# Talus Fractures

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# Outline:

Talar Neck Fractures

- Anatomy
- Incidence
- Imaging
- Classification
- Management
- Complications

Talar body, head and process fractures

Subtalar dislocations

- Classification
- Management
- Outcomes

# Anatomy

- Surface 60% cartilage
  - Articulations with Tibial Plafond, Medial Malleolus, Lateral Malleolus, Calcaneus, Navicular

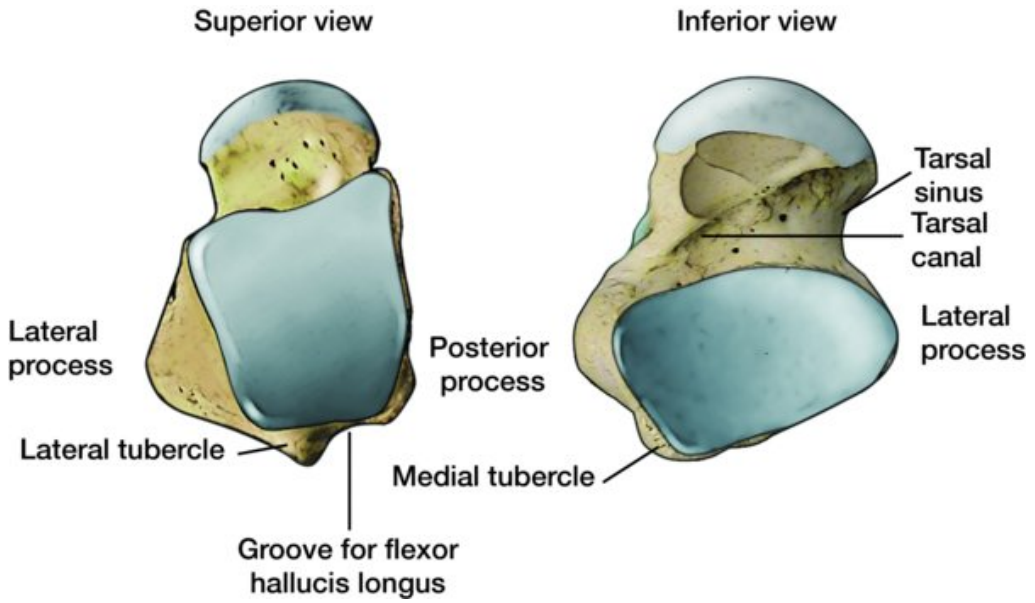
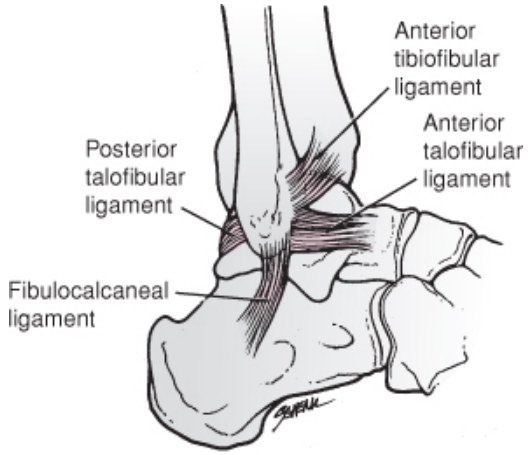



***Figure 65-18:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# Anatomy

- Multiple Ligamentous Attachments
  - Anterior talofibular ligament
  - Posterior talofibular ligament
  - Talocalcaneal ligaments
  - Tarsal Sinus ligaments
    - cervical ligament
    - talocalcaneal interosseous ligament
  - Deltoid ligament
    - Anterior tibiotalar ligament
    - Superficial posterior tibiotalar ligament
    - Deep posterior tibiotalar ligament
  - Dorsal talonavicular ligament



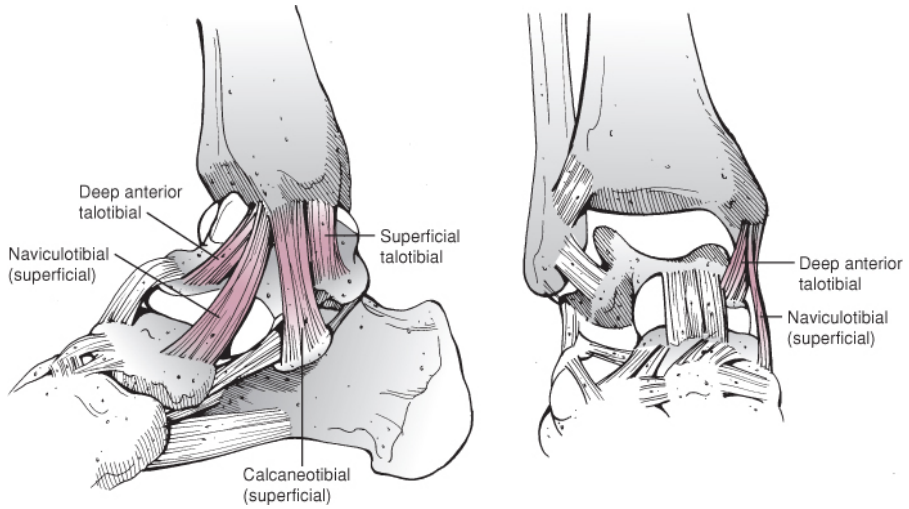
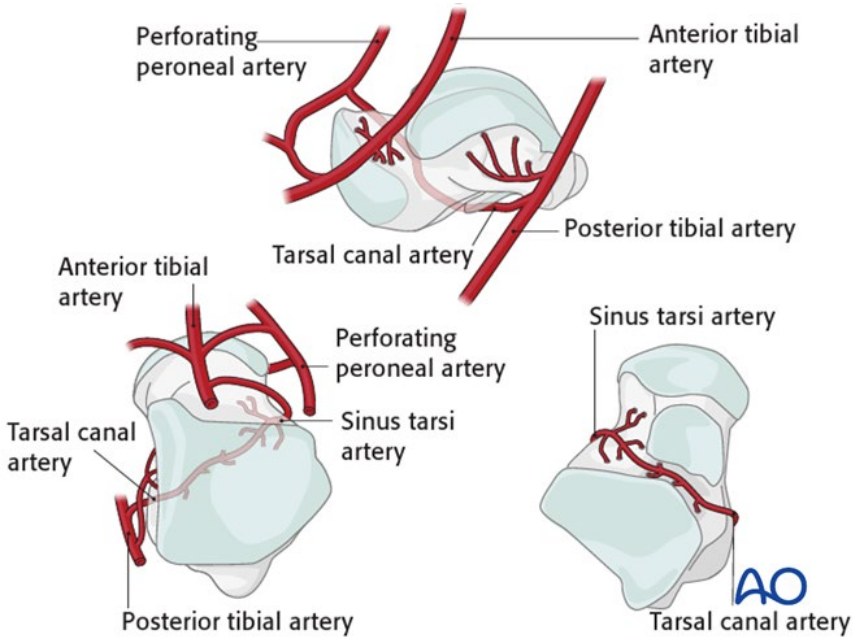




***Figure 64-4 and 64-5:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019..

# Complex Vascular Supply

- Posterior Tibial Artery (47%)
  - Artery of Tarsal Canal
    - Main Contributor Talar Body
  - Deltoid Branch
- Anterior Tibial Artery
- Artery Tarsal Sinus
  - Perforating Peroneal Arteries

