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Case Report

The Limb We Refused to Lose: Minimally Invasive Suction Curettage of Calcaneal Osteomyelitis Within a Staged Limb-Salvage Pathway of a Diabetic Patient with Gangrene— A Case Report

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Abstract

Calcaneal osteomyelitis underlying a chronic heel ulcer poses a significant risk of below-knee amputation (BKA) in patients with diabetes and peripheral arterial disease (PAD), with limb-salvage options becoming increasingly limited following a failed open partial calcanectomy. We report the case of a 68-year-old man with type 2 diabetes mellitus, end-stage renal disease requiring hemodialysis, and severe peripheral arterial disease (PAD), who presented with dry gangrene involving the right second through fifth toes and a 7.7 × 5.9 × 0.3 cm heel ulcer overlying a previously partially resected calcaneus. Deep wound culture grew methicillin-resistant Staphylococcus aureus (MRSA), and magnetic resonance imaging (MRI) showed osteomyelitis of the calcaneal remnant with a pathologic fracture extending to the subtalar joint. Seven physicians had previously recommended below-knee amputation (BKA). After endovascular recanalization of an ostial anterior tibial occlusion failed, a great saphenous vein bypass from the below-knee popliteal to the anterior tibial artery restored inflow. A transmetatarsal amputation was then combined with minimally invasive suction curettage of the calcaneus using a bone harvester through a 2-cm lateral incision under fluoroscopic guidance, with placement of vancomycin and tobramycin-loaded calcium sulfate beads. A second suction curettage with bead placement was performed nine weeks later, together with injectable adipose allograft and a biodegradable synthetic dermal matrix. With staged wound-bed preparation, culture-directed antibiotics and hyperbaric oxygen therapy, the heel was with complete closure approximately 21 months after the first suction curettage, and the limb was preserved. Suction curettage allows repeated debridement, bone sampling and local antibiotic delivery without further resection of a fractured calcaneal remnant, and may be useful when additional open resection is not feasible.

Keywords: *Calcaneal osteomyelitis; Suction curettage; Minimally invasive surgery; Limb salvage; Chronic limb-threatening ischemia*

Introduction

Diabetes-related foot infections are a major cause of hospitalization and lower-extremity amputation, [1,2] with calcaneal osteomyelitis presenting a particular challenge due to the heel's weight-bearing function, limited soft-tissue coverage, and impaired healing in patients with peripheral arterial disease (PAD). [3–6] Although partial or total calcanectomy offers an alternative to below-knee amputation (BKA), reported outcomes remain variable. In two series, wound healing was achieved in 78% and 81% of patients, respectively. [5,6]

However, extensive open resection can compromise the heel pad, remaining calcaneal bone stock, Achilles tendon insertion, and subtalar stability, particularly following a failed partial calcanectomy.

Minimally invasive, bone-preserving techniques offer an alternative by removing infected cancellous bone while preserving the cortical shell and surrounding soft tissues. Huchital et al. described calcaneal "cancelloplasty" using ultrasonic bone dissection and antibiotic-impregnated calcium phosphate.[7] Similarly, a suction-powered curettage bone harvester device is designed for minimally invasive cancellous bone harvesting and debridement, including the removal of infected or necrotic bone. [8–10] Although its application in osteomyelitis has been reported,1[1,12] detailed descriptions of its use for calcaneal infection remain limited.

We present a case of MRSA calcaneal osteomyelitis following a failed partial calcanectomy in a patient with gangrene of the forefoot due to severe PAD, for whom seven physicians had recommended BKA. Two minimally invasive calcaneal suction curettage procedures using the suction curettage bone harvester system were incorporated into a staged, multidisciplinary limb-salvage approach. We describe the surgical technique, its rationale, and its potential role in managing complex calcaneal osteomyelitis in patients with compromised vascular perfusion.

