Case 60: Charcot Reconstruction with Intramedullary Foot Fixation

Bradley M. Lamm

Contents

1 **Brief Clinical History** 429

2 **Preoperative Clinical Photos and Radiographs** 429

3 **Preoperative Problem List** 430

4 **Treatment Strategy** 430

4.1 Advantages of Intramedullary Foot Fixation 431

5 **Basic Principles** 431

5.1 Principles of Intramedullary Foot Fixation 432

6 **Images During Treatment** 432

7 **Technical Pearls** 433

8 **Outcome Clinical Photos and Radiographs** 434

9 **Avoiding and Managing Problems** 434

10 **Cross-References** 435

References and Suggested Reading 435

Abstract

Many patients with Charcot neuropathy develop a malaligned foot position. Deformity of the foot, instability, and ulceration are all common indications for Charcot reconstruction surgery. Internal fixation should always be used in caution when prior osteomyelitis has been diagnosed. Presented is a case of a 47 year old diabetic male with a Lisfranc and medial cuneiform Charcot of the left foot who underwent intramedullary foot fixation. Performing open formal fusion of the Charcot joints and stabilization of the adjacent joints with intramedullary foot fixation provides for anatomical realignment and stable fixation. Augmenting the intramedullary fixation with bone graft and/or external fixation can enhance the results.

1 Brief Clinical History

The patient has hypertension and hyperlipidemia, diabetes, Charcot neuroarthropathy, and status post fifth ray partial amputation. A hyperkeratotic lesion or preulcerative lesion along the plantar medial column of the foot was present for months without relief from debridement and offloading with insert/shoe gear changes. Equinus is noted with dorsiflexion of the ankle only to neutral. The Lisfranc/cuneiform Charcot is not stable upon loading of the forefoot. He does have palpable pedal pulses.

2 Preoperative Clinical Photos and Radiographs

See Figs. 1 and 2.

B.M. Lamm (✉)
International Center for Limb Lengthening, Rubin Institute for Advanced Orthopedics, Sinai Hospital, Baltimore, MD, USA
e-mail: blamm@lifebridgehealth.org; bradankle@yahoo.com

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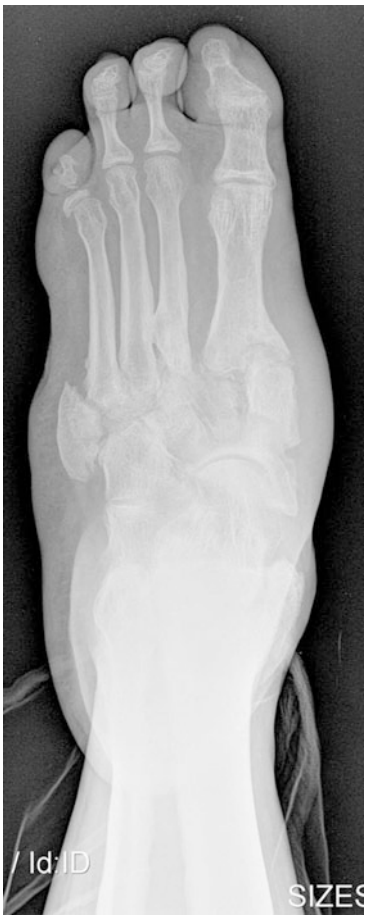

Fig. 1 Pre-operative anteroposterior weight-bearing radiographic view shows Charcot of the Lisfranc joint and cuneiforms. Note the prior fifth ray amputation and lateral translation of the forefoot

3 Preoperative Problem List

1. Diabetes mellitus
2. Peripheral neuropathy
3. Charcot neuroarthropathy of the Lisfranc and medial cuneiform with medial preulcerative lesion/callus
4. Equinus

4 Treatment Strategy

Intramedullary foot fixation is a recently developed method for stabilizing/fusion for a Charcot midfoot deformity. This novel reconstructive approach has gained vast attention recently, since the concept was first described by Grant (1997). However, the first published report of this innovative technique was described by Lamm and Paley (Lamm et al. 2006). Many terms have been utilized for describing this technique including: "beaming," "superconstruct," "axial screw fixation," and "rebar" (Sammarco 2009). However, the authors feel that descriptive terminology is most appropriate, hence the term intramedullary foot fixation (IMFF). The IMFF technique has various advantages when addressing Charcot midfoot deformity in the neuropathic patient.

