Endoscopic Plantar Fascia Release versus Platelet-Rich Plasma injection for Resistant Plantar Fasciopathy

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Abstract

Background
Plantar fasciopathy (PF) is considered one of the most common causes of heel pain. The aim of this study is to compare the functional outcomes of management of chronic resistant PF using endoscopic partial plantar fascia release (EPFR) and platelet-rich plasma (PRP) injection.

Patients and Methods
Sixty-six patients with resistant PF were included in randomized prospective study. Thirty-two patients in group A underwent endoscopic partial plantar fascia release (EPFR), while thirty-four patients in group B were treated using platelet-rich plasma (PRP) injection using the peppering technique. Functional assessment was done using the visual analogue scale (VAS) and the American Orthopedic Foot and Ankle-Hindfoot society (AOFAS) scores at 1, 3, and 12 months after the performed procedure. Subjective evaluation of the patients was done according to the criteria of Roles and Maudsley at the same time intervals.

Results
The mean follow-up periods were 14.47 (range: 12-19) and 15.41 (range: 13-20) months for group A and B respectively. In group A (EPFR): The mean VAS improved significantly from 8.22 (range: 7-9) preoperative to 1.59 (range: 1-4) at 12 months after surgery (p value <0.001), while the mean AOFAS score improved significantly from 45.44 (range: 41-67) to 87.97 (range: 77-97) at the same time intervals (p value <0.001).
In group B (PRP): The mean VAS showed significant improvement from 8.12 (range: 7-9) before injection to 1.53 (range: 1-4) at 12 months following injection (p value<0.001), while the mean AOFAS score improved significantly from 45.15 (range: 41-70) to 88.56 (range: 72-97) at the same time intervals (p value <0.001). No statistically significant differences existed between both groups in terms of the VAS, AOFAS score, Roles and Maudsley subjective evaluation at 12 months follow-up. However, the mean maximum walking distance and gait abnormality showed statistically significant differences between both groups after 1 month of follow-up.

Conclusions
PRP injection proved to be a safe, noninvasive, less costing method of treatment in chronic PF with comparable functional outcomes to EPFR at 12 months follow-up.

Level of Evidence: Level III, prospective comparative study.
Keywords: plantar fasciopathy, platelet-rich plasma injection, endoscopic release.

Introduction

Plantar fasciopathy (PF) is one of the most common causes of heel pain [1], with an incidence that peaks between ages 40 and 60 years [2]. The common precipitating factors for PF include high body mass index (BMI), tight Achilles tendon, flatfoot, advancing age, and inappropriate footwear [3,4]. The term plantar "fasciopathy" seems to be more precise than "fasciitis" due to the fact that histopathological examination of chronic cases showed degeneration of the plantar fascia with healing response failure and absence of inflammation [5,6]. Patients suffering PF classically present with heel pain during the first steps upon arising in the early morning or following rest periods. Nevertheless, pain gets better gradually with subsequent physical activity and deteriorates with dorsiflexion of the toes due to traction on the plantar fascia [7,8].

The cornerstone for PF management is conservative treatment as most of the patients improve with time and conservative treatment [9].

Conservative measures include, nonsteroidal anti-inflammatory drugs (NSAIDs), physiotherapy involving stretching exercises of the plantar fascia, use of foot orthosis or night splints, corticosteroid injection, and extracorporeal shock wave therapy [10-12]. However, surgical intervention releasing part of the plantar fascial insertion onto the calcaneus either endoscopic or open may be necessary in approximately 10% of the patients when symptoms continue [13].

Platelet-rich plasma (PRP) is defined as a part of the plasma fraction derived from autologous blood containing a platelet concentration above the baseline and rich in growth factors [14,15]. PRP injection is a developing treatment method for various chronic degenerative soft-tissue diseases including PF as PRP possesses various growth factors (cytokines) that enhance bone and soft tissue healing [16]. PRP acts as a growth factor agonist and has both mitogenic and chemotactic properties. Also, the growth factors found in PRP in conjunction with the anti-inflammatory components commence the healing cascade and assist in reversal of the degenerative process present in PF [17].

This study was designed to assess and compare the functional outcomes following endoscopic partial plantar fascia release (EPFR) and PRP injection in management of resistant PF.

Patients and methods

This research design was a single Centre prospective randomized research carried out at Cairo university (Kasr Al Ainy) hospital between June 2014 and September 2016. Informed consent was obtained from all patients. This study included 66 patients and the random assignment of all patients to enter either group was computerized using simple randomization.

