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Displaced Salter-Harris Type I Distal Fibula Fractures: Two Case Reports and a Review of the Literature

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ABSTRACT

Salter-Harris type I (SH-I) fractures of the distal fibula are commonly encountered in pediatric orthopedics. We describe 2 unique cases of adolescents with completely displaced SH-I distal fibula fractures that were treated operatively. In the first case, a closed reduction attempt failed and the patient required open reduction and internal fixation of the distal fibula and syndesmosis. The syndesmotic ligaments were avulsed from the distal fibular metaphysis. In the second case, closed reduction of the distal fibula fracture was partially successful, but anatomic reduction could not be achieved without open reduction. The distal fibula fracture was fixed with an intramedullary screw. We believe this pattern of injury represents a variant of the adolescent transitional ankle fracture. Because the distal tibial physes were nearing complete closure in these patients, the energy propagated through the distal fibular physis. To the best of our knowledge, this combination of injuries has not been previously reported. This type of physeal fracture raises concern for premature physeal closure, fibular growth disturbance, syndesmotic instability, and medial (deltoid ligament) injury. Both patients had excellent outcomes after anatomic reduction and fixation of the displaced SH-I distal fibula fractures at 1 and 6 years of follow up, respectively.

Lateral ankle fractures are routinely encountered in pediatric orthopedics. When these injuries involve the physis, the most frequently used classification is that of Salter and Harris (1963) (1). The most common lateral ankle fracture is a Salter-Harris type I (SH-I) fracture of the distal fibula (2). Physeal ankle fractures occur second only to distal radius fractures in frequency. Males sustain more physeal ankle fractures than females, predominantly from age 10 to 15 years (3). However, nondisplaced physeal injuries to the distal fibula might be less prevalent than traditionally believed. Most of these suspected SH-I fractures might represent ligament sprains, bone contusions, or joint effusions (4,5). In contrast to certain physeal fractures of the distal tibia, physeal fractures of the distal fibula are not at high risk of limb shortening, angular deformity, or joint incongruity (2).

The ossification center of the distal fibula appears at approximately 2 years of age and closes at approximately 19 to 20 years of age (6). The proximal and distal physes of the fibula contribute to 60% and 40% of the growth of the fibula, respectively (7). During growth, the distal fibular physis migrates distally 6 mm relative to the distal tibial physis, consistent with the distal fibular physis contributing a greater percentage of distal leg growth (8,9). The syndesmosis surrounds the medial border of the distal fibular physis through attachments of the anterior inferior tibiofibular ligament (AITFL), posterior inferior tibiofibular ligament (PITFL), inferior transverse ligament, and interosseous ligament (10). The interosseous membrane extends proximally along the medial border of the distal fibula.

To the best of our knowledge, only 2 cases of physeal fractures of the distal fibula have been previously reported. One case reported in Germany described a SH-IV distal fibula fracture in a 9-year-old male (11). Plain radiographs showed a minimally displaced physeal distal fibula fracture. Computed tomography revealed a SH-IV fracture pattern. The investigators believed that the medial metaphyseal fragment represented an avulsion of the AITF ligament (11). This patient underwent open reduction internal fixation (ORIF) with Kirschner wires and cerclage fixation. The patient did well, and the implants were removed 7 months postoperatively. Plain radiographs at 3 years postoperatively showed healed fracture lines and a maintained ankle mortise (11).

The second case described a 12-year-old female with syndesmotic diastasis caused by a SH-III distal fibula fracture (12). The displaced fibula fragment was incarcerated in the syndesmosis at the level of the physis. The patient underwent open reduction. The distal fibular physis

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was believed to be unstable after fracture fragment reduction and was stabilized with Kirschner wires (12). The patient was kept non-weightbearing in a below-the-knee cast for 6 weeks before hardware removal. At 3 months postoperatively, the patient had a painless range of motion (ROM) and was fully weightbearing. The investigators believed the injury represented a "reverse" Tillaux-type injury in which the anteromedial aspect of the distal fibula had avulsed rather than the usual anterolateral portion of the distal tibial plafond (12).

We describe 2 unique cases that involved completely displaced SH-I distal fibula fractures. Both patients were treated operatively, an injury and treatment combination that has not been previously described.

Case Report

Case 1

A 14-year-old male was transferred to our emergency department after sustaining an American football injury to his left leg. He reported falling to his right side while an opposing player was stepping on left his foot, causing it to invert forcefully.

His medical and surgical history was significant for Blount's disease treated with lateral proximal tibial temporary epiphysiodesis and subsequent removal of hardware. Examination of his left ankle revealed significant edema and tenderness laterally, with a palpable step-off about the distal fibular physis. The extremity had intact distal pulses and sensation. Radiographs showed a displaced SH-I distal fibula fracture with syndesmotic widening (Fig. 1). With the patient under conscious sedation, closed reduction was unsuccessful. At this time, the patient's lower extremity was believed to be too swollen for surgical intervention. The leg was placed in a non-weightbearing short leg splint, and the patient was discharged with instructions for strict elevation. He returned for surgery 10 days later, once the soft tissue swelling had resolved enough for ORIF.

With the patient under general anesthesia, closed reduction and the Quigley maneuver (13) were both unsuccessful in improving the fracture alignment. If closed reduction had been successful, we would have proceeded to evaluate the stability of the syndesmosis with an external rotation stress test applied to the dorsiflexed ankle. However, we would have had a low threshold for internal fixation based on the amount of initial fracture displacement and widening of the medial clear space.

With the patient supine and a thigh tourniquet inflated, an 8-cm lateral incision over the distal fibula was made, and the fracture was identified. The fracture ends were reduced using forceps, traction, and inversion of the foot. This reduction was difficult to obtain and highly unstable. Provisional reduction was maintained with Kirschner wires. The fluoroscopic images showed a reduced distal fibular physis but widening of the syndesmosis. On gross inspection, a periosteal avulsion from the metaphyseal distal fibula containing the AITFL and PITFL appeared to be present. We decided to use a plate and screw construct for fixation of the unstable distal fibula fracture and syndesmosis.

A one third tubular plate was then placed on the lateral aspect of the distal fibula. Two screws were placed distal to the fracture, one cortical and one locking. Two cortical screws were placed proximal to the fracture. A large periarticular reduction forceps was used to reduce the syndesmosis, and 1 syndesmotic screw was placed through the plate. Fluoroscopic images confirmed reduction of the fibula and ankle mortise (Fig. 2). The leg was placed into a short leg splint, and the patient was kept non-weightbearing with crutches.

At 2 weeks postoperatively, the patient was transitioned to a fracture boot for immobilization and began ROM exercises. Weightbearing was initiated at 6 weeks. The 3-month postoperative radiographs showed a healed fracture and maintained ankle mortise (Fig. 3). The syndesmotic screw was removed at 4 months postoperatively. The patient returned to sports at 2 months after screw removal (6 months after the index surgery). At the 1-year follow-up visit, the patient had full ankle ROM and was without ankle symptoms or complaints.

Fig. 1. Case 1. Anteroposterior, mortise, and lateral radiographic views of the injured left ankle on presentation showing anterior displacement of the distal fibular metaphysis at the fracture site and widening of the syndesmosis.