



UPMC

University of Pittsburgh  
Medical Center



# Charcot Foot Reconstruction: What, When and Why? Evidence Based Medicine

Dane K. Wukich MD

5th Annual  
Multidisciplinary Management  
of the High Risk Diabetic  
Foot Conference

# Goals of Surgical Treatment

---

- Plantigrade
- Stable
- Shoeable/Braceable
- Heal any ulcers
- Prevent recurrences
- Decrease or eliminate pain
- Avoid amputation
- Maintain ambulation



# How do we define a successful outcome in Charcot patients?

---

- Is it limb preservation ?
- Is it limited walking capacity with the use CROW or AFO?
- Is it a patient who can walk, is ulcer free and able to utilize custom shoes with accommodative inserts?



# Successful Outcome of Surgery

---

- Depends on geography
- Depends on the skill of the medical team
- Depends on available technology
- Depends on expectations of the patient
  
- Surgical treatment is controversial
- Surgical treatment lacks sound scientific evidence to support or refute surgical management at this point in time



# Multidisciplinary Approach

- Plastic Surgeons
- Vascular Surgeons
- Orthopaedic/ Podiatry
- Infectious Disease
- Endocrinology
- Cardiology
- Nursing



**UPMC** | University of Pittsburgh  
Medical Center



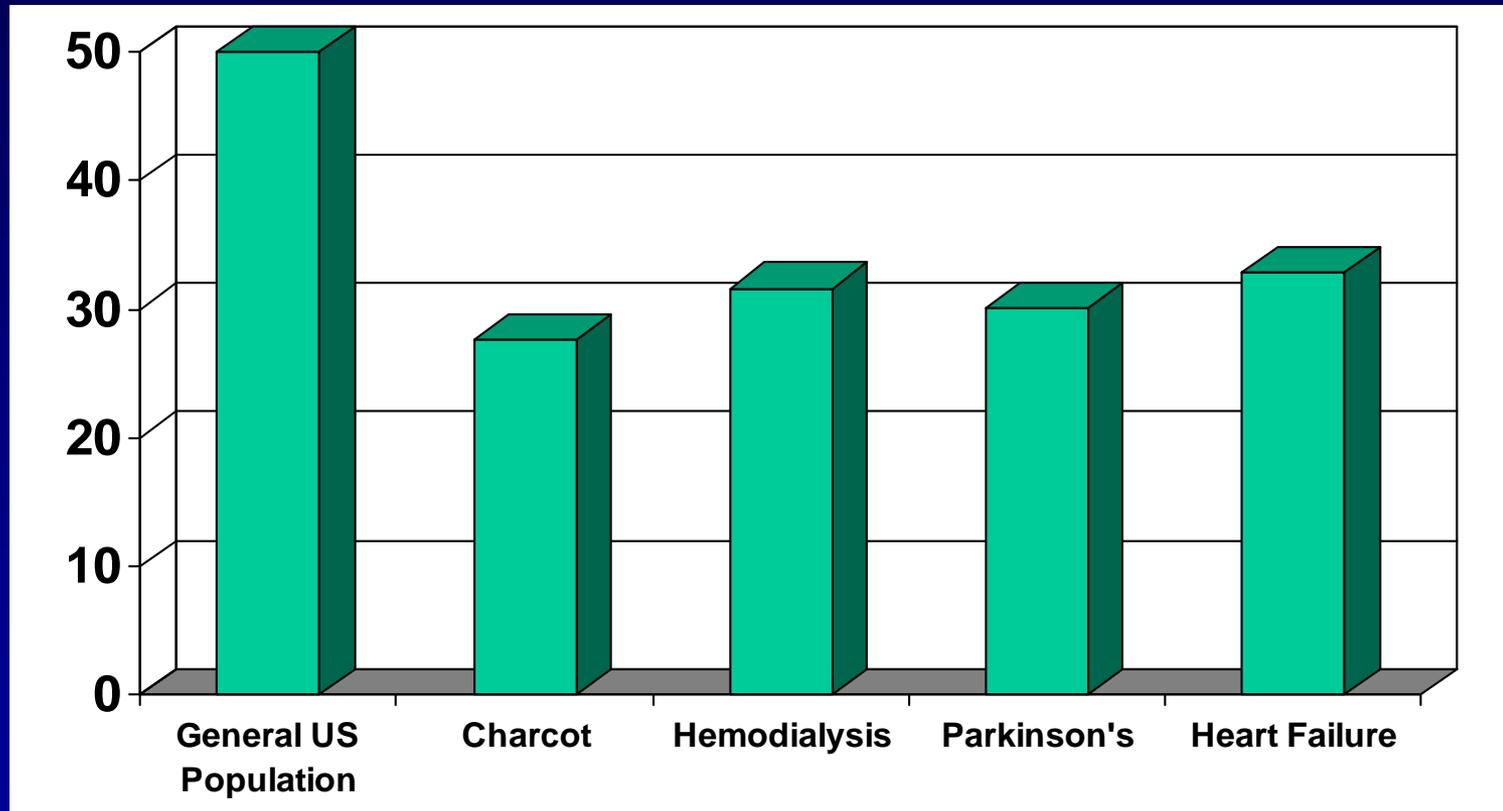
# Quality of life issues in Charcot

---

- AOFAS Diabetic Foot Questionnaire
- Clinician Diabetic Foot Survey
- Short Form Health Form (SF-36)
  
