Chapter 15
Open Tibial Fracture with Immediate Fixation and Early Soft Tissue Coverage

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Case Presentation

This is a 35-year-old male involved in a motorcycle collision. The patient was brought in as a trauma alert where he was noted to have injuries isolated to his right lower extremity, including an open distal tibia fracture, distal fibular fracture, and medial malleolar fracture. Exposed bone and soft tissue, including tendonous structures, were noted. His wounds were dressed sterilely and he was given appropriate prophylactic IV antibiotics. A short leg splint was applied.

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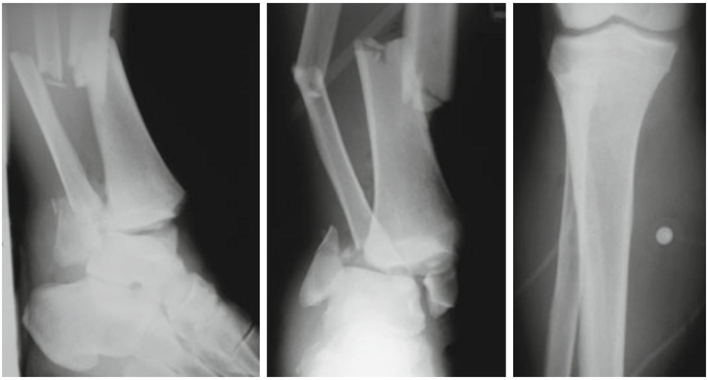

Fig. 15.1 Injury radiographs

Injury Films

AP and lateral (Fig. 15.1) demonstrated a comminuted fracture of the distal tibia and fibula with noncontiguous segmental fibula and medial malleolar involvement consistent with a local crush injury.

Treatment and Timing of Surgery

The treatment plan was based upon multiple factors, the most important of which was the degree of contamination and the underlying fracture pattern. Surgical debridement, intramedullary stabilization of the tibia as well as fixation of the fibula and medial malleolus was accomplished within 6 h of presentation to the trauma center.

Surgical Plan

Position

The patient was placed supine on a radiolucent table with a towel bump underneath the ipsilateral buttock/hip. A long offset leg wedge was used to provide for unobstructed access to the distal tibia, fibula, medial malleolus, as well as soft tissue injury. Additionally, a radiolucent triangle was utilized to assist in obtaining a starting portal and nail insertion.

Surgical Approach

The open fracture was first addressed utilizing a formal surgical debridement. Traumatic wounds were surgically extended in a manner to allow for appropriate exposure of the underlying bone and soft tissue, while not compromising future soft tissue coverage. Nonviable tissue was surgically excised. Priority was given to retaining neurovascular structures, tendonous structures, as well as bone with soft tissue attachment. The exposed tissue and bone were cleansed using multiple liters of sterile saline at low pressure. Once the debridement was completed, attention was shifted to obtaining an appropriate starting portal for the nail insertion. A patellar tendon splitting approach was chosen. The segmental fibular injury was addressed through a lateral exposure separate from the traumatic wound. The medial malleolar injury was addressed through the traumatic open wound allowing for direct reduction and screw fixation.

Fracture Reduction/Implant Insertion

The reduction was assisted by anatomical reduction of the segmental fibular fracture prior to nail insertion. The medial malleolar component of the injury was not addressed at this time. Once the fibular anatomy had been restored, further reduction of the tibial component of the injury was accomplished with manual manipulation and clamp application. A guide wire was advanced into the distal metaphysis, where sequential reaming to 1.5 mm over the chosen nail diameter was performed. The chosen nail diameter was determined at the time of surgery based upon resistance to reamer passing through the tibial isthmus and the presence of bone debris on the reamer head. The smallest diameter nail to accomplish this was chosen. This allows for the least amount of medullary blood flow disturbance, heat generation from reaming, and provides an opportunity for exchange nailing should a delayed union or nonunion arise. Interlocking screws were inserted with attention focused on the prevention of any excessive distraction at the tibial fracture site. Two distal interlocking screws were used based upon the infra-isthmal location of the tibial shaft fracture. One static interlock was used proximally. Finally, the medial malleolus was repaired with the use of retrograde cannulated lag screws (Fig. 15.2).

