

Comparative Study of Platelet-rich Plasma and Corticosteroid Injection in the Treatment of Plantar Fasciitis

¹Gyaneshwar Tank, ²Rohit Gupta, ³Amit Gupta, ⁴Ravikant Rohila

ABSTRACT

Introduction: Platelet-rich plasma (PRP) is promoted nowadays as an ideal autologous biological blood-derived product. It enhances wound healing, bone healing, tendon healing and is currently being widely used.

Aims and objectives: A prospective cohort study was done to assess the efficacy of autologous PRP injection and to compare it with corticosteroid injection in treatment of plantar fasciitis (PF).

Materials and methods: Eighty patients were included in the study and divided into two groups. Group I (30 patients) received PRP injection and group II (50 patients) were given steroid injection. Patients were clinically assessed at different intervals. Functional outcome was evaluated on the basis of visual analog scale (VAS) and foot and ankle ability measure (FAAM) scores. Planter fascia thickness was assessed pre- and postinjection by ultrasound.

Results: Platelet-rich plasma and corticosteroid injection groups at the initial visit had VAS score of 8.44 and 8.38 respectively which was reduced to 1.46 and 3.02 at the end of 6 months. The PRP and corticosteroid injection groups at the initial visit had FAAM score of 29.9 and 31.6 respectively which increased to 83.4 and 69.1 at the end of 6 months. After injection, the PRP group had significant reduction (35.90%) in the thickness of plantar fascia as compared to corticosteroid group (28.67%).

Conclusion: Treatment of PF with PRP extract reduces pain and significantly increases function, exceeding the effect of steroid on long-term follow-up.

Keywords: Foot ankle ability measure score, Plantar fasciitis, Platelet-rich plasma, Visual analog scale.

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INTRODUCTION

Plantar fasciitis (PF) accounts for 15% of all foot disorders. More than 10% of the population is affected by it over their lifetime.¹⁻³ Although etiology of PF remains ill-understood, but there are evidences to suggest that it is probably initiated by repeated microtrauma. Pathological changes are degenerative in nature (although partially reversible) and histologically changes, such as, collagen necrosis, angiofibroblastic hyperplasia, chondroid metaplasia and matrix calcification are seen.⁴⁻⁷

The most common presenting symptom of PF is a sharp pain of insidious onset with maximal tenderness at the anterior medial border of the calcaneus.⁸ The pain is typically worst on the first few steps in the morning and with initial steps after prolonged sitting or inactivity, and on examination, there is mild to severe tenderness on medial calcaneal tubercle and sometimes, on lateral aspect of heel.

Numerous methods have been advocated for treating PF, including rest, nonsteroidal anti-inflammatory drugs (NSAID),⁹ night splints, foot orthosis,¹⁰ stretching protocols¹¹ and extra corporeal shock wave therapy (ESWT).¹² The use of corticosteroids has been linked to rupture of plantar fascia especially, after repeated local injections.¹³ Various types of surgical procedures have also been recommended for refractory cases.^{14,15} Platelet-rich plasma (PRP) is an ideal autologous biological blood-derived product, which can be exogenously applied to various tissues where it releases high concentrations of platelet derived growth factors that enhance wound-healing, bone-healing and also tendon-healing. In addition, PRP possesses antimicrobial properties that may contribute to the prevention of infections: When platelets become activated, growth factors are released and initiate the body's natural healing response. The PRP injection might induce healing at the attachment of fascia at the os calcis.¹⁶

The purpose of this study was to assess the role and efficacy of autologous PRP injection in treatment of PF and compare it with corticosteroid injection.

MATERIALS AND METHODS

The study was conducted in the Department of Orthopaedics, Lala Lajpat Rai Memorial Medical College and associated SVBP Hospital, Meerut, Uttar Pradesh, India

from 2015 to 2017. The diagnosis of PF is made with a reasonable level of certainty on the basis of history, clinical, and radiological assessment.

