duration of follow-up and lack of a control group. To overcome the shortcomings of this study, RCT with a larger study population and a longer follow-up will be helpful in better understanding of the long-term benefits and efficacy of the PRP injection in the management of chronic plantar fasciitis.

Conclusion

The outcomes of this study suggest that the short-term results of single dose PRP injection in chronic plantar fasciitis showed clinically and statistically significant improvements in VAS for heel pain, functional outcome scores and restoration of plantar fascia thickness confirmed by USG measurements. Hence, the null hypothesis is rejected. The study concludes that local PRP injection is a viable and safe treatment option for chronic plantar fasciitis.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standard statement The Institutional Ethics Committee approved the study.

Informed consent Informed and written consent were obtained from all participants of the study.

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