



# ANKLE AND FOOT INJURIES



Presenter:  
Dr George Ayerh



## **I. Part: Ankle & Foot Injuries**

1. Ankle sprains
2. Fractures of the ankle
3. Pylon fractures
4. Achilles-tendon ruptures
5. Talus and calcaneus fractures
6. Metatarsal fractures and subtalar dislocation

## **II. Part: Post-traumatic complications**

1. Compartment-syndrome – *Volkman-contracture*
2. Sudeck Dystrophy (RSD)
3. Osteoarthritis

# ANKLE SPRAINS

## Diagnosis

### I. Physical examination:

- Inspection
- Palpation
- Range of motion
- Strength testing
- Special tests

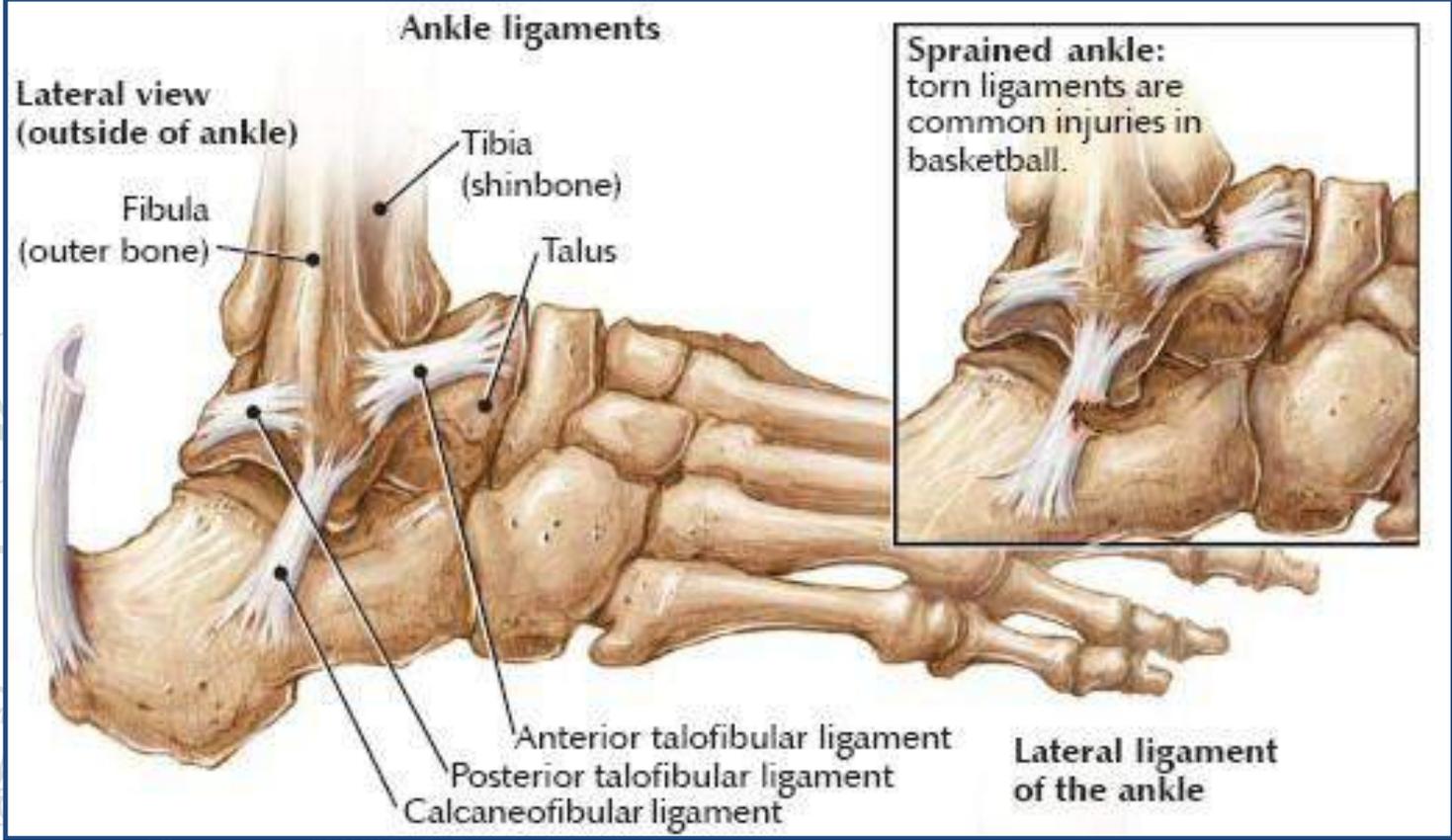


**AXIOM OF SPORTS MEDICINE:**

**“Find out what is tender, then figure out what’s there.”**

# ANKLE SPRAINS

## Anatomy of Ankle Ligaments



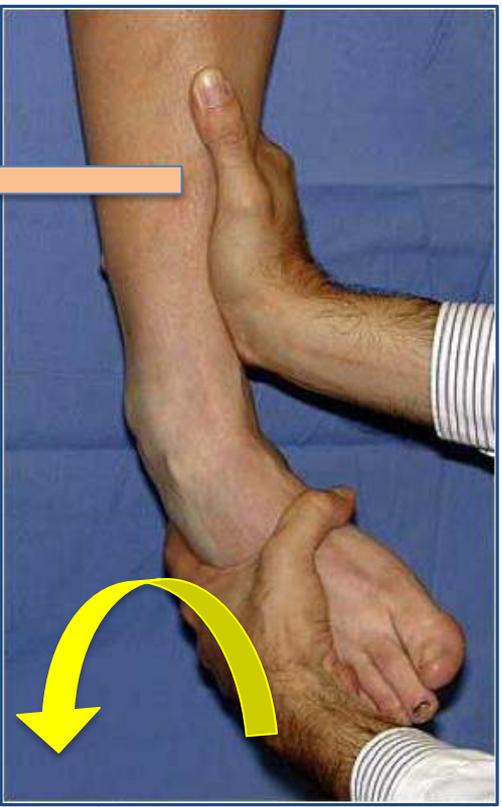
***Commonly torn ligaments***

# ANKLE SPRAINS

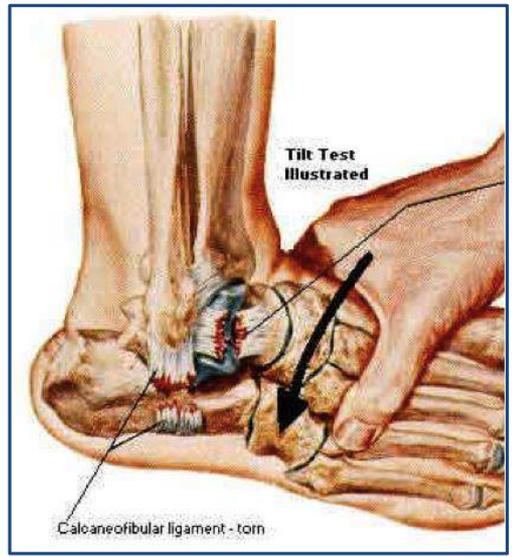
## Special Tests for Physical Examination



**Anterior Drawer Test (ADFL)**



**Talar Tilt (ATFL / CFL)**



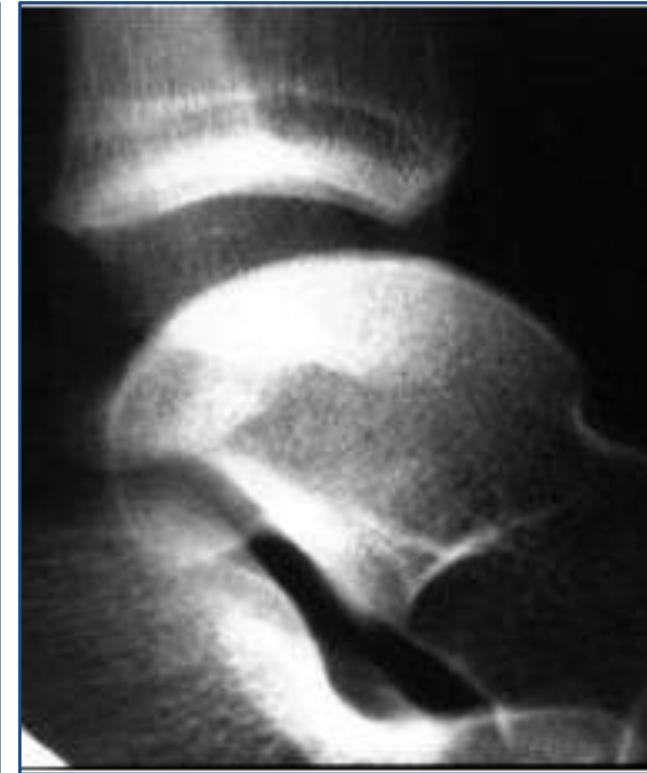
# ANKLE SPRAINS

---

## Diagnosis

### II. Imaging methods

- Conventional X-rays
- Stress X-rays
- CT-scan & MRI:  
only in selected cases



# ANKLE SPRAINS

## Treatments

### I. Non-operative treatment

- cast fixation
- special braces
- BIG 3:  
protection, strength exercise,  
proprioceptive training



### II. Operative treatment

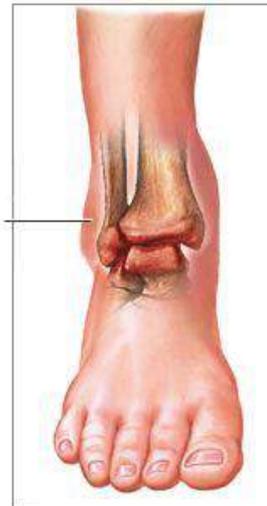
- primary reconstruction (suturing): professional athletes
- secondary surgery: chronic instability: Evans-method

# ANKLE FRACTURES

- I. History - *mechanism of injury!*
- II. Physical examination
- III. Radiological evaluation
- IV. Fracture classification
- V. Therapeutic plan