Inclusion Criteria

- Patients between age group of 18 to 60 years presenting with complaints of plantar heel pain, worse with rising in morning and/or after periods of sitting or lying presenting for 4 weeks or more
- Patients with maximal tenderness at the attachment of the plantar fascia on the medial tubercle of the calcaneus
- Willingness to participate in an investigational technique and follow-up with written consent
- Willingness to forgo any other concomitant conservative treatment modality; NSAIDs and orthotic devices during the study period.

Exclusion Criteria

- Previous surgery for heel pain
- Patient with neuropathic symptoms (radiculopathy, tarsal tunnel syndrome, tarsi sinus syndrome)
- Patient with complex regional pain syndrome or with metastatic cancer
- Achilles tendon pathology
- Systemic diseases like inflammatory or degenerative polyarthritis, diabetes mellitus, local or systemic infection, peripheral vascular diseases, metabolic disease, such as gout, clotting disorder, anticoagulation therapy
- Pregnant or breastfeeding female patients
- Dysfunction of the knee, ankle, or foot
- Work-related or compensable injury
- Previous treatment: Corticosteroid injection in the last 6 months or NSAIDs treatment within the last 7 day.

Study Design

Prospective interventional study

Method

After taking clearance from ethical committee, patients were selected according to inclusion and exclusion criteria. Informed written consent was taken from every patient who agreed to follow instructions and recommendations given by the clinician. Patient biography, detailed history, and clinical examination were done along with ultrasonographic evaluation of plantar fascia thickness of both feet. All the fresh cases were initially treated with contrast bath, foot-stretching exercise, and silicon heel pad for 4 weeks. The patients, who were not improved with initial treatment, were explained about the autologous PRP injection and steroid injection.

Patients were randomly allocated into two groups

- *Group I:* These patients were treated with single injection of 3 mL autologous PRP injection locally.
- *Group II:* These patients were treated with single injection of 3 cc, i.e., 80 mg methylprednisolone acetate locally.

Platelet-rich Plasma Preparation Method

A total of 20 mL of a patient's own venous blood was withdrawn from antecubital vein under aseptic conditions and was collected in presterilized centrifuge vials. These centrifuge vials were preloaded with anticoagulant acid citrate dextrose. This blood was then centrifuged at 3200 rpm for 15 minutes. The blood is then separated into platelet-poor plasma (PPP) and PRP. The PPP is extracted and discarded. The resulting platelets concentrate contains approximately 6 to 8 times the concentration of platelets compared to baseline whole blood. The PRP samples were sent to pathology lab at different intervals to know the concentration of platelets. The average platelet concentration in our sample was found to be 6.4 (SD \pm 1.2) times the baseline level.

INJECTION TECHNIQUE

The procedure was done on an outpatient basis and under complete aseptic conditions. Sites of maximum tenderness were pre-marked with a sterile marker. Patients of group I received a 3 cc PRP injection into the origin of the plantar fascia at the site of maximum tenderness. 2 cc of 2% Lidocaine was infiltrated prior to injection. A peppering technique, i.e., spreading in clockwise manner was used to achieve a more extensive zone of delivery, with a single skin portal and four to five passes through the fascia itself. Lidocaine sensitivity was done before starting the procedure. Patients are rested for 15 minutes and then they are allowed to walk.

Group II patients received 2 mL of depomedrol (80 mg methylprednisolone) locally. About 2 mL of 2% lidocaine was infiltrated prior to this as in group I. The patients were monitored for 20 minutes for adverse reactions and then sent home with instructions to limit their use of the feet for approximately 48 hours and use opioid for pain. After 48 hours, patients were given a standardized stretching protocol to follow for 2 weeks. A formal strengthening program is initiated after this stretching. At 4 weeks after the procedure, patients were allowed to proceed with normal sporting or recreational activities as tolerated. Any types of foot orthoses were not advised.

