A comparative study between endoscopic plantar fasciotomy and platelet-rich plasma for treatment of resistant plantar fasciitis

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Background
Plantar fasciitis (PF) is the most common cause of heel pain. Some patients with PF are resistant to conservative lines of management, which can lead to physical disability. The aim of this study is to compare the effectiveness and outcome of endoscopic plantar fasciotomy (EPF) and local injection of platelet-rich plasma (PRP) for treatment of resistant cases of PF.
Patients and methods
A total of 51 patients with resistant PF were enrolled in this study between August 2011 and May 2014. Patients were either enrolled in the surgical (EPF) group (25 patients) or to the PRP group (26 patients) after a minimum period of conservative treatment of 6 months. Before and after visual analog scores (VAS) and American orthopaedic foot and ankle society (AFOAS) were recorded and compared between the two groups.
Results
Both groups achieved improvement at 6 weeks, 6 months, and 12 months. At the end of follow-up, in the first group (EPF), the average VAS was improved from 8.31 to 2.34, and the average AFOAS was improved from 43.75 to 87.25. A total of 20 (80%) patients were satisfied, four (16%) patients were satisfied with reservation, and one (4%) patient was not satisfied. In the second group (PRP), the average VAS was improved from 8.28 to 2.55, and the average AFOAS was improved from 42.95 to 86.75. A total of 19 (73.08%) patients were satisfied, five (19.23%) patients were satisfied with reservation, and two (7.69%) patients were not satisfied.
Conclusion
Both EPF and PRP are effective in treating resistant PF, and the end results of EPF are better than those of PRP injection regarding pain relief, AFOAS, and patient satisfaction. So PRP injection should be tried before invasive surgical interference.

Keywords:
endoscopic release, patient satisfaction, platelet-rich plasma, resistant plantar fasciitis

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Introduction

Plantar fasciitis (PF) is the commonest cause of heel pain, affecting 10% of the US population [1]. The peak incidence of heel pain occurs between the ages of 40 and 60 years [2]. Although 80–90% of patients respond to conservative management, there is no general consensus regarding the treatment paradigm, and resistant cases of PF can be disabling [3].

It is essential that conservative care be exhausted for 6 months before resorting to surgical intervention and includes NSAIDs, relative rest, special shoes, taping, stretching exercises, local steroid injection, and physical therapy [4,5]. Surgery includes open plantar fasciotomy, release of abductor hallucis fascia, and resection of the heel spur. Complications of open surgery include residual pain, flatfoot deformity, medial calcaneal nerve damage, and plantar tendon scar [6]. Endoscopic plantar fasciotomy (EPF) for treatment of resistant PF is a relatively new procedure developed by Barrett and Day [7] and has been proven to achieve better results in comparison with traditional open surgery because it allows more rapid recovery and return to activity after surgery, with low rate of complications [8].

Platelet-rich plasma (PRP) is a bioactive component of whole blood with platelet concentrations elevated above baseline and containing high levels of various growth factors [3,9]. It is postulated to promote native tissue regeneration; however, consistent scientific evidence remains lacking [10]. Early success in using PRP to treat chronic tendinopathy has led to

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consideration for its use in the treatment of resistant cases of PF [11,12]. Although the procedure has proven to be safe, a better understanding of the systemic effects of PRP will be needed, as recent work by Wasterlai *et al.* [13] has documented serologic increases in cytokine levels in patients undergoing PRP treatment.

A prospective clinical randomized study was designed to compare the effectiveness of PRP and EPF in the treatment of resistant cases of PF. To our knowledge, and based on a midline search and on review of key journals, we present the first prospective comparative clinical study between EPF and PRP for treatment of resistant cases of PF.

Patients and methods

This study was conducted between August 2011 and May 2014 and 51 patients with chronic PF were included. This study was approved by the Ethical Committee of Department of Orthopedic Surgery, Faculty of Medicine, Al-Azhar University. All patients signed an informative consent form.