- Diabetic patients with Charcot had much lower physical scores than any other major illness
- These scores were more than 1 standard deviation below diabetic patients in general



# SF-36 Scores



# Surgery in Charcot patients

---

- Case Series
- Expert reports
- Most studies are small
- Report on a specific technique
- Inherent selection bias



# Technically Challenging Surgery

- Failure of fixation
- Pseudoarthrosis
- Wound problems
- Infection
- Amputation



- Limb salvage should be 90% with proper technique and good patient selection



# Bone Mineral Density

---

- Regional osteopenia of the involved lower extremity but not in the spine
- Dislocations are associated with relatively normal bone density
- Fractures are associated with decreased BMD

Herbst et al JBJS 2004

Jirkovska et al Diab Med 2001

Young et al Diab Care 1995



**UPMC** | University of Pittsburgh  
Medical Center



# Which patients need surgery is not well defined in 2008

- Deformities causing instability
- Inability to brace a deformity
- Impending compromise of the skin
- Non-healing ulcers
- Recurrent ulcers due to malalignment
- Pain
- *25-50% of patients will require some type of surgery*



# Risk of Amputation

- No ulcer @ presentation 7%
- Ulcer @ presentation 28%
- Recurring (2 or more) ulcers after treatment for Charcot 31%



# Acute Charcot (Stage 1)

- Surgery has traditionally not been recommended during the acute inflammatory stage
- Increased wound healing problems and increased failure of bone fixation
- Indication for surgery would be soft tissues at risk due to bony prominence



# Surgery during Stage 1: The acutely inflamed foot or ankle

---

- Very small number of patients in the studies that have been published
- Must be done before the bone fragments and becomes “soft”
- Arthrodesis/ Fusion
- At this point EBM is inconclusive regarding surgery in Stage



# Eichenholtz Stages 2 and 3

---

Surgical options during this non inflamed state include:

- Exostectomy
- Osteotomies
- Realignment arthrodesis



**UPMC** | University of Pittsburgh  
Medical Center



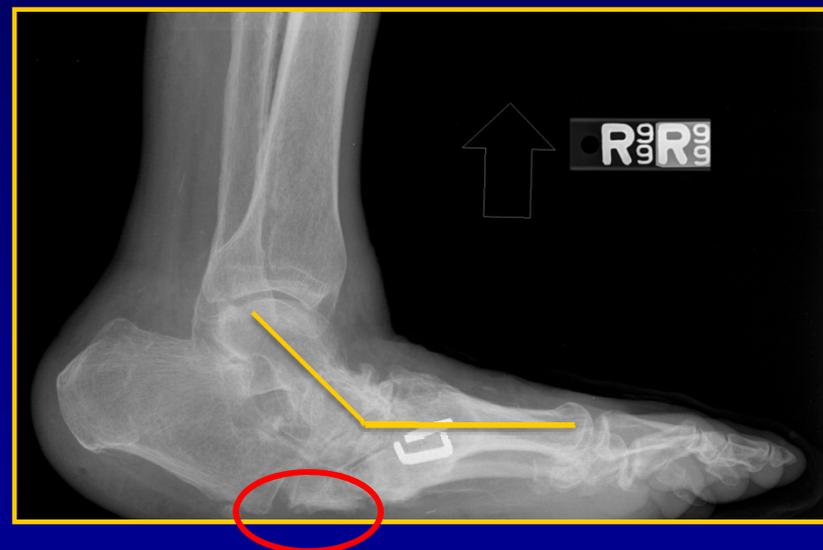
# Forefoot

- Achilles lengthening
- Gastroc slide
- Osteotomies
- First MTPJ arthrodesis
- Correction of hammertoes
- Metatarsal head excision



# Midfoot indications

- Non co-linear talar first metatarsal angle
- Weight bearing lateral radiographs
- Minus 27 degree angle associated with ulcer



**Bevan and Tomlinson: FAI 2008**



**UPMC** | University of Pittsburgh  
Medical Center



# Exostectomy

- Technically easy
- Medial column ulcers do better with exostectomy than lateral column ulcers
- Complications include *iatrogenic instability, recurrent ulceration, delayed wound healing and infection*
- Often combined with TAL



Lateral prominence



Prominence resected

# Midfoot Reconstruction

- Ideally performed after the ulcer has healed
- Decreases chance of infection but sometimes the ulcer will not heal without reconstruction