Follow-up

Follow-up of patients was done at 2, 4, 8, 12, and after 24 weeks. We used visual analog scale (VAS) and foot and ankle ability measure (FAAM) score for assessment

Table 1: Comparison of effect of treatment methods (groups I and II) on FAAM score

Group statistics	Groups	n	Mean \pm standard deviation	Standard error mean	p-value
FAAM base score	I	30	29.97 \pm 5.997	1.095	<0.001
	II	50	31.68 \pm 6.297	0.891	
FAAM score at 4 weeks	I	30	37.97 \pm 6.128	1.119	<0.001
	II	50	52.50 \pm 5.953	.842	
FAAM score at 8 weeks	I	30	54.00 \pm 6.052	1.105	<0.001
	II	50	72.36 \pm 5.989	.847	
FAAM score at 12 weeks	I	30	72.97 \pm 6.128	1.119	<0.001
	II	50	81.08 \pm 5.900	.834	
FAAM score at 24 weeks	I	30	83.43 \pm 5.661	1.034	<0.001
	II	50	69.12 \pm 5.795	.819	

of pain and functional outcome. Ultrasonographic evaluation of thickness of plantar fascia was done pretreatment and 6 months posttreatment.

RESULTS

The study comprised of a total of 87 patients of PF of which 7 were lost during follow-up period. Thus, we had 80 patients for final assessment.

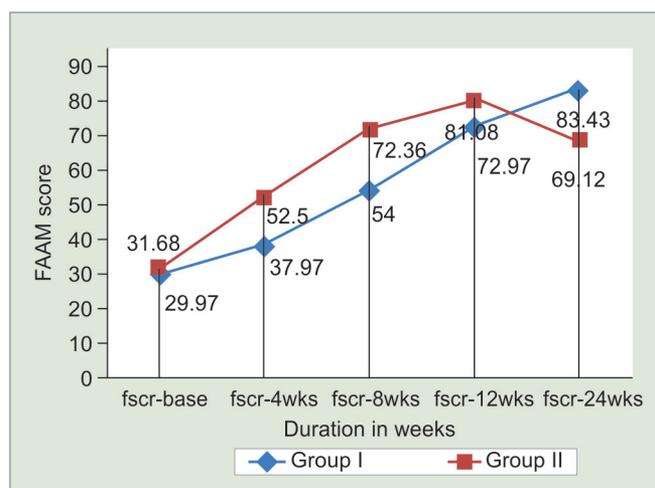
Statistical analysis was done by using Statistical Package for the Social Sciences (16.0 version) software. The comparison of means between two groups tested was done by using unpaired student's t-test. For repeated measure, paired t-test was also used. The p-value <0.05 is considered as significant.

Out of 80 patients, 30 were included in group I (PRP group) and 50 were included in group II (steroid group). The mean patient age was 40.90 ± 9.362 years in PRP group with minimum age of 24 and maximum age of 57 years and for group II, it is 37.82 ± 11.047 with minimum age of 19 years and maximum age of 59 years which was comparable ($p = 0.400$). There were 30 males (37.03%) and 50 females (62.97%) with total of 80 patients. Patients in PRP group, 11 (36.66%) were males and 19 (63.34%) were females. Patients in steroid group, 19 (38%) were males and 31 (62%) were females.

Visual analog scale: When we calculated the difference between mean VAS score in pretreatment period, i.e., baseline and mean VAS scores at different intervals in postinjection period, it was found that in PRP group, difference was maximum at 24 weeks and in the steroid group, it was at 12 weeks. This shows that maximum effect of PRP on VAS was at 24 weeks whereas in steroid group, it was at 12 weeks (Table 1 and Graph 1).

For within group comparison in PRP group, the results were statistically significant ($p = <0.05$). The mean VAS score decreased from baseline continuously at 4 weeks, 8, 12, and up to 24 weeks. The VAS score was found to be statistically significant in comparison with baseline at all durations.

We have seen that within group comparison for steroid group, the results were also statistically significant. The



Graph 1: Graphic presentation of effect of treatment methods (groups I and II) on FAAM score at different time intervals

mean VAS score decreased from baseline continuously at 4, 8, and up to 12. But, at the end of 24 weeks, there was rise in VAS score when compared to score at 12 weeks and found to be significant.