Inclusion criteria

The following were the inclusion criteria:

(1) Patients aged more than 18 years, with chronic PF and localized tenderness at medial calcaneal tubercle.
(2) Failure of at least three lines of conservative treatment for at least 6 months.
(3) Patients should be able to understand the purpose and content of the study and provide informed consent, as well as the visual analog scores (VAS) pain in the morning of higher than 5.

Exclusion criteria

The following were the exclusion criteria:

(1) Patients who received local steroid injection within 6 months, physical therapy within 6 weeks, or nonsteroidal anti-inflammatory within 1 week.
(2) Active bilateral PF.
(3) Previous surgery for PF.
(4) Vascular insufficiency or neuropathy related to heel pain.
(5) Diabetics or other painful or function limited disorders of the foot and ankle.
(6) Pregnancy.
(7) History of severe anemia (hemoglobin <5).
(8) Significant cardiovascular, renal, or hepatic disease.

Pretreatment heel radiographs were done to exclude intraosseous lesion, subtalar arthritis, or stress fracture. The patients were divided randomized into two groups (EPF and PRP) and so on after discussing the different options with the patient and declaration of the different two techniques.

Technique of endoscopic plantar fasciotomy

Under regional block anesthesia and supine position, the arthroscopic procedure was performed in all patients of group one using medial and lateral portals. A pneumatic tourniquet was maintained on the thigh or the calf throughout the procedure. The medial portal was placed 2 cm above the distal heel skin and 1 cm behind the posterior border of medial malleolus. A small incision and blunt dissection of subcutaneous tissue were done. A path was created using a curved elevator just distal to the plantar fascia from medial to lateral border. A slotted arthroscopic cannula was introduced in this plane until impinging on the lateral skin of the heel to create the lateral portal. The arthroscope was introduced from the medial portal for visualization of plantar fascia. A 4.5 motorized incisor blade was used to debride the subcutaneous tissue until clear visualization of the shiny fibers of plantar fascia. Using a hook knife through the lateral portal and the slotted cannula, divided the medial 2/3 of the plantar fascia from medial to lateral direction under direct vision. The posterior part of the divided medial 2/3 of the plantar fascia was then debrided using motorized incisor blade. The portals were closed and dressing is applied.

Postarthroscopy protocol

The patients are advised for early ankle and foot mobilization in the first week after arthroscopy with toes touch weight bearing. Ten days later, the stitches are removed, and the patient is advised to full weight bearing within 3 weeks according to pain tolerability. Then the patients are sent to the physiotherapist to start stretching exercises and strengthening exercises for 6 weeks. Then patients are allowed to start recreational activities after 3 months.

Platelet-rich plasma preparation

Blood is drawn from the patient (about 15 ml) into a 20-ml syringe that contained 2-ml sodium citrate. Then the blood was centrifuged for ~15 min (3000 rounds per minute) using desktop centrifuge. The blood is then separated into platelet-poor plasma and PRP. The platelet-poor plasma is then extracted and discarded. After one more shaking procedure, the PRP is withdrawn. The resulting platelets concentrate

contains approximately a six to eight times concentration of platelets compared with baseline whole blood. The total time from blood draw to injection in the patients is approximately 30–35 min.

Injection technique

The procedure is done on an outpatient basis and under completes aseptic condition. Then, 3–5 ml of platelet concentrate is injected using a 22-G needle into the tenderest area of plantar fascia using a peppering technique (a single skin portal and 4 or 5 penetrations to fascia). The patient is then observed for 15–20 min and then discharged.

Postinjection protocol

The use of NSAID or any type of foot orthoses is prohibited. Immediately after injection, the patients are kept in sitting position without moving the foot for 15 min. Because there may be discomfort experienced by the patient at the site of the injection for up to 48 h, patients are encouraged to ice the injection site, elevate the limb, and modify activities. Patients are discharged home with instruction to limit their activities for 48 h and use acetaminophen for pain control. After 2 days, patients are sent to the physiotherapist to start stretching exercises for 2 weeks and strengthening exercises for additional 2 weeks to optimize their recovery. At 4 weeks after injection, the patients are allowed to start normal recreational activities.

