CALCANEUS FRACTURES ANATOMY AND CLASSIFICATION

Steve Borland

Calcaneus fracture

- Osteology
- Soft tissues
- Fracture mechanics
- Imaging
- Classification systems
- Miscellaneous injuries

Osteology

- Largest bone of foot
- Articulates with talus superiorly
  - Subtalar joint
  - 3 articular facets (posterior, middle and anterior)
  - Posterior articulates with talar body
  - Middle and anterior articulate with talar head
  - Middle and anterior facets may be fused
- Articulates with cuboid anteriorly
  - Saddle shaped surface
  - Calcaneocuboid joint (mid tarsal)

Osteology

- Calcaneal sulcus
  - Between middle and posterior facets
  - Courses anteriorly and laterally to open into the sinus tarsi
  - Combines with sulcus tali to form tarsal canal
- Sustentaculum tali
  - Medial process
  - Middle facet lies on top
  - Groove inferiorly for FHL

Osteology

- Calcaneal tuberosity inferiorly
  - Divided into medial (larger) and lateral process
- Laterally
  - Retrotrochlear eminence near centre
  - Superiorly is the peroneal spine
    - Calcaneal attachment of CFL
  - Peroneal tubercle anteriorly
    - Peroneus brevis above
    - Peroneus longus below

Osteology

- Posterior
  - 3 parts
  - Upper 1/3 – Smooth, contains bursa
  - Middle 1/3 – Rough, attachment of TA
  - Fat pad between tendon and bone reduces friction

Soft tissues

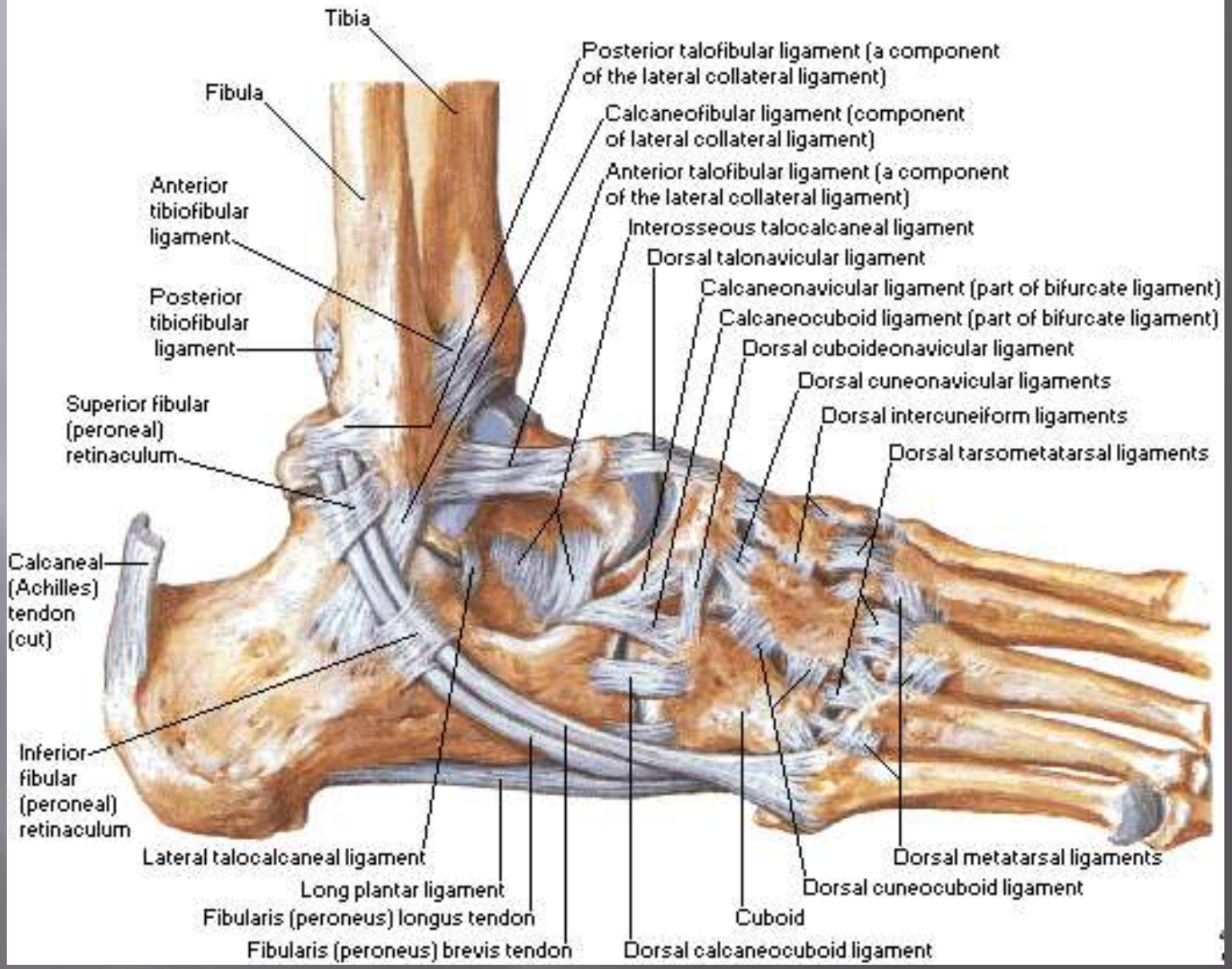
- Deltoid
  - Restraint to eversion
  - Portion from tibia to calcaneus (sustentaculum) is strongest
- Spring ligament
  - Primary stabiliser of the medial arch
  - Attaches from sustentaculum to medial navicular
- Calcaneofibular ligament
  - Primary restraint to inversion (dorsiflexion/neutral)
  - Anterior fibular 9mm proximal to tip
  - Peroneal tuberosity on calcaneous
- Lateral talocalcaneal ligament
  - Thought to stabilise subtalar joint
  - Lateral process of talus to lateral wall of calcaneus

