### Calcaneal Fractures

- **Bohler’s angle:**
  - Line from calcaneal tuberosity to posterior articular surface
  - Intersection with line from anterior to posterior articular surface prominences
  - Acute angle should be 20-40°

- **20%** have associated injuries of the spine, pelvis or hip

- **Essex-Lopresti classification:**
  - Extra-articular (25%)
    - Managed conservatively usually
    - 6-12 months for restoration of function
    - 10% have residual symptoms and disability
  - Intra-articular (75%)
    - Described a primary fracture line that runs from posteromedial to antero-lateral.
    - Looking at the subtalar fragment - Subsequent force causes secondary fracture lines: tongue or depressed type.
    - Minimally displaced treated conservatively
    - If displaced, conservative rx → 50% need arthrodesis within 5 years

- **Sanders Classification** – based on coronal CT
  - 1 = undisplaced
  - 2 = 2 part displaced, without comminution
  - 3 = 3 part displaced, with mild comminution
  - 4 = multiple fragments

  - Leave types 1 and 4, as either do not need fixation or too complex
  - Types 2 and 3 are subdivided into class A/B/C by position of primary fracture line. With more medial fracture lines, severity increases as it is harder to capture the ever smaller sustentaculum fragment.

### Vertical fracture of tuberosity:
- Extra-articular
- Conservative mx initially NWB → FWB as tolerated ± heel cushion

### Horizontal fractures:
- Postero-superior angle of calcaneus on lateral film
  - MUA if severe displacement
  - 4-6 weeks in BK-POP PWB
- Avulsion fracture of Achilles tendon – less common
  - ORIF with cancellous screw
  - Long leg cast with knee flexed, and ankle plantar flexed (to reduce tension on screw)
  - After 4 weeks replace with BK POP until 8th week or union
**Sustentaculum Tali**
- Caused by eversion injuries with usually only slight displacement
- NWB in BK-POP 6 weeks, then allow to walk with circular woven support

**Anterior calcaneal fractures**
- Can involve calcaneo-cuboid joint, from forced ABduction of foot
  
  *beware associated mid-tarsal dislocation*
- Can occur with forced inversion also where cuboid strikes calcaneus
- Mx:
  - If minimal shortening/compression – conservative 6 weeks BK-POP NWB
  - Mid tarsal dislocation is treated by closed reduction ± K-wire stabilization, with a NWB POP cast for 6-8 weeks; weekly check x-rays to detect late subluxation, with wire removal at 4 weeks.
  - Consider ORIF if severe shortening/compression

**Body of calcaneus – extra-articular**
- Vertical fracture behind talo-calcaneal joint on lateral film
- Slackening of Achilles tendon leads to impaired plantar flexion
- Reduction in Bohler’s angle
- Mx:
  - If slight displacement, conservative rx with RICE ± slab/POP. NWB 6 weeks, then build up weight bearing with intensive physiotherapy for calf strength.
  - If displaced *and good circulation* → use Gissane spike to achieve mini-open MUA, and incorporate spike into a plaster boot. *Remove at 1st sign of pin-tract infection*

**Body of calcaneus – intra-articular**
- CT scan useful
- Conservative mx:
  - 100% risk of sub-talar 2° OA
  - Calf function impaired
  - Heel pain and broadening of feel (shoes don’t fit)
  - Impingement against lateral malleolus
  - Pes planus
- ORIF:
  - Try Gissane spike with attempts to elevate any depressed lateral fragments with bone grafting
  - Plate and screws may be needed

**Central Crush Fracture**
- Talus drives down as a wedge into calcaneus
- Commination with sub-talar and calcaneo-cuboid involvement
- Conservative mx → may need late fusion / triple fusion
Complications

- **Early:**
  - Swelling & blistering
  - Compartment syndrome

- **Late:**
  - Malunion – broad/squat foot with difficulty fitting shoes
  - Peroneal tendon impingement → may need shaving of protuberant bone on lateral wall of calcaneus
  - Achilles tendon insufficiency
  - 2° OA of talo-calcaneal joint (sub-talar joint)

**Current Concepts:**

  - Meta-analysis suggested that operative fixation of calcaneal fractures in general did better:
  - Better shoe fitting, pain and less likely to need arthrodesis
  - Operate on the Sander 2 or 3 fractures

- **Gaskill (JBJS 2010), Basile (J Foot & Ank, 2010)**
  - Regardless of age, if good bone stock, accurate reduction and low demand patients do well.
  - Smoking not a contra-indication

- **Tenant 2001**
  - Timing of surgery – after swelling reduced, but not more than 2 weeks, as higher risk of infection

- **Gurkan V et al (JBJS 2011, 93-B (7):975-9)**
  - *Long-term results of conservative treatment of Sanders type 4 fractures of the calcaneum.*

83 calcaneal fractures (64 patients) managed non-operatively with average follow-up of 51 months (4.25 years). Initial closed reduction using technique described by Omoto (1983) – manual compression of medial and lateral aspects of calcaneus with the patient prone and sedated, and placed in a long-leg cast with knee flexed to 70° and the ankle in full equinus. Then a CT was taken to verify they were Sanders type 4. Admission to monitor swelling – oedema treated with elevation, cold compression and IM diclofenac b.d. Repeat reduction at 5 to 7 days, but with ankle placed in semi-equinus (20°). Cast changed to BK-POP at 4 weeks to allow knee movement, and removed at 8 weeks. Patients allowed to PWB at 12 weeks, and FWB at 16 weeks, using arch supports.

12 plaster complications (7%). 100% union rate at 3 months (on repeat CT), and only 12 (19%) could not return to work. Mean AOFAS score of 72 (satisfactory) on last follow-up. 16 had normal ROM (19%), and 75 had evidence of arthritis (90%)
Griffin D (BMJ 2014, 349;g4483)

Operative versus non-operative treatment for closed displaced intra-articular fractures of the calcaneus: RCT (UK HeFT)

Multi-centre RCT comparing acute displaced intra-articular calcaneal fractures treated by ORIF using a lateral extensile approach (n=73) vs. conservatively (n=78). No difference in Kerr-Atkins score (1° powered) or AOFAS score (2° under powered). Follow-up period 2 years. Surgical group early ROM, but with 6 weeks NWB and 6 weeks PWB. Conservative group had same protocol but with addition of removable splint. Similar BMI and smoking status in each group; bulk of patients Sanders 2 and 3. In addition to questionnaire scores, there was no difference in ankle / subtalar ROM, heel width, walking speed or gait analysis factors. Far fewer overall number of complications in non-operative group. At 2 years, 3 patients in non-operative group had required sub-talar fusion, with none in surgical group.