The first group was treated by EPF and included 25 patients (14 female and 11 male) with average age of 42.34 years (ranged between 28 and 53 years). The preoperative VAS ranged between 7 and 9, with an average of 8.31; the preoperative American orthopaedic foot and ankle society (AFOAS) ranged between 31 and 76, with an average of 43.75, and the pretreatment duration of symptoms ranged between 6 and 38 months, with an average of 11.45 months.

The second group was treated by PRP and included 26 patients (14 female and 12 male), with an average age of 39.94 years (ranged between 26 and 57 years). The preoperative VAS ranged between 7 and 9, with an average of 8.28; the preoperative AFOAS ranged between 34 and 74, with an average of 42.95; and the pretreatment duration of symptoms ranged between 6 and 36 months, with an average of 10.95 months.

Using the VAS, AFOAS, and patient questionnaire, all patients were evaluated before procedure and after 3, 6, and 12 months. This questionnaire includes the following: pain level using VAS when getting out of bed, at rest, and after activity; effect of the procedure on patient condition; and patient satisfaction. Statistical analysis using the Student *t* test was applied for each parameter. A *P* value of less than 0.05 was considered to be significant. All patients had a radiograph made of the heel before the treatment, immediately after injection or arthroscopy, and at the 6-month follow-up evaluation for detection of any structural changes of the hind foot or arch changes.

Result

Regarding demographic data (Table 1 and Fig. 1), there were no significant differences in the age of the patient, male and female ratio, grade of osteoarthritis, pretreatment AFOAS score, and VAS score between both groups ($P>0.001$) (table and figure). No major complications related to the injections were observed during the treatment and the follow-up period. In the EPF group, one patient complained of superficial infection of medial arthroscopic portal and was managed by dressing and antibiotic.