The inclusion criteria were:

1. Patients diagnosed with chronic PF and complaining of a single location heel pain at the plantar fascia proximal origin.

2. Failure of a minimum of three lines of conservative management over the past six months. Conservative management comprised: NSAIDs, physical therapy, stretching exercises for both the plantar fascia and Achilles tendon, corticosteroid injection, and orthotic devices as night splints and heel cups.

The exclusion criteria were:

1. Tarsal tunnel syndrome or bilateral heel affection.
2. Heel pain as a result of recent traumatic injury or the presence of deformity.
3. History of recent steroid injection (within the past six weeks).
4. Previous surgery to the involved foot.
5. Ipsilateral or contralateral neurovascular abnormality
6. Presence of arthritis or infection.
7. Hematological or metabolic disorders (particularly diabetes mellitus).
8. Inflammatory disorder like gout, rheumatoid arthritis, Ankylosing spondylosis.
9. Malignancy or patients unfit for surgery.

Radiographic assessment of the involved heels was done before starting treatment to exclude subtalar arthritis or the existence of intraosseous lesions as calcaneal cyst.

Participants in group A underwent endoscopic partial plantar fascia release (EPFR), while those in group B had platelet-rich plasma (PRP) injection using the peppering technique.

This study composed of 2 groups:

Group A (EPFR): included 32 patients; 14 males and 18 females. The mean age was 42.65± 4.87 SD (standard deviation) years. The right foot was affected in 16 patients while the left foot was involved in 16 cases. The mean symptoms duration was 11.19±2.15 SD months. The mean follow-up period was 14.47±1.98 SD months. Twenty-six participants had previous corticosteroid injection, while 6 patients did not take previous corticosteroid injection. The mean preoperative VAS and AOFAS score were 8.22±0.61 SD and 45.44±6.57 SD respectively.

Group B (PRP): included 34 patients; 13 males and 21 females. The mean age was 40.65± 6.13 SD years. The right foot was involved in 18 patients while the left foot was affected in 16 cases. The mean symptom duration was 10.47±2.51 SD months. The mean follow-up period was 15.41±2.08 SD months. Twenty-nine patients had previous corticosteroid injection, while 6 participants were not injected with corticosteroid. The mean preoperative VAS and AOFAS score were 8.12±0.73 SD and 45.15±6.96 SD respectively. No preoperative statistically significant differences existed between both groups (Table 1).

Table (1): Comparison of the preoperative data between the EPFR and PRP groups.

	EPFR n=32	PRP n=34	p value
Age	42.56±4.87 (36-52)	40.65±6.13 (34-54)	0.166
Male: Female:	14 (43.8%) 18 (56.2%)	13 (38.2%) 21 (61.8%)	0.649
Right: Left:	16 (50%) 16 (50%)	18 (52.9%) 16 (47.1%)	0.811
Weight in kilograms	81.44±11.66 (66-98)	81.79±12.51 (66-102)	0.905
Height in meters	1.71±0.07 (1.61-1.88)	1.71±0.07 (1.61-1.87)	0.636
BMI	27.69±3.42 (24.38-32.83)	28.09±4.01 (23.38-33.69)	0.66
Duration of symptoms in months	11.19±2.15 (8-18)	10.47±2.51 (7-18)	0.217
Follow-up period in months	14.47± 1.98 (12-19)	15.41± 2.08 (13-20)	0.064
Previous corticosteroid injection YES: NO:	 26 (81.3%) 6 (18.7%)	 29 (85.3%) 5 (14.7%)	 0.66
Preoperative VAS	8.22±0.61 (7-9)	8.12±0.73 (7-9)	0.544
Preoperative AOFAS	45.44±6.57 (41-67)	45.15±6.96 (41-70)	0.862

Values are expressed in the form of mean± standard deviation (SD), range, number of participants and their percentage within the group, n= number of patients in the group.

Functional assessment:

Sixty-six patients, who consisted the two study groups, were followed up at 1, 3, and 12 months after the index procedure using the visual analogue scale (VAS) and American Orthopedic Foot and Ankle-Hindfoot society (AOFAS) score [18].

Patients subjective evaluation was done according to the criteria of Roles and Maudsley [19] at the same time intervals as follows:

1) excellent: no pain, full movement, full activity;
2) good: occasional discomfort, full movement, full activity;
3) acceptable: some discomfort after prolonged activities; and
4) poor: pain-limiting activity.

