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An Alternative Technique for Transosseous Calcaneal Pinning in External Fixation

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A R T I C L E I N F O

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A B S T R A C T

The authors describe a technique in which two 5.5-mm pins are inserted from the posterior aspect of the calcaneus and advanced anteriorly on a slightly convergent vector. The 2 points of fixation, with a 5/8 ring, provide a “steering wheel” effect allowing for leverage and control of the hindfoot and ankle. The construct also allows for offloading of the posterior calcaneus.

External fixation can be used for the treatment of a variety of deformities in the lower extremity (1,2). Commonly used applications include traumatic osseous injury such as open fractures, limb stabilization for diffuse soft tissue disruption, sites with active infection, and stabilization for reconstruction of Charcot neuroarthropathy (2–4). Several benefits have been demonstrated when using this method of fixation, including the ability to accommodate extensive soft tissue injury and/or bony defects (4).

Effective surgical outcomes when using external fixation are strongly dependent on surgeon experience (2). A number of complications may occur because of pin placement in the vicinity of vital tendinous and neurovascular structures within the hindfoot region. These have been reported to include damage to the tendinous and neurovascular structures, healing impedance of cutaneous closure flaps, and pin tract infections (5–11).

The purpose of this article is to describe a technique for placement of calcaneal external fixator pins in a posterior-to-anterior direction (12). This orientation lessens the risk of damage to surrounding anatomical structures, increases stability and protection of the soft tissue, and may provide for decreased pin tract infections.

Technique

The external fixation procedure outlined in this report uses two 5.5-mm diameter pins, spanning 180 mm to 200 mm in length. The pins are inserted from the posterior aspect of the calcaneus and advanced anteriorly (Fig. 1). Ideal placement involves maximal depth of insertion while avoiding damage to the anterior aspect of the calcaneus (Figs. 2 and 3), unless the desire is to traverse the midtarsal joint. This technique can be modified to provide improved stability to the rearfoot by angling the pins toward the medial and lateral columns of the foot (Figs. 4 and 5). Regardless of the specific direction in which the pins are inserted, care should be taken to ensure that they are placed in a slightly convergent vector and at 2 distinct levels of insertion, with one pin superior to the other. After insertion of the pins, a variety of partial rings can be applied, including 5/8 rings and

Fig. 1. Lateral intraoperative view demonstrating 5.5-mm pins inserted posteriorly to anteriorly.

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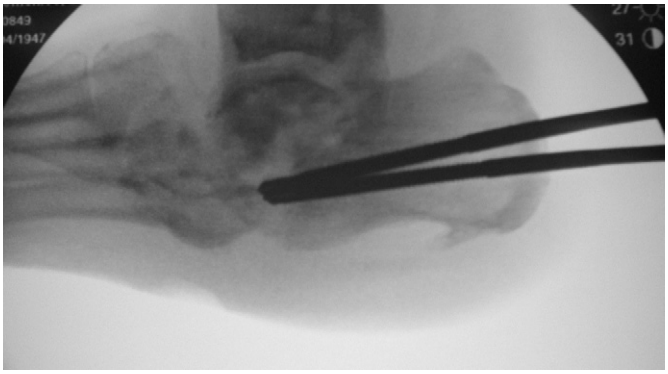

Fig. 2. Pins placed at a slightly convergent vector at 2 distinct levels of insertion.

a U-shaped bar (Fig. 6). After application of the external fixation frame, routine pin care is indicated.

Discussion

Strategic pin placement is a key component of operative planning when applying external fixation. A number of authors have detailed the regions within the foot that are least vulnerable to soft tissue traumatic injury, and have recommended using intraoperative fluoroscopy with blunt dissection to allow for minimally traumatic placement of pins. In a dissection study of 15 cadaver feet, Santi and Botte (10) determined that the 4 regions of the hindfoot that contain the least amount of neurovascular tissue, in particular named anatomic vessels and nerves, are the areas medial and lateral to the calcaneus and talus, with the exception of the tarsal tunnel, where the deep flexor tendons also reside. Other studies supported these findings, with similar outcomes (5,8). However, in each study, the risk of encountering vital structures in these areas of the foot was omnipresent. Specifically, the structures found to be the most vulnerable in the medial and lateral calcaneal and talar safe zones were the medial calcaneal branch of the tibial nerve, terminal branches of the saphenous nerve, and lateral calcaneal branches of the sural nerve, respectively (5,10). It has been recommended that a more posterior position of the calcaneal pin may decrease the possibility of damage to these structures (5,11).