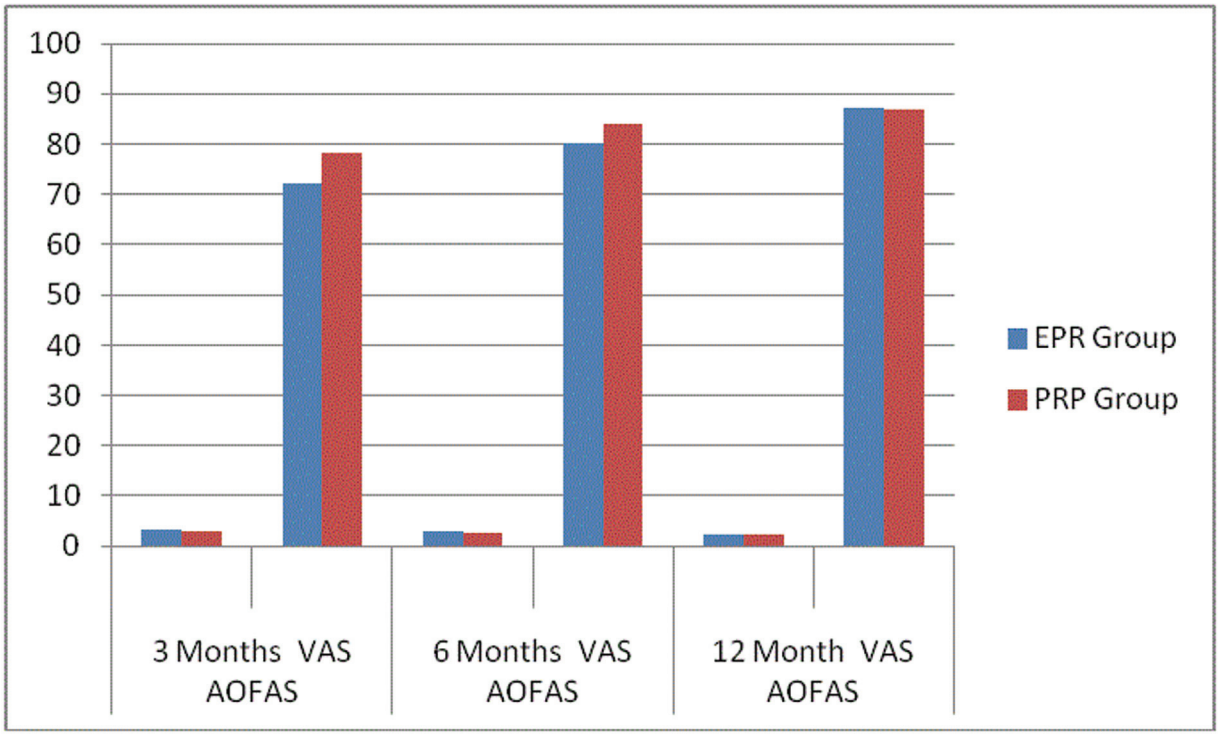
In the first group (EPF), the follow-up period ranged between 12 and 38 months with an average of 19.6 months. Most improvement were achieved and maintained throughout the 12 months after arthroscopy. The VAS was ranged between 1 and 4, with an average of 2.34 and improvement of 5.97 postoperatively in comparison with the preoperative score. The AFOAS ranged between 72 and 94, with an average of 87.25, and improvement of 43.50 postoperatively, in comparison with the preoperative score. In the second group (PRP), the follow-up period ranged between 13 and 40 months with an average of 19.8 months. Most improvements were achieved and maintained between 6 months after injection, and continued to a lesser extent for up to 1 year. The VAS ranged between 1 and 4, with an average of 2.41, and improvement of 5.87 postoperatively in comparison with the preoperative score. The AFOAS ranged between 73 and 95, with an average of 86.75, and improvement of 43.80 postoperatively in

Table 1 Pretreatment patient data

Patients' data	EPF group	PRP group
Number of patients	25	26
Average age (years)	42.34	39.94
Male : female	11 : 14	12 : 14
Average VAS	8.31	8.28
Average AFOAS	43.75	42.95
Pretreatment duration (months)	11.45	10.95

AFOAS, American orthopaedic foot and ankle society; EPF, endoscopic plantar fasciotomy; PRP, platelet-rich plasma; VAS, visual analog scores.

Figure 1



Pretreatment patient data.

Table 2 Patients' results at different follow-up durations

Duration of follow-up	EPF group	PRP group
3-month follow-up VAS	3.2	3
AOFAS	72.15	78.25
6-month follow-up VAS	2.8	2.61
AOFAS	80.21	84.1
12 months follow up VAS	2.34	2.41
AOFAS	87.25	86.75

EPF, endoscopic plantar fasciotomy; PRP, platelet-rich plasma; VAS, visual analog scores.

comparison with the preoperative score (Table 2 and Fig. 2).

Regarding patient satisfaction at the end of follow-up, in the EPF group, 20 (80%) patients were satisfied, four (16%) patients were satisfied with reservation, and one (4%) patient was not satisfied. In the PRP group, nineteen (73.08%) patients were satisfied, five (19.23%) patients were satisfied with reservation, and two (7.69%) patients were not satisfied (Table 3 and Fig. 3). At 2 years after treatment, telephone follow-up was conducted to ask the patient to rate their results as satisfied or not. We found that 14 (77.77%) of 18 patients of the EPF group and 12 (70.58%) of 17 patients of the PRP group are satisfied. At 3 years after treatment, we found that 12 (75%) of 16 patients of the EPF group and 10 (66.66%) of 15 patients of the PRP group are satisfied.

