The Journal of Foot & Ankle Surgery 54 (2015) 288–294

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Original Research

Management of Complex Fibular Fractures: Double Plating of Fibular Fractures

Kwasi Yiadom Kwaadu, DPM, AACFAS [1], Justin James Fleming, DPM, FACFAS [2], David Lin, DPM, AACFAS [3]

[1] Assistant Professor, Temple University School of Podiatric Medicine, Philadelphia, PA
[2] Podiatric Residency Director, Aria Health Systems, Philadelphia, PA
[3] Postgraduate Year 2 Resident, Aria Health Systems, Philadelphia, PA

A R T I C L E I N F O

Level of Clinical Evidence: 4

Keywords:
ankle fracture
comminution
complex fibula fracture
double plating
high-energy

A B S T R A C T

Complex fibular fractures as a result of either high-energy mechanisms or advanced age can be difficult to manage as significant comminution can preclude standard operative techniques. Furthermore, the maintenance of osseous reduction postoperatively throughout convalescence can present an equivalent challenge. Strict weightbearing restrictions in the elderly and the noncompliant postoperatively convey an additional risk of potential failure. We present a technique that has offered additional reassurance in these instances. We retrospectively evaluated 25 consecutive patients who had undergone this fibular double plating technique and evaluated the patient outcomes to determine whether this technique conferred any additional risk when weighed against its benefits. All 25 patients underwent benign postoperative courses. No additional operations were performed as a result of this technique. No patient undergoing this technique complained of any hardware irritation, and no hardware removal was required. This double plating technique may confer additional stability to fracture patterns that are inherently unstable. It does not appear to increase the incidence of hardware removal or irritation, and patient morbidity remained low. Based on our results, we advocate this technique especially for comminuted fracture patterns.

Fractures about the ankle joint can be associated with various outcomes after surgical repair. When the injury is complicated by poor bone quality, complex fracture patterns, and/or high-energy mechanisms, the prognosis has been generally less favorable. Particularly in the geriatric population, the preinjury functional capacity should be a significant influence on the decision to proceed with open reduction and internal fixation (1,2). Failure to restore and maintain the fibular length and rotational and axial alignment are known to create asymmetric loading patterns and altered contact characteristics in the ankle mortise, promoting degenerative changes and functional impairment (3).

Complex fractures of the fibula are most commonly seen in 2 scenarios. The first occurs in the geriatric population, with diminished bone stock. In this scenario, low-energy rotational forces can produce complex fracture patterns, complicating fracture reduction and maintenance. The second scenario is seen in fractures produced by high-energy mechanisms generated by combined axial and rotational loading and producing significant metaphyseal and diaphyseal comminution (Fig. 1). Various techniques have been described for the management of these injuries using a combination of load sharing and load bearing devices, the most common of which involve laterally or posteriorly placed locking plates. The use of single bridge plating augmented with intramedullary Kirschner wires has also been described, highlighting the biomechanical advantages over simpler bridge plating techniques (4,5). The technique presented in our report has been previously described as a single case study and has subsequently been noted by other investigators as an option for severely comminuted fractures (6,7). However, no studies have evaluated the outcomes of a larger patient cohort to ascertain its safety profile and efficacy. In the present retrospective case series, we evaluated the outcomes of 25 ankle fractures treated with this double bridge plating technique in order to offer another technique to surgeons who manage these more difficult fracture patterns.

Patients and Methods

Our indications for this technique were preoperative radiographs of ankle fractures demonstrating significant osteoporosis and/or significant comminution or bone loss associated with the fibular fracture. Additional indications included reduced bone quality at surgery and its reduced ability to accept hardware with appropriate torque. To assess the clinical value of this technique, we retrospectively evaluated the interval to radiographic union, subjective complaints related to hardware irritation, incidence of hardware removal, and incidence of wound complications. After approval by the

Financial Disclosure: Dr. Fleming is a consultant for Stryker.
Conflict of Interest: None reported.
Address correspondence to: Kwasi Yiadom Kwaadu, DPM, AACFAS, Temple University School of Podiatric Medicine, 148 North 8th Street, Philadelphia, PA 19107.
E-mail address: kkwaadu@gmail.com (K.Y. Kwaadu).

1067-2516/$ - see front matter
http://dx.doi.org/10.1053/j.jfas.2013.08.002

Fig. 1. (*A*) Anteroposterior radiograph and (*C*) lateral projection of a clinically osteoporotic geriatric rotational trimalleolar ankle fracture juxtaposed with an (*B*) anteroposterior and (*D*) lateral projection radiograph of high-energy fibular fracture in a young and healthy patient.

institutional board review, all patients provided informed consent to be included in the retrospective case series. Two study investigators (K.Y.K., D.L.) identified patients by reviewing all operative procedures performed by the primary author (J.J.F.) from January 1, 2007 through December 31, 2011 abstracted from the medical records. Both investigators (K.Y.K, D.L.) also participated in the operations and were not blinded to the outcome of the study. In order to ensure that additional procedures were not dictated incorrectly, one study investigator (K.Y.K.) also performed a search with the Current Procedural Terminology (CPT) codes 27792 (open treatment of distal fibular fracture), 27814 (open treatment of bimalleleolar ankle fracture), 27822 (open treatment of trimalleolar ankle fracture), 27826 (open treatment of fracture of weightbearing articular surface of distal tibia), and 27829 (open treatment of distal tibiofibular joint). We initially identified 524 operations matching these search criteria. The inclusion criteria were unstable malleolar fractures with the double plating technique used for fibular fractures without the use of interfragmentary fixation and the ability to provide informed consent. The exclusion criteria included any plating technique that incorporated interfragmentary screw fixation. Preoperative computed tomography was performed at the surgeon's discretion to evaluate posterior malleolar fracture size. Of the 524 patients, 25 (4.77%) met our inclusion criteria. Distal tibial fractures were classified with the Orthopaedic Trauma Association (OTA) fracture classification (8).