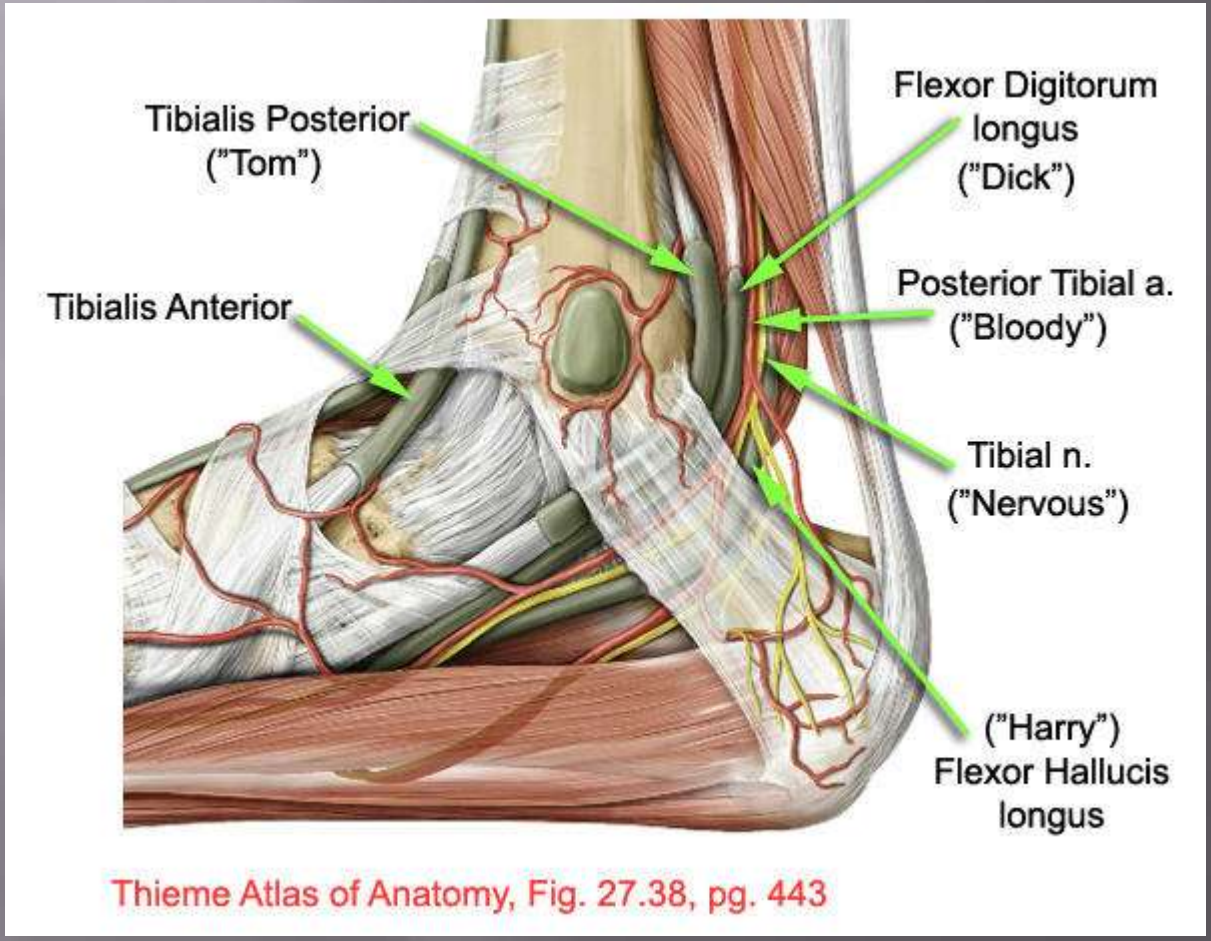
Soft tissues

- Achilles tendon
  - Inserts into middle 1/3 of posterior surface
  - Can provide a significant deforming force
- Peroneal tendons
  - Laterally
  - At risk during lateral approach
- Medial structures in tarsal tunnel
  - Tom, Dick and A Very Nervous Harry

