Case 56: Gradual Correction of Malunited Ankle Arthrodesis with the Taylor Spatial Frame

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Abstract

A 64 year old woman presented with pain and swelling in her right ankle. She had a closed ankle fracture that was corrected with open reduction and internal fixation 4 years prior to presentation. She underwent ankle fusion for post-traumatic arthritis, but her talus collapsed and a hindfoot fusion was then performed with a hindfoot fusion rod. After hindfoot fusion, the ankle developed a chronic infected nonunion. Ankle range of motion was within normal limits even though the ankle was supposed to be fused. She had a 5-cm limb length discrepancy (LLD) on her right side. Treatment included removal of the radiographically loose hindfoot fusion rod (locked only distally) and application of the Taylor Spatial Frame (TSF) (Smith & Nephew, Memphis, TN) for approximately 6 months to distract the nonunion. Two casts were applied sequentially, and then the patient transitioned to a custom ankle foot orthosis (AFO) with weight-bearing as tolerated. After treatment, she was given a 1-in. shoe lift to address the 3-cm LLD. Radiographs obtained 1 year after removal showed progressive bony healing at the fusion site. She did not have any appreciable range of motion at the ankle joint. Minimal dorsiflexion and plantarflexion were possible through the midtarsal joint, but this motion did not cause pain. She had limited inversion and eversion of the right subtalar joint (approximately 15 degrees of inversion and 15 degrees of eversion), but this motion was not painful.

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Fig. 1 Pre-operative anteroposterior (**a**), lateral (**b**), and Saltzman (**c**) view radiographs. On the AP view, note the radiolucent change that is present around the rod. On the lateral view, note the radiolucency around the posterior-to-anterior screw. On the Saltzman view, note the complete lateral disassociation of the hindfoot with respect to the tibia (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

1 Brief Clinical History

A 64 year old woman presented with pain and swelling in her right ankle, which had been problematic for the previous 4 years. Both lower extremities had palpable pulses and diminished sensation. She had a closed ankle fracture that was initially treated with open reduction and internal fixation. The internal fixation was removed 1 year after it was inserted. She developed post-traumatic arthritis and then underwent ankle fusion. Her talus went on to collapse, and subsequently, a hindfoot fusion was performed. After these procedures, the ankle developed a chronic infection and a nonunion. She observed intermittent drainage, but this drainage had stopped a few weeks prior to presenting at our clinic. The patient stated that she did not have any systemic symptoms of infection. At initial presentation, she wore a CAM Walker boot on the right ankle. The patient had a pressure ulcer on the plantar aspect of the first metatarsal head. The right heel was valgus, and the right lower extremity was erythematous and mildly swollen when compared with the left lower extremity. Sensation in both lower extremities was diminished. Ankle range of motion was within normal limits even though the ankle was

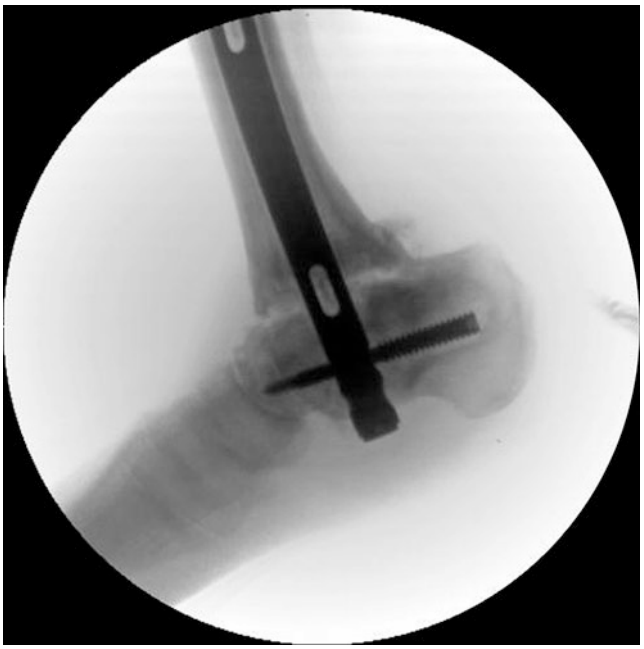

Fig. 2 Pre-operative lateral view fluoroscopic image (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

Fig. 3 Photo shows short right extremity and patient's "kickstand" right foot (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

supposed to be fused. Muscle strength of the right lower extremity was within normal limits, and both lower extremities had palpable pulses. She had a 5-cm LLD on her right side.

2 Preoperative Clinical Photos and Radiographs

See Figs. 1, 2, and 3.

