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Original research

The association of calcaneal spur length and clinical and functional parameters in plantar fasciitis

Ersin Kuyucu [a, *], Figen Koçyiğit [b], Mehmet Erdil [a]

[a] Istanbul Medipol University, Faculty of Medicine, Department of Orthopaedics and Traumatology, Istanbul, Turkey
[b] Pamukkale University, School of Physical Therapy and Rehabilitation, Denizli, Turkey

HIGHLIGHTS

- Calcaneal spurs are present in 80% of the patients with plantar fasciitis.
- Calcaneal spur length is significantly correlated with age and BMI.
- Calcaneal spur length is significantly correlated with pain and foot function index score.

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ABSTRACT

Introduction: Plantar fasciitis (PF)is the most common cause of plantar heel pain. Despite many treatment alternatives for heel spur, the association of calcaneal spur size with clinical and functional parameters is inconclusive. The objective of this study to investigate the correlation of calcaneal spur length with clinical findings and functional status documented with Foot Function Index in patients with plantar fasciitis.

Methods: We performed power analysis for the sample size estimation. 87 patients with PF were scrutinized to reach the estimated patient number 75. Computer-aided linear measurements were done for spur length from tip to base in milimeters. Perceived pain intensity was evaluated by visual analog scale (VAS). Patients were asked to rate the pain experienced on a 10-cm VAS. Foot function index was applied to the patients to evaluate pain, disability and activity limitation of the patients.

Results: Of the 75 participants, 24 were males (32%) and 51 were females (68%). The mean age was 47 ± 10 years (range 30–65 years). The mean calcaneal spur length was 3.86 ± 3.36 mm (range between 0 and 12.2). Calcaneal spur length was significantly correlated with age ($p = 0.003$), BMI ($p = 0.029$), symptom duration, ($p = 0.001$) VAS ($p = 0.003$), and FFI total score ($p < 0.001$).

Discussion: Our study demonstrated that length of the calcaneal spur is significantly correlated with age, BMI, symptom duration, perceived pain, FFI pain and disability subscores, and FFI total scores.

Conclusion: The size of the calcaneal spur is an important parameter correlated with pain and functional scores in PF.

1. Introduction

Plantar fasciitis (PF) is the most common cause of plantar heel pain in adults [1]. It is estimated that more than 1 million patients seek treatment annually for this condition in United States [2]. Historically, PF was considered an inflammatory syndrome; however, recent studies have demonstrated a degenerative process [1]. Biomechanical overuse from prolonged standing or running, thus creating microtears at the calcaneal enthesis is responsible for the degeneration of the plantar fascia [3].

Osseous spurring of the plantar aspect of the calcaneus was first documented in 1900 by the German physician Plettner [4]. Anatomically, the plantar fascia originates from the medial tubercle of the calcaneus. The apex of the spur is superior to the plantar fascia in the origin of the flexor digitorum brevis muscle [5]. Repetitive microtrauma is important in the pathogenesis of calcaneal spurs. The presence of other risk factors like obesity, pes planus, pes

* Corresponding author. Istanbul Medipol Üniversitesi, TEM Avrupa Otoyolu Göztepe Çıkışı, No:1, Bağcılar, 34214, Istanbul, Turkey.
E-mail addresses: ersinkuyucu@yahoo.com.tr (E. Kuyucu), figen7876@yahoo.com (F. Koçyiğit), drmehmeterdil@gmail.com (M. Erdil).

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cavus accelerates the injury. Neovascularization and ossification of the resultant scar tissue form the calcaneal spur [6].

Previous studies reported that sub calcaneal spurs were also found in patients without PF. However, recent studies reported calcaneal spur presence in 75.9–89% of patients with plantar heel pain/PF [7,8]. Johal et al. investigated the presence of calcaneal spurs in patients PF and ankle sprain. They reported a significant correlation between calcaneal spur presence and PF. However the association between spur length and functional parameters was not reported in this retrospective study [7]. Akkaya et al. reported a correlation between calcaneal spur presence and functional parameters. Nevertheless the researchers did not explore the effect of spur size.

Therefore, current literature detailing the effect of calcaneal spur dimensions on clinical and functional parameters is inconclusive. Despite the indecisive reported importance of calcaneal spur presence and dimensions, there is a wide range of treatment alternatives for management of calcaneal spur. Therefore, it is important to clarify the effect of spur presence and dimensions on clinical and functional parameters.