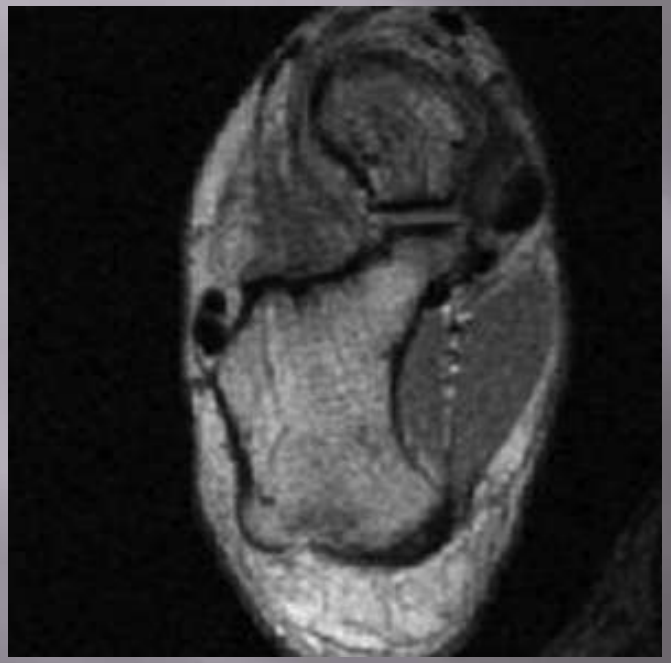
Ligaments and Tendons of Right Ankle

Lateral View





Thieme Atlas of Anatomy, Fig. 27.38, pg. 443



FHL lies close to sustentaculum
and is at risk during fracture fixation

Neurovascular

- Blood supply
  - Medial and lateral calcaneal arteries
    - Medial – posterior tibial artery
    - Lateral – peroneal artery
- Nerves
  - Branches of tibial, deep peroneal and sural
  - Sural nerve at risk during lateral approach