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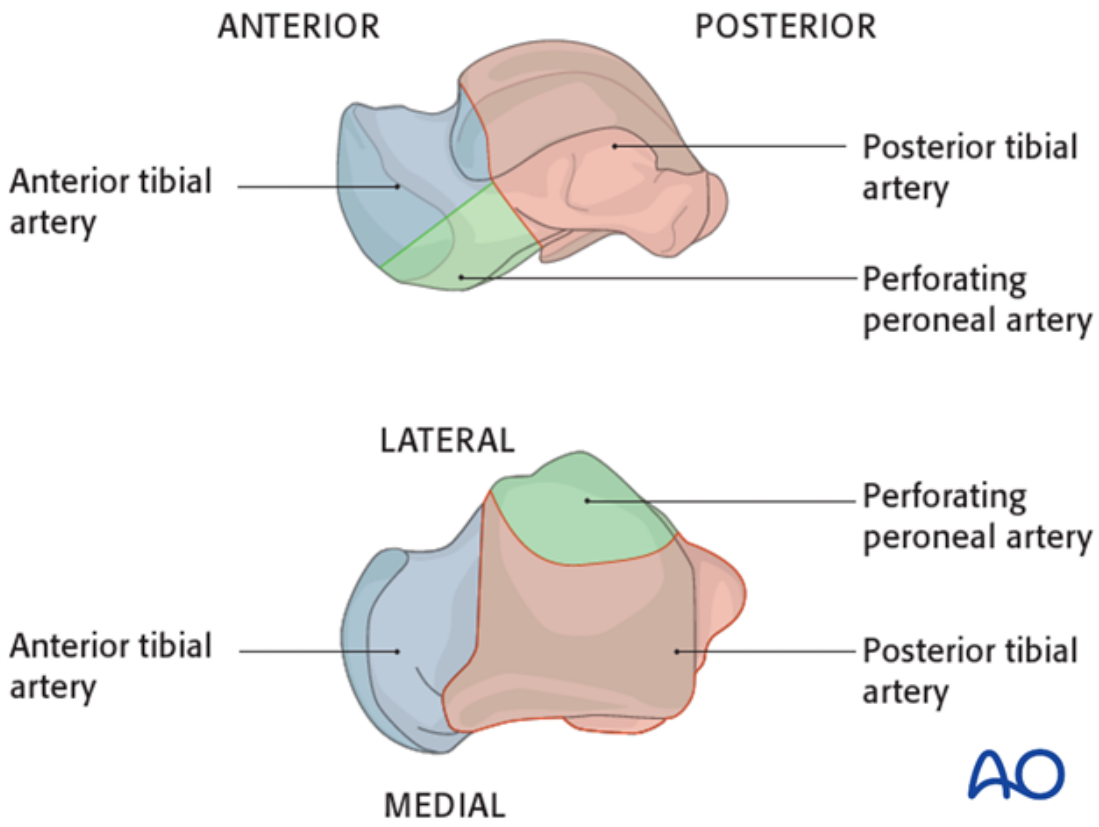
# Complex Vascular Supply

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# Talar Neck Fractures

# Incidence

- 2 % of all fractures
- Associated complications
  - avascular necrosis
  - post-traumatic arthritis
  - malunion

# Mechanism of Injury

- Hyperdorsiflexion of the foot on the leg
- Neck of talus impinges against anterior distal tibia, causing neck fracture
- If force continues:
  - Talar body dislocates posteromedial
  - Rotates around deltoid ligament

# Injury Mechanism

- Previously called “aviator’s astragalus”
- Usually due to motor vehicle accident or falls from height
- Approximately 50 % of patients have multiple traumatic injuries

# Imaging

- Multiple plain film orientations:
  - 3 views ankle
    - Demonstrates joint congruity


# Canale View

- Slight ankle plantarflexion with knee bent to rest foot on the table
- 15 degree pronation
- Xray Tube
  - 15 degree from vertical
- Outlines morphology talar neck
  - A True AP view talar neck

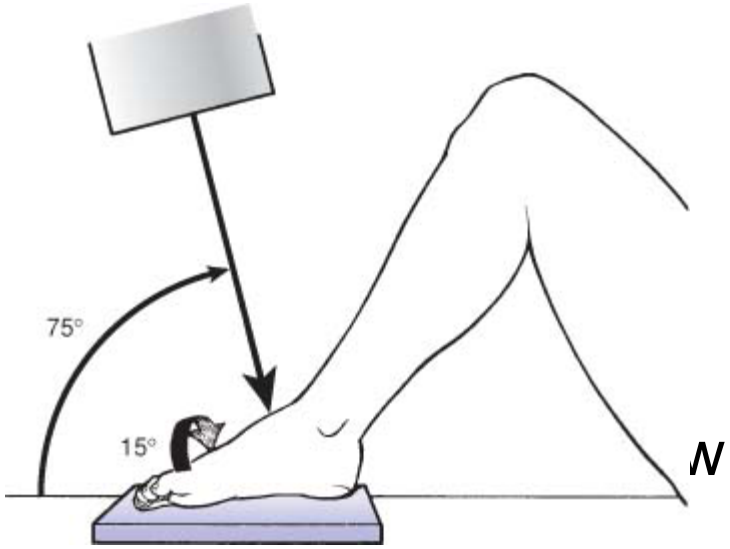
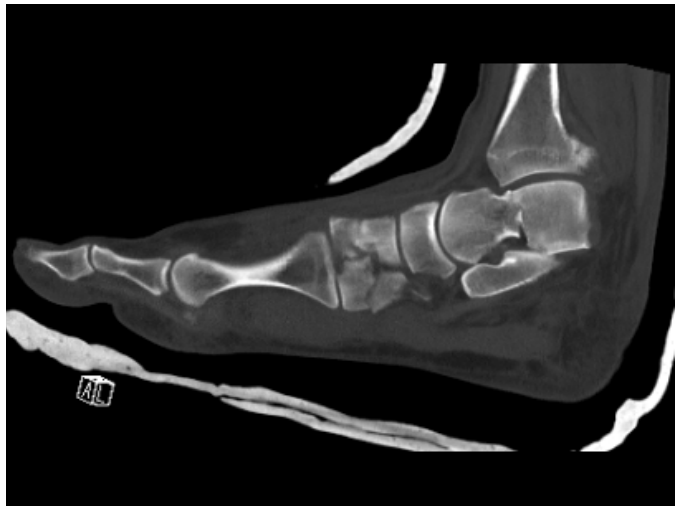



Figure 65-11: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# CT Scan

- Most useful assessment tool for surgical planning
- Confirms displacement
- Demonstrates subtalar joint reduction, comminution, osteochondral fractures/debris



# Talar Neck Fracture Classification

- Hawkins Fracture Classification
- Predictive of AVN rates
  - Overall incidence 31%
  - Anastomic sling formed between Artery Tarsal Canal and Artery Tarsal Sinus in the tarsal canal
    - Often injured in talar neck fractures
  - More recent studies have shown decrease AVN rates possibly due to improved surgical techniques

# Hawkins 1

- Type I: undisplaced
- AVN rate 0 – 13 %

- Uncommon
  - CT often demonstrates malreduction and rotation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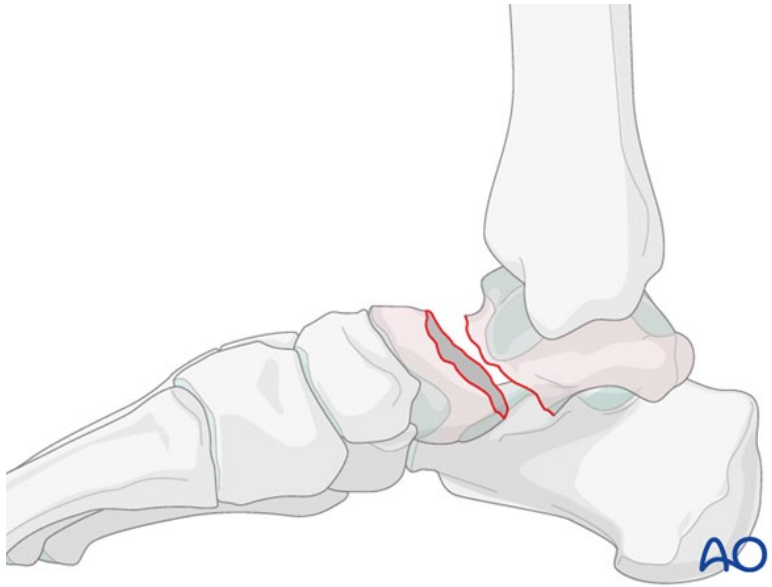
# Hawkins 2

- Displaced fracture with subtalar subluxation / dislocation
  - AVN 20 – 50 %
- Most common type
- Subdivided:
  - 2A: Subluxation 0% AVN
  - 2B: Dislocation 25% AVN

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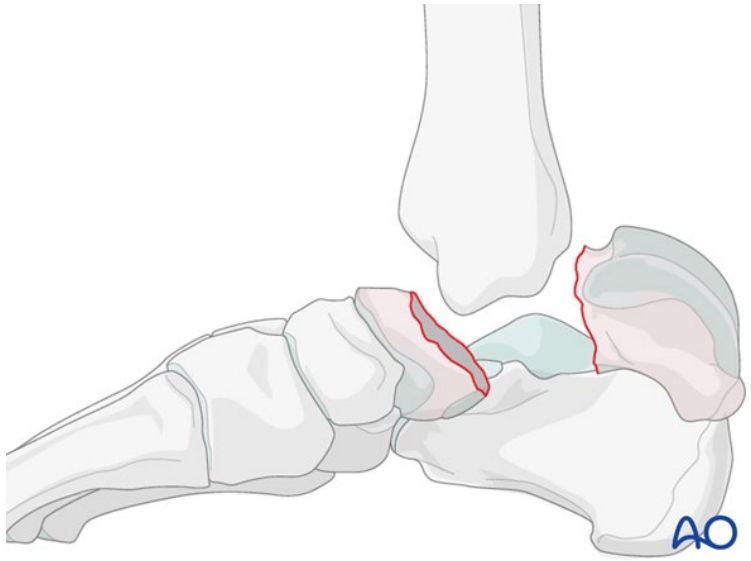
# Hawkins 3