3 Preoperative Problem List

- Nonunion
- Infection
- LLD

4 Treatment Strategy

Our strategy was to perform minimally invasive surgery to correct alignment and LLD. The intramedullary rod was removed, and the intramedullary canal was thoroughly irrigated and debrided. The nonunion site was not opened. The external fixator was then applied in order to gradually correct the deformity and LLD through the nonunion site. She received oral antibioics after this surgery. Distraction was performed at a rate of 0.5 mm per day. The patient was allowed weight-bearing as tolerated and completed the distraction phase of treatment 1 month after application of the TSF. After the distraction phase, she used an external bone stimulator to promote union. Distraction osteogenesis of a hypertrophic nonunion is effective for promoting bony union while at the same time correcting the LLD and the deformity. She had a minor pin tract infection that was treated with oral antibiotics. The chronic infection that she presented with did not seem to be clinically relevant. After the external fixation was removed, a short leg cast (non-weight-bearing status) was applied to protect the open pin sites. The short leg cast remained in place for 2 weeks, and then, a walking cast was applied for 6 weeks. Then, the patient transitioned to a custom ankle foot orthosis (AFO) with weight-bearing as tolerated. At 1-year follow-up, she did not use the AFO. She wore a shoe lift as well as a rocker bottom shoe to allow for ambulation. Radiographs obtained 1 year after removal showed progressive bony healing at the fusion site; therefore, no additional measures were taken to augment bone healing.

Fig. 4 (**a**) Bird's eye view photo of pin and wire placement. (**b**) Lateral view photo of foot. (**c**) Anteroposterior view photo shows a valgus deformity of 20° (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

5 Basic Principles

Distraction osteogenesis using an external fixator promotes bone union in two ways:

1. The external fixator provides rigid stability that is required for the nonunion to heal.
2. Distraction osteogenesis promotes bone healing through increased blood flow to the area.

The alignment must be corrected, and the infection must be eradicated by thoroughly débriding and irrigating the infection site. Early weight-bearing and normalizing vitamin D levels also promote bone healing.

6 Images During Treatment

See Figs. 4 and 5.

7 Technical Pearls

When applying the external fixator, it is important to build an "extra stable" frame by inserting multiple points of fixation in each segment (Fig. 5a). You should provide more points of fixation than normally would be inserted for a typical deformity correction with an osteotomy. Note the dual ring construct in Fig. 5a for the tibia. Additional wires were also inserted into the midfoot and forefoot to provide more