Case Presentation

History and examination

A 68-year-old man with type 2 diabetes mellitus, end-stage renal disease on hemodialysis, hypertension, hypercholesterolemia, congestive heart failure, coronary artery disease after coronary artery bypass grafting, and presented to our wound care center for an eighth opinion regarding gangrene of the right toes and a nonhealing chronic right heel ulcer with osteomyelitis. The patient had no history of tobacco use and was nonambulatory due to the foot, requiring a wheelchair for mobility. The heel ulcer had begun as a blister approximately eight months earlier. He had since undergone calcaneal surgery at an outside institution and multiple vascular procedures, and had been receiving weekly wound care, hyperbaric oxygen therapy (HBOT) and several months of intravenous cefepime administered with dialysis. Prior to presentation, the patient had been evaluated by seven physicians, all of whom recommended below-knee amputation (BKA) due to extensive tissue loss, deep infection, and compromised vascular perfusion.

On examination, dorsalis pedis and posterior tibial signals were present on Doppler, pedal hair was absent, and protective sensation was lost. The right heel was deformed, consistent with prior partial calcanectomy, and had a granular-based ulcer measuring 7.7 × 5.9 × 0.3 cm with callused edges, moderate serosanguineous drainage and discolored, edematous periwound skin. Dry gangrene involved the second through fifth toes, with dark discoloration of the forefoot (Wagner grade 4). There was no fluctuance, crepitus or erythema. White blood cell count was 7.7 × 103/μL and hemoglobin A1c was 8.2%. Deep wound culture of the heel grew MRSA, and systemic therapy was changed from cefepime to vancomycin with dialysis.

Imaging and vascular assessment

Radiographs of the right foot showed demineralized bone and partial resection of the calcaneus with a chronic fracture of the calcaneal remnant. Cortical indistinctness of the remnant beneath the soft-tissue wound raised concern for osteomyelitis. Additional findings included cortical indistinctness of the second through fifth distal phalanges underlying the digital wounds, diffuse soft-tissue swelling, and extensive vascular calcifications. MRI showed a large posterior heel wound overlying a pathologic fracture of the posterior calcaneus that extended to the subtalar joint, with fluid in the fracture gap. The posterior calcaneus had T1-hypointense marrow, edema and enhancement consistent with osteomyelitis, and the posterior tuberosity fragment was non-enhancing, suggesting vascular compromise. There was no abscess.

Diagnostic angiography 10 days after presentation showed a widely patent aorto-iliac and common femoral segment, mild proximal superficial femoral artery disease with a widely patent distal stent, and mild diffuse popliteal disease. The posterior tibial artery was patent in-line to the medial and lateral plantar arteries, and the peroneal artery was patent with diffuse disease. The anterior tibial artery had a heavily calcified ostial 100% occlusion; the remainder of the vessel was patent to the proximal dorsalis pedis, with delayed filling of the dorsal pedal branches.

Multidisciplinary planning

Rather than proceeding directly to major amputation, a staged limb-preservation strategy was developed jointly by podiatric surgery, vascular surgery and interventional cardiology. Because a partial calcanectomy had already failed and the remnant was fractured into the subtalar joint, further open resection was expected to leave an unsalvageable hindfoot. The guiding principles were (1) restore arterial inflow before tissue resection, (2) remove all non-viable forefoot tissue, (3) eradicate calcaneal infection with minimal further loss of bone and heel soft tissue, and (4) achieve durable soft-tissue coverage. The sequence of interventions is summarized in Table 1.

Table 1. Timeline of the staged multidisciplinary limb-salvage pathway (intervals from presentation).

Timing	Intervention	Purpose / findings
Presentation	Second-opinion assessment; deep wound culture; radiographs and MRI; systemic therapy changed from cefepime to vancomycin	Heel ulcer 7.0 × 5.9 × 0.3 cm; dry gangrene toes 2–5; MRSA; osteomyelitis of fractured calcaneal remnant
Day 10	Angiography; attempted antegrade and retrograde pedal recanalization of anterior tibial artery	Ostial calcified AT occlusion; could not be crossed
Day 18	Below-knee popliteal to anterior tibial artery bypass with great saphenous vein, tunneled through the interosseous membrane	Inflow restored despite extremely calcified tibial vessels; biphasic completion Doppler signals in graft and AT
~10 weeks	Transmetatarsal amputation + first suction curettage (anterior-medial body, 2-cm lateral portal) + vancomycin/ tobramycin calcium sulfate beads + heel debridement + synthetic dermal matrix	Gangrenous forefoot removed; targeted calcaneal debridement; bone specimens; local antibiotics
~19 weeks (+9 weeks)	Second suction curettage (central-posterior body) + vancomycin/ tobramycin antibiotic beads + injectable adipose matrix 9 mL + synthetic dermal matrix	Repeat targeted debridement and sampling; heel padding restored
~9.5 months	Excisional debridement of residual heel wounds + synthetic dermal matrix	No probe to bone; small purulent focus addressed
~24 months	Complete wound closure	Limb preserved without below-knee amputation

