CHAPTER **24**

ARTHROSCOPICALLY ASSISTED OPEN REDUCTION INTERNAL FIXATION OF THE CALCANEUS: A Computed Tomography Evaluation of Fracture Reduction

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OVERVIEW

Accurate reduction of calcaneal fractures is both challenging and often humbling even for the most experienced surgeon. The lateral extensile approach provides excellent visualization for the global reduction of the anterior and posterior calcaneal body, but only allows direct visualization of the central to lateral one-third of the posterior facet. Clearly the literature supports operative repair of these fractures in the appropriate patient, but superior results can only be achieved with exacting reduction. It is believed that anatomic restoration of the joint surfaces directly correlates with patient outcomes. Specialized radiographic techniques such as Brodens' views as well as intraoperative fluoroscopy have traditionally been a surgeon's benchmark for success; however postoperative computed tomography (CT) scans performed for quality control have demonstrated that these measures may not be sufficient enough in isolation to ensure success.[1] The complex shape of the calcaneus, and specifically the posterior facet of the subtalar joint can be easily imaged through the use of open subtalar joint arthroscopy. The author shares his technique and experience with arthroscopically assisted open reduction internal fixation (ORIF) of the calcaneus.

OPERATIVE TECHNIQUE

Once the soft tissue swelling has subsided, which typically occurs between 10-21 days, operative repair can proceed. The fracture is approach through the lateral extensile approach as described by Benirschke (Figure 1).[2] A full-thickness osteoperiosteal flap is elevated and retracted utilizing the "no touch" technique. Caution is exercised to preserve the inferior peroneal sheath during the initial dissection (Figure 2). The fracture can then start being dismantled (Figure 3).

The lateral wall is removed and placed on the back table. This may include the lateral joint fragment. Organized clot and debris can then be removed from the remaining posterior facet and the central calcaneal body. This allows for visualization of any depressed articular fragments as well as the medial wall fracture. A 5-mm Schantz pin is then introduced at the apex of the incision from lateral to medial to allow manual disimpaction and relocation of the tuber fragment (Figure 4).

The tuberosity fragment is then stabilized to the sustentacular fragment with 2.0-mm wires. This reduction must be confirmed radiographically (Figure 5). This step is a critical component in the reduction as realignment

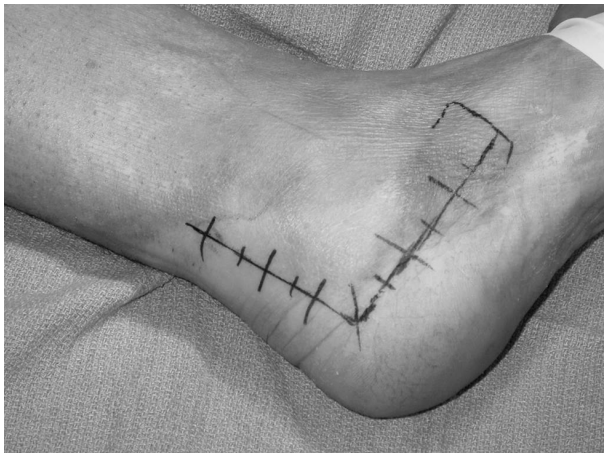

Figure 1. Lateral extensilve approach.

Figure 2. The inferior peroneal sheath is preserved during the initial dissection.

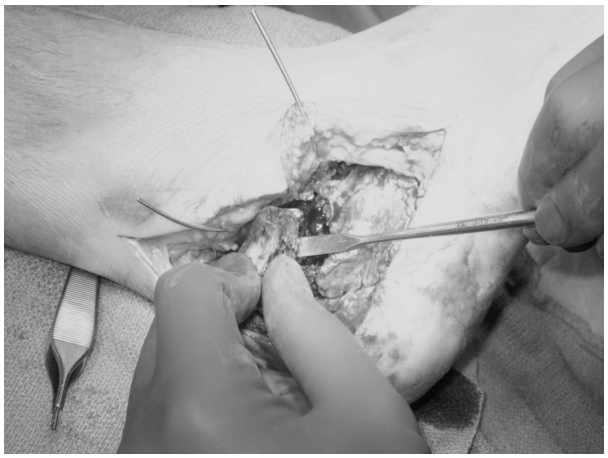

Figure 3. The fracture is dismantled.

