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The effect of calcaneal spur presence on the response to xtracorporeal shock wave therapy in plantar fasciitis treatment running head: Impact of calcaneal spur on ESWT response in plantar fasciitis

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Abstract

This study aimed to determine the effect of calcaneal spur (CS) presence on the response to extracorporeal shock wave therapy (ESWT) in patients with plantar fasciitis (PF). Eighty patients clinically diagnosed with PF were initially assessed, and 64 were included after exclusions. Patients were categorized into two groups according to the presence or absence of CS, identified through weight-bearing lateral radiographs. Both groups received ESWT once a week for three weeks at a frequency of 12 Hz, energy intensity of 3.0 Bar, and 2000 shocks per session. Pain severity and functionality were assessed using the Visual Analog Scale (VAS) and Foot Function Index (FFI), while the Roles and Maudsley Score (RMS) evaluated the relationship between pain and daily activities. The results showed notable enhancements in pain and functional outcomes in both groups following ESWT, demonstrating its effectiveness in treating PF regardless of CS presence. No statistically significant variation in treatment effectiveness was detected between the groups, suggesting that CS presence is not a determining factor in the effectiveness of ESWT. The findings highlight the need for further large-scale, controlled studies to explore the impact of CS size, type, and geometric characteristics on treatment outcomes. This study emphasizes ESWT as an effective treatment option for PF patients, irrespective of CS presence.

Keywords: Calcaneal spur, plantar fasciitis, extracorporeal shockwave therapy, pain, activities of daily living

Introduction

Plantar fasciitis (PF) is the leading cause of heel pain in adults, representing 11–15% of all foot and ankle complaints and primarily affecting individuals between the ages of 40 and 60 [1,2]. Contributors to PF encompass excess body weight, extended periods of standing, flatfoot, and restricted ankle dorsiflexion [3]. The identification of PF relies on the patient's medical history and findings from a physical assessment. Patients commonly describe heel pain that intensifies with initial steps taken in the morning or following prolonged rest periods. Although the pain may diminish with movement, it can recur and intensify with prolonged standing or weight-bearing throughout the day [4,5]. During physical examination, palpation of the anchoring site of the plantar fascia on the medial tuberosity of the calcaneus provokes sharp, stabbing pain. Local tenderness is also noted when the toes are dorsiflexed and the plantar fascia is palpated from the heel to the forefoot [6]. Imaging can aid in diagnosing PF but is not routinely recommended initially. It may be utilized in resistant cases to confirm the diagnosis or exclude other heel pathologies. Lateral and axial radiographs are helpful in evaluating bone pathologies [7].

Calcaneal spur (CS) is commonly described as a bony protrusion situated just anterior to the medial prominence of the calcaneal tuberosity; however, a standardized definition remains absent in the literature [6]. There is no consensus regarding the contribution of CS to PF symptoms. While CS is observed in approximately

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half of patients with plantar heel pain, it is also detected in %16 of asymptomatic individuals [8,9]. Some researchers propose that CS develops as a result of chronic traction of the plantar fascia, leading to inflammation, periostitis, and osteogenesis, while others consider CS as a primary or contributing factor to PF [9,10].

Extracorporeal shock wave therapy (ESWT) is thought to accelerate the repair process of degenerative or inflamed plantar fascia by stimulating neovascularization and growth factor production [11]. ESWT is recognized as an effective and safe treatment for PF and has become increasingly popular in recent years [12]. However, no studies have specifically investigated the impact of CS, which is frequently observed in PF patients, on the response to ESWT. The relationship between the presence of CS, pain, and treatment outcomes remains unclear, underscoring the importance of this issue in the treatment process [5,13,14]. Accordingly, this study seeks to assess and contrast the impacts of ESWT on pain and functionality in PF patients with and without CS.

Material and Methods

Study Design

This retrospective study was carried out between October 2024 and December 2024. Participants were retrospectively selected from individuals who visited the outpatient clinics between April 2024 and September 2024 and met the inclusion criteria. Ethical approval was granted by the Clinical Research Ethics Committee of Antalya Training and Research Hospital (date: October 24, 2024, approval number 16/2).

Participants

A total of 80 participants aged between 18-65 years, clinically diagnosed with PF and experiencing symptoms for at least 3 months, were initially evaluated for the study. Of these, 16 participants were excluded according to the exclusion criteria, leaving a final sample size of 64 participants. Exclusion criteria included bilateral heel pain, a history of heel injections within the past 6 months, physical therapy for PF within the last 4 weeks, or the use of nonsteroidal anti-inflammatory drugs (NSAIDs) within the past week. Additionally, patients undergoing systemic corticosteroid therapy, those with a history of foot or heel fractures, lumbar disc herniation, prior foot surgeries, reflex sympathetic dystrophy, peripheral vascular disease, type 2 diabetes, seronegative arthritis, malignancy, or osteoporosis were excluded from the study.

