CHAPTER **18**

CONSIDERATIONS OF A MIDLINE POSTERIOR APPROACH TO THE ANKLE AND SUBTALAR JOINTS

Ian R. Hersh, DPM
Justin J. Fleming, DPM

INTRODUCTION

Many incisional approaches have been described for various facets of foot and ankle reconstruction. The majority of these exposures are from the medial, lateral, or anterior aspects thus taking advantage of the subcutaneous position of both osseous and soft tissue structures. These incisions are not always practical however, especially in cases of previous infection, local soft tissue compromise (high energy fractures, compartment syndrome, crush injuries, skin graft, or burns) or pathology that is primarily posterior in location. In these situations, exposure though the posterior corridor is indicated. Although the notion of splitting the Achilles tendon through to gain hindfoot joint exposure may sound daunting, the technique can be effective and "safe".[1-4] The approach is also warranted in other cases of posterior manipulation as outlined in Table I. The authors review the pertinent literature and describe their limited experience with a posterior midline incision.

LITERATURE REVIEW

Subtalar distraction arthrodesis and tibiocalcaneal arthrodesis have been discussed in detail by previous authors. As far back as 1956, Staples described the advantages and disadvantages of using a posteromedial approach for arthrodesis of the ankle and subtalar joints. He noted that it was advantageous to utilize the long distal surface of the talus and calcaneus when bone graft was needed. He also outlined the ability to access both the ankle and subtalar joints from a single incision.[5]

Pollard and Schuberth detailed a posterior bone block arthrodesis of the subtalar joint over a 7 year period utilizing a posterolateral approach. The main indication of their technique was for neglected calcaneal fractures with severe joint depression (36%). They achieved a 95.5% union rate and reported a total of 3 wound dehiscences (13.6%). Furthermore, 11 of the patients had delayed wound healing (24%). The high incidence of delayed wound healing in their experience may be from a combination of surgical approach in the fact that 8 of the 11 patients were smokers.[6]

In 2008, Garras et al concluded that subtalar distraction arthrodesis through a posterolateral approach with the use of structural allograft or autograft was an effective way to treat severe subtalar joint arthritis with loss of heel height. The authors demonstrated a 90% fusion rate with an AOFAS hindfoot score improvement from 21 to 71 points in 21 total patients.[7] They did not present any wound complications in their results. While these studies solidify that a posteromedial or posterolateral approach is advantageous in a distraction arthrodesis of the hindfoot, few studies have detailed the central midline posterior approach.

In a study by Hammit et al in 2006, a low wound complication rate was reported in 33 patients who underwent a midline posterior approach. Five total wound complications were reported in their results. Two of these five subjects had a prior history of deep infection and two had considerable comorbidities. Of significance, none of the 33 patients followed developed a flap necrosis and only 2 out of the 33 patients did not achieve an excellent initial primary closure (6.1%).[4] The statistically low incidence of wound complications when using a posterior approach most likely is due to the fact that the midline posterior incision lies between the aforementioned angiosomes.[4]

In a related study, DeOrio et al reported on 6 patients who underwent subtalar joint distraction arthrodesis through a midline posterior approach. Five of these patients had a severe valgus deformity while 1 presented with the hindfoot in varus. Although the sample size of the study was small, all 6 of the patients were noted to achieve a successful subtalar

Table 1

INDICATIONS FOR THE MIDLINE POSTERIOR APPROACH

Ankle Arthrodesis
Bone Block Distraction of Neglected Calcaneal Fractures
Achilles Tendon Reconstruction
Deformity Correction – Hindfoot/Ankle/Distal Tibia
Tibiotalacalcaneal/Tibiocalcaneal Arthrodesis
Fracture Stabilization

joint fusion. The frontal plane deformity and calcaneal height was successfully restored in each patient. No Achilles tendon disruptions or hardware failures were noted in any case. Furthermore the authors reported no wound complications postoperatively and did not find a need to dose any antibiotics.[3]