Figure 4. A 5-mm Schantz pin is then introduced at the apex of the incision.

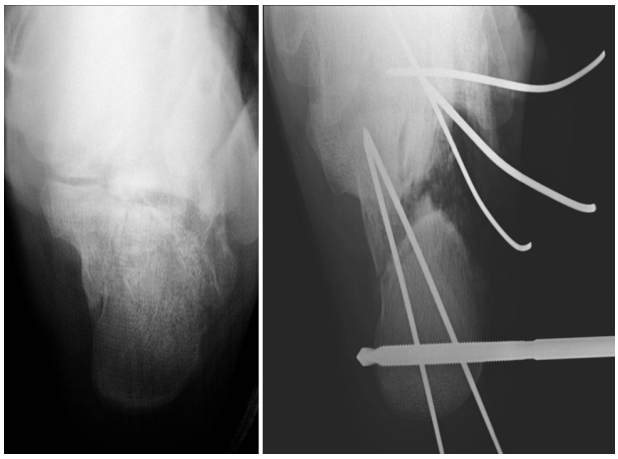

Figure 5. The reduction is confirmed radiographically.

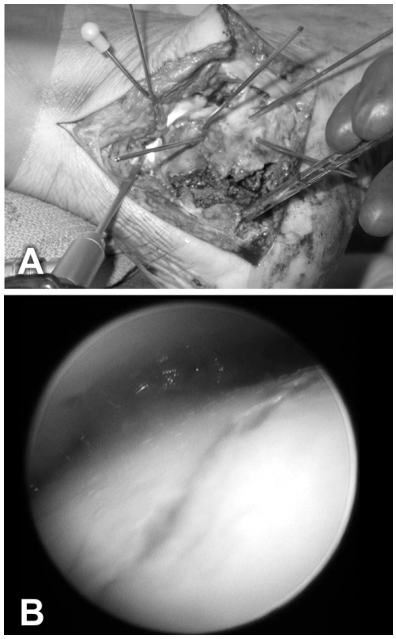

Figure 6. The posterior facet is inspected.

restores the hindfoot alignment and decompresses the posterior facet allowing for restoration of the joint surfaces. Malreduction of the tuberosity fragment will hinder realignment of the posterior facet as the repair process is sequential and dependent on the previous steps. Following reduction of the tuberosity, the anterior body is reconstructed and reduced to the sustentacular fragment. Intermediate articular fragments may be stabilized with small absorbable pins.

The lateral joint fragment is retrieved from the back table and reassembled to the intermediate/sustentacular fragments. The posterior facet is inspected via 2.7-mm or 4.0-mm arthroscope (Figure 6). If the articular reduction is imperfect, the provisional fixation wires are removed and the joint is rereduced under arthroscopic guidance. Fluoroscopy is necessary to ensure appropriate reduction of the anterior and posterior calcaneal body. If alignment is exact, bone graft is then added followed by replacement of the lateral wall.

Final lateral plate fixation may then occur. Subarticular screws may be placed independently from the lateral plate or may be placed through a smaller (2.4-mm) plate. The latter is particularly helpful in severe comminution or in cases in which the lateral joint fragment may be too small to accept 3.5-mm screw fixation (Figure 7). This technique also helps to eliminate diastasis between joint fragments. Following final fixation, the arthroscope is again introduced into the joint to make sure no loss of reduction has occurred during final fixation (Figure 8).

