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Ultrasound-guided platelet-rich plasma vs. radiofrequency nerve ablation for refractory plantar fasciitis

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ABSTRACT

Objectives: Plantar fasciitis (PF), which accounts for approximately 80% of heel pain, is a common condition affecting adults' quality of life. There are many different treatment modalities used in the treatment of PF. In this study, we compared the clinical and functional outcomes of patients diagnosed with chronic PF in our clinic who underwent USG-guided PRP (platelet-rich plasma) injection and patients who underwent RFNA (radiofrequency nerve ablation) treatment.

Methods: Ultrasound-guided PRP injection or RFNA was performed on 95 patients who were diagnosed with chronic PF and met the inclusion criteria. This group of patients was followed for at least one year (October 2021-October 2023), and the clinical and functional results of the patients were compared.

Results: The mean pre-treatment Visual Analog Scale (VAS), Foot Function Index (FFI), and American Orthopaedic Foot and Ankle Society (AOFAS) posterior-ankle scores were similar, and no significant difference was found ($P>0.05$). A significant improvement was observed in the groups' FFI, VAS, and AFOAS scores after treatment ($P<0.05$). However, no significant difference was found in treatment modalities ($P>0.05$).

Conclusions: As a result of the study, it was concluded that PRP injection and RFNA are effective treatment methods in patients diagnosed with chronic plantar fasciitis without response to other conservative treatment methods, but these two methods are not superior to each other.

Keywords: Plantar fasciitis, platelet-rich plasma, radiofrequency nerve ablation

Plantar fasciitis (PF) is the most prevalent cause of heel pain, accounting for about 80% of cases; its occurrence in society is estimated at 7% [1]. This common condition is a health problem that frequently affects the quality of life of adults. Sharp, excruciating pain is the hallmark of plantar fasciitis, and it typically flares up at the most inconvenient times - first thing in the morning or right before an activity begins. Although this pain tends to improve over time, in some cases, it can become chronic and become a limiting factor in patients' daily lives.

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The etiology of plantar fasciitis, one of the insidious causes of heel pain, is still not fully understood. However, it is a disorder that is associated with several risk factors such as age, increased body mass index (BMI), overuse, Achilles strain, calcaneal sprain, pes planus, pes cavus, lack of flexibility of the plantar flexors (reduced ankle dorsiflexion) [2]. Pathophysiologically, in the presence of increased fascial load, it causes changes in the extracellular matrix after being detected by the gap junctions (mechanotransduction) between fibrocytes, causing myxoid degeneration and disintegration of the plantar fascia [3]. Current literature suggests that PF has a degenerative pathology rather than an inflammatory process, and the term plantar fasciitis is recommended instead of PF due to chronic inflammatory changes without histological signs of fibroblastic proliferation [4].

There is a notable range of treatments available for plantar fasciitis. Conservative treatment methods are frequently used and include the use of anti-inflammatory drugs, physical therapy, stretching exercises, foot pads, and orthotic devices. Remarkably, the success rate of these conservative treatments can be as high as 90% [5]. Additionally, surgical treatment can be applied in resistant cases by releasing the fascia, and success rates vary between 70% and 90% [6]. Nonetheless, because the plantar fascia area is subject to pressure, there is a risk of complications, including issues with soft tissue healing, superficial infections, or even arch collapse. To mitigate the potential for these significant complications, minimally invasive treatments have been suggested over the years to manage this condition. These options include injections (e.g., steroids or platelet-rich plasma [PRP]), extracorporeal shock wave therapy (ESWT), and radiofrequency nerve ablation (RFNA) targeting the plantar fascia [7-9].

The purpose of this article is to evaluate and compare the functional and clinical results of patients with persistent plantar fasciitis who were treated at our clinic using RFNA or PRP.