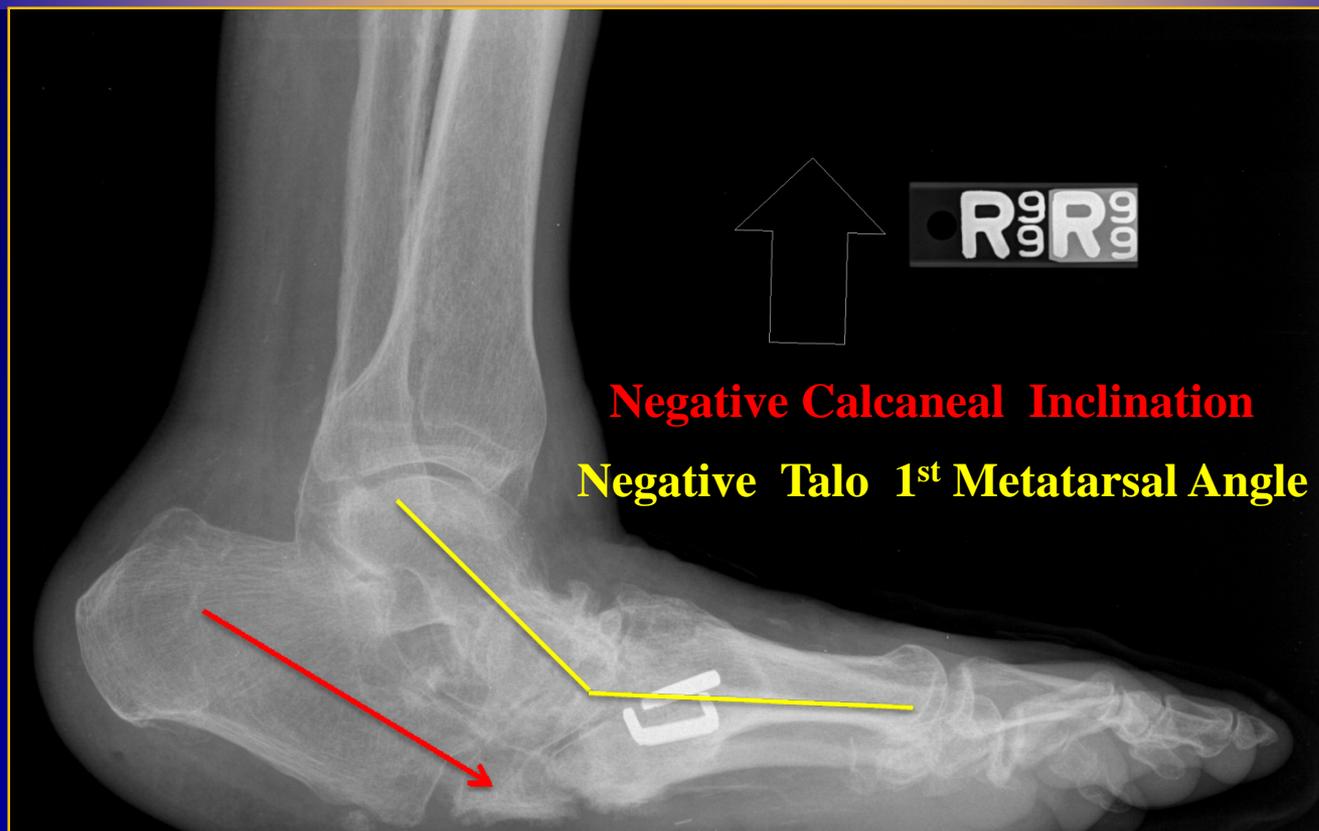
# Midfoot Reconstruction

## Indications for external fixation

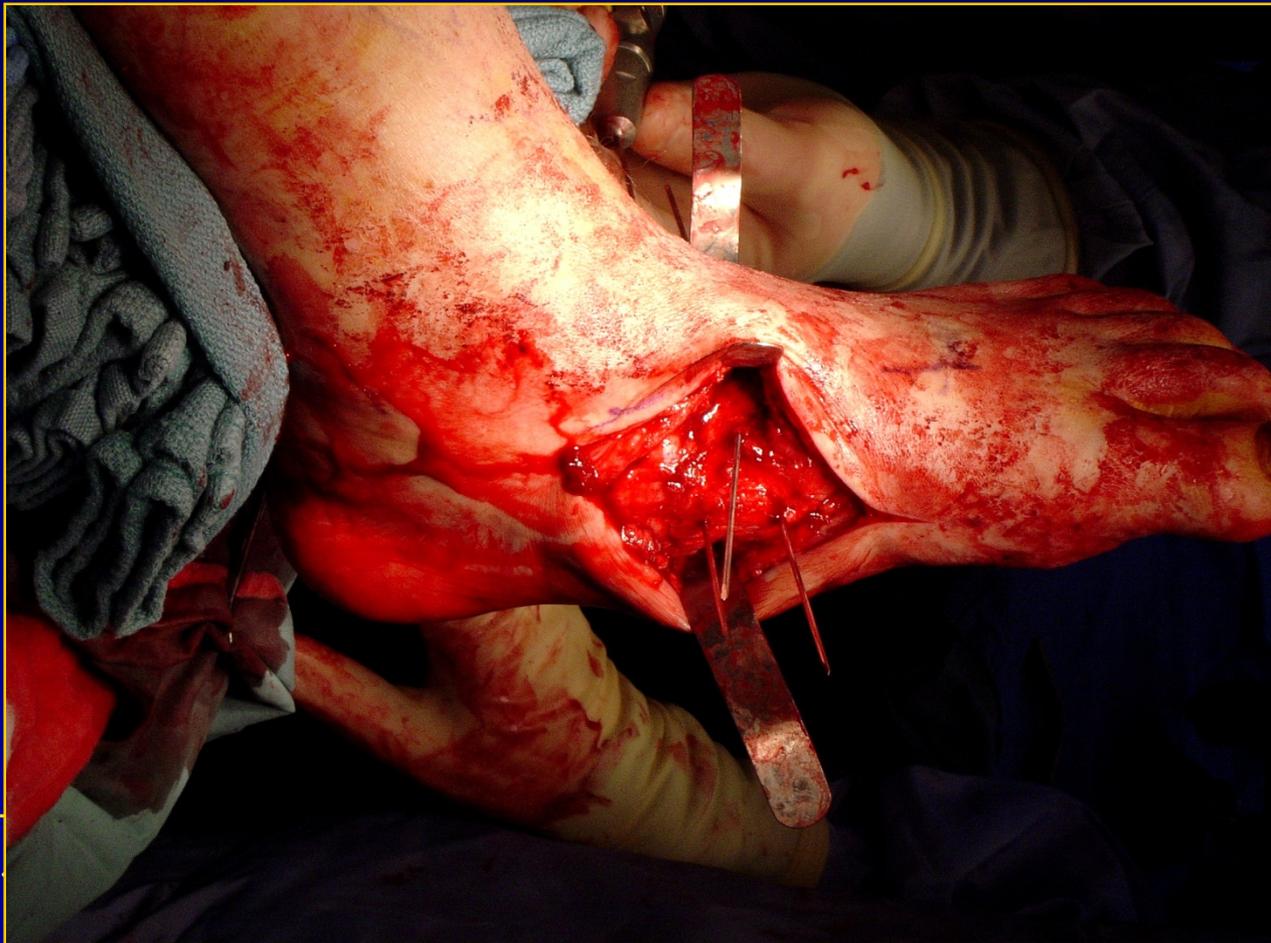
- *Open ulcer*
- *Active soft tissue infection*
- *Bone infection (osteomyelitis)*
- *Poor bone quality*
- *Decreased bone mineral density (Charcot + nephropathy)*
- *Obese patients*