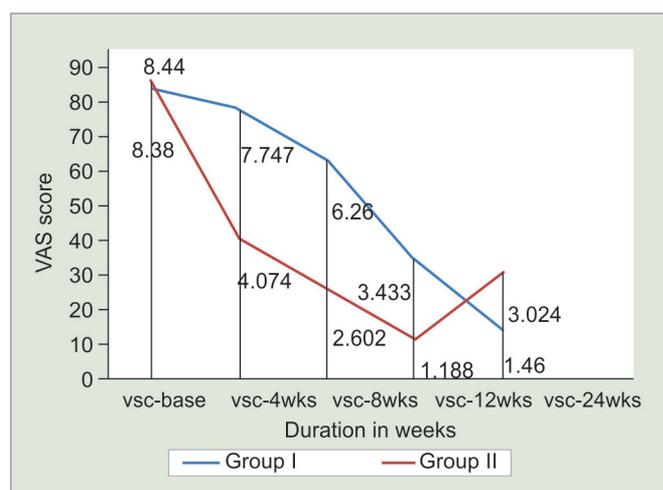
When both treatment methods were compared, it was observed that VAS score is significantly lower at 4, 8, and 12 weeks in steroid group as compare to PRP group. But at 24 weeks, VAS score was significantly lower in PRP group as compare to steroid group.

Foot ankle ability measure score: When we calculated the difference between mean FAAM score in pretreatment period, i.e., baseline and mean FAAM scores at different intervals in postinjection period, it was found that in PRP group, difference was maximum at 24 weeks and in the steroid group, it was at 12 weeks. This shows that maximum effect of PRP on FAAM score was at 24 weeks whereas in steroid group, it was at 12 weeks (Table 1 and Graph 1). For within group comparison in PRP group, the results are statistically significant ($p = <0.05$). The mean FAAM score increased from baseline continuously at 4, 8, 12, and up to 24 weeks (Table 2 and Graph 2). FAAM score is statistically significant in comparison with baseline at all durations.

Within group comparison for steroid group, the results are statistically significant. The mean FAAM score

Table 2: Comparison of effect of treatment methods (group I and II) on VAS score

Group statistics	Groups	n	Mean standard deviation	Standard error mean	p-value
VAS base score	I	30	8.38 ± 0.6820	0.1245	<0.001
	II	50	8.44 ± 0.6021	0.0851	
VAS score at 4 weeks	I	30	7.747 ± 0.7514	0.1372	<0.001
	II	50	4.074 ± 0.9762	0.1381	
VAS score at 8 weeks	I	30	6.260 ± 0.8896	0.1624	<0.001
	II	50	2.602 ± 0.8105	0.1146	
VAS score at 12 weeks	I	30	3.433 ± 0.7875	0.1438	<0.001
	II	50	1.188 ± 0.5189	0.0734	
VAS score at 24 weeks	I	30	1.460 ± 0.6911	0.1262	<0.001
	II	50	3.024 ± 0.9572	0.1354	

**Graph 2:** Graphic presentation of effect of treatment methods (groups I and II) on VAS score at different time intervals

increased from baseline continuously at 4, 8, and up to 12 weeks. But at the end of 24 weeks, there is fall in FAAM score when compared to score at 12 weeks.

When both treatment methods were compared, it was observed that FAAM score is significantly higher at 4, 8, and 12 weeks in steroid group as compare to PRP group. But at 24 weeks, FAAM score is significantly higher in PRP group as compare to steroid group.

