

DISTRACTION ARTHRODESIS OF THE SUBTALAR JOINT FOR POST-TRAUMATIC DEFORMITY: A Case Report With an Alternative Grafting Method

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INTRODUCTION

The most common late sequela associated with calcaneal fractures are subtalar joint arthritis, tibiotalar impingement, loss of heel height, and calcaneofibular abutment with peroneal tendon entrapment. Other sequela include varus and valgus hindfoot malalignment, sural neuritis, tarsal tunnel syndrome, painful plantar heel, rocker-bottom collapse of the medial longitudinal arch, and mid-tarsal joint arthrosis.^{1,22} In 1931 Bohler²³ described the angular relationship of the subtalar articular facets of the calcaneus in the sagittal plane. This angle is formed by a line from the superior point on the posterior articular surface to the superior portion of the calcaneal tuberosity that intersects with a line from the superior point on the posterior articular surface to the superior point of the anterior process of the calcaneus. The normal relationship ranges from 25° to 40°, with an average of 35°, according to Stephenson.²⁴ This angle is decreased and often reversed with joint depression fractures of the calcaneus. Depression of the posterior facet of the calcaneus disrupts the anatomic relationship between the talus and calcaneus in the subtalar joint. This abnormal relationship between the depressed calcaneal posterior facet and the talar posterior facet leads to the development of post-traumatic arthritis, the most commonly encountered late sequela of calcaneal fractures involving the subtalar joint. Depression of the posterior facet into the calcaneal tubor also causes a loss of heel height and impingement of the talar neck on the anterior aspect of the tibial plafond. Loss of heel height combined with the increased heel width caused by the lateral calcaneal wall blowout can result in calcaneofibular abutment and peroneal tendon impingement.

In situ fusion of the subtalar joint will eliminate the degenerated articular facets and can reduce the varus or valgus hindfoot position through wedge resection. However, the shortened heel height, calcaneofibular abutment, and tibiotalar impinge-

ment are not addressed through this approach. Carr et al² first described the technique for distraction arthrodesis of the subtalar joint in 1988. They used a tricortical piece of autogenous posterior iliac crest graft that was fashioned to increase the height of the depressed posterior facet and to correct the varus/valgus position of the hindfoot. They noted that this procedure would restore the talocalcaneal relationship, relieve the tibiotalar neck impingement, increase heel height improving shoe wear comfort, and decompress the peroneal tendons. In their series of 16 feet, one patient exhibited a hematoma at the graft harvest site.

Myerson and Quill³ reported on their experience with the procedure in 1993. They used autogenous tricortical iliac crest grafts in 14 patients, and described two patients with neuritis involving the lateral femoral cutaneous nerve after harvesting of the graft. Amendola and Lammens⁴ performed this procedure on fifteen patients using iliac crest bone graft and reported their results in 1996. The procedure was successful in eleven patients, and there was no mention of donor site morbidity among the complications. In 1997, Bednarz et al⁵ reported on 29 feet that underwent distraction arthrodesis using autogenous posterior iliac crest graft. They mentioned no complications associated with the graft harvest site. Chan and Alexander⁶ performed the operation on 10 patients using autogenous posterior iliac crest graft. They modified their procedure to include two grafts to avoid graft sinkage in osteoporotic patients. They also used a single partially threaded 6.5mm cancellous screw oriented from the talar neck into the calcaneal body because of early hardware pain with the use of a plantar screw. No incidence of harvest site complications was reported. In 1998, Burton et al⁷ used autogenous iliac crest graft in 15 operations for distraction arthrodesis. One patient was reported having continued mild pain at the graft donor site two years later. Catanzariti⁸ also mentioned the use of bone grafting for subtalar joint distraction arthrodesis. He believes

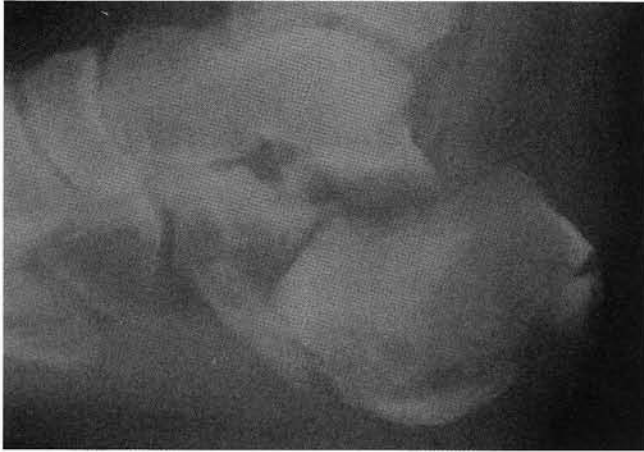


Figure 1. Initial preoperative lateral radiograph.