- Subtalar and ankle joint dislocated
  - AVN 50 – 100 %
- Talar body extrudes, usually around deltoid ligament
- Closed reduction often unsuccessful
  - Urgent open reduction required
  - Clear interposed soft tissue
    - Flexor tendons/posterior tibial tendon incarcerated
    - Use joysticks and distractor for reduction
    - Carefully plan surgical incisions if planning for delayed ORIF

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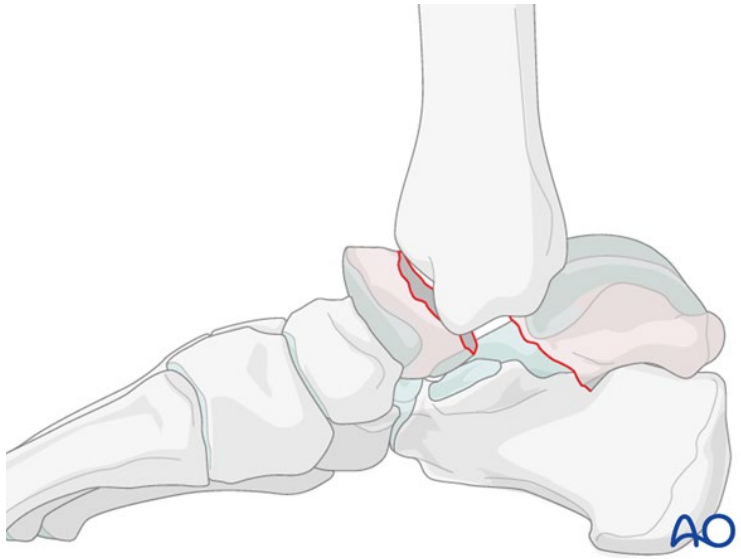
# Hawkins 4

- Incorporates talonavicular subluxation
  - AVN 100%
- Rare variant

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# Hawkins Classification

- Predictor of outcomes
  - AVN
  - Malunion
    - Varus malunion 25-30%
  - Subtalar joint arthritis
    - 50% subtalar arthritis

# Goals of Management

- Immediate reduction of dislocated joints
  - Skin tension
  - Vascular compromise
- Anatomic fracture reduction
- Stable fixation
- Facilitate union
- Avoid complications

# Treatment Plan

- Initial Presentation
  - Nondisplaced fracture
    - CT scan
    - Splint immobilization
  - Displaced
    - Attempt closed reduction →
      - Be aware of the skin/skin compromise
      - Successful 30-60%

- Adequate sedation
- Flex knee to relax gastrocs
- Traction on plantar flexed forefoot to realign head with body
- Varus/valgus correction as necessary
- Direct pressure on talar body

# Treatment Plan

- Emergent OR
  - Irreducible
  - Open Fractures
    - 20-38%
  - Skin/Vascular Compromise
- Open reduction
  - Definitive ORIF vs Temporary External Fixation
  - Plan incisions for definitive management

Temporizing spanning external fixation with reduced talus fracture waiting until swelling decreases for definitive ORIF (no fixation in zone of surgical incisions)

# Treatment Plan

- Place in temporary splint once talar neck fracture reduced
- Time to definitive fixation NOT related to increased risk of AVN
  - Wait for appropriate soft tissue envelope to reduce complications
    - Despite optimizing skin envelope risk of wound dehiscence, skin necrosis, and infection →10%

# Hawkins I Fracture

- Non Operative & Non-Weight-Bearing Cast

OR:

- Percutaneous screw fixation and early motion
  - AP screws acceptable treatment/union
    - Limited risk to surrounding structures
  - PA screws
    - Biomechanically superior
    - Perpendicular to fracture line
    - Increased risk to surrounding structures FHL/sural nerve

# Hawkins II, III, and IV Fractures:

- Results dependent upon development of complications
  - Osteonecrosis
  - Malunion
  - Arthritis

# Surgical Treatment

- Achieve anatomic reduction
- Utilize dual incisions
  - Maintain capsular soft-tissue insertions to protect blood flow
  - Allows for visualization and correction of medial talar neck comminution
- Utilize osteotomies as necessary
- Take x-ray of uninjured side for morphology comparison

# 1st Approach:

- Medial to Tib Ant
- Make incision more posterior for talar body fractures to facilitate medial malleolar osteotomy (if osteotomy planned)

# 1st Approach:

- Provides view of neck alignment and medial comminution
- Extend incision distally to talonavicular joint – hardware is placed distal to proximal and needs to be well countersunk to avoid impingement

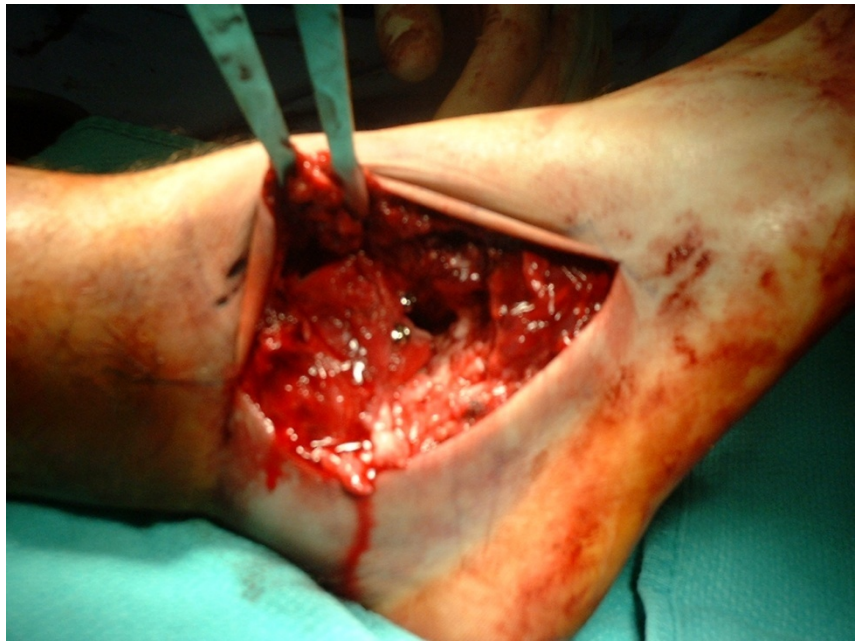
# Medial Malleolar Osteotomy

- Predrill and pretap malleolus
- Osteotomy aims just off the medial corner of mortise to facilitate interdigitation
- Align exit point into the joint to allow for maximum visualization
- Chevron, straight, or stepcut techniques
- Osteotome to crack cartilage helps avoid mortise malalignment
- Care when retracting and dissecting to leave deltoid INTACT

Reference with figures: Vallier HA, Nork SE, et al. Surgical treatment of talar body fractures. J Bone Joint Surg 2004; Supp 1: 180-92; and 2003; 85-A: 1716-24

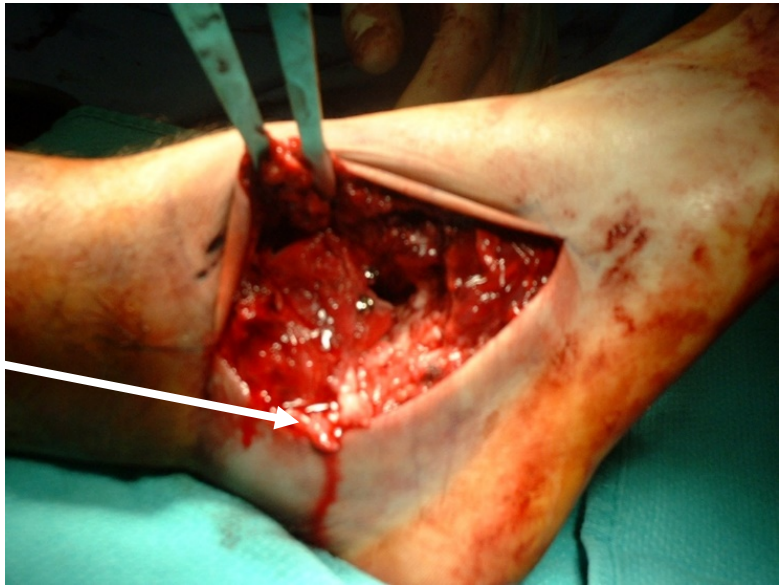
# 2nd Approach:

- Tip of Fibula Base of the 4th metatarsal
- Mobilize EDB as sleeve



# 2nd Approach:

- Visualizes Anterolateral alignment and subtalar joint
- Allows for debridement of debris in subtalar joint
- Facilitates Placement of “Shoulder Screw” or lateral plate



# 2 incisions: Skin bridge

- Narrow skin bridge but generally well tolerated
- Be sure to not dissect the dorsal capsular structures to the distal neck /head

# Fixation Options

- Stable Fixation to allow early motion is the goal
- Often a combination of mini-fragment plate fixation and screw fixation
  - Depends on fracture comminution and medial neck shortening
  - Consider fully-threaded screws medially to prevent medial neck shortening and varus
  - Lateral plating for buttress

# Anterior Screw Fixation:

Screw fixation alone is acceptable for non-comminuted fractures, but consider adding a lateral plate if there is comminution.