Swelling and  
discoloration



# ANKLE FRACTURES

I. **Physical examination:** signs of fracture

II. **Radiological Evaluation:** standard X-rays, additional views;  
CT-scan or MRI: only in selected cases



AP



LATERAL



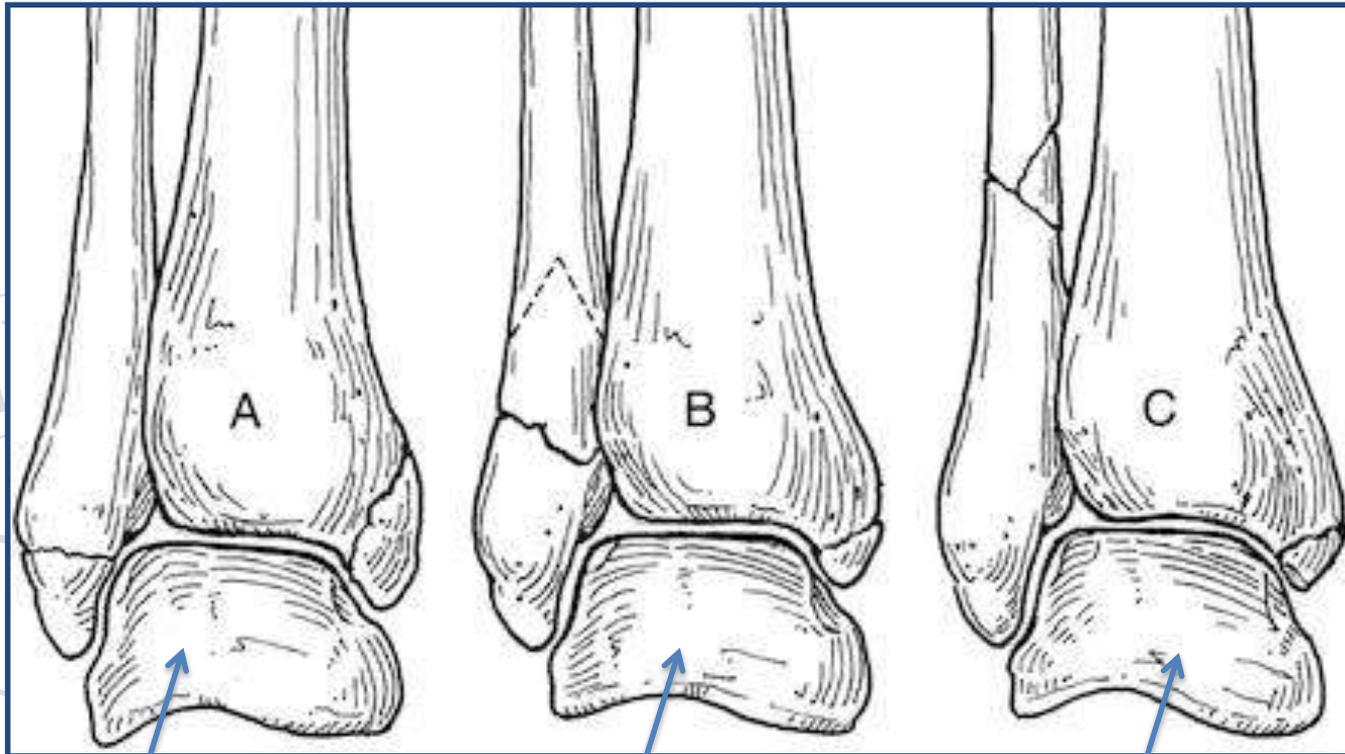
MORTISE-VIEW

# ANKLE FRACTURES - Classifications

I. AO / ASIF

II. Lauge-Hansen

III. Weber – classification:



below the syndesmosis  
mechanism: pronation

level of syndesmosis  
mechanism: supination

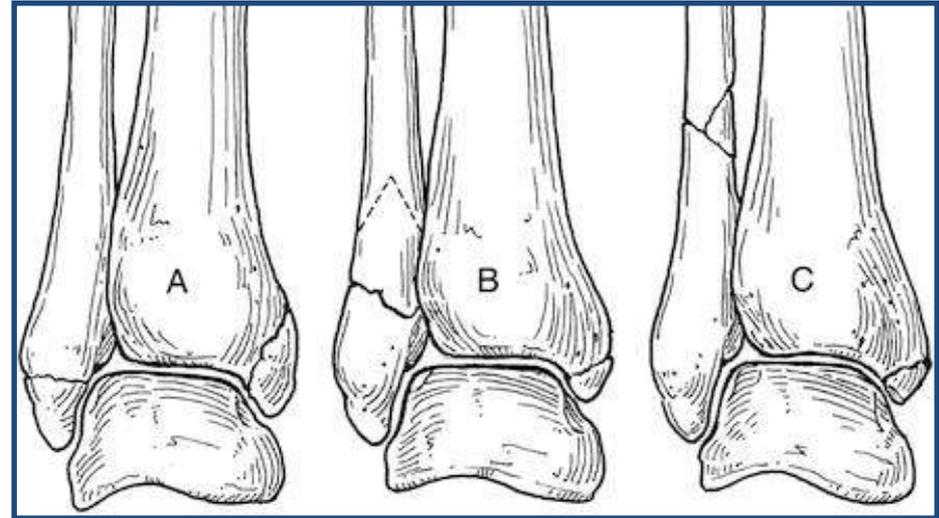
above the syndesmosis  
mechanism: supination

# ANKLE FRACTURES

## Weber – Classification

*Always look for other bone injuries – not only the fibula may be affected..*

- fracture of the medial malleolus
- fracture of the Volkmann-triangle (posterior edge of the tibia)



- **Monomalleolar**
- **Bimalleolar**
- Bimalleolar plus Volkmann-triangle = **Trimalleolar**

# ANKLE FRACTURES

---

**Weber: Type A**



**Weber: Type B**



**Weber: Type C**



# ANKLE FRACTURES

---

## Treatment

**Conservative treatment:** cast fixation – 6-8 (12) weeks

**Operative treatment:**

- buttress-plate
- 1/3 tubular plate-fixation
- malleolar screw fixation
- cancellous bone screw (Volkman-triangle)
- syndesmolythesis: 'setting-screw' (= syndesmolytic stabilization)

**Maisonneuve-fracture:** medial malleolar fracture (or delta-ligament tear, rupture of the interosseal membrane, proximal fibula fracture): screw fixation sign: syndesmolythesis

# Classification?



# Treatment ?



# Ankle fracture



# Ankle fracture



# PILON FRACTURES

---

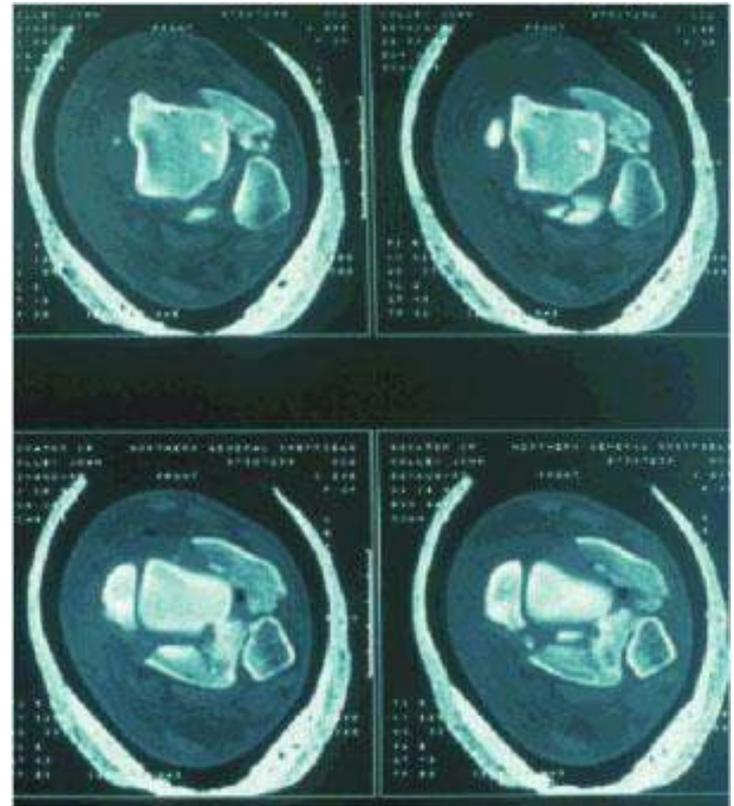
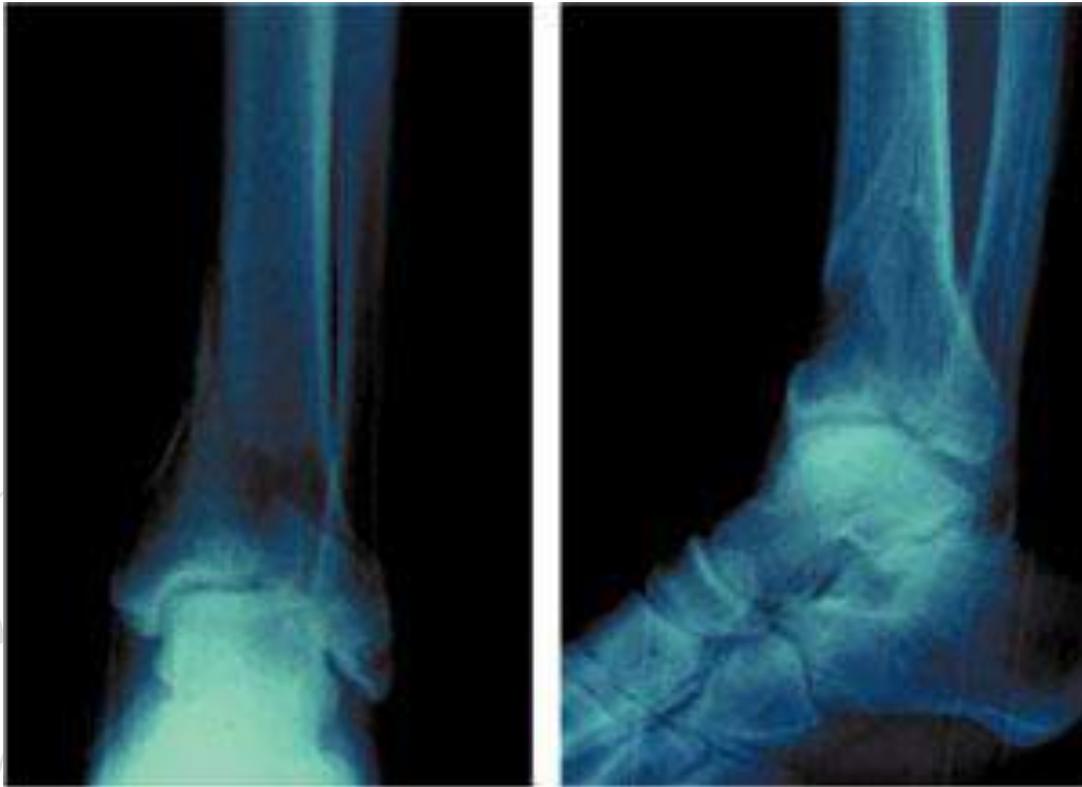
## History & Definition



*Pilon fractures in the distal tibia result from axial forces that can range from low to high energy and produce a spectrum of articular and metaphyseal injuries.*

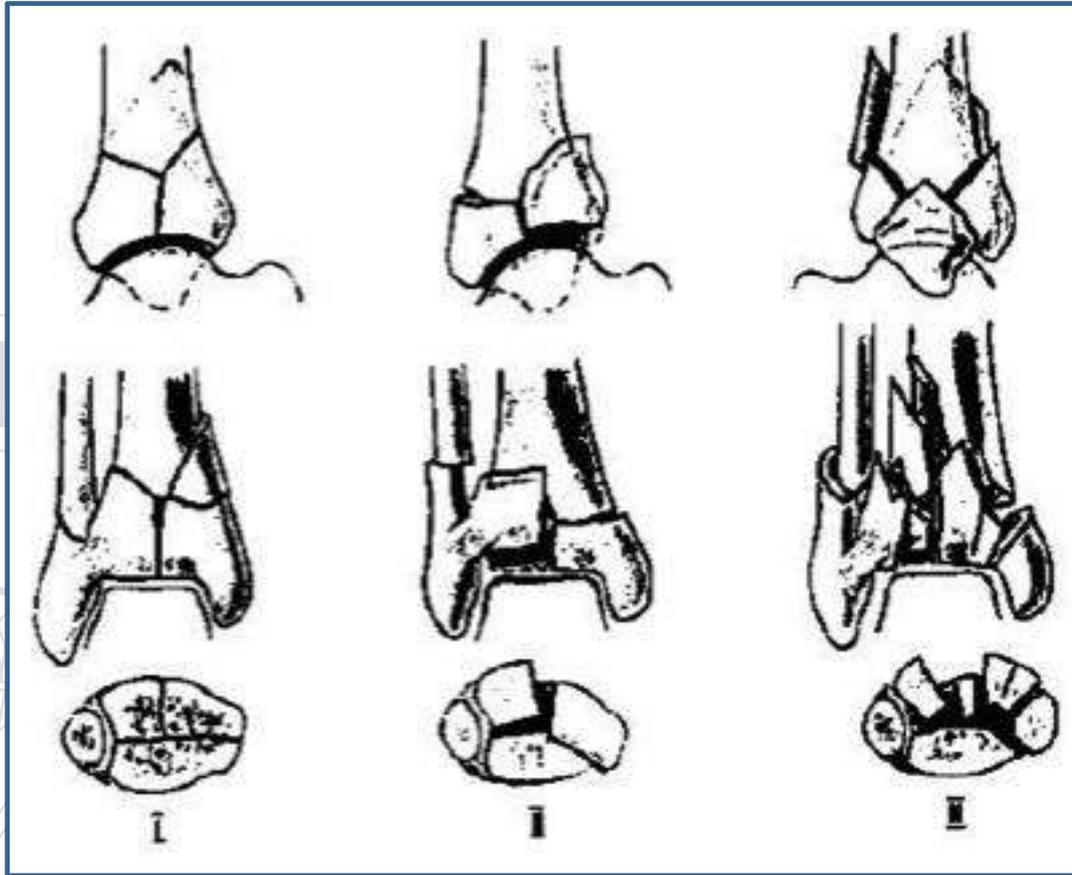
# PILON FRACTURES

## Conventional X-rays and CT-scan



# PYLON FRACTURES

## Rüedi & Allgöwer Classification



# PYLON FRACTURES

## Treatment

### Type I – II:

- non-operative
- ORIF



### Type III:

- two-phase reconstruction:

1. External Fixation: length

2. ORIF: joint surface



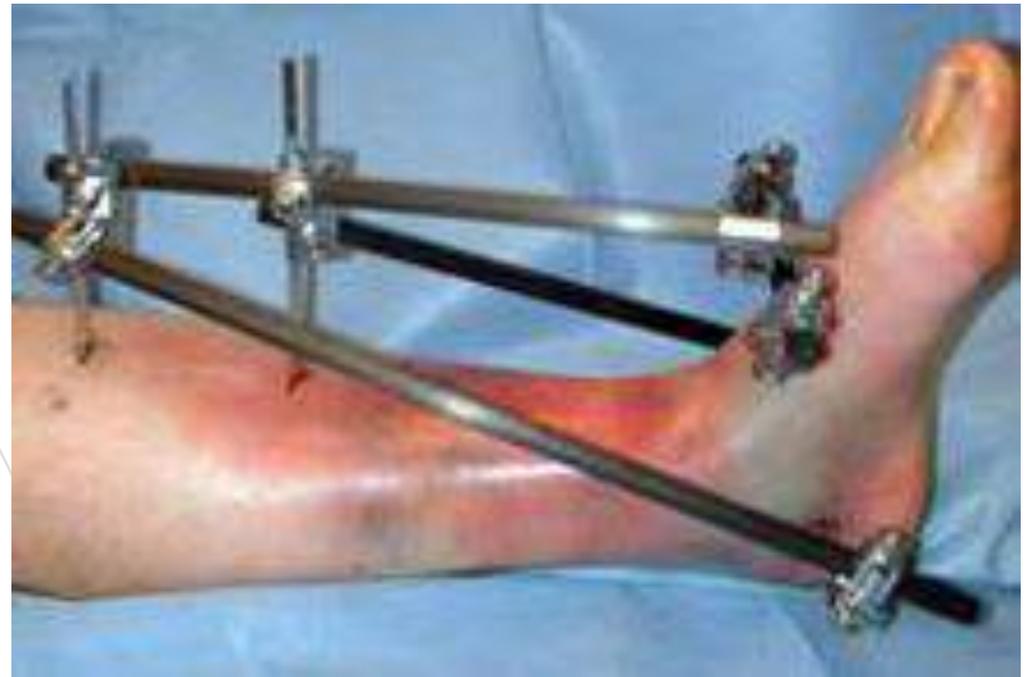
# Pylon fracture

## *Tibia distal end intra-articular fracture*



# Pylon fracture

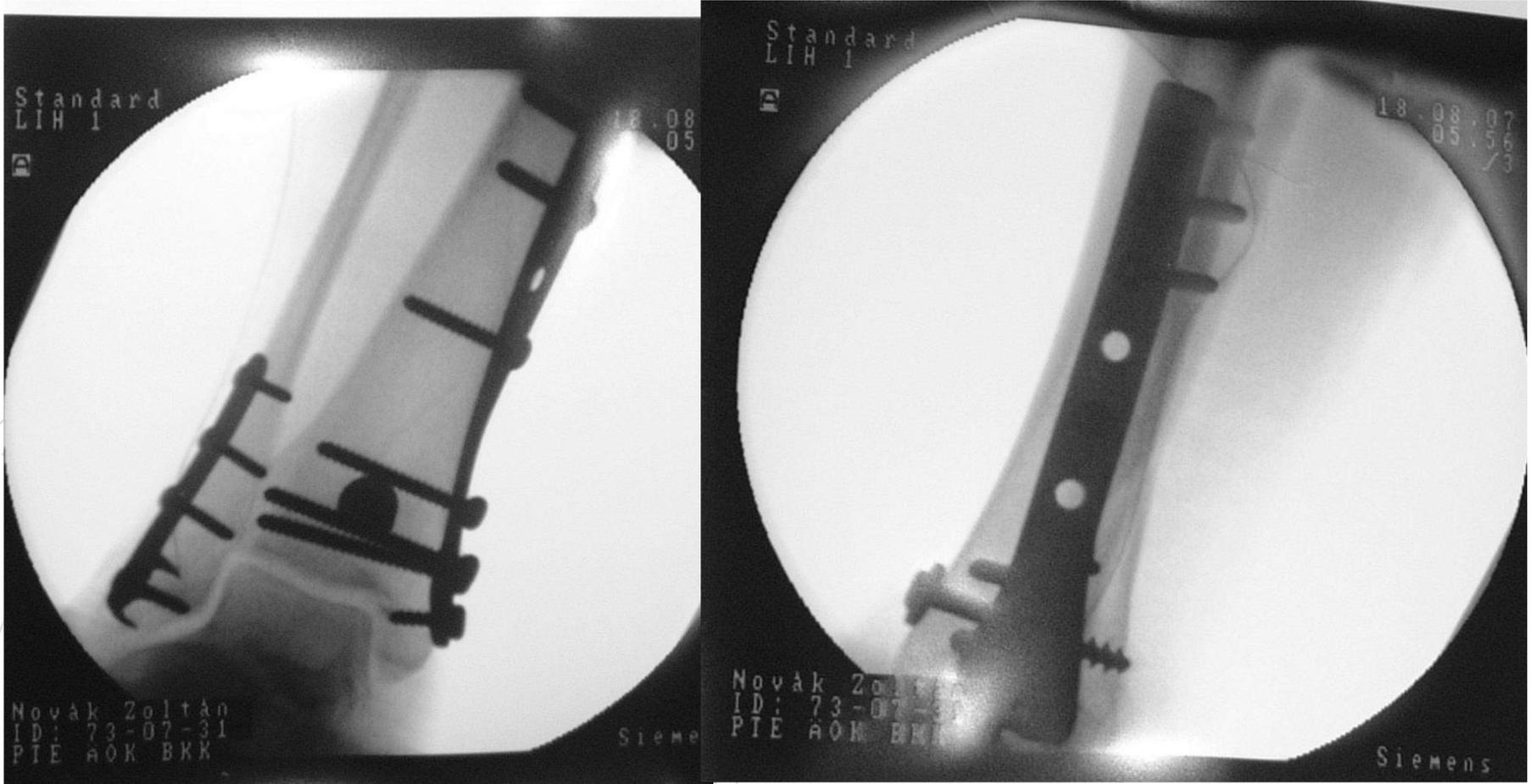
## *Tibia distal end intra-articular fracture*



***Reconstruction of the articular surface***

# Pylon fracture

## *Tibia distal end intra-articular fracture*



## *Reconstruction of the articular surface*

# Pylon fracture

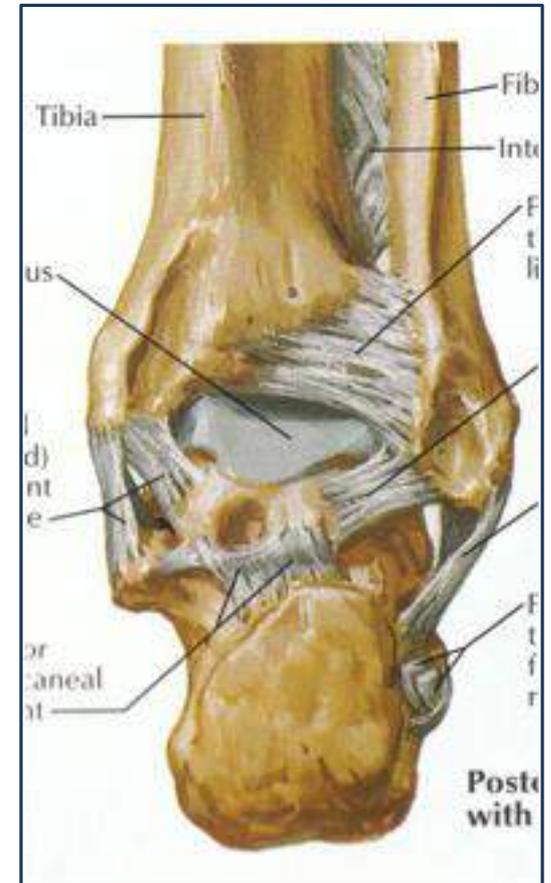
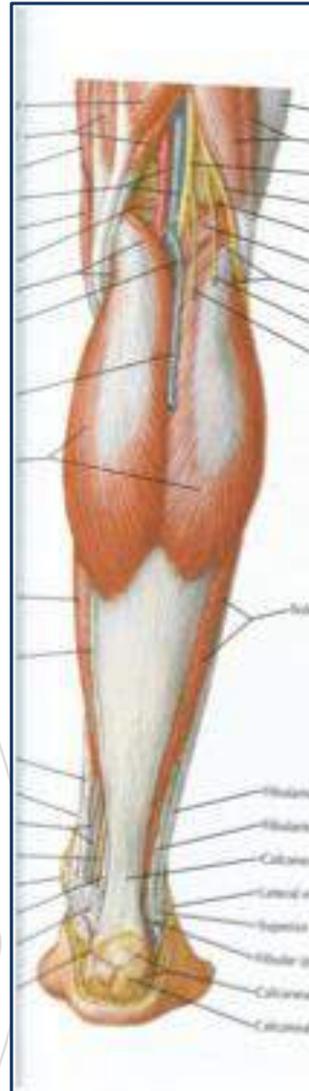
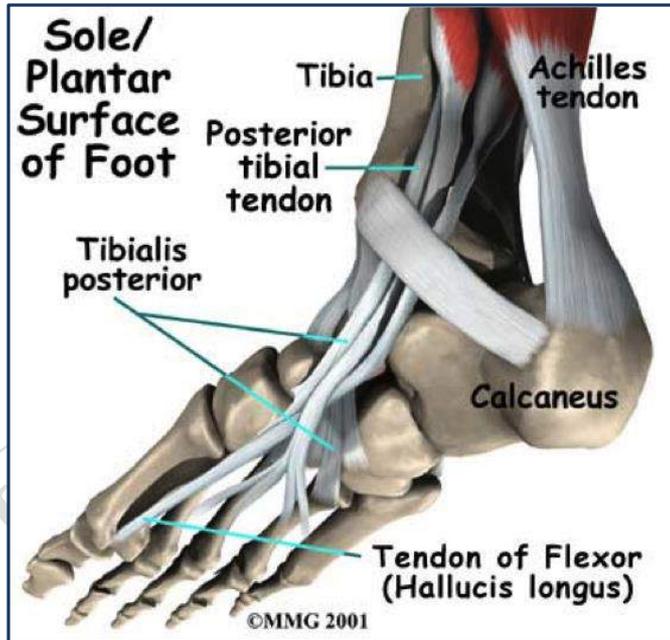
## *Tibia distal end intra-articular fracture*