ADVANTAGES OF THE POSTERIOR MIDLINE INCISION

Exposure and Realignment

Hindfoot/ankle position is best appreciated from the posterior vantage point. With the patient in the prone position the angular relationships between the knee, ankle and foot are readily visible and are easily reproducible. This is critical since varus/equinus malpostition is a common avoidable complication.[3,4] Rotation can be more challenging to evaluate and careful preoperative assessment of the contralateral limb is warranted. Additionally, the intra-operative "unwinding" the varus deformity in the subtalar joint during arthrodesis can be very challenging. Difficulty is often encountered when attempting to medialize the bone block through the traditional posterolateral incision. The medial ligaments of the subtalar joint often thwart medialization of the graft to achieve the often necessary valgus correction. The medial and anterior capsular ligaments of the subtalar joint are easily released through this approach. Furthermore, if an autograft is preferred, the posterior iliac crest can be easily accessed with the patient in a prone position.[7] The increased surface area gained in comparison to other approaches allows for the addition of bone graft if necessary.[3,4]

Additionally nonunited/malunited fractures of the distal tibia can be addressed via a posterior approach and uncomplicated submuscular hardware placement can be achieved. Lastly, the approach provides the surgeon with the ability to perform multiple procedures from a single incision (i.e. calcaneal osteotomy and a tendo Achilles lengthening), thus reducing unnecessary soft tissue trauma.

Vascularity

One of the more intriguing reasons for choosing the midline posterior approach lies in the fact that the dissection lays between two distinct angiosomes.[3] The source arteries in the foot and ankle are the posterior tibial artery, the anterior tibial artery, and the peroneal artery. Along with these demarcated angiosomes are choke vessels that not only mark the separation of two angiosomes, but also provide the meshwork that allows two distinct angiosomes to communicate.[1,2,4] The angiosome of the posterior tibial artery in the leg spans from the distal medial leg to the medial half of the posterior calf. In the foot and ankle it incorporates the posterior medial half the Achilles tendon with the central raphe of the tendon marking its division from the peroneal angiosome. The angiosome of the peroneal artery supplies the posterolateral lower leg, ankle, and heel. In the foot and ankle it extends from the central raphe of the Achilles tendon to anterior edge of the peroneal compartment. In the anterolateral approach, the incision lies on the lateral aspect of the anterior tibial angiosome. The posterolateral approach violates the peroneal angiosome as the incision cuts through its mid-portion.[2] Since the posterior central midline incision lies between these two unique angiosomes, the arterial supply to the foot remains patent when dissection is carried out properly.

It is crucial for the performing surgeon to realize that some complications may be avoided by the choice of incision placement and dissection. Attinger et al described four factors that should be considered when choosing incision placement. First off, the incision must be able to provide sufficient exposure. Secondly, there should be enough blood supply surrounding the incision to promote healing. Next, the incision should attempt to avoid damage to sensory and motor nerves. Finally, if possible, the incision should lie within relaxed skin tension lines, as perpendicular incisions have a higher chance of poor healing and scarring.[1,2] Attinger recommended placing incisions between two angiosomes if possible as it would improve the chances of avoiding vascular compromise. It must be noted that even if the incision is made between angiosomes, it is crucial to determine whether each angiosome has adequate blood supply before the location is chosen.[2] A simple way of confirming that angiosomes are well perfused pre-operatively can be achieved using a Doppler to manually listen to source vessel pulses.[1,2,4]

The incision used in our midline posterior approach was directly midline to the Achilles tendon along its central raphe (Figure 1). The incision fulfills three out of four of the recommendations laid out by Attinger. Once the overlying soft tissue is retracted, exposure achieved by the posterior approach is sufficient with excellent visualization of both the subtalar and ankle joint. The approach also protects from nerve damage to the foot as the posterior foot and ankle does not contain any major neural structures. In regard to vasculature, it lies directly between the mapped angiosomes of posterior tibial and peroneal.[2] Altogether, the dissection is relatively safe in regard to compromising vasculature (Figure 2).

