DOI: 10.4274/gulhane.galenos.2019.730
Gulhane Med J 2020;62:8-13

Evaluation of the radiotherapeutic management of refractory painful heel spur and plantar fasciitis: a single center experience of 45 years

Murat Beyzadeoğlu, Ömer Sağer, Ferrat Dinçoğlan, Selçuk Demiral, Bora Uysal, Hakan Gamsız, Fatih Özcan, Onurhan Çolak, Bahar Dirican

University of Health Sciences Turkey, Gülhane Faculty of Medicine, Department of Radiation Oncology, Ankara, Turkey

Date submitted:
30.05.2019
Date accepted:
19.12.2019
Online publication date:
15.03.2020

Corresponding Author:
Murat Beyzadeoğlu MD, University of Health Sciences Turkey, Gülhane Faculty of Medicine, Department of Radiation Oncology, Ankara, Turkey
mbeyzadeoglum@gmail.com

ORCID:
orcid.org/0000-0003-1035-7209

Keywords: Heel spur, plantar fasciitis, radiation therapy, refractory pain management

ABSTRACT

Aim: Heel spur is exostosis of the calcaneus. Plantar fasciitis and heel spur constitute a very common cause of plantar pain, which may be managed with radiation therapy (RT). In this study, we assessed the radiotherapeutic management of refractory painful heel spur and plantar fasciitis.

Methods: In this retrospective study, we report our single center experience with RT for refractory painful heel spur and plantar fasciitis management over a period of 45 years and describe patient and treatment characteristics.

Results: Between 1974 and 2019, a total of 4904 patients received RT at our department using cobalt-60 teletherapy machine for the management of refractory painful heel spur and plantar fasciitis. Out of the total 4904 patients, 2012 patients (41%) were male and 2892 patients (59%) were female. The median age was 51 (range: 41-85) years. All patients had received previous therapies for refractory painful heel spur and plantar fasciitis before the management with RT. Total RT dose was 8 Gy delivered in 2 consecutive days with daily fractions of 4 Gy using 2 opposing anterior-posterior RT fields to both heels without bolus material. Treatment response was assessed 3 to 5 weeks after the completion of RT. Response to RT was complete in 3579 patients (73%), partial in 1188 patients (24.2%), and none in 137 patients (2.8%). No therapy-related toxicity was observed in the whole series.

Conclusion: RT for refractory painful heel spur and plantar fasciitis may offer effective palliation of pain and may be considered as a viable therapeutic option for selected patients exhausted with other treatment modalities.

Introduction

Plantar fasciitis and associated bone formation, referred to as “plantar heel spur”, constitute a very common cause of plantar pain. Plettner, a German surgeon, was first to describe calcaneal spur in 1900 (1). Factors associated with plantar fasciitis include increased body weight, intensive workload and sportive activity and working on hard surfaces (2-4). Patient symptomatology typically includes stinging and severe heel pain with potential gait and mobility disturbances accompanied by worsened quality of life.

Several mechanisms are thought to play a role in the occurrence of pain from heel spur. Vertical compression leads to continual microtraumas and eventual degeneration of fascia at calcaneal insertion area, which is typically followed by inflammatory tissue reactions (5). Inflammation may result in thickening of the fascia along with exostotic bone formation as the heel spur. Staged development of heel spur has been described by Kumai and Benjamin (6). While patients with heel spur may typically suffer from severe pain, there may be cases without pain and also some patients with plantar fasciitis may present with pain albeit without radiographic evidence of heel spur formation. Diagnosis is based on history and physical examination findings with typical localization of pain (7). While sophisticated imaging techniques including ultrasonography or magnetic resonance imaging are not routinely utilized, radiographs may be used for showing heel spurs and facilitates

the exclusion of other diseases such as metastatic involvement of the bone.

Over a decade after its first description, several therapeutic modalities have been used for the management of painful heel spur and plantar fasciitis. Modification of life style to prioritize resting, losing weight and avoiding from intensive physical workload, analgesics, cold compresses, iontophoresis, antiinflammatory agent and steroid injections, stretching exercises and physical therapy, laser, microwave, ultrasound therapy, orthotics and shoe modifications, foot orthoses and insoles, heel pads, efforts to decrease pressure on the affected site, orthopedic interventions, and radiation therapy (RT) are among the methods for eradicating or alleviating pain from heel spur and plantar fasciitis (8-10). The use of foot orthoses and insoles may result in functional improvement and reduction of pain from plantar fasciitis and heel spurs (9,10).