# Rockerbottom Foot

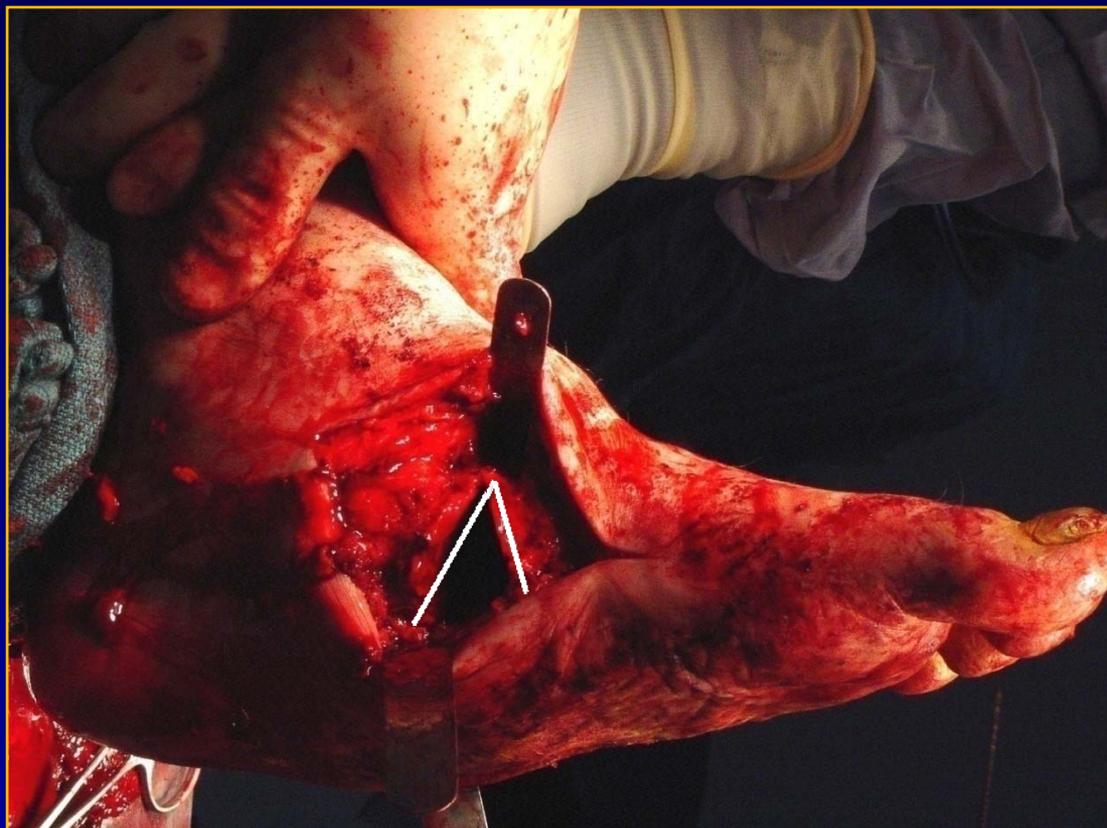


# K wires as guide for the osteotomy



U

# Remove a biplanar wedge



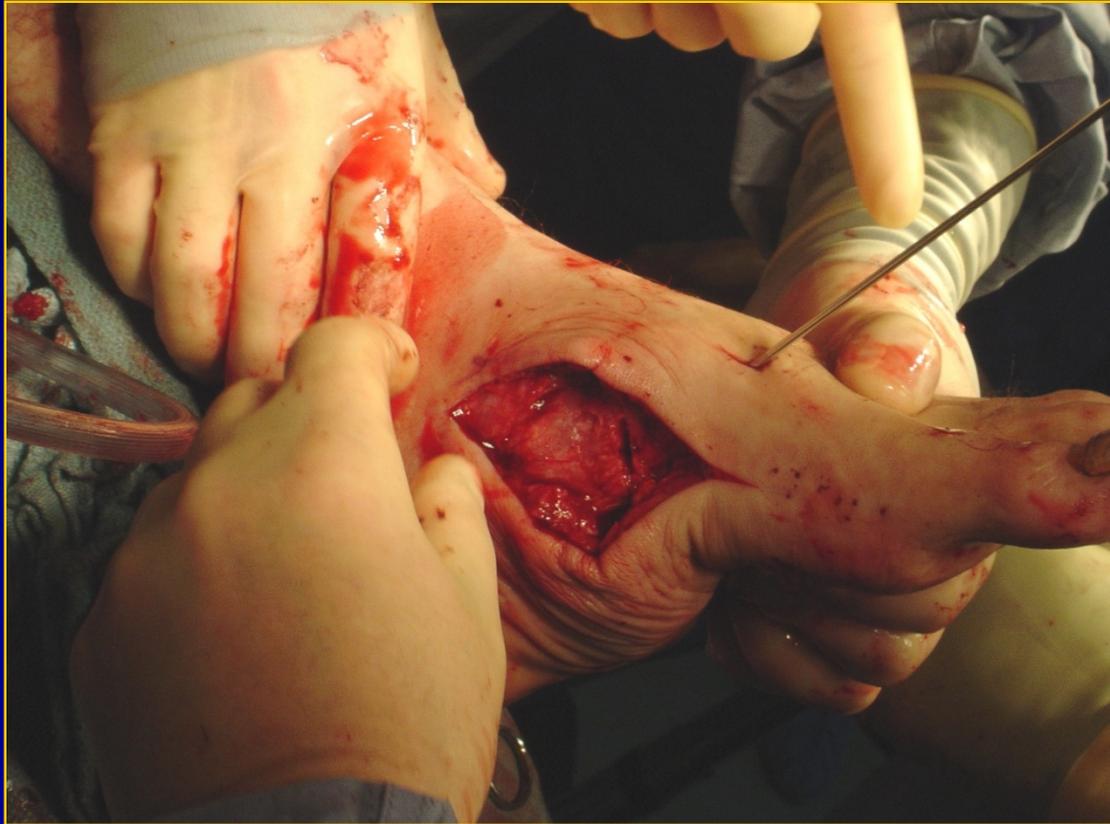
# Reduction accomplished by plantarflexion and adduction



**UPMC** | University of Pittsburgh  
Medical Center



# Provisional fixation ( K wires)



**UPMC** | University of Pittsburgh  
Medical Center

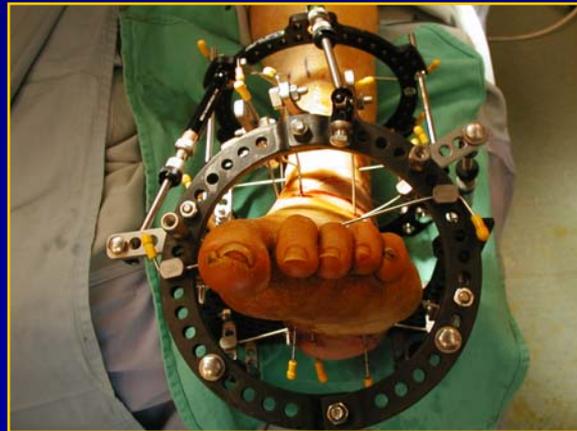


# Temporary Stabilization



# External Fixation

- Stable fixation/immobilization
- Allows treatment for ulcers & open wounds
- Useful in patients with decreased bone density
- Ideal in infected cases



# Complications of Ext. Fixation

---

- Pin tract infection
- Cellulitis
- Pin breakage
- Tibia fracture
- 80-100% of patients experience at least a minor complication



