1. debridement of all infected bone
2. correction of deformity
3. provisional fixation with K-wires
4. maintenance of correction with pre-assembled static circular fixator

References

CHRONIC LISFRANC and CHARCOT MIDFOOT ARTHROPATHY: Reconstruction with Transpedal Closing Wedges & Plantar Plating

Lew C. Schon, MD
lewschon@comcast.net
Director, Foot and Ankle Services
The Union Memorial Hospital
Baltimore, Maryland

I. Goals of treatment:
Achieve stability, establish a plantigrade foot, maintain ulcer- and infection-free tissues, limit acute flares of Charcot or arthritis, maximize biomechanical function, balance malalignments, reduce neuropathic and arthritic pain

II. Classification:
A. Midfoot deformities based on degree of collapse (Schon Stage)
   A = mild collapse
   B = midfoot, touching the floor
   C = midfoot, below level of metatarsal
B. Radiographic Types: Location of deformity: midfoot and hindfoot
   Schon Types I-IV: Radiographic diagnosis
   Type I deformity occurs through Lisfranc; plantar prominence begins medially and progresses in stage C (severe) to plantar-laterally; most of these feet are abducted.
   Type II deformity begins at the naviculocuneiform joint and progresses in Stage C to the 4th and 5th metatarsal-cuboid joints. Plantar prominence begins laterally under the 4th to 5th metatarsal-cuboid joints and then progresses medially; approximately half are abducted.
   Type III deformity begins with collapse of the navicular. The plantar prominence is under the 4th to 5th metatarsal-cuboid joint. The foot often supinates and adducts.
   Type IV deformity is through the transverse tarsal joints. Plantar prominence is under the calcaneo-cuboid joint and/or under talus or navicular.
C. Radiographic: Severity
   Alpha – better prognosis, less likely to require aggressive long-term surgical or non-surgical intervention. Lower risk of ulceration, infection or osteomyelitis. *All of following criteria must be met.*
For Clinical Stage C or Radiographic Beta -severe deformities: Following exposure as above K-wires are placed delineating the wedge of bone to be resected from the medial to the central columns. Sometimes the corrective wedge includes the lateral column. Fluoroscopy is used to ensure that the effected joints are resected and that the wedge stays in the proximal metatarsal metaphyseal bone. An osteotomy is done with a 10mm wide, greater than 30mm long microsagittal saw or larger saw patella blade. The osteotomy begins medially and progresses laterally. A wedge, block, or trapezoid shape may be removed as dictated by the necessary correction. It is very important when doing the osteotomy to avoid cutting into the bases of the metatarsals, staying as proximal as possible in the metaphyseal bone. This maintains the metatarsal as a unit as avoids the intermetatarsal arteries. The 4th and 5th MTC joints are often either included in the wedge or are approached separated with local resection and reduction.

Following reduction of the osteotomy, cannulated screws are placed as above. A 1/3 semi tubular plate is contoured to fit across the plantar TMT joint, with plantar to dorsal placed screws in the first metatarsal, medial cuneiform and or navicular. The screws can be placed obliquely into the central column. A thin plate with proximal flare can also be used. Several wider specifically designed plates are also available. These allow for greater footprint for screw fixation underneath the proximal bones. Lateral plantar plating for the 4th and 5th MTC joint is biomechanically more stable but is technically challenging. A lateral dorsal plate may be used for additional fixation along with axial screws.

In certain instances, after correction of the deformity, a bone defect will be present that can be addressed with a sliding wedge local bone graft. Another option for a larger void is to use allograft which is soaked in concentrated bone marrow aspirate taken from the iliac crest.