If alignment is confirmed, anatomic layered wound closure is begun over a closed suction drain. The subcutaneous tissues are closed with a 2-0 vicryl and skin

Figure 7. Subarticular screws may be placed independently

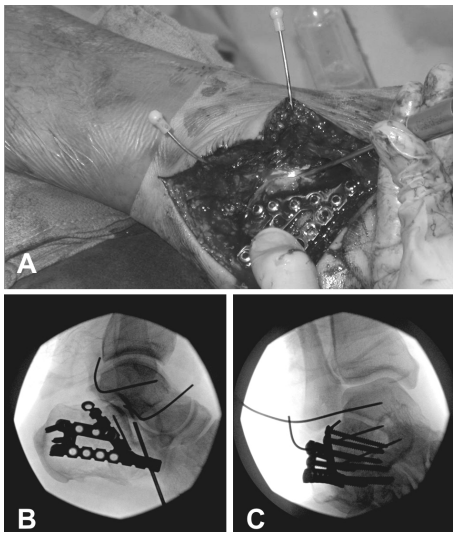

Figure 8. The arthroscope is introduced into the joint to make sure no loss of reduction has occurred.

Figure 9. The subcutaneous tissues are closed.

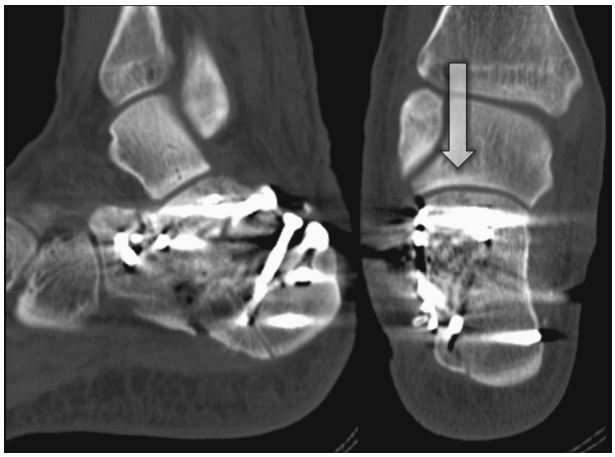

Figure 10. Postoperative CT scan demonstrating anatomic reduction of the posterior facet.

closure is accomplished with 3-0 prolene utilizing a modified Algower-Donati stitch with the suture knots placed away from the flap at risk (Figure 9). Full-length steri strips are used to further direct tension away from the incision line, and a modified Jones compression dressing is applied.

RESULTS

During a 12-month period from September 2006 to September 2007 the author operatively repaired 17 joint depression calcaneal fractures. Fifteen were repaired utilizing arthroscopic assistance. Eleven patients underwent traditional open reduction while 4 were done through limited percutaneous approaches. Preoperative and postoperative CT scans were obtained in addition to traditional plain-film radiographs. Postoperative imaging was done for quality assurance purposes. Postoperative CT scans demonstrated anatomic reduction of the posterior facet in 93% of the cases (14 of 15) (Figure 10). Anatomic reduction was defined as up to 1-mm of fracture diastasis with less than 1-mm of articular incongruity.

DISCUSSION

The concept of using arthroscopy in aiding fracture repair is not new. The orthopaedic literature has described the success of closed or traditional arthroscopic techniques in various intraarticular fractures. Zwipp[3] was the first to describe the operative repair of calcaneal fractures with arthroscopic assistance. Joint depression calcaneal fractures present many challenges to surgeons treating them. Several factors have shown to be critical in affecting patient

outcomes including the magnitude of the injury, the presence or absence of primary chondral damage, and the surgeon's ability to directly restore the articular surfaces and overall architecture of the calcaneus. Despite the extensile approaches described to expose the lateral hindfoot and the talocalcaneal joint, visualization remains difficult often leading to malreduction. Arthroscopic visualization of the central, medial, and posterior portions of the subtalar joint greatly increase the surgeon's ability to restore congruity necessary for "normal" joint function. Although we do not fully understand the entity post-traumatic arthritis there are 2 major causative factors that can be identified with respect to calcaneal fractures: primary chondral damage[4] and malreduction. There are certain injury characteristics that cannot be changed by the surgeon: the degree of soft tissue injury, the degree of chondral damage, the degree of bony inury and any comorbid conditions that may be present (smoking, diabetes, etc.). Joint reduction is one of the few variables that are not predetermined by the magnitude of the injury. Surgeons treating calcaneal fractures can benefit form the use of intraoperative arthroscopy to improve fracture reduction.

REFERENCES

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