The Journal of Foot & Ankle Surgery 50 (2011) 626–629

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Posterior Approach Using Anterior Ankle Arthrodesis Locking Plate for Tibiotalocalcaneal Arthrodesis

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ARTICLE INFO

Keywords:
arthritis
calcaneus
Charcot
internal fixation
talus
tibia

ABSTRACT

Tibiotalocalcaneal arthrodesis is a successful treatment for patients with severe pain and functional disability in the ankle and subtalar joint. Patients with post-traumatic ankle and subtalar joint arthritis, and/or Charcot deformity, often present with compromised skin and soft tissue structures. In the present report, we describe a technique using an anterior ankle arthrodesis locking plate placed posteriorly to obtain hindfoot and ankle fusion. This technique, which uses the well vascularized, thick, posterior soft tissue envelope, provides very good exposure of the articular surfaces for resection and tibiotalocalcaneal fusion. The technique provides a valuable option for patients with compromised skin and soft tissue structures over aspects of the ankle that make other approaches risky and complicated.

Tibiotalocalcaneal arthrodesis is a salvage procedure for the treatment of Charcot joint disease or pain and dysfunction due to arthritic ankle and subtalar joints. The primary goals of performing ankle and subtalar arthrodesis include providing anatomic alignment, pain relief, and a stable, plantigrade foot. Obtaining stable fixation and preserving the surrounding soft tissue is essential for a successful outcome (1). We present a method of fixation that uses an anterior ankle arthrodesis locking plate with a posterior approach for a tibiotalocalcaneal arthrodesis. This method, which uses the design of the Synthes LCP anterior ankle arthrodesis locking plate (Synthes USA, Paoli, PA), has versatility and provides a good fit anatomically along the posterior surface of the tibia and the superior aspect of the calcaneus. Stable fixation is achieved with the benefit of the robust, well vascularized soft tissue envelope provided by the posterior structures, in particular, the low lying muscle belly of the flexor hallucis longus. Thus, we believe this approach is an excellent alternative in patients who require ankle and hindfoot fusion but have compromised soft tissues that make other approaches unsafe. For example, we present the case of a patient with Charcot neuroarthropathy who came to us after having undergone midfoot amputation that led to chronic ulceration with osteomyelitis, secondary to bony misalignment, and equinus deformity (Fig. 1).

The ideal fusion should provide stability through secure fixation, reduce excessive forces through good alignment, preserve the soft tissue envelope, and have a high fusion rate (1). It has been shown that rigid internal fixation has increased rates of union with fewer complications (1,2) compared with other fixation techniques. Care must be taken to minimize the soft tissue damage that occurs with dissection, debride all sclerotic bone to bleeding, use an autologous bone graft, and obtain maximal apposition with stable fixation for an optimal result (3). The preferred position of the ankle and hindfoot is to be fused in neutral flexion, 5° to 10° of external rotation, 5° of valgus, and slight posterior displacement of the talus under the tibia (1,3–5). Misalignment can lead to persistent pain and problems ambulating, as well increased stress to the ligaments of the neighboring joint (3).

Conservative treatment should be the first consideration for ankle and hindfoot arthritis. Nonsteroidal anti-inflammatory drugs or intra-articular corticosteroid injections can provide relief from pain and inflammation (6). The use of the SACH heel, molded ankle-foot orthosis, or a rocker-bottom sole can also assist in ambulation by restricting motion in the ankle and might lessen the pain (7,8).

In preparation for surgery, all efforts should be made to promote postoperative healing. Smoking cessation should be encouraged in patients, because it has been reported to have a 14-fold greater rate of nonunion (3). A rheumatologist can be helpful relative to the medical management of patients receiving steroid therapy for rheumatoid arthritis. Patients should be weaned to an operative dose of less than 10 mg/day, if permitted, and methotrexate or similar antimetabolic drugs should be discontinued 1 week before surgery until about 2 weeks postoperatively (9).

Financial Disclosure: None reported.
Conflict of Interest: None reported.

