Low-Dose Radiotherapy for Painful Heel Spur

Retrospective Study of 117 Patients

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Purpose: Retrospective analysis of 117 patients treated between 1996 and 2000 with low-dose radiotherapy (RT) for painful heel spurs.
Patients and Methods: 71 women and 46 men were irradiated on 136 painful heel spurs in one (n = 104) or two radiation series (n = 13). The painful spurs were located either at the plantar (n = 94), dorsal (n = 5) or bilateral heel (n = 18). 82 patients had prior treatments, in 35 patients RT was the primary treatment. Low-dose RT was performed twice a week with one 6-MV photon field. Ten fractions of 0.5 Gy were applied to a total dose of 5 Gy. Evaluation was done on completion and during follow-up using the four-scale von Pannewitz score.
Results: On completion of RT, 27 patients were free of pain, 40 were much improved, 31 reported slight improvement, and 19 experienced no change. After a mean follow-up of 20 months, 75 out of 100 patients were free of pain, twelve had marked and three some improvement. Ten patients reported no change of symptoms. Mean duration of pain before RT was 6 months. RT applied ≤ 6 months after the onset of clinical symptoms resulted in improvement in 94%. By contrast, an interval of > 6 months until the initiation of RT resulted in only 73% of patients with clinical improvement.
Conclusion: Low-dose RT reveals a benefit in > 80% of the patients. RT should start during the first 6 months of symptoms. Prospective clinical studies with validated symptom scores should be conducted to assess optimal dose and fractionation scheme of RT.

Key Words: Benign disorder · Painful heel spur · Low-dose radiotherapy · 6-MV photons

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Strahlentherapie des schmerzhaften Fersensporns. Eine retrospektive Analyse von 117 Patienten

Ziel: Analyse der analgetischen Radiotherapie (RT) von 117 Patienten mit schmerzhaftem Fersensporn, die von 1996 bis 2000 behandelt wurden.
Patienten und Methodik: 71 Frauen und 46 Männer mit einem Altersmedian von 58 Jahren (30–84 Jahre) und 136 Fersensporn (links n = 43, rechts n = 55, beide n = 19) wurden in einer (n = 104) oder zwei Serien (n = 13) bestrahlt. 94-mal lag ein plantarer, fünfmal ein dorsaler und 18-mal ein beidseitiger Fersensporn vor. 82 Patienten berichteten über vorher durchgeführte Therapien, bei 35 Patienten wurde die RT als erste Maßnahme eingesetzt.
Die RT erfolgte zweimal pro Woche mit einem 6-MV-Photonen-Stehfeld mit 0,5 Gy Einzeldosis bis zu einer Gesamtdosis von 5,0 Gy. Die Therapieergebnisse wurden am Ende und aktuell nach dem Von-Pannewitz-Score bewertet (Tabelle 1).
Ergebnisse: Direkt nach RT waren 27 Patienten schmerzfrei, 40 Patienten gaben eine wesentliche Besserung, 31 Patienten eine leichte Besserung sowie 19 Patienten keine Beeinflussung an (Tabelle 1). Mit einem medianen Follow-up von 20 Monaten (1–63 Monate) waren 03/2001 von 100 untersuchten Patienten 75 schmerzfrei, zwölf gaben eine wesentliche Besserung, drei eine Besserung und zehn keine Beeinflussung an (Tabelle 1). Bei einer medianen Schmerzdauer vor RT von 6 Monaten (1–60 Monate) führte der Beginn der RT im Intervall ≤ 6 Monate (n = 70) bei 94,2% zu einer Schmerzkontrolle, im Gegensatz dazu im Intervall > 6 Monate (n = 30) bei 72,8% (Abbildung 1).
Schlussfolgerung: Die RT mit 6-MV-Photonen ist bei über 80% der behandelten Patienten langfristig erfolgreich. Die RT sollte innerhalb der ersten 6 Monate nach Symptombeginn erfolgen. Weitere prospektive Untersuchungen mit validierten Scores sollten durchgeführt werden.