Fig. 2 Pre-operative lateral weight-bearing radiographic view shows Charcot of the Lisfranc joint and cuneiforms. Note the medial column collapse and equinus of the hindfoot

4.1 Advantages of Intramedullary Foot Fixation

- Anatomical realignment
- Minimally invasive fixation technique
- Formal multiple joint fusion
- Adjacent joint fixation beyond the level of Charcot collapse
- Rigid interosseus fixation
- Preservation of foot length
- Combined with external fixation if necessary

5 Basic Principles

Midfoot Charcot collapse commonly occurs through the tarsometatarsal and/or midtarsal joints, which creates the characteristic "rocker bottom" deformity (Lamm et al. 2010). Various surgical approaches have been described for the management of Charcot collapse with traditional methods of fixation (plantar plating, pins, plates, screws, and staples). However, this fixation technique, intramedullary foot fixation, provides superior advances to Charcot midfoot deformity correction when compared to the traditional methods. The goal of the intramedullary foot fixation procedure is to recreate a stable, plantigrade, and ulcer-free foot which can be placed in a custom-molded orthotic and shoe. The indications for Charcot reconstruction via intramedullary foot fixation are an unstable midfoot Charcot or a stable but deformed midfoot Charcot. The presence of a deep ulcer to bone and osteomyelitis current or past are relative contraindications to this technique. Another factor is equinus which is typically present with a Charcot deformity and is important to be evaluated and treated when present.

Fig. 4 Intra-operative lateral fluoroscopy view shows insertion of a temporary extra-articular ankle arthrodesis pin. This large-diameter pin is inserted from the calcaneus into the tibia posterior to the ankle joint, while the ankle is loaded to maximum ankle dorsiflexion

Fig. 3 Intra-operative lateral fluoroscopy view shows loading of the foot with a foot board and mallet to a maximum ankle dorsiflexion. Note the medial column collapse and equinus of the hindfoot

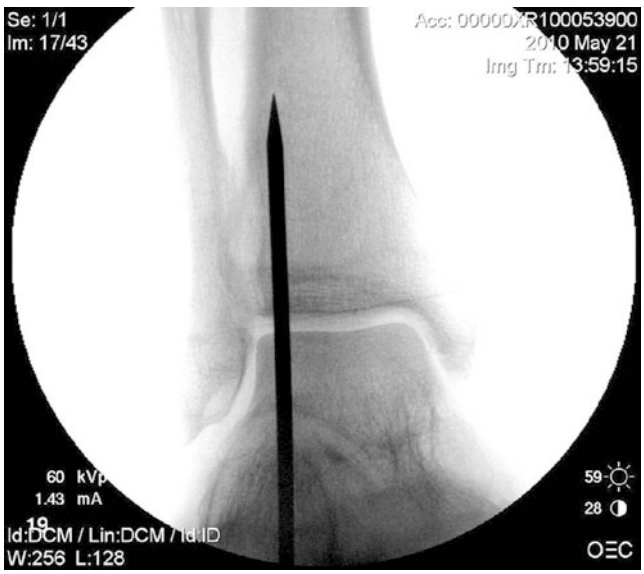

Fig. 5 Intra-operative anterior-posterior ankle fluoroscopy view shows insertion of a temporary extra-articular ankle arthrodesis pin. This large-diameter pin is inserted posterior lateral to avoid the posterior neurovascular bundle

5.1 Principles of Intramedullary Foot Fixation

- Anatomical realignment of the foot
- Adjacent joint fixation beyond the level of Charcot collapse
- Rigid interosseus fixation
- Preservation of foot length