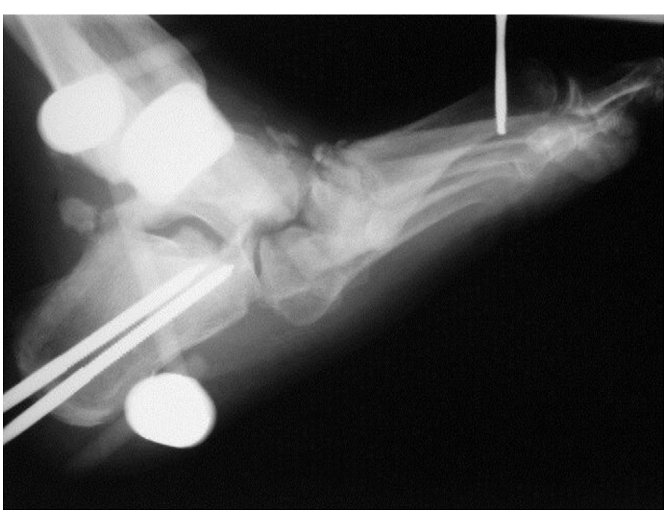

Fig. 3. Pins extend to the maximal length of the calcaneus.

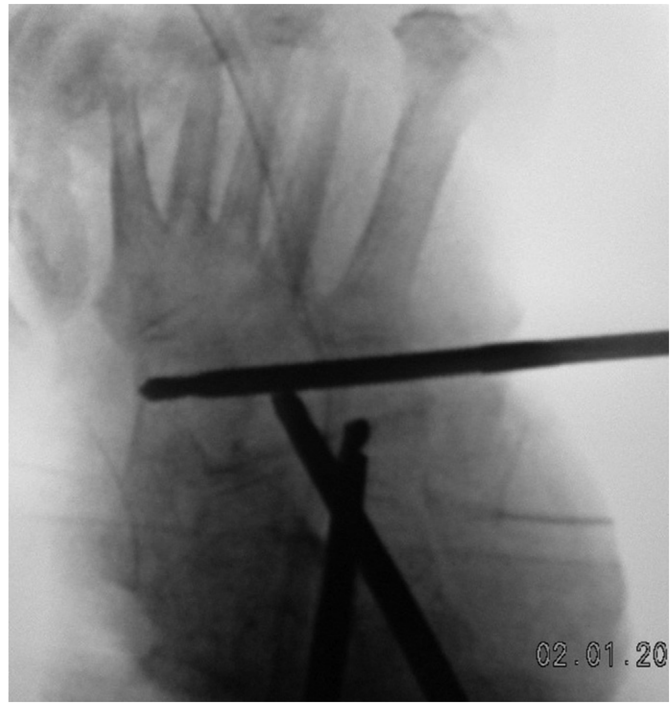

Fig. 4. Anteroposterior and lateral intraoperative radiographs demonstrating the converging 5.5-mm pins, using the entire length of the calcaneus providing stabilization, leverage, and control of the hindfoot.

Preservation and protection of surrounding superficial soft tissue structures are also key considerations when applying external fixation. Use of the external fixator components to form a “kickstand” to protect the posterior soft tissue structures has also been described (6,9). This method allows for elevation of the limb, particularly in

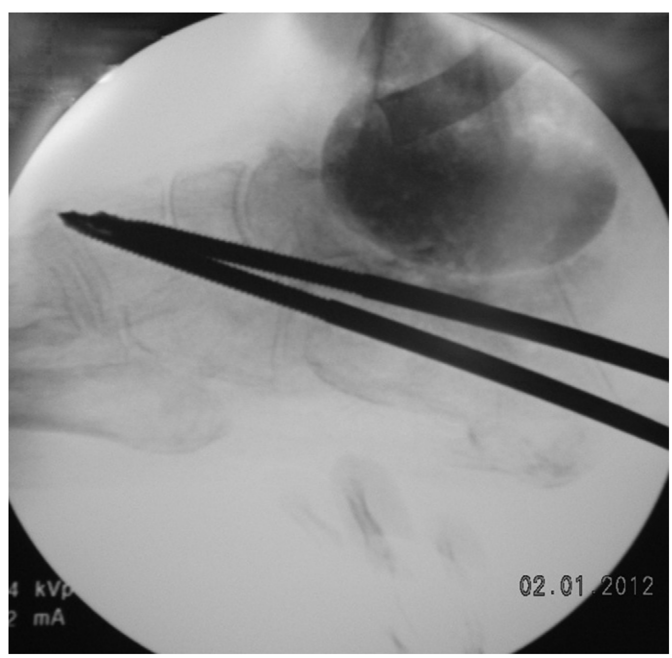

Fig. 5. Lateral intraoperative radiograph demonstrates the converging 5.5-mm pins passing through the calcaneous and into the midfoot, providing for stabilization of the hindfoot and midfoot.