Schlüsselwörter: Schmerzhafter Fersensporn · Strahlentherapie · 6-MV-Photonen

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Introduction

The term "heel spur" was first described by the German surgeon Plettner in 1900 who used the anatomic term "Kalkaneussporn" (English: calcaneal spur). He described, in his radiomorphologic study, the exostotic plantar bone formation at the insertion of the plantar fascia and muscles of the calf (cited in [42]) which is termed nowadays "plantar heel spur". By contrast, the exostosis at the insertion of the Achilles tendon is called "dorsal heel spur". The latter exostosis develops less often and is asymptomatic in a higher percentage. A combination of both spurs is possible. Bilateral manifestations can be observed in many cases. The overall prevalence is estimated between 8% to 10% [31]. Data on the male/female ratio vary in a large range [15, 40]. Patients are usually > 40 years. Most spurs have a dimension of 4–6 mm length, but larger spurs are possible. No correlation exists between the length of the spur(s) and the extent of the clinical symptoms. Typical symptoms consist of a stinging and sometimes extensive pain under the heel which may extend or radiates into the lower leg. Usually, gait and mobility are markedly impaired. A typical finding is the localized pain at the medial and distal aspect of the tuber calcanei.

Chronic damage or continuous microtrauma to the insertion of the plantar aponeurosis and the small foot muscles due to increased strain plays an important role in the pathogenesis. The increased strain may be a result of foot deformity, obesity, or extensive sports activities [36, 49]. The chronic damage is followed by a decreased elasticity of the insertional cartilage. Gaps in the impaired cartilage are invaded by mesenchymal cells which form scar tissue. After new vessels have developed, the scar slowly ossifies which can lead to the growing bony spurs [42].

The treatment follows the principles of therapy for osteoarthritis: decreasing weight burden by means of orthopedic shoes or insoles, local infiltration with corticoid crystal suspensions, and local anesthesia. Systemic nonsteroidal anti-inflammatory agents (NSAIDs), iontophoresis, microwave and ultrasound applications are common treatment modalities [3, 7]. Different surgical techniques are also in use [3]. Although radiotherapy (RT) is known for good results in heel spurs and other musculoskeletal degenerative and inflammatory entities [34] in the past, the decision for RT is still regarded as "last resort" approach to treat refractory cases.

The goal of this retrospective clinical study was to analyze the therapeutic effect of irradiation with 6-MV photons immediately after completion of RT and during follow-up and to identify possible prognostic factors.

Patients and Methods

At the Department of Radiotherapy, Radiooncology and Nuclear Medicine, Weiden Hospital, Germany, a total of 117 patients (71 female, 46 male) with painful heel spurs were treated between January 1996 and December 2000. Median age was 58 (range: 30–84) years. 104 patients received a single RT series, 13 patients a second RT series after 3 months.

136 heel spurs were treated (43 left, 55 right foot, 19 both feet). 112 were located at the plantar and five spurs at the dorsal heel. All lesions were radiographically detectable. 82 patients (70%) received treatments prior to RT: local analgesic injections (n = 42; 36%), orthopedic insoles (n = 18; 15%), NSAIDs (n = 13; 11%), and physiotherapy (n = 8; 7%). One patient had prior surgery (1%). In 35 cases (30%), RT was the primary treatment. The indication for RT were clinical symptoms like pain in typical locations and functional deficit with decreased range of pain-free motion.

Treatment portals were simulated and included the whole calcaneus and the insertion of the Achilles tendon. The dose maximum was in 1.6 cm depth when using 6-MV photons. RT was given twice weekly with a single portal and ten fractions of 0.5 Gy up to 5 Gy total dose. Patients treated with a second RT series received the same single and total dose. Clinical outcome was assessed by means of the von Pannewitz score (Table 1) [35]. All patients were assessed at the end of RT. Follow-up was completed in March 2001 with a median of 20 (range: 1–63) months. A total of 100 patients provided all data required for full clinical assessment. At each follow-up visit (immediately after RT and during follow-up), acute or chronic side effects were recorded. Statistical analysis was done using the SPSS program.

Results

Table 1 summarizes the results. At the end of RT, 27 patients (23%) were free of pain, 40 patients (34%) experienced marked improvement, 31 (27%) some improvement, and 19 patients (16%) felt no change. Because of persistent complaints 13 patients (11.1%) received a second course of RT after 3 months.

Follow-up data were available for 100 patients with a median of 20 (range: 1–63) months. 75 patients were free of symptoms, twelve reported substantial improvement, and some improvement was observed by three patients. Ten patients had no change. With regard to the number of RT series, 78 of 88 patients (86.6%) who underwent a single RT series had pain control compared to nine of 13 patients (69.2%) with two RT series. Pain control (free of pain, considerable and some improvement) was achieved by 86% (Kaplan-Meier method) among 100 patients.

Table 1. Results at the end of radiotherapy and time of data analysis according to the von Pannewitz score [35].

Tabelle 1. Ergebnisse zum Ende der Strahlentherapie und Zeitpunkt der aktuellen Datenerhebung nach dem Von-Pannewitz-Score [35].