The objective of our study is to investigate the correlation of calcaneal spur length with clinical findings and functional status documented with Foot Function Index in patients diagnosed as PF.

2. Materials and methods

The study was approved by the institutional ethics committee. All of the patients gave written informed consent. The study was conducted in accordance with Helsinki Declaration.

2.1. Study population

87 patients who were presented to the institutional outpatient clinic with a primary complaint of plantar heel pain were scrutinized for enrollment in the study to reach the estimated allocation number. Table 1 represents the inclusion and exclusion criteria.

The admission complaint of the involved patients was plantar heel pain. Diagnosis of PF is based on patient history, risk factors (pes planus, pes cavus, sedentary life style, obesity, prolonged walking/standing occupations), and physical examination findings (plantar fascia tenderness, heel pression test). Morning heel pain and tightness after standing up from bed is common in patients with PF. Typically, the heel pain will improve with ambulation [1].

2.2. Outcome measures

We questioned and recorded demographical parameters (age, gender, educational status, employment), dominant and involved sides, symptom duration of the patients. Weight and height were measured and recorded.

We applied heel pression test for diagnosis PF. The pressure was applied to the medial plantar region of the heel. If pain was elicited test was accepted positive. Plantar fascia was palpated for tenderness bilaterally. Other specific tests for neuroma, nerve entrapment, calcaneal stress fracture were performed to rule out these disorders. Comprehensive physical and neurological evaluations were performed to rule out lumbar radiculopathy, and myofascial pain syndrome is causing plantar heel pain.

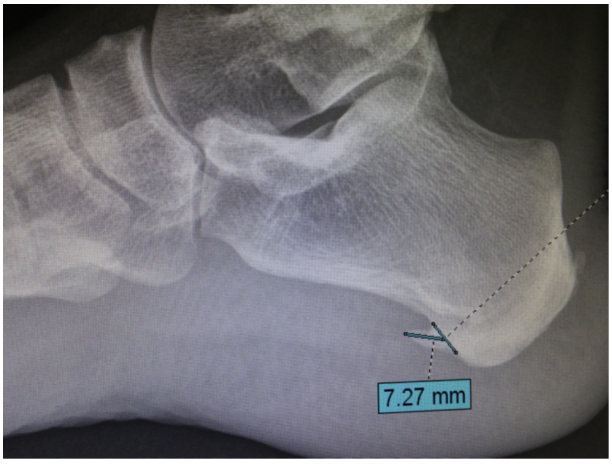

Fig. 1. Lateral calcaneal roentgenogram of demonsrates the calcaneal spur and the measurement method of calcaneal spur length. Two lines are demonstrated. One line demarcating the calcaneal border and another line from the calcaneal border to calcaneal tip.

Perceived pain intensity was evaluated by visual analog scale (VAS). Patients were asked to rate the pain experienced on a 10-cm VAS.

Foot function index (FFI) was applied to the patients to evaluate pain, disability and activity limitation of the patients. FFI is a self-administered questionnaire that was developed to assess effect of foot disorders on pain, disability and activity limitation. It consists of 3 subscales (pain, disability, and activity limitation) and 23 items. Higher FFI scores indicate poor foot health. It was mostly used in patients with rheumatoid arthritis and PF [9]. Validity and reliability of the Turkish version in PF was documented in 2014 [10].

Lateral calcaneal roentgenogram helps to evaluate bony lesions of the foot in PF although it is not routinely needed initially. Calcaneal spur, recalcitrant PF, calcaneal stress fractures may be visualized on lateral calcaneal roentgenogram [11,12]. We looked for these lesions on the roentgenograms. We recorded present lesions. For all roentgenograms where a spur was present, computer-aided linear measurements were recorded for spur length (mm) from tip to base as defined by a line demarcating the calcaneal border as described by Johal (Fig. 1) [7]. All of the measurements were made by the same researcher (EK).

2.3. Statistical analysis

We performed power analysis for the sample size estimation. Type I error (α) was set at 0.05 and power of the test was selected 0.90 and calculated sample size appropriate to test the hypothesis and have confidence was 75. Statistical analysis was performed with SPSS software, release 21.0 (SPSS Inc. an IBM Company, and Chicago, IL, USA). Standard descriptive statistics was used to

Table 1
Inclusion and exclusion criteria for the study.