# Chopart and Subtalar

- More difficult to manage than mid or forefoot
- Inherently unstable because they are closer to the long axis of the leg
- Exostectomy and or Arthrodesis



# External Fixation

- Allows distraction / compression / neutralization
- Early patient mobilization & motion of adjacent joints
- Visualization of local wound status, flaps & skin grafts



# Ankle Charcot

---

- Difficult to manage in Orthoses once deformity develops
- Can be very unstable
- Prone to ulceration over the medial and lateral malleoli
- Varus and valgus of more than 15 degrees are difficult to accommodate in any orthoses



# Salvage of Ankle Charcot



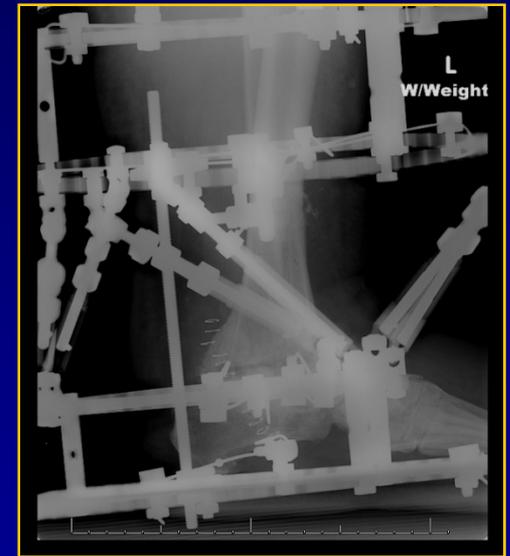
# Tibiotalocalcaneal fusion for neuropathic arthropathy