Result	Patients (n = 117) at the end of radiotherapy	Patients (n = 100) at the time of data analysis
Complete pain relief	27 (23.1%)	75
Markedly improved	40 (34.2%)	12
Slightly improved	31 (26.5%)	3
Unchanged	19 (16.2%)	10

Mean duration of symptoms was 6 (range: 1–60) months before onset of RT. Treatment onset within the first 6 months of symptoms (n = 70) led to pain control in 94% of patients. RT given > 6 months after the beginning of clinical symptoms (n = 30) resulted in pain control in 73% of cases (p = 0.045; Figure 1). Patients with one RT series (n = 88) had pain control in 93%. Patients who required a second RT course (n = 12) had pain control in 73%. Acute and chronic radiation side effects did not occur in any of our patients during the follow-up time.

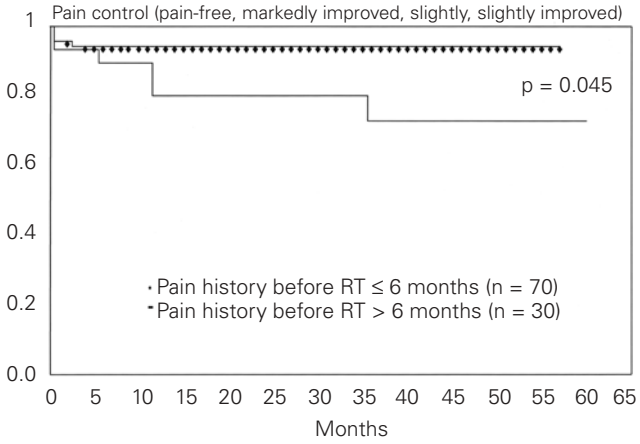

Figure 1. Univariate analysis (log-rank) for pain control (60 months) depending on duration of pain history: upper curve: ≤ 6 months, lower curve: > 6 months.

Abbildung 1. Univariate Analyse (Log-Rank) der Schmerzkontrolle (60 Monate) in Abhängigkeit von der Schmerzdauer: obere Kurve: ≤ 6 Monate, untere Kurve: > 6 Monate.

Discussion

There is a long tradition for RT of benign – degenerative or inflammatory – lesions [1, 24, 26, 27, 34, 35, 39, 45]. RT of benign diseases accounts for 8–10% of all RT procedures in Germany. As much as 70% of these indications represent painful disorders in the locomotor system [42]. In several studies, the good response of patients with heel spurs is emphasized. Numerous studies have described the effectiveness of RT under orthovolt as well as megavolt conditions [2, 9, 14, 23, 29, 33–35, 39, 40, 43, 45, 50] (Table 2). The improvement rate in these studies was 65–100%.

Unfortunately, the descriptions of the patient collectives and possible influencing factors in some reports are not very precise. Moreover, different evaluation scores were used in the past. Our results with a subjective improvement rate (free of pain, markedly improved, and improved) of 84% immediately after RT seem to confirm previous studies. After a fast initial pain relief, the effect lasts up to several years. In our study, 75% of patients reported no residual pain after a median follow-up of 20 (range: 1–63) months. Although only a few studies report long-term results, our data confirm long-term data by Schäfer et al. [40] and Lindner & Freislederer [26].

In one prospective study, different RT dose regimens were evaluated. In 72 cases a total dose of 12 Gy was applied (two series of 6 × 1 Gy over 2 weeks), 50 patients received 10 × 0.3 Gy and 48 cases 10 × 0.5 Gy. Best response was achieved with a total dose of 5 Gy given in 0.5 Gy single doses. Higher doses with 3 × 1 Gy per week up to 12 Gy total dose did not improve the response rate. In long-term follow-up, 5 Gy and 12 Gy proved to be better than a total dose of 3 Gy with a single dose of 0.3 Gy [45]. Single doses < 0.3 Gy are not recommended, as this dose is regarded as threshold for tissue alkalosis which some authors see as the underlying cause for

Table 2. Review of the literature.

Tabelle 2. Literaturübersicht.

