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Case Report
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Salvage of Bilateral Infected Calcaneal Avulsion Fractures with a Unique Method of Limited Internal Fixation using a Steinman Pin and Wire

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Abstract

Background: Operative management of calcaneal fractures is fraught with complications such as malunions, nonunions, wound problems and infections. We present the case of a patient with bilateral open calcaneal avulsion fractures and failure of initial fixation with screws salvaged with a unique method of limited internal fixation using a Steinman pin and 18-gauge wire.

Materials and Methods: The patient is a 35 year old male from a correctional facility who presented with bilateral open calcaneal fractures after jumping down from an upper bunk bed. Due to soft tissue concerns the patient was admitted and taken acutely for reduction and fixation. The patient returned on his second postoperative visit with fixation failure wound break down and drainage bilaterally, possibly from a repeat upper bunk jump to the floor. Further treatment consisted of cannulated screw removal serial debridements and negative pressure wound therapy changes every fourth day for 2 weeks, leaving the gastrocnemius disconnected via the avulsed fragment. Culture specific IV antibiotics were administered. After an 8 week course of antibiotics and negative wound cultures repeat fracture reduction and fixation was achieved by placing a smooth 5 mm Steinman pin retrograde up through the calcaneus talus and to but not through the distal anterior tibia. 18-Gauge wire was wrapped around the avulsed fragment at the junction of the Achilles tendon and fracture fragment. The pin served as a post to wrap the loose ends of the 18-guage wire around to secure the avulsed piece in a reduced position.

Results: The bilateral Steinman pins and 18-gauge wires were removed eight weeks after repeat repair of the avulsed fractures in an outpatient procedure. Six weeks later the patient was pain free full weight bearing with intact plantar flexion. Dorsiflexion was reduced on each ankle to 15 degrees. A gastroc recession or other procedure at the time of final hardware removal should have been considered in this particular patient to restore full ankle dorsiflexion motion.

Discussion: The use of a trans articular ankle pin was first reported in the 1970's in JBJS for unstable ankle fractures even after internal fixation. A biomechanical study revisited this topic in 2008. And then again it was the subject of an article by Scioscia and Ziran. This is the first report of using a transarticular pin for the purposes of salvaging infected open calcaneal avulsion fractures. Our technique describes a modification of a previously reported technique.

After eradication of the infection the fixation options for repeat fracture repair were limited due to comminution of the avulsed fragments and concern that continued use of cannulated screws may lead to a return of the infection due to their cavities remote from local blood flow and remote from systemic antibiotics. The Banerjee method was a repair option possibly using Fiber wire and other braided suture materials were due to their tensile strength. These suture materials were avoided in this fracture re-repair due to concerns about infection perpetuation. The smooth Steinman pin and smooth 18-guage wire provided the perfect combination of material strength to hold the repair and smooth material surface to hopefully minimize bacterial colonization, biofilm formation, and infection return.

Conclusion: This unique method of fixation to salvage infected bilateral open calcaneal avulsion fractures proved successful in restoring ambulation in a patient with complicated bilateral calcaneal fractures. In the future patients this open fracture pattern surgical method will be given consideration will be given to this surgical method as the primary mode of fixation with prospective data collection to assess its utility in terms of outcomes and complication avoidance.

Keywords: Calcaneal fractures; Steinman pin; Malunions; Nonunions

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Introduction

Operative management of calcaneal fractures is fraught with complications such as malunions, nonunions, wound problems and infections [1-5]. We present the case of a patient with bilateral open calcaneal avulsion fractures and failure of initial fixation with screws salvaged with a unique method of limited internal fixation using a Steinman pin and 18-gauge wire [6].

Materials and Methods

The patient is a 35 year old male from a correctional facility who presented with bilateral open calcaneal fractures (Figure 1) after jumping down from an upper bunk bed. Due to soft tissue concerns the patient was admitted and taken acutely for reduction and fixation (Figure 2). The patient returned on his second postoperative visit approximately 6 weeks later with tattered splints, fixation failure (Figure 3) wound break down and drainage bilaterally (Figure 3) after a suspected. Repeat jump to the floor from his upper bunk. The patient was discharged with dorsal foot splints to block dorsiflexion and instructions to remain strict non-weight bearing. Further treatment consisted of cannulated screw removal serial debridements and negative pressure wound therapy changes every third day for 2 weeks, leaving the gastrocnemius disconnected via the avulsed fragment. Culture specific IV antibiotics were administered. After an 8 week course of antibiotics and negative wound cultures repeat fracture reduction and fixation was achieved by placing a smooth 5mm Steinman pin retrograde up through the calcaneus talus and tibia. 18- Gauge wire was wrapped around the avulsed fragment at the junction of the Achilles tendon and fracture fragment [7]. The pin served as a post to wrap the loose ends of the 18-guage wire around to secure the avulsed piece in a reduced position fragment (Figure 2). The patient returned on his second postoperative visit approximately 6 weeks later with fixation failure wound break down and drainage bilaterally (Figure 3). The patient was discharged with dorsal foot splints to block dorsiflexion and instructions to remain strict non-weight bearing. Further treatment consisted of cannulated screw removal bony debridements and negative pressure wound therapy dressing changes 2 times for a total of 4 surgeries to this point including the index fixation surgery and also intravenous antibiotics for two weeks specific to intra-operative cultures. At this point the gastrocnemius was disconnected via the original avulsion fracture. There was no loss of any portion of the Achilles tendons bilaterally. Repeat fracture reduction and union was achieved by placing a smooth Steinman pin retrograde up through the calcaneus talus and tibia. 18-Gauge wire was looped around the avulsed fragment at the junction of the Achilles tendon and fracture fragment. The pin served as a post to wrap the 18-guage wire around to secure the avulsed piece in a reduced position (Figure 4). The Steinman pin also limited any ankle dorsiflexion which further protected the reduction of the avulsed fragment. The use of a trans-articular ankle pin was first reported in the 1970's in JBJS [8,9] for unstable ankle fractures even after internal fixation. A biomechanical study revisited this topic in 2008 by League et al. [10] and then again it was the subject of an article by Scioscia and Ziran [11]. This is the first report of using a transarticular pin for the purposes of salvaging infected open calcaneal avulsion fractures.

