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Treatment of Calcaneal Fracture With Severe Soft Tissue Injury and Osteomyelitis: A Case Report

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ABSTRACT

Advancements in surgical technique have resulted in the ability to reconstruct lower extremity injuries that would have previously been treated by amputation. Currently, a paucity of data is available specifically addressing limb amputation versus reconstruction for calcaneal fractures with severe soft tissue compromise. Reconstruction leaves the patient with their native limb; however, multiple surgeries, infections, chronic pain, and a poor functional outcome are very real possibilities. We present the case of a complex calcaneal fracture complicated by soft tissue injury and osteomyelitis that highlights the importance of shared decision-making between patient and surgeon when considering reconstruction versus amputation. This case exemplifies the need for open communication concerning the risks and benefits of treatment modalities while simultaneously considering the patient's expectations and desired outcomes.

Advancements in surgical technique have resulted in the ability to reconstruct injuries that would have previously been treated by amputation. Reconstruction leaves patients with their native limb; however, multiple surgeries, infections, chronic pain, and a poor functional outcome are very real possibilities. We present the case of a complex calcaneal fracture that highlights the importance of shared decision-making between patient and surgeon when considering reconstruction versus amputation. This case exemplifies the need for open communication concerning the risks and benefits of treatment modalities while simultaneously considering the patient's expectations and desired outcomes.

Case Report

A 56-year-old male presented with a displaced left intra-articular calcaneal fracture (Sanders type IV, Orthopaedic Trauma Association 83-C2) and a left lateral tibial plateau fracture and left distal radius fracture on November 2009 (Fig. 1*A–C*). He had fallen 25 ft from a grain bin while working on his farm. Both the tibial plateau and distal radius fractures were treated by open reduction and internal fixation (ORIF); however, the closed calcaneal injury was complicated by severely damaged soft tissues with concomitant massive edema and circumferential hemorrhagic fracture blisters. The state of the soft tissues precluded early operative intervention (1–4). The fracture blisters were debrided, and the patient was closely followed up for wound care and expectant management after resolution of soft tissue injury (5). The patient was counseled that reconstruction would involve extensive surgical intervention with staged ORIF coupled with primary subtalar arthrodesis with a valgus corrective osteotomy and possible lateral wall exostosis. Below the knee amputation as definitive reconstruction was also discussed as an alternative.

At 12 weeks after the index injury, the swelling had resolved to the point at which operative intervention could be considered; however, significant full-thickness skin breakdown had occurred over the lateral malleolus, which was healing by secondary intention. The severity of the calcaneal fracture, complicated by an inadequate soft tissue envelope, prompted a plastic surgery consultation to determine whether soft tissue coverage (free-tissue transfer) was an option for the patient.

Before intervention, the patient had developed increasing heel pain. The magnetic resonance imaging findings were consistent with the diagnosis of osteomyelitis of the calcaneus. The definitive reconstruction options recommended to the patient included calcaneal bone excision, free tissue transfer with subtalar arthrodesis, and calcaneal osteotomy versus below the knee amputation. Both the treating physicians and the patient expressed significant concern for

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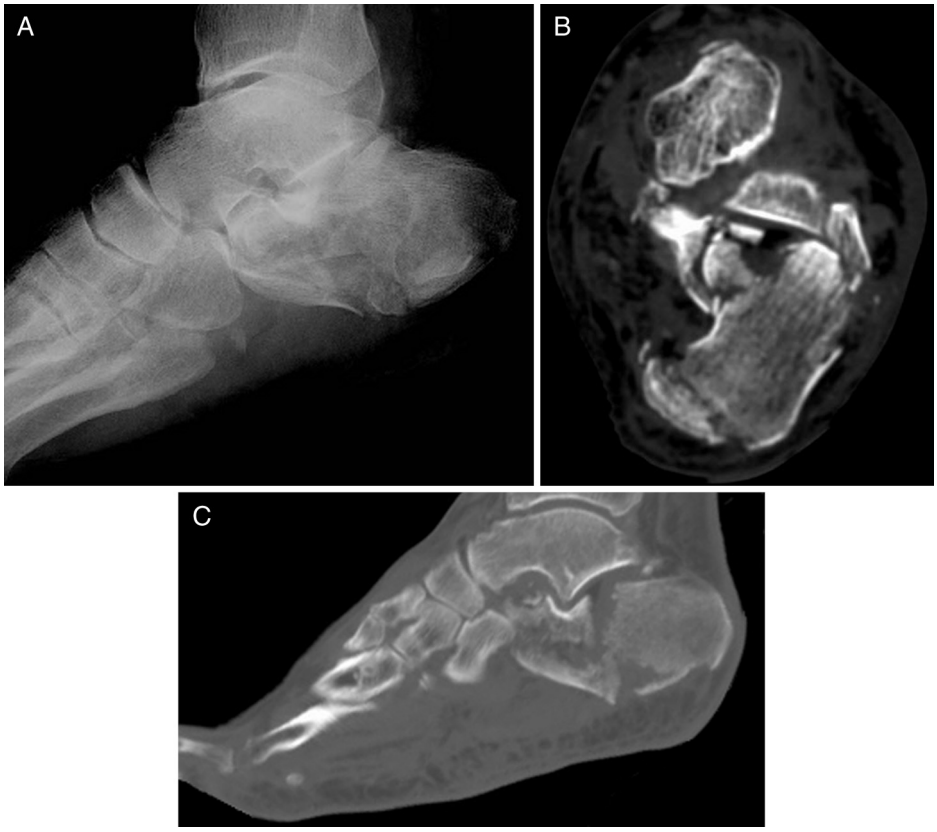

