LOWER LIMB FRACTURES

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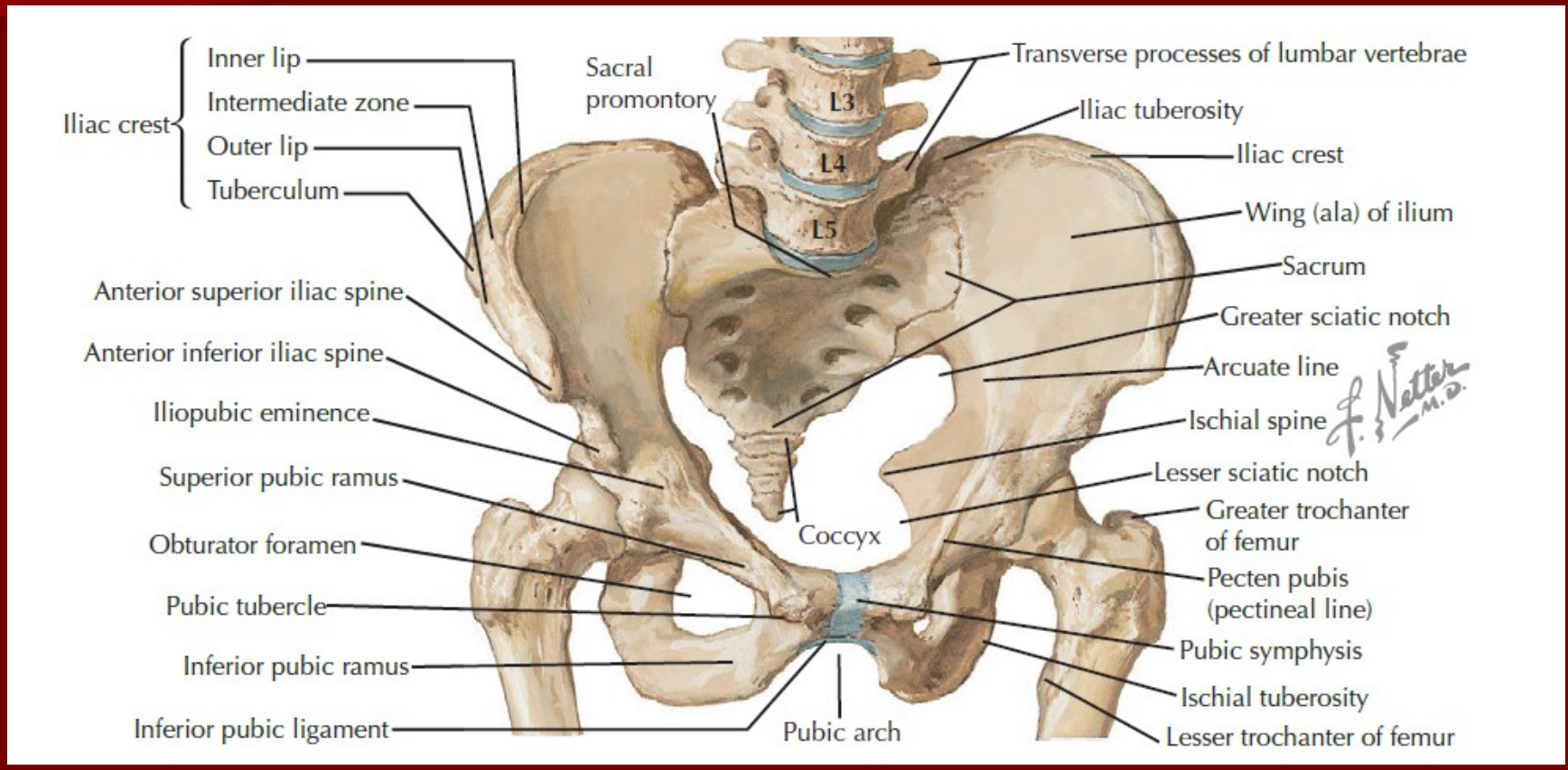
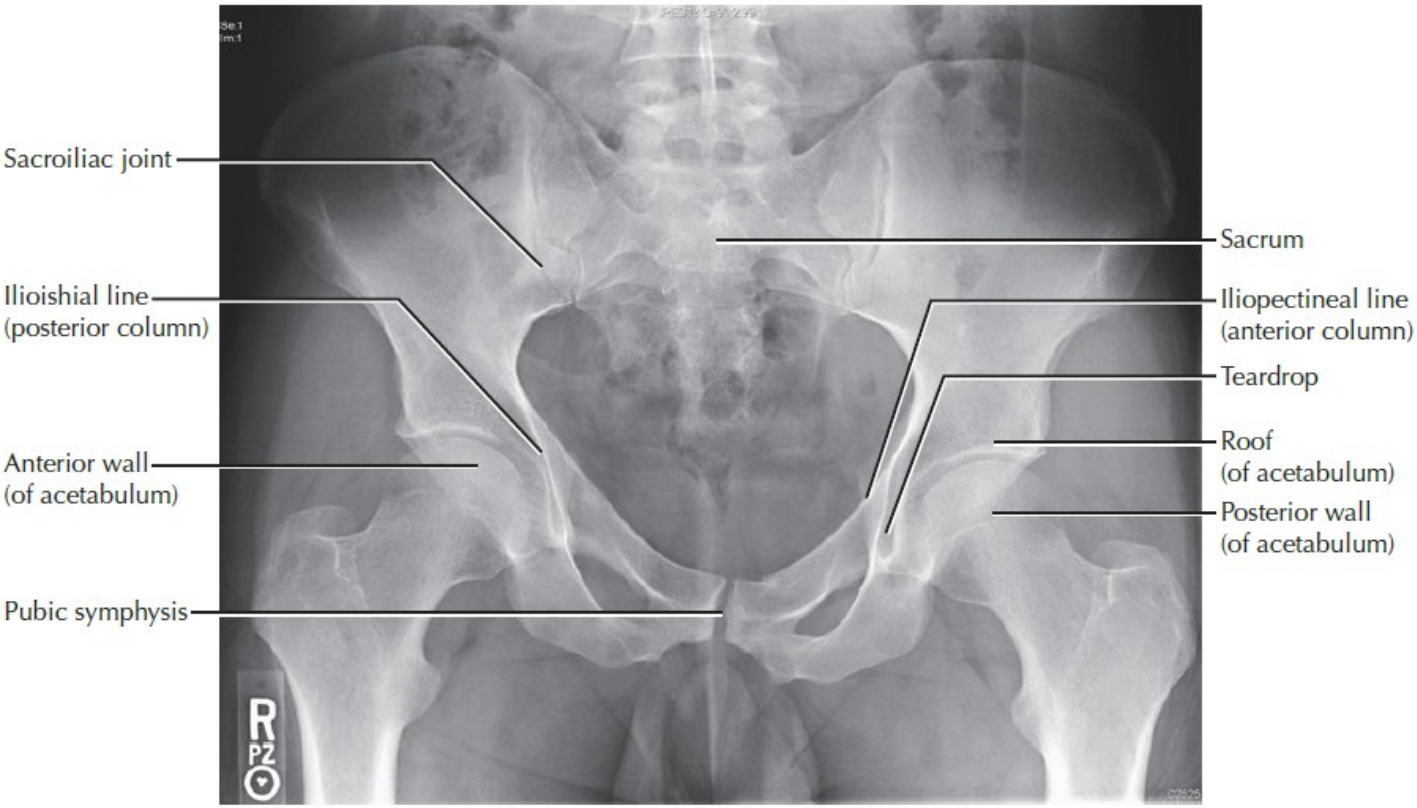
Lower Extremity Trauma