METHODS

Patients with plantar fasciitis in our clinic who received conservative or minimally invasive treatment (ESWLT, steroid injection, etc.) but still had chronic plantar heel pain for longer than six months were included in this study. Diagnosing plantar fasciitis was established through clinical findings, adhering to the diagnostic criteria outlined in the guidelines presented by McPoil *et al*. [10]. Plantar fasciitis was diagnosed by considering particular clinical observations, such as tenderness when pressing on the inner part of the heel's sole, heightened discomfort during initial steps following extended inactivity, worsened pain after prolonged standing or walking, and frequently experiencing pain due to recent increases in weight-bearing activities. These findings were indicative of the condition. PRP or RFNA was applied to 95 patients who met the inclusion criteria for the study due to persistent heel pain. The patients data who were followed for at least one year (October 2021-October 2023) were analyzed, and their clinical and functional results were compared.

The inclusion and exclusion criteria for patients can be found in Table 1. Our institute's clinical research ethics committee approved the study (approval number 23.10.2023/20230040), and we obtained informed consent from each patient. Patients' age, gender, and BMI were recorded. Information was obtained about the types of treatment previously applied to the patients, previous trauma, or systemic disease status. Three scales assessed the patients' clinical scores before and 12 months after treatment. Initially, pain was evaluated using the Visual Analog Scale (VAS), where a score of 0 represented the absence of pain, and a score of 10 indicated the most severe pain imaginable. The Foot Function Index (FFI) comprises a questionnaire with 23 items categorized into three subgroups: 5 items related to activity limitations, nine items focusing on pain severity, and another nine items addressing disability. Finally, the assessment of foot function involved using the American Orthopedic Foot and Ankle Society (AOFAS) posterior-ankle scale.

Preparation and Application of PRP

It was prepared for our patients according to the method described by Anitua *et al*. [11-12]. Under aseptic precautions, 30 ml of peripheral blood is collected from the antecubital area into tubes containing 3.2% sodium citrate. With the double centrifugation technique, approximately 3 mL of PRP is extracted after centrifugation for 10 minutes at 1300 rpm and 3500 rpm to separate erythrocytes and concentrate

platelets. Under sterile conditions, a 13 MHz linear transducer-enabled ultrasound probe (Clarius L7 HD3, Clarius Health Corp, Canada) is placed on the most sensitive point of the foot by palpation in the medial region of the foot and applied to the area where the plantar fascia is thickest (Figure 1). The procedure was completed by using two PRP injections with a two-week interval in between.

Percutaneous radiofrequency ablation

The region of highest sensitivity on the affected side of the plantar fascia is pinpointed, and specific locations where radio frequency treatment will be applied are marked within the area of pain, ensuring a 5 mm spacing between each marked point. Following standard disinfection using iodine and alcohol and skin preparation with a sterile cover, the calcaneal branch of the posterior tibial nerve is localized and locally anesthetized using 1% lidocaine under the guidance of ultrasound, approximately 2 centimeters distal to the tip of the medial malleolus. After administering local anesthesia, entry points on the skin for radiofrequency are established using a 1.5 mm Kirschner wire. This is done to facilitate the insertion of the radiofrequency probe beneath the skin. Subsequently, percutaneous radiofrequency ablation is conducted by positioning a radiofrequency probe at the level of the plantar fascia under ultrasound guidance at each of the marked grid's puncture points (CoATherm AK-A304, Gyeonggi-do, South Korea). At the end of the procedure, a sterile dressing is applied locally. Standard Achilles and plantar fascia stretching and strengthening exercises were given during the follow-up of patients in both groups. Patients were advised not to exercise and to rest on the first day after the injection. Non-steroidal anti-inflammatory drugs were not recommended to any patient in the PRP group after the procedure, and paracetamol was given to the patients in the RFNA group; however, no orthosis or splint was recommended.