***Reconstruction of the articular surface***

# ACHILLES TENDON RUPTURE

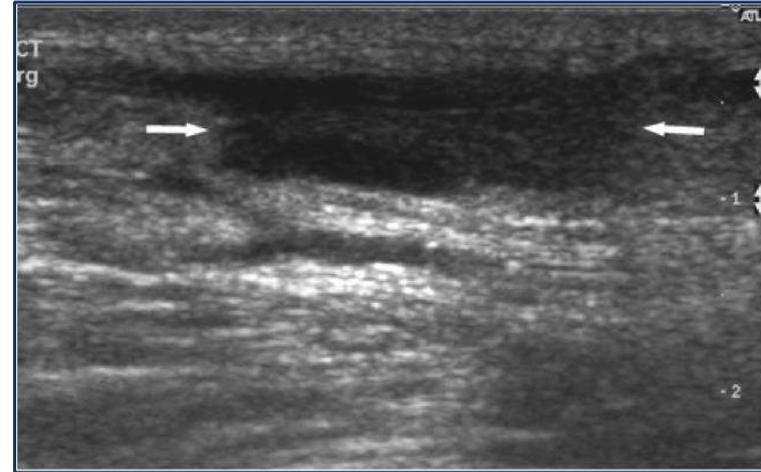
## Anatomy



# ACHILLES TENDON RUPTURE

## Diagnosis – Special Tests

- Thompson Test positive
- May have gap in tendon
- Ultrasound sensitive for tear



# ACHILLES TENDON RUPTURE

## Treatment

*Literature: treatment is controversial*

### Casting:

- better for old, less active
- Up to 40% re-rupture
- Lower cost and wound complications

### Surgical:

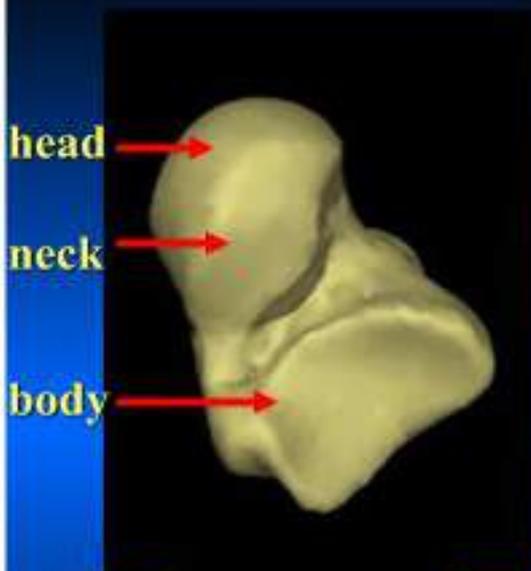
- better for young, active
- Lower rate of re-rupture
- Higher wound complications



# TALUS FRACTURES

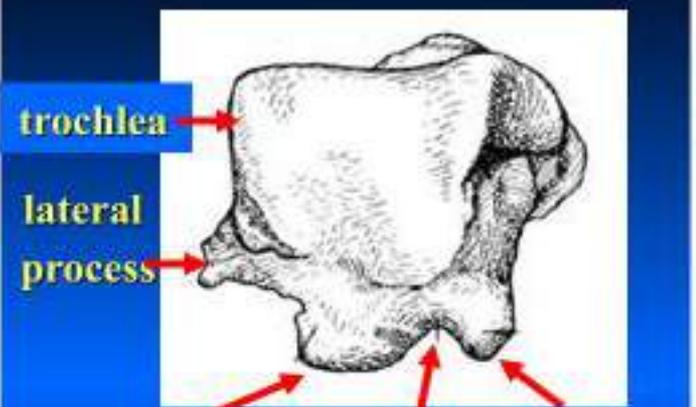
## Anatomy

### Inferior view

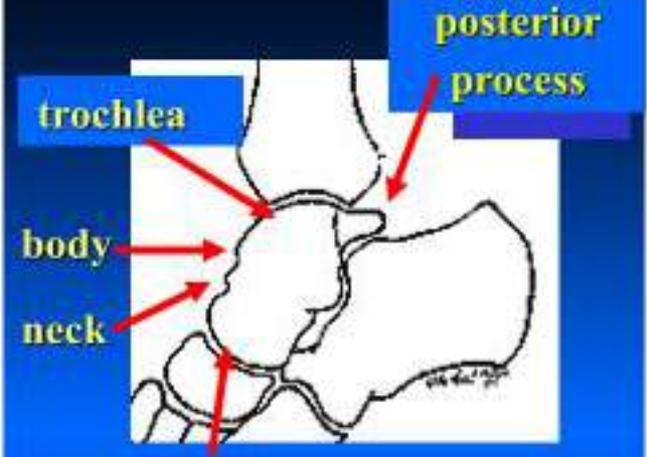


**Covered by cartilage**

### Posterior view



### Lateral view



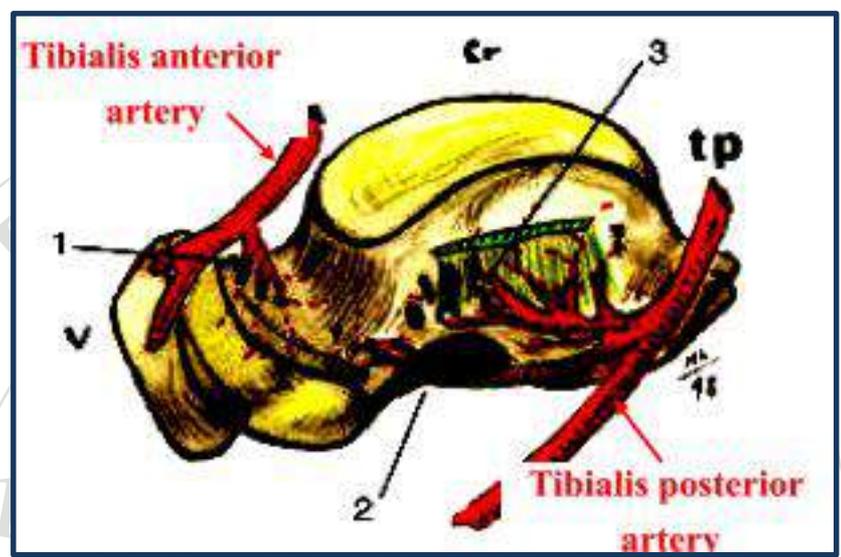
# TALUS FRACTURES

## Blood Supply

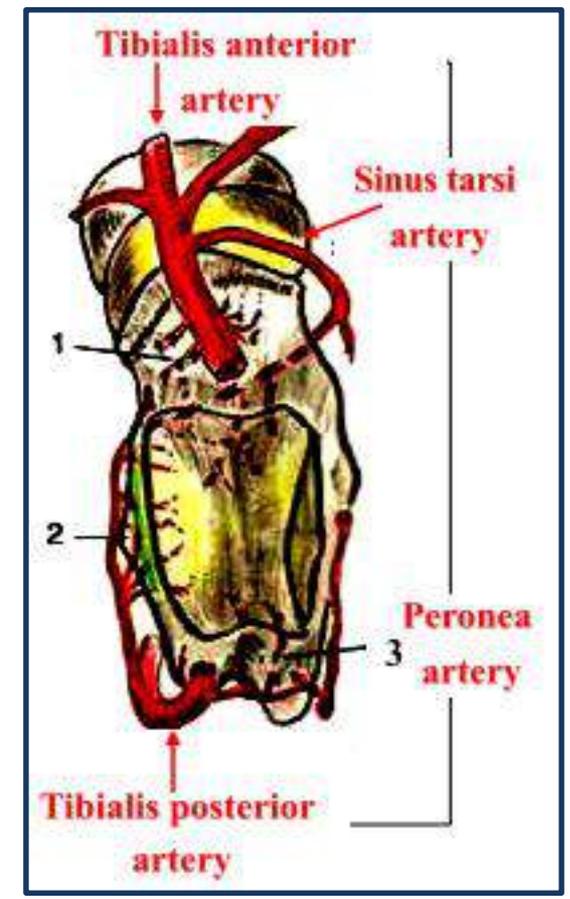
Neck fracture



Avascular necrosis of the talus body



- 1. neck
- 2. roof of sinus tarsi
- 3. deltoid ligament



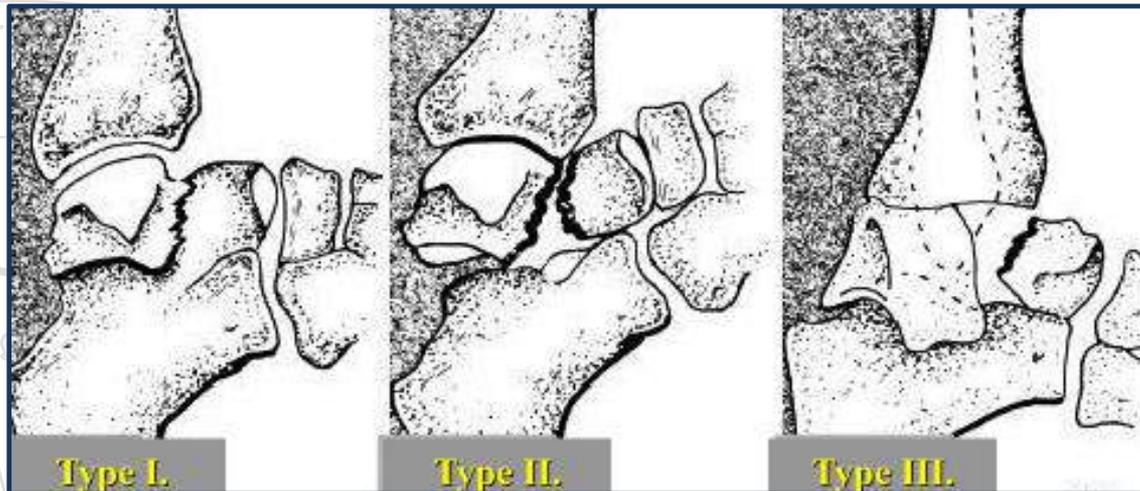
- 1. neck
- 2. deltoid ligament
- 3. posterior process

# TALUS FRACTURES

## Fracture Pattern

1. Talar neck fractures
2. Talar body fractures
3. Fractures of posterior, medial or lateral process of talus
4. Transchondral fractures of talus / Flake-fractures /

## Hawkin's Classification



Type I.: nondisplaced vertical fractures of the neck

Type II.: displaced fractures + subluxation or dislocation of the subtalar joint

Type III.: fractures with dislocation of both the subtalar and ankle joints

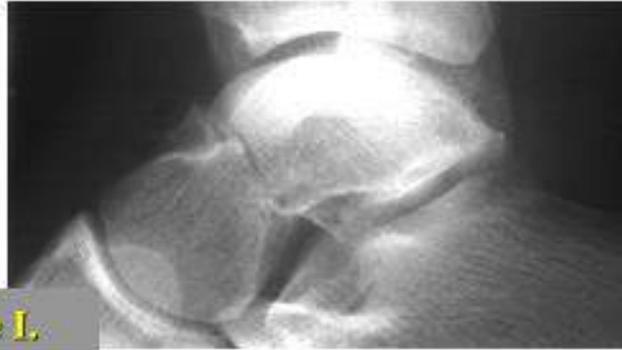
# TALUS FRACTURES

## Prognosis

**Outcome**

**GOOD**

Type I.

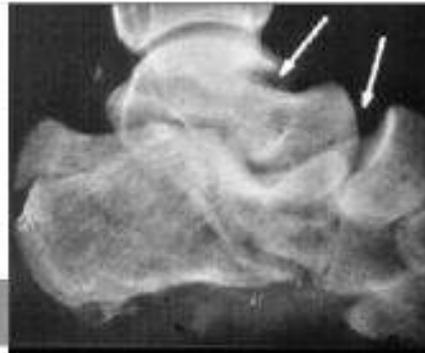


**AVN**

**10 %**

**FAIR**

Type II.



**30 %**

**POOR**

Type III.



