Case 30: C3.3 Pilon Fracture Closed. Ilizarov Fixation with Limited Open Reduction of Joint Surface and Distal Tibia Bridging Distraction of Ankle Joint

James J. Hutson Jr.

Contents

Abstract

Complex pilon fractures require meticulous soft tissue handling, accurate open reduction of the joint surface, and restoration of length and alignment. Axial alignment and initial stability are usually accomplished with lower-extremity bridging distraction using external fixation.

1 Brief Clinical History

A maintenance worker fell 10 f. to the floor while working on a ladder. The patient sustained a closed C3.3 pilon fracture with an associated transverse distal fibula fracture.

2 Preoperative Clinical Photos and Radiographs

See Fig. 1.

3 Preoperative Problem List

1. The injury will have rapid swelling which will compromise the safety of open operative approaches. Delayed open reduction and internal fixation after restoration of limb alignment with external fixation allow for soft tissue resuscitation. The typical delay is usually 10–21 days.
2. The fracture is in a shortened position. A resuscitation bridging half pin distraction frame needs to be applied to the fracture. The distraction frame should accomplish four parameters: (1) The fracture is distracted to length or slightly over-distracted. (2) The dome of the talus is centered under the tibial plafond; it should be aligned axially on the AP and lateral flouroscopic images. (3) The foot is in correct rotation – the second toe is aligned with the tibia tubercle and patella. (4) The foot

J.J. Hutson Jr. (✉)
Miller School of Medicine, Ryder Trauma Center, University of Miami, Miami, FL, USA
e-mail: jhutson@med.miami.edu

S.R. Rozbruch, R.C. Hamdy (eds.), *Trauma/Foot and Ankle*,
DOI 10.1007/978-3-319-18026-7_178

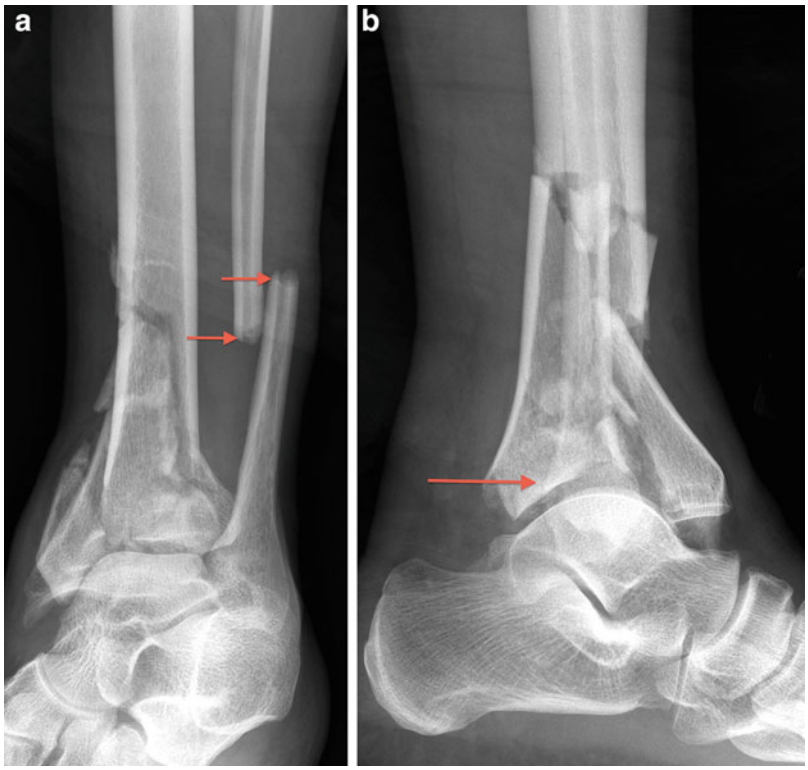

Fig. 1 (**a**) The anterior-posterior (AP) X-ray reveals that the joint surface has a complex fracture pattern which extends to the distal shaft. The fibular fracture overlap (*arrows*) heralds the amount of limb shortening and articular impaction. (**b**) The lateral X-ray provides information on the fracture fragments. The anterior fragment is actually aligned at anatomic length and the dome of the talus is impacted proximally. The posterior fragment has a complex fracture pattern (*arrow*) in which the joint fragment is impacted and disassociated from the posterior cortex. This will require an open reduction, disimpaction of the articular surface, and rotation of the fragment to recreate a congruent articular surface

is in plantar neutral alignment – an equinus position is unacceptable.