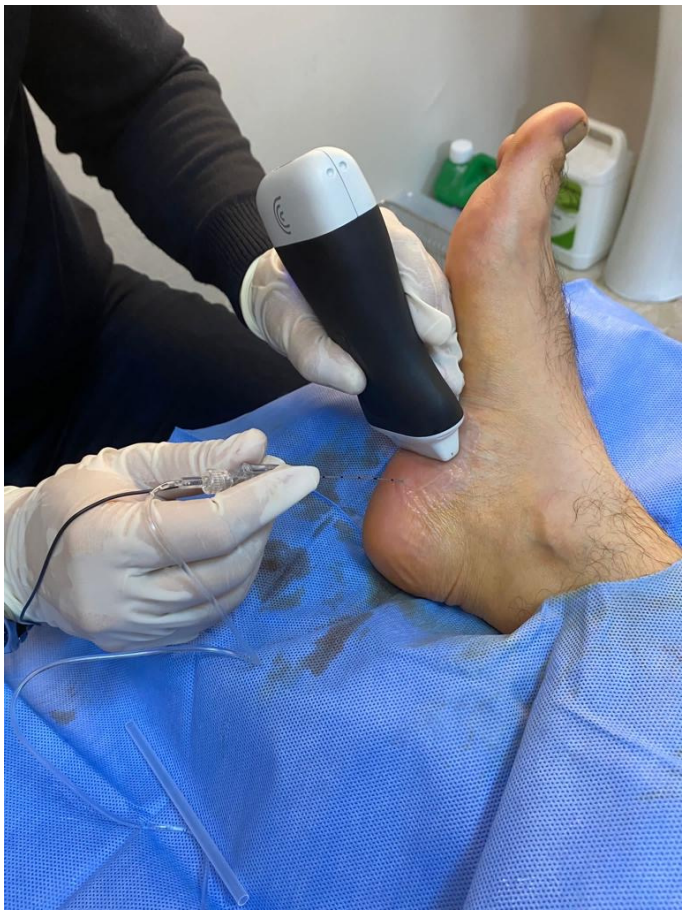

Fig. 1. PRP (platelet-rich plasma) application under ultrasound guidance in the treatment of plantar fasciitis.

Statistical Analysis

Data files were processed using IBM SPSS Statistics version 25 (IBM Corp, based in the USA). The Shapiro-Wilk test was employed to assess the distribution of continuous variables. When comparing normally distributed variables among groups, one-way analysis of variance (ANOVA) was the chosen statistical method. In cases where the variables did not exhibit a normal distribution, the Kruskal-Wallis test was utilized for group comparisons. The Friedman Test was selected to compare variables that showed non-normal distribution at various time points. We employed the Pearson Chi-Square and Fisher-Freeman-Halton tests to assess qualitative data. A P-value less than 0.05 indicated a statistically significant difference for all the statistical tests performed.

RESULTS

Demographic data of the patients included in our study are shown in Table 2. Treatment groups were similar in age, gender, and BMI distribution. However, the mean VAS, FFI, and AFOAS scores before the procedure were similar in all treatment groups, and no significant difference was found (P>0.05). VAS, FFI, and

Table 1. Inclusion and exclusion criteria of the patients

Inclusion Criteria	Exclusion Criteria
Patients with chronic plantar fasciitis after failure of conservative treatment for at least six months	Patients aged < 18 years
Failure of conservative treatment (stretching exercises, nonsteroidal anti-inflammatory drugs, and heel pads) for at least six months	Associated pathology involving the lower limb such as – a history of tarsal tunnel syndrome, ankle fractures, any deformity of foot and ankle, Achilles tendinopathy
Patient should be able to understand the informed consent	Patients with inflammatory diseases (e.g., ankylosing spondylitis, rheumatoid arthritis, Reiter syndrome)
Visual analog scale pain higher than 5 (on a 10-point visual analog scale)	Pregnancy or lactation

AFOAS score changes in PRP and RFNA groups before and after treatment are presented in Table 3. Following the treatment, a notable enhancement was noted in the groups' FFI, VAS, and AFOAS scores (P<0.05). Nevertheless, no significant distinction was found when comparing the various treatment methods (P>0.05). Although the percentage decrease trend in mean VAS and FFI scores after treatment was consistent among the groups, there was a notably more substantial improvement in mean AFOAS (American Foot and Ankle Outcome Score) scores in favor of the PRP group (88.6±12.8 compared to 92.7±11.6). Body mass index, thought to be one of the factors that may affect the treatment outcome, did not affect the functional outcome of either treatment group (P>0.05). When previously unsuccessful treatment groups were compared with new treatment methods, it was seen that there was no significant effect on the outcome (P>0.05).