Fig. 1. (*A*) A lateral radiograph and (*B*) coronal and (*C*) sagittal computed tomography scans of the left foot demonstrating a comminuted fracture of the calcaneus with accompanying soft tissue swelling.

the potential recurrence of calcaneal osteomyelitis with limb reconstruction; therefore, the patient decided to proceed with amputation.

Surgical Technique

Approximately 3 months after the initial injury, the patient underwent a transtibial amputation with bone bridge arthrodesis as described by Ertl et al (6) (Fig. 2*A* and *B*). The patient was brought to the operating room, placed in the supine position, and placed under general anesthesia. During surgery, all the vessels were individually clipped and ligated, and care was taken to sharply transect the nerves, which were allowed to retract proximally into muscle belly. The tibia was amputated 15 cm from the tubercle, and the fibula was cut 7 cm longer. The fibula was then osteotomized 5 cm from the distal end. Drill holes were created in the distal fibula and distal tibia. Sutures were then used to approximate the bone bridge arthrodesis. The periosteal sleeve was sewn over the bone bridge and fascia. The patient tolerated the procedure well and was discharged without complications.

Follow-Up

The patient was kept non–weightbearing for 3 months. The patient was then fitted for a prosthesis and allowed to bear weight as tolerated with a walker. On April 2012 (26 months postoperatively), the patient was ambulating in his prosthesis without assistance. He described mild intermittent joint and bone pain in the residual limb that was gradually improving. The below the knee amputation wound had fully healed. The knee range of motion was 0° to 130°, with no varus or valgus instability of the residual limb. His knee flexion and extension strength were 5 of 5. Radiographs obtained at the final follow-up visit revealed a consolidated bone bridge and fully healed plateau fracture (Fig. 3*A* and *B*). At that point, the patient was released to perform activities as tolerated without restrictions.

Discussion

The management of intra-articular calcaneal fractures has been the subject of debate among orthopedic surgeons. Historically, closed management of these injuries was plagued with failure. Cotton and Wilson (7) noted, “The man who breaks his heel bone is done.” Even today, universal consensus on the proper treatment of these injuries is lacking. A key problem in management has been the inability to uniformly classify these injuries. Before the development of computed tomography, multiple attempts to classify calcaneus fractures using plain film radiographs dictated the treatment but not the prognosis (1). Sanders et al (2) described a system that used coronal computed tomography scans to classify calcaneus fractures. The posterior facet is divided into 4 potential fracture components, and injuries are classified according to the number of displaced components. This can help determine the appropriate treatment and predict the prognosis (4).

Management of intra-articular fractures of the calcaneus can be broadly divided into nonoperative, ORIF, and primary arthrodesis (1). Nonoperative management consists of early range of motion exercises and no weightbearing for 10 to 14 weeks and is generally reserved for nondisplaced or minimally displaced fractures or patients not amenable to surgical treatment. In cases of soft tissue compromise,