Stage 1: Revascularization

Endovascular recanalization of the anterior tibial occlusion failed from both antegrade femoral and retrograde pedal approaches, because the calcified proximal cap could not be penetrated. Eighteen days after presentation, the patient underwent an urgent below-knee popliteal to anterior tibial artery bypass with ipsilateral great saphenous vein, tunneled through the interosseous membrane. Severe tibial artery calcification precluded adequate vascular control with a tourniquet alone, necessitating adjunctive clamp control and significantly complicating the distal anastomosis. Completion Doppler assessment confirmed biphasic flow signals within the graft and anterior tibial artery. Estimated intraoperative blood loss was 500 mL, requiring transfusion of one unit of packed red blood cells.

Stage 2: Transmetatarsal amputation

Seven weeks after bypass, under monitored anesthesia care with an ankle block, a transmetatarsal amputation with a long plantar flap was performed, with the metatarsal parabola planned under mini C-arm fluoroscopy and bleeding bone stock confirmed before primary closure. The first calcaneal suction curettage and heel wound management were performed under the same anesthetic.

Stages 2 and 3: Minimally invasive calcaneal suction curettage

Device. The suction curettage bone harvester is a sterile, single-use instrument that connects to standard operating-room suction. Cutting tips are available in 6-mm and 8-mm diameters, and disposable pilot-hole creators allow a controlled cortical window to be made before the harvester is introduced. Debrided cancellous bone and marrow are drawn into, and retained within, a closed collection chamber in the device handle, so that infected material is evacuated without being dispersed into the operative field and can be submitted intact for laboratory analysis. [10]

First suction curettage (at the time of transmetatarsal amputation). The patient was repositioned in the lateral decubitus position. Using the mini C-arm, a Freer elevator was used to triangulate the osteomyelitic zone, localized to the anterior-medial calcaneal body. A 2-cm incision was made on the lateral wall of the calcaneus with a #15 blade, away from the plantar ulcer, and carried down to bone with protection of the neurovascular structures. A cortical window was created with the pilot-hole creator, and fluoroscopy confirmed entry through the calcaneal cortex without fracture of the demineralized remnant. The harvester was advanced through the window and rotated circumferentially to excise the infected cancellous bone. The captured bone was sent for pathology and microbiology. Calcium sulfate beads loaded with 1 g of vancomycin and 40 mL of tobramycin were placed into the calcaneal defect through the same portal, and the skin was closed with 3-0 nylon.

Heel ulcer. The plantar heel ulcer, measuring 5.4 × 3.5 × 0.2 cm, was excisionally debrided to bone with a curette and blade, giving post-debridement dimensions of 8.0 × 3.8 × 0.4 cm. After pulse lavage with 3 L of normal saline and povidone-iodine, a 10 × 10 cm biodegradable synthetic dermal matrix was stapled to the wound edges under a bolster dressing, and a posterior splint was applied.

Second suction curettage (nine weeks later). A planned second procedure was performed in the lateral decubitus position. The central-posterior calcaneal body was localized under mini C-arm, a 2-cm lateral incision was made to bone, and a new cortical window was created with the pilot-hole creator. After fluoroscopic confirmation of position, the harvester was advanced and rotated circumferentially to excise remaining infected bone, and the captured bone was again sent for pathology and microbiology. Absorbable calcium sulfate beads loaded with 1 g of vancomycin and 40 mL of tobramycin were placed into the defect, and the skin was closed with 2-0 nylon and staples.