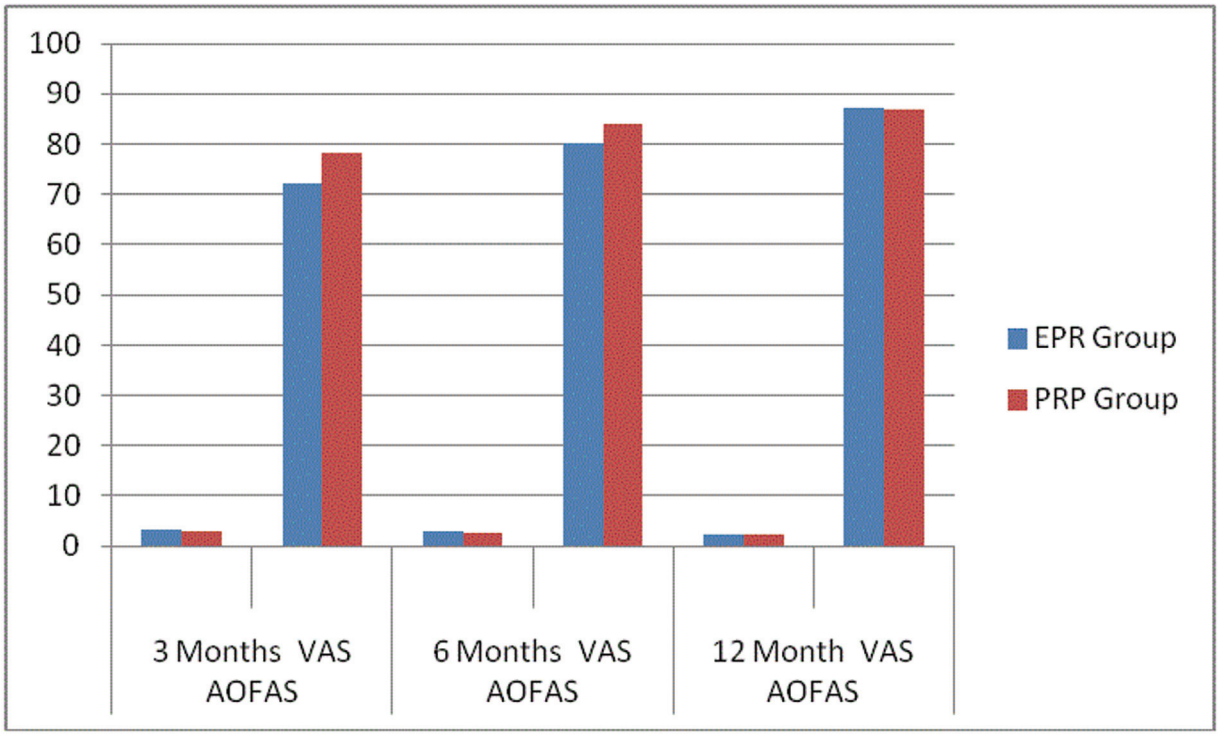
Discussion

PF is the most common condition treated by podiatric foot and ankle specialist. However, the true etiology of PF is still unknown and has been attributed to many different etiological factors. Conservative treatment remains the preferred approach to treating PF and successfully managing 85–90% of cases [14,15]. A 2010 clinical practice guideline from the American College of Foot and Ankle Surgeon recommends conservative treatments, such as NSAIDs, rest, activity modification, stretching exercise, and orthotics for the initial management of plantar heel pain for 6 months [16].

Surgery of PF should be considered only after all other forms of treatment have failed. The most common procedure is a partial plantar fasciotomy that may be open, percutaneously, or endoscopically. The success rate of surgical release is variable from 70–90%. Recover from surgery can vary from several weeks to few months, and potential complications include transient swelling of the heel, heel hypoesthesia, rupture of plantar fascia, flattening of the longitudinal arch, and calcaneal fracture [17].