RT has a long history in the management of painful heel spur and plantar fasciitis. Accumulated data from several centers have consistently reported effective palliation of painful plantar fasciitis and heel spur; however, dose fractionation schemes and treatment fields may vary among the institutions and are typically based on retrospective data and experiences (2,11-26).

In this study, we report our single center experience with RT for painful heel spur and plantar fasciitis management over a period of 45 years and describe patient and treatment characteristics including RT dose, fractionation, target volume, and pain response.

Methods

This retrospective study was conducted in accordance with the Code of Ethics of the World Medical Association, Declaration of Helsinki principles, and Uniform Requirements for manuscripts submitted to medical journals with the approval of Gülhane Faculty of Medicine, Radiation Oncology Department (date: 07.02.2020).

Informed consents of all patients were taken before RT.

A total of 4904 patients with painful heel spur and plantar fasciitis were treated at our institution over a period of 45 years between 1974 and 2019. All patients were referred for refractory painful heel spur and plantar fasciitis and had received previous medications including analgesics, cold compresses, iontophoresis, antiinflammatory agent and steroid injections, stretching exercises and physical therapy, laser, microwave, ultrasound therapy, orthotics and shoe modifications, heel pads, efforts to decrease pressure on the affected site and orthopedic interventions before RT. If available, imaging data of the patients were assessed for precise localization of plantar heel spur as shown in Figure 1.

Patient and treatment characteristics such as age, gender, RT dose and fractionation, toxicity and response to treatment were analyzed. Response to RT was stratified as no response, partial response, and complete response. Patients were simulated at X-ray 2D (dimensional) simulator available at our department. After 2D simulation for the designation of treatment portals and marking of the treatment fields on the patients' heels with permanent markers, setup of the patients was performed at cobalt-60 (Co-60) teletherapy unit with both soles apposing as shown on Figure 2. Total RT dose was 8 Gy delivered in 2 fractions using 2 opposing anterior-posterior (AP/PA) RT fields to both heels without bolus material (Figure 2). Treatment response was assessed 3 to 5 weeks after the completion of RT.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL) software (version 15.0) was used for analysis.

Figure 1. Plantar heel spur of a patient shown on radiograph

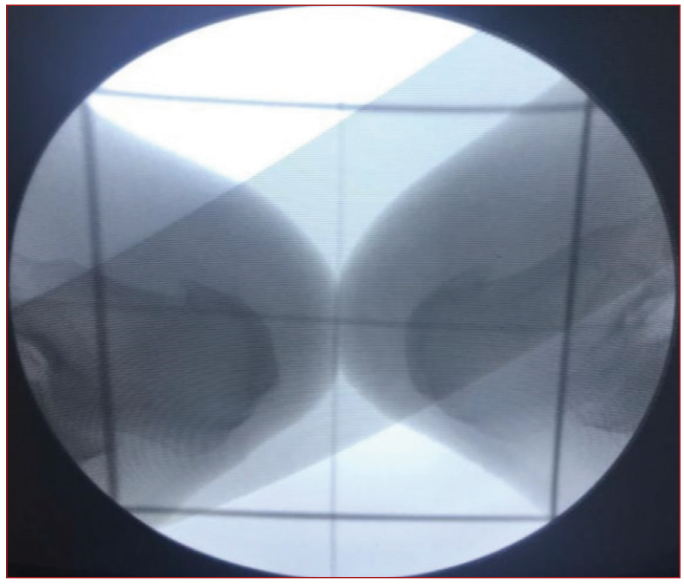

Figure 2. 2D simulation image showing treatment portal including bilateral heel spur

Descriptive statistics were used for the description of basic features of data in our study.

Results

Between 1974 and 2019, 4904 patients received RT for the management of refractory painful heel spur and plantar fasciitis. All patients were treated at our department using Co-60 teletherapy machine for refractory painful plantar fasciitis or heel spur. Patient characteristics, treatment characteristics and response are shown on Table 1 and Table 2, respectively.