Post-traumatic Reconstruction

Perhaps the most effective use of the posterior midline approach is in post-traumatic reconstruction. Often the posterior tissue is spared from extensive soft tissue damage in

Figure 1. Indications for the midline posterior approach

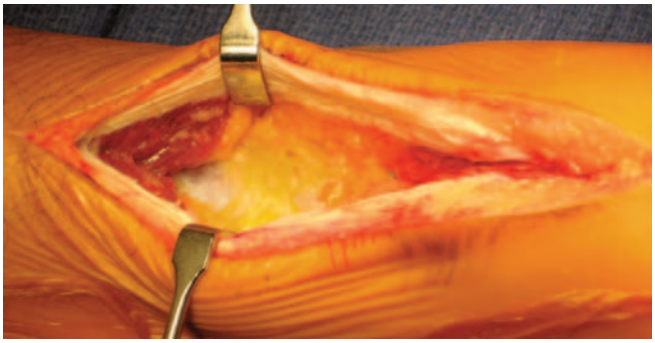

Figure 2. The central midline incision is carried through the substance of the Achilles tendon longitudinally creating two equal halves that can be retracted to gain exposure to the underlying tissue and joints. The midline posterior dissection is considered a "safe" approach due to the fact that it avoids violating the posterior tibial or peroneal angiosome.

traumatic injuries, making it a superior choice when the anterior, medial, and/or lateral soft tissues have been violated either from prior surgical attempts, local infection or high energy fractures. Operating through a compromised soft tissue envelope increases the potential for developing postoperative soft tissue complications, ranging from wound dehiscence to full thickness flap necrosis, which often requires plastics involvement or prolonged convalescence.[1,2,3,4] The midline approach allows for two distinct full thickness flaps to be created. The paratenon is ideally not dissected from overlying tissue or Achilles tendon, however in our experience more extensive dissection may be needed in order to provide adequate hemostasis. The vascularity of the posterior soft tissue envelope augments the probability of complete wound healing and as previously mentioned allows for submuscular implant placement. The linear nature of the incision is also favorable in regard to limiting swelling as compared to a curved linear incision often seen in rearfoot approaches. Not only does the approach most likely avoid previous surgical incisions, it also avoids possible disruption of the sural or superficial peroneal nerve encountered during a lateral approach or the posterior tibial artery and nerve in a medial dissection.[8]

DISADVANTAGES OF THE POSTERIOR MIDLINE INCISION

Rotation

There are several disadvantages of a midline posterior approach that deserve mention. While visualization in all planes can be achieved, rotation still remains an obstacle that is difficult to evaluate. Rotation that goes undiagnosed during surgery may cause a gait disturbance postoperatively that will be difficult to correct with any foot or ankle orthosis. Careful preoperative assessment of the contralateral limb is warranted with the patient in both the supine and prone position.

Achilles Tendon

Another factor that should be considered is the proximity of the Achilles tendon to the overlying soft tissues. If a wound complication or dehiscence develops at the incision site, the surgeon is left with an exposed tendon that is often difficult to treat. Even if the wound heals without complication, the patient is still at risk of developing an aesthetically unpleasing or painful scar due to the location of the incision. When the patient returns to weight-bearing, he/she may complain of discomfort at the incision site due to friction of the skin on shoe gear. Undesirable scarring or contracture of skin may be attributed to the fact the midline incision violates relaxed skin tension lines in the posterior aspect of the ankle.[2,4]

Incision Length

Additionally, the posterior incision must be longer because of the depth of the target tissue within the wound. Deeper dissection is required for adequate exposure as compared with the other approaches especially if plating fixation is utilized because percutaneous insertion of screws is not possible.

