Charcot Arthropathy: Surgical Indications and Options

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Disclosures

- Arthrex - Speaker
- Celularity - Speaker
- Stryker - Consultant
Brief History of Charcot

- **Diabetes**
  - 29 million adults in the US

- **Jean-Martin Charcot – 1868**
  - Neuroarthropathy

- **Jordan – 1936**
  - Diabetic Charcot neuroarthropathy
  - Neurotraumatic vs Neurovascular
  - Inflammation = TNFa upregulates receptor activator of nuclear factor-kB (RANKL)
  - RANKL intensifies abnormal osteoclastogenesis and excessive bone turnover
  - -RANKL antagonist anti-inflammatory cytokines are downregulated

Brief History of Charcot

- Sohn et al – 2010
  - Charcot alone may not pose amputation risk
  - Charcot with ulceration = 12x higher risk of amputation

“With the increased number of diabetics worldwide and the increased incidence of morbid obesity in more prosperous cultures, there has become an increased awareness of Charcot arthropathy of the foot and ankle. Outcome studies would suggest that patients with deformity associated with Charcot Foot arthropathy have impaired health related quality of life. This awareness has led reconstructive-minded foot and ankle surgeons to develop surgical strategies to treat these acquired deformities” – Michael S. Pinzur

Brief History of Charcot

- **Charcot Incidence:**
  - 0.1% – 5.0% of diabetic patients
  - 80% of Charcot occurs in those with DM for more than 15 years
  - 60% of Charcot occurs in those with DM for more than 10 years
  - Forefoot – 3%
  - Midfoot – 50%
  - Hindfoot – 28%
  - Ankle – 19%

- **Herbst et al – 2004 (Prospective)**
  - 55 patients
  - Classified by:
    - Injury (fracture, dislocation, combination)
    - Location (forefoot, midfoot, hindfoot, ankle)
  - Poorer outcomes associated with forefoot and ankle fracture patterns

Brief History of Charcot

- Pinzur – 2004
  - Comparative Study
    - Surgical vs Conservative
  - 201 Charcot feet (198 pts)
    - 1 yr min follow up
    - Conservative
      - 59.2% had plantigrade foot
    - Surgical
      - 40.8% required surgical correction
    - More than ½ limbs were managed without surgical intervention
Brief History of Charcot

- Fabrin et al – 2000 (Retrospective)
  - 140 limbs (115 pts)
  - 48 months follow up
  - All patients managed with Conservative NWB, protective shoes, or crutches until normal foot temperature achieved
  - 94.3% healed
  - Late complications
    - 47% developed new onset Charcot or ulcer (nearly half of patients developed late complication)

- Although current orthopaedic textbooks are in almost universal agreement that treatment should be nonoperative, accommodating the deformity with orthotic methods, most peer-reviewed clinical studies recommend early surgical correction of the deformity
Current Concepts and Expert Recommendations

- Conservative Treatment Indications:
  - Acute Charcot
  - Clinically **stable** midfoot
  - No evidence of nonunions
  - No ulcerations
  - Asymptomatic

- Early Conservative Treatment Options:
  - NWB cast or TCC
    - Change every 3 wks (8-12 wks)
  - Knee scooter, wheelchair
  - Serial Xrays
  - Walker boot
    - Bridge with AFO or CROW
  - Therapeutic shoes

Hyer CF, Pinzur MS, Ellington JK, Davis WH, Jones CP. 2014. Foot Ankle Specialist. Vol 7 (4);286-
• Current Concepts and Expert Recommendations

Surgical Treatment Indications:

• Acute Charcot
• Chronic Charcot
• Clinically unstable
• Symptomatic
• Nonunions present
• Ulcerations
  • Infection?
Current Concepts and Expert Recommendations

• Early Surgical Intervention:
  • Possible minimally invasive sx
    • Percutaneous beaming (no ulcer)
    • External fixator (ulcers) (12 wks)
  • Soft tissue envelope drives treatment
  • Acute vs Dynamic Gradual Correction
    • Trend towards single stage
    • No clear consensus
Current Concepts and Expert Recommendations

• Surgical Treatment:
  
  • Internal fixation
    • 1<sup>st</sup> ray/medial column beaming
      • Medial column plating
        • Long M-L lag screws
      • Belt and Suspenders
    • 2<sup>nd</sup> ray beaming?
    • 3<sup>rd</sup> or 4<sup>th</sup> ray beaming into hindfoot
    • TN and NC joints for proximal stabilization
  
  • External fixation
  
  • Combination
    • Stabilize at least one level proximal to the Charcot deformity
    • TAL vs Gastroc recession
Current Concepts and Expert Recommendations

• Surgical Treatment
  • Midfoot Wedge Osteotomies
    • Biplanar correction
    • Re-establish Meary’s Angle
    • Navicular excision?
  • Midfoot and Medial Column Fusions

• Hindfoot and Ankle Charcot
  • Subtalar joint fusion
  • Tibiotalocalcaneal (TTC) fusion
    • Intramedullary nail preferred
      • Load sharing
      • Dynamic nail tolerates bone subsidence (settling) over time
    • Decreased risk wound breakdown and hardware exposure vs plate and screws
  • External fixator in addition