Soft-tissue augmentation. At the second procedure the heel ulcer measured 5.0 × 3.0 × 0.1 cm and was granular without drainage, and a linear dehiscence of the transmetatarsal amputation site measured 0.5 × 8.0 × 0.2 cm. After excisional debridement, an 18-gauge needle was used to release scar attachments beneath the heel, and 9 mL of injectable allograft adipose matrix was infiltrated, 7.5 mL along the plantar and posterior calcaneus beneath the ulcer and 1.5 mL at the amputation site, to restore soft-tissue padding over the bony prominences. A 10 × 10 cm synthetic dermal matrix was applied to the heel wound, and a posterior splint was applied.

Outcome

The heel wound closed completely approximately 14 months after this final grafting, about 21 months after the first suction curettage and 24 months after presentation. The extremity was preserved without below-knee amputation.



Figure 1. Presentation: dry gangrene of the second to fifth toes and the 7.7 × 5.9 × 0.3 cm heel ulcer over the previously resected calcaneus.



Figure 2. (A) Lateral radiograph and (B) sagittal MRI showing the fractured calcaneal remnant with osteomyelitis extending toward the subtalar joint.

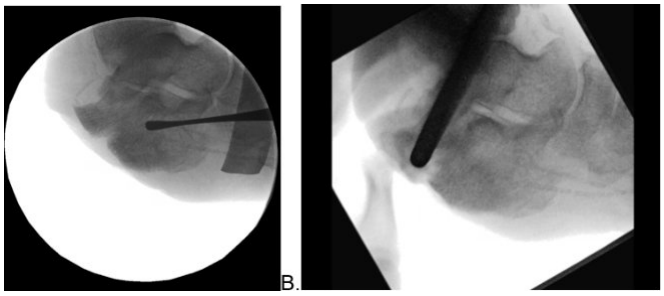


Figure 3. Minimally invasive calcaneal suction curettage: (A) fluoroscopic localization and pilot-hole creation through the 2-cm lateral portal; (B) the Bone Harvester within the calcaneus.



Figure 4. Final outcome: healed transmetatarsal amputation and heel with the limb.

Table 2. Comparison of open partial calcanectomy and minimally invasive suction curettage for calcaneal osteomyelitis.

Feature	Open partial calcanectomy	MIS suction curettage (Avitus®)
Access	Extensile posterior or plantar incision, often excising the ulcer[5,6]	Single 2-cm lateral cortical portal away from the plantar ulcer[10,12]
Bone removed	Block resection of posterior/plantar calcaneus	Fluoroscopically targeted removal of infected cancellous bone; cortical shell retained[10]
Heel pad and soft tissue	Partially sacrificed; large wound to heal	Largely preserved
Handling of infected tissue	Open field	Closed capture in device handle[10]
Diagnostic specimen	Obtained from resected bone	Captured bone submitted directly for culture and histopathology[1,11]
Dead space	Open wound; may need external fixation or flap[5]	Contained cavity suited to antibiotic bead filling
Repeatability	Limited after prior resection	Repeat session through a new small portal (performed at nine weeks in this case)
Main limitation	Wound burden in PAD; functional loss of heel	Cancellous bone only; indirect visualization; limited comparative evidence[11]

Table 3. Technical steps and rationale for minimally invasive calcaneal suction curettage with the Bone Harvester.

Step	Technique in this case	Rationale
Planning	MRI used to define the involved cancellous zone; each session given a separate target (anterior-medial body, then central-posterior body)	Bone is removed only where it is infected
Positioning	Lateral decubitus, operative side up	Direct access to the lateral calcaneal wall and true lateral fluoroscopy
Targeting	Freer elevator on the skin under mini C-arm to triangulate portal and trajectory	Short, accurate approach without an extensile exposure
Portal	2-cm lateral incision with #15 blade directly to bone, away from the plantar ulcer	Avoids plantar weight-bearing skin and the medial neurovascular bundle; sural nerve and peroneal tendons protected under vision[13]
Cortical window	Pilot-hole creator; fluoroscopic confirmation of cortical entry without fracture	Controlled round window in demineralized, previously fractured bone
Debridement	Harvester advanced and rotated circumferentially, redirected through the single window	Cavity larger than the portal; infected bone captured in a closed chamber[10]
Specimens	Captured bone sent from the chamber to pathology and microbiology at each session	Minimal handling; diagnosis and culture-directed therapy[1]
Local antibiotics	Calcium sulfate beads with vancomycin and tobramycin placed through the same window	Dead-space management; high local concentration against MRSA[14]
Closure	Primary closure of the 2-cm incision (nylon ± staples)	Small wound away from the weight-bearing heel
Repeat session	Planned second-look curettage at nine weeks through a new lateral window	Further debridement and sampling without loss of calcaneal structure