TECHNIQUE

The posterior incision provides excellent exposure to the subtalar and/or ankle joints. This is not an approach that is routinely performed by the foot and ankle surgeon and therefore preoperative cadaveric dissection or review of the applied anatomy should be undertaken. With the patient in a prone position a midline linear incision is carried out over the posterior ankle and hindfoot. The incision should be carried out to at least the superior half of the heel to allow for appropriate retraction of the Achilles tendon. The incision can be extended proximally to the desired length to allow for the appropriate manipulation and fixation of the

target tissue. A full thickness flap is carried out through the midline Achilles tendon and avoids undermining of the skin, subcutaneous tissue and paratenon. The flap is critical to the maintenance of the soft tissue envelope. The medial and lateral slips of the tendon are retracted and the fascia overlying the deep compartment lies just beneath a shallow layer of adipose tissue. This fascia is divided and the FHL muscle belly is immediately encountered. The FHL muscle and the contents of the posterior compartment are retracted medially providing unopposed access to the posterior ankle and subtalar joints (Figure 3).

In cases of neglected calcaneal fractures, reduced talar height and profound arthritis of the joint surfaces can often be difficult to identify initially. Fluoroscopic guidance can be helpful in these instances. Once the targeted joint is indentified, sharp intraarticular dissection with an elevator is often needed to release intraarticular adhesions and the scarified peripheral ligaments and allow sufficient distraction. This is particularly evident in repositioning a varus subtalar joint in which the medial ligaments tether the joint and prevent relocation. In situations where posterior plating is planned, the FHL muscle belly can be bluntly elevated off the posterior tibia and fibula. Joint cartilage can be curetted in order to prepare the fusion site for insertion of a bone block. At this point, osseous manipulation may be performed.

Upon completion of all osseous correction, closure should be accomplished with the aid of a closed suction drain. If the FHL muscle belly was displaced it should be relocated and loosely secured over the fusion / hardware. The fascia of the posterior compartment and reapproximation of the Achilles tendon reduce tension on the skin closure. The skin is then closed using a modified Allgower-Donati suture.

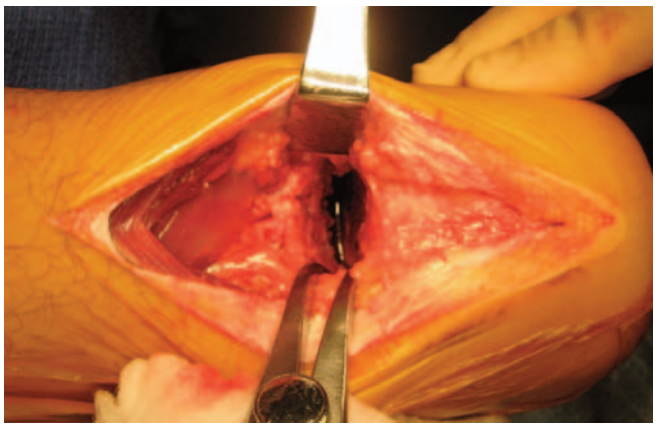

Figure 3. A lamina spreader is used to gain to easily gain access to the subtalar joint.

Figure 4. Clinically the patient presented with a severe valgus deformity with associated diabetic charcot arthropathy, chronic osteomyelits, and a tibiocalcaneal dislocation with associated non-healing wounds.

Figure 5. Preoperative view.

Figure 6. Preoperative radiograph demonstrating avascular necrosis of the talus with complete collapse of the bone and severe joint depression.

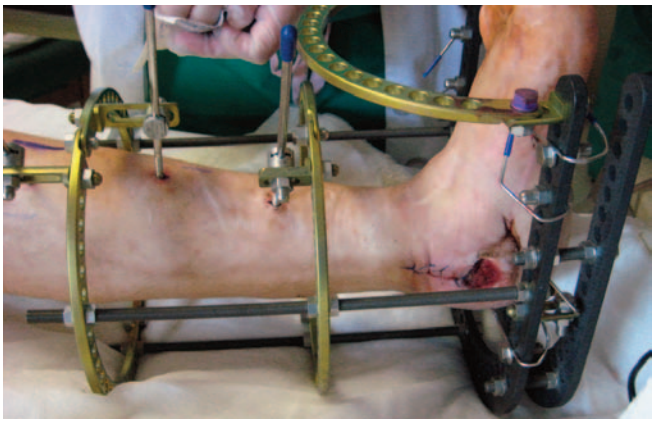

Figure 7. The patient underwent a staged procedure. In the first operation, the patient was placed in an external ring fixator and received debridement of a medial ankle wound with insertion of an antibiotic spacer and antibiotic beads.

