Isolated Foot Delta Frame Construct for External Fixation of Midfoot and Rearfoot Fracture Dislocations

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Case Study

Patient Presentation

A 36 year old female without tobacco use or significant past medical history presented to the emergency department (ED) approximately 30 minutes after sustaining a work-related left foot crush injury involving a 5 ft 2 in x 5 ft 2 in flat. Physical exam demonstrated gross dislocation of the medial aspect of the foot, extending from the heel to the midfoot (Figure 4). This involved a full-thickness degloving injury to the calcaneus and metatarsals with Lisfranc dislocation. No gross appreciable vascular or neurologic compromise was identified on exam. Plain film X-ray of the foot demonstrated the foot deformity involving the calcaneus, cuboid, first metatarsal, and second metatarsal (Figure 3). Extreme plantar angulation of the first metatarsal was identified with taping of the remaining dorsal soft tissues. There was also dislocation of the calcaneocuboid joint with lateral shortening through the fractured cuboid. No osseous injury was identified at the talus, tibia, or fibula. No additional injuries were identified. Tetsani prophylaxis and IV antibiotics were administered.

Procedure Selection Criteria

We commonly use the isolated foot delta frame construct for initial reduction and stabilization of unstable or comminuted fracture-dislocation injuries involving the Lisfranc, Chopart joint, and tarsometatarsal, navicular, and cuboid. These injuries can result in medial and lateral column shortening that require length restoration. This frame construct is particularly useful when there is significant soft tissue compromise and/or or significant degloving or crush injury that potentially compromises local soft tissue and contraindicates extensive dissection for internal fixation. Additionally, external fixation may be used to augment internal fixation that requires additional stability. This construct preserves ankle joint range of motion, and is not appropriate in the setting of fractures involving the talus, ankle, or distal tibia.

Stage I Surgical Technique

Emergency surgery was performed on the date of injury under general anesthesia. No tourniquet was utilized. The operation involves placement of a platelet rich plasma (PRP) dressing, inspection, irrigation, excision of non-viable tissue, reduction, and percutaneous pin fixation of the calcaneus fracture, primary closure of the open wound, insertion of pin halfs, and reduction / stabilization of the midfoot fracture dislocation injuries via frame application (Figure 4a).

An isolated foot delta frame was made as the fractures were partially accessible through the degloved plantar tissue. Reduction of the calcaneus fracture was performed, which was temporarily fixed with two 0.062 inch Kirschner wires. Reduction was performed at the intra-articular calcaneocuboid joint fracture-dislocation. An isolated foot delta frame was applied laterally to maintain lateral column length. This involved placement of three 4.0 mm Smooth Pins, each for the calcaneal tuberosity, talon and 5th metatarsal base, avoiding the fractures. Combination clamps were used to connect 4.0 mm carbon fiber pins to the calcaneus and first metatarsal head construct (Figure 4b).

An isolated midfoot delta frame was constructed and stabilized with a medial isolated foot delta frame positioned. 4.0 mm Smooth Pins were placed in the talon neck and first metatarsal head (Figure 4c).

Postoperative Care and Stage II Fracture Fixation

Postoperative care involved admission for pain management, strict bed rest, and monitoring of tissue swelling. At postoperative day one, the patient was noted to have symptomatic and abnormal blood hemoglobin at 9.8 g/dL. No transfusion was required. Three weeks after the initial operation, the second stage operation was performed with cannulated screw fixation of the calcaneus and open reduction with internal fixation (ORIF) of the medial column as shown in Figure 5. Stage 2 surgery involved reapplication of the medial and lateral delta frame constructs. The frames were left in place for an additional six weeks to support internal fixation of any remaining soft tissue and bony injury. Protected weight bearing in a below-knee fracture boot began approximately four weeks after frame removal to facilitate progression to full ambulation in regular shoes. Imaging at eight weeks following ORIF (Figure 5a) and at twelve months (Figure 6b-c) following the injury confirmed desired healing processes, without complications, infection, or instability despite major fracture dislocation injuries.

Figure 2. Clinical photos of crush injury upon presentation to ED

Imaging demonstrates comminuted fractures through the midfoot and rearfoot. Note comminuted calcaneal and cuboid fractures with minimally malgnant first metatarsal base fracture with Lisfranc injury. Fracture options were limited by the severe soft tissue injury.

Figure 3. Initial imaging of foot crush injury

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