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1067-2516/$ - see front matter
doi:10.1053/j.jfas.2011.05.007

Fig. 1. Preoperative lateral radiograph demonstrating misaligned Charcot ankle and subtalar joint associated with significant equinus deformity. Equinus contracture associated with Charcot joint resulted in chronic ongoing ulceration on plantar aspect of foot.

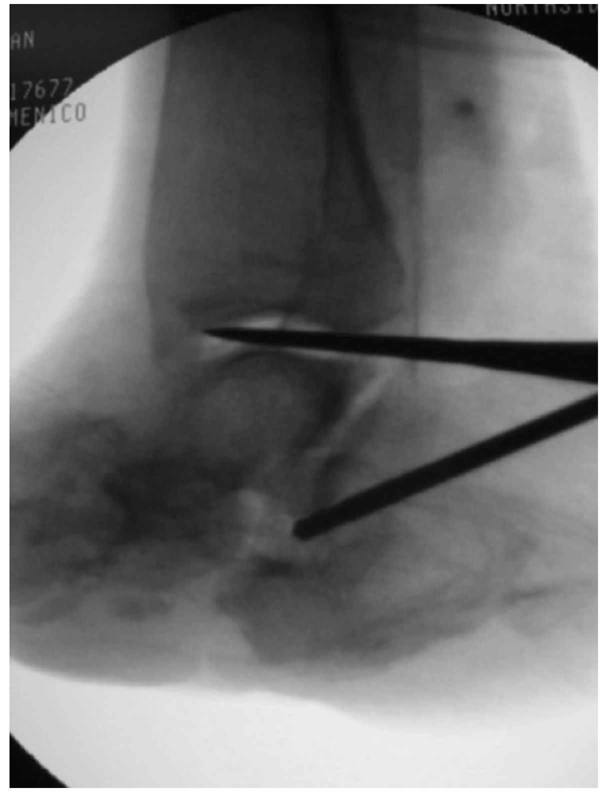

Fig. 3. Intraoperative lateral radiograph demonstrating use of osteotome for ankle joint debridement. Note, posterior approach allowed for complete exposure of the joints.

Surgical Technique

Once general anesthesia has been achieved, the patient is placed in a prone position with the foot and ankle slightly hanging off the end of the operating table, allowing the surgeon to position the ankle into a neutral position. A mid thigh tourniquet is used for hemostasis. A large posterior incision is made over the Achilles tendon. Because arthrodesis is being attempted and the Achilles tendon has little vascularity, the tendon is excised and discarded (Fig. 2). This provides a better vascularized environment, allowing for excellent soft tissue exposure and easier closure, with less stress on the soft tissues postoperatively. The deep fascia layer is then incised, providing exposure to the deep soft tissues, in particular the low lying muscle belly of the flexor hallucis longus. Careful dissection is carried deep to the distal tibia and continued proximally and distally to expose the posterior tibia, calcaneus, ankle, and subtalar joint. With outstanding exposure, the ankle and subtalar joints are debrided, removing all the articular surfaces to healthy bleeding bone (Fig. 3). The ankle and subtalar joints are then placed in anatomic alignment and temporarily fixated with large Steinmann pins and guide wires. Using fluoroscopic guidance, two 2.8-mm guide wires are inserted from the posterior-inferior portion of the calcaneus into the distal-anterior portion of the tibia (Fig. 4). The guide wires are measured, and two fully threaded 7.3-mm cancellous screws are inserted from the distal inferior calcaneus into the distal anterior tibia (Fig. 5). The ankle and subtalar joints are then packed tightly with allogeneic bone graft to fill in any voids and to provide a shear strain relief graft (10). The anterior ankle arthrodesis locking plate is inserted and applied to the posterior tibia, talus, and calcaneus. This is fixated to the tibia, talus, and calcaneus with a combination of locking and nonlocking screws (Fig. 6). A drain is inserted, and standard deep soft tissue closure is performed, allowing for coverage of the fixation with the flexor hallucis longus muscle belly, followed with standard skin closure.