CASE STUDY I

The first subject was a 59-year-old man with diabetic charcot arthropathy, chronic osteomyelits, and a tibiocalcaneal dislocation with associated non-healing wounds (Figures 4, 5). The patient had previously undergone a triple arthrodesis that went on to develop avascular necrosis of the talus with complete collapse and development of a medial wound (Figure 6). He was brought to our facility where he underwent debridement of the distal tibia, intramedullary reaming and insertion of an antibiotic spacer, intramedullary antibiotic beads, and an external fixator (Figure 7). Following culture-directed intravenous antibiotics, he was then brought back to the operating room approximately 8 weeks later where the posterior midline approach was used to perform a tibiocalcaneal fusion with use of a humeral blade plate, screws, autograft (iliac crest) and implantable bone stimulator (Figures 8, 9).

CASE STUDY II

The second subject was a 30-year-old male carpenter who fell approximately 12 feet and sustained bilateral calcaneal fractures. He presented five months following non-operative treatment. Radiographs demonstrated significant joint depression with arthritis and loss of hindfoot height (Figure 10). He presented with an painful valgus deformity and significant subtalar joint depression (Figure 11). He underwent bone block distraction arthrodesis of the subtalar joint in an attempt to alleviate pain and restore hindfoot alignment. This was carried out with 6.5 mm solid core screws and the insertion of a femoral head bone block utilizing the midline posterior approach (Figures 12, 13)

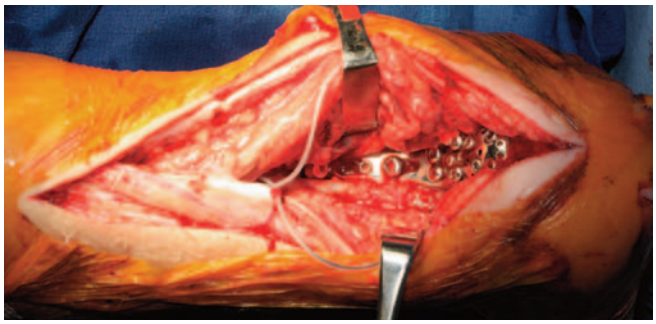

Figure 8. A humeral blade plate was used to provide rigid internal fixation of the subtalar joint after insertion of a bone block.

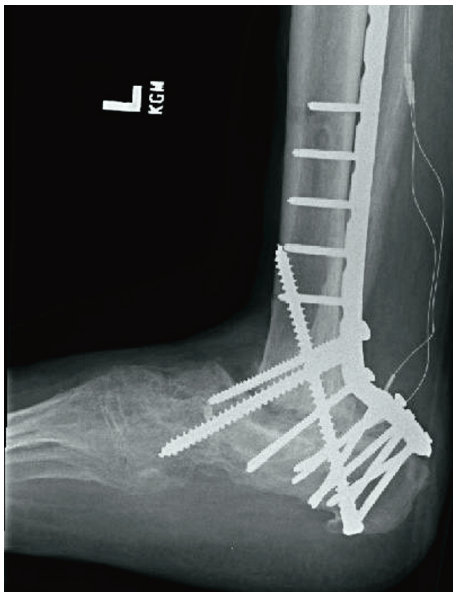

Figure 9. Postoperative radiograph shows the subtalar joint has been fused with internal fixation consisting of a plate and screws. A relatively large amount of fixation was used due to the patient's diabetic charcot arthropathy.

CONCLUSION

From our limited experience the midline posterior approach to the ankle and subtalar joints has proven to be both a safe and effective surgical modality. The exposure gained from the approach is unparalleled when compared to similar approaches to the joints. The robust soft tissue envelope and submuscular placement of hardware, as well as its dissection between distinct angiosomes minimizes potential wound complications and the chance of secondary surgeries related to such. The crucial and traditionally difficult to assess frontal plane positioning can easily be assessed from a direct posterior vantage point. When a bone block distraction is indicated, the ability to medialize the graft without the hindrance of the subtalar joint ligaments will save the

Figure 10. The patient presented with bilateral untreated calcaneal fractures. He clinically showed a severe painful valgus deformity.

