Complications of Pediatric Foot and Ankle Fractures

Jaime R. Denning, MD

KEYWORDS

• Pediatric foot and ankle fractures • Complications • Premature physeal closure
• Posttraumatic arthritis

KEY POINTS

- Phalangeal fractures that are at the highest risk for complications include intraarticular phalangeal fractures of the hallux, distal phalangeal physeal fractures that extend through the nail matrix, and phalangeal fractures with severe flexion/extension displacement.
- Foot fractures that are at the highest risk for complications include Jones fifth metatarsal fractures, Lisfranc, talus, and calcaneus fractures.
- Ankle fractures that are at the highest risk for complications include high-energy fractures, articular displacement greater than 2 mm or physeal widening greater than 3 mm after final reduction.
- Children with chronic regional pain syndrome type I (CRPSI) have a higher preponderance of foot and ankle injuries than adults with CRPSI.

INTRODUCTION

Ankle fractures account for 5% and foot fractures account for approximately 8% of fractures in children.[1,2] Although there is abundant literature discussing adult treatment and outcomes (including complications) of foot and ankle trauma, there is a paucity of literature specifically discussing certain risks and treatments of ankle, and especially foot, injuries in children. Some complications, including compartment syndrome (CS), extensor retinaculum syndrome, reflex sympathetic dystrophy (RSD)/complex regional pain syndrome, infection, neurovascular injuries, and cast complications, are evident early in the treatment or natural history of foot and ankle fractures. Other complications, such as osteonecrosis (ON), missed injuries, premature physeal closure (PPC), malunion, nonunion, and arthrofibrosis, do not become apparent until weeks, months, or years after the original fracture. The incidence of long-term sequelae like posttraumatic arthritis from childhood foot and ankle fractures is poorly studied because decades or lifelong follow-up have not been accomplished to date. This article discusses a variety of complications associated with foot and ankle fractures in children or the treatment of these injuries. Foot fractures, including those of the phalanges, metatarsals, Lisfranc complex, talus, and calcaneus, and pediatric ankle fractures, including physeal, triplane, and Tillaux fractures, are described with a brief overview of each type followed by the complications unique to each fracture type. General complications associated with any pediatric foot or ankle injury are reviewed at the end of the article.

FOOT INJURIES

Phalangeal Fractures

The incidence of phalangeal fractures in children is not reported in the literature. The mechanism of injury is usually a stubbing injury or an object dropped on the toe. There have been a few recent case series specifically discussing skeletally immature patients with intraarticular hallux phalangeal fractures.[3,4]

The generally accepted threshold for choosing operative fixation of an intraarticular

Orthopaedic Surgery, Cincinnati Children's Hospital Medical Center, 3333 Burnet Avenue, ML 2017, Cincinnati, OH 45229, USA
E-mail address: jaime.denning@cchmc.org

Orthop Clin N Am ■ (2016) ■–■
http://dx.doi.org/10.1016/j.ocl.2016.08.010

proximal phalanx fracture of the hallux is involvement of more than 30% of the articular surface or articular displacement greater than 3 mm.[5,6]

To avoid certain phalangeal fracture complications (even rare ones), treating providers should not always just assume that all toes fractures in children will do well. The phalangeal fractures listed in Table 1 (and discussed later) should be approached with appropriate caution.

Posttraumatic arthritis/hallux rigidus

Damaging any joint (intraarticular injury) increases the chances of developing arthritis 7-fold, according to the American Academy of Orthopaedic Surgeons (AAOS).[7] Kramer and colleagues[4] reported on a series of 10 patients with intraarticular hallux fractures occurring at an average age of 12.6 years, who were followed for a median 50.5 months (longest follow-up was 123 months); there was a 10% rate of posttraumatic arthritis requiring fusion.

Infection

Pinckney fractures are distal phalangeal physeal fractures that extend through the nail matrix. These fractures usually occur in the hallux. If they are not recognized or treated appropriately as open fractures, osteomyelitis can occur. In Pinckney and colleagues'[8] original article describing this injury in 6 children, the first 4 presented with cellulitis or osteomyelitis, but the last 2 were given antibiotics and did not develop infection caused by this open fracture type. To minimize the infection risk, treatment can be extrapolated from the hand literature describing appropriate treatment of Seymour fractures, Salter-Harris (SH) I or II fractures of the distal phalanx of the hand with associated nailbed laceration. Timely (within 24 hours) treatment involves irrigation and debridement, fracture reduction to ensure that there is no interposed periosteum in the fracture site, and antibiotic administration.[9] In the study by Reyes and Ho,[9] there were 0 out of 11 infections in the group treated within 24 hours of sustaining a Seymour fracture, and there were 5 out of 11 (45%) infections in the delayed treatment group.

Table 1
Phalangeal fractures in children with high risk of complications

Type of Phalangeal Fracture	Complication
Intra-articular phalangeal fractures of hallux	Posttraumatic arthritis
Distal phalangeal physeal fractures that extend through nail matrix (Pinckney fracture)	Infection
Phalangeal fracture with severe flexion/extension displacement	Malunion

Rare phalangeal fracture complications

Phalangeal fractures in children can, rarely, result in ON and malunion. ON is a rare complication of intraarticular hallux phalangeal fractures that usually occurs if there is disruption of the vascularity of small fragments attached to the collateral ligament.[4] Fig. 1 shows an example of ON of a phalangeal fracture treated with open reduction with Kirschner (K) wire fixation. Phalangeal fractures (except border toes) can tolerate some varus/valgus and rotation, but can create abnormal pressure/callus on the plantar surface of the foot or difficulty with shoe wear if they heal in flexion or extension. Fig. 2 shows a case that could have healed in excessive extension if treated without reduction and fixation.

Fig. 1. ON of the lateral distal aspect of a hallux proximal phalangeal fracture treated with open reduction and Kirschner-wire fixation. Soft tissue stripping of the tiny fragment at the time of open reduction likely caused this ON, which did not cause any pain to the patient once the fracture healed.