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Research Article

Preliminary study reveals the efficiency of platelet rich plasma injection over physiotherapy for chronic plantar fasciitis treatment

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Background: Plantar Fasciitis (PF) is considered as one of the most prominent causes of heel pain in adults. Regenerative medicine has been developed as one of the therapeutic strategies for treatment of chronic tendinopathy using Platelet-Rich Plasma (PRP). So, the present study was intended to solve the controversial role of PRP injection as anti-inflammatory or as regenerative therapy for treatment of chronic tendinopathy.

Aim of the work: To evaluate the effect of Platelet Rich Plasma (PRP) injections under Musculoskeletal Ultrasonography (MSUS) guidance in the management of patient's chronic plantar fasciitis in comparison to physiotherapy.

Methods: The present study involved twenty plantar fasciitis patients with 3 months failed of traditional treatment. One of them received local steroid injection during follow up, so excluded from the study. The studied patients were classified into two main groups as follows: PRP group (10 patients) and physiotherapy group (9 patients). All patients were evaluated using the American Orthopedic Foot Association Society (AOFAS) score and MSUS was done before and 4 weeks after treatment.

Results: The AOFAS increased significantly among the PRP group by 36% increase versus 13% in the physiotherapy group after treatment. Tendon echogenicity was significantly changed in 70% of cases after PRP injection (p-value<0.05). Tendon thickness was significantly decreased in the PRP group compared to physiotherapy group after treatment (p-value=0.04).

Conclusions: PRP significantly can be used as therapy of choice among plantar fasciitis patients.

Keywords: Plantar fasciitis (PF) • American Orthopedic Foot Association Society (AOFAS) • platelet rich plasma (PRP) • Regenerative medicine

Introduction

Plantar Fasciitis (PF) is considered as one of the most extreme common causes of pain in the heel area among adult foot [1,2]. Also, pain is exaggerated by different activities such as longstanding weight bearing [3,4]. It can affect any age group but, individuals among 40-60 are at increased risk without sex predilection. Diagnosis of plantar fasciitis depends on history, clinical examination, and imaging modalities. PF treatment is divided into drug, non-drug, and surgical strategies. Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), corticosteroid injections are considered the foremost drugs; whereas, nondrug approaches have different common sorts, such as shoe embeds, ice backs, extracorporeal shock wave treatment, plantar fascia extending exercises [5-7].

Anatomically, the plantar fascias have a vital role in the connection between the medial calcaneal tuberosity and the proximal aspect of the phalanges and maintain the assistance of the medial longitudinal arch and sustain the ability to absorb dynamic shock [8]. Additionally, plantar fascia and tendons and ligaments share the same histological and mechanical traits [9]. So, they have the same etiological, pathophysiology, and management of the degeneration of tendons diseases called tendinosis [10]. Unfortunately, up till now, there is no gold considered standard therapy for the treatment of plantar fasciitis either drug or non-drug or surgical. Moreover, Ferrero et al. [11] revealed the mitigated regenerative role of Platelet-Rich Plasma (PRP) injections in tendon regeneration through the enhanced platelets development in the treatment of chronic tendinopathy, muscle, and cartilage injuries**.** Furthermore, Platelet-rich plasma, commonly referred to as "PRP', is a non-operative, permanent solution for conditions such as arthritis and ligament/tendon sprains and tears. Additionally,

platelets are rich in their content of regenerative components such as growth and healing factors. So, treatment with PRP enhances the average level of an injured individual and can get back to a pain-free life in 4 to 6 to weeks. So, PRP was popular target treatment that used in common by professional athletes with minimizing dysfunctional behavior and symptoms such as stiffness and swelling, and their leading inflammation, tenderness, and pain [12].

Platelet-Rich Plasma (PRP) injection is an autologous biological blood-derived product that contains high concentrations of development growth factors. Delicate tissue recuperating is thought to be fortified through upgraded fibroblast relocation and multiplication, up controlled vascularization, and expanded collagen deposition [13]. Kumar et al. [14] revealed that PRP has the vital role to enhance the recovery of PF and the mean pain severity improvement has been enhanced for 45% during the 6 months follow-up with a high degree of satisfaction between patients of the treatment.