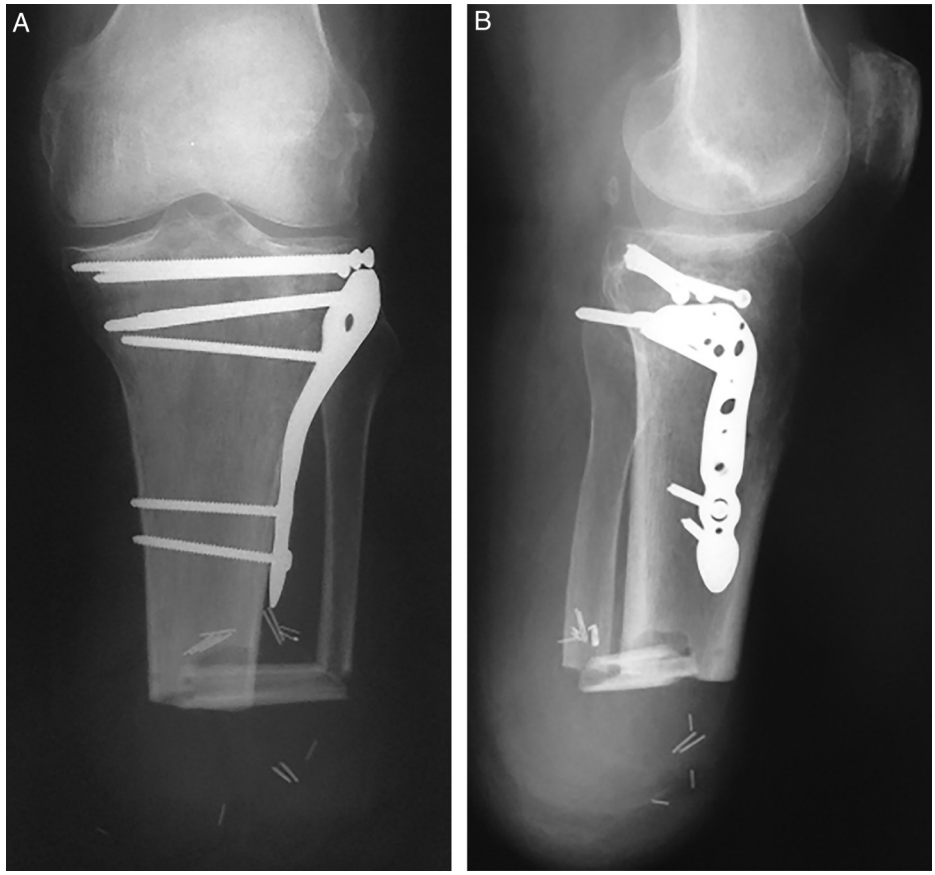

Fig. 2. Postoperative (*A*) anteroposterior and (*B*) lateral radiographs of the left knee demonstrating the residual limb status after below the knee amputation using an Ertl procedure.

severe peripheral vascular disease, diabetes mellitus, and life-threatening injury that precludes intervention, nonoperative treatment could also be indicated (1,3). Heier et al (4) found that calcaneal fractures with extensive soft tissue injury could be at high risk of osteomyelitis and subsequent amputation if surgery is attempted before adequate treatment of the soft tissue envelope. Displaced intra-articular fractures treated nonoperatively will have a poor prognosis for return to function, because malunion is likely (1,3). Buckley et al (8) observed significantly better outcomes for specific subsets of patients who underwent ORIF versus nonoperative treatment of displaced intra-articular calcaneal fractures, although a recent Cochrane review found insufficient evidence to identify whether ORIF or conservative management was superior for displaced intra-articular calcaneal fractures (9).

Operative intervention should be performed within 3 weeks of injury to reduce the fracture before early consolidation. However, surgery should be postponed until the fracture blisters have resolved and swelling has decreased (1). The timing will often correlate with the return of skin wrinkles. Burdeaux (10) reported on his 20-plus-year experience with a medial approach for ORIF. Four large series reported good results using similar operative treatment with the extensile lateral approach and lag screw fixation of the posterior facet and plate fixation of the calcaneal body (2,11–13). In cases of severely comminuted calcaneal fractures, some investigators have advocated subtalar arthrodesis as the initial treatment (1,3,14). Some patients, however, will present with significant soft tissue injury or systemic trauma that precludes early surgical intervention. Multiple surgeries and soft tissue reconstruction procedures might not be desirable for all patients, and all potential treatment options should be considered.

Wound management is imperative when treating calcaneal fractures. Open fractures can require soft tissue coverage procedures or free tissue transfer. Severe, concomitant soft tissue injury in closed fractures can also preclude early surgical intervention. Occasionally, the waiting period for expectant treatment of a closed injury awaiting soft tissue injury resolution can become excessively prolonged. In the present case, the extensive soft tissue injury did not improve for 12 weeks. Ultimately, the patient developed occult osteomyelitis of the calcaneus before surgical intervention. The required operative treatment (including bone excision, reconstruction with subtalar arthrodesis, and soft tissue coverage) was more than the patient was interested in pursuing. Just as with other limb-threatening injuries, primary amputation should be considered as a treatment option.

Advancements in surgical technique have resulted in the ability to reconstruct injuries that would have previously been treated by amputation. Reconstruction can leave patients with their native limb; however, multiple surgeries, infections, chronic pain, and poor functional outcome are very real possibilities. The Lower Extremity Assessment Project is a multicenter, prospective study that considered the functional outcomes after reconstruction versus amputation of severe lower extremity injuries. Although not specific to calcaneal fractures, the study found no significant difference in functional outcomes between the amputation and reconstruction arms at 24 months after injury and at 7 years of follow-up (15,16).