Inclusion criteria	Exclusion criteria
Plantar heel pain diagnosed as plantar fasciitis	History of previous ankle/heel fracture/surgery
Requirement of lateral calcaneal roentgenogram for diagnosis and management of plantar fasciitis	Presence of adsorder that can affect foot function (Lomber radiculopathy, Achilles tendinitis, Morton Neuroma)
Age between 18 and 65 years	Presence of Inflammatory joint disease
Approval of inclusion in the study	Presence of anklylosing spondylitis or other inflammatory spondylarthropathies

summarize characteristics of the participants including means and standard deviations (SD) of all continuous variables and counts and percentages for the categorical variables. Pearson correlation coefficient (r) was used to compare calcaneal spur length to age, gender, BMI, symptom duration, presence of morning stiffness, heel pression test positivity, VAS, FFI pain score, FFI disability score, FFI activity limitation score, FFI total score. We defined two-sided statistical significance as $p<0.05$.

3. Results

84 patients with a primary complaint of plantar heel pain were scrutinized for enrollment in the study to reach the estimated participant number 75. In three patients, lateral calcaneal roentgenogram was not necessary for the management of the patient. Two patients had a physical examination findings representative of lumbar radiculopathy and were excluded. Two patients were diagnosed as ankylosing spondylitis and were also excluded. One patient had extracorporeal shock wave therapy (ESWT) for heel and one patient undergone heel corticosteroid injection and data from 75 patients were analyzed finally.

Of the 75 participants, 24 were males (32%) and 51 were females (68%). The mean age was 47 ± ten years (range 30–65 years). Table 2 shows other demographical parameters. PF was on the right side in 49 patients (52%) on the left side in 21 (28%) patients and bilateral in 15 patients (20%). The mean symptom duration was 31 ± 29 weeks (range 4–104 weeks). The mean calcaneal spur length was 3.86 ± 3.36 mm (range between 0 and 12.2). Mean VAS was 6 ± 2 (range between 3 and 10). 72 patients (96%) had morning stiffness. Heel pression test was positive in 48 patients (64%) where all patients demonstrated plantar fascia tenderness on palpation.

A Pearson correlation was run to determine the relationship between calcaneal spur length age, gender, BMI, symptom duration, presence of morning stiffness, heel pression test positivity, VAS, FFI pain score, FFI disability score, FFI activity limitation score and FFI total score. There was a strong, positive correlation between calcaneal spur length and VAS which was statistically significant ($r = 0.355$, $n = 75$, $p = 0.002$). Calcaneal spur length was also significantly correlated with age, BMI, symptom duration, FFI pain and disability subscores and FFI total score. Table 3 shows results of Pearson correlation analysis.

Table 2
Demographical Parameters of the study group.

Gender	
Female	51
Male	24
Educational status	
Primary school	45
Elementary school	9
High school and more	21
Employment Status	
Present employee	30
Unemployed	36
Retired	9
Presence of comorbidities	
None	64
Only one comorbidity	7
>1 comorbidities	4
Hand dominance	
Right	72
Left	3
Involvement	
Right	39
Left	21
Bilateral	15
Body mass index(kg/m^2)	
Normal weight (18.5–24.9)	5
Overweight (25–29.9)	36
Obesity (>30)	34
Total	75

4. Discussion

Our study demonstrated that length of the calcaneal spur is significantly correlated with age, BMI, symptom duration, perceived pain, FFI pain and disability subscores, and FFI total score. Despite clinical and radiological studies demonstrating a correlation between calcaneal spur presence and PF conclusive data about the association of spur size with perceived pain and functional scores is limited [7,11].

Previous studies reported calcaneal spur presence in 75.9–89% of the cases with PF. However the presence of calcaneal spurs in asymptomatic patients was reported in 16–46% in various studies [7,12]. We could not report data on the presence of calcaneal spurs in asymptomatic patients as it is not the focus of our study. However, we documented that calcaneal spurs were present in 80% of the patients with PF similar to reported ratios in the literature.