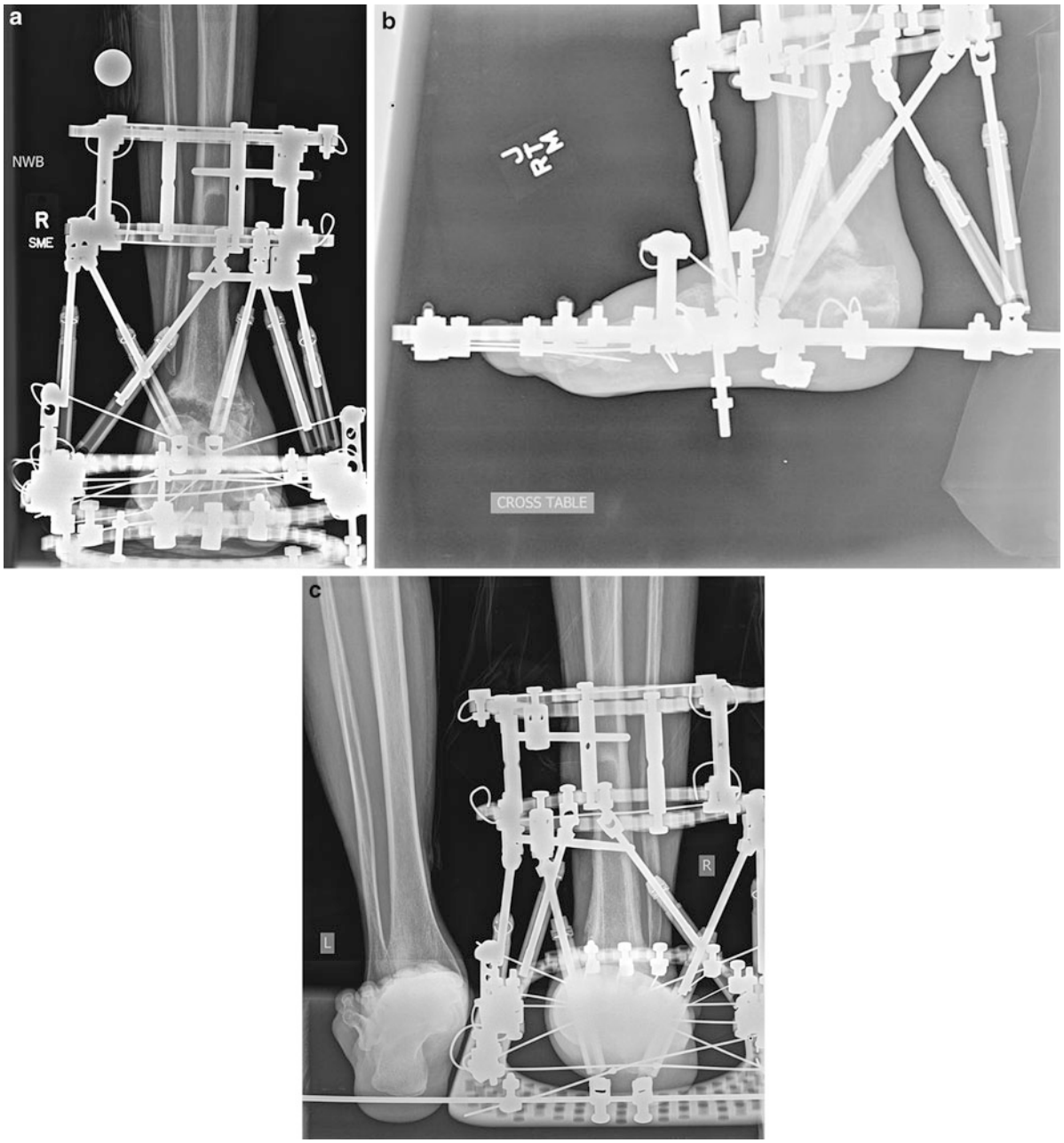

Fig. 5 Anteroposterior (**a**), lateral (**b**), and hindfoot alignment (**c**) view radiographs obtained after deformity correction was achieved but before consolidation had occurred (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

stability to the distal foot segment. To promote healing, it is also important to normalize vitamin D levels.

8 Outcome Clinical Photos and Radiographs

See Figs. 6 and 7.

9 Avoiding and Managing Problems

In this case, an external bone stimulator was used during the consolidation phase to prevent nonunion. If consolidation is delayed, early bone grafting can be performed with the external fixator still in place. Early bone grafting takes advantage of the extra stable frame fixation. If there is pin

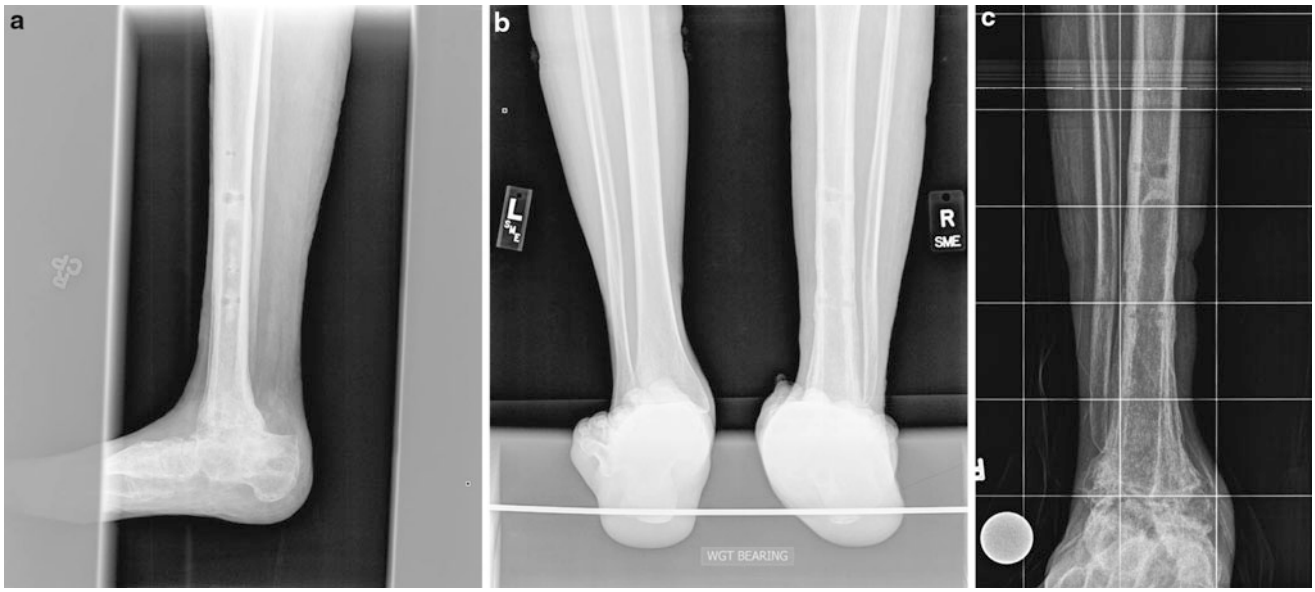

Fig. 6 Lateral (**a**), hindfoot alignment (**b**), and anteroposterior (**c**) view radiographs obtained several months after the TSF was removed (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