Wound Management

Surgical incisions were closed primarily after thorough inspection for hemostasis and final irrigation. The traumatic open wounds were managed with the use of a negative pressure wound dressing (Fig. 15.3). Repeat surgical debridements of the open wounds were performed at 72 h intervals. The negative pressure wound dressing was replaced at that time. Definitive soft tissue coverage was accomplished at postinjury day 9, noting a clean wound with healthy granulation tissue (Fig. 15.4). A reverse flow sural artery fasciocutaneous flap was chosen as well as split thickness skin graft (Fig. 15.5). Antibiotics were continued until definitive soft tissue coverage was achieved.

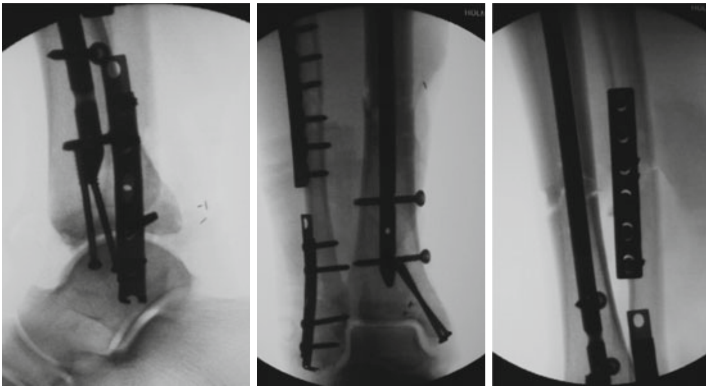

Fig. 15.2 Intraoperative radiographs after immediate fixation

Fig. 15.3 Initial wound and NPWT management

Fig. 15.4 POD # 9 wound appearance

Fig. 15.5 POD # 9 medial wound after sural artery pedicle flap and STSG

Postoperative Plan

Full range of motion of the knee was allowed beginning postoperative day 1. Range of motion of the ankle was restricted for two weeks to allow for sural flap healing. Dressing changes were performed until staples and sutures were removed at two weeks post sural flap coverage, at which time full range of motion of the foot and ankle was allowed. Because of the ipsilateral fibular and medial malleolar fractures, a postoperative non-weight-bearing restriction was imposed. Progressive weight bearing was begun 6 weeks postoperatively.

Outcome

The patient was seen monthly, with follow-up radiographs. Radiographs performed at the 8-month postoperative visit revealed no progression of healing, consistent with nonunion of the tibial shaft component of the injury. The fibula, as well as medial malleolus, was noted to be healed (Fig. 15.6) There were no clinical signs of infection; however, serologic studies were ordered to assess the potential for underlying infection. White blood cell count, erythrocyte sedimentation rate, as well as C-reactive protein were all noted to be normal. An exchange tibial nailing was performed enlarging the nail size by 2 mm. The nail was interlocked using two distal screws. No proximal interlocking screws were utilized to provide for dynamic fixation. Prominent, painful hardware at the fibula and medial malleolus was removed at that time. Follow-up radiographs 2.5 years post injury demonstrated bony union (Fig. 15.7). Prominent hardware at the proximal tibia nail insertion site as well as the distal interlocking screw site prompted removal of the remaining implants (Fig. 15.8). The patient obtained excellent cosmesis (Fig. 15.9) and functional recovery including the ability to participate in CrossFit training as well as running and cycling.

Complications

Nonunion surgically treated at 8 months, and hardware irritation requiring surgical removal.

Teaching Points

Open fractures of the lower extremity mandate a well thought out plan for skeletal stabilization as well as soft tissue management.