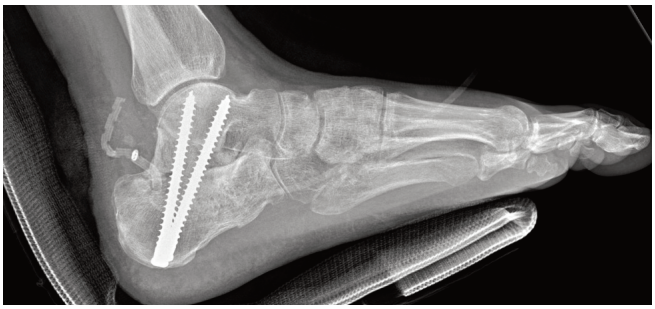

Figure 12. Postoperative radiograph showing two 6.5 mm non-cannulated screws fixating the subtalar joint with joint depression corrected with a bone block.

surgeon both time and anguish. With the approaches' high capacity of replication with a relatively low learning curve, the posterior midline approach to the ankle and subtalar joints should be the modality of choice in some cases of trauma or deformity.

REFERENCES

1. Attinger et al. Soft tissue reconstruction for calcaneal fractures or osteomyelitis. Foot Ankle Clin N Am 6 (2001) 745–799.
2. Attinger CE, Cooper P, Blume P. Vascular anatomy of the foot and ankle. Operative Techniques in Plastic Reconstructive Surgery 1997;4:183–98.
3. Deorio JK, Thaddeus Leaseburg J, and Shapiro SA. Subtalar Distraction Arthrodesis Through a Posterior Approach. Foot & ankle international / American Orthopaedic Foot and Ankle Society [and] Swiss Foot and Ankle Society 29(12):1189-94, Dec 2008; 1189-1194.

Figure 11. Preoperative radiograph demonstrating the large amount of joint depression in association with an untreated calcaneal fracture.

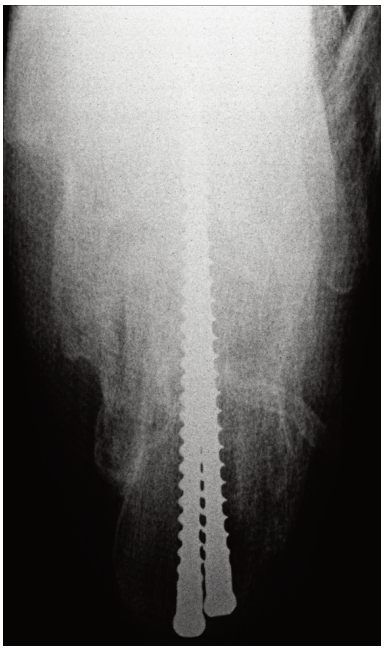

Figure 13.

4. Hammit et al: Midline Posterior Approach to the Ankle and Hindfoot. Foot & Ankle International/Vol. 27, No. 9/September (2006) 711-715.
5. Staples OS. Posterior Arthrodesis of the Ankle and Subtalar Joints. The Journal Bone & Joint Surgery. Vol. 38 (1956) 50-83.
6. Pollard JD, Schuberth JM. Posterior Bone Block Distraction Arthrodesis of the Subtalar Joint: A Review of 22 Cases. The Journal of Foot and Ankle Surgery. Vol 47, No. 3, May/June (2008) 191-198.
7. Garras et al. Subtalar Distraction Arthrodesis Using Interpositional Frozen Sturctural Allograft. Foot & Ankle International/Vol. 29, No. 6/June 2008.
8. Amendola et al. Technique and Early Experience with Posterior Arthroscopic Subtalar Arthrodesis. Foot & Ankle International/Vol. 28, No. 3/March 2007.