Ilizarov bone transport with muscle flap coverage has been shown to provide good functional outcomes and lower overall treatment costs compared with amputation for severe tibial defects. The optimal treatment of calcaneal fractures, however, has not been well-defined (17). A recent Cochrane review concerning conservative versus operative intervention for intra-articular calcaneal fractures in adults

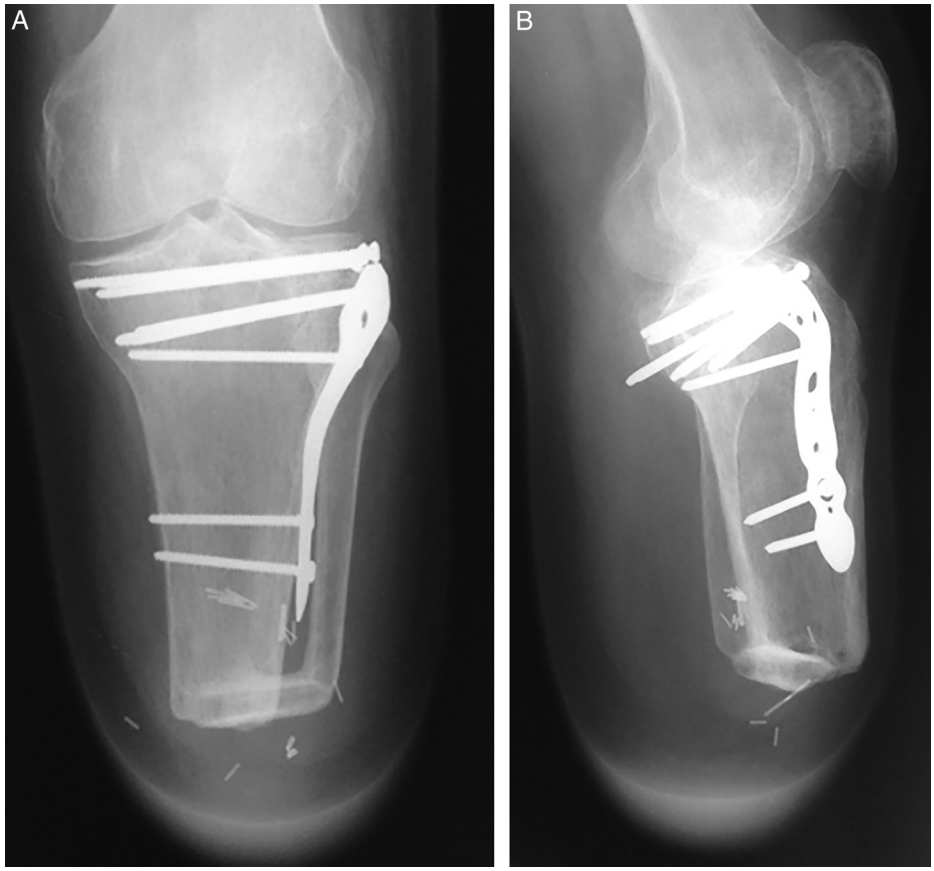

Fig. 3. (*A*) Anteroposterior and (*B*) lateral radiographs of the left knee at 26 months of follow-up demonstrating full consolidation of the bony bridge.

concluded that, currently, evidence is insufficient to support 1 treatment modality over the other (9). In a retrospective review of 102 high-energy combat-related open calcaneal fractures, Dickens et al (18) found that 42% (43 limbs) underwent amputation. The risk factors for amputation included a plantar wound location, a larger size of the open wound, escalating Gustilo and Anderson classification types, and a "blast" mechanism of injury. At an average follow-up of 4 years, the patients who had undergone amputation had slightly lower visual analog scores for pain (2.0 versus 4.1, $p < .0001$) and higher Tegner activity scores (5.4 versus 3.5, $p < .0001$) than the patients who had undergone limb salvage (18). Theirs was the first study to investigate the outcomes of amputation versus reconstruction for open calcaneal fractures, although it is unclear whether the results would also apply to a civilian population, who are much more likely to sustain an open calcaneal fracture after a fall rather than a "blast" injury.

Currently, a paucity of data is available specifically addressing limb amputation versus reconstruction for calcaneal fractures with severe soft tissue compromise. With evidence supporting equivalent functional outcomes between amputation and reconstruction for limb-threatening lower extremity injuries, an attempt at limb salvage by calcaneal reconstruction would have been a reasonable treatment approach for our patient. The complicating factor of occult osteomyelitis and the increased risk of recurrent infections, the possibility of multiple surgeries, and the potential for a poor functional outcome made our case complex. Through in-depth discussion of the risks and benefits of reconstruction versus amputation between the senior author (M.T.A.), consultants, and patient, the patient ultimately thought a below the knee amputation would offer him the best functional outcome with acceptable morbidity. This case exemplifies the need for open communication concerning the risks and benefits of treatment modalities while considering the patient's expectations and desired outcomes.

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