Statistical methods:

Data were coded and entered using computer program IBM SPSS (statistical package for the social science) version 25 for Microsoft Windows. Data were summarized using mean, standard deviation, minimum and maximum for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparison between both groups was done using unpaired t test [20]. For comparing categorical data, Chi square ($\chi 2$) test was performed. Exact test was used instead when the expected frequency is less than 5 [21]. For comparison of serial measurements within each group repeated measures ANOVA was used [22]. p values less than 0.05 were considered as statistically significant.

Surgical technique

EPFR group:

All patients were placed in the supine position with the foot hanging outside the edge of the operating table after administration of either spinal or general anesthesia. A pneumatic tourniquet was applied to the upper thigh throughout the whole procedure. A medial portal was placed approximately 10-15 millimeters (mm) proximal to the plantar skin along a vertical line drawn from the posterior border of the medial malleolus with the foot in neutral position. A blunt trocar was passed through the medial portal perpendicular and deep to the plantar fascia towards the lateral heel skin. A lateral portal was then established by doing approximately a 5 mm incision over the tip of the trocar. The lateral portal was the visualizing portal while the medial one was the working portal.

A 5 mm cannula was then inserted over the trocar tip through the lateral portal, through which a 30° 4.0 mm endoscope was introduced. The fluid inflow pressure was set between 50 and 60 mmHg to inflate the subcutaneous tunnel allowing proper visualization. Debridement of the subcutaneous tissue was done using a 4.5 motorized incisor blade until clear vision of the shiny fibers of the plantar fascia was achieved (Figure 1). A landmark for the middle of the plantar fascia was made by introducing a needle perpendicular to the plantar heel skin and visualized by the endoscope (Figure 2). Full thickness incision of the medial half of the plantar fascia was accomplished under direct visualization utilizing a standard scalpel blade No. 11 (Figure 3). The posterior portion of the divided fascia was then completely debrided using a motorized incisor blade followed by tunnel irrigation (Figure 4). Skin portals closure was done followed by application of dressing and crepe bandage.

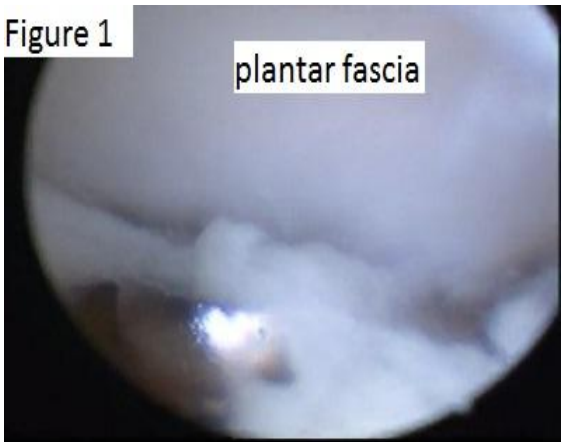

Figure (1): Arthroscopic image showing debridement of the subcutaneous tissue showing the plantar fascia shiny fibers,

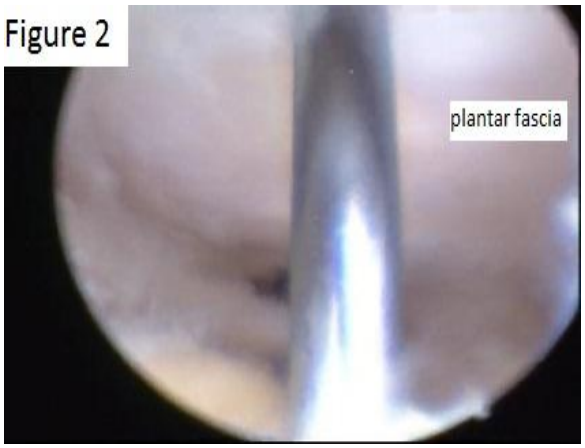

Figure (2): Arthroscopic image showing a needle introduced perpendicular to and bisecting the heel.

Figure (3): Arthroscopic image showing full thickness incision of the medial half of the plantar fascia using a scalpel

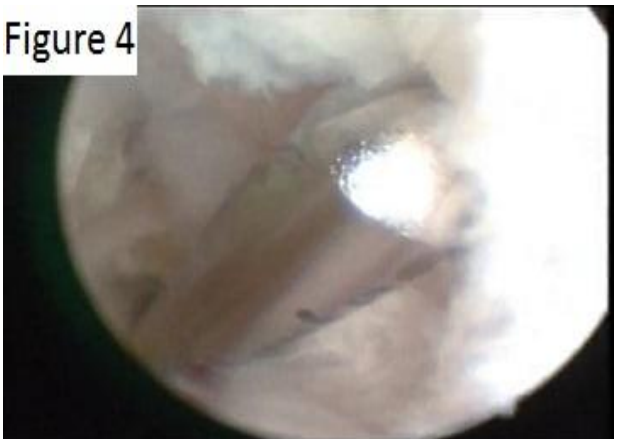

Figure (4): Arthroscopic image showing debridement of the plantar fascia posterior leaflet.