3. Check for compartment syndromes of leg and foot. These are rare complications but can occur.
4. The pilon, like most articular injuries, has a complex fracture pattern that is not amenable to percutaneous reduction techniques. It will require an open approach.
5. Further fracture information is needed for pre-operative planning. A CT scan is obtained after the joint spanning resuscitation external fixator is placed. CT scans done in a splint before fixator placement have little value.

See Figs. 2 and 3.

Fig. 2 Mortise view X-ray of the ankle after placement of a distraction external fixator. The fracture is distracted to length with the talus aligned axially with the tibial shaft. The fibula is still shortened because the flexible soft tissue attachment to the ankle and fracturing of the anterolateral fragment (*arrow*) do not provide enough stiffness to gain full length with traction. The calcaneal traction pin may be replaced with one or two tensioned wires to reduce the size of the tuberosity defect

4 Treatment Strategy

After the soft tissues have improved, the fracture can be reconstructed. The Ilizarov distraction frame will be placed to align and distract the pilon fracture, facilitating reduction of the joint surface. The strategy illustrated in this case presentation employs the technique of applying the frame before the internal fixation of the plafond to gain axial alignment and length. The fixator will provide axial stability during the entire healing process. This allows the internal fixation to be limited to the task of maintaining the reduction of the joint surface. The mass and surface area of the internal fixation in the zone of injury in this case are limited, with beneficial effect on the soft tissue and reduced surface area for bacteria to adhere.

The fixation of the fibula is elective. In this case, fixation of the fibula will help align the anterior fragment of the plafond

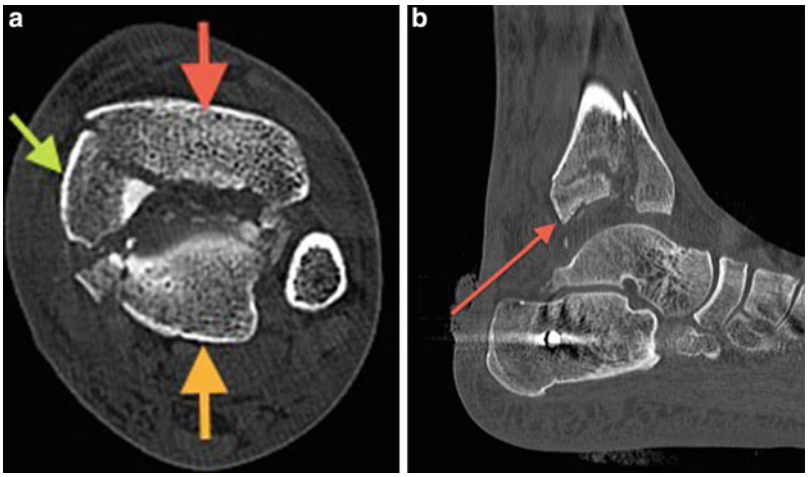

Fig. 3 (**a**) Axial CT scan image at the level of the tibial plafond. This pilon fracture has a classic pattern. There is an anterior fragment (*red arrow*), a posterior fragment (*orange arrow*), and the medial malleolar fragment (*green arrow*) with edge comminution of the fragments and debris in the fracture gap. The fracture pattern also indicates that an anterior medial approach will provide the optimal exposure of the fracture. (**b**) Saggital image through mid-joint. The posterior fragment's marginal impaction and comminution are clearly illustrated by the CT scan (*arrow*). The joint osteochondral fragment will need to have reduction onto the talar joint surface with bone graft placed to support it proximally. Of note, the transfixation calcaneal pin is placed too anterior. It should be placed more posterior and inferior in the calcaneal tubercle. This provides better bone purchase and avoids the medial neurovascular bundle

