Chapter 12
Cuboid and Nutcracker Fractures

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Case Presentation

The case presentation is a 21-year-old male involved in a motor vehicle collision as a restrained driver. He reported no loss of consciousness and arrived via helicopter in full backboard and cervical spine immobilization. ATLS protocol was initiated and the patient was noted to be hemodynamically stable. The patient was awake, alert, and oriented. He complained of right foot and right lower leg pain. There was an obvious deformity to his right lower extremity with exposed bone. Pulses were present via Doppler examination with gross sensation intact to light touch. The open wound over his mid-tibia was dressed with a saline-soaked sterile gauze bandage, and well-padded short leg splint was applied.

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N.C. Tejwani (ed.), *Fractures of the Foot and Ankle*,
DOI 10.1007/978-3-319-60456-5_12,

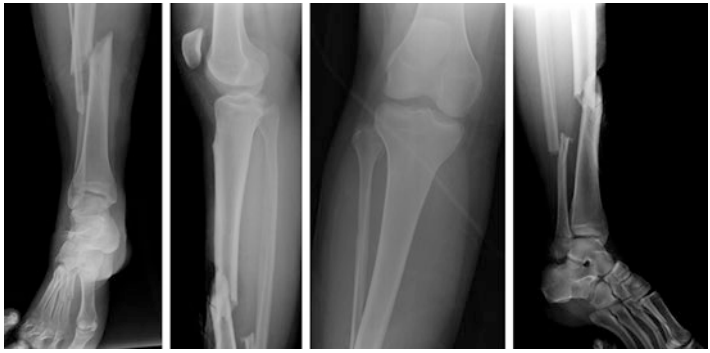

FIGURE 12.1 AP and lateral injury radiographs of the right tibia and right foot

Injury Films

AP and lateral plain film radiographs of the right lower extremity, foot, and ankle demonstrated fractures of the tibia and fibula, first through third metatarsals, and navicular (Fig. 12.1). A CT scan with two-dimensional and three-dimensional reformats was performed which confirmed fractures observed on plain film, in addition to fractures of the cuboid and first metatarsal base (Figs. 12.2 and 12.3).

Treatment and Timing of Surgery

After administration of appropriate prophylactic antibiotics, the patient was taken to the operating room for emergent treatment of his open tibia and fibula fractures. After tibial stabilization, stress radiographs were obtained to further assess the foot injury. First tarsal-metatarsal joint instability was noted along with an avulsion fracture of the base of the second metatarsal (Fig. 12.4). Excessive swelling of the foot

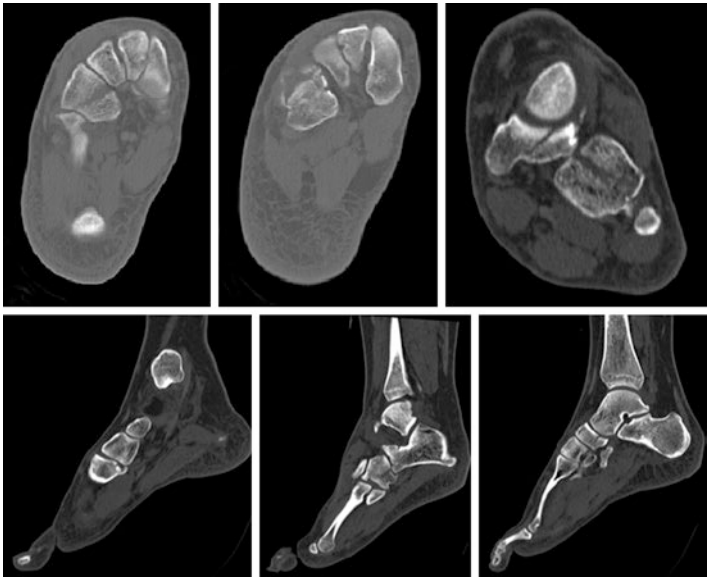

FIGURE 12.2 Axial, coronal, and sagittal reformats of the right foot

FIGURE 12.3 Three-dimensional reformats of the right foot

Figure 12.4 Intraoperative stress radiographs

was present and therefore it was planned to perform delayed reconstruction of the foot injuries. Postoperatively, the patient was placed into a well-padded posterior splint for soft-tissue immobilization. The patient had significant foot and ankle edema, which precluded surgical intervention at the primary hospital admission. He was discharged to home and then seen in the outpatient office 7 days later to assess edema. Once his edema had resolved and the soft tissues were amenable to surgical dissection, he was electively scheduled for repair of his right-foot injury.