The presence of the calcaneal spur in asymptomatic individuals is expected according to currently accepted the degenerative process for PF development. The clinical course of PF may show exacerbations similar to osteoarthritis, another degenerative disorder. Therefore, calcaneal spurs may be present in calcaneal radiograms of patients in the asymptomatic phase of the disease.

A recent research reported a correlation between age and presence of the calcaneal spur. However, they did not observe a correlation between calcaneal spur presence and BMI, gender [8]. Irving et al. investigated factors associated with chronic plantar heel pain in a systematic review. They included 16 articles in their analysis and concluded that increased weight and increased age demonstrated some evidence of an association with plantar heel pain in non-athletic population [13]. We found that calcaneal spur length was associated with age and BMI similarly.

Morning pain and stiffness are important for the diagnosis of PF. The severity of morning pain and stiffness were used both for diagnosis and follow-up in previous studies [14,15]. All of the patients in our study reported morning stiffness. Moreover, length of the calcaneal spur was significantly correlated with morning stiffness.

Mean total AFI score of our patients was 95 ± 30. Rathleff et al. conducted a research to investigate the effectiveness of shoe inserts and plantar fascia specific stretching in patients with PF. The mean total FFI scores of the 48 patients included in their study were 78 ± 30 similar to our data [16]. Akkaya et al. explored the correlation between calcaneal spur presence and functional status. They evaluated functional status by - Rear foot Score of the American Orthopaedic Foot and Ankle Society (RFS). They reported a significant correlation with calcaneal spur presence and RFS score [8]. Score of the American Orthopaedic Foot and Ankle Society is used in a variety of degenerative and traumatic foot disorders [17]. Score of the American Orthopaedic Foot and Ankle Society was used in a limited number of studies in Turkey. However, the only index that was translated and adapted to Turkish according to International Society for Pharmacoeconomics and Outcomes Research is FFI [8,10,18]. We found a significant correlation between calcaneal spur length and FFI pain, disability subscores, and total score. The presence of permanent structural changes in the tissue and amount of these changes is expected to affect functions of the involved tissue in general. Our data supports this idea: the longer the calcaneal spur, worse the foot functions evaluated by FFI.

The prospective study design, sample size assessment with a power of 90%, measurement of calcaneal spur length by one and only experienced orthopedist, strict inclusion and exclusion criteria

Table 3
Pearson correlation analysis results of calcaneal spur length, FFI total score, VAS and clinical and demographical parameters.

Parameter	Spur length		FFI score		VAS	
	Correlation coefficient (r)	P Value	Correlation coefficient (r)	P Value	Correlation coefficient (r)	P Value
Age	0.338	0.003	0.217	0.018	0.115	0.324
Sypmtom Duration	0.377	0.001	0.271	0.043	0.920	0.018
VAS	0.337	0.003	0.866	<0.001		
FFI Pain Score	0.269	0.20	0.856	<0.001	0.862	<0.001
FFI Disability Score	0.452	<0.001	0.931	<0.001	0.766	<0.001
FFI Activity limitation Score	−0.009	0.939	0.277	0.016	0.106	0.365
FFI Total Score	0.416	<0.001			0.866	<0.001
BMI	0.253	0.029	0.337	0.003	0.353	0.002
Morning Stiffness	−0.216	0.063	0.110	0.345	0.243	0.036
Heel Pression Test	−0.156	0.181	−0.45	0.702	−0.170	0.883

VAS:Visual analog scale.
FFI:Foot function index.
BMI:body mass index.

are strengths of this study.

X-ray and calcaneal ultrasonography can document plantar fascia thickening. We did not evaluate plantar fascia thickness in our study population. This one of the limitations of our study.

The angle between the calcaneus and calcaneal spur, and the size of the calcaneal spur may also affect pain and functional scores in PF. Further studies investigating the other dimensional properties of the calcaneal spur are necessary.

In conclusion, our data showed that, the size of the calcaneal spur affects the perceived pain and foot functions in PF.

Ethical approval

The study was approved by Noninvasive Clinical Research Ethics Committee of Pamukkale University. The registration number of the study was 60116867020/1007.

Conflict of interest statement

No conflicts of interest to declare.

Registration research

0201007.

Author contribution

EK study design, data collection, writing.
FK study design, writing, data analysis.
ME study design, data analysis.

Guarantor

Ersin Kuyucu.