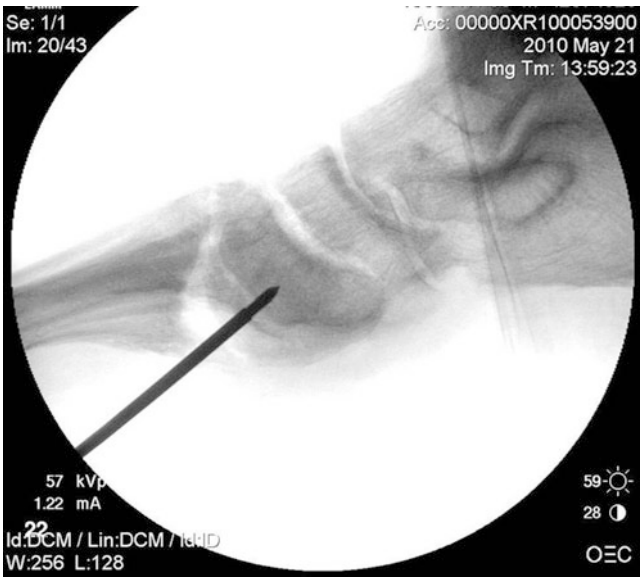

Fig. 6 Intra-operative lateral fluoroscopy view shows insertion of a guide pin from the medial cuneiform through the medial longitudinal incision

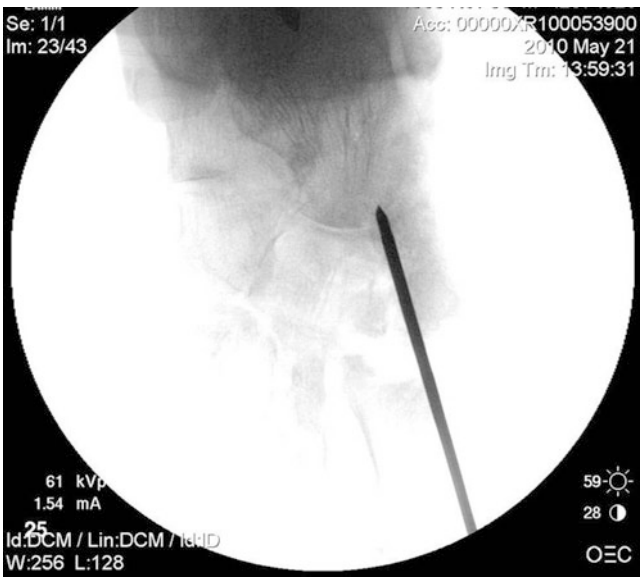

Fig. 7 Intra-operative anterior-posterior foot fluoroscopy view shows insertion of a guide pin through the medial cuneiform across the central aspect of the talonavicular joint. Note that the entire medial column has undergone joint debridement. The guide wire was inserted though the talus and out the posterior lateral aspect of the ankle. Then, the guide wire is inserted into the first metatarsal retrograde out the plantar aspect of the first metatarsal phalangeal joint

6 Images During Treatment

See Figs. 3, 4, 5, 6, 7, 8, 9, 10, and 11.

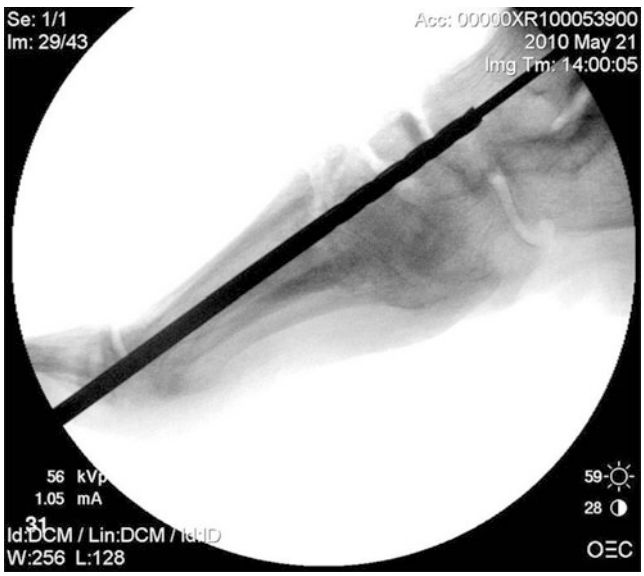

Fig. 8 Intra-operative lateral foot fluoroscopy view shows drilling over the medial column guide pin from the first metatarsal to the talus

Fig. 9 Intra-operative lateral foot fluoroscopy view shows insertion of a partially threaded large-diameter cannulated screw across the entire medial column. This creates stability and compression

7 Technical Pearls

The goal of medial column stabilization is to obtain a formal fusion of all medial column joints. In this case, an antegrade followed by a retrograde guide pin insertion was employed; however, a pure antegrade insertion is more typically performed and is outlined by the following technique.