- Easy to insert under direct visualization
- Countersink screw heads if encroaching on articular surfaces
- No difference in strength of countersinking vs headless screws

# Plate Fixation:

- Very useful in comminuted fractures:
  - 2.0 or 2.4 mm plates
  - Easiest to apply to lateral cortex – impinge on medial side
  - Provides a length stable construct
  - Careful contouring of the lateral plate to prevent subfibular/lateral gutter impingement

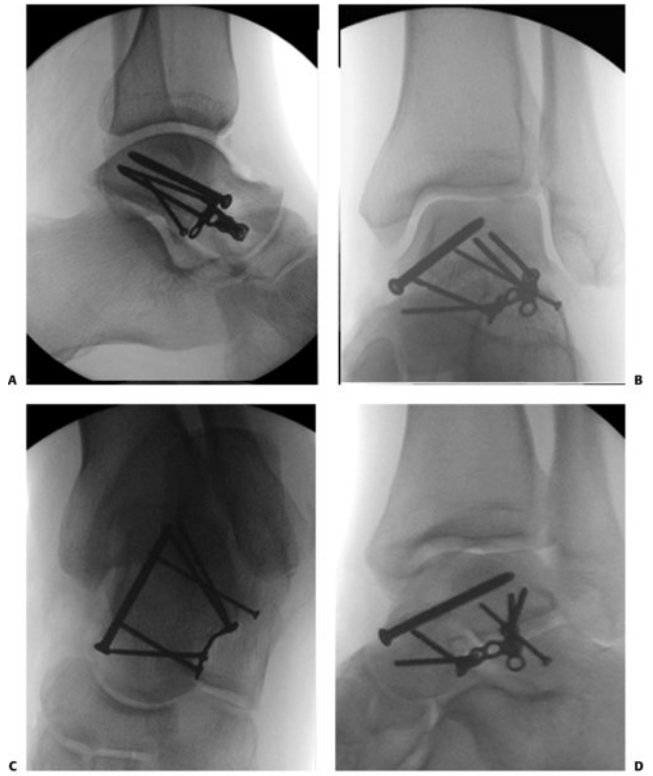



***Figure 65-12:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# Treatment

- Post operative rehabilitation:
- Sample protocol:
  - Initial immobilization, 2-6 weeks depending upon soft tissue injury and patient factors, to prevent contractures and facilitate healing
  - Non weight-bearing, Range of Motion therapy until 3 months or fracture union

# Complications

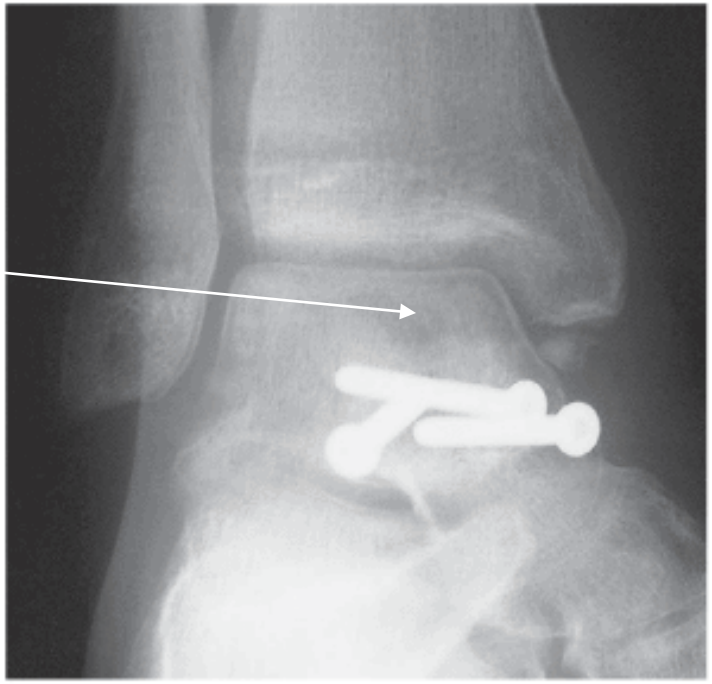
- AVN
- Malunion
- Nonunion
- Arthritis

# AVASCULAR NECROSIS

-  Rates with  Hawkins Class
- Functional outcomes significantly worse with AVN
- Early ORIF does not prevent development of AVN
- Can see revascularization without collapse in 34-47% patients with radiographic osteonecrosis

# AVN: Diagnosis

- Hawkins' Sign:  Xray finding 6-8 weeks post injury
  - Presence of subchondral lucency implies revascularization
- Increased radiodensity c/w Osteonecrosis has been seen from 4wk-6month after injury



# AVN: Imaging

- Plain radiographs: sclerosis common, decreases with revascularization
- MRI: very sensitive to decreased vascularity

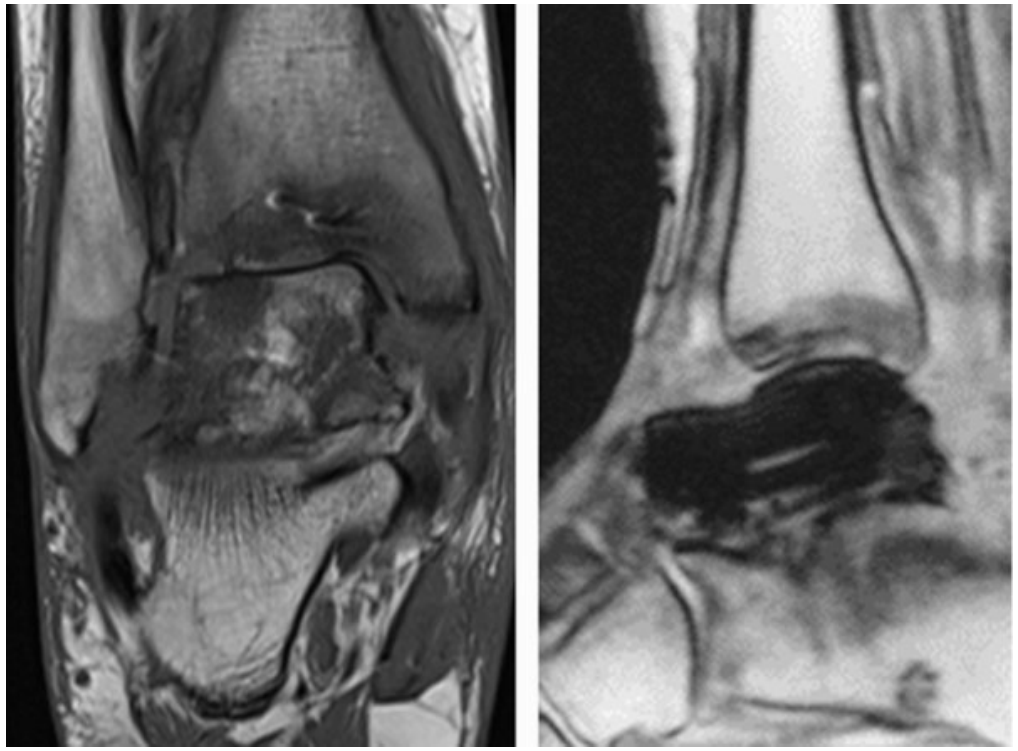


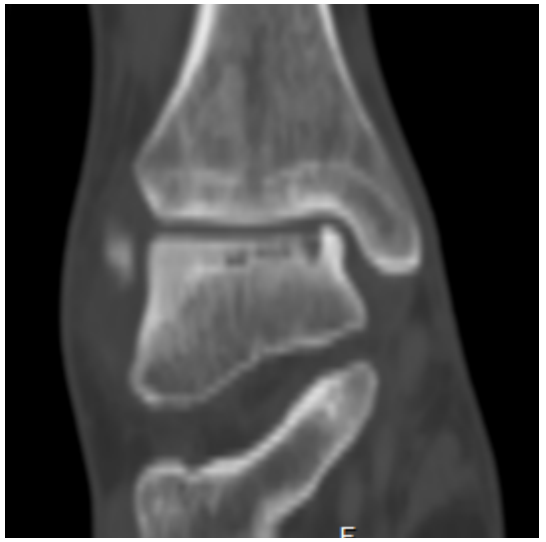
***Figure 65-37:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# AVN Treatment:

- Precollapse:
  - Modified WB
  - PTB cast
  - Compliance difficult
  - Efficacy unknown
- Postcollapse:
  - Observation
  - Hindfoot fusions are option if symptomatic

# AVN Surgical Treatment

- 10-50% patients with AVN have collapse
- Surgical treatments
  - Patient age/comorbities
  - Bone stock availability
  - Degree and location of arthrosis



# Surgical Treatments

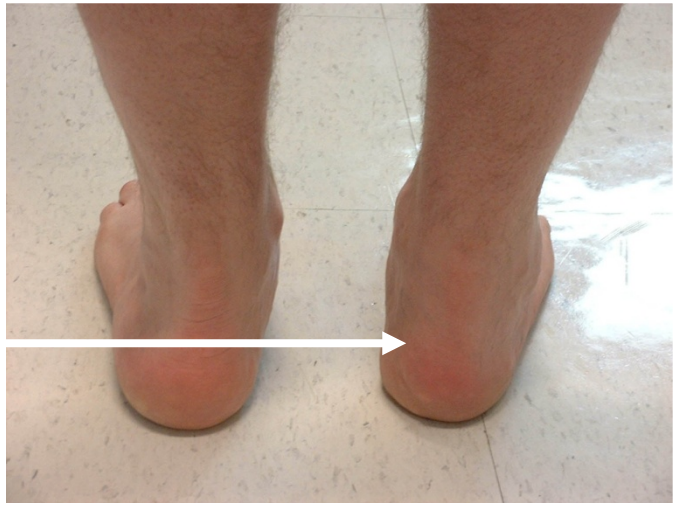
- Options
  - Total talus prosthesis
  - Total ankle arthroplasty
    - Dependent on talar bone stock health
  - Hindfoot fusions

# Malunion: Incidence

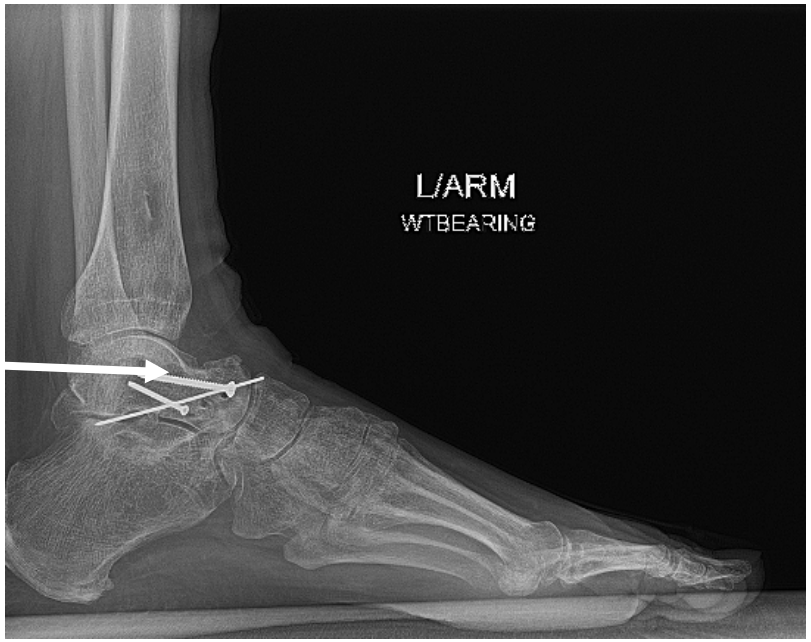
- Common: up to 40%
- Most often Varus
  - Medial neck collapse and medial column shortening

# Malunion: Diagnosis

- Varus hindfoot, midfoot supination on clinical exam



- Dorsal malunion on Xray



# Clinical Effect of Malunion

- Malunion:
  - More pain
    - Lateral foot overload and ankle instability
  - Less satisfaction
  - Less ankle and subtalar motion
  - Worse functional outcome

# Malunion Correction

- Intact motion with minimal OA
  - Talar neck osteotomy
  - Calcaneus osteotomy
  - Possible midfoot derotational osteotomy
  - Tendo Achilles Lengthening
- May require triple arthrodesis in fixed deformity with OA

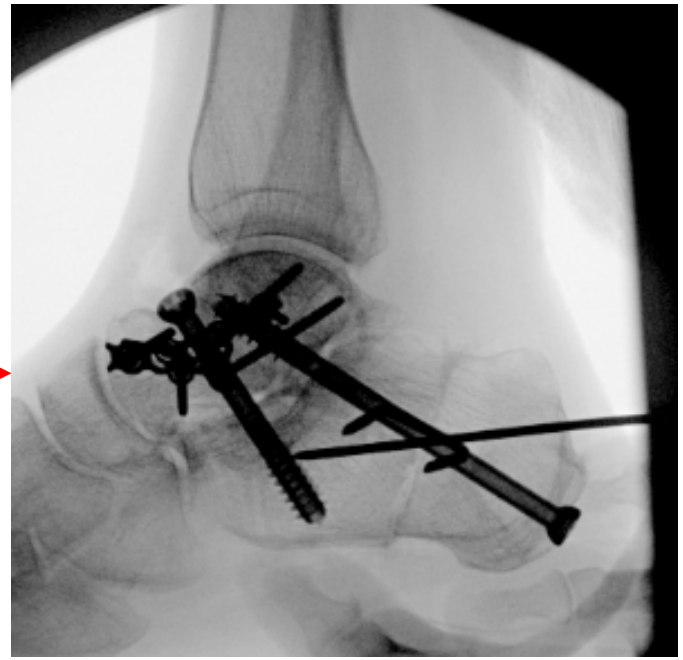

***Figures 65-42 and 65-43:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019..

# Post -Traumatic Arthritis

- Incidence of post-traumatic arthritis
  - 30-90 %
  - Variations reported in outcomes are multifactorial
- Increases with subtalar dislocation

# Post-Traumatic Arthritis

- Most commonly involves Subtalar joint
- Rx: Arthrodesis

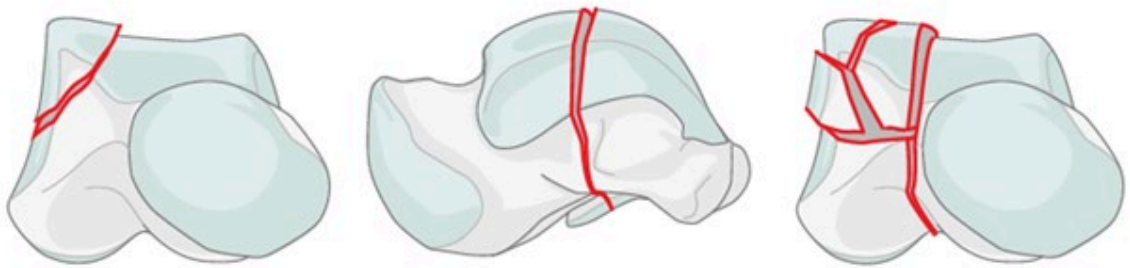



# Talar Body Fractures

# Talar Body Fractures

- Treatment strategy and outcomes similar to talar neck fractures
- Fracture extends within or posterior to the lateral process
- Medial or Lateral Malleolar Osteotomy frequently required for visualization