Postoperative protocol:

Patients were permitted to bear weight as tolerated starting from toe touch in the first week and progressed to full weight bearing 2-4 weeks postoperative. Early foot and ankle mobilization was recommended to all patients.

PRP group:

The PRP sample was prepared by the double-centrifugation protocol at a constant temperature of 22°C. A blood sample of 20 ml. was withdrawn from all patients into tubes containing sodium citrate. The first centrifugation (separation spin) was used to separate the blood cellular component. The tubes were centrifuged at 1400 Revolutions Per Minute (RPM) for 10 minutes resulting into three layers; the red blood corpuscles at the bottom, the buffy coat layer containing the platelets and the white blood corpuscles, and the plasma on the top. The resultant plasma portion is then extracted into another tube with calcium gluconate and subjected to the second centrifugation (concentration spin). The second centrifugation

was set at 1600 RPM for 10 minutes. Approximately 3 ml of the prepared PRP was injected using a 23 gauge 1.5-inch needle using the peppering technique.

Post-injection protocol:
Patients were instructed to avoid strenuous activities for at least 3 days. Ice packs, foot elevation, and NSAIDs were recommended if necessary for few days. Patients started stretching exercises 2 days after injection once the pain has subsided and strengthening exercises were initiated 2 weeks post-injection under supervision of professional physiotherapists. Patients were allowed to start normal recreational activities 4 weeks post-injection.

Results

EPFR group showed:
The mean follow-up period was 14.47±1.98 SD months. The mean VAS improved significantly from 8.22±0.61 SD preoperative to 1.59±0.8 SD at 12 months postoperative (p value <0.001), while the mean AOFAS score showed significant improvement from 45.44±6.57 SD to 87.97±3.05 SD at the same previous time intervals (p value <0.001) (Table 2).

Table (2): Comparison between the VAS and AOFAS score in the EPFR group at different time intervals.

EPFR group	Preoperative	1 month postoperative	3 months postoperative	12 months postoperative	P value	Test used
VAS	8.22±0.61 (7-9)	5.66±0.65 * (5-7)	3.53±0.62 * (3-5)	1.59±0.8 *# (1-4)	< 0.001	Repeated measures ANOVA
AOFAS	45.44±6.57 (41-67)	67.03±5.13 * (48-75)	78.06±5.67 * (70-86)	87.97±3.05 *# (77-97)	< 0.001	

*Values are expressed in the form of mean± standard deviation (SD), range. *Significantly different from the precedent time period.*
 # Significant difference between preoperative and at 12 months postoperative.

PRP group showed:
The mean follow-up period was 15.41 ± 2.08 SD months. The mean VAS improved significantly from 8.12±0.73 SD pre- injection to 1.53±0.83 SD at 12 months post-injection (p value <0.001), while the mean AOFAS score showed significant improvement from 45.15±6.96 SD to 88.56±4.51 SD at the same previous time intervals (p value <0.001) (Table 3).

Table (3): Comparison between the VAS and AOFAS score in the PRP group at different time intervals.

PRP group	Preoperative	1 month post-injection	3 months post-injection	12 months post-injection	p value	Test used
VAS	8.12±0.73 (7-9)	5.59±0.74 * (5-8)	3.41±0.61 * (3-5)	1.53±0.83 *# (1-4)	< 0.001	Repeated measures ANOVA
AOFAS	45.15±6.96 (41-70)	68.24±7.99 * (47-84)	77.65±8.25 * (67-87)	88.56±4.51 *# (72-97)	< 0.001	

*Values are expressed in the form of mean± standard deviation (SD), range. *Significantly different from the precedent time period.*
 # Significant difference between preoperative and at 12 months post-injection.

According to the Roles and Maudsley score:
Twenty-four (75%) patients were rated as excellent or good in the EPFR group at 12 months postoperative. This was statistically significant compared to the preoperative values (p value <0.001). Twenty-five (73.5%) patients in the PRP group were rated as excellent or good at 12 months post-injection. This was statistically significant compared to the preoperative values (p value<0.001). There was no statistically significant difference between both groups in terms of the Roles and Maudsley subjective evaluation at 12 months follow-up. Comparison between the EPFR and PRP groups across variable time intervals is shown in table (4).