DISCUSSION

Most heel pain cases, around 70% to 90%, can be effectively managed through conservative treatment. However, for the remaining 10% to 30% of patients,

Table 2. Distribution of different variables in 2 groups

	PRP	RFNA	P value
Age (years)			
Mean±SD	45.3±10.2	47.4±8.3	0.647
Range	34-59	37- 62	
Gender, n			
Female	34	21	0.369
Male	23	17	
BMI (kg/m^2)			
Mean±SD	29.4±2.2	31.4±3.6	0.415
Range	25-33	25-34	
Previous treatments, n			
Steroid injection	47		0.745
Steroid injection+ESWL	27		
PRP	21		

BMI= body mass index, SD=standard deviation, ESWL=extracorporeal shock wave lithotripsy, PRP=platelet-rich plasma, RFNA=radiofrequency nerve ablation

Tablo 3. Distribution of functional outcome variables in 2 groups

	Preinjection	6 Month (First Follow-up)	12 Month (Second Follow-up)	P value
VAS				
PRP	8.1±2.2	4.8±1.7	3.2±0.9	**0.016**
RFNA	7.8±1.5	5.6±1.3	3.4±1	**0.022**
P value	0.785	0.689	0.572	
AFOAS				
PRP	68.2±14.4	89.1±16.2	92.7±11.6	**0.031**
RFNA	70.2±11.3	86.7±11.8	88.6±12.8	**0.036**
P value	0.943	0.879	0.347	
FFI				
PRP	71.1±13.5	38.7±16.4	34.1±19.0	**0.031**
RFNA	68.3±14.7	51.2±21.7	32.3±17.2	**0.029**
P value	0.658	0.753	0.699	

Data are shown as mean±standard deviation. PRP=platelet-rich plasma, RFNA=radiofrequency nerve ablation, VAS=Visual Analog Scale, FFI=Foot Function Index, AOFAS=American Orthopaedic Foot and Ankle Society score

more invasive or surgical interventions may be necessary [6]. The histopathological characteristics of this condition involve elevated vascularity, an abundance of ground substance proteins, localized regions with fibroblast overgrowth, and damaged collagen fibers. Additionally, some studies have shown nonspecific signs of inflammation in plantar fasciitis. Etiologically, chronic plantar heel pain can develop due to many factors, including nerve lesions. However, regarding the calcaneal spur formations that may first come to mind in the etiology of patients with plantar fasciitis, the results are contradictory regarding the relationship between the size of the spurs and pain and symptoms [13, 14]. For this reason, different treatments for many other mechanisms, including spur excision, can be used to treat the disease [15, 16]. In this study, the mean age of the patients was 41, which is consistent with the age range often observed in similar studies. Furthermore, some research has indicated that plantar fasciitis affects individuals within their fourth decade. Additionally, evidence suggests that plantar fasciitis is more prevalent in the obese population. In our study, the average BMI of the patients was found to be 31.4 kg/m2, which was similar to the literature. Although there was a slight female predominance in terms of gender in our study, it could not be shown to be associated with plantar fasciitis.

Substantial enhancements were noted in all assessment scores for both treatment groups. The RFNA group displayed superior outcomes in terms of VAS and AOFAS scores when compared to the PRP group at 6 and 12 months. Nevertheless, by the 12th month, a slight increase in the decrease of all scores was observed in the PRP group compared to the other group (Table 3). While there was no statistically significant distinction in functional scores, it is noteworthy that the clinical outcomes exhibited more significant improvement in the RFNA group compared to the PRP group (Table 3).

