

Partial calcaneotomy with antibiotic biocomposite injection for diabetes patients with heel ulcers and calcaneal osteomyelitis: a single-stage treatment

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Article points

1. Heel ulcers in diabetes have substantial morbidity and frequently lead to below-knee amputations.
2. Patients with below-knee amputations have higher mortality and poorer mobility, and most patients would prefer limb preservation.
3. Partial calcaneotomy and injection of local antibiotic-loaded biocomposite offers a simpler way to treat these infections while conserving the limb
4. Additionally, the cost burden to the NHS, secondary to amputations, can be substantially reduced.

Key words

- Calcaneal osteomyelitis
- Cerament® injection
- Diabetic heel ulcer
- Partial calcaneotomy

Authors

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Heel ulcers with calcaneal infection are difficult to treat, with frequent relapses. The authors report a series of four patients who presented with a heel ulcer and calcaneal osteomyelitis. The results show that using a single-stage partial resection of calcaneum with primary closure of wound and an antibiotic biocomposite injection (Cerament®, Bonesupport) injection is a viable and useful technique in managing calcaneal osteomyelitis.

Patients with a diabetic foot infection have a 50-fold increased risk of hospitalisation and 150-fold increased risk of lower-extremity amputation compared with patients with diabetes who have no foot infection — equivalent to 7,000 patients losing a limb every year (Lavery et al, 2006; Pickwell et al, 2015). The cost of management in the NHS is estimated to be between £837 million and £962 million a year (Kerr et al, 2019).

Heel ulcers with calcaneal infection are difficult to treat, with frequent relapses, and the heel is the most likely location for an ulcer that results in lower extremity amputation (Oliver et al, 2015; Sabater-Martos et al, 2019). Most patients would prefer multiple procedures for limb salvage to amputation and partial calcaneotomy is a suitable alternative in these cases (Hoffstad et al, 2015; Gok et al, 2016; Wukich and Raspovic, 2016; Sabater-Martos et al, 2019).

Materials and methods

We report a series of four patients who presented with a heel ulcer and calcaneal osteomyelitis. These patients were managed by our multidisciplinary team as per standard protocol. Only patients with satisfactory vascular assessment were taken for surgery. The treatment protocol flow chart is shown in *Figure 1*.

Cerament G

Cerament G® (Bonesupport AB, Lund, Sweden) is a bio-composite of calcium sulphate and hydroxyapatite with compressive strength equal to cancellous bone. It is injectable, has osteoconductive properties and is completely resorbable. It not only acts as bone filler, but also allows optimum local antibiotic levels (Nilsson et al, 2004; McNally et al, 2015; Ferguson et al, 2017).

Operative technique

The surgery was planned as a single-stage procedure. Patients were operated on in floppy lateral position. A thigh tourniquet was used in all cases. A longitudinal posterior incision was used, extending the distal and proximal ends of the ulcer. The ulcer was debrided to bleeding healthy tissue margins and the Achilles tendon was sharply reflected off the bone. Multiple soft tissue and bone samples were taken for microbiology.

Based on MRI images (*Figure 2*), calcaneal excision was planned, with the aim of trying to conserve at least 50% of the bone and the posterior subtalar joint. For local delivery of antibiotic, Cerament G was injected using the Silo technique (*Figure 3*; Drampalos et al, 2018).