Furthermore, other case study with no more than 1-year follow-up has detailed comparable results with understanding fulfillment rates of 79%-96% [15,16]. To date, no controlled case studies for using PRP injections for the real improvement of chronic PF with fixed methodology and promising outcomes. PRP utilization in the treatment of plantar fasciitis may be an unused methodology with promising outcomes, advancing the recovery by and regenerative medicine progress and induction of the healing process [17].

Ultrasound is a well-known, radiation-free, and low-cost effective imaging process that commonly used to diagnose a wide range of musculoskeletal conditions and to guide percutaneous procedures precisely. Moreover, knowledge of its guidelines and technical aspects are important to carry out with safe and accurate methods on the target tissues [18]. Additionally, Musculoskeletal Ultrasonography (MSUS) was considered as one of the important aspects that aid in the evaluation of structural changes and improvement of tissue inflammation following the PRP injections [19].

Moreover, the literature studies lacking the comparing of the outcomes of Platelet-rich plasma injections over physiotherapy as one of the standard method of treatment of PF long time ago are considered the rationalizing motives for our research aims.

The present study was hypothesized to assess the effect, functional and structural, of PRP injections under Musculoskeletal Ultrasonography (MSUS) guidance in the treatment of chronic plantar fasciitis patients in comparison to physiotherapy.

Patients and methods

The present study prospectively recruited 20 patients suffering from plantar fasciitis who failed a minimum of three months of conservative treatment. Studied patients have been recruited from the clinic of the department of rheumatology and rehabilitation, Fayoum University Hospital. One patient has been excluded due to receiving local steroid injection during the follow-up. Patients were divided into two groups as follows:

- PRP group included 10 patients.
- Physiotherapy group included 9 patients. All patients were subjected to history reporting including according to the clinical and functional assessment of American Orthopedic Foot Association Society (AOFAS) score. It is noted to mention that 100 scores indicate optimal activity.

The study was revised and approved by the Faculty of Medicine, Fayoum University Ethical Committee, and all subjects gave an informed written consent after explanation of the study.

Ultrasonographic evaluation

Patients were examined in a prone position with their heels overhanging the examination couch. The ankles have been in dorsiflexed 90° position in order to keep the plantar fascia in a straight position. The examination has been carried out using Ultrasound scanner model GE logiq P5 with a 12-MHz linear transducer. Moreover, the scanning was aimed at the longitudinal and transversal sections of the tendon. Sonographic criteria for the diagnosis of plantar fasciitis included plantar thickness at a standard well-known location with fascia crosses the anterior area of the calcaneal border exceeds 4 mm [20]. Moreover, the best measurement is in the long axis that reveals signs of tendinopathy (hypo-echoic or disrupted febrile pattern). MSUS assessments at the baseline and follow up plus guided injection have been carried out by the same sonographer.

Intervention

Platelet concentrate preparation

Platelet-rich plasma has been carried out by extraction of 8 mL of peripheral blood with Sodium Citrate has as anticoagulant followed by single centrifugation cycle for 30 minutes at 500 Revolutions Per Minute (RPM) according to the preparation protocol using (HERMLE Z 206 A) without second centrifugation. Successively, the present protocol has yielded about 4 mL of PRP, without any activation before injection to prevent rapid fibrin clot, which will be used to the local injection under sterile aseptic conditions.

Injection technique

All patients were informed to stop their Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) 2 weeks prior to the injection, with an exceptional factor of paracetamol intake.

The procedure was done on an out-patient basis under complete aseptic conditions. The considered area was that showed the highest thickest area of the plantar fascia and/or the hypoechogenicity area within the thickened fascia. Additionally, 2 mL of PRP were injected using 22 gauge needle under the management of the images of ultrasound targeting the facial plane between subcutaneous fat and the plantar surface of the fascia. The injection was incorporated using an implanted needle that passed through the medial approach in-line to the probe and advanced under continuous ultrasound directions into the proximal plantar fascia level. Additionally, the successful injected has been considered in case of the supported smooth spread of injectate over the fascia.

Post-injection precautions

After two days of injection, the only allowed drug that can be used was the Acetaminophen (paracetamol) as an analgesic. Moreover, patients have been recommended with weight bearing and stretching exercises with restricted vigorous activities and prolonged standing for at least 48 hours.

Physiotherapy

The second group of patients was instructed to receive 10 sessions of therapeutic ultrasound (1 megahertz, continuous, 1.5 watt), each session was for 10 minutes with recommended icing and stretching exercises.