**90 %**

# TALUS FRACTURES

---

## Treatment

- surgery in the first 6 hours - to prevent AVN
- accurate reduction is essential
- non-displaced fracture - surgical treatment
  - screw fixation is preferred
  - plaster fixation for 6 - 12 weeks
- non-weight bearing mobilization for at least 6 weeks duration - depending on Hawkins's sign

# TALUS FRACTURES

## Treatment



# HINDFOOT FRACTURES: CALCANEUS

---

## Anatomy & Diagnosis

1. Physical examination: *plantar hematoma*
2. Conventional X-rays: lateral + Broden-views
3. CT or MRI-scan: in selected cases



# HINDFOOT FRACTURES: CALCANEUS

## Anatomy & Diagnosis

1. Physical examination: *plantar hematoma*
2. Conventional X-rays: lateral + Broden-views
3. CT or MRI-scan: in selected cases

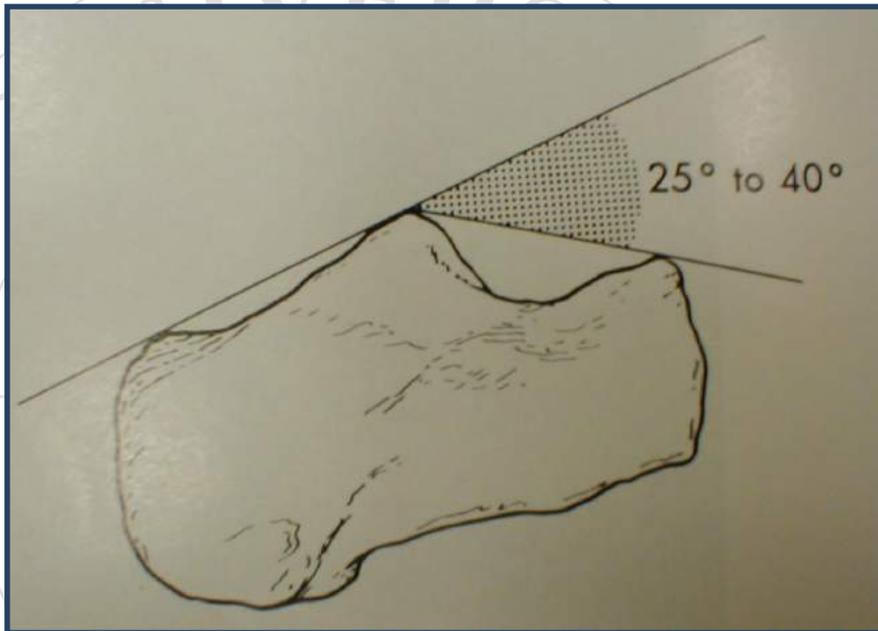


# HINDFOOT FRACTURES: CALCANEUS

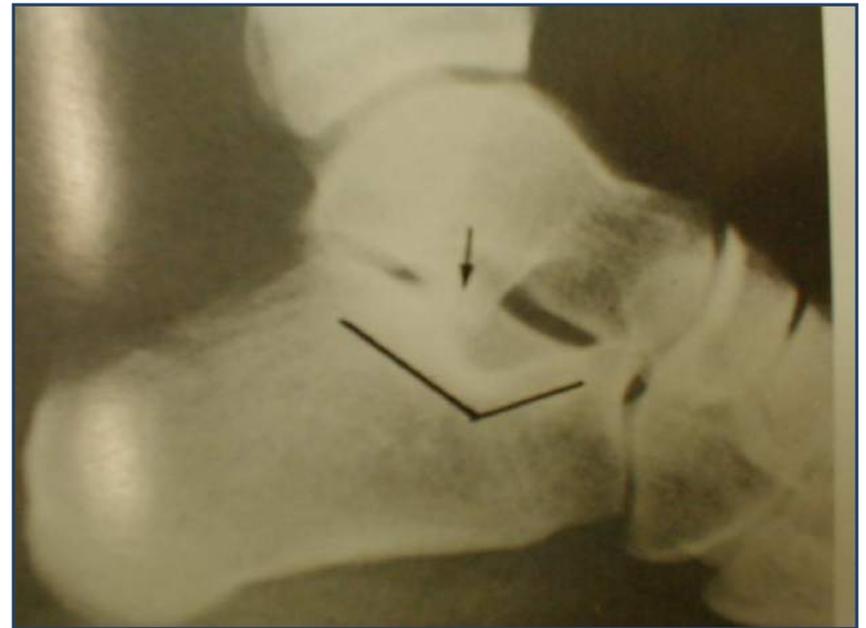
## Anatomy & Diagnosis

1. Physical examination: *plantar hematoma*
2. Conventional X-rays: lateral + Broden-views
3. CT or MRI-scan: in selected cases

**Böhler's angle**



**Gissane's angle**

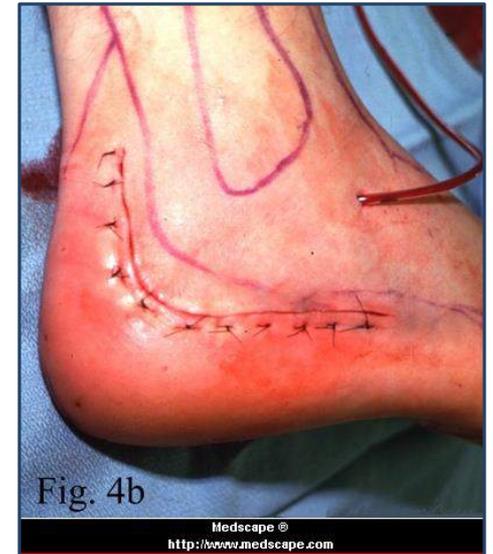
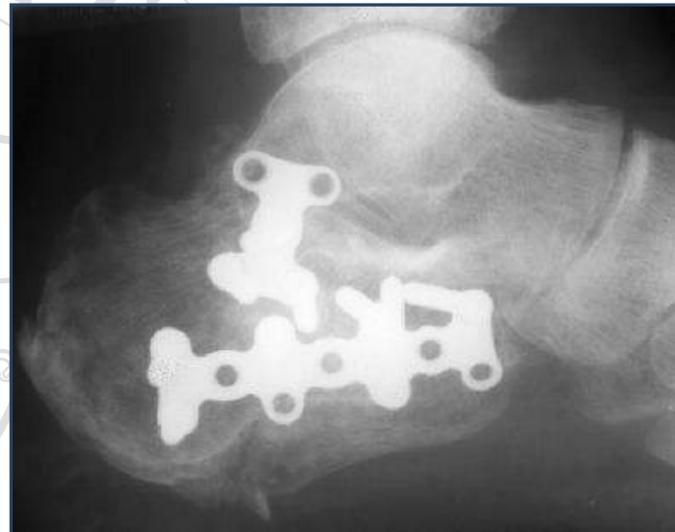
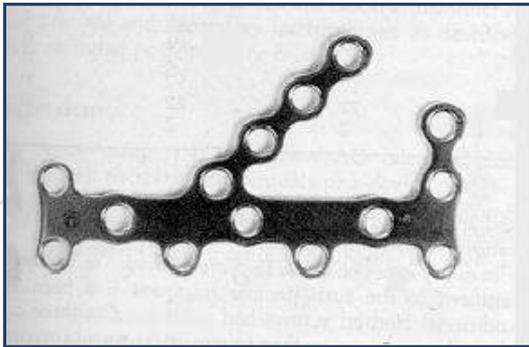




# HINDFOOT FRACTURES: CALCANUS

## Treatment

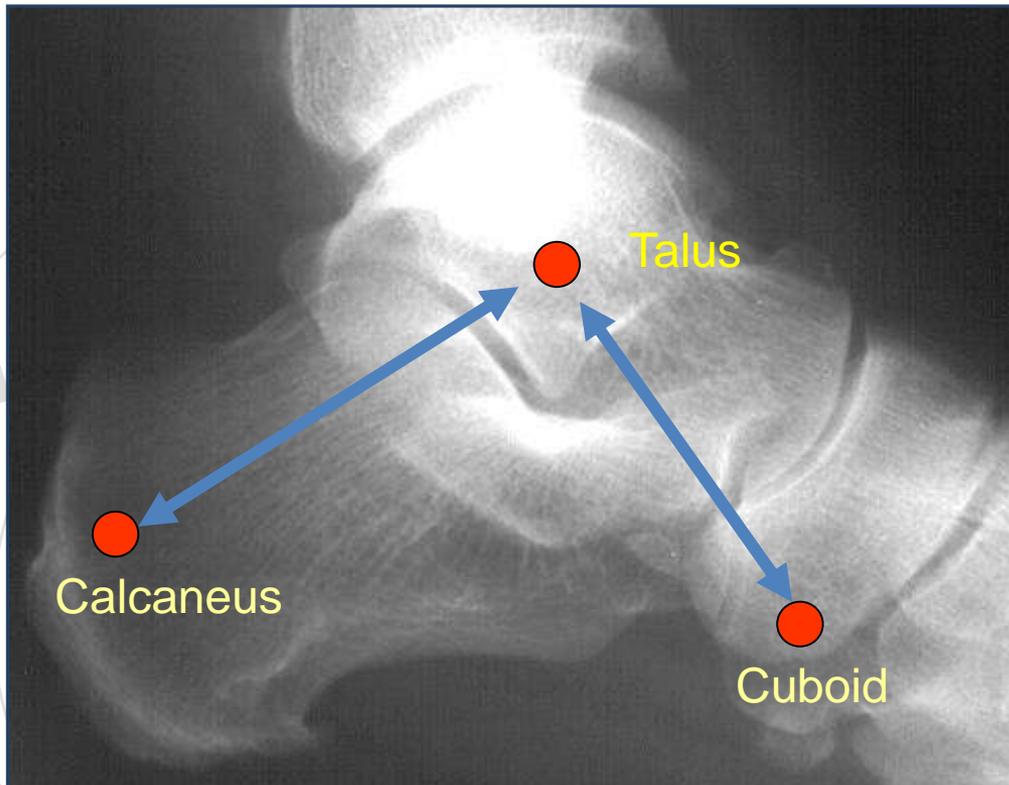
1. Non-operative management
2. ORIF: open reduction + plate fixation
3. 'Zdravetz'-type distraction (ligamentotaxis) + screw fixation



# HINDFOOT FRACTURES: CALCANEUS

## Treatment

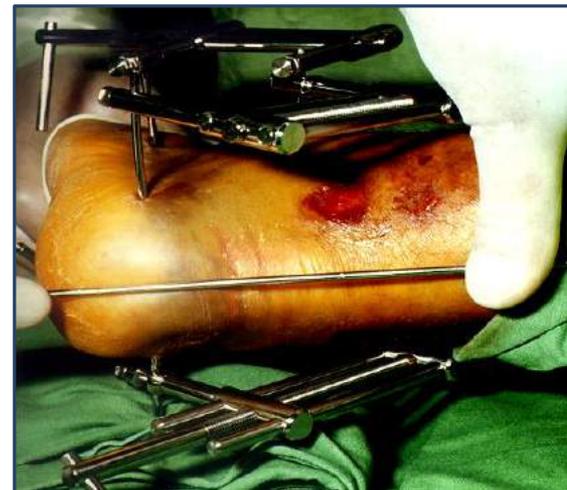
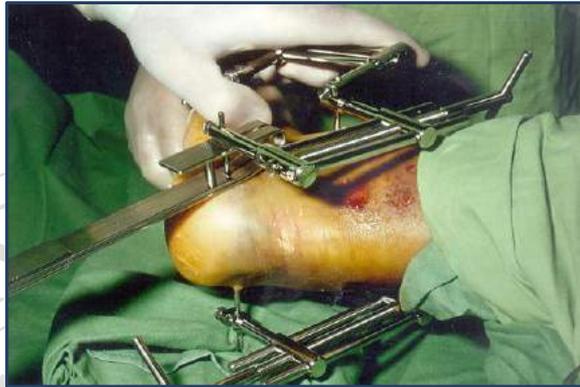
1. Non-operative management
2. ORIF: open reduction + plate fixation
3. 'Zdravec'z'-type distraction (ligamentotaxis) + screw fixation



# HINDFOOT FRACTURES: CALCANUS

## Treatment

1. Non-operative management
2. ORIF: open reduction + plate fixation
3. 'Zdravetz'-type distraction (ligamentotaxis) + screw fixation

