Sinus Tarsi Approach to Calcaneus Fracture Treatment
Evolution or Revolution
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Calcaneus Fractures
Most common tarsal bone to be fractured
1-2% of all bone fractures
Typically from an axial load: Fall from height

Classification
INTERARTICULAR
70-75%
Essex-Lopresti:
Tongue Type
Joint Depression
Sander’s Classification
EXTRAARTICULAR
30-35%
Fracture does not involve the posterior facet
Anterior Process
Mid Calcaneal
Body
Sustentaculum Tali
Peroneal Tubercle
Lateral Process
Posterior Calcaneal

Tongue Type
Posterior facet remains attached to the calcaneus tuberosity
Orthopaedic Trauma Protocols: Hansen/Swiontkowski
Classification

Joint Depression

Posterior facet impacted into the body of the calcaneus

Sander’s Classification

- Type I - Non-displaced
- Type II/III - have 2 and 3 fragments that are medial or lateral and subdivided into primary and secondary fracture lines.
- Type IV - Severely comminuted

Historical Treatment

1720 Petit and DeSault in France. First accurate description of treatment of calcaneus fractures.

1908 Cotton and Wilson: Operative treatment contra-indicated
- Recommended closed treatment with a medially placed sandbag and a hammer to reduce the lateral wall.
- Reimpact the fracture

1931 Bohler: Advocated operative treatment but technical complications
- Infected, malunion, non-union, need for amputation

1943 Gallie: Subtalar arthrodesis as definitive treatment for healed, malunited fractures.

1948 Palmer Unsatisfied with non-operative and late treatment. Advocated acute treatment through Kocher approach
- Patients did “well” and many returned to work

1952 Essex-Lopresti:
- Tongue-type: percutaneous reduction
- Joint Depression: ORIF

1993 Benerschke and Sangeorzan: Surgical treatment with extensile lateral approach, rigid internal fixation, early motion.
With CT scans, IV antibiotics, fluoroscopy, AO/ASIF techniques, and better anesthesia there has been a trend toward more aggressive surgical intervention

Indications for Operative Management

**INDICATIONS**
- High energy
- Substantial depression
- Widening of the heel
- Extension into posterior facet with displacement of > 2 mm

**CONTRAINDICATIONS**
- Severely comminuted fracture
- Impaired vascularity
- Infection
- Severe neuropathy or IDDM
- Unable to be non-weight bearing

Extensile Lateral Approach

Popularized by
- Palmer and Letournel
- Benerschke

Full Thickness Flap that protects
- Peroneal tendons
- Sural Nerve
- ? Vascular supply
Associated Complications

Any Approach
- Malunion
- Nonunion

Extensile Approach
- Dehiscence
- Hematoma/Seroma
- Infection

High Complication Rate

Wound complications occur in up to 25% of surgically treated calcaneal fractures

Berschke & Kramer (2004) JOT 18:1
Howard et al. (2003) JOT 17:241
Soohoo et al. (2011) Foot Ankle Surg 17:233

Tips To Avoid Complications

- Wait
  - Allows swelling to go down
  - Fracture starts to heal
  - Bony reabsorption

- Mark Myerson
  - Elevation
  - Unna Boot
  - Plexipulse
  - Lasix

Why is this area such a problem?

- Extensile approach requires making incisions just proximal to the arteries supplying the flap
- Little to no underlying muscle to fall back on

Angiosomes

Three dimensional blocks of tissue fed by source arteries
Understanding their boundaries and anastomoses provides the basis for designing incisions and exposures that preserve blood supply

First described by: Taylor and Palmer, Br J Plast Surg (1990) 43:1
Angiosomes

Source Arteries
- Main vascular supply to a given angiosome

Choke Arteries
- Supply vessels which link adjacent angiosomes to one another
- Provide safety conduit that allows a given angiosome to provide blood flow to an adjacent angiosome

Angiosomes of the Foot

Peroneal Angiosome

Lateral heel is the lateral border of the peroneal angiosome which is fed by the fibular (peroneal) artery, a branch of posterior tibial artery.

An incision above the glabrous juncture leaves intervening tissue between the incision and lateral border of the peroneal angiosome in jeopardy.

Rational for the Sinus Tarsi Incision

- With a calcaneal fracture the choke vessels between the peroneal and anterior tibial angiosomes may not have time to open up
- Takes 4-10 days
- May take longer in the traumatic setting of soft tissue damage and inflammation

Initial Management
Physical Exam

- Always associated with soft tissue trauma
- Measure compartment pressure if pain out of proportion
Radiographs

Lateral
- Evaluate type of fracture
  - Tongue Type
  - Joint Depression
- Assess displacement of facet

Axial
- Lateral displacement
- Varus alignment
- Shortening

Oblique
- Check for associated mid foot and calcaneal-cuboid injuries

CT Scan
- Confirms posterior facet fracture complexity
- Evaluate the relationship of the sustentaculum tali
- Calcaneal-cuboid joint displacement

Management
- Not emergency
- Bulky Jones dressing/splint/elevate
- Operate when skin lines present
- Usually 5-7 days
- Longer when fracture blisters
- Open fractures managed acutely

Techniques
- Lateral position
- Thigh Tourniquet
- Stable platform with folded blankets
- Prep/Drape entire leg
**Tools of the Trade**

- Technique Incision
  - Standard approach to sinus tarsi
    - Tip of fibula
    - Extend towards base of 4th metatarsal
    - 5-8 cm
    - Visualize calcaneal-cuboid joint

**Tips/Techniques**

- Elevate extensor digitorum brevis dorsally

**Exposure**

- Debride hematoma and small fracture fragments
- Enter peroneal tendon sheath

**Exposure**

- Elevate and protect tendons
- Subperiosteal dissection of lateral wall with periosteal elevator
- Open a portion of lateral wall and examine the posterior facet

**Reduce Anterior Calcaneus**

- Fix calcaneal-cuboid joint if necessary
- Pin anterior calcaneus to sustentaculum tali
Reduce Posterior Tuberosity

- Restore calcaneus tuberosity to sustentaculum tali: shortened and in varus
- With 4 mm Schanz pin: placed lateral or posterior
- Apply plantar and valgus directed force
- Translate medially

Orthopaedic Trauma Protocols: Hansen/Swiontkowski

Case Example

Intraoperative Axial View

Very Important!

Provisional Fixation

Sustentaculum tali is constant fragment
Progress medial to lateral
Restore Gissane’s angle

Master Techniques in Orthopaedic Surgery: The Foot and Ankle, Kitaoka
Reduce Posterior Facet

- Place laminar spreader
- Visualize sustentaculum tali
- Freer elevator and dental pick
- Elevate depressed fragments

Cannulated Screws to Facet

- Place into subchondral bone of posterior facet
- “Trampoline Screw”

Bone Graft

- If necessary:
  - Autograft
  - Allograft
  - Synthetics
- I use allograft cancellous bone chips for large voids

Apply Plate

- Slide plate onto bone
- Contour plate

Apply Plate

- Make sure it is sitting flush
**Closure**

- Irrigation and hemostasis
- 2-0 absorbable for deep tissue and EDB repair
- Close subQ with 4-0 absorbable
- Close skin with vertical mattress stitches
- Drain

**Robert Jones Type Dressing**

**Post-Op**

- Ice and elevate
- Remove drain after 1 day
- Remove splint after 10-14 days
- Apply cast or boot
- Remain NWB until healed, typically 6-10 weeks

**Case Example**

35 yo male
Fall from ladder
Closed fracture
Joint depression

**Case Example**