Table (4): comparison between the EPFR and PRP groups at different time intervals.

	preoperative	1 month follow-up	3 months follow-up	12 months follow-up
VAS:				
• EPFR	8.22±0.61	5.66±0.65	3.53±0.62	1.59±0.8
• PRP	8.12±0.73	5.59±0.74	3.41±0.61	1.53±0.83
• p value	0.544	0.695	0.433	0.749
AOFAS score:				
• EPFR	45.44±6.57	67.03±5.13	78.06±5.67	87.97±3.05
• PRP	45.15±6.96	68.24±7.99	77.65±8.25	88.56±4.51
• p value	0.862	0.472	0.812	0.539
Pain				
• EPFR	1.25±4.92	19.06±5.3	25.31±5.07	30±2.54
• PRP	1.18±4.78	19.12±6.68	25.29±5.07	30.88±3.79
• p value	0.951	0.971	0.988	0.268
Activity limitation				
• EPFR	4.75±1.32	5.03±1.45	6.25±1.32	8.22±1.5
• PRP	4.62±1.23	4.79±1.34	5.94±1.46	8.06±1.79
• p value	0.675	0.493	0.371	0.696
Maximum walking distance				
• EPFR	2.56±0.91	2.87±1.01	4.19±0.4	4.81±0.4
• PRP	2.59±0.92	4.03±0.63	4.24±0.43	4.68±0.47
• p value	0.91	<0.001*	0.641	0.21
Walking surfaces				
• EPFR	3.5±0.88	4.06±1.01	4.19±1	4.94±0.35
• PRP	3.59±0.92	3.59±0.92	4.06±1.01	5±0
• p value	0.639	0.052	0.605	0.325
Gait abnormality				
• EPFR	1.38±1.93	4±0	6.13±2.03	8±0
• PRP	1.18±1.85	4.71±1.55	6.12±2.03	7.94±0.24
• p value	0.671	0.012*	0.988	0.16
Sagittal motion				
• EPFR	8±0	8±0	8±0	8±0
• PRP	8±0	8±0	8±0	8±0
• p value	1	1	1	1
hindfoot motion				
• EPFR	6±0	6±0	6±0	6±0
• PRP	6±0	6±0	6±0	6±0
• p value	1	1	1	1
Ankle- hindfoot stability				
• EPFR	8±0	8±0	8±0	8±0
• PRP	8±0	8±0	8±0	8±0
• p value	1	1	1	1
Alignment				
• EPFR	10±0	10±0	10±0	10±0
• PRP	10±0	10±0	10±0	10±0
• p value	1	1	1	1

*Values are expressed in the form of mean± standard deviation (SD). * Statistically significant difference exists.*

No statistically significant differences were found between both groups at 12 months follow-up. However, statistically significant differences were found between both groups in terms of the maximum walking distance (p value <0.001) and the gait abnormality (p value =0.012) at 1 month follow-up in favor of the PRP group. This could be explained by the nature of the performed procedure as EPFR is a surgical procedure while PRP injection is considered as a minor procedure.

Discussion

The underlying pathology of PF is a process of degeneration. In fact, histological examination of chronic cases of PF showed absence of inflammatory cell invasion into the involved area, and that angiofibroblastic hyperplastic tissue substitute the normal fascial tissue which propagates itself to the surrounding tissue generating a self-perpetuating cycle of degeneration [5].

The previous fact introduced the use of PRP in treatment of resistant cases of PF as platelets transported to the diseases site release several growth factors from their α-granules including (platelet-derived growth factor, transforming growth factor-β, and vascular-derived endothelial growth factor) that stimulates the regeneration process in the plantar fascia [23-25].
In our study, PRP injection was done using the peppering technique to allow growth factors prevalence to a larger area. Furthermore, the peppering technique causes injury which subsequently triggers bleeding and creates openings in the degenerative hypo-vascular fascia, permitting an enhanced healing response [26].
The results of the PRP group in this study showed that the mean VAS showed significant improvement from 8.12±0.73 SD before injection to 1.53±0.83 SD at 12 months post-injection (p value <0.001), while the mean AOFAS score improved significantly from 45.15±6.96 SD to 88.56±4.51 SD at the same time intervals (p value <0.001).
Early pain amelioration following PRP injection may be due to an anti-inflammatory influence resulting from suppression of the cyclooxygenase-2 enzyme by the cytokines supplied by the injected platelets. In addition, later improvement may be due to local cellular proliferation, new blood vessels formation, and raised type 1 collagen production [27-31].
Franceschi et al. [32] carried out a systematic review regarding the efficiency PRP injection in PF including only prospective studies in humans. Eight studies fulfilled the inclusion criteria and three of the included articles were randomized. All studies documented significant amelioration in symptoms between baseline and last follow-up evaluation. No major complications were reported in any of the included studies.
Furthermore, several studies asserted the long-term efficiency and preponderance of PRP over corticosteroid injection in management of chronic PF [33,34].

