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Case Reports and Series

The Use of Pediatric Flexible Intramedullary Nails for Minimally Invasive Fibular Fracture Fixation

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A B S T R A C T

Fibular fractures in the setting of an unstable ankle joint require surgical fixation; however, several factors contradict open surgical correction. Severe soft tissue compromise can delay adequate fracture reduction and preclude the standard incisional approach. The soft tissue envelope in the setting of obesity, diabetes, and/or peripheral vascular disease further complicates definitive treatment. Poorly timed open fixation can lead to delayed healing of the incision site, with wound breakdown and the potential for hardware failure. Proximal fibular fractures are also at unique risk of neurovascular compromise with open reduction and internal fixation. Surgical fixation has now focused on minimizing the soft tissue insult using percutaneous techniques in the comorbid patient. We present a case that highlights a minimally invasive technique that provides dynamic stable internal fixation of fibular fractures with the use of flexible pediatric intramedullary nails, typically used in long bone fractures of children.

Traumatic foot and ankle injuries pose a difficult challenge for surgeons. Because of energy transfer, pilon fractures should be considered soft tissue injuries that involve underlying fractures (1). These injuries can vary greatly in severity, and can be either closed or open fractures, with the patient's soft tissue envelope the rate-limiting component for surgical timing. The distal tibia possesses inherent vulnerability to comminuted fractures, because of the lack of muscular origin and vascularized soft tissue coverage (2). This predisposes the ankle to a greater propensity for damage of the surrounding thin dermal layer (3). The surgical trend has shifted from the 2-stage approach of early open reduction and internal fixation (ORIF) of associated fibular fractures to focus on initial minimally invasive surgical management (4). The use of intramedullary (IM) nail fixation for fibular fractures in conjunction with a delta frame application has the potential to restore the length to the fibula without disturbing the potential incision sites for eventual ORIF of the tibia (5). The incision healing complications associated with high-risk medical comorbidities such as obesity, diabetes, and peripheral vascular disease must not be disregarded (6). The use of flexible IM nails has typically been used in pediatric orthopedic injuries of the upper extremity for radial fracture fixation (7). The pediatric elastic nail design allows for negligible disturbance of the growth plate, and the flexible nature provides tension across the IM canal to maintain fracture reduction (7). In patients with lower ambulatory requirements, flexible pediatric IM nail fixation has the capability for reduction and permanent internal fixation of fibular fractures with only minimal disruption of the lateral soft tissue envelope. This technique is useful for fibular fractures associated with compromised soft tissue or in patients with an increased risk of incision healing complications. In the present case, we describe a novel minimally invasive technique used to achieve near anatomic reduction of a fibular fracture in a marginally ambulatory patient with several comorbidities.

Case Report

An 82-year-old female presented to the emergency department after a traumatic twist and fall. She was noted to have pain and deformity to the left distal tibial and ankle region. Her medical history included insulin-dependent diabetes mellitus, obesity, peripheral vascular disease, and dementia. She lived alone and had an inability to ambulate on presentation. Plain film radiographs were obtained (Fig. 1), and a displaced spiral fracture of the distal tibia and fibula were noted. Because of her medical comorbidities, we decided to fixate the

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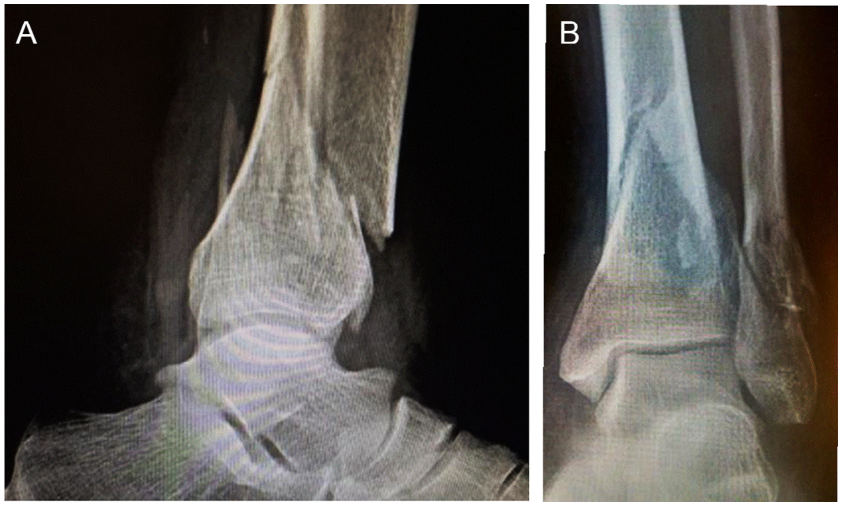

Fig. 1. *(A,B)* Plain film radiographs demonstrating displaced distal tibial and fibular fracture.

fractures in a single stage, using a minimally invasive plate osteosynthesis technique for the distal tibia and 2 crossed pediatric flexible IM nails to fixate the fibula using a percutaneous technique.

Operative Technique

The patient was placed on the operating table in the supine position. A standard radiolucent table was used. After the successful induction of general anesthesia, the operative limb was further closed reduced using manual traction and ligamentotaxis. The distal tibia was then temporarily fixated with Kirschner wires and guidewires for the cannulated interfragmentary screws (Fig. 2). The tibia was then fixated using 2 cannulated 4.5-mm screws in percutaneous fashion, followed by a medial tibial locking plate placed supraperiosteally using a minimally invasive plate osteosynthesis technique. The fixation and alignment of the tibial fracture allowed for increased mobilization of the fibular fracture, which aided in the percutaneous reduction.

Attention was then directed to the fibular fracture, which was reduced percutaneously using pointed reduction forceps and temporarily held in the corrected position. Insertion of the 1.75-mm flexible fibular nail (Stryker T2 Kids Flexible Nailing System; Stryker, Kalamazoo, MI) required only a small incision just distal to the fibula. A 2.0-mm drill was inserted into the medullary canal (Fig. 3). The first flexible nail was contoured using the bending guide to provide a convexity adjacent to the fracture site (Fig. 4). The nail was maneuvered into the canal using a cannulated locking T-handle and rotating the tapered tip past the fracture (Fig. 5). Care was taken to angle the nail tip away from the fracture orientation (Fig. 6). This allowed the contoured tip of the nail to cross past the fracture line without disrupting the percutaneous fracture reduction. The nail was then impacted into place, and the second nail was inserted using an identical technique. Once the flexible IM nails were in place, they were cut and buried into the cortical bone of the distal fibula. The IM position of nails was confirmed using intraoperative fluoroscopy,

Fig. 2. Intraoperative photograph showing closed reduction with temporary percutaneous fixation.

Fig. 3. Intraoperative photograph showing drilling the nail insertion point into the medullary canal.