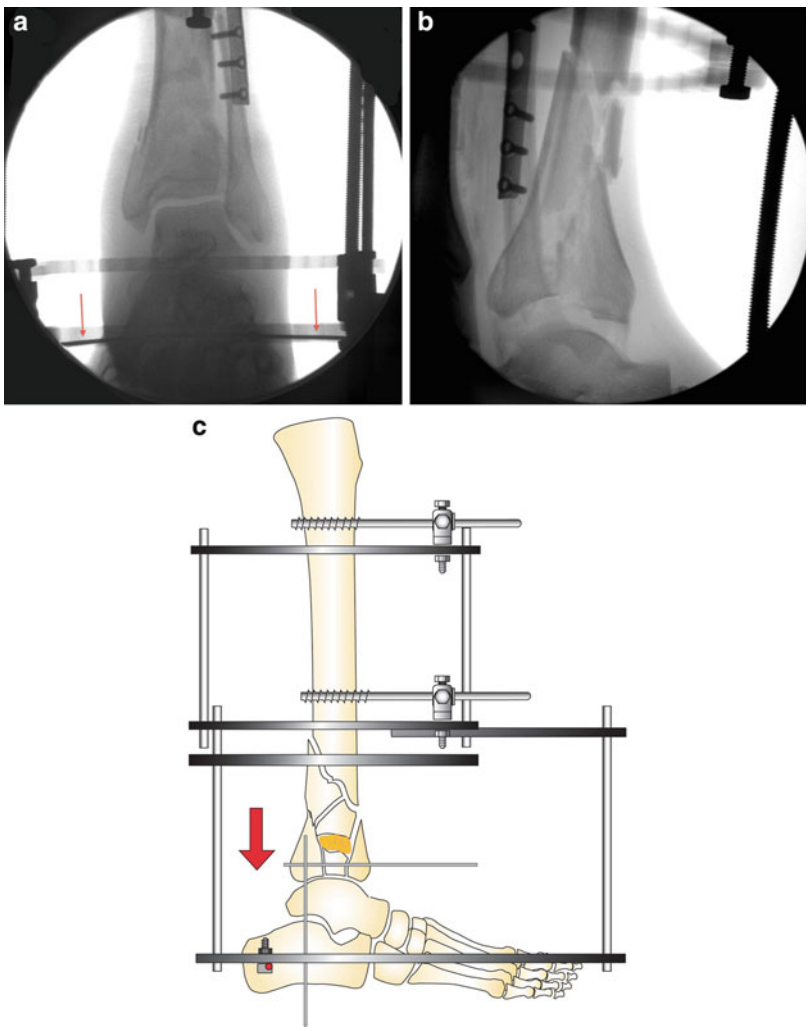

Fig. 4 (**a**) AP flouroscopic image of the fracture after the placement of Ilizarov distraction frame. The hindfoot is being distracted by the horizontal reference wire in the calcaneus (*arrows*). The fracture is distracted to length aligned with the tibial shaft. The fibula has been reconstructed to length with 1/3 tubular plate before application of the fixator. (**b**) Lateral flouroscopic image. The fracture is distracted with the dome of the talus centered on tibial shaft. The horizontal reference wire is manipulated on the foot plate until the fracture is aligned. This must be accomplished as the first step in the reduction. It is impossible to reduce the fracture if the talus is not aligned. (**c**) Drawing of fixator with double-ring fixation block, the fracture reduction ring placed temporarily in a superior position on the threaded rods connecting the two ring stable base and the foot plate. The foot plate must be closed anteriorly with a carbon fiber half ring off set above the foot plate with two centimeter hexagonal sockets

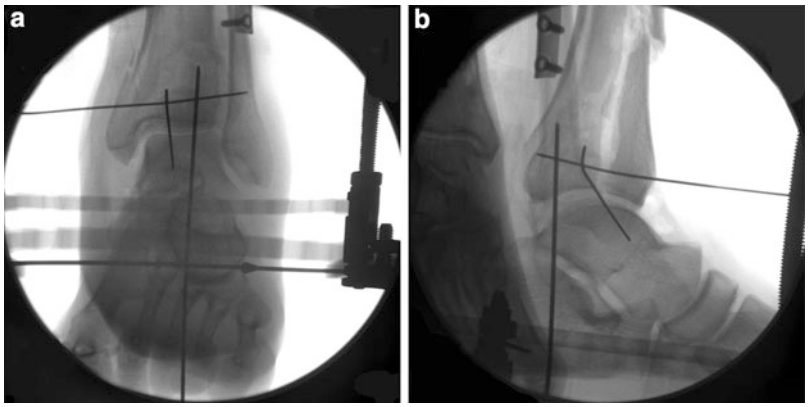

Fig. 5 (**a**) AP flouroscopic view after limited internal fixation of posterior plafond followed by the reduction of anterior fragment to reduce posterior fragment. (**b**) Lateral fluoroscopic view. The posterior fragment is reduced with a 0.0062 Steinman pin and secondary anterior fragment reduction has been performed