- Retrograde IM nailing
- Approximately 100 patients reported over the past 12 years
- Fusion rate is approximately 85% when combining series
- Complications are frequent but overall limb salvage is > 90%



# Arthrodesis with External Fixation in Ankle Charcot

- Eleven patients (12 ankles)
- 1990-2001
- Three types of frames
- Seven tibiotalar fusions
- Five tibiocalcaneal fusions
- 92% limb salvage rate



Int J Low Extrem Wounds: June 2007



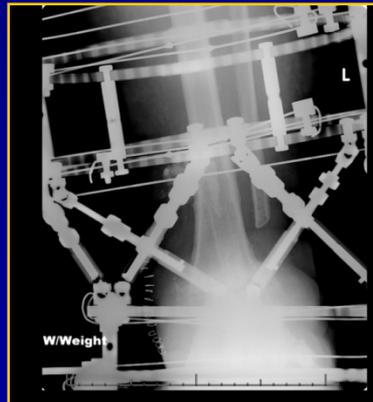
**UPMC** | University of Pittsburgh  
Medical Center



# Arthrodesis with External Fixation in Ankle Charcot



- 1 below knee amputation (8.5%)
- 6 bony unions (50%)
- 4 stable fibrous “union” (33%)
- 1 unstable fibrous “healing” (8.5%)



# Evidence Based Medicine

---

- On line electronic search for English language articles
- Medline (Pubmed)
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- Key terms: *Charcot, surgery, arthropathy, neuropathic arthropathy, neuro-osteoarthopathy*



# Methods

---

- Only patients with Charcot arthropathy due to diabetes were reviewed
- Excluded leprosy, syphilis, alcoholism, idiopathic neuropathy etc
- Only patients with Charcot arthropathy localized to the foot and ankle were included in this review



# Evidence Based Medicine

*Foot & Ankle International/Vol. 28, No. 8/August 2007*

**Table 1:** Level of evidence and grades of recommendation

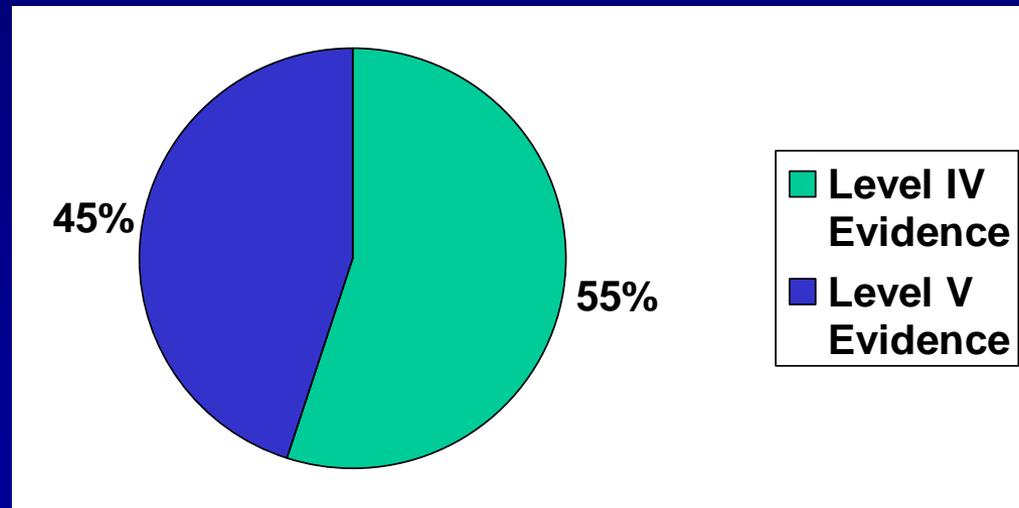
---

## **Level of Evidence**

- Level I: high quality prospective randomized clinical trial
- Level II: prospective comparative study
- Level III: retrospective case control study
- Level IV: case series
- Level V: expert opinion

# Results: 430 articles cited from 1963-2008

- 85 articles met the criteria for inclusion
- 38 (45%) were case reports or expert opinions (Level IV)
- 47 (55%) were retrospective case series (Level V)



# Results: 85 articles on Diabetic Charcot arthropathy

- No randomized studies
- No prospective studies
- No control groups



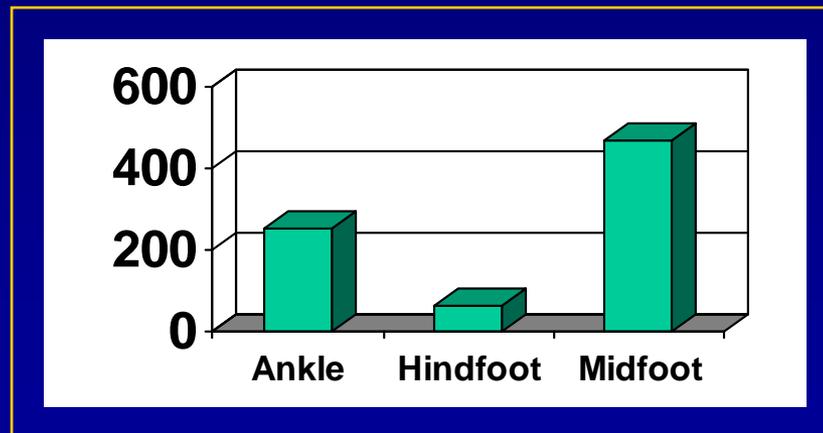
# 981 patients reported

- Number of patients ranged from 1-120
- Mean 20 patients per study
- Median 14 patients per study