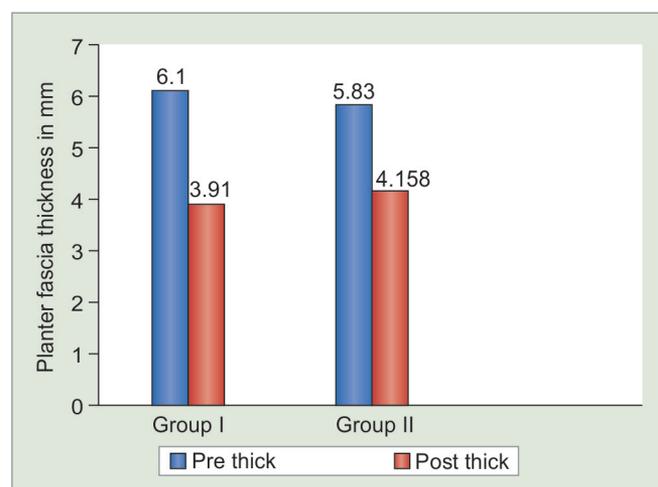
Plantar fascia thickness: Both modalities of treatment have caused significant decrease in mean plantar fascia thickness when compared baseline value with value at the end of 24 weeks after injection. There was 35.90% reduction in mean plantar fascia thickness in group I and 28.67% reduction in steroid group. Both the groups do not differ significantly at baseline and posttreatment at 6 months ($p > 0.05$) (Table 3 and Graph 3).

DISCUSSION

Chronic heel pain is a difficult condition to treat. It is well known that pain does not subside quickly, but can persist for several months and results in significant disability. Platelet rich plasma injection has emerged as a treatment alternative for many musculoskeletal conditions.

Table 3: Test of significance of plantar fascia thickness in groups I and II

Groups	Mean plantar fascia thickness pretreatment	Mean plantar fascia thickness posttreatment	p-value
I	6.100	3.910	<0.001
II	5.830	4.158	<0.001

**Graph 3:** Planter fascia thickness in both groups I and II pretreatment and posttreatment

The method of PRP preparation is based on studies conducted by Augustus D. Mazzocca, Mary Beth R, McCarthy et al¹⁷ who concluded that platelet high spin method results in higher number of growth factors and platelets in the sample, so we adopted this method. The technique of PRP injection (peppering) was based on the studies by Mark W. Scio, Joost C Peerbooms et al¹⁸ found this method to be very effective.

Matthew V. Smith, MD, Sandra E. Klein, MD, John C, et al¹⁹ have concluded that FAAM score is the most extensively validated foot and ankle outcome instrument available. The score is sensitive to overall health status and comorbidities.²⁰ That is why, we took FAAM scoring as one of our tools for evaluating functional outcome of foot in postinjection period.

Direct imaging of the plantar fascia is possible with magnetic resonance imaging (MRI) and ultrasound

(McMillan et al²¹). These methods have revealed that plantar fascia is thicker in patients with PF than in those without PF (Cheng et al; Wu et al²²). Therefore, the changes in plantar fascia thickness after interventions in patients with PF are measurable with imaging techniques. The advantages of ultrasonography as compared with MRI are that it is noninvasive, it is radiation free, it is a cost-effective approach, i.e., also well tolerated by patients and it is appropriate for serial follow-up (Fabrikant and Park²³).

D Gould et al²⁴ concluded that VAS is widely used due to its simplicity and adaptability to a broad range of populations and settings. The VAS is more sensitive to small changes, especially when looking at change within individuals. The VAS takes <1 minute to complete, no training is required other than the ability to use a ruler to measure distance to determine a score.

For within group comparison in PRP group the results are statistically significant ($p = <0.05$). The mean VAS score decreased from baseline continuously at 4, 8, 12, and up to 24 weeks. The VAS score is statistically significant in comparison with baseline at all durations. We have seen that within group comparison for steroid group, the results are also statistically significant. The mean VAS score decreased from baseline continuously at 4, 8, and up to 12 weeks. But at the end of 24 weeks, there is rise in VAS score when compared to score at 12 weeks.

Thus as in both the groups, there has been a significant reduction in VAS score from the baseline over the course of study, so both the treatment methods are effective ways for treatment of PF. But when both treatment methods are compared it is observed that the decline in VAS score was at much faster rate in steroid group as compare to PRP group in the initial period of study, i.e., at 4, 8, and 12 weeks. But in steroid group, mean VAS at 24 weeks is higher than the mean VAS score at 12 weeks where as in the PRP group, VAS score continues to decline up to 24 weeks. Still the mean VAS score at 24 weeks is significantly less than the baseline score in both the groups.