Follow up

All patients were subjected to follow up, and clinical assessment in the outpatient clinic by AOFAS scores. Additionally, patients have been evaluated after 4 weeks for bony irregularity, tendon thickness; echogenicity and Doppler activity using ultrasonography for both study groups.

Statistical analysis

Statistical analysis has been carried out using coded collected data and checked before recording, followed by analysis using SPSS software version 18 in windows 7. Data analysis has been carried out using descriptive analysis for qualitative data with numbers and percentages using Chi-square test and Mc-Nemar test. Parametric data of the quantitative analysis has been carried out using means and standard deviations. Additionally, non-parametric quantitative data have been analyzed using the Mann-Whitney test to compare two independent groups, and Wilcoxon tests compare two dependent groups data. The significant value was considered if $p \leq 0.05$.

Results

The present study has been carried out on 19 plantar fasciitis patients, who have been classified into 2 groups as follows; group 1 received PRP and group 2 received physiotherapy using familiar ultrasound therapy. Both groups were age and sex matched; also they were matched as regards baseline characteristics e.g. AOFAS score and ultrasonography parameters (Tables 1 and 2).

Table 1. Comparisons of demographic characters in different study groups.

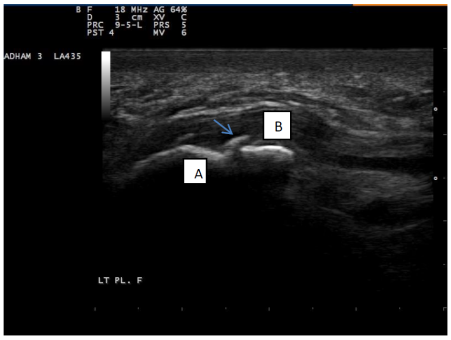
Variables	PRP (n=10)		Physiotherapy (n=9)		p-value
Age (years					
Mean/SD	41.2	6.9	44.1	6.9	0.4
Sex					
Male	4	40%	6	66.70%	0.4
Female	6	60%	3	33.30%	
Abbreviation: PRP: Platelet Rich Plasma.					

Table 2. Comparisons of patient assessment before treatment in different study groups.						
Variables	**PRP (n=10)**		**Physiotherapy (n=9)**		**p-value**	**OR (CI)**
Tendon thickness	0.53	0.12	0.5	0.09	0.6	-
AOFAS	58.6	14.1	54.6	9.4	0.5	-
Bone irregularity						
Absent	5	50%	6	66.70%	0.7	0.5
Present	5	50%	3	33.30%		(0.08-3.2)
Calcaneal bursa						
Absent	10	100%	9	100%	-	-
Present	0	0%	0	0%		
Tendon echogenicity						
Absent	10	100%	6	66.70%	0.09	0.4
Present	0	0%	3	33.30%		(0.2-0.7)
Doppler signal						
Absent	9	90%	9	100%	0.9	0.5
Present	1	10%	0	0%		(0.3-0.8)
Abbreviation: PRP: Platelet Rich Plasma; AOFAS: American Orthopedic Foot Association Society.						

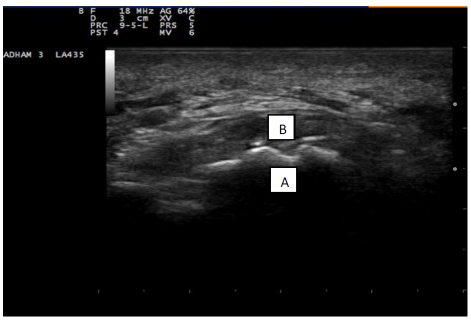
Group 1 (PRP group)

It included 10 patients (4 males and 6 females) with a mean age of (41.2 ± 6.9 years). Furthermore, the AOFAS assessment score of pain before treatment was (58.6 ± 14.1) and the musculoskeletal ultrasound evaluation showed that 5 patients had bony irregularity and all patients showed hypoechogenicity of plantar facia with tendon thickness of (0.53 ± 0.12) (Figures 1 & 2).