Additional sensory involvement
Site of traction injury

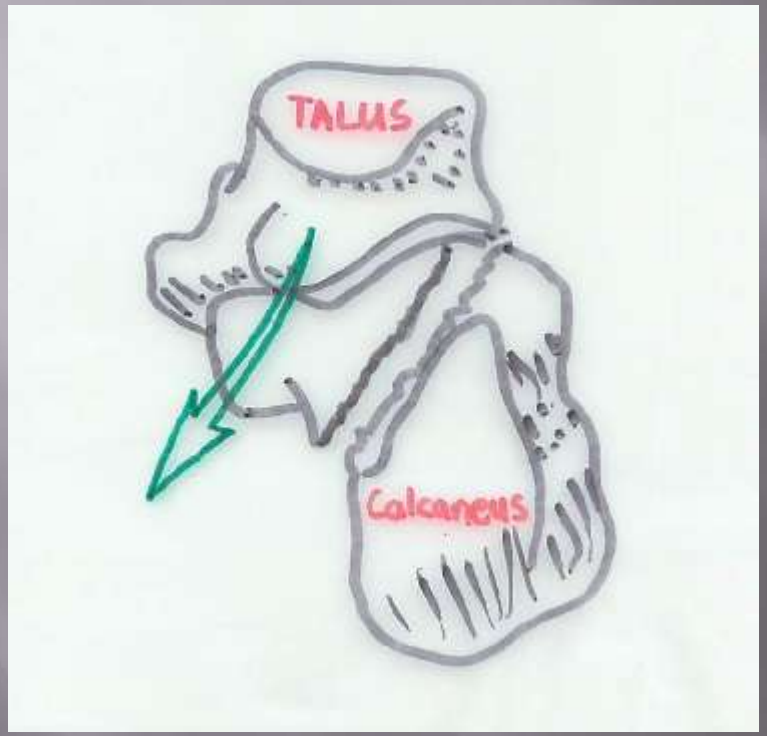
Calcaneus fractures

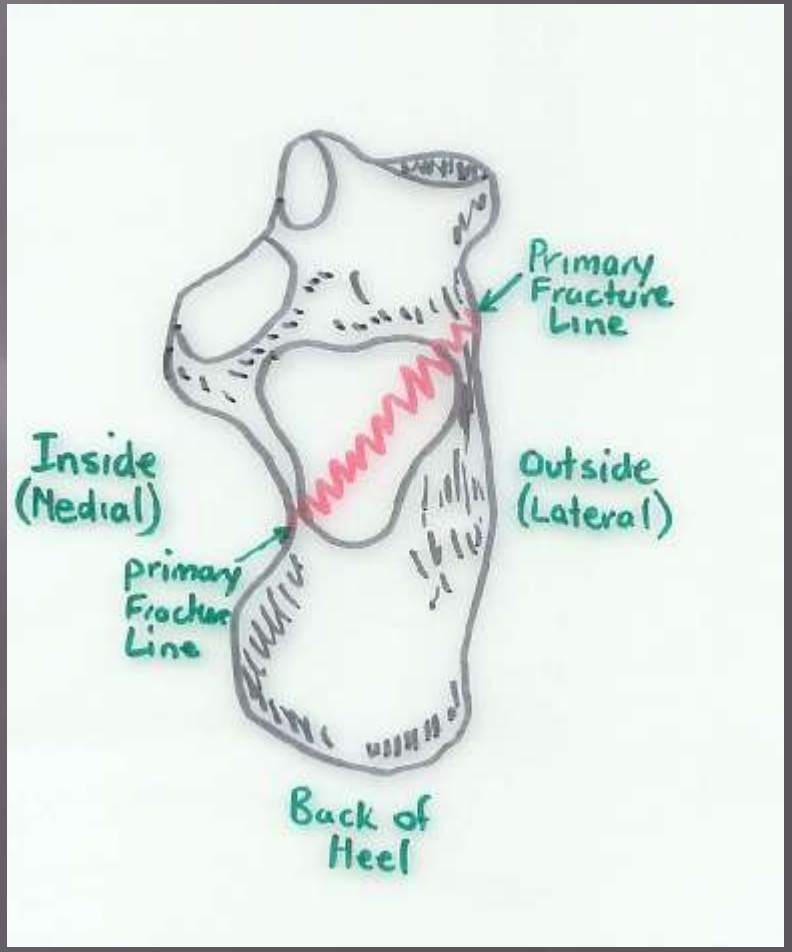
- Most frequent tarsal fracture
- 17% open
- Due to traumatic axial loading
- High energy injury
- Associated with other axial loading pattern
  - Pilon, Tibial plateau, Acetabulum, Pawel 3 NOF
  - Vertebral (10%), other foot (10%)
  - Full primary and secondary survey needed