Reference	Patients (n)	Heels (n)	Type of RT	Response rate (%)	Complete pain relief (%)	Markedly improved (%)	Unchanged (%)
Pannewitz (1933) [35]	88	88	Orthovoltage	92			
Mitrov & Hargov (1967) [33]	1,520	1,520	Orthovoltage	88	50	38	12
Zschache (1972) [50]	49	49	Orthovoltage	86	12	74	14
Mantell (1978) [29]	17	26	240–300 KV	65	53	12	35
Basche et al. (1980) [2]	102	102	120 KV	90	32	58	10
Sautter-Bihl et al. (1993) [39]	15	15	Cobalt	80	60	20	20
Schäfer et al. (1995) [40]	18	21	Highvoltage	67	58	8	33
Seegenschmiedt et al. (1996) [45]	141	72 pat. 12 Gy 98 pat. 3–5 Gy	200–250 KV	100 95	67 72	33 23	0 5
Oehler & Hentschel (2000) [34]	212	258	Orthovoltage	88	81	7	12
Koeppen et al. (2000) [23]	673	673	250 KV	78	13	65	22
Schreiber et al. (2000) [43]	70	87	6 MV	86	67	29	14
Heyd et al. (2001) [14]	105	127	6 MV	88	46	42	12
Glatzel et al. (2001) [9]	141	161	175 KV	89	63	26	11

pain relief [37]. Most authors recommend single doses of 0.3–0.5 Gy up to total doses of 3–6 Gy [2, 23, 33, 40, 45, 49]. So far, no better response rates have been observed with higher single or total doses [45, 48].

A placebo effect of RT for pain treatment is possible. So far, there are no data available for treatment of heel spurs. In one double-blinded study by Goldie et al. [10] from the 1970s, different degenerative skeletal diseases (among them nine heel spurs) were treated and analyzed. Response rates for treated and untreated patients were 68% and 64%, respectively. Effectiveness of RT was considered questionable. These data are in contrast to recent retrospective and prospective studies (Table 2). A double-blinded study using sham irradiation could answer this question. Also, a comparison of RT with other competing treatments like shock-wave therapy (lithotripsy) is still lacking [12]. For the latter modality, a long-term improvement in two thirds of all patients has been reported [28, 46]. For these treatments, prospective studies should be conducted.

The precise pathophysiologic mechanisms of pain relief after RT remains unclear. Arthritis models using rabbits revealed an anti-inflammatory effect with decreasing synovitis after irradiation [47]. Other studies describe an influence on the vascular endothelium with improved tissue perfusion; destruction of inflammatory cells (especially lymphocytes) with release of cytokines and proteolytic enzymes; modulation of the vegetative nervous system; altering of the tissue pH; increased membrane permeability [26, 30, 47, 48]. Recent studies showed, that there are also effects of low-dose ionizing radiation on the molecular and cellular level involving adhesion molecules, cytokine expression, and inflammation cascade [16–18, 21, 32, 38]. Most likely, irradiation acts not through a single mechanism but through a complex interaction of different effects.

Radiation side effects did not occur in any of our patients. This corresponds to the reported absence of chronic or acute adverse effects in the literature (Table 2). Some authors describe an initial increase of pain symptoms after the first dose fractions [14, 26]. This is attributed to a transient local acidosis [11, 19, 26, 41].

Many colleagues from non-radiotherapy specialities are reluctant to recommend RT due to concerns about potential damage to gonads or tumor induction. However, so far, no increased tumor rate has been reported in the literature for the chosen dose range [8, 22, 25, 39]. In a literature review by Kim et al. [22] and Brady [4], no osteosarcoma had been described after a fractioned application of 30 Gy over 3 weeks. Johansson et al. [20] reported that the mean absorbed dose in red marrow is estimated at 0 for patients in whom only distal parts of extremities were irradiated. It seems useful to recall the epidemiologic evidence that the attributable carcinogenic lifetime risk is considerably smaller at older age than earlier in life [5, 6, 8].The applied gonad dose during the treatment of heel spurs is in the range of diagnostic imaging [13]. When standard radiation protection measures are taken (minimal field size, gonad shields, etc.), the risk of RT in this subpopulation of mostly elder patients can almost be neglected. Younger patients should be treated only in very exceptional cases and after careful evaluation of the potential risk compared with the expected benefit. The risk of medical treatments like NSAIDs should also be taken into account.

Duration of pain before initiation of RT was a prognostic factor for treatment failure in univariate analysis. Pain control was 94% after a disease record of ≤ 6 months compared to 73% after a disease record of > 6 months ($p = 0.045$). This finding is confirmed by Seegenschmiedt et al. [45]. Another prognostic factor for treatment failure was the response after the first RT course. 13 of 19 patients with no change after completion of the first RT series required a second RT series. Treatment response should be evaluated at 3 months follow-up as improvement can be delayed [45].

Conclusion

Radiotherapy with 6-MV photons is effective in > 80% of patients with painful heel spur. No side effects have been observed. RT should not be regarded as "last resort", but should begin during the first 6 months of symptoms. Controlled prospective studies should assess the effect of RT by comparison with sham treatments to assess the possible role of placebo effects.

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