Case 28: Proximal Tibial Bone Defect Treated with Intentional Deformity and Bone Transport

Austin T. Fragomen

Contents

Abstract

Septic nonunion of the tibia presents a challenge for limb reconstruction. Proximal tibial bone defects are uncommon and require distal osteoplasty surgery. This case will present two challenges: the management of a bone and soft tissue defect of the proximal tibia without tissue transfer and the challenges of a distal tibial lengthening. The decision between classic bone transport and shortening-lengthening transport will also be addressed.

1 Brief Clinical History

This is a 55 year old male whose leg was crushed in an earthquake-related building collapse. This occurred in an underdeveloped nation where he was treated with an IM nail and local wound care. He presented 1 year after the injury with an open wound, purulence, and an infected nonunion of the tibia.

Fig. 1 This photo of the anterior proximal leg demonstrates a 5 cm × 4 cm soft tissue defect with purulent bubbles and necrotic bone grossly visible

A.T. Fragomen (✉)
Limb Lengthening and Complex Reconstruction, Hospital for Special Surgery, New York, NY, USA
e-mail: fragomena@hss.edu; afragomen@gmail.com

S.R. Rozbruch, R.C. Hamdy (eds.), *Trauma/Foot and Ankle*,
DOI 10.1007/978-3-319-18026-7_143

Fig. 2 (**a** and **b**) AP and lateral radiographs demonstrate a normotrophic nonunion of the tibia and fibula with retained hardware. A radiopaque anterior dressing is seen covering the wound

Fig. 3 The devitalized bone and soft tissue were excised creating a 5 cm bone defect

2 Preoperative Clinical Photos and Radiographs

See Figs. 1 and 2.

3 Preoperative Problem List

1. Septic nonunion of the tibia and fibula
2. Contaminated retained hardware
3. Soft tissue defect
4. Necrotic tibia bone with impending bone defect

4 Treatment Strategy

Eradication of infection was achieved with wound excision, removal of all poorly vascularized bone, hardware removal, culture-specific antibiotics, stability, and wound closure. The external fixator was used with pin fixation maintained outside the zone of infection. The rings were manipulated to allow for a tension-free wound closure with no regard for the position of the bone ends. A fibular resection was performed to allow for shortening of the defect site independently from the future lengthening site. This also assisted with wound closure.

5 Basic Principles

Five deep soft tissue cultures were sent for aerobic, anaerobic, fungal, and mycobacterial investigation. Intravenous antibiotics were started empirically and were altered based on sensitivities. The challenged soft tissue was allowed to heal for 2 weeks before gradually correcting the proximal deformity and shortening the bone defect site. The use of external fixation was critical for its ability to gradually move the bone and stretch soft tissues. The lengthening osteotomy was delayed to prevent contamination of the osteotomy site and to minimize stress on the soft tissues. The patient was encouraged to stretch the gastrocnemius and soleus muscles to