Discussion

This case shows that calcaneal osteomyelitis in a patient with advanced PAD and end-stage renal disease does not necessarily mandate major amputation, even after a failed partial calcanectomy and repeated recommendations for BKA. Revascularization and forefoot amputation were prerequisites, but the step that made salvage of the hindfoot realistic was the ability to eradicate calcaneal infection without removing more of the calcaneus or the heel soft tissue. Minimally invasive suction curettage provided that ability.

Why open resection was not an option

Partial calcanectomy is an effective salvage operation in selected patients, [5,6] but in this patient it had already failed. The remnant was demineralized and fractured into the subtalar joint, and the posterior tuberosity fragment appeared devascularized. A second open resection would have risked near-total calcanectomy, loss of the Achilles insertion and an unstable hindfoot, and would have created a large new plantar wound in a limb that had just undergone a distal bypass and forefoot amputation. Revascularization improves the odds of healing, [3,4] but it does not create spare bone or soft tissue.The primary challenge was achieving adequate resection of infected bone while minimizing additional surgical trauma and preserving the remaining viable tissue.

How suction curettage addresses the calcaneus

The calcaneus is well suited to suction curettage. It is the largest tarsal bone, composed mainly of cancellous bone within a thin cortical shell, and osteomyelitis beneath a heel ulcer typically spreads through this cancellous core. A device that cuts and aspirates cancellous bone can reach that core through a small cortical window and remove infected bone from the inside, leaving the cortex, the heel pad and the plantar skin in place. In this case the suction curettage offered six advantages (Table 2). The incision was small and remote from the ulcer, on the lateral wall rather than the plantar weight-bearing surface. Bone removal was targeted, because fluoroscopic triangulation directed each session to the zone defined on MRI. The cortex was preserved, so the remaining calcaneus kept its shape and its function as a lever for the Achilles tendon. Infected material was captured in a closed chamber rather than dispersed through an open field.[10] The captured bone served directly as a specimen for culture and histopathology, as recommended by current guidance.[1] Finally, the cavity left behind was contained by cortex and readily accepted antibiotic beads through the same portal.

Technical considerations

The principal technical steps of calcaneal suction curettage are outlined in Table 3. The lateral calcaneal wall was selected as the portal site because it is subcutaneous and lies remote from both the plantar weight-bearing surface and the medial neurovascular bundle. Although the sural nerve and peroneal tendons traverse the lateral hindfoot, a cadaveric study of percutaneous lateral calcaneal osteotomy located the sural nerve 9 to 21 mm anterosuperior to the entry point, with no significant neurovascular injury.[13] In this patient, a 2-cm incision carried directly to bone allowed these structures to be identified and protected under direct vision. Of note, the anterior-medial focus targeted during the first procedure was accessed entirely through this lateral portal, avoiding a medial approach near the neurovascular bundle. The extent of involvement was mapped on preoperative MRI, and a Freer elevator positioned on the skin under mini C-arm fluoroscopy was used to triangulate the entry point and trajectory before incision. A round, controlled cortical window was then created with the dedicated pilot-hole creator.[10] Controlled entry is particularly relevant in demineralized bone, and the small cortical apertures used for vacuum-assisted harvesting have not been associated with donor-site fracture;[8] intraoperative fluoroscopy confirmed that cortical integrity was maintained. The harvester was then advanced, rotated circumferentially and redirected through the single window, producing an intraosseous cavity considerably larger than the portal itself. Because debrided bone is aspirated directly into a sealed collection chamber, specimens require minimal handling before culture and histopathology,[10,11] consistent with guideline recommendations for bone sampling in diabetic foot osteomyelitis.1 Finally, the dead space was filled with absorbable antibiotic-loaded calcium sulfate beads through the same window,[12,14] and the small incision, located away from the weight-bearing surface, was closed primarily.