# Talar Body Fracture Classification

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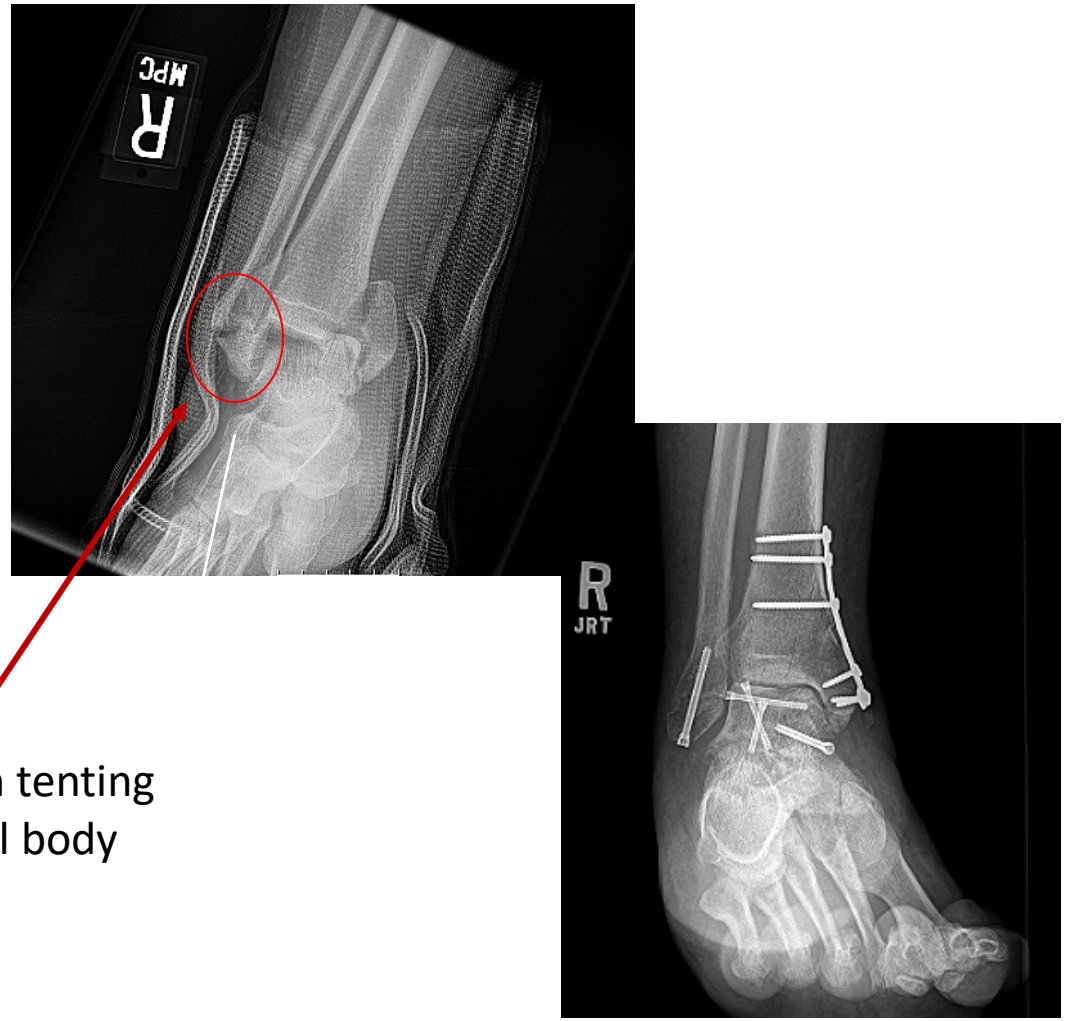
# Talar Body Fracture Management

- Shear
  - Nondisplaced
    - Non-op treatment with immobilization/nonweightbearing
  - Displaced
    - ORIF
      - Countersink screws
      - Headless compression screws

- Compression
  - Highly comminuted
    - Acute fusion
      - Blair fusion
        - Strut from anterior tibia
      - Tibiocalcaneal fusion

# Talar Body Fractures

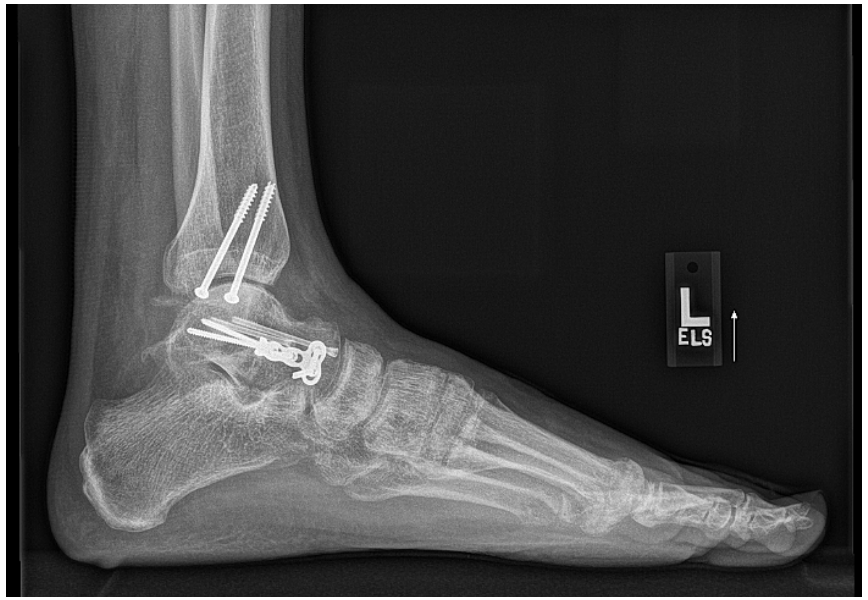
- Be aware of  threatened skin from fracture fragments
- Use both lateral and medial malleolar osteotomies/fractures for visualization




Lateral Skin tenting from lateral body fragment

# Talar Body Fracture

- Similar fracture fixation principles as the talar neck fracture
  - Plate fixation in highly comminuted fractures with impaction and bone loss
- AVN rates and posttraumatic OA rates increase with fracture severity
- No significant difference in posttraumatic OA and rates of AVN when compared to talar neck fractures