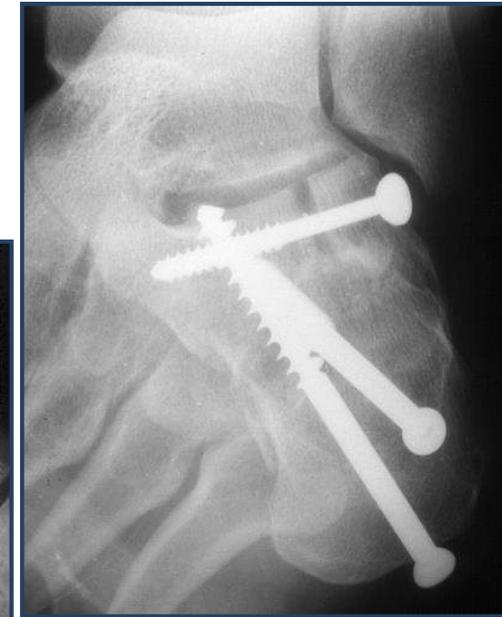
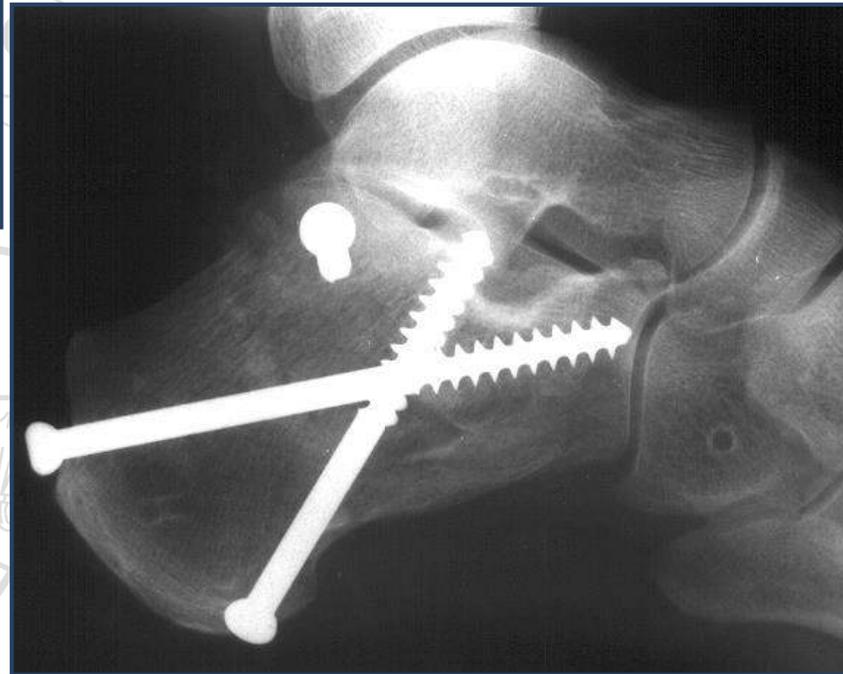


# HINDFOOT FRACTURES: CALCANEUS

---

## Treatment

1. Non-operative management
2. ORIF: open reduction + plate fixation
3. 'Zdravetz'-type distraction (ligamentotaxis) + screw fixation



# 5<sup>th</sup> METATARSAL FRACTURES

---

## Types

**1. Avulsion** of base

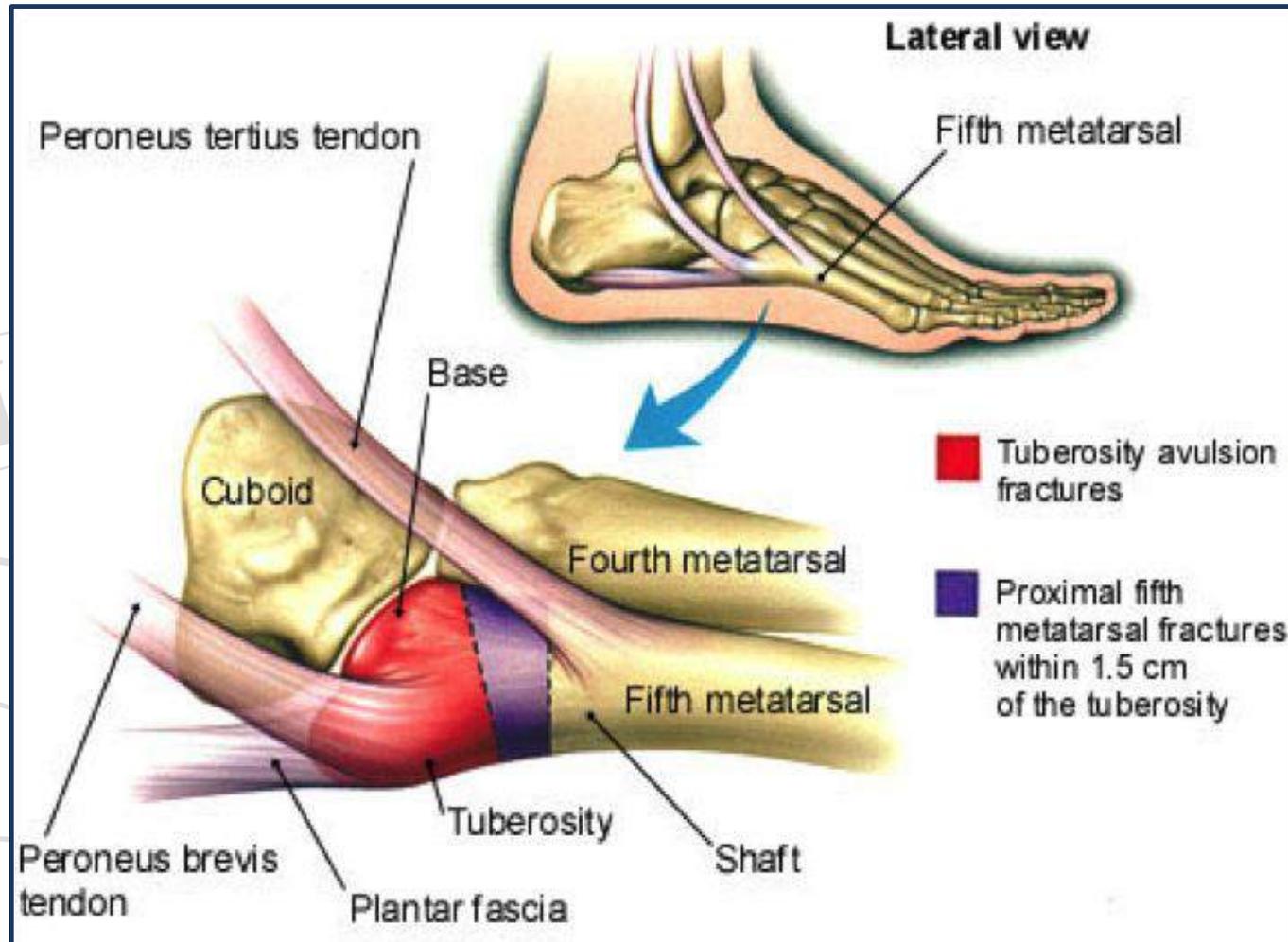
**2. Jones Fracture:**

- Metaphyseal-Diaphyseal junction w/in 1.5 cm of tuberosity

**3. Midshaft Fracture** (stress fractures are different!)

# 5<sup>th</sup> METATARSAL FRACTURES

## Anatomy



# 5<sup>th</sup> METATARSAL FRACTURES

## Anatomy - X-ray

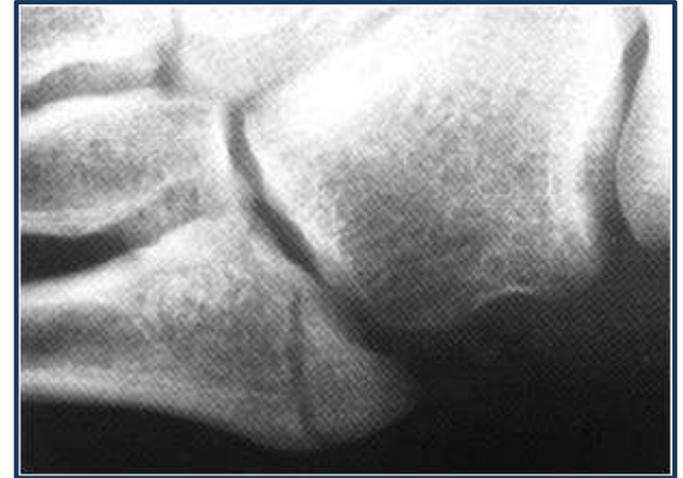


# 5<sup>th</sup> METATARSAL FRACTURES

---

## 5<sup>th</sup> MT Base Avulsions

- Treat similar to ankle sprains
- Bulky dressing
- X-rays in 2-4 weeks to assure healing
- RTP 4-6 weeks



**EXCEPTION:** intra-articular fractures

# 5<sup>th</sup> METATARSAL FRACTURES

---

## 5<sup>th</sup> MT Metaphysis/Diaphysis Jxn

- **Screw fixation OR NWB short-leg cast** for 6 weeks
- Trend for faster healing with screw  
/8 wks vs 12 wks/
- Lower rate of Nonunion  
/20% vs 7%/



# 5<sup>th</sup> METATARSAL FRACTURES

---

## 5<sup>th</sup> MT Shaft Fracture

- **Cast fixation** or hard-sole shoe,
- **Surgical treatment** is rarely needed
- bulky dressings as needed
- RTP in about 6 weeks

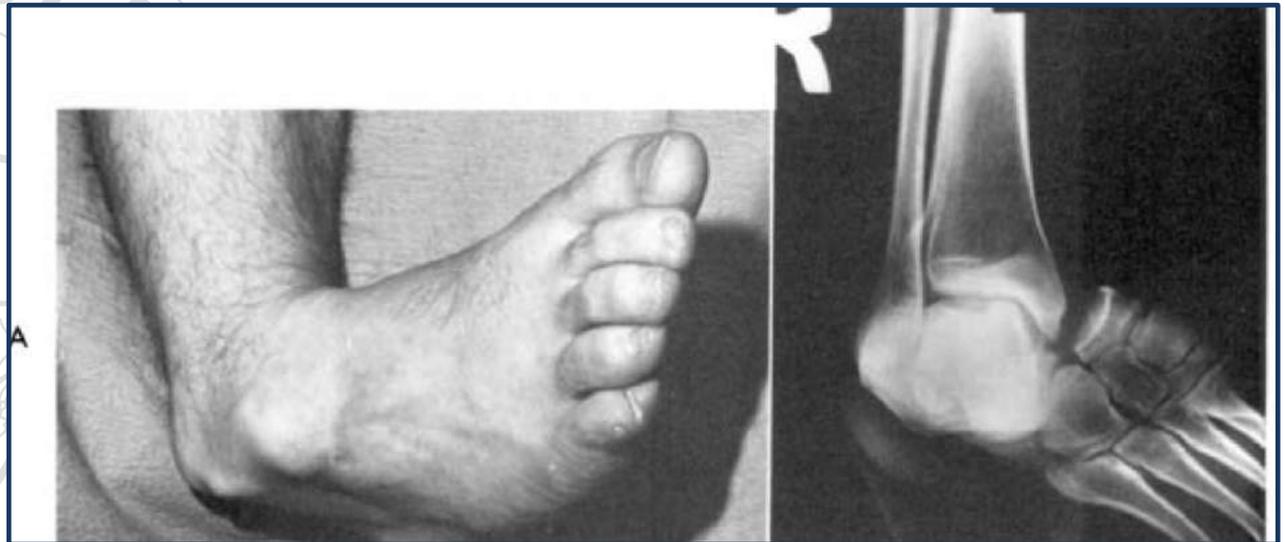


# SUBTALAR DISLOCATION

---

## Description & Classification

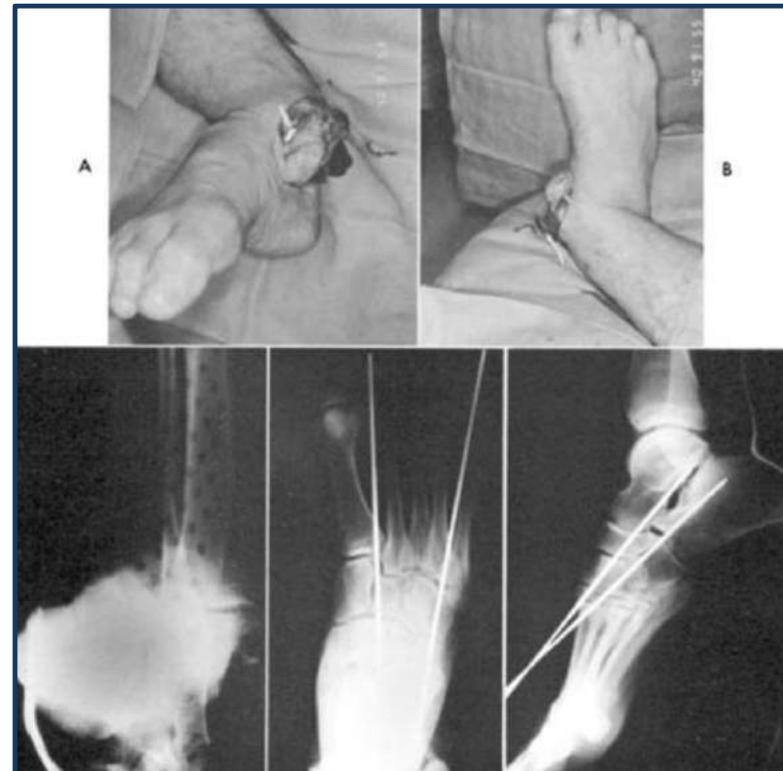
- The calcaneus, cuboid, navicular, and all of the forefoot become displaced from the talus
- Medial, lateral, anterior, and posterior dislocations may occur
- Most often the foot is dislocated medial to the talus