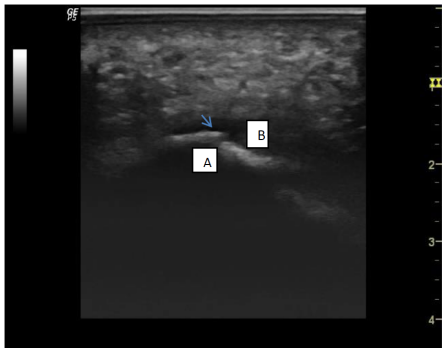
Moreover, PRP injection showed significant improved AOFAS through follow up of four weeks later with the value of (78.2 ± 17.9) and P-value=0.004; further, tendon echogenicity improved in 70% of cases (p-value=0.001) with a significant decrease in tendon thickness of (0.44 ± 0.1) (p-value=0.008) as shown in Table 3, and a follow up case in Figures 3 and 4.



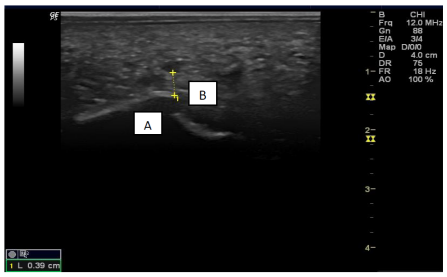
Key: A=Calcaneus, B=Plantar fascia.
Figure 1. Plantar fascia longitudinal scan showing calcaneal spur (blue arrow), hypoechoic thickened fascia



Key: A=Calcaneus, B=Plantar fascia.
Figure 2. Plantar fascia transverse scan showing severe hypoechogenicity, lost the fibrillar pattern and increased thickness.



Key: A=Calcaneus, B=Plantar fascia.
Figure 3. Plantar fascia longitudinal scan showing calcaneal spur (blue arrow), hypoechoic fascia before PRP injection.



Key: A=Calcaneus, B= Plantar fascia.
Figure 4. Plantar fascia after PRP injection. Showing improved echogenicity and decreased thickness of the plantar fascia.

Table 3. Comparisons of patient assessment before and after treatment among PRP group.

Variables	Before		After		p-value
Tendon thickness	0.53	0.12	0.44	0.1	0.008*
AOFAS	58.6	14.1	78.2	17.9	0.004*
Bone irregularity	5	50%	5	50%	-
Tendon echogenicity	0	0%	7	70%	-

Key: *statistical significance difference with p-value<0.05.
Abbreviation: AOFAS: American Orthopedic Foot Association Society.

Group 2 (physiotherapy group)

It included 9 patients received physiotherapy as follows (3 males and 6 females) with a mean age (44.1 ± 6.9) and mean American Orthopedic Foot Association Society (AOFAS) score of pain (54.6 ± 9.4 SD) before therapy. On one side, musculoskeletal ultrasound assessment revealed that 3 patients had bony irregularity and 6 patients with hypoechogenicity of plantar fascia, and no Doppler signal has been appeared and mean tendon thickness was (0.5 ± 0.09). On the other side, physiotherapy showed further amelioration for the AOFAS with a non-significant score from 54.6 to 58.8 (p-value=0.1) and no significant improvement of tendon echogenicity, bone irregularity, and tendon thickness as shown in Tables 4 and 5.

Discussion

Plantar fasciitis is considered as one of the common collagen degenerative tissue aspects more than site inflammation at the medial tuberosity of the calcaneus [21,22]. Moreover, it triggers heel pains among sedentary adults and athletics. Additionally, obesity, excessive foot pronation, excessive running, and prolonged standing are risk factors for developing plantar fasciitis [23]. Moreover, platelet-rich plasma injection was aimed to be used in order to

Table 4. Comparisons of patient assessment before and after treatment among Physiotherapy group.

Variables	Before		After		p-value
Tendon thickness	0.5	0.09	0.47	0.09	0.2
AOFAS	54.6	9.4	58.8	11.3	0.1
Bone irregularity	3	33.30%	3	33.30%	-
Tendon echogenicity	3	33.30%	3	33.30%	-

Abbreviation: AOFAS: American Orthopedic Foot Association Society.

Table 5. Comparison of tendon thickness after treatment in different study groups.