Out of the total 4904 patients, 2012 patients (41%) were male and 2892 patients (59%) were female. The median age was 51 (range: 41-85) years. All patients had received previous therapies for painful plantar fasciitis or heel spur before RT. Total RT dose was 8 Gy delivered in 2 consecutive days with daily fractions of 4 Gy using 2 opposing AP/PA RT fields to both heels without bolus material. Treatment response was assessed 3 to 5 weeks after the completion of RT. Treatment response was complete in 3579 patients (73%), partial in 1188 patients (24.2%), and none in 137 patients (2.8%). No therapy-related toxicity was observed in the whole series.

Table 1. Patient characteristics

Patient characteristic	Number	%
Number of patients	4904	100
Male	2012	41
Female	2892	59
Median age (range)	51 (41-85) years	
Diagnosis		
Painful plantar fasciitis/heel spur	4904	100
Use of previous therapies	4904	100

Table 2. Treatment characteristics and response

Indication for RT Refractory painful plantar fasciitis/heel spur	4904 patients	100
RT dose per fraction	4 Gy	100
Total number of RT fractions	2	100
Total RT dose	8 Gy	100
Treatment length	2 consecutive days	100
Treatment modality EBRT	4904 patients	100
Treatment machine Co-60	4904 patients	100
RT technique Two opposing AP/PA RT fields including bilateral heels	4904 patients	100
Time period for treatment response assessment 3 to 5 weeks after completion of RT	4904 patients	100
Treatment response		
Complete response	3579 patients	73
Partial response	1188 patients	24.2
No response	137 patients	2.8

RT: Radiation therapy, EBRT: External beam radiation therapy, AP/PA: Anterior-posterior, Co-60: Cobalt-60

Discussion

Our study comprises a large series of patients treated over a long period of 45 years at a tertiary referral institution. Our single center experience confirms the efficacy of RT with Co-60 teletherapy machine for the management of refractory painful heel spur and plantar fasciitis.

Plantar heel spur has been defined as an exostotic bone formation localized at the insertion site of plantar fascia (1,12). While there is no established preponderance for gender in the literature, our series of 4904 total patients included more female patients than male patients. Typical age of presentation is over 40 years, which is consistent with our study population having a median age of 51 (range: 41-85) years. Affected patients may suffer from stinging and severe heel pain with potential gait and mobility disturbances accompanied by worsened quality of life. Repetitive microtraumas with resultant damage of the plantar aponeurosis and muscle insertions by excessive stress on the heels may have role in pathogenesis (27). Increased straining may stem from intensive sport activities, foot deformities, increased body weight, and working on hard surfaces (2-4,12,27-29). A plethora of treatments have been used for the management including modification of life style to prioritize resting, losing weight and avoiding from intensive physical workload, analgesics, cold compresses, iontophoresis, antiinflammatory agent and steroid injections, stretching exercises and physical therapy, laser, microwave, ultrasound therapy, orthotics and shoe modifications, heel pads, efforts to decrease pressure on the affected site, orthopedic interventions, and RT.

Traditionally, RT has been reserved for refractory cases due to concerns about adverse radiation effects such as carcinogenesis (15). While several countries in Europe have adopted RT for the management of several benign conditions including musculoskeletal, degenerative, and inflammatory disorders with encouraging treatment outcomes, the use of RT for nonmalignant benign conditions have been considered skeptical as well by several centers (15,30-34). Besides its utility in the management of several cancers throughout the whole human body, ionizing radiation may induce mutations and carcinogenesis. However, no carcinogenesis was reported in our series, and decision making for management with RT should be individualized based on a harm to benefit ratio (35). Mechanism of action for RT has been extensively studied, and may be possibly through modulating the intensity of inflammation along with possible neurolysis of the sural and posterior tibial nerves

responsible for dominant pain through the obstruction of the capillaries nourishing these nerves (8,15,16,36-38).