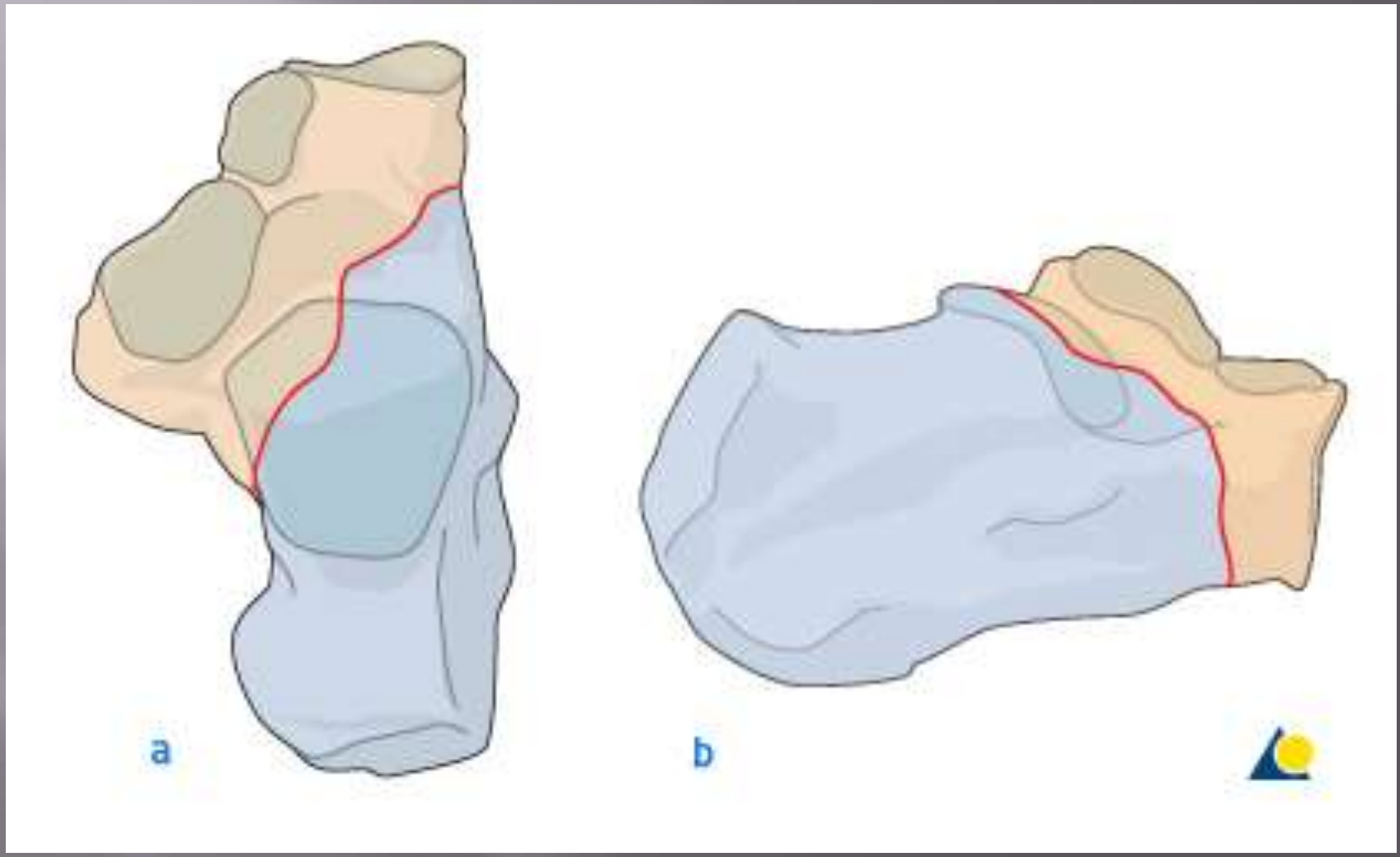
Fracture mechanics

- Most are intraarticular and involve the subtalar joint
- Up to 2/3 can also involve calcaneocuboid joint
- Primary fracture line
  - Due to oblique shear
  - Extends from posteromedial to anterolateral
  - 2 fragments created
    - Superomedial (constant fragment including sustentaculum)
    - Lateral (includes intrarticular aspect through posterior facet)

Fracture mechanics



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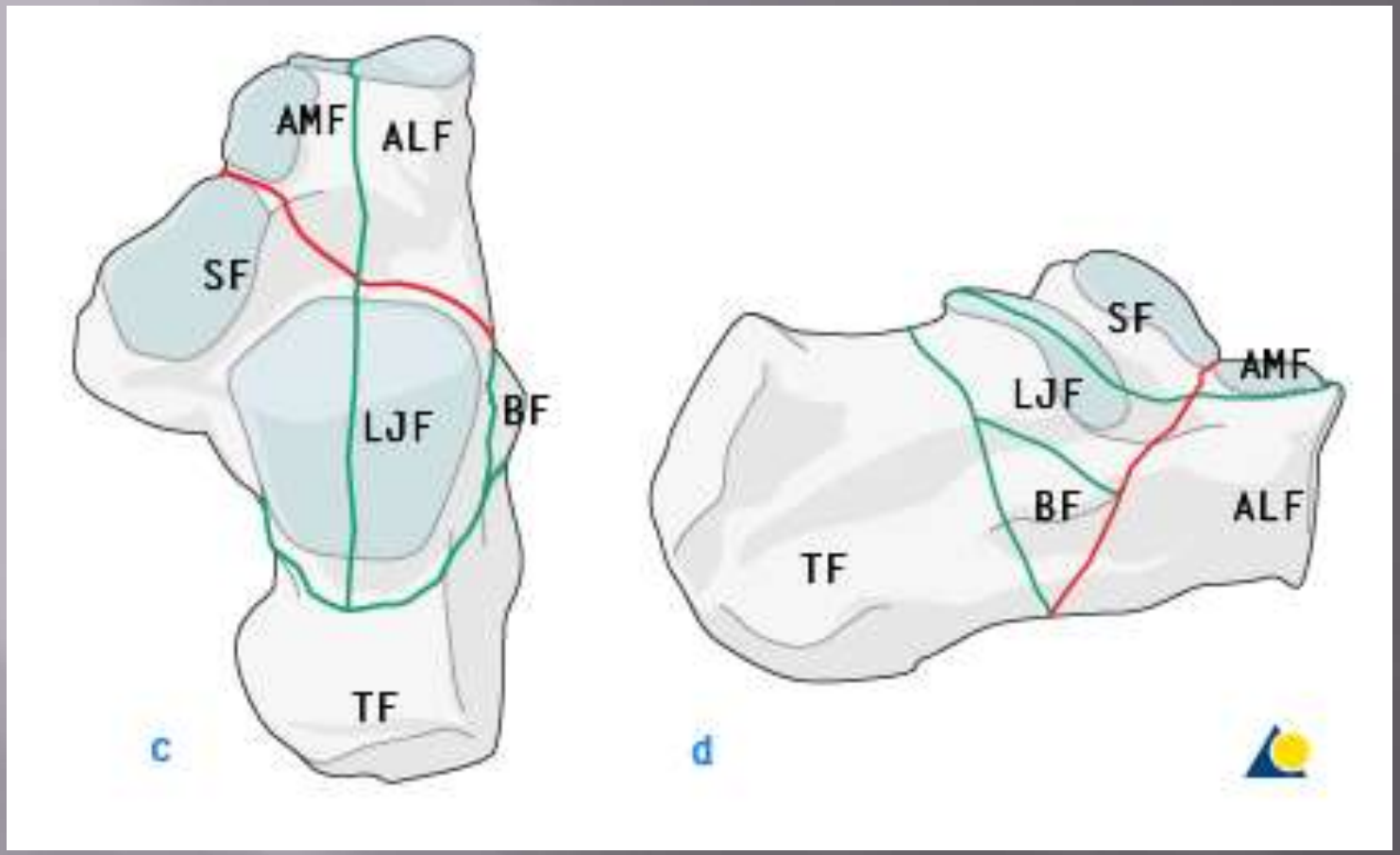
Fracture mechanics

- Secondary fracture lines are common and variable
- Can involve
  - Lateral joint depression
  - Calcaneocuboid joint
  - Medial propagation
  - Posterior propagation
- Lateral joint depression can lead to ‘blow out’ of the lateral wall



LJF Lateral joint fragment.
SF Sustentacular fragment.
TF Tuberosity or body fragment.
ALF Anterolateral fragment.
AMF Anteromedial fragment.
BF Lateral wall blow-out fragment.