Surgical Tact

Position

Supine on a radiolucent operating table with a rolled sheet bump under the ipsilateral hip and fluoroscopy from the contralateral side of the table. The operative leg had an unsterile tourniquet placed prior to draping and a sterile radiolucent padded triangle was placed behind the knee for optimal positioning of the foot and relaxation of the gastrocnemius soleus (Fig. 12.5). Appropriate antibiotic prophylaxis was delivered within 60 mins of incision and a surgical time-out was performed.

FIGURE 12.5 Limb position with padded triangular wedge

Approach

Due to combined medial and lateral columnar injuries, a dual-incision approach was utilized. This encompassed a dorsal medial utility incision as well as a lateral incision allowing for surgical visualization of the first and second tarsometatarsal junction, navicular injury, as well as lateral column/cuboid injury.

Fracture Reduction and Fixation (Medial Column)

Reconstruction began with medial column restoration. Direct exposure of the entire medial column provided for anatomical reduction and safe hardware placement. Reconstruction began by addressing the first metatarsal injury. Direct visualization of the joint is mandatory to avoid medial columnar mal-reduction. Retrograde screw fixation from the base of the first metatarsal into the medial cuneiform was utilized and provided for adequate stabilization.

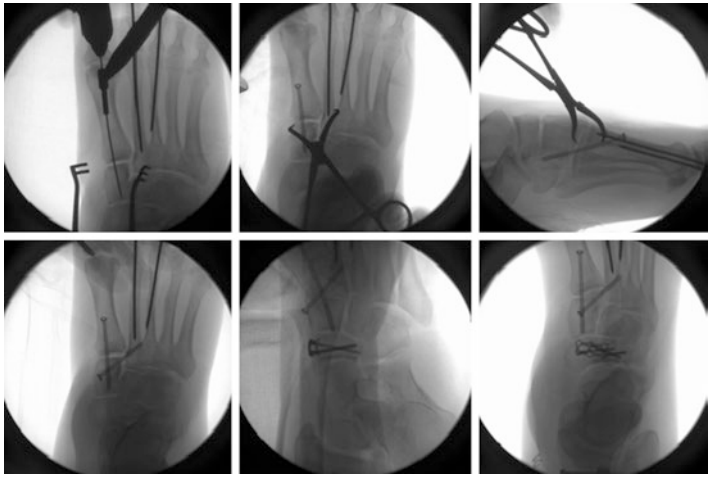

Figure 12.6 Intraoperative views of the medial column reconstruction

Adequacy of the reduction was assessed with both direct visualization and adjuvant fluoroscopy. After fixation of the first tarsometatarsal injury, the second metatarsal base/Lisfranc joint complex was evaluated to assess anatomical alignment. Finally, reconstruction of the medial column addressed the navicular injury. Direct exposure of the navicular provided for anatomical reduction and safe hardware placement (Fig. 12.6).

Fracture Reduction and Fixation (Lateral Column)

Attention was then focused on the lateral column injury focusing on the cuboid. A linear incision was made in line with the fourth metatarsal and extended proximally to ensure adequate visualization of the cuboid (Fig. 12.7). Subcutaneous branches of the superficial peroneal nerve are commonly seen after skin incision and should be gently dissected

FIGURE 12.7 Surgical approach

FIGURE 12.8 Superficial peroneal nerve branch

(Fig. 12.8). The interval between the peroneus tertius and peroneus brevis is exploited to reveal the underlying lateral wall of the cuboid. Further dissection proximally reveals the inferior aspect of the extensor digitorum brevis muscle belly. This was elevated as a full-thickness flap from the lateral cuboid (Fig. 12.9). Next, the articulations at the calcaneal cuboid and cuboid metatarsal joints were directly visualized (Fig. 12.10). Articular impaction was addressed with