Urovitz *et al.* [18] in retrospective study of the use of EPF in the treatment of chronic heel pain that was unresponsive to conservative treatment concluded that

Figure 2



Patient's results at different FU durations. FU, follow-up.

Table 3 End patients' results

Results	EPF group	PRP group
Posttreatment FU (months)	16.5	16.6
VAS	2.34	2.41
AFOAS	87.25	86.75
Satisfied	20(80)	19 (73.08)
Satisfied with reservation	4 (16)	5 (19.23)
Not satisfied	1(4)	2 (7.69)

AFOAS, American orthopaedic foot and ankle society; EPF, endoscopic plantar fasciotomy; FU, follow-up; PRP, platelet-rich plasma; VAS, visual analog scores.

EPF gives favorable results in more than 80% of patients and is a reasonable option in the treatment of chronic heel pain that failed to respond to a trial of conservative treatment. Our results of the prospective study of the first group EPF are comparable to the results of the retrospective study by Urovitz and colleagues.

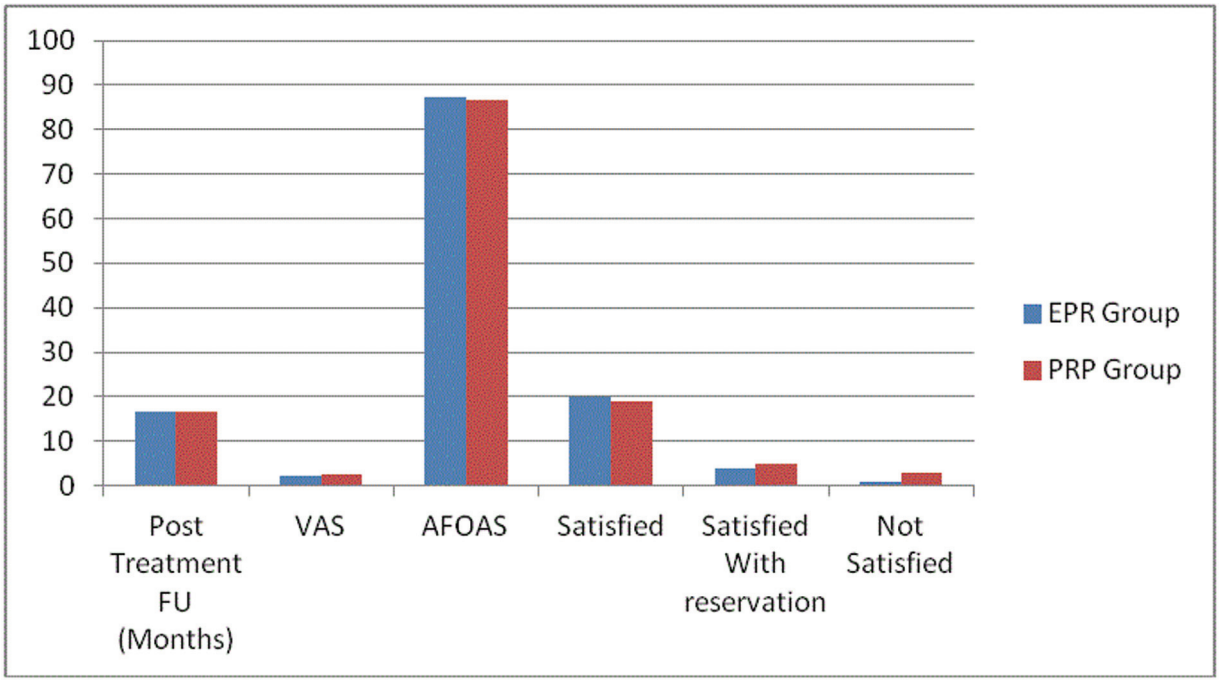
Nery *et al.* [19] treated 23 patients with endoscopically assisted plantar fascia release for symptomatic patients with PF. The mean preoperative AOFAS score of 51 (range, 41–63) improved to 89 (range, 41–97) at the last follow-up. Moreover, our results of the prospective study of the first group EPF are comparable to results of the prospective study of Nery.