In the PRP group, there is a steady decline in the VAS score at 4, 8, 12, and 24 weeks. But the rate of decline of VAS score is much less than the steroid group, i.e., why, VAS score at 4, 8, and 12 weeks in PRP group was significantly higher than the steroid group. At 24 weeks, mean VAS score in PRP group was significantly less than the steroid group.

Earlier Lee et al conducted prospective randomised controlled study of 64 patients for a period of 6 months by comparing PRP with corticosteroid injection. The authors found that there was significant reduction in VAS for both the groups over a time. At 6 weeks and 3 months, the corticosteroid group had significantly lower VAS than the PRP group, but the difference was not significant at

6 months. But in our study, we found a significant reduction in VAS score at 4 weeks, 8 weeks, and 3 months with corticosteroid group, whereas at 6 months, there was significant reduction in VAS in the PRP group compared to corticosteroid group.

A study performed by Aksahin et al²⁵ compared the effects of corticosteroid injections and PRP injections to treat PF. Their study consisted of 60 patients who did not respond to conservative treatment for at least 3 months prior to either injection. The patients were placed into two groups in which 30 patients were treated with a corticosteroid injection and 30 patients were treated with a PRP injection. They found no significant difference in pain or patient satisfaction, thus demonstrating that PRP injections are as effective as corticosteroid injections.

In a study conducted by Mukesh et al²⁶ the cortisone group had a pretreatment mean VAS score of 8.5, which initially improved to 1.1 at 12 weeks posttreatment to 4.9 at 26 weeks, and then continuous increased to near baseline levels of 8.4 at 52 weeks. In contrast, the PRP group started with an average pretreatment 8.6 score decreased to 3.4 at 12 weeks, remained declining to 1.2 at 26 weeks and 0.3 at 52 weeks.

Similarly within group, results of FAAM scoring are statistically significant. For within group comparison in PRP group, the results are statistically significant ($p = <0.05$). The mean FAAM score increased from baseline continuously at 4, 8, 12, and up to 24 weeks. The FAAM score is statistically significant in comparison with baseline at all durations. For within group comparison, the similar results were observed as in VAS score.

In the current study, the reduction of plantar fascia thickness measured by ultrasonography in both groups is statistically significant posttreatment after 24 weeks. Although, the reduction in the thickness was more in PRP (35.90%) group than steroid group (28.67%), yet did not reach significant value.

Out of 80 patients, only 2 patients had pretreatment plantar fascia thickness less than 4 mm. Almost all patients showed reduction in plantar fascia thickness after injection except 3 cases, 2 cases in steroid group and 1 in PRP group, which did not show any change in the thickness.

All the patients responded to the treatment except 3 cases in steroid group, which did not have any improvement in VAS or FAAM score or in their symptoms and was treated with some other modality. On the contrary, in PRP group, all the patients responded to the treatment.

Heel fat pad atrophy and plantar fascia rupture are two of the most feared complications associated with corticosteroid injections, as they can lead to intractable long-term complications. Fortunately, no complications were seen in any patients.

Other studies for PF have had conflicting results regarding various issues surrounding PRP, such as preparation technique of PRP, amount to be injected, injection technique, the number of sessions and the interval between them required for best therapeutic effect. However, much more work needs to be done in order to determine the best protocols and patient selection for the use of PRP.

This study outlines that both injecting steroid and PRP are effective and safe modalities in treatment of plantar fasciitis. The data suggest that steroid injection is better in short-term period but in long-term follow up PRP therapy is better than steroid ($p < 0.05$)

CONCLUSION

Chronic heel pain is a difficult condition to treat and takes a long time to resolve. This study has shown that local corticosteroid injection is effective for immediate pain relief. The PRP injection is better for long-term pain relief in plantar fasciitis with no side effects. The study has also established the efficacy of our method of extracting PRP from peripheral blood by high spin technique. Further studies are needed to see the effects of combined corticosteroid and PRP injection for chronic heel pain.

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