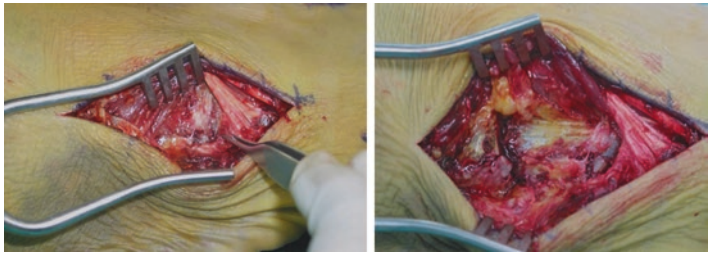

FIGURE 12.9 Deep dissection with cuboid exposure

FIGURE 12.10 Deep exposure with visualization of the cuboid metatarsal articulation

mobilization of the lateral cuboid cortical surface and elevation of the depressed articular segments to produce a congruent articular surface (Fig. 12.11). Any bone void should be addressed with supplemental graft material (i.e., allograft bone graft) and temporary K-wire fixation is placed to maintain the reduction. Definitive stabilization was accomplished with small fragment plate fixation. Contouring is usually necessary to ensure appropriate screw placement/trajectory and minimize hardware prominence. Newer anatomically

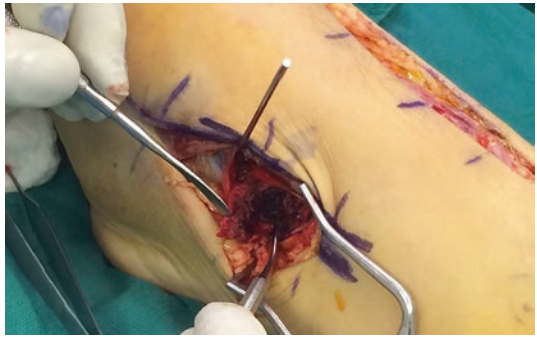

Figure 12.11 Exposure of cuboid articular impaction

Figure 12.12 Placement of anatomically contoured cuboid plate

contoured plates may be beneficial for certain fracture patterns. Additionally, angular stable screw fixation may be warranted for patients with severe comminution or osteoporotic bone (Fig. 12.12).

After definitive fixation, articular surfaces were inspected for congruency and stability. Position of the hardware was assessed with the use of intraoperative fluoroscopic imaging (Fig. 12.13).

Figure 12.13 Final intraoperative images

Postoperative Plan

After the surgical incisions were dressed sterile, a well-padded short-leg posterior splint was applied for positional comfort and soft-tissue immobilization. Toes were left exposed to allow for adequate postoperative neurocirculatory evaluations. The patient was given appropriate prophylactic antibiotics for 24 h postoperatively. Deep venous thromboembolism prophylaxis is ideally based upon risk assessment, but at a minimum, should include mechanical compression to the contralateral limb.

Outcome

The patient was seen in follow-up in the outpatient office for suture removal 10 days post-definitive repair and physical therapy without weight bearing was initiated. The therapy protocol focused on edema control and range-of-motion exercises to prevent equinus contracture. Serial radiographs were obtained at 6-week intervals for 3 months. Temporary K-wire fixation was discontinued at 6 weeks postoperatively.

Aquatic therapy was initiated at 6 weeks with full weight bearing allowed to begin at 10 weeks. Aggressive formal and self-directed physical therapy continued until 8 months post-injury. At that time, radiographs revealed healed fractures of the tibia, fibula, midfoot, and forefoot.

Following a routine protocol, screw removal was performed 9 months post-injury (Fig. 12.14). Final functional outcome included minimal pain, full return to work as a construction worker, and normal gait.

Salient Points/Pearls

- Fractures of the cuboid present a diagnostic dilemma due to vague clinical symptoms and complex osteology. Clinical suspicion should always be present with a combination of midfoot swelling, ecchymosis, and pain.
- Cuboid fractures rarely occur in isolation; therefore the concern always exists for associated injuries [1–4]. Plain-film oblique radiographs help with the initial assessment of a potential injury. CT evaluation with 2D and 3D reformats is mandatory to accurately assess the overall cuboid architecture as well as determine frequently associated additional injuries [1].
- Stress radiographs can help determine subtle instabilities and are recommended if the clinical opportunities arise (Fig. 12.4).

Figure 12.14 Final plain films 9 months post-op

- The timing of fixation is dependent upon soft-tissue swelling resolution. Columnar external fixation or medullary K-wires can provide temporary stabilization while maintaining length and assisting in soft-tissue swelling resolution (Fig. 12.15).