Hyer CF, Pinzur MS, Ellington JK, Davis WH, Jones CP. 2014. Foot Ankle Specialist. Vol 7 (4);286-
• **Current Concepts and Expert Recommendations**

  • Surgical Treatment
    • Infection?
      • (cultures, MRI, bone scan, SPEC-CT)
      • WBC, ESR, CRP, HgbA1c

  • + Infection:
    • Ulcer excision/debridement/VAC
    • Resection of osteomyelitis
      • Bone culture and pathology
    • PMMA(6 wk exchange)
    • external fixation
      • Single stage vs Staged procedures
        • Pinzur (78 pts with OM single stage correction)

  • - Infection:
    • internal fixation, external fixation, combination

Hyer CF, Pinzur MS, Ellington JK, Davis WH, Jones CP. 2014. Foot Ankle Specialist. Vol 7 (4);286-
Current Concepts and Expert Recommendations

- **Orthobiologics:**
  - *Never used in setting of infection*
    - Antibiotic spacers/beads

- **Autograft**
  - Typically not used (poor host bone)

- **Allograft**
  - (no consensus on whether to use at all or what type when used, but tend to avoid use)

- **Bone chips**

- **Structural grafts (Dead Bone Sandwich?)**
  - Calcaneal
  - Iliac crest
  - Femoral head

- **Synthetics**
  - Calcium Triphosphate

- **BMA – most common when biologics are used**
Current Concepts and Expert Recommendations

• Post-op Protocols:
  • NWB with internal fixation
    • Cast vs Splint 6-8 wks
  • NWB to PWB with frame or combination
    • 15-30lbs of weight for transfers
  • Ex-fix for 8-12 weeks
  • TCC for additional 4-6 wks
  • FWB at 4-6 months
    • AFO, Walking boot, Therapeutic shoe

• CROW (optional)
  • Transition into CROW after casting or surgery for stable plantigrade foot (6-9 months)

• AFO brace or diabetic footwear after stable surgical or conservative care

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Current Concepts and Expert Recommendations

• Post-op Protocols:
  • Wound Management
    • Pulse lavage irrigation and debridement
    • Primary excision and closure
    • Wound VAC
    • Skin graft if necessary
    • Fluffy dressings
  • Post-op Antibiotics (no consensus)
    • Culture driven
      • 14 days PO antibiotics
      • 6 wks IV
Charcot Outcomes

- **Chraim et al.** (2001)
  - 19 feet in 18 patients
  - Charcot arthropathy
  - Including hindfoot arthrodesis
  - Follow up 46.36 mo
  - Limb salvage rate 16/19 limbs
  - 3 patients had BKA
    - Infection
  - Infection, nonunion, persistent ulcers
  - Postop functional scores significantly improved vs preoperative scores AOFAS, FFI, VAS, FAOS

Charcot Outcomes

- **Pinzur et al – 2018 (retrospective)**
  - Historic treatment
    - Immobilize during active phase
    - Accommodative bracing of deformity
  - New Paradigm
    - Attempted operative correction of deformity
    - Timing
      - Acute phase vs Consolidation phase

- 223 Limbs (214 pts)
  - 12 year follow up
    - Midtarsal Charcot reconstruction
    - 3 patterns of deformity
      - Varus - 48
      - Valgus - 138
      - Talocalcaneal dislocation – 37

- 77.6% achieved favorable outcome (independent ambulation in therapeutic footwear)
  - Valgus – 87%
  - Dislocation – 70.3%
  - Varus – 56.3%

Pinzur, et al. 2018. Foot Ankle Int. Vol 39 (3);
Charcot

- Pinzur et al – 2018
  - Surgical intervention
    - Resection of infection
    - Correction of structural deformity by wedge resection at the apex
    - TAL
    - Immobilization with a 3-level circular external fixator
    - Additional procedures added over time as necessary
  - Stratification of patients by deformity pattern allowed alterations of the basic surgery to afford improved outcomes
  - ~80% of patients achieved functional goal of independent ambulation with therapeutic footwear
  - Supports the modern paradigm of operative correction of deformity in this complex patient population
  - Helpful in counseling patients and providing a risk-benefit ratio associated with surgery

Pinzur, et al. 2018. Foot Ankle Int. Vol 39 (3);
Charcot Arthropathy

- Complications/Failures
Charcot Arthropathy

- Complications/Failures
Summary

- Management is complicated by a lack of consensus on diagnostic criteria and an incomplete understanding of the pathogenesis.
  - Likely dependent on several interrelated factors in combination with neuropathy:
    - Genetic
    - Neuropeptide decrease
    - Abnormal bone formation and resorption
    - Abnormal nuclear factors leading to osteoclastogenesis

- Treatment:
  - Conservative vs Surgical
    - MIS vs Open
    - Internal vs External vs Combination
  - “Limb Salvage”
    - Achieve a stable, plantigrade foot without areas of excess pressure or prominence
      - Acute vs Chronic
      - Stable vs Unstable
      - Ulcerations?
        - Infection?

- Shifting Treatment Paradigm???????
Thank You