The functional outcomes of the PRP group reported in this study are comparable to several studies in literature [17,26,28,30]
Barrett and Day [35] introduced the endoscopic plantar fasciotomy technique in treatment of chronic PF. Endoscopic fasciotomy had several advantages compared to the traditional open release including earlier functional recovery and less incidence of pain recurrence and neuritis [13].
The aim of partial fasciotomy is to decrease the mechanical overload in the involved area. It has been recommended to release only the medial two thirds of the plantar fascia to avoid lateral column overload resulting in calcaneocuboid and midtarsal joints pain [36].
In this study, we inserted a needle perpendicular to the heel and bisecting it in order to release only the medial half of the plantar fascia under direct visualization to avoid lateral column overload symptoms associated with complete fascial release.
Various studies in literature reported the successful outcomes following EPFR in treatment of resistant PF. A study carried out by Nery et al. [37] evaluated the results of EPFR in treatment of resistant PF in 22 (26feet) patients who were available for an average of 9.6 years of follow-up. The previous study reported improvement of the mean AOFAS score from 51 preoperative to 89 points at final follow-up.
A retrospective study carried out by Urovitz et al. [38] revised the charts of 55 patients who underwent EPFR for resistant PF. The previous study documented that the mean AOFAS score improved significantly from 66.5 preoperative to 88.2 points, while the mean preoperative pain score improved significantly from 18.6 to 31.1 after a mean follow-up period of 18 months.
The results of the EPFR group in this study documented that the mean VAS improved significantly 8.22±0.61 SD preoperative to 1.59±0.8 SD at 12 months after surgery (p value <0.001), while the mean AOFAS score improved significantly from 45.44±6.57 SD to 87.97±3.05 SD at the same time intervals (p value <0.001).
A sensible improvement of symptoms was accomplished in this study after 1 month from EPFR, and a cumulative improvement continued at 12 months postoperative. Our results are in line with those reported by several studies [10,37-40].
The results of this study are in line with a randomized study including 50 patients carried out by Othman et al. [41] who compared the functional outcomes of EPFR versus PRP injection in treatment of chronic PF. The average follow-up periods in the previous study were 18.25 and 17.45 months for the EPFR and PRP groups respectively. Statistically significant improvement in the VAS and AOFAS scores were documented between baseline and the final follow-up values in each group. However, no statistically significant differences were noted between both groups in terms of the VAS and AOFAS score at final follow-up.
The complications encountered in the EPFR group in this study included 2 (6.25%) patients with superficial infection over the skin portals which resolved successfully with oral antibiotics. No other complications like neurovascular injury,

arch collapse, or lateral column overload symptoms were observed. The complication rate in the EPFR group in this study was comparable to other literature studies [38,39]. The complications observed in the PRP group included 2 (5.88%) patients who complained of mild pain following injection which resolved after few days of rest and pain killers.

This study has some limitations. First, the relatively short follow-up period. Second, this study lacks radiographic assessment of the plantar fascia through ultrasound or magnetic resonance imaging. Third, the PRP was injected without ultrasound guidance. However, Kane et al. [42] proved that ultrasound guided injection had no superiority over direct palpation guidance during corticosteroid injection in management of PF. Finally, several factors influence the final PRP volume and growth factors concentration including the amount of withdrawn autologous blood, centrifugation time/rate, and the use of activating agents. Therefore, precise comparison between this study and previous PRP studies could not be achieved due to various methods used in PRP preparation.

Conclusion

PRP proved to be a safe, noninvasive, efficient and less costing method of treatment in patients with resistant PF. PRP injection in treatment of resistant PF achieved comparable functional outcomes with the EPFR after 12 months of follow-up. PRP is a wise decision that should be considered after failure of traditional conservative measures in chronic PF before surgical intervention.

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