Percutaneous Fixation for Calcaneus Fractures: Really?

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Thanks to the OTA archives and Rob Harris MD
Goals

• Review Calcaneus Anatomy
• Classifications
• Discuss operative vs Nonoperative treatment where it gets the patient with individual fracture patterns
• Discuss where a limited operative approach may be considered
Introduction

“…the man who breaks his heel bone is done.”
- Cotton and Henderson, 1916

“…results of crush fractures of the os calcis are rotten.”
- Bankhart, 1942
Introduction

• High potential for disability
  — Pain
  — Gait disturbance
  — Unable to work

“Best” treatment method controversial
Anatomy
Boney & Articular Anatomy

- Subtalar joint
  - Facets: anterior, middle, posterior
- Calcaneocuboid joint
- Sustentaculum
- Tuberosity
- Anterior process
Soft Tissue

- Subcutaneous nature of the bone
- Tendons
Hinfoot Function
Hindfoot Function

Calcaneus

- Lever arm powered by gastrocnemius
- Foundation for body wt.
- Supports/maintains lat. column of foot
Hindfoot Function: Subtler Joint

Inversion/ eversion of hind foot

Hindfoot position locks/ unlocks midfoot joint
“Extra-articular” Fractures

- Anterior process fracture
- Tuberosity (body) fracture
- Tuberosity avulsion
- Sustentacular fracture
Tuberosity Fracture

- Fall/MVA
- Usually non-operative
  - Swelling control
  - Early ROM
- PWB
• May consider percutaneous stabilization if the will allow a multiply injured patient to mobilize.
Tuberosity Avulsion

- Achilles avulsion
- Wound problems
- Surgical urgency
  - Lag screws or tension band
Bilateral Tongue Type
“Intra-articular” Fractures
Mechanism of Injury

- High energy:
  - MVA, fall
- Lateral process of talus acts as wedge
- Impaction fracture
Pathoanatomy

- Primary fracture line
- Constant fragment
Pathoanatomy

- Secondary fracture line
- Extends posteriorly through tuberosity
- Creates 3 parts
Pathoanatomy

- Articular incongruity
- Hindfoot varus
- Shape of foot
  - Wide
  - Loss of height
  - Short
- Peroneal impingement
- Heel pad crush
Clinical Problems

- Stiffness
- Loss of normal gait
- Shoewear problems
- Arthritic pain
- Peroneal pain
- Heel pad pain
Lateral View

Bohler's Angle: 20-40°

Gissane’s Angle: 130-145°
Axial View

- Assesses varus/valgus
- $45^\circ$ axial of heel
- $2^{nd}$ toe in line w/ tibia
- Normal H $10^\circ$ valgus
Classifications

• Several used - None are ideal
• Most commonly used
  – Essex-Lopresti
  – Sanders
ESSEX-LOPRESTI Classification

- Historical
- Basic

1. Joint depression type
2. Tongue type
Sanders Classification

- Based on CT findings
- # joint fragments
  - 2 = type II
  - 3 = type III
  - 4 or more = type IV

Subtype: L → M fx position

Predictive of results
Treatment: Historical

- <1850: bandages/elevation
- 1850: Clark: traction
- 1931: Bohler: cl. red./cast
- 1952: Essex-Lopresti: perc. fixation
- 1993: Benirschke/Letournel/Sanders: “modern” plating
Non-op Treatment: Natural History

Nade and Monahan, Injury, 1973

- 57% long term symptoms (pain, swelling, stiffness)
- 95% symptoms on uneven ground
- 76% broad heel
Non-op Treatment: Complications

Malunion

- Varus hindfoot
  - Locks midfoot
  - Medializes “foundation” for stance
- Shortened foot = short lever arm
- Peroneal impingement/dislocation
- Shoewear problems
Non-op Treatment:

Injury
Non-op Treatment:

Malunion
Non-op Treatment: Complications

- Malunion treatment
  - Orthosis/ custom shoe
  - Lateral wall exostectomy
- Peroneal tenodesis
- Subtalar fusion +/- bone block
- Sliding wedge osteotomy
Operative Treatment: Natural History