Surgical Technique

Patients were placed in the supine position with a bolster under the ipsilateral hip. With hemostasis accomplished with the aid of a pneumatic thigh tourniquet, a standard lateral incision was created over the fibula. This incisional approach was modified in cases of concomitant tibial plafond fractures and those patients requiring direct posterior exposures to the ankle. If a medial malleolar fracture was present, it was frequently fixed first to provide a stabilizing effect on the talus and facilitate the lateral reduction. Exposure was facilitated using sharp and blunt dissection techniques. After debridement of the fracture interface and periosteal reflection, reduction was performed and maintained with a combination of bone reduction clamps and Kirschner wires. Periosteal stripping was minimized, and the attached cortical fragments were maintained on a periosteal hinge in an effort to preserve the blood supply.

At that point, an intraoperative assessment of bone quality was performed. If the reduction forceps could sink into the cortex of the fibula with little resistance, the utility of an interfragmentary screw was precluded (Fig. 2). Often, the geometry of the fracture did not lend itself to screw compression.

When direct cortical interdigitation could not be used to confirm the reduction because of severe comminution, bone loss, or both, the distal fragment was often provisionally fixated to the talus to maintain the length and rotation. A 1/3 tubular plate with the locking capability was placed posterolaterally with its most inferior end just proximal to the superior peroneal retinaculum. The plate was compressed to the bone using a serrated bone clamp. Six cortices were engaged in the diaphysis, with the first screw placed just proximal to the fracture. The application of locking screws on the posterior plate is rarely needed because the available cortical bulk in the fibular diaphysis. Although a distal screw in the posterior plate has not been standardly employed in published studies, we found that this screw routinely has good purchase and appears to provide rotational control of the distal fragment. With careful technique, bicortical purchase can be achieved. In a patient with a smaller diameter fibula, a 1/4 tubular plate can be substituted. After posterolateral plate placement, a 1/3 tubular plate with similar capacity was applied laterally and its length confirmed fluoroscopically (Fig. 3). Plate contouring was performed, as needed. Bicortical screw fixation was then performed proximal to the fracture, with multiple unicortical locking screw fixation within the lateral malleolus. At the most proximal end of the plate, a bicortical nonlocking screw can be used for 2 main reasons. First, the fibular diaphysis offers ample cortical purchase, and, as such, the benefit of locking screws is not significantly greater than nonlocking screws. Second, evidence has shown that the use of a nonlocking screw in long bone fractures can be associated with a reduction of the incidence of periprosthetic fracture (9). We have not observed this problem in the fibula.

Another beneficial technique in the severely comminuted setting is to overdrill the near fibular cortex immediately deep to the plate and subsequently underdrill the far fibular cortex. This serves to reduce scattering of the comminuted fragments during screw insertion. Once satisfactory alignment has been achieved, the provisional fixation

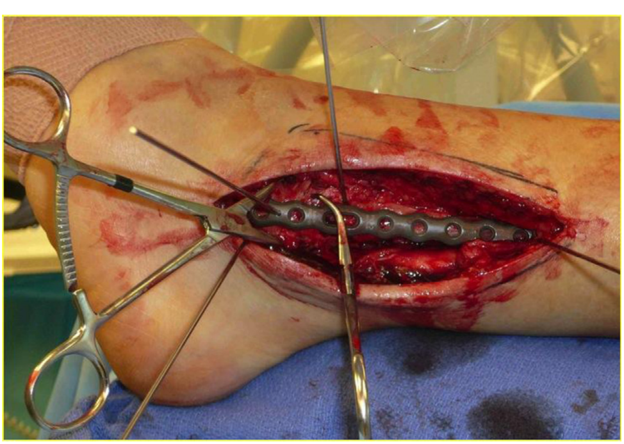

Fig. 2. Reduction and rotation of the fibular fracture maintained with Kirschner wires.

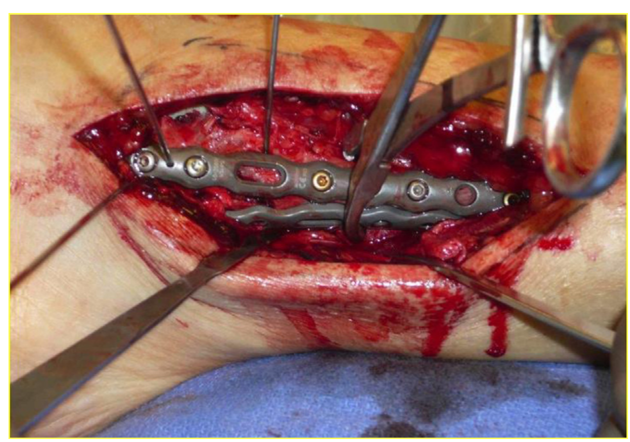

Fig. 3. Lateral plate applied with locking screws *(silver)* in malleolus and nonlocking screws *(gold)* in proximal segment of plate. The posterior plate can be visualized inferiorly.