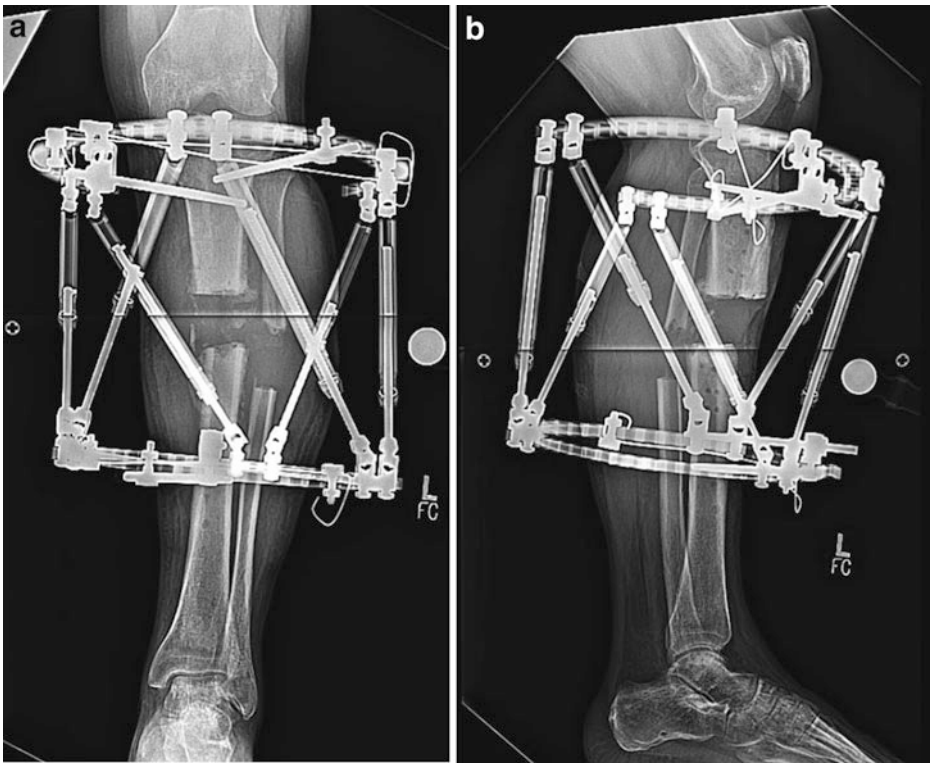

Fig. 4 (**a** and **b**) AP and lateral radiographs show a mild deformity introduced to provide a tension-free wound closure

Fig. 5 The wound was closed without tension after the initial debridement

Fig. 6 Local wound care and gradual shortening allowed for wound closure

prevent contracture during distal tibial lengthening. Acute closure of a contaminated wound is possible after a thorough debridement of all tissues.

6 Images During Treatment

See Figs. 3, 4, 5, 6, and 7.

7 Technical Pearls

The wires and pins need to be outside the zone of infection and dissection whenever possible to prevent pin infection leading to deep wound infection. Distal tibial lengthenings are less osteogenic than proximal lengthenings and need to proceed at a slower rate. In this case the bone was distracted at 0.5 mm/day. The decision to resect the fibula was made in