Fig. 10 Intra-operative lateral foot fluoroscopy view shows insertion of a partially threaded large-diameter cannulated screws across the entire medial and lateral columns. The lateral column screw is inserted from the fourth metatarsal into the calcaneus

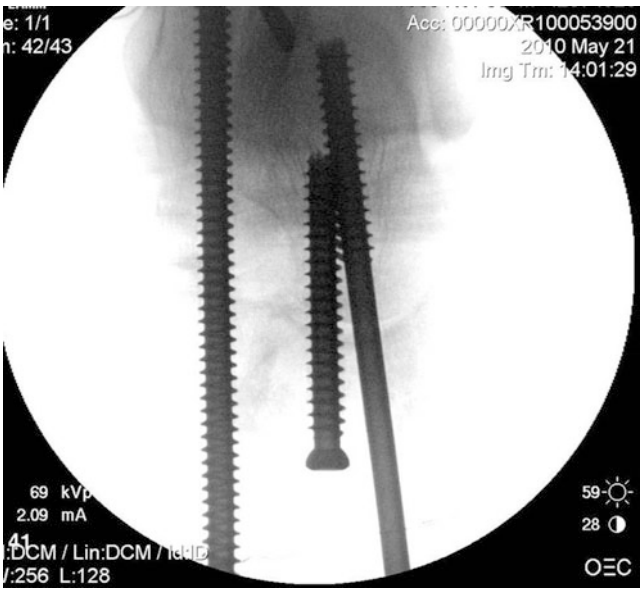

Fig. 11 Intra-operative anterior-posterior foot fluoroscopy view shows insertion of a total of three partially threaded large-diameter cannulated screws across the entire medial and lateral columns. The central column screw is inserted across the second metatarsal into the talus

An anterior-posterior radiographic fluoroscopy image is obtained by flexing the ipsilateral knee to 90° and placing a towel beneath the forefoot. Then, a 1.8 mm Ilizarov wire is inserted through the plantar aspect of the first metatarsal phalangeal joint directed to the center of the first metatarsal head. This is accomplished by maximum dorsiflexion of the first metatarsal phalangeal joint. The anterior-posterior radiographic fluoroscopy image should show the tip of the guide wire located on the edge of the cortical bone of the first metatarsal head "equator" without superimposition. Confirm on a lateral fluoroscopy the direction of the wire insertion being parallel and coinciding with the lateral anatomic axis of the first metatarsal. Insert the guide pin manually via a mallet to the base of the metatarsal, ensuring intramedullary placement, then drive it into the talus. It may be necessary to use separate small wires to reduce the individual medial column joints prior to ensure accurate insertion of the guide pin. When confirmed on a lateral and anterior-posterior fluoroscopy, the cannulated drill and screw is inserted (7.0/8.0 mm cannulated screw). Note that all guide

Fig. 12 Post-operative anterior-posterior foot weight-bearing radiographic view shows consolidation of the medial column and realignment of the forefoot

wires are inserted prior to screw placement so that the lateral fluoroscopy imaging is possible. This technique is repeated for the central and lateral column fixation.

The patient is placed in a 90° bivalved non-weight-bearing short-leg cast for the initial post-operative course. The patient is then seen 1 week post-operatively and skin incisions are evaluated. The patient is then placed in a non-weight-bearing short-leg cast for a total of 8–12 weeks, with intermittent follow-up. In some cases, IMFF is utilized in combination with external fixation. In those instances, the follow-up is bi-weekly with the patient weight-bearing as tolerated using an assistive device.

8 Outcome Clinical Photos and Radiographs

See Figs. 12, 13, 14, and 15.

9 Avoiding and Managing Problems

Charcot patients take a greater amount of time for osseous consolidation; therefore, multiple host factors have to been addressed in combination with accurate well-planned surgical technique.