FIGURE 12.15 Temporary fixation with either external fixation or temporary K-wires

- Pending compartment syndrome is always a concern. Mechanism of injury combined with physical examination and compartment pressure measurements all contribute to the diagnosis. Timely temporizing stabilization, combined with fascial release, is the usual treatment. Fascial release can be achieved through larger medial and lateral incisions or multiple small (pie crust) incisions (Fig. 12.16). Either method needs to take into account future surgical approaches to help avoid skin compromise.
- Frequently, multiple incisions/approaches are needed to address the full constellation of injuries. Careful planning is used to maximize injury visualization and preserve skin bridges to avoid postoperative wound issues.

Figure 12.16 Fasciotomy incisions

- If associated injuries are present, surgical reconstruction usually begins medially, with restoration of the medial column and/or first–third tarsal-metatarsal joints. Screw fixation remains the preferred stabilization technique with plate fixation occasionally utilized for significant comminution or column substitution. Retrograde medullary K-wire stabilization can be useful for stabilization while helping to avoid soft-tissue disruption (Fig. 12.17).
- Definitive stabilization of the cuboid injury mandates direct visualization via an open exposure. A generous incision is made in line with the fourth metatarsal, allowing for calcaneal cuboid and cuboid metatarsal articular assessment. Sural and superficial peroneal nerve branches are carefully mobilized away from the operative approach. The interval between the peroneus tertius and peroneus brevis is utilized along with full-thickness elevation of the extensor digitorum brevis muscle belly [1–3].
- A bone void filler should be readily available to support corrected articular impaction.

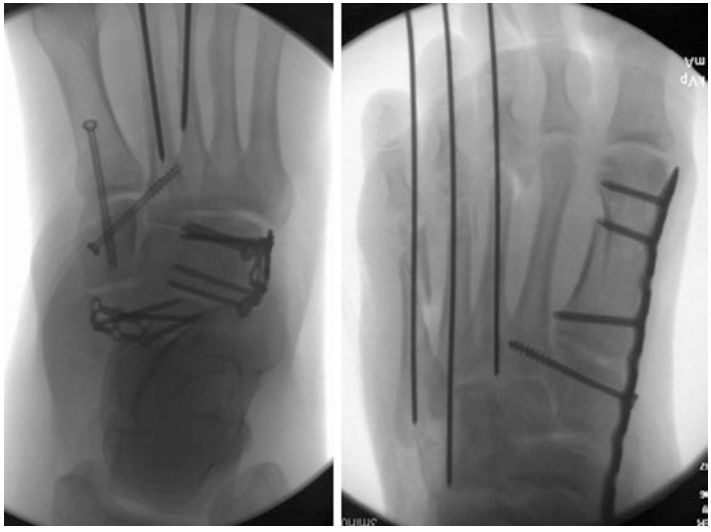

FIGURE 12.17 Temporary K-wire stabilization

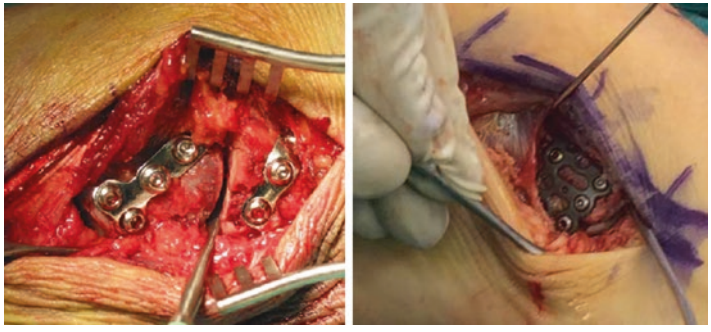

FIGURE 12.18 Plate fixation options

- Plate fixation is frequently chosen to support the restored cuboid anatomy and maintain graft containment. Newer, anatomically contoured small fragment plates with locking screw options may enhance surgical repair. However, the potential clinical benefit should be weighed against the added cost (Fig. 12.18).

- Postoperative protocol needs to take into account the frequently encountered constellation of injuries. Six to eight weeks of strict non-weight bearing followed by 4–6 weeks of protected weight bearing allows adequate healing time for both the osseous and ligamentous injuries (author's preferred method). The inclusion of aquatic exercises may allow for earlier weight bearing and enhance the recovery process.

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