Fig. 15.6 Eight-month postoperative radiographs

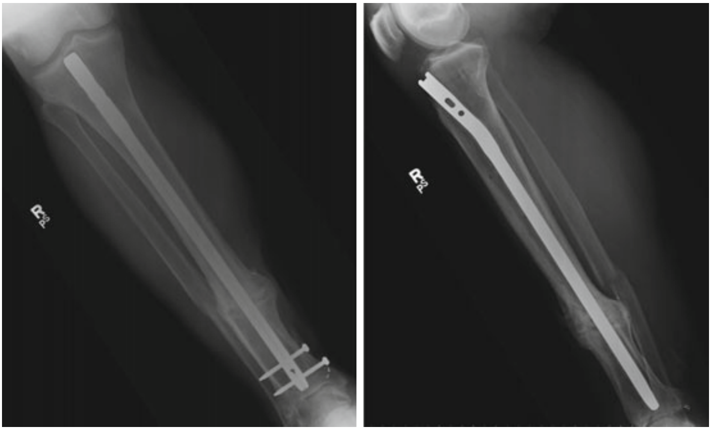

Fig. 15.7 Fracture union 1 year after exchange nailing

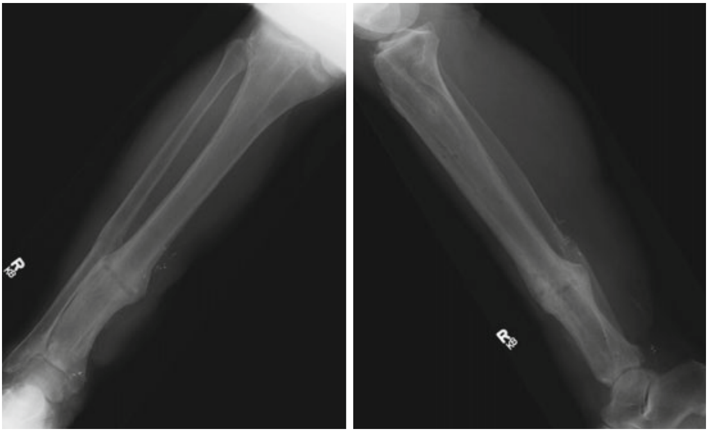

Fig. 15.8 Final radiographs after hardware removal, 2.5 years after injury

The prompt administration of IV prophylactic antibiotics is mandatory. Clean wound dressings and splint stabilization are adequate prior to the patient presenting to the operating room.

Fig. 15.9 Final clinical photo 2.5 years after injury

Once in the operating room, attention to detail is crucial, beginning with patient positioning. This facilitates surgical exposure as well as fluoroscopic visualization.

Open fracture and wound debridement should be accomplished before operative stabilization is performed. If no gross contamination is appreciated, intramedullary stabilization can be safely accomplished. Contaminated instruments should be removed from the operative field prior to nail insertion.

Anatomic restoration and stabilization of the fibula aid in reduction of the tibia. Additionally, direct visualization of the fracture site assists with tibial reduction and may be enhanced using clamp application. If an ipsilateral medial malleolar injury is present, fixation of this component of the injury is accomplished after intramedullary nail placement and interlocking screw insertion. This avoids any potential obstruction of the nail insertion into the distal tibia.

A minimum of two screws should be used for distal interlocking due to the infra-isthmal location of the fracture. A single static interlocking screw should be placed proximally for rotational control and to prevent any excessive shortening.

Negative pressure wound therapy can be helpful in the early management of open extremity wounds.

The postoperative rehabilitation protocol focuses initially on knee and ankle range of motion to prevent contracture. Full weight bearing can be allowed immediately postoperatively in isolated tibial fractures stabilized with a locked intramedullary nail. Injuries with concomitant complicated wounds and / or additional fractures around the ankle require a non-weight-bearing protocol to prevent early loss of fixation and excessive wound edema .

Complications are divided into acute and delayed. Acute postinjury/surgical complications include infection and loss of alignment. Delayed complications include nonunion, late infection, hardware irritation, and anterior knee pain.

Further Reading

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