- Hip Fractures / Dislocations
- Femur Fractures
- Patella Fractures
- Knee Dislocations
- Tibia Fractures
- Ankle Fractures

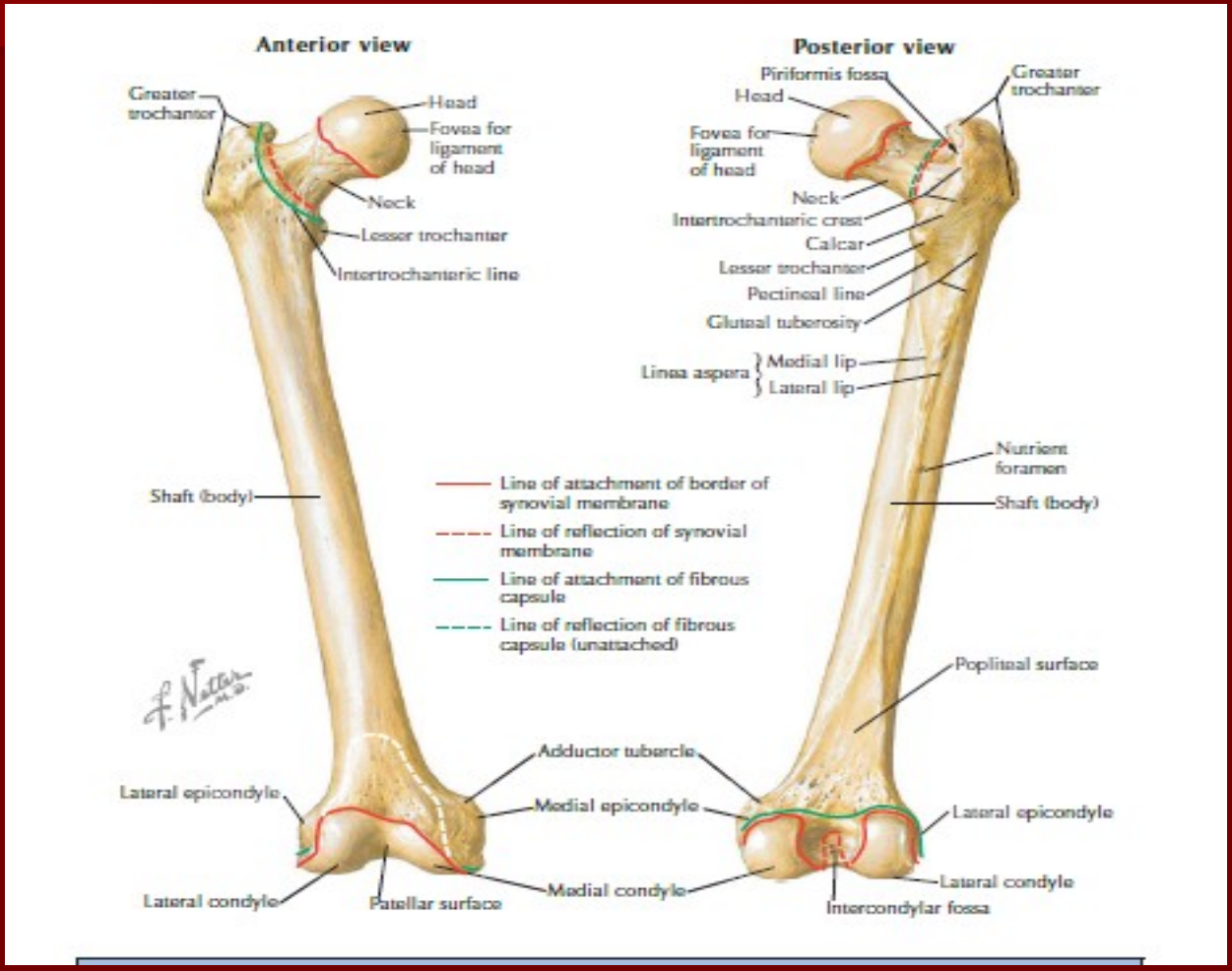
Pelvic anatomy