Soft tissues

- Often severe soft tissue damage and swelling
- Mondor's sign – haematoma along sole of foot
- Soft tissue state will usually dictate timing of surgery
- Open fractures treated appropriately
- In closed injuries neurovascular structures are usually intact
- Important to examine posterior heel especially with displaced achilles insertion
  - Can lead to skin tenting and imminent necrosis

Imaging

- Plain X rays
- Lateral and axillary views allow the basic fracture to be identified
- Lateral
  - Shows joint depression versus tongue type
  - Depression can be quantified by measuring
    - Bohler angle
    - Critical angle of Gissane
- Axillary (Harris) view
  - Will show any varus and shortening of heel
  - Also shows any increase in heel width

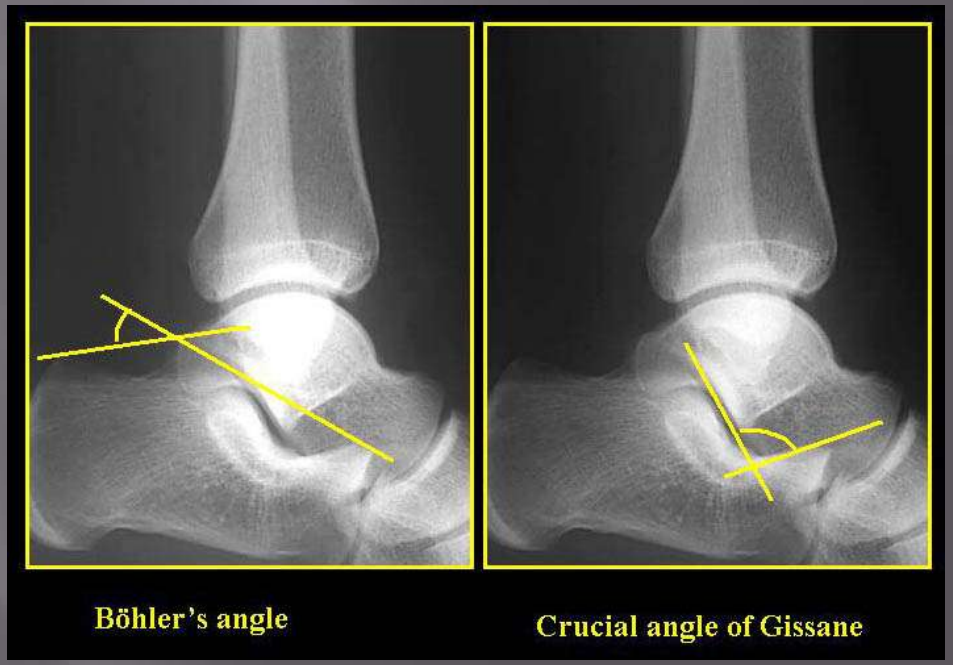
Bohler angle

- Line drawn from most cephalic point on anterior process to highest point of posterior facet w/ line from latter to most cephalic part of posterior process of calcaneus

- Measures height of posterior facet
- Normal range is 20-40 deg
- Severe decreases have been associated with poorer long term results (<0deg)

Angle of Gissane

- Formed by the upward and downward slopes of the calcaneal superior surface
- Normal is 130-145 degrees
- Decrease can represent depression of posterior facet



Imaging

- Other plain films that can be useful include:
  - Oblique and AP films
    - Can show extension into CC joint
  - Broden view
    - Oblique view of posterior subtalar joint
    - Often useful intraoperatively to assess subtalar reduction