Figure 2 Postoperative open reduction internal fixation lateral radiograph.

that autogenous bone was more advantageous for fusion because it promotes osteoconduction and osteoinduction, heals at a faster rate, and avoids the host's immune system response to allogenic bone that can cause graft rejection. He noted that cortico-cancellous grafts were the best option for distraction arthrodesis because the cortical bone would maintain the distraction and alignment by functioning as a strut while the cancellous bone would promote osseous consolidation. The potential for donor site morbidity was recognized.

Cohen⁹ was the first to report on the use of allogenic graft for bone block fusion of the subtalar joint. He used allogenic graft in eight of the 15 patients he reported on in 1996. None of the patients experienced non-union or malunion. The use of allogenic graft in fusions has been controversial because it only promotes osteoconduction by serving as a lattice work for the patient's own osteocytes to migrate through. When greater deformity exists in the talocalcaneal relationship, allogenic bone may delay healing time or result in a nonunion because the healing will take place at the host-graft interface. Because of the lack of vascularity in allogenic bone grafts, this could leave a large avascular area that would be more prone to complication.⁸

The following case report describes a complicated tongue-type calcaneal fracture treated with distraction arthrodesis of the subtalar joint. The redundant bone afforded by the deformity served as an excellent source of an autogenous corticocancellous graft, thereby avoiding a second site of surgical morbidity.

CASE REPORT

A 31-year-old woman, involved in domestic violence, fell fifteen feet from a second story balcony and injured her left heel. She was treated at an emergency room with a posterior splint. One week later, the patient went to see a local doctor who detected an ulceration at the posterior aspect of the left heel. Radiographs revealed a severe tongue-type fracture of the left calcaneus with fragments present near the ulcer (Figure 1). The patient was then referred to Northlake Regional Medical Center, Tucker, Georgia.

The ulcer began to heal with debridement, local wound care, and intravenous antibiotics. A computed tomography scan was taken of the left foot and revealed a complete disruption of the posterior facet with a shear fracture of the sustentaculum tali. Severe comminution of the calcaneal tubor was noted with no involvement of the calcaneocuboid joint. No evidence of calcaneofibular abutment was seen.

Four-and-a-half weeks after the injury, an attempt was made at open reduction and internal fixation of the fracture. Exposure of the subtalar joint was gained through a lateral incisional approach. The peroneal tendons were retracted in their sheath along with the lateral calcaneal wall. The posterior facet of the talus was articulating with the posterior margin of the posterior facet of the calcaneus. The posterior superior portion of the calcaneus was in severe equinus. Despite multiple attempts at reducing the fracture, a partial reduction with three smooth 0.062 inch Kirschner-wires (K-wires) was



Figure 3. Clinical appearance of the left heel at 11 months. Lateral view showing the posterior prominence.

accepted (Figure 2). A bone biopsy obtained from the posterior ulcer during the reduction was negative for osteomyelitis. The posterior heel wound was subsequently closed with a rotational flap.

The patient was kept in a short-leg nonweight-bearing cast for three months, and range of motion exercises were initiated at 6 weeks. At one year after injury, the patient had developed arthritic symptoms at the subtalar joint, a significantly large posterior calcaneal prominence (Figures 3 and 4), and anterior ankle complaints due to tibiotalar neck impingement from the depression of the posterior facet of the talocalcaneal joint. Dorsal-plantar and lateral radiographs showed consolidation of the calcaneus with a significant posterior prominence, signs of degenerative arthritis at the subtalar joint with sparing of the midtarsal joints, tibiotalar neck impingement, and loss of calcaneal height (Figure 5).