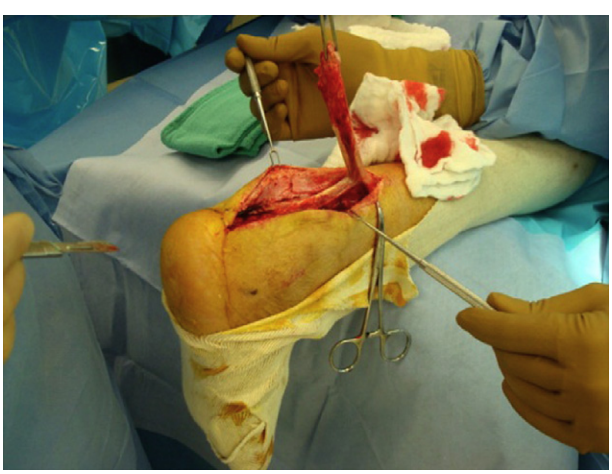

Fig. 2. Intraoperative view demonstrating posterior approach and removal of Achilles tendon, providing excellent exposure.

Discussion

Ankle arthrodesis using blade plate fixation has shown good clinical results for tibiotalocalcaneal arthrodesis (11,12). Many plate designs exist, allowing a selection to fit the surgeon's preference in achieving stabilization in different configurations and alignments. Locking plates use compression for reduction of arthrodesis and stable internal fixation without the drawbacks of external fixators

Fig. 4. Intraoperative anteroposterior view demonstrating large bony defect of Charcot joint after bony debridement. Two 2.8-mm guide wires inserted for temporary fixation.

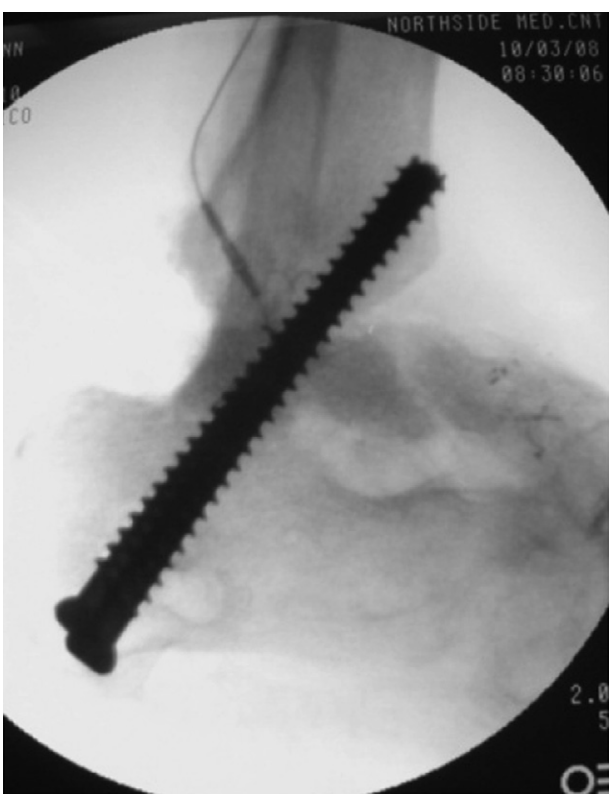

Fig. 5. Intraoperative lateral radiographic view with two fully threaded 7.3-mm cancellous screws inserted for position with bone graft packed very tightly, along with implantable electric bone stimulator.