# SUBTALAR DISLOCATION

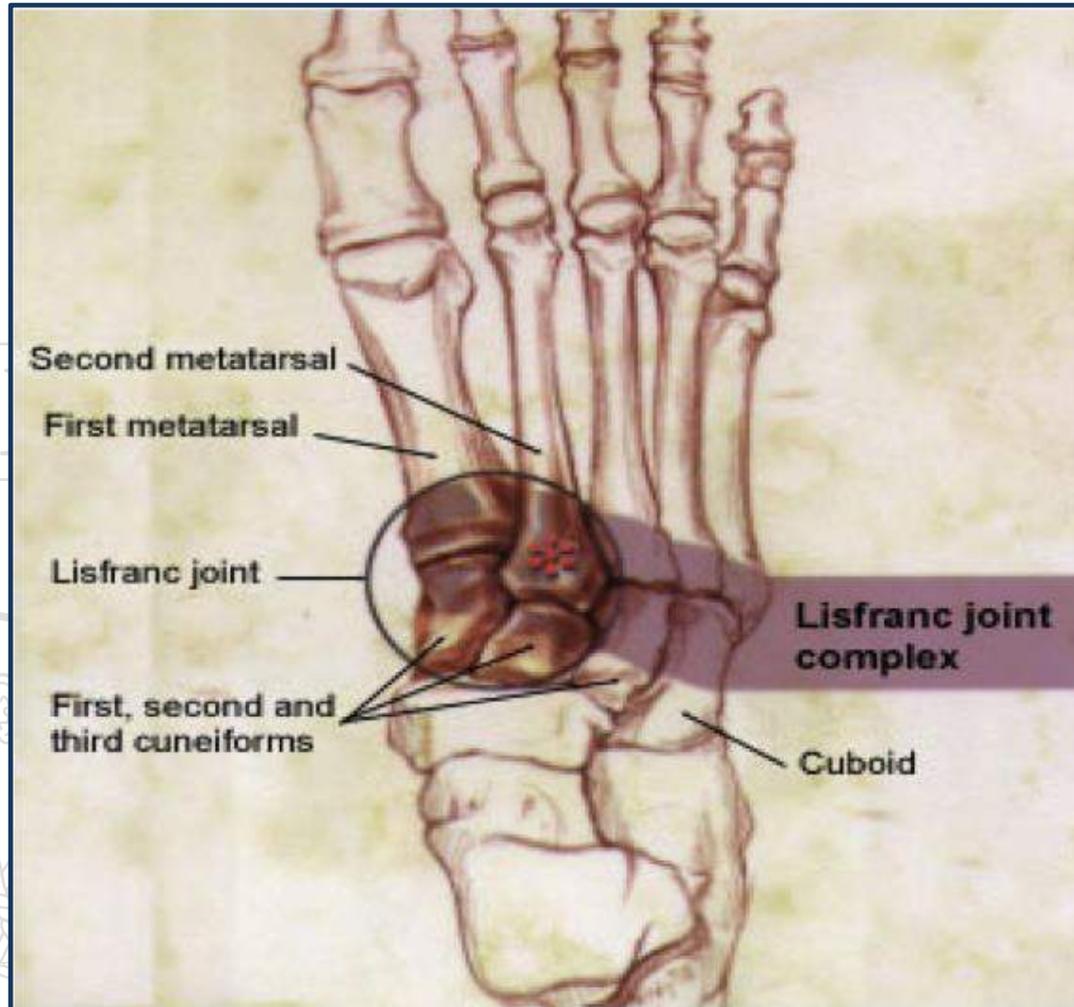
## Treatment

- closed reduction or open reduction:
  - if the fragment in the subtalar joint prevents reduction
  - if an osteochondral fracture develops in subtalar joint
- cast immobilization - for 6 weeks
- longitudinally placed Steinmann pins across the calcaneocuboid and talonavicular joints for 4 weeks may be needed



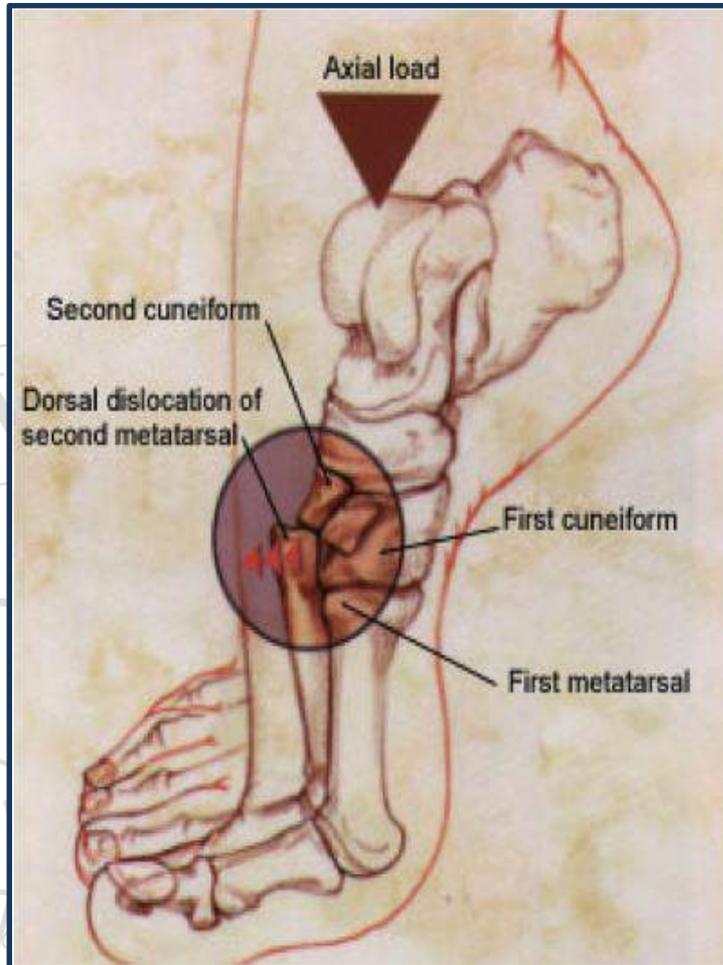
# LISFRANC INJURY

## Anatomy



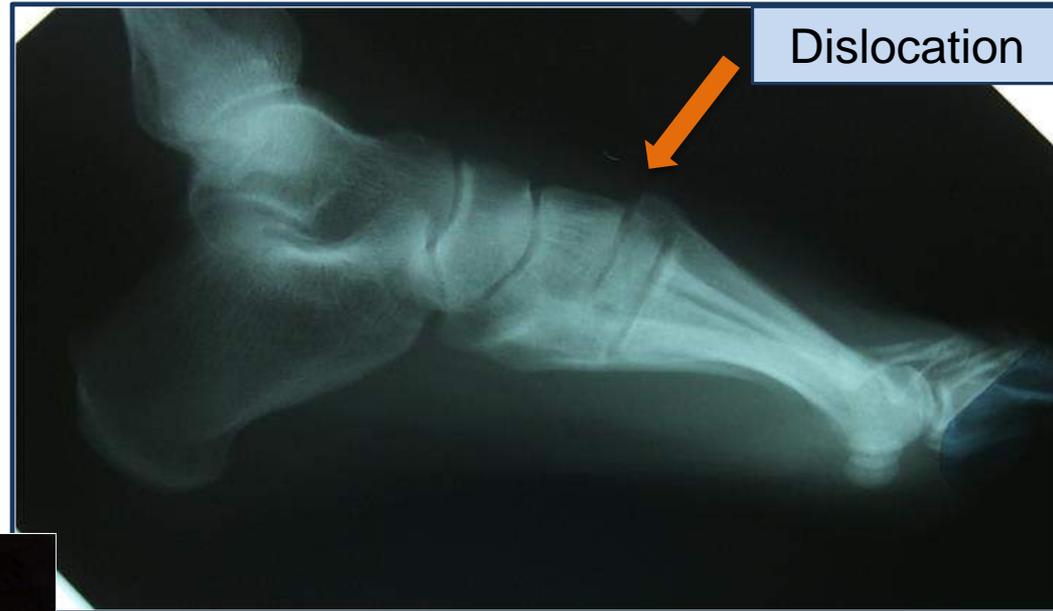
# LISFRANC INJURY

## Dislocation



# LISFRANC INJURY

## Dislocation



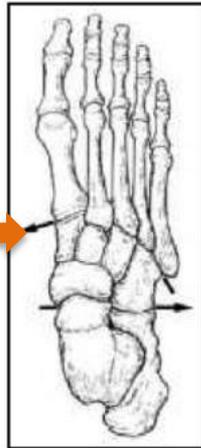
*Importance of weight-bearing x-rays*

# LISFRANC INJURY

## Treatment

- closed reduction + cast immobilization for 6 weeks  
/ closed, nondisplaced (less than 2 mm) injuries /
- open reduction + screw or K-wire fixation  
/ displaced fractures /

Tarsometatarsal  
articulation





# POST-TRAUMATIC COMPLICATIONS



Presenter:  
Dr Laszlo G Nöt



# POSTRAUMATIC COMPLICATIONS

---

## **Perioperative:**

Malreduction

Inadequate fixation

Intra-articular hardware penetration

## **Early Postoperative:**

Wound edge dehiscence/necrosis

Infection

Compartment syndrome

## **Late:**

Stiffness

Distal tibiofibular synostosis

Malunion

Nonunion

Post-traumatic arthritis

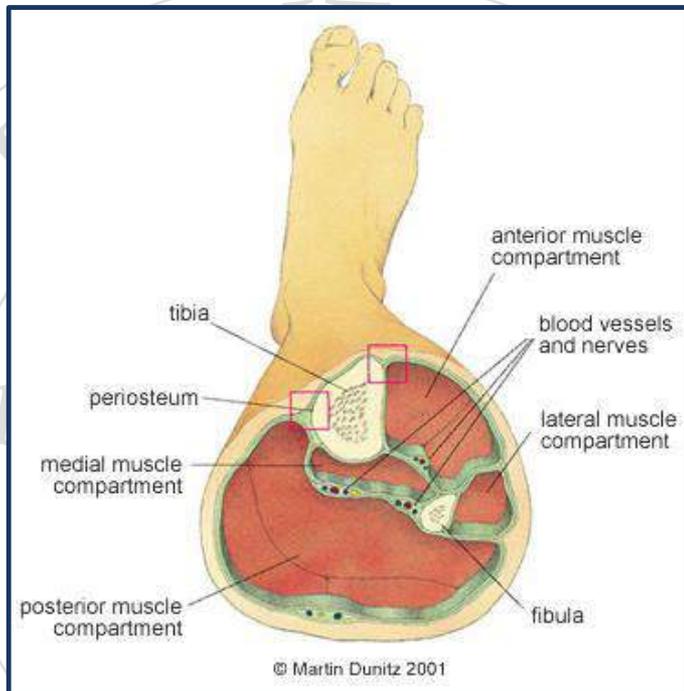
Hardware related complications

Complex regional pain syndrome type 1

# POSTTRAUMATIC COMPLICATIONS

## Compartment Syndrome

- Increasing the pressure in the compartments of the lower and the upper limbs or in the muscles of the abdomen
- The pressure will be higher than 30 Hgmm in a closed anatomical structure, like one of the crural compartments or in the all of them



