Calcaneus Fractures

Resident Comprehensive Fracture Course

Anatomy

- Posterior Facet
- Middle Facet
- Sustentaculum
- Anterior Process

Epidemiology

- 2% of all fractures
- Mechanism
  - Axial load
  - MVA
- 80-90% occur in men 20-40 years old
- 20% of individuals are incapacitated for 3-5 years

Epidemiology

- Rule of 10's
  - 10% with associated spine injuries
  - 10% Open injuries
  - 10% Bilateral
  - 25% associated with other limb injuries
  - Articular surface involved 75% of time

Radiographic evaluation

- Bohler's angle (20-40 degrees)
- Angle of Gissane (130-145 degrees)

Radiographs

- Radiographs
  - Harris view
    - Sustentaculum
    - Lateral wall
    - Hindfoot varus/valgus
      - 10 degrees of valgus
Radiographs

Broden View
- Provides visualization of the posterior facet articular surface

Computed Tomography
- Provides detailed imaging of the articular involvement

Classification

- Essex-Lopresti
  - Joint depression vs. tongue-type
  - Does not correlate with prognosis
  - Based upon plain radiographs

- Sanders
  - Evaluates posterior facet step-off
  - More prognostic/determine treatment
  - Based upon CT

Classification

- Sanders
  - CT scan semi-coronal image plane

Classification

- Sanders
  - Intra-articular tongue
  - Fracture-dislocations
Fracture Patterns

- Extra-articular
  - 25-33% of calcaneus fractures
  - Twisting injury or direct impact (not compressive)
  - Involve anterior process, sustentaculum, body, or posterior tuberosity
- Intra-articular (75%)
  - Involve Posterior Facet
    - Essex-Lopresti Classification
    - Sanders Classification

Posterior Tuberosity Fracture

- Avulsion injury
  - Frequently occurs in osteoporotic bone due to a forceful contraction of the gastrocsoleus complex
  - More common in older and diabetic population
  - Non-displaced = nonoperative
  - Displaced = ORIF/percutaneous
  - Beware of soft tissues!

Historical Relevance

- Have we come full circle?

"Ordinarily speaking, the man who breaks his heel bone is done, so far as his industrial future is concerned...."

Operative Indications

- Why fix these?
  - >2mm displacement results in abnormal loading
  - Shortening impacts lateral column support
  - Hindfoot malalignment prevents unlocking of the subtalar complex
  - Height loss can result in anterior ankle impingement

Historical Relevance

- 1950’s
  - Introduction of operative treatment
- 1960’s
  - Enthusiasm waned...
- 1980’s
  - Limited exposure
- 1990’s
  - CT re-defined fracture anatomy
    - Permitted more ‘refined’ fracture care

Calcaneal Malunion

- Sub-fibular impingement
- Varus Alignment
- Horizontal talus/Anterior ankle impingement
To Fix or Not to Fix?
- 108 fractures (93 patients)
- Follow-up minimum 10 yrs
  - Ave 15.22 yrs (10.5-21.2 yrs)
  - 80 Joint depression/28 Tongue type
  - 70 Type II/38 Type III
  - 103 Anatomic (95%)
  - 3 Near-anatomic (1-3mm)
  - 2 Approximate (3-5 mm)

Operative vs. Nonoperative
- Six RCTs/Four CCTs
- 891 patients
- ORIF favors
  - Recovery of Böhler angle
  - Stable calcaneal height/width
  - Improved shoe wear
  - More likely to resume pre-injury work
- Higher risk of complications

Who do we fix?
- Nonoperative vs. Operative outcomes similar
- Work Comp worse
- ORIF > nonoperative outcomes
- ST arthrodesis more likely
  - Work Comp
  - Nonoperative
  - Böhler angle < 89.1
  - Sanders Type IV
- Complications ORIF (25%) vs. Nonop (18%)

To Fix or Not to Fix?
- 11% Local wound care
- One patient requiring ST arthrodesis for osteomyelitis
- 31 Fractures developed ST arthritis/requiring arthrodesis
  - Overall failure rate of 29%
  - Type III - 47% vs. Type II - 10%
  - Type III 4x more likely to require arthrodesis

Operative vs. Nonoperative
- RCT
- 191 patients with acute displaced intraarticular calcaneus fractures
  - ORIF - 73
  - Nonop - 78
  - 2 year F/U
- Complications more common with ORIF

Operative vs. Nonoperative

• RCT
• 151 patients with acute displaced intraarticular calcaneus fractures
  • ORIF – 73
  • Nonop – 78
• 2 year F/U
• Complications more common with ORIF

"Based on these findings, operative treatment by open reduction and internal fixation is not recommended for these fractures"


Decision Making

• Age < 50-55 years
• Health status
• Fracture pattern
• Timing

Younger, healthier, active patients WITH fractures that can be fixed anatomically

Operative Goals

• Restore posterior facet
• Restore height
• Reduction of heel width
• Decompression of subfibular space
• Realign tuberosity

Operative Treatment

• Percutaneous techniques
  • Open fractures (high grade)
    • <4cm
  • Poor skin quality or comorbidities

Operative Treatment

- External fixation
- Minimally invasive
- Restoration of morphology

Operative Treatment

- Extensile ORIF
  - Sander's Type II & III injuries

Operative Treatment

- ORIF with primary arthrodesis
  - Sander’s Type IV (and select III) injuries
  - Poor soft tissues or non-reconstructable articular injury (Restore calcaneal pitch and height)

Operative Treatment

- Sinus Tarsi
  - Better alternative?

Sinus Tarsi

- 271 fractures (256 patients)
- Good to excellent outcome 75%
- Wound complications
  - Minor 4.1%
  - Major 0.7%
- Secondary subtalar arthrodesis 4.3%

Extensile

- Incision
  - Full thickness soft tissue flap centrally
  - Beware of sural nerve proximally/distally
  - Protect peroneal tendons
    - LCA
- Exposure
  - Hands-free retraction
  - 5.0 mm Shanz pin in tuberosity

Extensile/Sinus Tarsi

- Sequential reduction
  - (Front to back vs. Joint first”)
  - Anatomically fix the posterior facet
  - Restore height (Bohler’s) and angle of Gissane
  - Restore normal valgus/neutral alignment

Extensile/Sinus Tarsi

- Temporarily fix everything with K-wires
- Stabilize posterior facet with lag screws
- Lag screws for anterior process if needed
- Plate application
- Void management
- Drain
Postoperative protocol

- Immobilize and elevate
- Wound Vac?
- Fracture brace
- Ankle/subtalar ROM
- Progressive weight-bearing at 8-12 weeks
- Wound will dictate advance of motion

Complications

- Subtalar arthrosis
  - Increased with nonoperative treatment
  - 6x more likely to undergo arthrodesis
- Subtalar stiffness
- Wound healing (2-10%)
- Smokers
- Diabetics
- Open fractures
  - 7-12% infection
  - 5% osteomyelitis
  - 5% amputation
- Delay in treatment

Outcomes

- Ideal treatment controversial
- Some subtalar stiffness can be expected
- Good results can be achieved after selective operative fixation
- Poorer results expected with, articular incongruity, flattened Bohler’s angle, and Workman’s Compensation related injuries
- Avoidance of complications is paramount for favorable outcomes

Thank You