A meta-analysis conducted by Ling *et al*. [17] reported that PRP effectively reduces pain and improves physical function in patients with plantar fasciitis. However, they also found that long-term PRP applications can improve pain and physical function over 12 months, whereas short-term PRP treatments, lasting from 1 to 6 months, did not yield the same effect [17]. In the study conducted by Say *et al*. [18], they determined VAS and AFOAS scores at baseline and after a 6-month follow-up as 8.8±1 and 62.9±8.5 at the 0th month, and 1±0.8 and 90.6±2.6 at 6th month, respec-

tively. They thus concluded that PRP injections showed an excellent clinical response in patients with chronic plantar fasciitis [18]. Jain *et al*. [19] found that the mean VAS and AOFAS scores in patients who underwent PRP were 8.3 and 58.6 before the procedure and 3.3 and 88.5 at 12 months, respectively. Our study is similar to the literature (Table 3). However, although there are many application guidelines in clinical practice regarding the procedure of the PRP method, platelet density, and number of sessions, there is no consensus. Generally, PRP injections can be administered in several sessions once a week or more per week.

The superiority of ultrasound-guided injections over palpation-guided injections is still controversial. To treat plantar fasciitis, some prior research has recommended using ultrasound guidance for injection, as this may enable more accurate injection administration [20]. However, the results of trials by Kane [21] suggest that ultrasound-guided injection is less effective than palpation-guided injection in treating idiopathic plantar fasciitis. Specific authors propose that employing ultrasound guidance can help prevent complications, such as the development of flexor hallucis longus tendinosis resulting from excessively deep punctures [22]. The patients in the study were treated with ultrasound guidance, so subgroup analysis could not be performed to investigate whether it was more effective than palpation-guided injection.

Erken *et al*. [7] reported that this method dramatically improved the results in patients in whom they applied RFNA and followed up long-term, with the VAS score before the procedure being 9.2±1.9, the score after one year being 1.3±1.8 and the AOFAS scores being 66.9±8.1 and 93±7.5, respectively [7]. In a retrospective study by Liden *et al*. [23], they reported that the VAS was 8.12±1.61 before the procedure and 2.07±2.06 in the 6th month after the injection and that the treatment was successful at a rate of 92%. Yuan *et al*. [24] reported that VAS and AFOAS scores improved significantly in 12 months in patients who underwent RFNA and were followed up for an average of 58.7 months. In the 12th month, it was determined that VAS scores changed from 7.87±1.73 to 0.73±1.28, and AFOAS scores changed from 42.73±10.75 to 98.40±4.24. Our clinical results in the study are consistent with the literature; however, in the literature, we did not come across an isolated survey comparing both treatment methods. Nevertheless, reports compare different methods for treating plantar fasciitis [9, 25].

This study demonstrates that the two methods used for treating plantar fasciitis have similar effectiveness, and no complications were detected in the following patients. Both treatment methods have different technical requirements. PRP injection includes disadvantages such as equipment setup, blood collection, and PRP preparation, but it may be a relatively more cost-effective option. On the other hand, the RFNA procedure can lead to peripheral nerve damage, muscle-tendon injury, and the use of expensive equipment, and it should be applied with caution.

Limitations

The study's shortcomings were a small sample size, a brief follow-up period, and the need for a control group. More studies with a bigger patient population, extended follow-up periods, and a control group might offer a more thorough knowledge of how well both treatment approaches work.

CONCLUSION

These findings suggest that these standard treatment methods can potentially improve chronic plantar fasciitis symptoms that do not respond to other conservative treatment methods, but they do not appear to have a superiority over each other.

Authors' Contribution

Study Conception: FE; Study Design: TC; Supervision: İB; Funding: FE; Materials: FE; Data Collection and/or Processing: FE; Statistical Analysis and/or Data Interpretation: AY; Literature Review: TC; Manuscript Preparation: FE and Critical Review: AY, İB.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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