# Talar Body Fractures

- May consider percutaneous fixation in non-displaced
- Difficult Salvage


6wks→NonCompliant

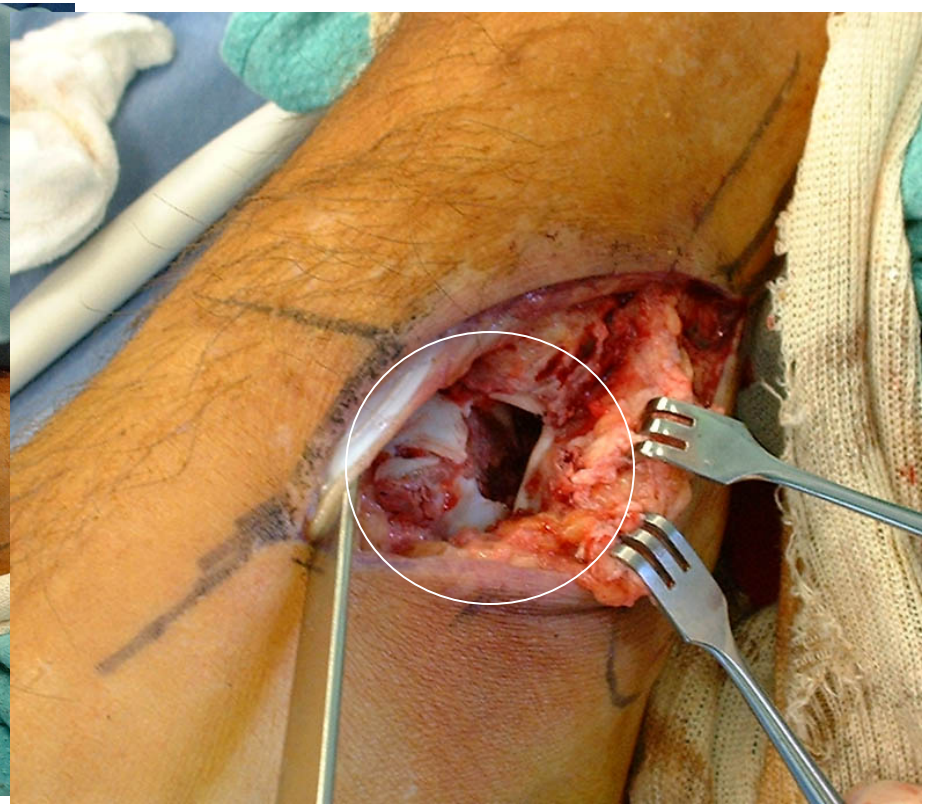

TTC Fusion

# Osteochondral Injury

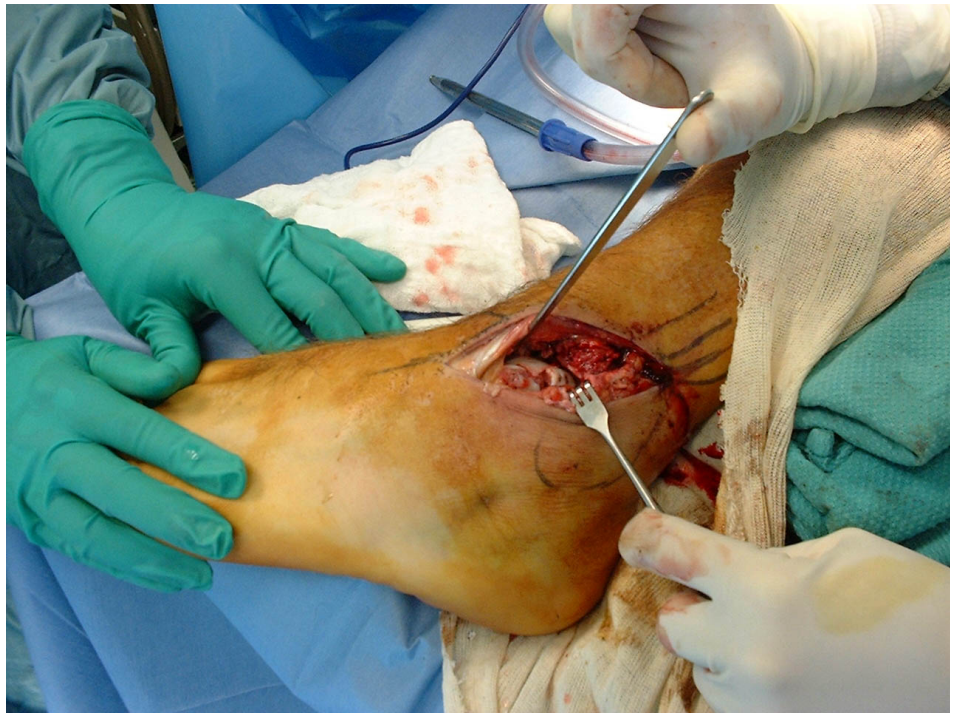
# Osteochondral Injuries

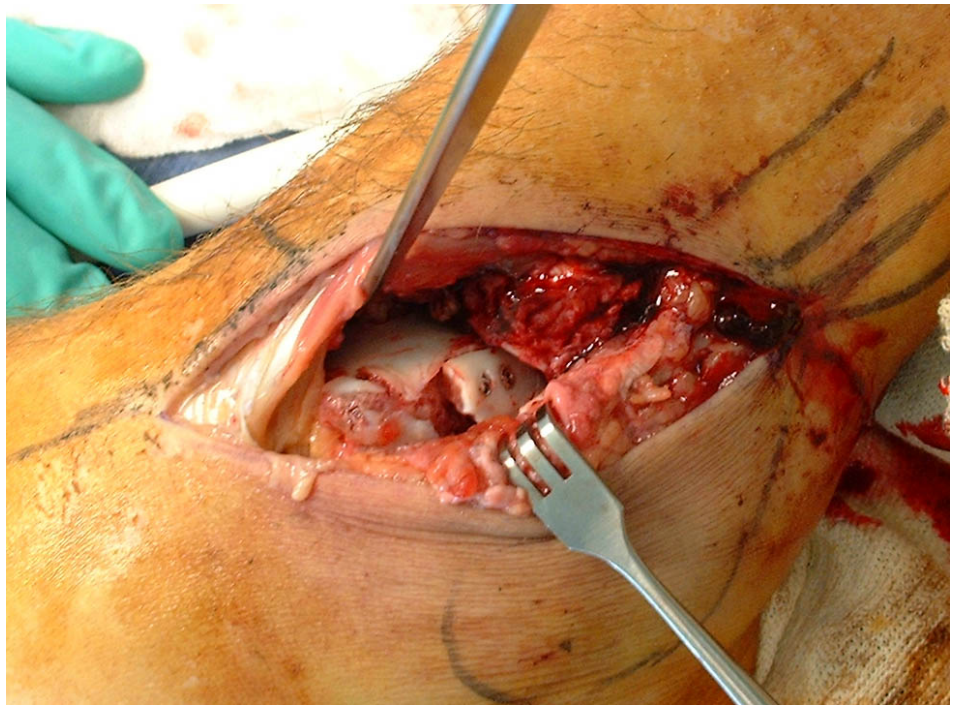
- Frequently encountered with talus neck and body fractures
- Require small implants for fixation
- Excise if unstable and too small to fix

# Osteochondral Injuries



# Osteochondral Fragment Repair

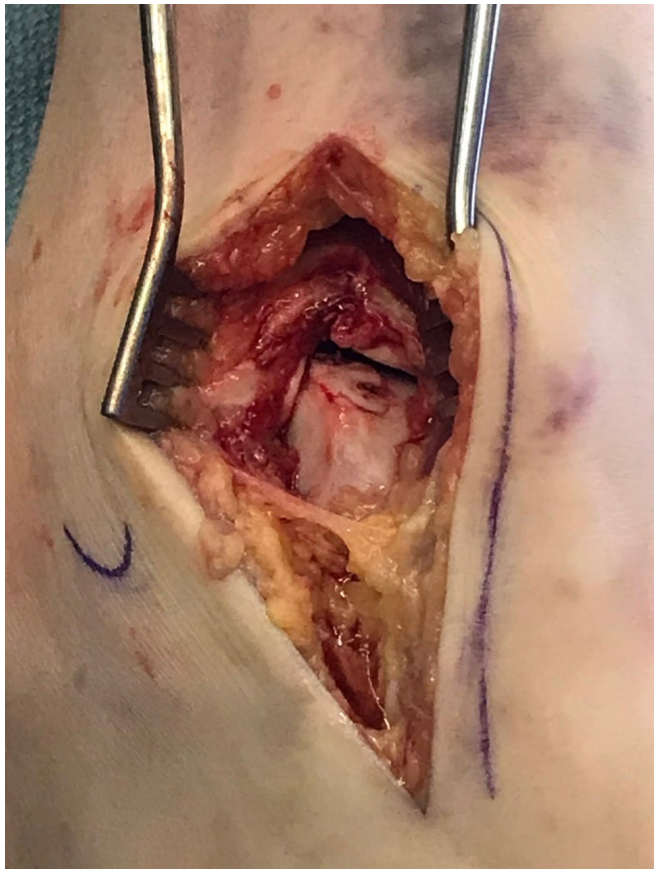




Large fragment repaired, small fragment excised

# Osteochondral Fragment Repair

- Counter-sink screw fixation
- Headless compression screws



# Talar Head and Process Fractures

# Talar Head and Process Fractures

- Treat according to injury
- Operate when associated with joint subluxation, incongruity, impingement or marked displacement
- Fragments often too small to fix and require excision

# Talar Head Fracture

- Can be subtle
- CT demonstrates subtalar injury and subluxation

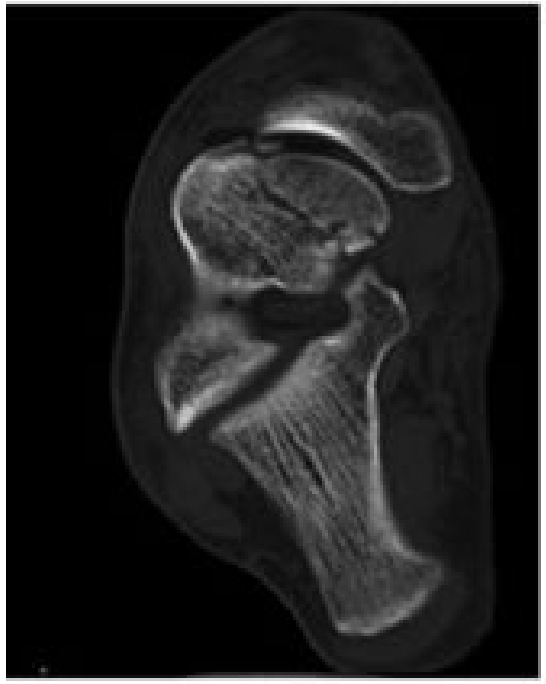


***Figure 60-30:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# Treatment of Talar Head Fracture

- Requires 2 incisions to debride subtalar joint from lateral approach, and reduce / stabilize fracture from medial side
- Consider bridge plating across the fracture to maintain length and prevent collapse


***Figure 60-30:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# Lateral Talar Process Fractures

- “Snowboarder’s fracture”
- Mechanism: may occur from inversion (avulsion injury) or eversion and axial loading (impaction fracture)
- Often misdiagnosed as “ankle sprain”
- Best results if treated early, either by immobilization, ORIF or fragment excision
- If diagnosed late consider fragment excision as attempts to achieve union often fail

# Lateral Process Example

- Usually require CT scan
- Often excised due to size of fragments
- Difficult to achieve union