Intervention

The Modus Focused ESWT Device (Ankara, Türkiye, Inceler Medikal) was used for treatment. ESWT was administered once a week for three weeks, energy intensity of 3.0 Bar, at a frequency of 12 Hz and 2000 shocks per session. During the procedure, patients were positioned prone, and ultrasound gel was used as the conductive agent. The treatment was performed using a 15 mm applicator, which was applied vertically. Shock waves were delivered starting from the most sensitive area on the medial side of the calcaneus and targeted the most painful points extending toward the metatarsals. The treatment was conducted by the same physiotherapist for all patients to ensure consistency. No local anesthetic agents were used before the procedure. Patients were instructed not to use analgesics and to refrain from applying any additional treatments to the heel region during the treatment period. They were, however, allowed to continue their daily activities.

Outcome Measures

Patients' demographics, body mass index (BMI), affected side, and symptom duration were recorded. The severity of foot pain was assessed using the Visual Analog Scale (VAS), scored between 0 and 100 (0: no pain, 100: worst possible pain) [15]. The Foot Function Index (FFI) was used to evaluate the patients' pain levels, functional disability and activity restriction. The FFI is a scale that comprises three subcomponents: pain, disability, and activity restriction, and it includes a total of 23 questions [16]. Higher scores indicate increased foot disability. In the present research, the Turkish version of the scale, previously tested and validated for reliability, was utilized [17]. Additionally, the relationship between patients' pain levels and daily activities was assessed using the Roles and Maudsley Score (RMS). In this scale, a score of 1 (excellent) indicates no pain, complete range of motion, and unrestricted activity; a score of 2 (good) represents occasional discomfort with full range of motion and activity; a score of 3 (fair) reflects mild pain after prolonged activity; and a score of 4 (poor) denotes constant pain that limits activities [18]. All assessments were conducted by examining the patients' records before and after the treatment.

Weight-bearing lateral radiographs obtained based on a standard protocol were evaluated for all patients prior to treatment. The presence of plantar CS was determined according to the criteria defined by Davis et al. and Prichasuk et al. [19,20]. Accordingly, horizontal protrusions measuring ≥2 mm from the posterior tuberosity of the calcaneus were considered indicative of CS presence, while protrusions <2 mm were classified as CS absence. In accordance with these criteria, the patients were separated into two groups: Group 1 (non-spur group) and Group 2 (spur group).

All outcome measures utilized in this study are standardized, publicly accessible, and do not necessitate prior permission for their application in scientific research.

Statistical Analysis

Data analysis was conducted using SPSS version 22 for Windows (IBM Corp, Armonk, NY, USA). Continuous data were presented as mean±standard deviation, whereas categorical data were summarized as percentage and frequency. The Shapiro-Wilk test was utilized to assess the normality of the data distribution. Between-group differences were evaluated using the Independent Samples T-Test for parametric data and the Mann-Whitney U Test for non-parametric data. For within-group comparisons, the Paired Samples T-Test was applied under parametric conditions, while the Wilcoxon Signed Rank Test was used for non-parametric cases. Categorical variables were compared using the Chi-Square Test. A value p<0.05 was considered statistically significant.

Results

A total of 80 participants were initially enrolled in the study. However, 16 participants were excluded due to failure to meet the inclusion criteria, leaving a final sample size of 64 participants (Figure 1). Participants were categorized based on the presence of a calcaneal spur into two groups: those without a calcaneal spur (non-spur group) and those with a calcaneal spur (spur group). The non-spur group consisted of 30 participants, while the spur group included 34 participants. No notable differences were detected between the groups in age, gender, BMI, symptomatic side, or symptom duration (p>0.05) (Table 1).

Both groups demonstrated notable improvements in VAS, RMS, and FFI pain, disability, and activity restriction scores after treatment (p<0.05) (Table 2).

When comparing pre-to-post-treatment change scores between the groups, no statistically significant variations in other parameters, including VAS, RMS, and the FFI subscales for pain, disability, and activity restriction (p>0.05) (Table 3).