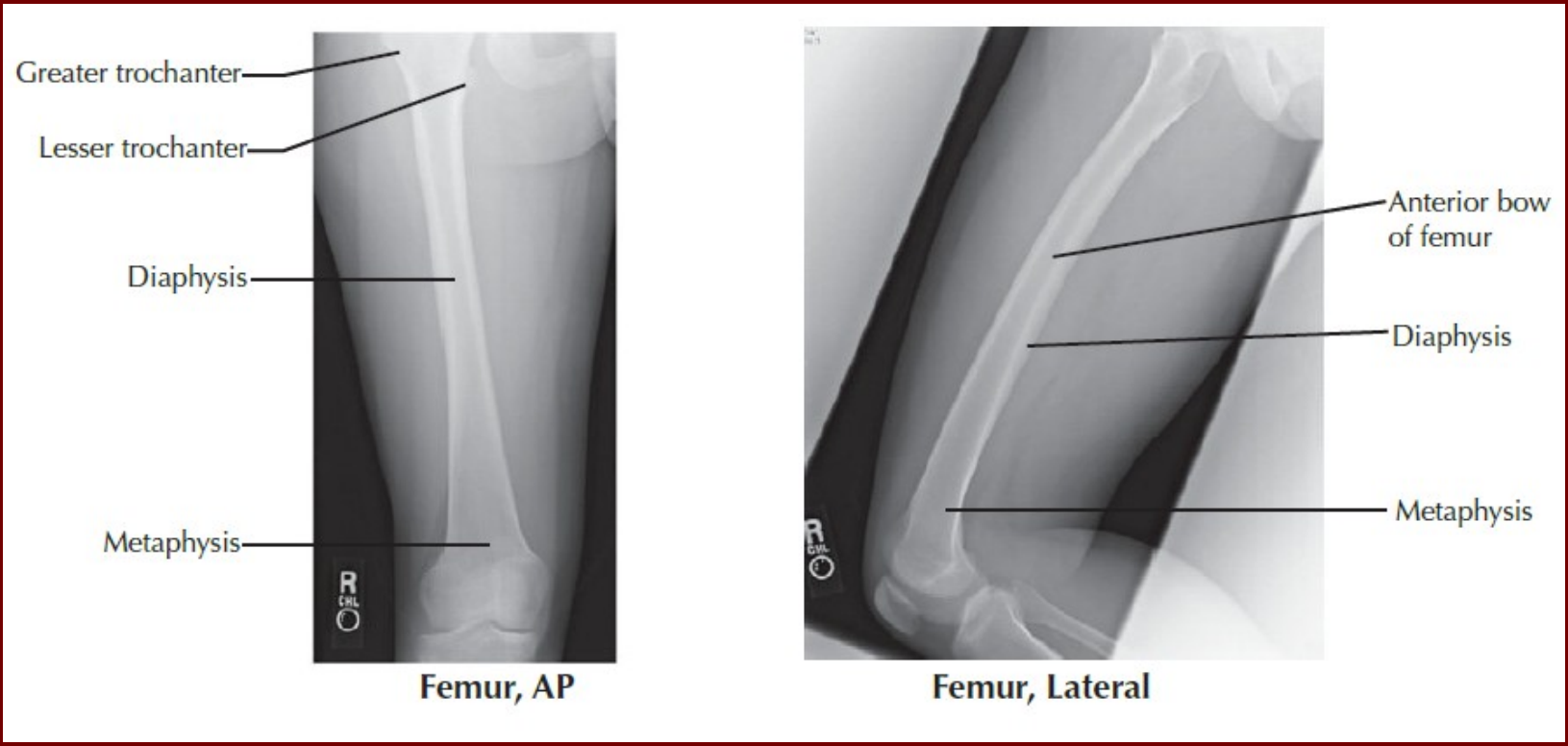
Pelvic radiology



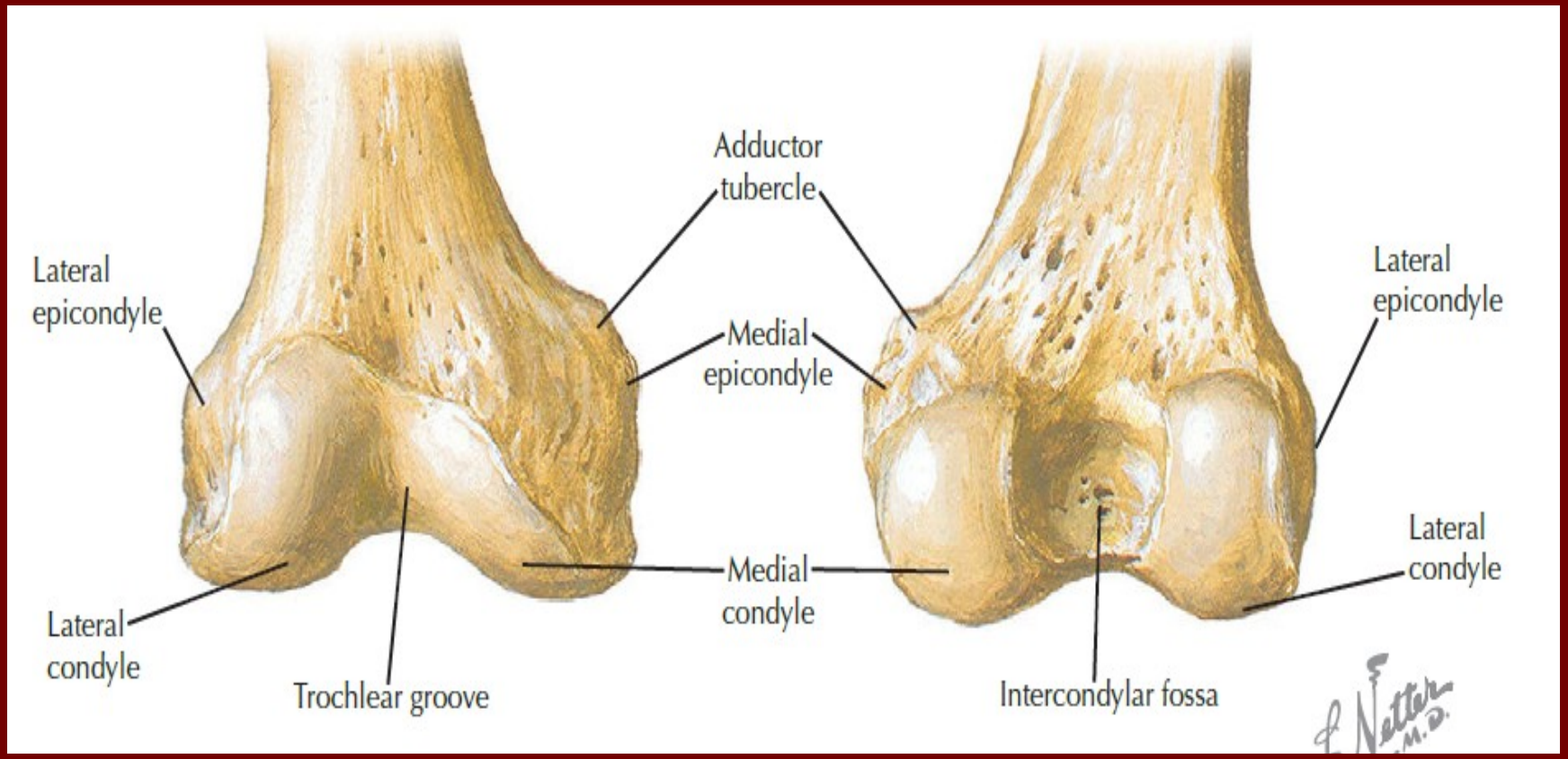