# Lateral Process Fractures

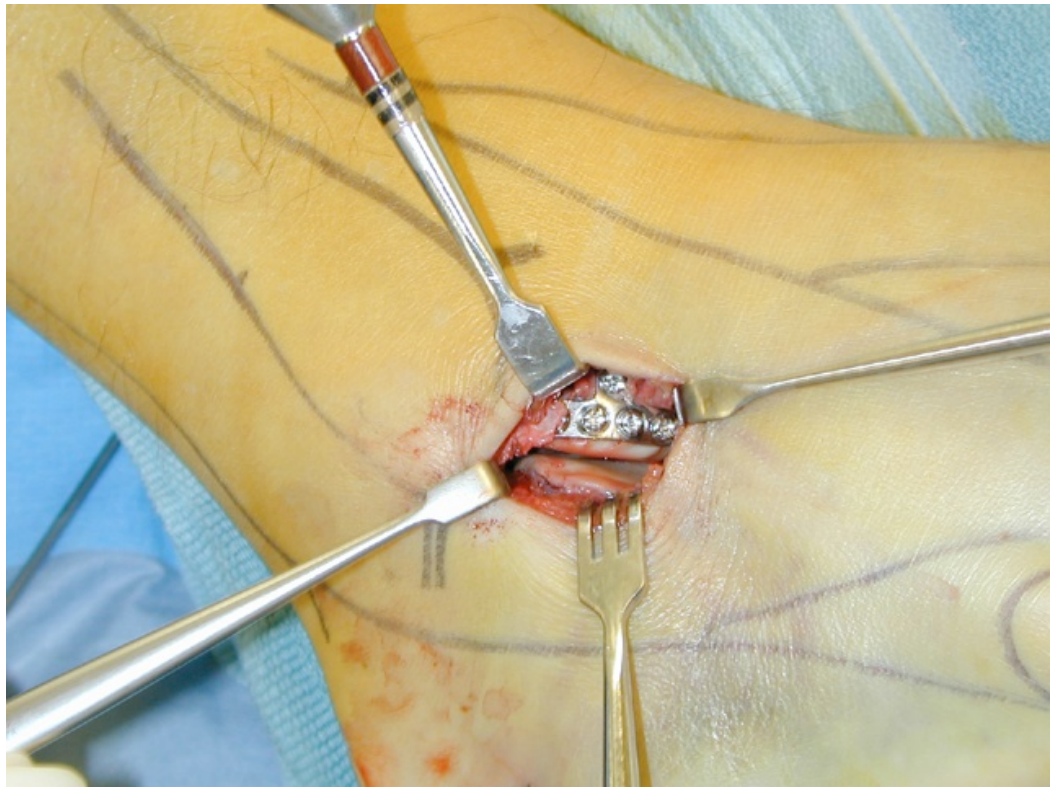
- Can lead to subtalar OA and deformity through the subtalar joint
- Can also see cartilage damage of the posterior facet subtalar joint

# Treatment Options

- Non-operatively for minimally displaced fractures
- Excision of fragment
- Isolated mini fragment screws
- Mini plate fixation

# Mini Plate Procedure

1. Lateral approach
2. Subtalar chondral debris removed
3. Impaction elevated if present & filled with allograft if required
4. Preliminary 0.45 Kirschner wire (K-wire) fixation.
5. 2.0 mm “T” plate applied upside down
6. Lag screw fixation - avoiding overcompression with comminution



# Posterior Talar Process Fracture

- 2 components: medial and lateral tubercle
- Groove for FHL tendon separates the two tubercles
- Differentiate fracture from os trigonum – well corticated, smooth oval or round structure

***Figure 65-31:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.

# Posterior Talar Process Fractures

- Medial tubercle fracture: “Cedell’s fracture”
- Lateral tubercle: “Shepherd’s fracture”

- Treatment: immobilize or excise or ORIF
- Use low profile fixation to prevent posterior impingement or FHL tendon irritation

# Treatment

- Usually associated with Talar Neck Fx
- Posteromedial Approach behind Neurovascular Bundle
- Medial Malleolar Osteotomy – usually not effective for exposure or fixation
- Significant displacement or nonunion can lead to varus hindfoot as the subtalar joint subsides into defect

# Open Talar Body Extrusion

- Catastrophic Injury
- 60% Open injuries
- Infection Rates 25-50%
- Reinsert extruded bone after thorough washing
  - Maintain bone stock
  - Maintain height

# Subtalar Dislocations

- Spectrum of injuries

Relatively Innocent

Very Disabling

# Classification

- Usually based upon direction of dislocation:

- Medial dislocation: 85 %, low energy
- Lateral dislocation: 15 %, high energy

# Other Important Considerations:

- Open vs Closed
- High or low energy mechanism
- Stable or unstable post reduction
- Reducible by closed means or requiring open reduction
- Associated impaction injuries

# Important Distinction:

## Pantalar dislocation vs Subtalar Dislocation

- Total talar dislocation, or pan talar dislocation
- Results from continuation of force causing subtalar dislocation
- High risk of AVN, usually open, poor prognosis

Open pantalar dislocation with skin loss showing Incongruent reduction: Result was AVN and pantalar fusion

# Management of Subtalar Dislocation

- Urgent Closed reduction:
  - Adequate sedation
  - Knee flexion
  - Longitudinal foot traction
  - Accentuate, then reverse deformity

- Successful in up to 90 % of patients

# Anatomic Barriers for Unsucessful Closed Reductions

**Medial Dislocation**

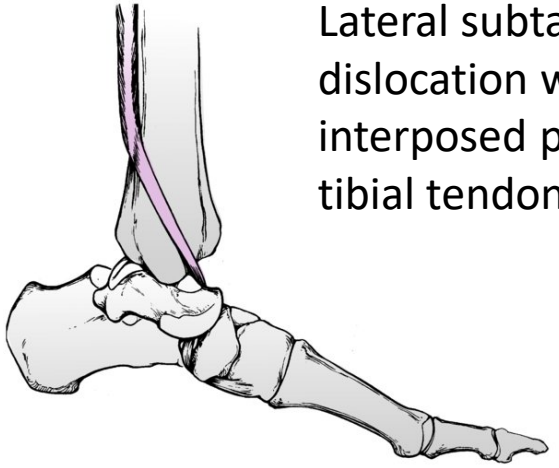
- Peroneal Tendons
- EDB
- Talonavicular joint capsule

**Lateral Dislocation**

- Posterior tibial tendon
- Flexor Hallucis Longus
- Flexor Digitorum Longus

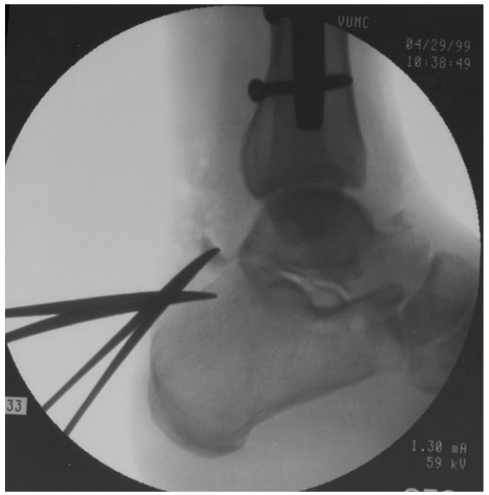
# Open Reduction:

- More likely after high energy injury
- More likely with lateral dislocation
- Cause:
  - soft tissue interposition (Tib post, FHL, extensor tendons, capsule)
  - bony impaction between the talus and navicular



Lateral subtalar dislocation with interposed posterior tibial tendon

***Figure 65-51:*** Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019.




Use a small posteromedial incision, retract interposed soft tissue to reduce dislocation

Be sure to plan for any necessary f/u surgical incisions!!

# Associated Fractures

**Medial dislocation**

- Talar Head
- Posterior Process
- Navicular

**Lateral Dislocation**

- Cuboid
- Anterior process calcaneus
- Fibula
- Posterior process

# Rehabilitation:

- Stable injuries:
  - 4 weeks immobilization
  - Physical Therapy for mobilization
- Unstable injuries:
  - Usually don’t require internal fixation once reduction achieved
  - If necessary – external fixation or transarticular wire fixation

# Outcome of Subtalar Dislocations:

- Less benign than previously thought
- Subtalar arthritis:
  - Up to 89 % radiographically
  - Symptomatic in up to 63 %
- Ankle and midfoot arthritis less common

# Summary:

Talar Neck Fractures

- Anatomy
- Incidence
- Imaging
- Classification
- Management
- Complications

Talar body, head and process fractures

Subtalar dislocations

- Classification
- Management
- Outcomes

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•*the two classics on talus fractures. Rates of AVN, classification, etc. Good descriptive papers.*

*Additional Clinical papers:*

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