Imaging

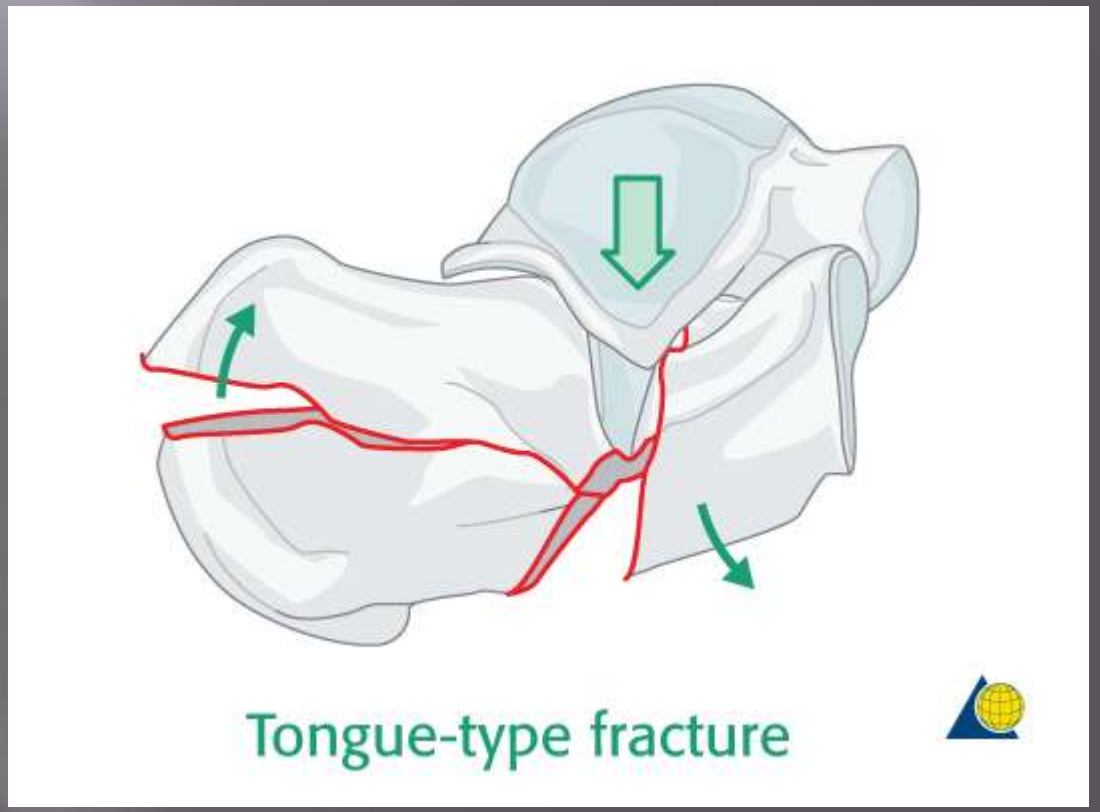
- CT scans in the axial and coronal plane usually necessary to understand the fracture pattern fully
- Coronal images show posterior facet injury and position of heel
- Axial images also show extension into CCJ
- Sagittal images can be useful to look at joint depression

Classification

- Several
- None perfect
- Most common
  - Essex-Lopresti
  - Sanders
  - OTA
  - AO – being developed

