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Use of Tensioned Olive Wires through a Neutralization Plate for Syndesmotic Reduction

Robert B. Weinstein, DPM, FACFAS [1], G. Clay Taylor, DPM, FACFAS [1], Nicholas A. Giovinco, DPM, FACFAS [2]

[1] *Faculty, Podiatry Institute, Decatur, GA; Private Practice, Ankle and Foot Centers of Georgia, Atlanta, GA*
[2] *Dekalb Medical Podiatry Residency Training Program, Decatur, GA*

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ABSTRACT

Ankle fractures are a common osteologic outcome from trauma. These fracture patterns include a variety of concomitant soft tissue disruptions, including diastasis. Surgical treatment of a syndesmotic injury can be performed in conjunction with open reduction with internal fixation. The present technique guide demonstrates the use of pre-existing hardware, after open reduction with internal fixation from a previous ankle fracture, with an Ilizarov fixation construct to percutaneously reduce a bimalleolar equivalent fracture and diastasis to the syndesmosis.

Ankle fractures, resulting in both osseous and syndesmotic offenses, are common outcomes of trauma to the lower extremity. These injuries often represent an advanced stage ankle fracture pattern and merit specific consideration by surgeons (1). Many reduction techniques to stabilize a diastasis of the tibial and fibular syndesmosis have been described (2,3). In the present study, we report a case example of a novel use of external fixation to reduce a syndesmotic injury in the presence of pre-existing hardware from a previous ankle fracture that had undergone open reduction with internal fixation. We chose percutaneous removal of selected hardware from the previous injury reduction, and used the remaining hardware in situ for reduction of the diastasis with an Ilizarov external construct.

Case Report

A 70-year-old diabetic female was seen in the outpatient clinic with a history of "stepping in a hole" 2 days previously and "hearing a pop." The pertinent history included a previous ankle fracture on the ipsilateral extremity that had been surgically fixated approximately 20 years before the present incident. She related an uneventful postoperative course after the initial surgery and was able to ambulate with no pain or instability. She presented in a wheelchair and was unable to weight bear on the affected extremity. The clinical evaluation revealed significant edema to the extremity, with pain to palpation of the entire ankle complex and to the leg, with high tibiofibular compression. Her neurovascular status was intact at all levels. The initial radiographs (Fig. 1) demonstrated a one-third tubular plate laterally placed along the distal fibula with well-seated cortical screws throughout the extent of the plate. A drop-screw tension band wire fixation construct was noted across the tibial malleolus, indicating bimalleolar fracture fixation. This fixation is commonly seen with Weber B injuries, specifically of the supination-external rotation injury pattern described by Lauge-Hansen. No previous syndesmotic fixation was appreciated radiographically. The hardware was noted to be intact. Diastasis of the distal tibiofibular complex was appreciated, along with a mildly displaced short oblique medial malleolar fracture below the Kirschner wires holding the tension band. A Weber C injury with syndesmotic rupture and medial malleolar fracture was diagnosed. The patient was placed in a compressive dressing and posterior splint, and surgery was performed 7 days after the injury.

Surgical Technique

The patient was placed supine on the operating table, and a tourniquet was applied to the thigh, although it was not inflated. General anesthesia was administered. The leg was prepared to just above the knee. Fluoroscopy was used to identify the level of the ankle joint line. An appropriate size Ilizarov™ (Smith and Nephew, Memphis, TN) double ring construct was assembled, with 4 longitudinal rods connecting the rings. The construct was brought up the leg so that the inferior ring would lie just above the syndesmosis. This set up anticipated using wires dropped from the inferior ring and would permit full visualization of the reduced joint. The proximal ring was not placed to reach the fibula fracture, and no attempt was made to

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Address correspondence to: Nicholas A. Giovinco, DPM, FACFAS, 201 West Ponce de Leon Avenue, Apartment No. 221, Decatur, GA, 30030.
E-mail address: ngiovinco@gmail.com (N.A. Giovinco).