The goal of EPF is to reduce the mechanical load in the affected area without the incidence of lateral column overload and collapse. So in the current study, we release only medial 2/3 of the plantar fascia and debride the pathological tissue at the fascial origin and the inflamed periosteum (expected to improve the final result).

To our knowledge, many recent clinical trials compared the effectiveness of EPF and other modalities except PRP for treatment of resistant cases of PF. Saxena *et al.* [20] in a study included 37 patients were either enrolled in surgical group or the Extracorporeal shock wave therapy (ESWT) group. The results showed statistical improvement within the EPF and ESWT groups, with EPF being significantly better than ESWT in the long-term outcome.

The use of autologous PRP is not a new treatment. Injection of PRP into the affected tissues addresses the healing stages necessary to reverse the degenerative process which are going on in the base of plantar fascia. The individual cytokines present in the platelet α granules have been shown to enhance fibroblast migration and proliferation, up-regulate vascularization, and increase collagen deposition. Transforming growth factor β1 is shown to significantly increase type I collagen production by tendon sheath fibroblast. Additionally, many of these cytokines have been thought to work in a dose-dependent manner [21]. Early pain relief after

Figure 3



End results of patients.

PRP injection may be owing to an anti-inflammatory effect resulting from the inhibition of cyclo-oxygenase-2 enzymes by cytokines provided by the platelets, whereas later benefits may be due to local cellular proliferation, neoangiogenesis, and increased type 1 collagen production [11].

Ragab and Othman examined and treat a group of 25 patients who were injected with PRP and were then followed up for an average of 10.3 months after treatment. VAS scores improved from 9.1 before treatment to 1.6 after treatment. Before treatment, 72% of patients noted severe activity limitations, whereas 28% were moderately limited. After PRP treatment, 60% had no functional limitation, 32% had mild limitation, and 8% noted moderate limitations. Ultrasonography was completed before and after PRP treatment and demonstrated decreased plantar fascial thickening [12].

Martinelli and colleagues treated 14 patients with chronic PF receiving three injections of PRP into the plantar fascia. According to the criteria of the Roles and Maudsley score, at 12 months of follow-up, results were rated as excellent in nine (64.3%), good in two (14.3%), acceptable in two (14.3%), and poor in one (7.1%) patients. VAS was significantly decreased from 7.1±1.1 before treatment to 1.9±1.5 at the latest follow-up [22]. Our results of the prospective study of the second group PRP are comparable to the results of the prospective study of Martinelli.

Franceschi and colleagues performed a systematic review on the effects of PRP in PF. They only included prospectively designed studies in humans. Eight articles met the inclusion criteria, and three of them were randomized. All studies yielded a significantly greater improvement in symptoms between baseline and last follow-up assessment. None of the papers recorded major complications [23]. Moreover, our results of the prospective study of the second group PRP are comparable to the results of the retrospective study of Franceschi.

Wilson and colleagues conducted a prospective study, including 24 PF cases, to report patient-rated pain and disability following PRP injection. Patients reported clinically and statistically significant improvement in all outcome measures (Foot Ankle Ability Measure score and Foot Single Assessment Numeric Evaluation) [10]. From data mentioned before and to our knowledge, we present the first prospective comparative clinical study between EPF and PRP injection for the treatment of resistant cases of PF.

Conclusion

The results of the current study have revealed comparable results of PRP and EPF during 1 year after treatment of resistant cases of PF. EPF in our study had little better long-term outcome than PRP. In comparison with EPF, PRP injection is economic, safer, and without special precautions. The use of PRP in the treatment of resistant

cases of PF must be considered as an alternative to surgical release and will reduce the necessity for surgical release. Patients who are treated with PRP should continue stretching and eccentric exercise after the injection to optimize their recovery.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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