Staged and repeatable debridement

A further advantage, and one that open resection cannot easily offer, is repeatability. Nine weeks after the first session, a planned second suction curettage targeted a different zone, the central-posterior calcaneal body, through a new lateral window. This allowed further removal of infected bone, new specimens for pathology and culture, and replacement of local antibiotic beads, without any loss of calcaneal structure or heel soft tissue. In a patient who could not tolerate a second large hindfoot wound, staged debridement through small portals made it possible to treat a diffusely involved calcaneus incrementally.

Patient selection

From this experience, suction curettage of the calcaneus appears best suited to osteomyelitis confined largely to cancellous bone with a reasonably preserved cortical shell, in a limb with adequate or restored perfusion, and particularly when open resection would be destabilizing or has already failed. It is less suitable when there are large cortical sequestra, extensive cortical destruction, devitalized fragments that must be excised, or an abscess requiring open drainage. In those situations open resection remains necessary, and the two approaches may be combined.

Evidence for vacuum-assisted bone debridement

Published clinical experience remains limited. In a retrospective cohort of 44 patients treated with the a bone harvester repurposed for tissue removal, the infection clearance rate was 85.0% in primary infection cases (osteomyelitis and periprosthetic joint infection) and 50.0% in post-traumatic infection, with an overall reoperation rate of 47.7%; the authors advised weighing device use against cost and patient-specific risk.[11]

Abbas and colleagues combined minimally invasive suction-curettage bone harvesting with local and systemic antibiotics for lower-extremity osteomyelitis in patients with diabetes and PAD.[12] Harvest literature supports the safety of a small cortical window: in ten patients who underwent proximal tibial harvest with a vacuum-assisted device, no donor-site fractures occurred at one year.[8] The present case adds a technique-level description of repeated suction curettage in the calcaneus after failed partial calcanectomy in a revascularization limb.

Local antibiotic delivery and soft-tissue reconstruction

Absorbable calcium sulfate carriers deliver high local antibiotic concentrations, require no removal and fill dead space; in diabetic forefoot osteomyelitis they have been associated with fewer postoperative infections and complications.[14] Vancomycin matched the MRSA isolate. In a patient on hemodialysis, systemic absorption from local carriers is a consideration, and drug levels should be monitored. Injectable adipose matrix restored padding beneath the heel, and a synthetic dermal matrix provided a scaffold for plantar wound coverage.

Limitations

This is a single case, and the contribution of each intervention, including revascularization, systemic vancomycin and hyperbaric oxygen, cannot be isolated. Healing was slow, and residual heel wounds required further debridement and grafting before closure. Without direct visualization, the adequacy of debridement must be judged from imaging, tactile feedback and the captured specimen. Device cost and the need for long-term follow-up to confirm remission are further considerations.1,11 Comparative studies are needed to establish whether suction curettage matches or exceeds conventional debridement or partial calcanectomy.

Conclusion

Complex limb-threatening pathology in the setting of advanced PAD requires an individualized strategy that addresses both vascular and podiatric disease. In this patient with end-stage renal disease, MRSA calcaneal osteomyelitis and a failed prior partial calcanectomy, previously advised by seven physicians to undergo BKA, a staged approach achieved complete wound healing and preservation of the limb. That approach combined surgical bypass after failed endovascular therapy, transmetatarsal amputation, two sessions of minimally invasive calcaneal suction curettage with bone harvester, local antibiotic delivery, adipose matrix augmentation and dermal matrix grafting. Suction curettage allowed targeted, repeatable debridement of the calcaneus, diagnostic bone sampling and local antibiotic placement through a 2-cm lateral portal, without further resection of a fractured calcaneal remnant. It merits consideration within staged limb-salvage protocols for calcaneal osteomyelitis in high-risk vascular patients, particularly when further open resection is not feasible.

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Conflict of Interest

The authors declare no conflicts of interest.

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