# POSTRAUMATIC COMPLICATIONS

---

## Compartment Syndrome

### Reasons:

1. The fracture of long tube bones
2. Damage of the circulation (strangulation – cast fixation !!)
3. Big contusions

**Incidental frequency:**

- lower limb
- upper limb
- abdominal muscle

**Diagnosis:**

- pain
- pulse
- neurological deficit
- tissue pressure detection

# POSTTRAUMATIC COMPLICATIONS

---

## Compartment Syndrome

- In the cases of abdominal compartment syndrome the pressure limit is 15 watercm
- *The incision of the fascia is necessary within 6 hours !!*



# POSTTRAUMATIC COMPLICATIONS

---

## Compartment Syndrome

### Complications:

- 1. Nerve damages
- 2. Contractures
- 3. Infections
- 4. Loss of limb
- 5. Death  
*contracture*
- 6. Cosmetical problems



*Volkmann's ischemic*

# REFLEX SYMPATHETIC DYSTROPHY SYNDROME (RSD)

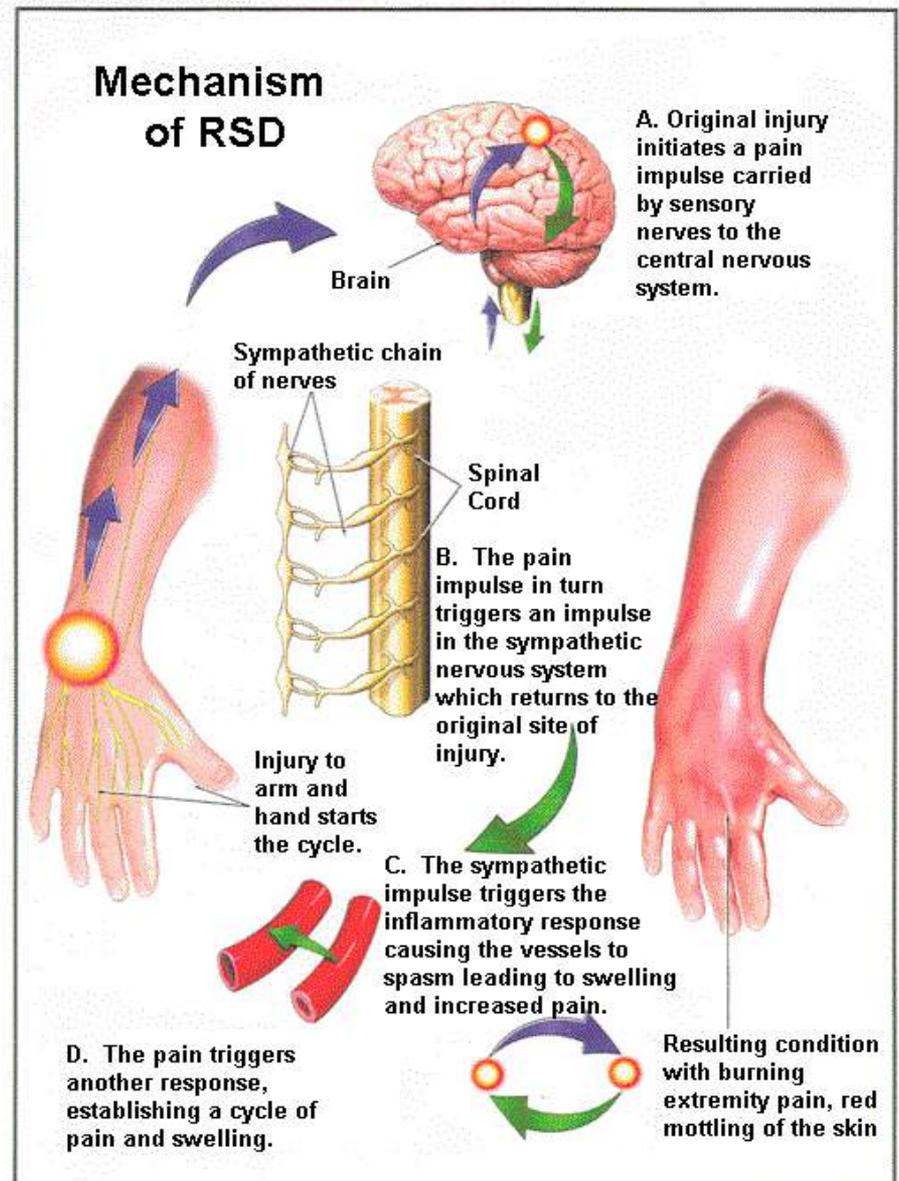
Peripheral nerve irritation

Patologhycal sympathetic response

Metaarteriolar spasm

Opening of the shunts

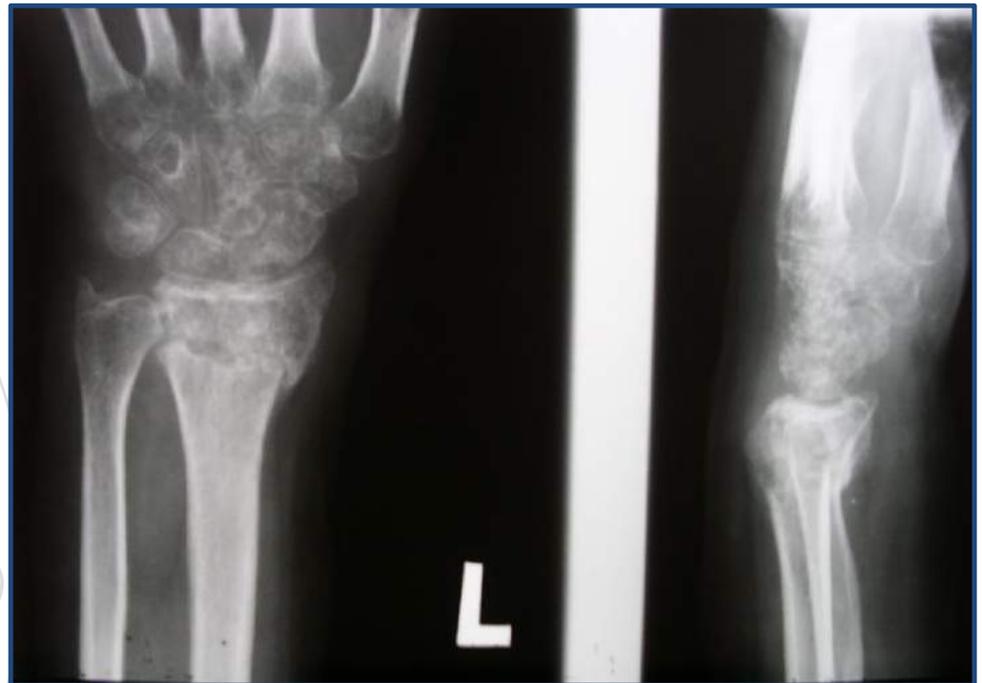
Capillary stasis



# REFLEX SYMPATHETIC DYSTROPHY SYNDROME (RSD)

## The three stages of RSD

1. Stage (0 - 3 months): pseudo-inflammation
2. Stage (4 - 6 months): dystrophy
3. Stage (> 6 – 12 months): atrophy



# REFLEX SYMPATHETIC DYSTROPHY SYNDROME (RSD)

## Possible Treatments...

Physical and occupational therapy  
Drugs  
Mirror box therapy  
Graded motor imagery  
Tactile discrimination training  
Local anaesthetic blocks/injections  
Intramuscular botox injections  
Spinal cord stimulators  
Sympathectomy  
Ketamine  
Bisphosphonate treatment  
Topical treatment  
Adjunctive treatment  
Amputation

**BETTER: PREVENTION**

# ANKLE AND FOOT INJURIES POST-TRAUMATIC COMPLICATIONS

---

## Useful Links:

- **Reflex Sympathetic**

**Dystrophy:** [http://www.wheelessonline.com/ortho/reflex\\_sympathetic\\_dystrophy\\_complex\\_regional\\_pain\\_syndrome](http://www.wheelessonline.com/ortho/reflex_sympathetic_dystrophy_complex_regional_pain_syndrome)

<http://orthoinfo.aaos.org/topic.cfm?topic=a00021>

- **Compartment Syndrome:**

[http://www.wheelessonline.com/ortho/compartment\\_syndrome](http://www.wheelessonline.com/ortho/compartment_syndrome)

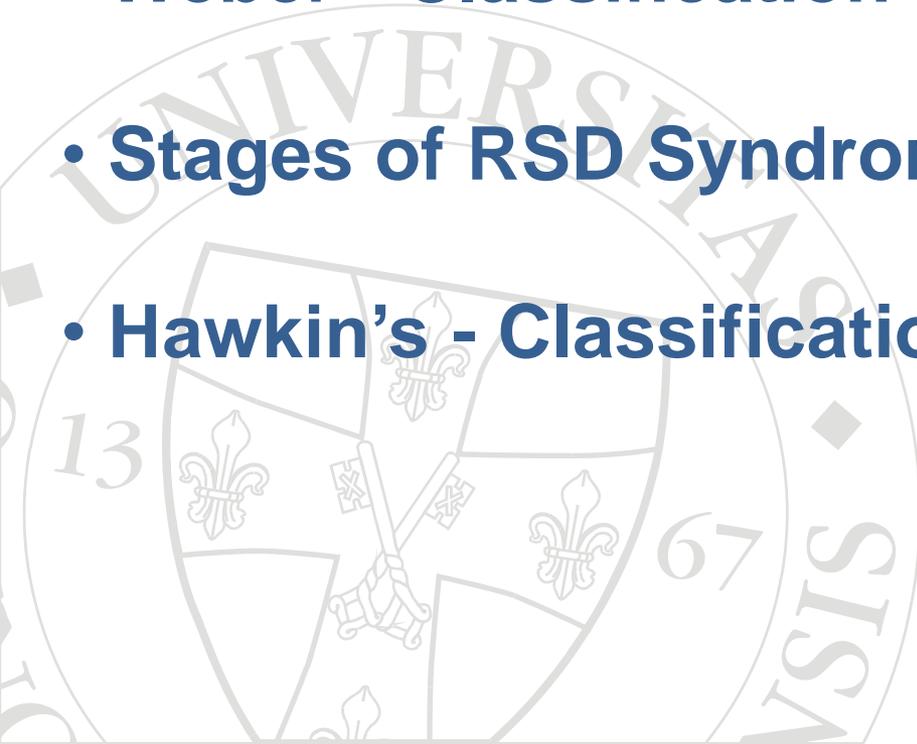
# ANKLE AND FOOT INJURIES POST-TRAUMATIC COMPLICATIONS

---

## CLASSIFICATIONS for the EXAM:

*Here are some hints to help...*

- **Weber - Classification**
- **Stages of RSD Syndrome**
- **Hawkin's - Classification**





**AO Foundation**

Transforming Surgery—Changing Lives



**THANKS FOR YOUR  
ATTENTION!**