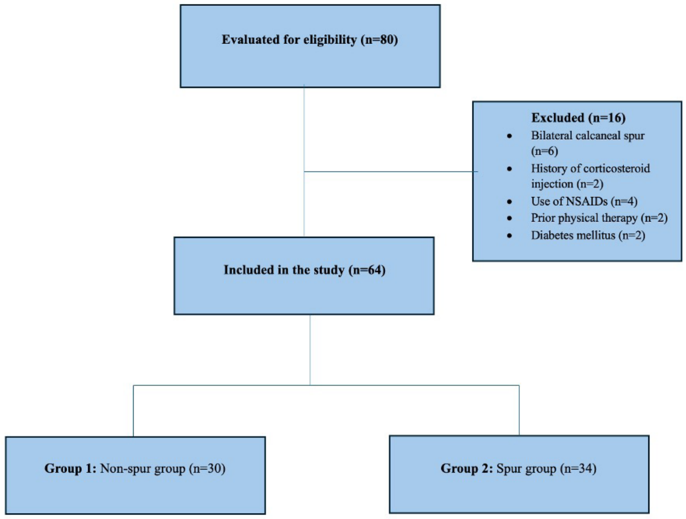

Figure 1. Flowchart of patients

Table 1. Demographic properties of the groups

Parameters	Mean±SD		p
	Group 1 (Non-spur group) (n=30)	Group 2 (Spur group) (n=34)	
Age (years)	47.30±9.95	49.35±9.44	0.400[1]
Gender, n (%)			
Female	23 (76.67)	32 (94.12)	0.100[2]
Male	7 (23.33)	2 (5.88)	
BMI (kg/m²)	27.11±3.17	29.22±3.32	0.717[1]
Symptomatic side, n (%)			
Left	16 (53.33)	15 (44.12)	0.627[2]
Right	14 (46.67)	19 (55.88)	
Symptom duration (month)	14.57±17.67	12.21±14.22	0.732[3]

SD: standard deviation, BMI: body mass index; [1]Independent Samples T-Test, [2]Chi-Square test, [3]Mann-Whitney U test

Table 2. Comparison of outcome parameters within groups

Parameters	Mean±SD					
	Group 1 (Non-spur group) (n=30)			Group 2 (Spur group) (n=34)		
	Before	After	p	Before	After	p
VAS	89.37±10.22	32.27±29.57	**0.001[1]**	88.24±14.40	43.38±29.99	**0.001[1]**
Roles and Maudsley scores	3.67±0.55	1.60±0.93	**0.001[1]**	3.65±0.60	2.12±1.04	**0.001[1]**
FFI						
FFI-pain	80.17±9.34	30.50±27.69	**0.001[1]**	71.79±15.34	34.12±24.92	**0.001[1]**
FFI-disability	71.47±13.04	24.17±24.52	**0.001[1]**	69.68±15.28	33.53±23.20	**0.001[2]**
FFI-activity restriction	23.03±9.40	7.20±7.39	**0.001[1]**	18.21±8.32	10.03±8.39	**0.001[1]**

SD: standard deviation, VAS: Visual Analog Scale, FFI: Foot Function Index; [1]Wilcoxon Signed Rank test, [2]Paired Samples T-Test

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Table 3. Comparison of pre-treatment and post-treatment changes in outcome parameters between groups

Parametres	Mean±SD		
	Group 1 (Non-spur group) (n=30)	Group 2 (Spur group) (n=34)	p
VAS	-57.10±31.63	- 44.85±33.02	0.126[1]
Roles and Maudsley scores	-2.07±1.11	-1.53±1.13	0.055[1]
FFI			
FFI-pain	-49.67±26.38	-37.68±28.26	0.101[1]
FFI-disability	-47.30±25.36	-36.15±24.67	0.072[1]
FFI-activity restriction	-15.83±9.71	-10.18±7.71	0.117[1]

SD: standard deviation, VAS: Visual Analog Scale, FFI: Foot Function Index; [1]Mann Whitney U test

Discussion

CS is often highlighted in the literature as a prevalent contributor to heel pain, which adversely affects quality of life and daily activities [21]. However, some studies have reported that CS is not directly associated with pain in PF and is often observed in asymptomatic individuals. While certain studies have indicated no meaningful association with the presence of CS and pain severity, others have emphasized that CS may exacerbate pain by increasing mechanical pressure on the plantar fascia [13,21-24]. The effects of CS on PF remain a subject of ongoing debate. Investigating the relationship between the presence of CS and treatment outcomes in PF represents an important gap in the literature and has the potential to make valuable contributions to this field, as it has not been previously studied. This study is unique in being the first to evaluate the impact of CS presence or absence on pain and functionality in PF patients treated with ESWT.