# Anatomic location of surgery

- Could be identified in 783 of 981 pts
  - Ankle: 252 32.2%
  - Hindfoot: 65 8.3%
  - Midfoot: 466 59.5%



# Surgical Procedures

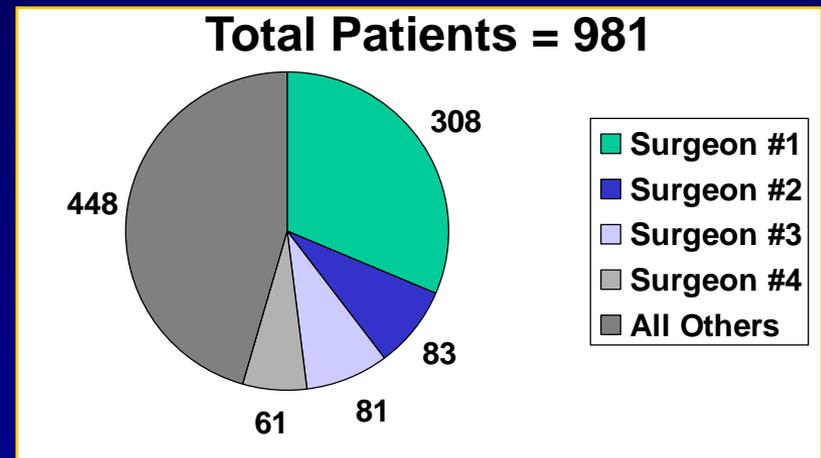
---

- Amputations
- Arthrodesis
- Debridement
- Incision and Drainage
- Exostectomy



# 981 patients reported

- Surgeon 1: 308 patients 31.4%
- Surgeon 2: 83 patients 8.4%
- Surgeon 3: 81 patients 8.2%
- Surgeon 4: 61 patients 6.2%



- *Four independent surgeons have reported on 54.2% of the patients cited over the past 45 years.*



**TABLE I Grades of Recommendation for Summaries or Reviews of Orthopaedic Surgical Studies**

Grade	Description
A	Good evidence (Level-I studies with consistent findings) for or against recommending intervention.
B	Fair evidence (Level-II or III studies with consistent findings) for or against recommending intervention.
C	Conflicting or poor-quality evidence (Level-IV or V studies) not allowing a recommendation for or against intervention.
I	There is insufficient evidence to make a recommendation.

**JBJS 87A: 2005**

**Modified from Oxford Level of Evidence**

# Evidence Based Medicine

---

- Exostectomy is useful for relieving pressure due to bone that can not be accommodated with prosthetics and or orthotics
- Grade C Recommendation
- Treatment is supported by consistent Level IV studies



# Evidence Based Medicine

---

- Arthrodesis with realignment is useful in patients with pain, instability or recurrent ulcers who fail non-operative treatment
- Grade C Recommendation
- Treatment is supported by consistent Level IV studies



# Evidence Based Medicine

---

- Achilles tendon or gastrocnemius lengthening reduces forefoot pressure and improves the alignment of the ankle/hindfoot to the Midfoot/forefoot and allows forefoot ulcers to heal
- Grade C Recommendation
- Treatment is supported by Level IV studies



# Evidence Based Medicine

---

- Inconclusive evidence to recommend one form of fixation over another ( i.e. internal vs. external) in patients who are not infected
- Grade I recommendation
- Studies are heterogeneous and not comparable



# Evidence Based Medicine

---

- Inconclusive evidence to recommend reconstructive surgery over amputation
- Grade I recommendation
- No studies have been done comparing Charcot reconstruction patients who have been reconstructed versus those who underwent amputation



# Conclusions

---

- Must have passion since there will be many highs and lows
- Complications are frequent but they typically do not require treatment alteration
- Limb salvage should approach 90%
- Must appreciate co-morbidities of neuropathy, PAD and immunopathy
- Evidence based outcomes are lacking
- Our learning is dynamic and our treatment is evolving as more is learned