VI. Post operative care
A. Immobilization: 3 months for Traumatic non-Charcot, 6 months for Charcot
B. Weight bearing: 6 weeks for Traumatic non-Charcot, 3 months for Charcot

VII. Results:
A. Traumatic non-Charcot: 90% good to excellent results
B. Charcot: My unpublished series of 250 patients with rocker bottom deformity with 5- to 16-year follow-up, (final analysis pending), showed a high rate of limb salvage, improved footwear, and easier foot maintenance. Overall, the patients have had improved function and quality of life. Usually patients are able to wear regular or extra-depth shoes. Occasionally screw breakage occurs, but this is generally well-tolerated and not associated with a poor outcome. There were some wound complications, local infections and some delayed or incomplete unions. It was uncommon for the patients to require an ankle-foot orthosis (AFO). Recurrent ulceration has been minimal, but it has been noted to be more common in patients with osteolysis, bone loss, diffuse osteomyelitis and poor circulation.
a. AP talo-1st MT < 35 deg
b. LAT talo-1st MT < 30 deg
c. LAT calc-5th MT > 0 deg
d. No dislocation

Beta – worse prognosis, more likely to require aggressive long-term care. higher risk of ulceration, infection, and osteomyelitis.

Any one of the following criteria establishes this stage.

a. AP talo-1st MT > 35 deg
b. LAT talo-1st MT > 30 deg
c. LAT calc-5th MT < 0 deg
d. Dislocation

III. Indications for Closing wedge reduction and plantar plating
A. Deformities include abducted foot, adducted foot, supinated foot, pronated foot. Schon clinical Stage B and C. (Stage A can be treated without wedge but plantar plate is useful with poor bone stock or neuropathy)
B. Types I, II, III, IV
C. Radiographic Beta
D. Pain, swelling, shoe wear difficulties, instability, ulcers

IV. Relative contraindication for internal fixation: consider screws/ wires supplemented with frame
A. Active Superficial infection- delay until resolution,
B. Deep infection- debride tissues, resect or debride ulcer and use two stage approach
C. Osteomyelitis- resect and frame
D. Ischemia- angioplasty , bypass then fixation as indicated
E. Severe Osteolysis (inadequate bone stock): consider block allografts for voids
F. Active inflamed Charcot: immobilization and rest to settle then fixation
G. Severe unmanageable medical co-morbidities

V. Arthrodesis/osteotomy technique:
Medial and central column exposure is through a plantar-medial longitudinal incision. The fascia of the abductor hallucis is incised. The fascia-skin layer is elevated as a flap dorsally. The abductor hallucis muscle and tendon is reflected plantarly. The capsular/periosteal tissues are lifted as a flap off the medial and plantar surfaces of the bone exposing the first TMT joints, as well as the NC and TN joints as necessary. Part of the tibialis anterior can be reflected off the cuneiform as needed but must be repaired at the end of the case. With severe abduction deformity in Schon type I or II, the tibialis anterior tendon can be detached with a wafer of medial cuneiform. After correction of the deformity this should be reduced. A dorsal longitudinal incision can be made between the second and third TMT joints but typically this approach is not necessary for a transpedal wedge as debridement and correction of the joints is done through the osteotomy. The lateral column is exposure through a dorsal longitudinal incision is made between the fourth and fifth metatarso-cuboid (MTC) joint. A tendo Achilles lengthening or gastrocnemius recession is performed to address equinus deformity

For Radiographic Alpha or Stage I feet: The joints are debrided down to subchondral bone using a chisel. A .045 Kirchner wire is then used to drill holes in the bony surfaces. Each joint is reduced and provisionally fixed with guide wires for either the 4.0 or 4.5 cannulated screws: in the orientation described below. In good bone stock, these screws are inserted for the joints in the medial cuneiform into first metatarsal, the first metatarsal into medial cuneiform, the medial cuneiform into second metatarsal, the second metatarsal into middle cuneiform, the third metatarsal into lateral cuneiform, the fourth metatarsal into cuboid, and two screws from fifth metatarsal into cuboid. For the 5th MT cuboid screws, a guide wire is started at the plantar-lateral corner of the triangular shaped metatarsal and driven obliquely into the cuboid. A second guidewire/ screw is then placed parallel to the first one. One alternative to achieve fixation is going from cuneiform to metatarsal, in the patient with amputated great toe, a guide wire can be placed retrograde down the metatarsal shaft and into medial cuneiform, followed by screw fixation, providing a stable axial configuration.