Loose single layer wound closure was achieved

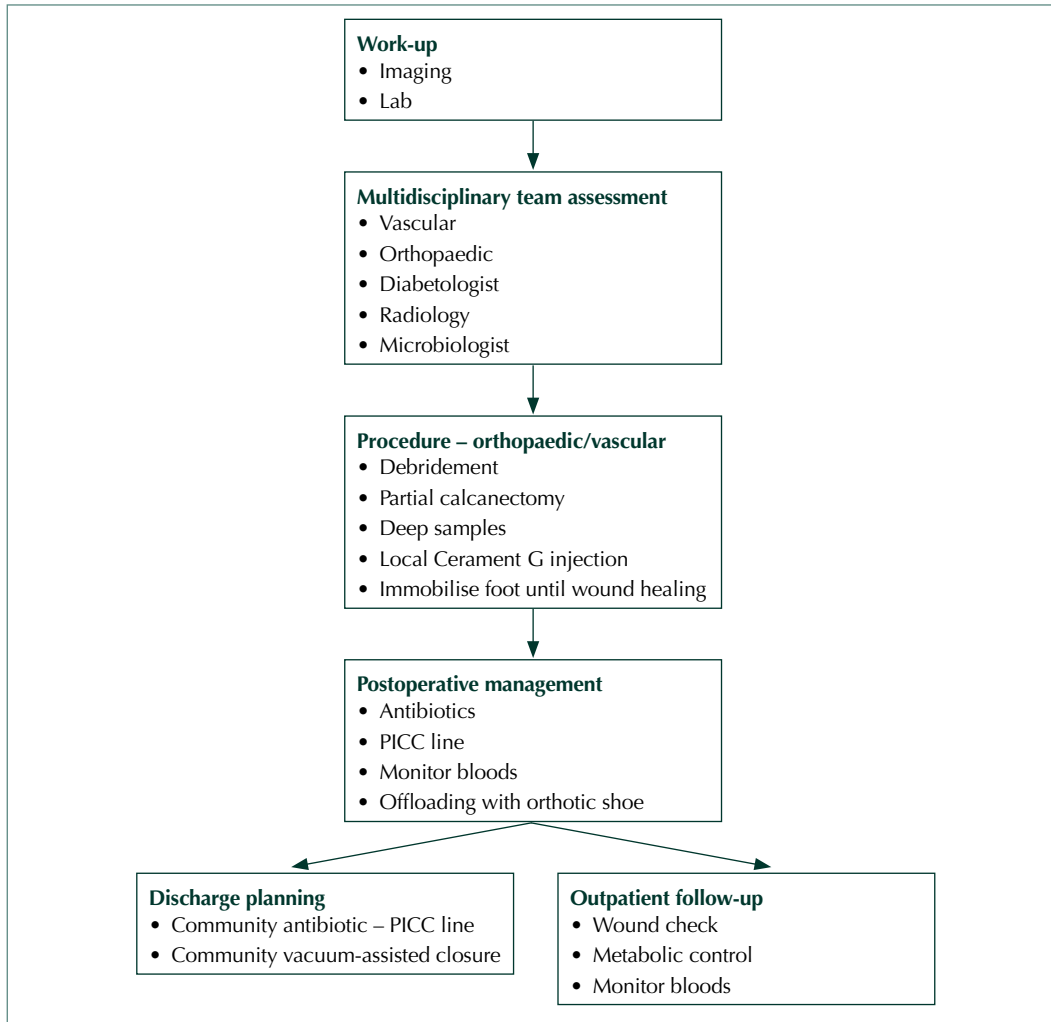


Figure 1. The treatment protocol.

in all cases, as the excision of calcaneum de-tensioned the skin in spite of the loss of tissue due to the ulcer. Empirical antibiotic treatment was initially given postoperatively and modified according to the microbiology results from intra-operative samples, for a total of 6 weeks.

Results

Three of the four cases achieved wound healing in an average time of 14.7 weeks (range 12–16 weeks). These wounds always showed delayed primary healing response. Patient four was not compliant with non-weight bearing status and smoking, and eventually had to have a below-knee amputation. The three patients whose wounds healed achieved good postoperative mobility with orthosis in spite of the removal of the insertion of the Achilles tendon during surgery (Table 1).

Discussion

Osteomyelitis of the calcaneum with heel ulcers is a huge challenge to manage, due to coexisting neuropathy, peripheral vascular disease and comorbidities. Partial calcanectomy removes infected bone and de-tensions soft tissue. A recent systematic review of this surgery reports 80% healing rates, with better results occurring with partial rather than total calcanectomies (Yammine et al, 2021).

Local antibiotic delivery systems can deliver high local concentrations of antibiotic without any associated systemic toxicity.

The Cerament G used in our study contains 17.5 mg/ml of gentamicin. Gentamicin elution from Cerament G remains above minimum inhibitory concentration (MIC) for at least 28 days. Local gentamicin concentration levels are 64–150 times higher than the MIC for gentamicin-sensitive

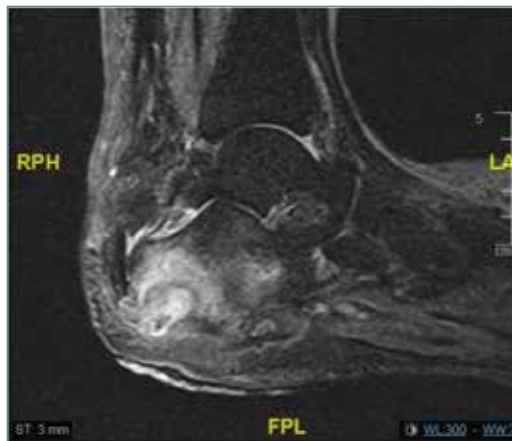


Figure 2. MRI of calcaneal osteomyelitis – STIR sequence, sagittal section.



Figure 3. Post Cerament injection of residual calcaneum.

Table 1. Demographics, staging, microbiology and results.

Sex, age and ulcer location	Co-morbidities	University of Texas ulcer grading and staging	Intra-operative sample microbiology	Final result and mobility
Male* 70 years Left heel	Diabetes Hypertension Bilateral leg lymphoedema	3B	<i>Enterococcus faecium</i> , <i>Morganella morganii</i> , <i>Citrobacter koseri</i>	Healed 16 weeks; mobile with orthosis
Female 61 years Left heel	Diabetes Ischaemic heart disease	3B	Mixed enteric flora	Healed in 12 weeks; mobile with orthosis
Male 71 years Left heel	Diabetes Obesity	3B	Coagulase-negative <i>Staphylococcus</i>	Healed in 16 weeks; mobile with orthosis
Female 53 years Right heel	Diabetes Obesity Smoker	3B	<i>Kocuria kristinae</i>	Below-knee amputation 1 year after index procedure

*Recently deceased

pathogens, such as *Staphylococcus* and *Pseudomonas* (Colding-Rasmussen et al, 2018).

Multiple studies have shown have excellent results using Cerament as void filler in cases of diabetic foot infection (Armstrong et al, 2001; McNally et al, 2016; Drampalos et al, 2018; Niazi et al, 2019).

Conclusion

Our results also show that using a single-stage partial resection of calcaneum with primary closure of wound and local Cerament injection is a viable and useful technique in managing calcaneal osteomyelitis.

The use of Cerament/surgery combination in

further larger series of patients can give a clearer picture of the usefulness of this limb-preserving surgery and its role in managing diabetic heel ulcers and calcaneal osteomyelitis in mobile patients with preserved distal vascularity who want to avoid below-knee amputation. ■

Declaration and conflict of interests

The research was performed in accordance with the 1964 Declaration of Helsinki ethical standards.

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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