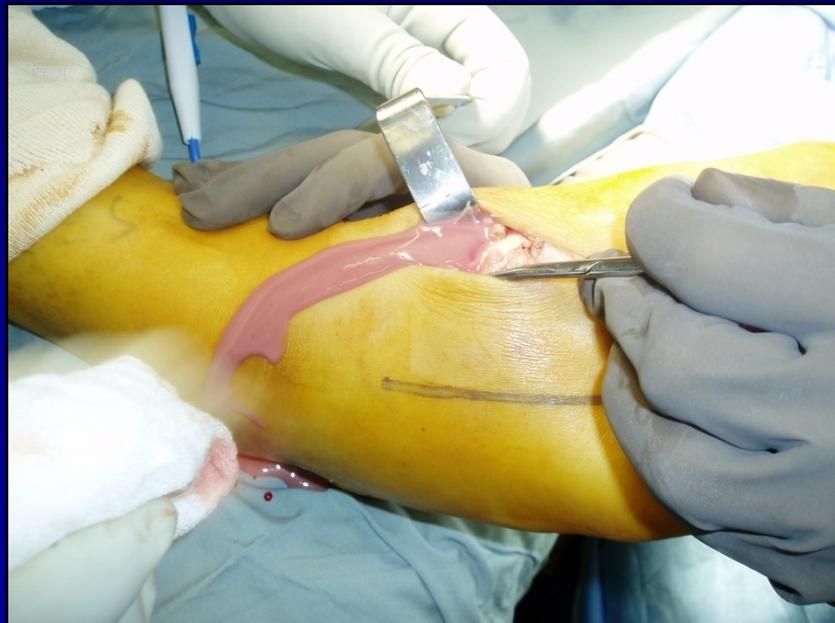
1920

# PITTSBURGH

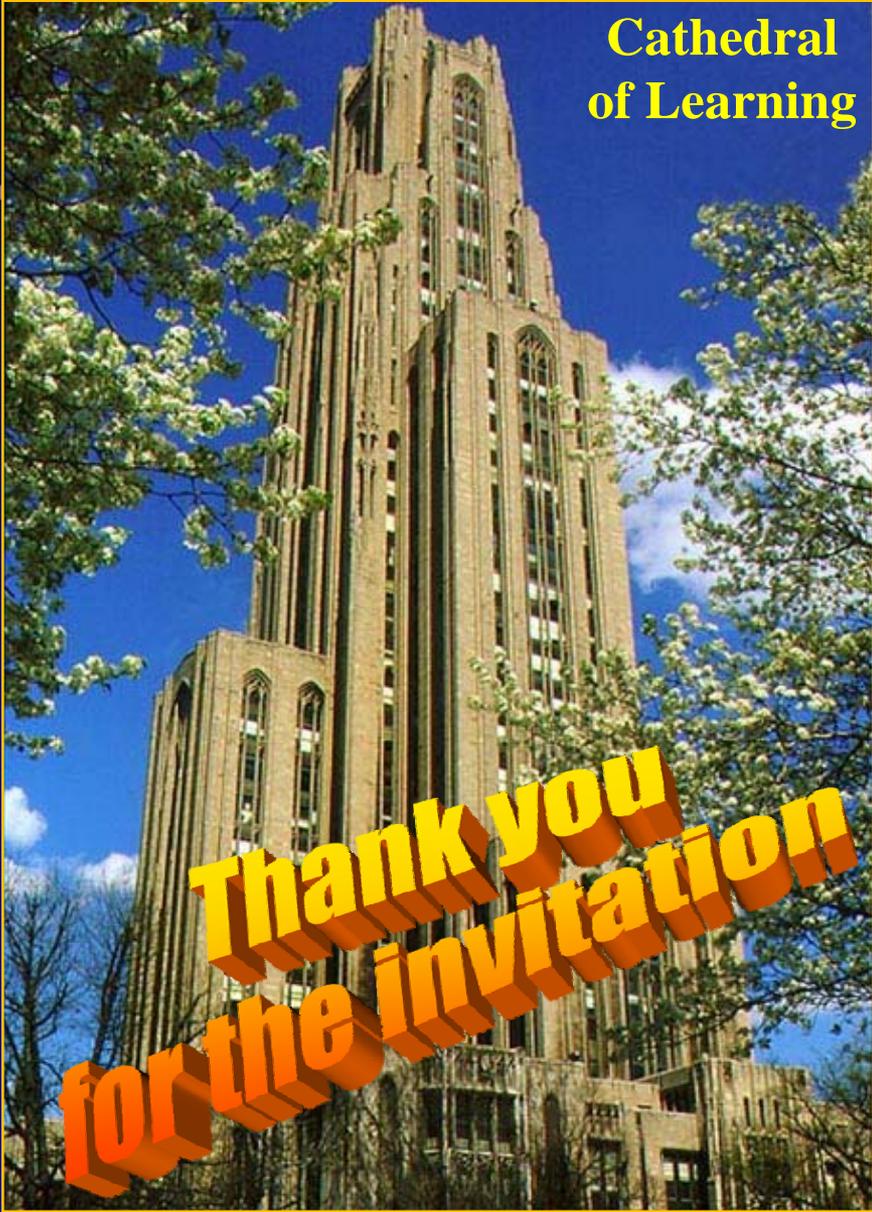


2008

- The “official” orthopaedic color is **pink**
- A combination of **blood, pus and tears**



**Cathedral  
of Learning**



**Thank you  
for the invitation**



**UPMC**

**Grades of Recommendation** (given to various treatment options based on Level of Evidence supporting that treatment)

- **Grade A** treatment options are supported by strong evidence (consistent with Level I or II studies)
- **Grade B** treatment options are supported by fair evidence (consistent with Level III or IV studies)
- **Grade C** treatment options are supported by either conflicting or poor quality evidence (Level IV studies)
- **Grade I** when insufficient evidence exists to make a recommendation

**TABLE I Grades of Recommendation for Summaries or Reviews of Orthopaedic Surgical Studies**

Grade	Description
A	Good evidence (Level-I studies with consistent findings) for or against recommending intervention.
B	Fair evidence (Level-II or III studies with consistent findings) for or against recommending intervention.
C	Conflicting or poor-quality evidence (Level-IV or V studies) not allowing a recommendation for or against intervention.
I	There is insufficient evidence to make a recommendation.