References

[1] P. Tu, J.R. Bytomski, Diagnosis of heel pain, Am. Fam. Physician 84 (2011) 909–916.
[2] D.L. Riddle, S.M. Schappert, Volume of ambulatory care visits and patterns of care for patients diagnosed with plantar fasciitis: a national study of medical doctors, Foot Ankle Int. 25 (2004) 303–310.
[3] J.L. Thomas, J.C. Christensen, S.R. Kravitz, et al., American college of foot and ankle surgeons heel pain committee. The diagnosis and treatment of heel pain: a clinical practice guideline-revision 2010, J. Foot Ankle Surg. 4 (2010) 1–19.
[4] P. Plettner, Exostosen des Fersenbeins. Jahresbericht der Gesellschaft für Natur und Heilkunde in Dresden, 1900.
[5] D.J. McCarthy, G.E. Gorecki, The anatomical basis of inferior calcaneal lesions. A cryomicrotomy study, J. Am. Podiatry Assoc. 69 (1979) 527–536.
[6] R. Mücke, K. Schönekaes, O. Micke, M.H. Seegenschmiedt, D. Berning, R. Heyder, Low-dose radiotherapy for painful heel Spur, Strahlenther Onkol. 179 (2003) 774–778.
[7] K.S. Johal, S.A. Milner, Plantar fasciitis and the calcaneal spur: fact or fiction? Foot Ankle Surg. 18 (2012) 39–41.
[8] S. Akkaya, N. Akkaya, N. Yıldız, N.S. Atalay, G. Fındıkoğlu, A. Sarsan, F. Şahin, The association of physical examination findingsand functional status with radiological and clinical variables in plantar heel pain, Romatol Tıp Rehab 21 (2011) 1–5.
[9] E. Budiman-Mak, K.J. Conrad, J. Mazza, R.M. Stuck, A review of the foot function index and the foot function index–revised, Foot Ankle Res. 6 (2013) 5.
[10] A. Yalıman, E.I. Şen, N. Eskiyurt, Budıman-mak e turkish translation and adaptation of foot function Index in patients with plantar fasciitis, Turk J. Phys. Med. Rehab 60 (2014) 212–222, http://dx.doi.org/10.5152/tftrd.2014.26086.
[11] M.T. DiMarcangelo, T.C. Yu, Diagnostic imaging of heel pain and plantar fasciitis, Clin. Podiatr. Med. Surg. 14 (1997) 281–330.
[12] H.R. Osborne, W.H. Breidahl, G.T. Allison, Critical differences in lateral X-rays with and without a diagnosis of plantar fasciitis, J. Sci. Med. Sport 9 (2006) 231–237.
[13] D.B. Irving, J.L. Cook, H.B. Menz, Factors associated with chronic plantar heel pain: a systematic review, J. Sci. Med. Sport 9 (2006) 11–22.
[14] Ilieva EM, Radial shock wave therapy for plantar fasciitis: a one year follow-up study, Folia Med. Plovdiv. 2055 (2012) 42–48.
[15] C.W. Wu, P. Zheng, J. Wu, J. Lu, A. Yan, Case-control study of stretching exercise on treatment of plantar fasciitis, Zhongguo Gu Shang 26 (2013) 297–301.
[16] M.S. Rathleff, C.M. Mølgaard, U. Fredberg, S. Kaalund, K.B. Andersen, T.T. Jensen, et al., High-load strength training improves outcome in patients with plantar fasciitis: a randomized controlled trial with 12-month follow-up, Scand. J. Med. Sci. Sports 25 (2014) 292–300, http://dx.doi.org/10.1111/sms.12313 (Epub ahead of print).
[17] S.J. Wei, F. Han, S.H. Lan, X.H. Cai, Surgical treatment of pilon fracture based on ankle position at the time of injury/initial direction of fracture displacement: a prospective cohort study, Int. J. Surg. 12 (2014) 418–425, http://dx.doi.org/10.1016/j.ijsu.2014.03.008.
[18] E. Kiter, E. Celikbas, S. Akkaya, F. Demirkan, B.A. Kiliç, Comparison of injection modalities in the treatment ofplantar heel pain: a randomized controlled trial, J. Am. Podiatr. Med. Assoc. 96 (2006) 293–296.