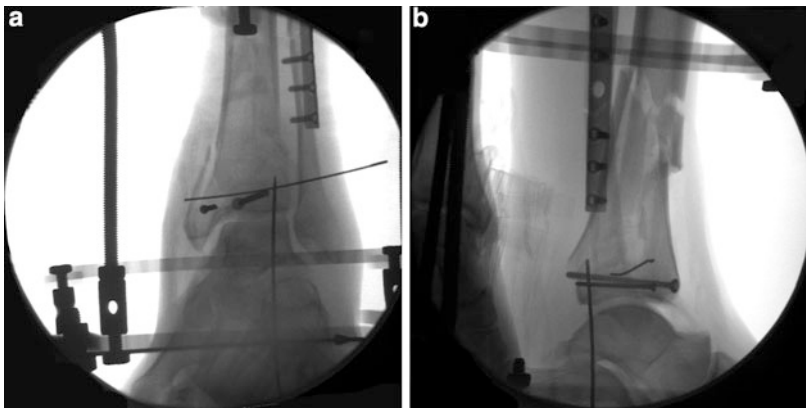

Fig. 6 (**a**, **b**) Limited internal fixation of the joint surface

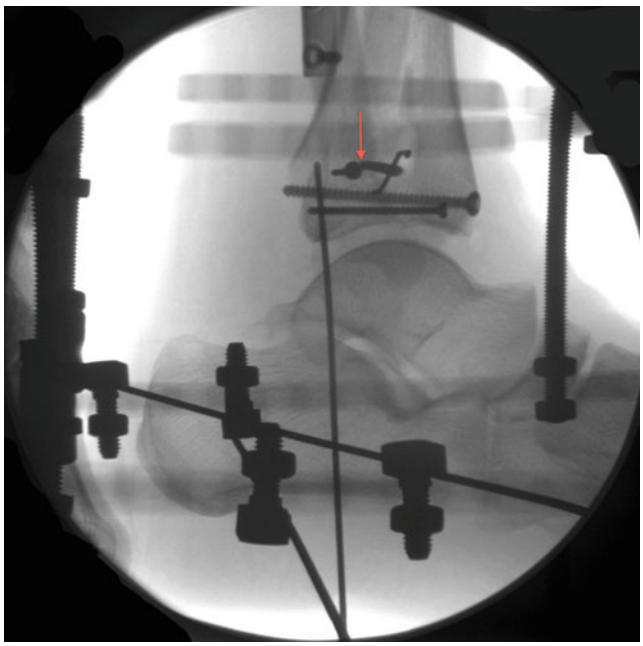

Fig. 7 The fracture ring is moved inferior to the level of the plafond and a horizontal reference wire placed above the fixation screws (*arrow*)

and improve the alignment of the ankle mortise. The fibula reduction can be accomplished with a Steinman pin or plate. The fibula in this case was plated before application of the external fixator. It can also be done with percutaneous technique and Steinman pins with the Ilizarov distraction frame in place.

5 Basic Principles

1. The double-ring fixation block is applied to the midshaft tibia with two titanium hydroxyapatite 5 mm half pins on universal Rancho cubes (Smith & Nephew).
2. A horizontal reference wire is placed into the calcaneus, and the hindfoot is aligned axially with the tibial shaft on the AP and lateral fluoroscopic views.
3. The fracture is distracted out to length. The talus is positioned into anatomic alignment and distracted to length. It then becomes a template to reconstruct the fragments of the tibial plafond.
4. The fracture is reduced through an anterior medial or lateral incision.
5. The posterior fragment is aligned as the first step of the reduction. The fragment is usually displaced posteriorly