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Fig. 1. Radiograph on initial presentation. Syndesmotic disruption and peri-prosthetic medial malleoloar fracture identified.

purchase the proximal fibula with securing wires. Two opposing Ilizarov wires were placed along standard corridors to mount the proximal and distal rings, and tension was placed on all 4 wires to 110 kg. Before surgery, it was determined that the olive or stopper on the 1.6-mm Ilizarov™ wires would seat within the plate hole of the Synthes one-third tubular plate (Synthes, Paoli, PA). The 2 screws

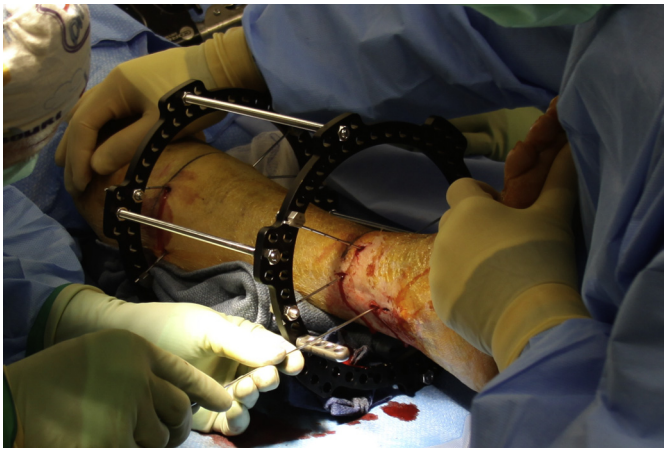

Fig. 2. Percutaneous removal of 2 cortical screws from the fibula plate allow for placement of olive wires through a "needling" technique. Manual advancement is followed by powered insertion from posterolateral to anteromedial direction.

Fig. 3. The assembly to capture the medial malleolar fragment using olive wires is constructed from the inferior ring.

immediately above the ankle joint in the plate overlying the fibula were identified. Small incisions were made over each screw, and each were removed using a small fragment screw driver. Olive wires were then advanced through the now vacant screw holes in the fibular plate from posterolateral to anteromedial to capture the tibia and exit medially (Fig. 2). A 4-hole post was connected to opposite sides of the inferior ring, with both pointing toward the foot to connect these olive wires (Fig. 3). The olive wires were secured medially and laterally with slotted bolts but were not fully tightened. Once fluoroscopic imaging confirmed that both olive wires were resting against the plate, the medial post was secured in place, and the medial slotted bolts were tightened. This post was then rotated using the "post-turning" technique under fluoroscopy until the syndesmosis was reduced and the fibula was well-seated within the incisura (Fig. 4). The slotted bolts were then tightened but not tensioned laterally. Simple 5-0 nylon suture was used to close the skin around the smooth wires laterally where the screws had been removed.

The oblique medial malleolar fracture was next approached from the medial side of the ankle. Using fluoroscopy, a set of olive wires were percutaneously advanced from the inferior pole of the malleolus and across the fracture line (Fig. 5). The wires were cut, with several centimeters of wire exterior to the skin. A mallet was used to reduce the fragments by pushing the olives against the malleolus. These wires were then bent to a 45° angle and affixed to slotted bolts on another post dropped from the previously placed medial post. These wires were not tensioned (Fig. 6). The final construct is shown in Figs. 7 and 8.

Dressings were applied consisting of Betadine® gel (Purdue Products LP, Stamford, CT) and sterile gauze. The patient was kept non-weightbearing for 12 weeks, and ankle range of motion to tolerance was encouraged. At 12 weeks postoperatively, radiographs demonstrated consolidation of the medial fragment, and the frame construct was removed. At this point, the patient was placed in a pneumatic fracture walker, and full active range of motion was encouraged for 2 weeks, followed by physical therapist-guided gait training and range of motion exercises for the next 4 weeks. The patient was removed from all supportive bracing at 18 weeks postoperatively. She reported that she was pain free and fully ambulating without difficulty. At her 1-year follow-up examination, the patient reported a complete return to her preinjury functional level and no pain in her ankle or leg. Radiographs revealed a stable syndesmosis with no evidence of diastasis or union problem with the medial malleolus (Fig. 9).

Discussion

The reduction of ankle fractures using external ring fixators is a well-described technique (4). This modality is often reserved for complex scenarios, in which internal fixation is suboptimal or has previously failed (5,6).