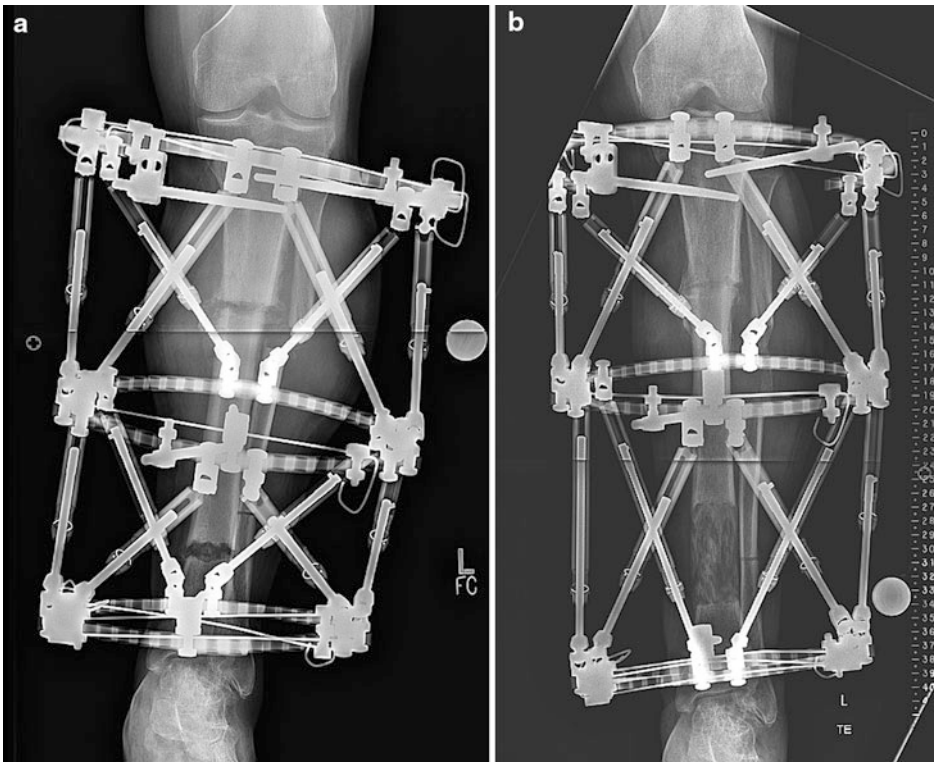

Fig. 7 (**a** and **b**) Serial AP radiographs show the growing distal tibial osteotomy site

Fig. 8 At end distraction the long X-ray shows a well-aligned leg with length restoration

part to allow for early docking and provide an extended time for healing at the nonunion site. This way the nonunion site would be healed around the same time as the lengthening site, minimizing the time in the frame. One needs to estimate the time for healing at the lengthening site and the docking site independently and then use a technique to ensure the fastest healing at both sites. I recommend 50 % weight-bearing until the bone defect has docked and then advance to full weight-bearing.

8 Outcome Clinical Photos and Radiographs

See Figs. 8, 9, and 10.

9 Avoiding and Managing Problems

Distal tibial lengthening causes equinus ankle contractures. Calf muscle stretching needs to be performed by patients immediately post-op 3–5 times per day. A neutral foot splint is also helpful to keep the ankle in a plantigrade position. A gastroc-soleus recession may be needed in the future. A foot ring can be used but needs to include ankle distraction to avoid compression of the articular cartilage.

Fig. 9 (**a** and **b**) Final radiographs show full healing of the nonunion and distraction site

Fig. 10 The wound has fully healed with no further signs of infection

Bone healing may be accelerated by partial weight-bearing, vitamin D and calcium, a high-protein diet, and external bone stimulation. Slow distraction of the osteotomy will make better regenerate bone. Delayed union of the regenerate can be treated with slowing or cessation of the distraction or, if distraction is complete, a percutaneous injection of bone marrow aspirate concentrate.

10 Cross-References

- Case 11: Bone Transport Over a Nail for Infected Tibial Nonunion and Bone Defect
- Case 28: Proximal Tibial Bone Defect Treated with Intentional Deformity and Bone Transport

11 See Also in Vol. 3

Case 54: Deformity Correction (Tibial Bone Defect due to Osteomyelitis) in Lower Limb Using Taylor Spatial Frame
Case 55: Motorized Intramedullary Transport and Lengthening Nail Used to Reconstruct a Nonunion/Bone Defect of the Tibia

References and Suggested Reading

Beltran MJ, Ochoa LM, Graves RM, Hsu JR (2010) Composite bone and soft tissue loss treated with distraction histiogenesis. J Surg Orthop Adv 19(1):23–28

Gulsen M, Ozkan C (2009) Angular shortening and delayed gradual distraction for the treatment of asymmetrical bone and soft tissue defects of the tibia: a case series. J Trauma 66(5):E61–6

Nho SJ, Helfet DL, Rozbruch SR (2006) Temporary intentional leg shortening and deformation to facilitate wound closure using the Ilizarov/Taylor spatial frame. J Orthop Trauma 20(6):419–424

Rozbruch SR, Pugsley J, Fragomen A, Ilizarov S (2008) Repair of tibial nonunions and bone defects with the Taylor spatial frame. J Orthop Trauma 22(2):88–95

Rozbruch SR, Segal K, Ilizarov S, Fragomen AT, Ilizarov G (2010) Does the Taylor spatial frame accurately correct tibial deformities? Clin Orthop Relat Res 468(5):1352–1361. Epub 2009 Nov 13