Approximately 13 months after injury, the patient was taken back to the operating room. Exposure of the lateral calcaneal wall and subtalar joint was obtained with a lateral approach through the previous cicatrix. The K-wires were located and removed. The joint was distracted with a lamina spreader placed in the sinus tarsi. The posterior facet of the calcaneus was severely flattened from the depression of the initial injury. The inferior surface of the talus showed degenerative changes. Exposure of the posterior aspect of the calcaneal tuberosity and subtalar joint was obtained through a linear incision made anterior to the lateral margin of the tendoachilles. A lamina spreader was then placed in the posterior medial aspect of the poste-



Figure 4. Clinical appearance of the left heel at 11 months. Posterior view showing the healed rotational flap.

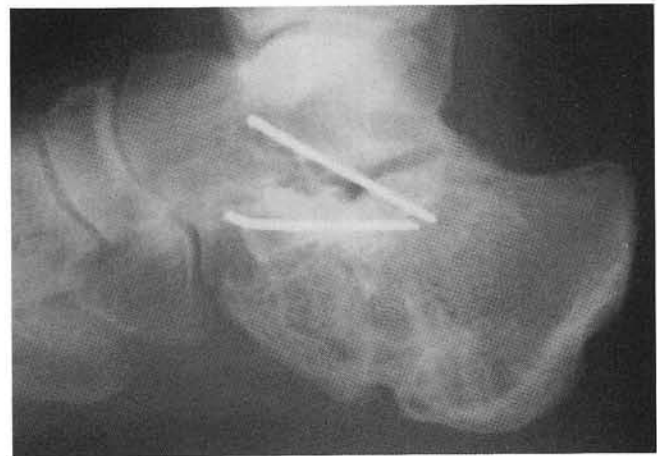


Figure 5. Lateral radiograph of the rearfoot at 11 months post injury.

rior facet and distraction was used to increase the calcaneal inclination and talar declination restoring the anatomic alignment (Figure 6). The desired position of the hindfoot was confirmed with a lateral radiograph. The redundant bone from the posterior calcaneal tuberosity was then resected and fashioned into a trapezoidal wedge with the medial side two millimeters thicker than the lateral side to correct a varus malalignment. The graft was then positioned between the denuded posterior facets (Figures 7 and 8) and fixated with a 6.5 mm

partially-threaded, short thread cancellous screw directed from the plantar aspect of the calcaneal tuberosity, through the graft and into the talar body (Figure 9). The tendoAchilles was reattached to the calcaneus. A large, closed suction drain was inserted prior to closure of the lateral incision.

The patient was maintained nonweightbearing in a short-leg cast for 10 weeks. Radiographic evidence of graft consolidation was seen at 6 weeks, and the patient was allowed progressive weight-bearing at 10 weeks. Deformity correction was maintained as proven by no change in the measurement of the distance from the talar dome to the weight-bearing surface of the calcaneal tuberosity.⁷ The patient was last seen 9 months postoperative distraction arthrodesis, and only complained of pain over the dorsal aspect of the fifth metatarsal base.

There was no noticeable difference in limb length compared to the contralateral leg. The patient was able to wear the types of shoes that she could not before the surgery. No signs of tarsal tunnel syndrome, sural neuritis, calcaneofibular abutment, or peroneal tendon pathology were evident on examination. Ankle joint range of motion was equal for both sides. The heel was in two degrees of valgus. The midtarsal joint demonstrated full and painfree range of motion compared to the contralateral foot. Only mild pain was noticed at the fifth metatarsal cuboid joint dorsally with range of motion. Radiographs show complete consolidation of the graft and arthrodesis with neither loss of heel height nor tibiotalar neck impingement (Figure 10). Early signs of arthrosis at the fifth metatarsal cuboid articulation were noted.

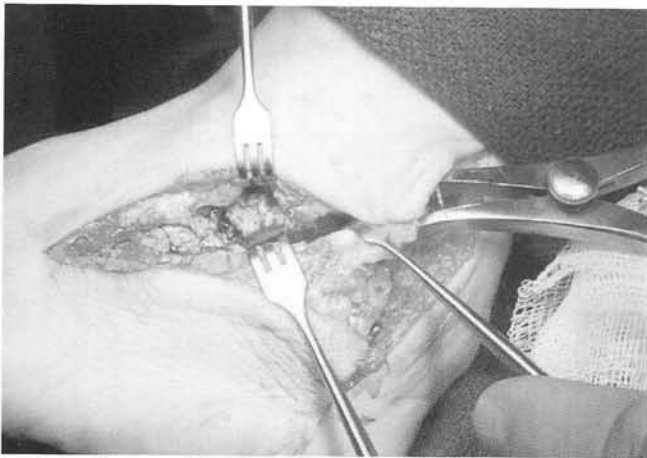


Figure 6. Clinical intraoperative photo demonstrating distraction of the subtalar joint with the lamina spreader.



