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### Case report

# Total calcaneotomy for metastasis of renal cell carcinoma in the calcaneus: A case report

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#### ABSTRACT

We present a rare case of metastasis of renal cell carcinoma to the calcaneus in a 59-year-old man who presented with pain and inability to bear weight on the left foot 3 years after right nephrectomy for renal cell carcinoma. He successfully underwent en bloc resection of his right calcaneus with a limb salvage procedure, total calcaneotomy without bony reconstruction. Histological findings identified the lesion as a metastasis originating from a renal cell carcinoma. Recent follow-up examination showed no recurrence. To the best of our knowledge, this is the first reported case to be treated with total calcaneotomy for renal cell carcinoma metastasis.

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## 1. Introduction

For renal cell carcinoma (RCC), the most frequent metastatic localizations, in order of frequency, are the lungs, bones, liver, lymph nodes, adrenals, and brain. In the case of bone metastases, the spine (80% of localizations) and the long bones (10%) are most commonly involved; the distal bones of the feet are very rarely involved [1]. The incidence of foot and ankle metastases is approximately 2% of all skeletal metastasis [2,3].

Limb salvage surgery has become an established alternative to amputation in the treatment of bony metastatic carcinoma or primary malignant bone tumors in the extremities. However, the occurrence of bony metastatic carcinoma in the calcaneus continues to be one of the most challenging areas to treat. Total calcaneotomy may provide better quality of life than other more proximal amputations such as Syme or transtibial amputation although there is no report about total calcaneotomy for bony metastatic carcinoma.

Reconstruction following total calcaneotomy for primary malignant tumor in the calcaneus is combined with reconstruction using an allograft or vascularized graft [4–16]. However, a few reports have described total calcaneotomy for primary malignant tumor without bony reconstruction [17–19], which is less invasive

than reconstruction. Moreover, there is no report about total calcaneotomy for bony metastatic carcinoma.

This is the first report to describe total calcaneotomy performed for a rare metastasis of RCC to the left calcaneus. After calcaneotomy without bony reconstruction was successfully performed as a limb salvage procedure, recovery including wound healing was quick.

## 2. Case report

A 59-year-old man was referred to our department with a 4-month history of pain, diffuse swelling of the left heel, and inability to bear weight on the left leg, 3 years after he underwent right nephrectomy for clear cell RCC (TNM classification; cT3a-bN0M0) followed by postoperative adjuvant chemotherapy (axitinib). His symptoms had progressively worsened since approximately 1 month. The pain and swelling of the left heel had worsened despite the use of over-the-counter and prescription anti-inflammatory drugs and physiotherapy sessions. Physical examination revealed a narrow range of motion of the left ankle, as well as hindfoot edema and tenderness over the heel with ecchymosis. No distal neurovascular deficit was noted.

A lateral radiograph of the left heel revealed a lytic lesion involving the entire calcaneus, with an osteolytic appearance (Fig. 1). Computed tomography (CT) showed a tumor measuring 7.5 × 4.9 × 5.4 mm, with the lytic lesions localized to the calcaneus with cortical erosion (Fig. 2a–c). Magnetic resonance image (MRI) scans showed an expansive lesion with irregular borders. In T1-weighted images, the entire tumor showed relatively homogeneously low intensity (Fig. 3a). T2-weighted images revealed

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**Fig. 1.** Preoperative lateral radiograph of the left foot showed a lytic lesion involving the entire calcaneus, with a cystic appearance.

low intensity within the tumor, while the marginal intensity was high (Fig. 3b). In the short T1 inversion recovery (STIR) images, the entire tumor showed heterogeneously high intensity (Fig. 3c). A triphasic bone  $^{99m}\text{Tc}$ -MDP scintigraphic scan showed an increased area of uptake in the region of the left calcaneus (Fig. 4). The preoperative diagnosis, based on the aforementioned clinical and imaging examinations, was metastasis of RCC in the calcaneus, without even biopsy. We decided to perform total calcanectomy for this metastasis, because Ratasvuori et al. reported that en bloc resection of solitary metastases was associated with a significantly longer survival in kidney cancer [20], and preservation of skin and soft tissue was possible during surgery. The patient underwent total calcanectomy without reconstruction, as described by Madhuri et al. and Geertzen et al. [18] and Madhuri et al. [19], using the Cincinnati approach [21], which involved a horizontal approach to the lateral malleolus. This approach allowed wide exposure of the subtalar surface of the calcaneus and clear access to all areas of the calcaneus for careful extraperiosteal excision with preservation of adjacent soft tissue margins (Fig. 5). No vascular invasion or capsular extension of the tumor was observed.

The triceps surae function was preserved by attaching the Achilles tendon to the posterior surface of the talus using a suture anchor system (Depuy Mitek, Inc., Raynham, MA) (Fig. 6). The distal end of the Achilles tendon was sutured to plantar soft tissue including heel fat pad. Histopathological analysis of the resected specimen revealed a tumor composed of small round cells with scanty cytoplasm (Fig. 7); this confirmed the diagnosis of clear cell RCC. The specimen exhibited no tumor cells at its wide resection margins.

Postoperatively, immobilization with a below-knee cast was carried out for 6 weeks, and the patient was allowed to bear weight to tolerance with crutches following surgery. There was no evidence of tumor recurrence locally as examined with postoperative radiographs at the latest follow-up, 1 year after surgery. Examination of the left ankle showed  $5^\circ$  dorsiflexion and  $25^\circ$  plantarflexion. Although slight pain in the midfoot and remaining hindfoot persisted postoperatively, the patient could walk without aid for short distances, although a prosthesis, such as an insole in the customized orthopedic shoe, was necessary for walking long distances (more than 600 m without rest). Lower extremity Musculoskeletal Tumor Society (MSTS) score improved from overall 3/30 (pain 0/5, function 0/5, emotional 1/5, supports 0/5, walking 2/5, gait 0/5) to 20/30 (pain 4/5, function 2/5, emotional 3/5, supports 4/5, walking 4/5, gait 3/5).

The patient provided informed consent for this report.

### 3. Discussion

Metastatic disease in the foot and ankle is rare. Lung is the most common single organ (22.7%) to be affected by metastases, followed by the kidney (14.4%) and breast (9.6%) [2]. With regard to the incidence of bone involvement in foot metastases, the calcaneus is the most commonly involved (31.1%), followed by the phalanges (26.3%) and metatarsals (25.3%) [2]. Thus far, only 7 cases of RCC metastasis in the calcaneus have been reported in detail in 6 papers (Table 1) [1,22–26]. To the best of our knowledge, this is the first case report to describe total calcanectomy for metastasis of RCC in the calcaneus.

The operative treatment of bony metastatic carcinoma in the calcaneus poses a therapeutic dilemma. Below-knee or Syme amputation has often been applied for bony metastatic carcinoma of the foot [2,27], although a limb salvage surgery for malignant tumors tends to be tried because patients do not want to accept an amputation. It has been reported that amputations lead to



**Fig. 2.** Preoperative CT scan of the left foot showed marked osteolysis of the calcaneus in the coronal (a), axial (b), and sagittal (c) views.

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