Several trials have been conducted to assess the utility of low dose irradiation in the management of heel spur and plantar fasciitis (11-26). While the exact mechanism of pain relief by irradiation is an area of research, RT may also induce a placebo effect in some patients (24). In terms of dose and fractionation, there is no standard fractionation scheme for the irradiation of painful heel spur and plantar fasciitis. Several dose-fractionation schemes have been evaluated, and total delivered doses in the range of 3 to 12 Gy have been found to be effective (24). In the study by Seegenschmiedt et al. (11), 3 dose-fractionation schemes were comparatively assessed, and 10x0.5 Gy to a total dose of 5 Gy was reported to be superior than 10x0.3 Gy to a total dose of 3 Gy and 12x1 Gy to a total dose of 12 Gy in terms of pain relief. In the retrospective study by Mücke et al. (12) assessing low dose irradiation for the management of painful heel spur in 117 patients, over 80% of the patients benefited from RT. The authors suggested commencing RT within 6 months of symptom onset to achieve effective pain palliation (12). Micke et al. (13) reported the results of a national patterns of care study from German. The study included a very high number of cases treated with RT for painful heel spur syndrome in several centers of Germany, and confirmed the safety and efficacy of irradiation for this indication (13). Complete relief of pain over 3 months has been achieved in median 70% (range: 25%-100%) of all treated patients (13). Persisting pain relief for at least 1 year has been reported in median 65% (range: 19%-99%) of the patients (13). The median percentage of patients without symptomatic improvement was 15% (range: 5%-50%), and no toxicity or secondary cancers have been reported during the follow-up period (13). Vast majority of radiation oncologists participating in the national survey has considered RT as a viable and essential treatment indication for painful heel spur syndrome (13). Schwarz et al. (14) assessed the use of single fraction RT for heel spur and plantar fasciitis, and concluded that irradiation with single fraction might be further investigated in future trials. Heyd et al. (16) prospectively evaluated 130 patients in a randomized study and found comparable results with both fractionation schemes of 6x0.5 Gy and 6x1 Gy. In a study by Niewald et al. (19), two fractionation schemes of 6x1 Gy and 6x0.1 Gy were comparatively assessed, and a total dose of 6 Gy delivered in 6 fractions of 1 Gy each was found to achieve superior pain relief than 6x0.1 Gy. Hermann et al. (20) assessed the effect of field size and plantar spur length on the outcome of RT for plantar fasciitis management. They reported that patients with short heel spurs benefited from RT equally as patients with no radiological evidence of spur (20). Also, they reported that the use of smaller field sizes was also effective and could be used for minimizing exposure of normal tissues (20). Koca et al. (21) reported the results of 62 patients treated using a Co-60 teletherapy machine. Their series of 62 patients included 53 female and 9 male patients with female preponderance consistent with our series (21). With a total dose of 8 Gy, response to RT was reported to be no response in 21%, partial response in 21%, and complete response in 58% of the total 62 patients (21).

Although irradiation for painful heel spur and plantar fasciitis has been considered as a last resort treatment traditionally, there is accumulating data supporting the utility of RT for the management of pain from heel spur and plantar fasciitis (2,11-26). Our study adds to the literature with high number of patients treated using a standard treatment machine and uniform dose-fractionation scheme at a single institution over 45 years. Since our results reveal satisfactory pain relief by the use of RT without treatment-related toxicity and secondary malignancies in accordance with the literature, we conclude that RT is safe and effective for the management of refractory painful heel spur and plantar fasciitis management. Clearly, comparative evaluation of different modalities for this indication in future studies may shed light on optimal decision making for the management of patients with painful heel spur and plantar fasciitis.

Conclusion

Our single center experience confirms the efficacy of RT for the management of refractory painful heel spur and plantar fasciitis. RT offers a non-invasive treatment modality and should be considered as a viable therapeutic option for this indication. Without downsizing of the spur, RT achieves effective pain relief which is a major cause of deterioration in quality of life. Future studies are warranted to assess the comparative efficacy of different modalities in the management of painful heel spur and plantar fasciitis.

Ethics

Ethics Committee Approval: This retrospective study was conducted in accordance with the Code of Ethics of the World Medical Association, Declaration of Helsinki principles, and Uniform Requirements for manuscripts submitted to medical journals with the approval of Gülhane Faculty of Medicine, Radiation Oncology Department (date: 07.02.2020).

Informed Consent: Informed consents of all patients were taken.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: M.B., Ö.S., S.D., H.G., F.Ö., B.D., Design: Ö.S., F.D., S.D., H.G., F.Ö., B.D., Data Collection or Processing: M.B., Ö.S., F.D., S.D., B.U., H.G., F.Ö., O.Ç., B.D., Analysis or Interpretation: M.B., Ö.S., S.D., B.U., H.G., O.Ç., B.D., Literature

Search: M.B., Ö.S., F.D., B.U., B.D., Writing: M.B., Ö.S., F.D., B.U., B.D.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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