- Early studies recommending non-op treatment:
  - Old ORIF techniques
  - No CT classification
  - No assessment of fracture reduction
Operative Treatment: Natural History

• Initial results were poor (wound problems)
• Newer ORIF techniques improved results
  ─ Anatomic reduction in simple fracture patterns give good result
  ─ Fracture severity correlates with results
  ─ Learning curve
Operative Treatment: Rationale

- Restore anatomy
  - Shape and alignment of hindfoot
  - Articular congruency
- Return to function & prevent arthritis
- Typically, restoring articular anatomy gives improved results if complications are avoided
Operative vs. Non-op Treatment

- Orthopedic literature is lacking
- No prospective, randomized studies with longterm follow-up
We believe that certain conclusions can be reached from our data regardless of a patient’s sex, age, or WC status:

1. The classification system seems to remain prognostic as Sanders type III fractures were 6.5 times more likely to develop PTA and 4 times more likely to require an ST fusion than Sanders type II fractures. Subtyping does seem to aid the surgeon in when planning surgery but is not prognostic.

2. Using a lateral extensile incision with a standard non-locked plate and screw construct, without bone graft or void fillers, in a “joint first” manner, is a reproducible procedure that permits an anatomic reconstruction of both the body and the articular surface of the ST joint and the CCJ. This brings the need for either bone graft or locked plates into question.

3. Once a fracture is anatomically reconstructed, the functional outcome will be determined by the amount of cartilage damage. This is evidenced by the 31 fractures that required only an in situ fusion, despite an excellent initial reduction.

4. If anatomic restoration can be attained, we believe that improved function, near normal gait, regular or slightly modified shoe wear, and return to previous or modified employment is possible in many cases and for a prolonged period. Patients must be cautioned, however, that even with the best treatment, difficulty with uneven ground, altered physical activity, and mild or annoying pain related to the injury may be permanent.

5. Finally, it is the senior author’s belief that only surgeons interested in this fracture, who are well trained in this procedure and perform it frequently, should attempt these reconstructions.
Wei Zhang et al., Operative Versus Non-operative Treatment of Displaced Intra-articular Calcaneal Fractures: A Meta-analysis of Randomized Controlled Trials; JOT 2015 accepted for publication

- Operative Treatment for DIACFs
  - reduce pain associated with walking
  - improve comfort wearing shoes
  - benefits were contrasted with an increased risk of complications, mostly wound infection

- Postoperative function, quality of life, and subtalar fusion rate, no differences were identified between the two groups.
Operative Treatment: Contraindications

- Diabetes
- Vascular insufficiency
- Smoker
- Severe swelling
- Open fractures
- Sanders type IV (very comminuted)
- Elderly
- Neuropathic
- Non-compliant pt.
- In-experienced surgeon
Treatment: A Rational Approach?

- Many treatment methods attempted
- “Best” method remains controversial
- Assess each case individually
  - Injury/ patient/ surgeon
  - Risks vs. benefits
Operative Treatment: Complications

Wound problems
- Apical wound necrosis
  - Stop ROM
  - Leave sutures in

Infection
- Antibiotics
- I&D
- Soft tissue coverage?
So what about Percutaneous Fixation?

- Less post-operative wound complications.
- Poorer reduction of articular
- Can restore some anatomy
  - Improve Böhler’s angle and the Crucial Angle of Gissane
  - Restore alignment
  - ? Length
- May get you to a ST fusion with less risk???
Surgery: Percutaneous

- Fewer wound problems
- More difficult reductions?
- Ex. Essex-Lopresti maneuver
Surgery: Percutaneous I

- Essex-Lopresti maneuver
- Tongue type fractures
Surgery: Percutaneous I

Essex - Lopresti, Clin Orthop, 290: 3-16, 1993
Summary

• High energy injuries
• Risk for long term morbidity
• ORIF can give good, reproducible results if complications are avoided; sometimes limited approaches can help reach that goal
• Individualize treatment
• Long term outcomes studies are needed comparing treatment alternatives
Thank You!