In our study, the average age of patients was 47.30±9.95 years in the non-spur group and 49.35±9.44 years in the spur group, with PF being more common in women in both groups. The findings align with the literature, which attributes the higher prevalence of PF in individuals aged 40–60 years to age-related atrophy of the heel fat pad and a reduction in water and collagen content. Additionally, the decreased elasticity of the plantar fascia due to the effects of estrogen further explains the higher prevalence in women [2,25]. Previous studies have reported a significant correlation between increased BMI and the development of PF [3]. Van Leeuwen et al. demonstrated that individuals with a BMI >27 kg/m² have an increased risk of developing PF [26]. In our study, the BMI values in both groups were above this threshold.

In our study, ESWT was found to be an effective treatment method, providing significant post-treatment improvements in pain and functional scores in both the spur and non-spur groups of patients with PF. However, the treatment effectiveness did not differ significantly between the groups. This result indicates that the effectiveness of ESWT is similar in both spur and non-spur groups. Similarly, Hermann et al. investigated the impact of CS size and length on treatment outcomes in PF patients undergoing low-dose radiotherapy, reporting no meaningful difference in treatment response between patients with spurs and those without spurs. However, better treatment outcomes were observed in patients with spurs smaller than 6.5 mm. The authors attributed the poorer treatment response in patients with longer spurs to the development of these spurs as a reaction to repeated vertical compressions, which may lead to tension-induced fissures in the plantar fascia. Over time, this process may reflect more advanced tissue degeneration, suggesting that longer spurs could exacerbate the severity of the underlying degenerative process, thereby negatively affecting treatment outcomes [27].

Zhou et al. evaluated the response to surgical treatment based on different CS types, categorizing spurs above the plantar fascia insertion as Type A and those within the fascia as Type B. The study revealed that surgical interventions achieved remarkable success levels for both CS types. Although the rate of improvement in pain and functionality was higher in the Type B group compared to Type A, this difference was not statistically significant [28].

Ahmad et al. investigated the responses to rehabilitation treatments based on horizontal, vertical, and hooked types of CS in their study. They observed more significant improvements in pain and functionality in patients with spurs larger than 5 mm. This finding may be attributed to differences in the demographic characteristics of the patient groups or the morphological features of the CS. For instance, the biomechanical resilience of the plantar fascia may influence the amount of stress exerted on the calcaneus during heel strike, which could be related more to individual variations rather than the size or type of the CS. Furthermore, whether CS is merely a reflection of degenerative processes or a contributing factor to these processes remains unclear. In our study, no classification was made based on CS types; instead, a comparison was made between the presence and absence of CS, and no significant difference in treatment response was recorded between the groups [14].

In the research carried out by Okçu et al., it was reported that CS size showed a significant correlation with pain severity and symptom duration. It was noted that ESWT was less effective in patients with CS smaller than 5 mm or vertical-type CS [13]. However, contrary to the findings in the literature, the absence of

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a significant difference in pain scores between the groups in our study suggests that the impact of CS on treatment outcomes may not always be a determining factor. Instead, it can be proposed that the effect of ESWT primarily aims to enhance the elasticity and mechanical stability of the plantar fascia. In individuals without CS, the influence of these mechanisms may be less pronounced, potentially limiting the treatment outcomes.

Tuncer et al. evaluated the effect of ESWT response in PF patients divided into three categories based on the angle formed by the CS and the calcaneus, reporting that improvements in pain and functionality after treatment were more pronounced in the group with the highest CS angle values [29].

Lee et al. evaluated the effects of ESWT treatment in patients with chronic PF, reporting an improvement rate of %82 in patients with spurs and 79% in those without spurs. However, no statistical comparison of improvement rates between the groups was conducted in that study. In contrast, our study evaluated the treatment responses between the groups with no statistically significant differences identified between them [30].

Study Limitations

One notable limitation of this study is its retrospective design, which inherently limits the ability to control for confounding variables and to establish causality. Additionally, the limited sample size may restrict the generalizability of the findings to larger populations. Increasing the sample size would improve the statistical power and strengthen the reliability of the findings. Another significant limitation is the absence of a control group. The application of ESWT to both the spur and non-spur groups limits the opportunity to compare the effectiveness of ESWT with other potential treatment modalities or a placebo. Future research with prospective designs, larger sample sizes, and the inclusion of control groups is essential to confirm and further explore these findings.

Conclusion

In conclusion, our study demonstrates that ESWT is an effective treatment option for both spur and non-spur PF patients, with no significant difference in treatment response between the two groups. This indicates that the presence of CS is not a determining factor in the effectiveness of ESWT. However, more extensive, controlled studies are required to gain a deeper understanding of the impact of CS size, type, and geometric characteristics on treatment outcomes.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
Ethical approval for the study was obtained from the Clinical Research Ethics Committee of Antalya Training and Research Hospital (approval number 16/2, date: October 24, 2024). The study was conducted in accordance with the principles of the 2013 Declaration of Helsinki.

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