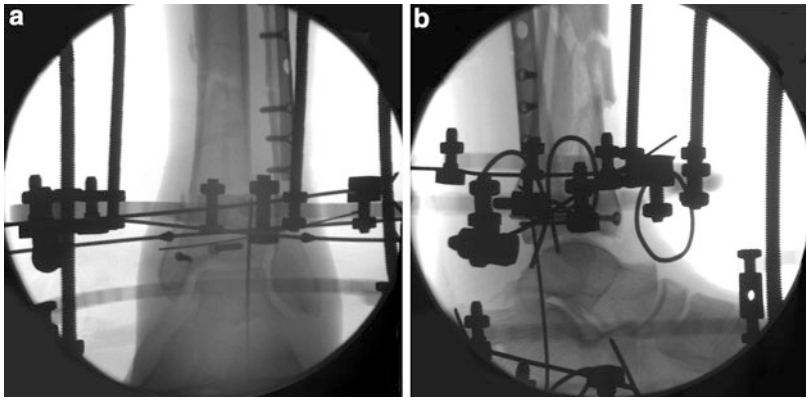

Fig. 8 (**a**, **b**) Three-tensioned-wire fixation of the tibial metaphysis with opposed olive wires in safe wire fixation zones. Notice that the comminuted metaphysis is aligned by axial distraction negating the need for large plates extending to the mid-tibial shaft

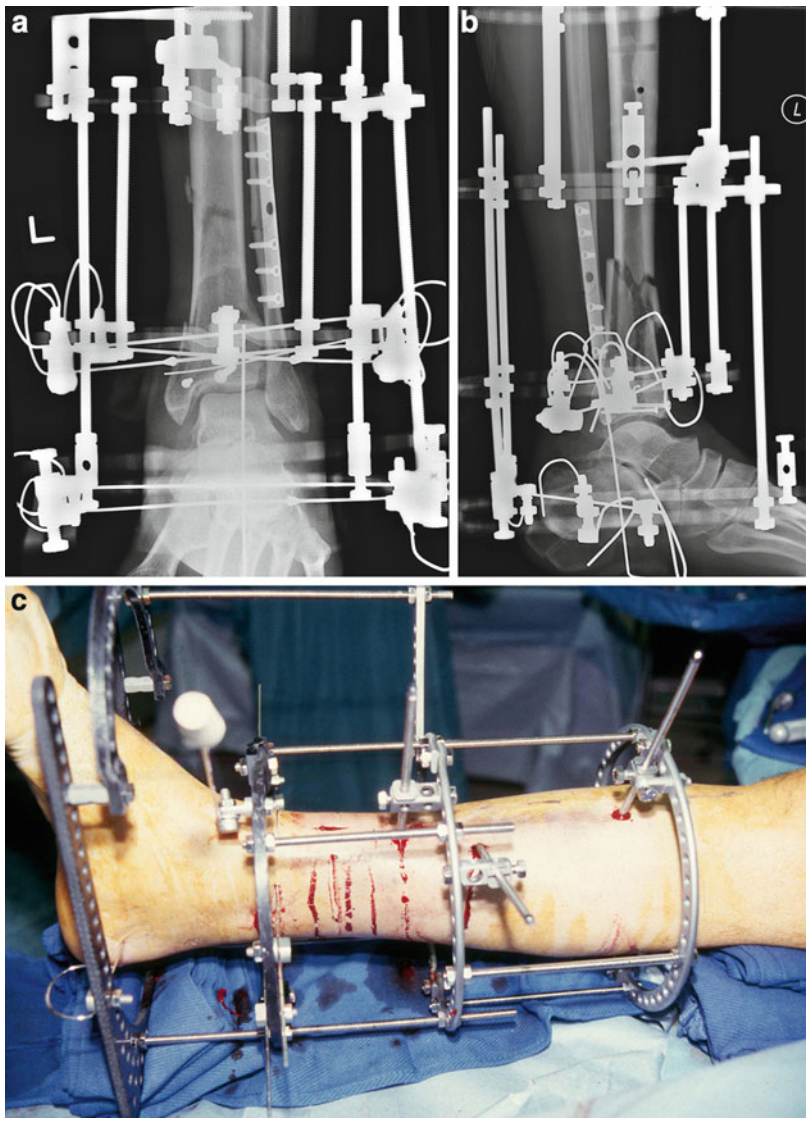

Fig. 9 (**a**–**c**) Post-operative X-rays of pilon fracture reconstruction. Clinical photograph of similar frame. Notice the half ring off set with two centimeter sockets closing the foot ring to increase ring stiffness. The Steinman pin fixating the posterior fragment is left in place for 6 weeks