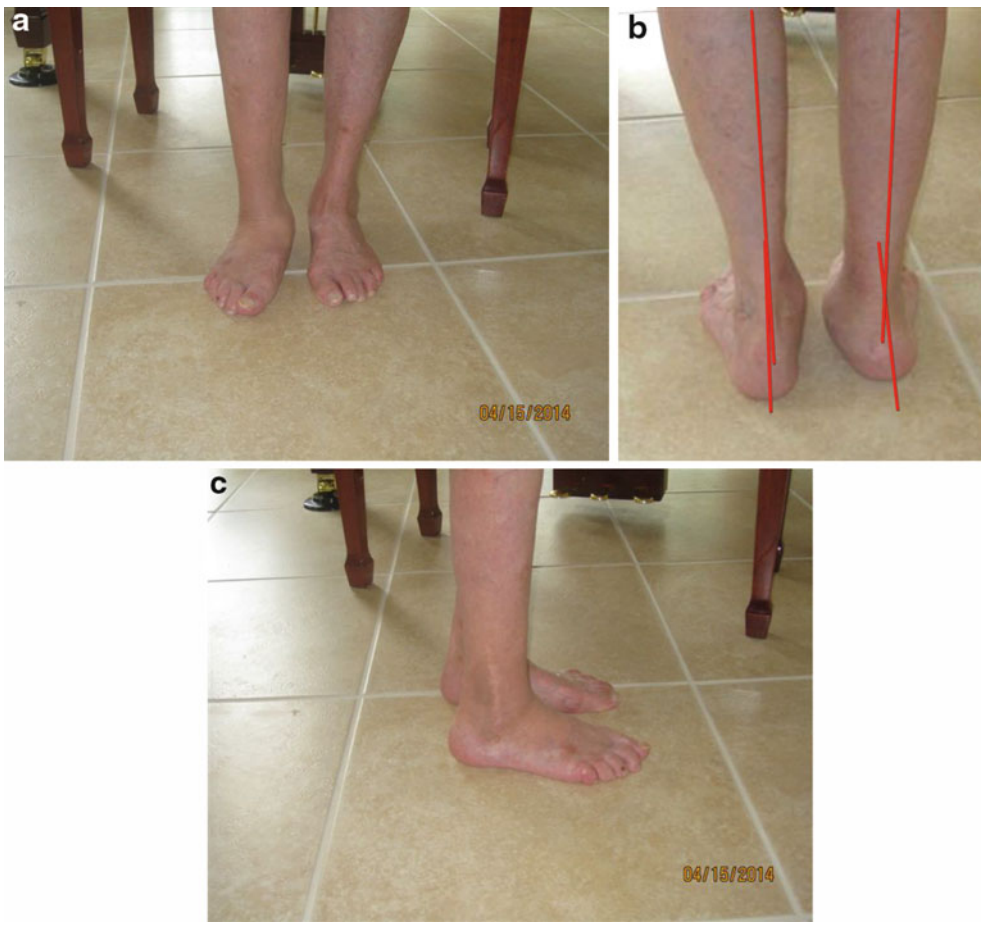

Fig. 7 (**a**) Anteroposterior view photo after treatment. Note that the patient no longer has a kickstand foot and that the foot is plantigrade. (**b**) Photo shows the matching hindfoot alignment. (**c**) Lateral view photo obtained after treatment shows that the foot is plantigrade (Copyright 2014, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore)

loosening at the time of bone grafting, additional pins or wires should be inserted and the loose pins removed. For this procedure, blue towels and Betadine-soaked (Purdue Products, Stamford, CT) Ray-Tec sponges (Johnson & Johnson, New Brunswick, NJ) are placed around the frame and pins to prevent contamination of the bone graft incision site.

10 Cross-References

- Case 39: Ilizarov Ankle Fusion
- Case 41: Ankle Arthrodesis with Tibial Lengthening for Failed Pilon Fracture
- Case 45: Ankle Fusion and Tibial Lengthening (LATN Technique) for Failed Ankle Replacement
- Case 48: Salvage of Infected Tibio Talo Calcaneal Fusion
- Foot and Ankle: An Introduction

References and Suggested Reading

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