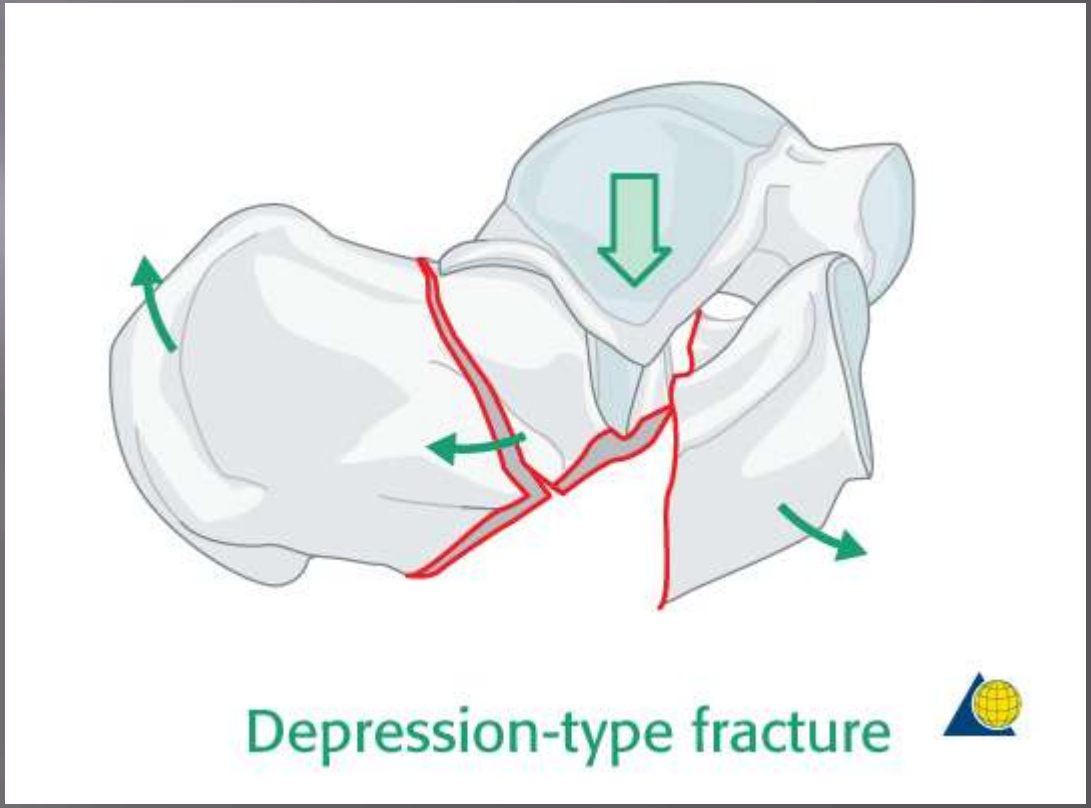
Essex Lopresti

- Depends on location of secondary fracture line
- Tongue type



Essex Lopresti

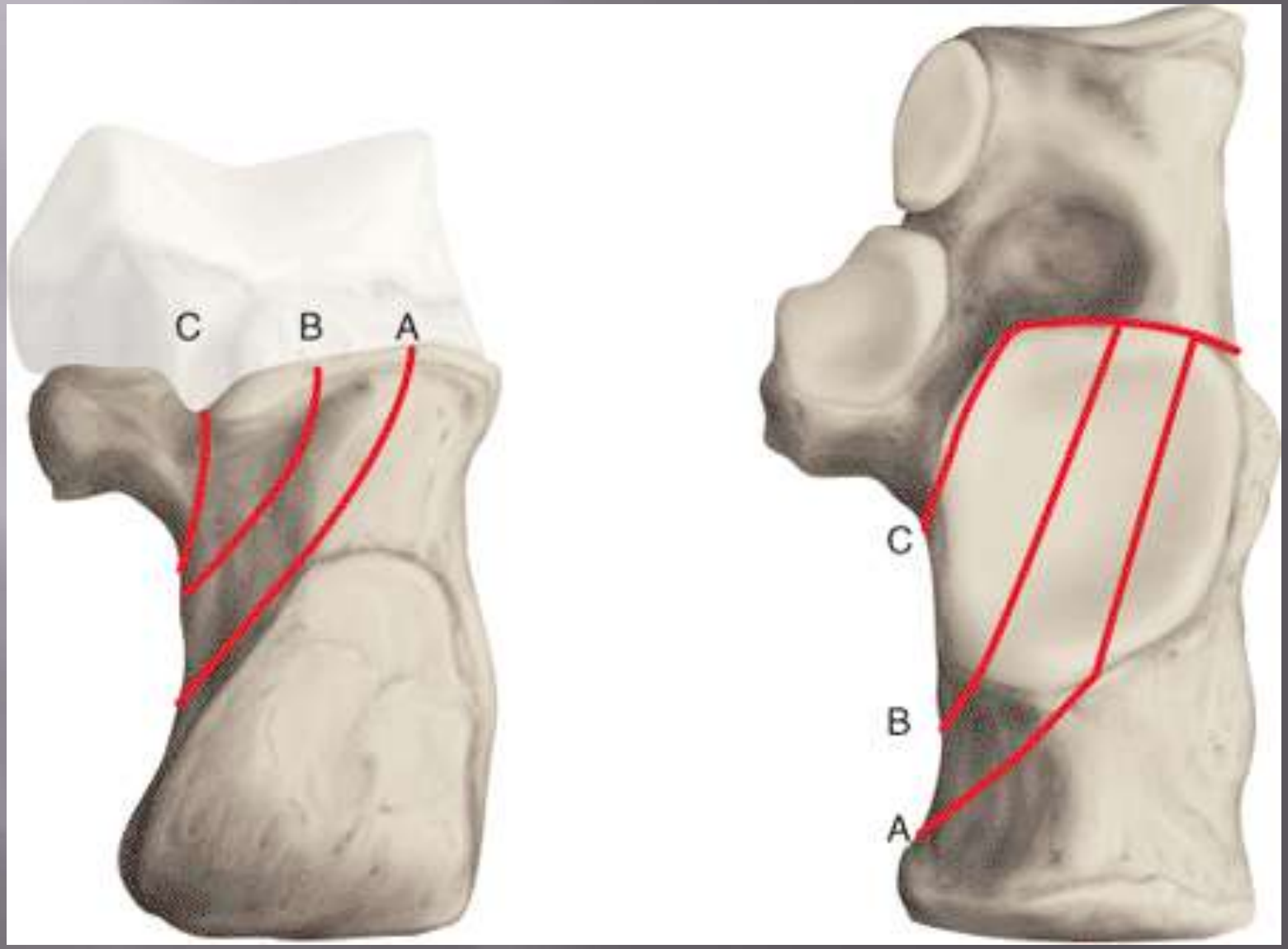
- Joint depression



Essex-Lopresti P. The mechanism, reduction technique, and results in fractures of the os calcis, 1951-52. Br J Surg. 1952 Mar;39(157):395-419

Sanders Classification

- Most commonly used in clinical practice and literature
- Based on CT scan findings
- 1 - the articular fragments are displaced less than 2mm
- 2 - there are two articular fragments which are displaced at least 2mm
- 3 - there are three articular fragments which are displaced at least 2mm
- 4 - there are four or more articular fragments which are displaced at least 2mm


C
B
A
C
B
A

Other fractures

- Extraarticular
  - Avulsion of achilles

  - Tuberosity

Other fractures

- Anterior process (Casanova fracture)
- Commonly mistaken as sprained ankle
- Occasionally non union can lead to chronic pain