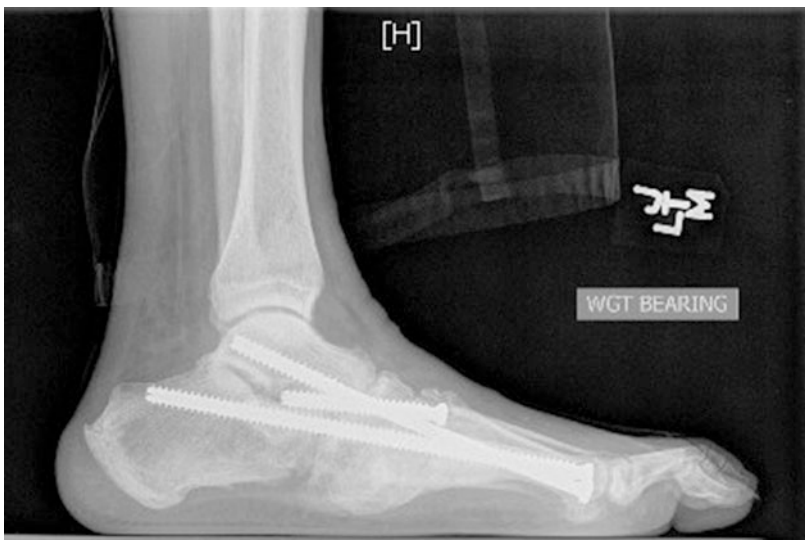

Fig. 13 Lateral foot weight-bearing radiographic view shows consolidation of the medial column and realignment of the forefoot

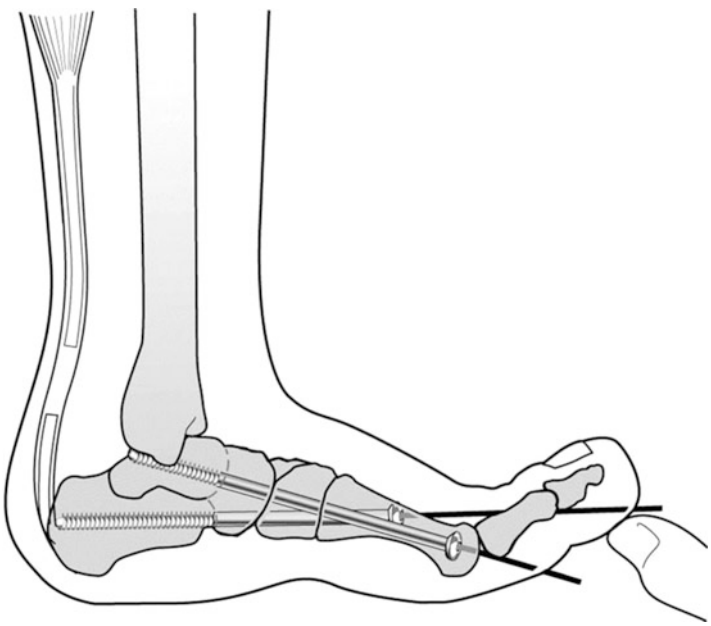

Fig. 14 A lateral illustration of the foot shows dorsiflexion of the metatarsal phalangeal joints and insertion of the large-diameter cannulated intramedullary metatarsal screws

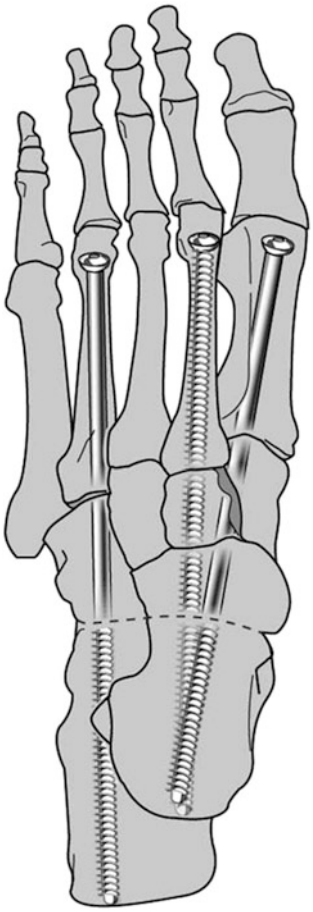

Fig. 15 Anterior-posterior illustration of the foot shows the targeted location, type, size, and length of the intramedullary metatarsal screws

When this fixation constructs fail, the screws can be removed by hammering the screw posteriorly.

Infection can occur and when present beware of a rapid onset of systemic symptoms without superficial concern of a wound or sinus (medullary osteomyelitis). Treatment of infected intramedullary foot fixation consists of debridement and over-reaming the canals as well as insertion of antibiotic-coated pins called sparklers.

This IMFF technique has been reported to have positive short-term results as a primary or salvage procedure for non acute midfoot Charcot deformity.

10 Cross-References

▶ Case 59: Charcot Reconstruction with External Fixation

References and Suggested Reading

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