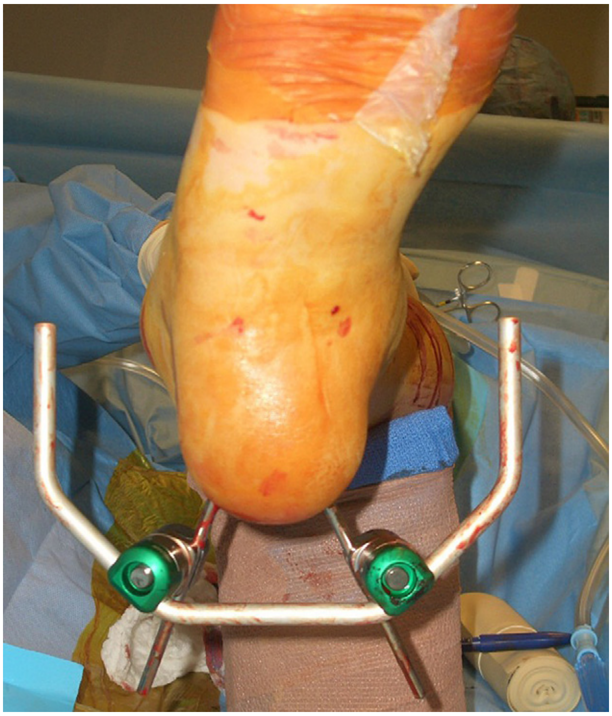

Fig. 6. Intraoperative view demonstrates 2 converging 5.5-mm pins entering the posterior calcaneus.

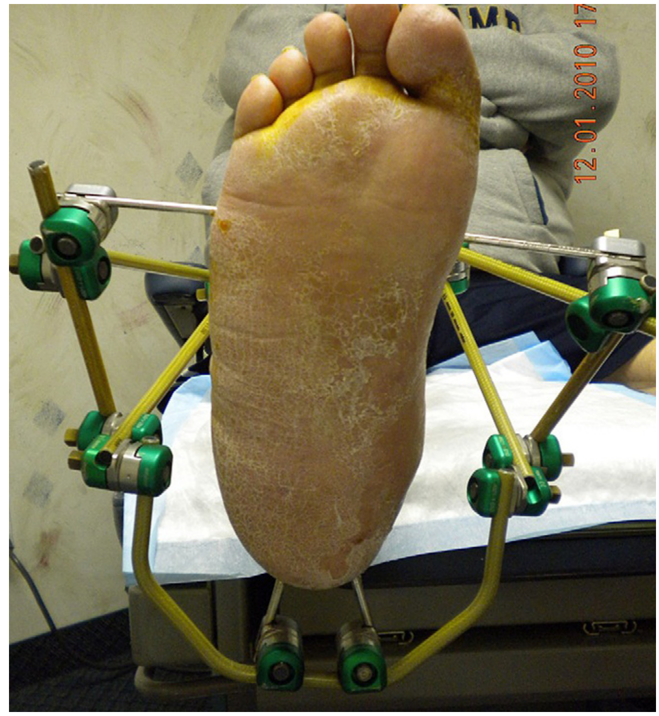

Fig. 7. Clinical view demonstrating 2 converging 5.5-mm pins entering the posterior calcaneus. The 2 points of fixation with the 5/8 ring provide a “steering wheel,” which allows for leverage and control of the hindfoot and ankle. This construct also acts as a “kickstand,” allowing for offloading of the posterior calcaneus.

patients with wounds, thereby decreasing pressure from the load-bearing posterior surface. Another consideration when applying external fixation is limitation of the amount of pin tract infections secondary to pin placement. Pin placement in areas with ample subcutaneous tissue layers, as well as thinner cortical bone, may help decrease the risk of developing infection (7).

The method of calcaneal pin placement described herein may provide for some advantages over the more traditional medial-to-lateral placement (12). Consistent avoidance of vital neurologic and tendinous structures is offered with this technique, and the posterior projection of the pins allows for a simplified version of the previously described “kickstand” offloading technique to protect surround soft tissues. This technique also provides tremendous control and leverage of the hindfoot in all planes, creating a “steering wheel” effect and keeping the ankle out of equinus (6). Anecdotally, it appears the posterior pins do not have the same skin wound issues as seen with traditional medial-lateral pin placement (Figs. 6 and 7). Additionally, this technique provides more bone-to-pin interface, because the pins may span the entire length of the calcaneus versus its width. Furthermore, advancement of the pins into the medial and lateral columns can provide increased stability to the midfoot. Moreover, the lateral radiograph will allow for better visibility of the anatomy as the bars and clamps are out of the view as compared with the traditional medial-to-lateral insertion (Fig. 5). Although further clinical and surgical research must be done, we have noted that the anatomic structures of soft tissues and bone may provide for a decreased risk of developing pin tract infections at the insertion sites described in this report.

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