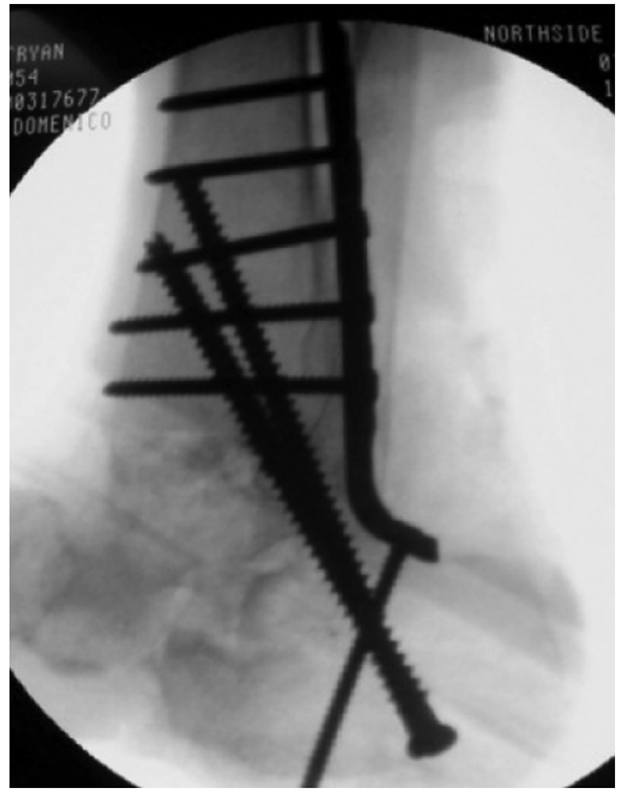

Fig. 6. Intraoperative lateral view demonstrating two fully threaded cancellous screws and anterior ankle arthrodesis locking plate applied posteriorly with hind foot and ankle out of equinus and in good anatomic alignment.

(13,14). With locking plate technology, the development of an interlocking interface between the screw head and plate achieves high angular stability, and stable anchoring does not depend on direct apposition of the plate to bone (15). The locking screws are placed in different directions, thereby offering stability in multiple planes (14). Rigid fixed angle fixation is obtained as a single beam construct, allowing failure to occur at a greater threshold than with traditional plates (14,16), if it were to fail. This is particularly advantageous in patients with questionable bone stock, because locking plates have a lower, irreversible deformation in osteoporotic bone than an

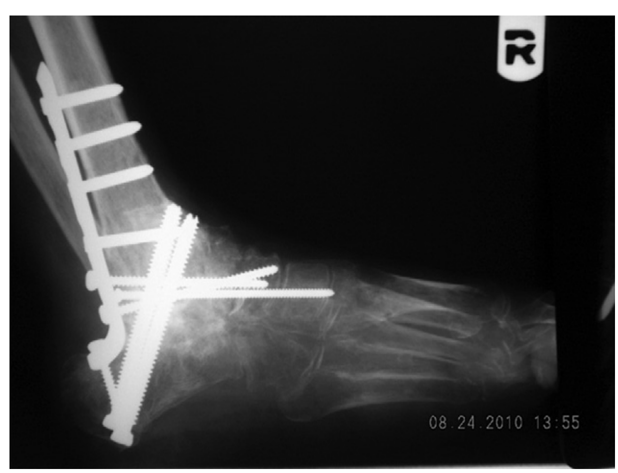

Fig. 7. Postoperative view demonstrating good anatomic alignment and successful arthrodesis of ankle and subtalar joint using anterior ankle arthrodesis locking plate.

Fig. 8. Lateral view demonstrating anterior ankle arthrodesis locking plate applied posteriorly with good anatomic alignment. Preoperative lateral radiograph of patient C demonstrating significant equinus contracture and Charcot arthropathy of hindfoot and ankle.

intramedullary nail or blade plate (17). Locking plates are not technically difficult to use and have the advantage of ease of use compared with the intramedullary nail when it comes to placing the tibiotalocalcaneal augmentation screw, because the intramedullary canal is not occupied in the fixation construct (13).

In conclusion, we have presented a new method of fixation that uses a posterior approach to tibiotalocalcaneal ankle arthrodesis using the design of the Synthes LCP anterior ankle arthrodesis locking plate (Synthes, Paoli, PA). This technique shows the versatile positioning of the existing design, because it fits anatomically along the posterior surface of tibia and the superior aspect of the calcaneus (Figs. 7 and 8). Stable fixation is achieved with the benefit of a thicker and well vascularized soft tissue envelope provided by the posterior structures. This is an excellent technique to achieve stable fixation for tibiotalocalcaneal arthrodesis in patients with compromised soft tissues that prevent the use of other approaches.

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