Variables	Group 1 (PRP)		Group 2 (Physiotherapy)		p-value	Sig.
	Mean	SD	Mean	SD		
Tendon thickness						
Before	0.53	0.13	0.5	0.09	0.05	S
After	0.44	0.11	0.47	0.09	0.04	S
p-value	0.008		0.2			

Abbreviation: PRP= Platelet Rich Plasma.

platelets with growth factors delivery to the site of injury in high concentrations [24]. The most common diagnostic criteria of plantar fasciitis are depending upon the history and physical examination using imaging radiography for heel pain and tenderness over the plantar medial aspect of the calcaneal tuberosity, near the insertion of the plantar fascia [25].

In this paper, we proposed that imaging using ultrasound radiography have beneficial diagnostic aspects that enhance the measuring activities of plantar fascia thickness and echogenicity. Additionally, the present study research is a modest contribution to the ongoing discussions about the vital role of platelet-rich plasma to mitigate the heel pain and plantar fascia. So, our study included the examination of 19 patients with plantar fasciitis, which classified into two groups, one with PRP and the other treated with physiotherapy and follow up was done after 4 weeks for both groups. On one side, the present study showed that PRP injection ameliorated the tendon echogenicity with a significant decrease in the tendon thickness and a significant increase in AOFAS level. On the other side, the physiotherapy group showed neither significant improvement of tendon echogenicity nor thickness but showed a significant increase in the mean AOFAS score.

Recently, Baz et al. [26] disclosed in their study

that conventional treatment has not effective in their study patients with chronic plantar fasciitis. Patients were diagnosed and treated by ultrasound-guided PRP injection and followed up after 4 months by both clinical and ultrasound examinations. There was a mild improvement in plantar fascia thickness from 6.04 mm (mean thickness pre-injection) to 4.93 mm (mean thickness 4 months post last injection). VAS showed significant improvement from 8.14 to 2.59 post-injection.

Moreover, our results were in agreement with Kumar et al. [14] who studied the use of PRP in plantar fasciitis and concluded that PRP is safe with no reported complications and could be with ameliorative effects and evidence may need more upcoming randomized trials on large scale.

Moreover, our study was in concordance with Vahdatpour et al. [7] who stated that PRP has more efficacies over the local steroid injection treatment. Our study agreed with them in the improvement of PRP to cure the pain severity and physical limitation in patients with plantar fasciitis. However, the results were not in accordance with them in the time of follow-up. As, there were differences in the amelioration period among their study and ours with 3 months and 1 month of follow up, respectively.

Jain et al. [27] compared the efficacy of PRP to local steroid injection for the treatment of plantar fasciitis and followed up the patients at 3, 6, 12 months. They stated that PRP injection has similar impacts like steroid injection without active relief of symptoms from three to six months. While, follow-up at 12 months exposed that PRP has significantly effective symptoms relief more than steroid injection. So, there is a big difference between our study follow-up and their study due to factors which prominently could be a good chance for loosing and not enough obedient.

Omar et al. [28] performed their 30 patient's randomized controlled trial and revealed that PRP injection has significant efficiency more than steroid injection in the amelioration of pain and foot function at 1.5 months. On the contrary, Sherpy et al. [29] found a similar reaction for PRP and corticosteroid injections after 3–months of follow up. Moreover, Franceschi et al. [30] confirmed the PRP treatment injection of Plantar Fasciitis (PF) with promising therapeutic improved outcomes.

As regard to physiotherapy, Zanon et al. [31] found that the high-power continuous ultrasound did not add value for function and pain for plantar fasciitis patients. Moreover, they showed that exercises with specific stretching have been effective in the reduction of pain by more than 50% among patients with chronic plantar fasciitis.

The finding of the present study was quite surprising and suggests that PRP treatment has a safer impact on the plantar fasciitis dysfunctions, as our study considered as the first study to construct a comparison between PRP and physiotherapy as different treatment modalities for plantar fasciitis. On other meaning, it is the first to construct a comparative study between the conventional physical therapies and new innovative treatments (PRP). Therefore, it is crucial to carry out more intensive research on the use of PRP as a new regenerative therapy with a large number of patients with plantar fasciitis dysfunctions should be conducted in the future.

Conclusion

Based on the results, it can be concluded that the research into new innovative regenerative methods such as PRP injection has been very successful and effective than physiotherapy for the medication of chronic plantar fasciitis. From our point of view, PRP is considered as a safe therapeutic approach. Ultrasound has a great role as regarding diagnosis and guided injection and follow up of structural changes.

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