Figure 7. Clinical intraoperative photo showing graft in place. The lessersaphenous vein, sural nerve, and peroneal tendons are retracted superiorly.

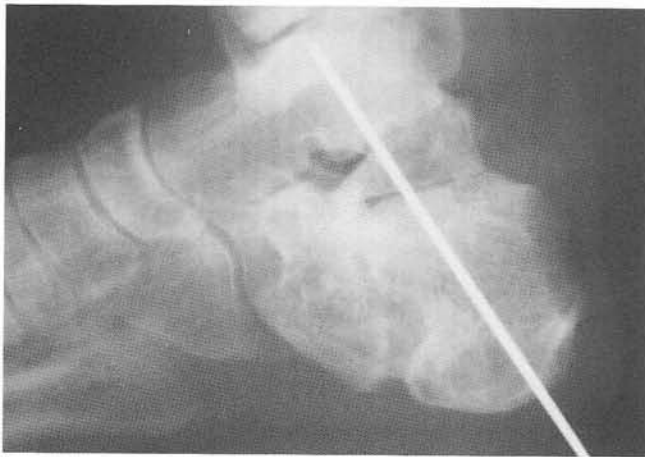


Figure 8. Intraoperative lateral radiograph confirms reestablishment of talocalcaneal relationship.

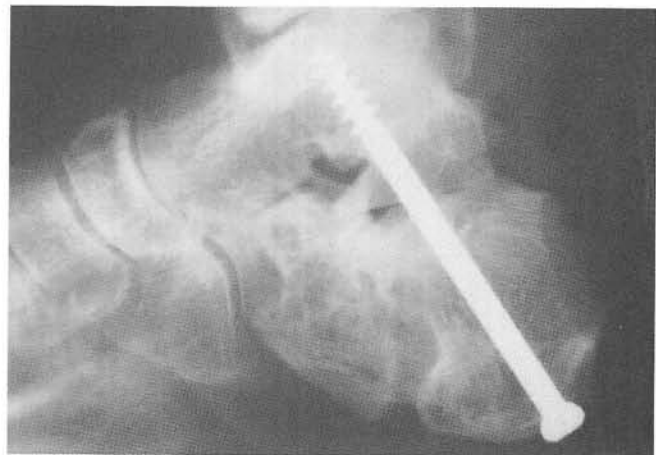


Figure 9. Final intraoperative lateral radiograph showing position of rearfoot and fixation.



Figure 10. Nine month follow-up lateral radiograph showing complete incorporation of graft with no change in position of rearfoot.

DISCUSSION

The technique of distraction arthrodesis of the subtalar joint enables the surgeon to reconstruct the talocalcaneal relationship into a more functional position. This particular procedure will correct more of the late sequela of calcaneal fractures than in situ fusion. The case demonstrates the ability of distraction arthrodesis to correct tibiotalar neck impingement, loss of calcaneal height, varus malalignment, and severe arthrosis of the subtalar joint. The patient was able to return to a more functional lifestyle and wear a wider variety of shoes. The patient's only complaint after fusion was occasional pain in the fifth metatarsal cuboid articulation. This can be attributed to increased demand for dorsiflexion at this joint due to the loss of dorsiflexion at the subtalar joint.

The patient had a symptomatic posterior prominence as the result of a partially reducible severe tongue type fracture of the calcaneus. Instead of subjecting the patient to another site of potential morbidity in order to obtain iliac crest graft, the redundant bone was removed and fashioned into an interpositional corticocancellous graft. This alternative grafting method provided a quicker recovery course, allowed for an earlier fusion than allograft, maintained the correction of the deformity by eliminating resorption at the graft-host interface, and avoided potential complications associated with harvesting an iliac crest graft.

A case study involving a tongue-type calcaneal fracture that was ultimately treated with distraction

arthrodesis of the subtalar joint was presented. The resultant pathologic anatomy enabled avoidance of an additional site of potential morbidity associated with harvest of an iliac crest bone graft. This technique for alternative autogenous graft may be considered when treating post-traumatic arthrosis of the subtalar joint following tongue type fractures of the calcaneus.

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