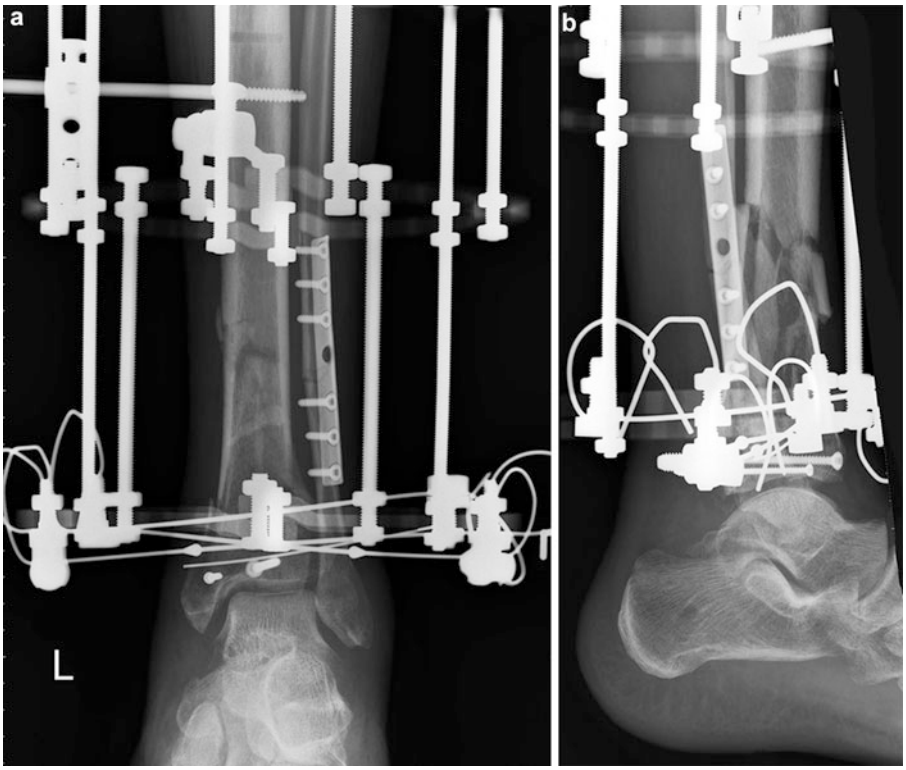

Fig. 10 (**a**, **b**) Six weeks following fracture reduction, the foot frame is removed and partial weight bearing with range of motion exercises for the ankle and hindfoot is initiated

Fig. 11 (**a**, **b**) Eight-month AP and lateral X-rays of reconstructed pilon fracture with shaft extension. Clinical exam revealed 3° of ankle dorsiflexion, 30° plantar flexion, and >5° inversion eversion. Returned to work

and needs to be moved anteriorly over the dome of the talus to be in anatomic position.
6. The anterior fragment is reduced to the posterior fragment and limited internal fixation is placed based on the fracture pattern.
7. Tensioned wires are placed through the plafond on a ring which is moved down over the fracture site after the operative approach is closed. These wires are sometimes not placed if there is severe comminution of the plafond. The wires at the plafond can also be placed in a delayed sequence 6 weeks after the operative reduction of the plafond.

6 Images During Treatment

See Figs. 4, 5, 6, 7, 8, 9, and 10.

7 Technical Pearls

1. Do not schedule these cases at the end of the day. Patience is necessary to work through these complex reconstructions.
2. Fractures with crushing of the plafond trabecular bone are augmented with cancellous allograft.
3. Once the reduction is completed, reduce the distraction of the frame to neutral.
4. Remove the frames with outpatient anesthesia. The hydroxyapatite pins are painful to remove.

8 Outcome Clinical Photos and Radiographs

See Fig. 11.

9 Avoiding and Managing Problems

1. Pin track infection requires active treatment. Use oral antibiotics for inflammation and advance to intravenous antibiotics and pin removal if infection persists.
2. Demand that patients participate in physical therapy and partial weight bearing during treatment. Discourage the use of wheel chairs.

References and Suggested Reading

Hutson JJ (2007) Chapter 3, Tibial pilon fractures. In: Rozbruch R, Ilizarov S (eds) Limb lengthening and reconstruction surgery. Informa Healthcare, New York, pp 107–121

Hutson JJ (2013) Chapter 32, Tibial pilon fractures: tensioned wire circular fixation. In: Wiss DA (ed) Master techniques in orthopedic surgery fractures, 3rd edn. Lippincott Williams and Wilkins, New York, pp 635–672

Hutson JJ, Zych GA (2000) The treatment of 100 Tibia/Fibula, distal segment (43) fractures with circular tensioned wire fixators. Podium Presentation, Orthopedic Trauma Association, San Antonio