Figure 1: Initial lateral view of right calcaneus fracture prior to first repair surgery. Note proximal position of the fragment and its comminution. The left calcaneus is nearly identical in fracture pattern.

Figure 2: Post-reduction radiograph. Note 3 separate screws holding 3 reduced fracture fragments together to a larger main calcaneal fragment. The left calcaneus is similar in all regards. Also note dorsal ankle splint to protect the repair.

A) B)

Figure 3: A) Lateral view of right calcaneus demonstrating fixation failure. B) Re-displacement tuberosity.

Figure 4: Lateral radiograph with revision fixation including, 18-gauge wire and a smooth Steinman pin passed retrograde through the calcaneus, talus and tibia. Note the Steinman pin was intentionally advanced to the distal anterior tibial cortex and not centered into the medullary canal to avoid inadvertent migration of the pin further proximally up the tibial canal. Which has not been reported in the orthopaedic literature but has been observed in the senior author's DRS practice.

Figure 5: Lateral radiograph 11 months after initial fracture.

Results

The Steinman pins and 18-gauge wires were removed eight weeks after repeat repair of the avulsed fractures in an outpatient procedure. Six weeks later the patient was full weight bearing with intact plantar flexion. Dorsiflexion was reduced on each ankle to 15 degrees [12]. A gastrocnemius muscle recession or other procedure at the time of final hardware removal would have been a good consideration in this particular patient to restore full ankle motion (Figure 5) [13].

Discussion

After treating the infection the options for repeat fracture repair were limited due to comminution of the avulsed fragments and concern that continued use of cannulated screws, braided suture, or any other fixation device may lead to a return of the infection due to their surfaces and cavities remote from local blood flow and systemic antibiotics [11]. Fiber wire and other braided suture materials were avoided in the fracture re-repair due to concerns about infection perpetuation [14-17]. The smooth Steinman pin and smooth 18-guage wire provided the perfect combination of material strength to hold the repair and smooth material surfaces to hopefully minimize bacterial colonization and infection return [14-17].

Conclusion

This unique method of fixation to salvage bilateral infected calcaneal avulsion fractures proved successful in restoring ambulation in a patient with complicated bilateral calcaneal fractures. The success achieved in these 2 infected tuberosity fractures is not enough evidence to declare that implants with smooth surfaces are better at resisting biofilm formation and infection recurrence. More work on the pathophysiology of infections in particular to the role of biofilms and the influence implant surface morphology plays are needed before any further conclusions can be made about implant selection in this surgical technique case report. In the future patients with a tuberosity avulsion fracture pattern the authors will give strong consideration for this surgical method as the primary mode of fixation with prospective data collection to assess its utility, outcomes, and complication avoidance. Naturally the need for a secondary procedure for hardware removal is a limitation of this technique even if it is on an out-patient procedure. Long term damage to the ankle joint is also a reason for reservation with this new method. In one study Childress reviewed 16 years of using the trans-articular ankle pin without noting major long term ankle damage [18]. Care should be taken in placement of the Steinmann pin. One article reports its use to be fairly uniform in success and without major complication [18]. Engagement of the pin a few mm into the distal anterior tibial cortex as opposed to having the tip of the Steinmann pin centered in the tibial canal may prevent migration of the pin further up in to the tibial canal. This very scenario was seen in the senior (DS) author's practice, whereby pin removal required an osteotomy of the proximal tibia for pin removal. The osteotomy healed without consequence, nonetheless making this particular patient non-weight bearing for 8 weeks after the osteotomy was not well received by the patient. The immobilization imparted to the ankle by the trans-articular pin may result in contractures of the surrounding soft tissues which may need to be addressed at the time of Steinmann pin removal with a recession, or other tendon lengthening procedure.

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