Femur anatomy



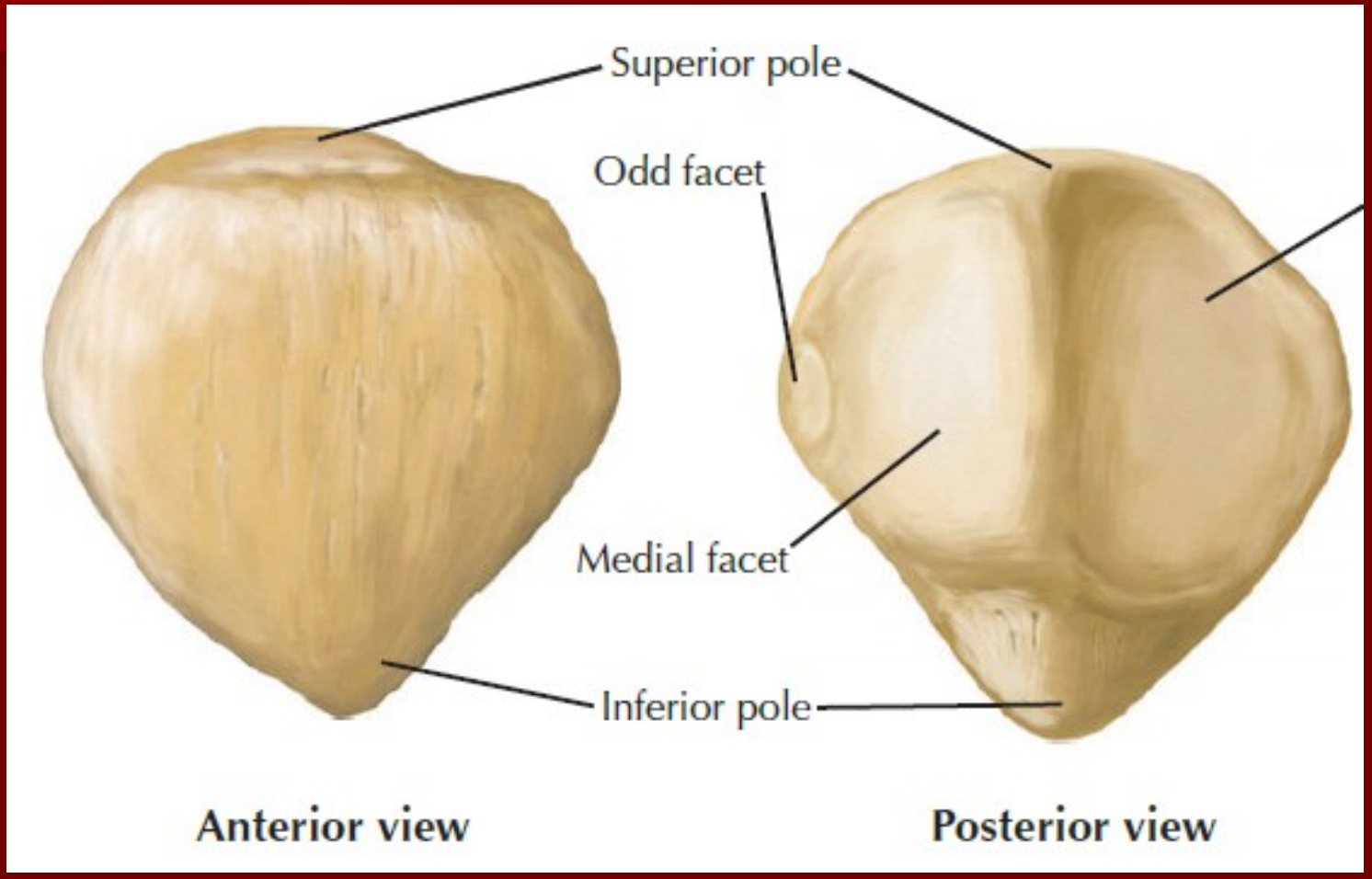
Femur radiology



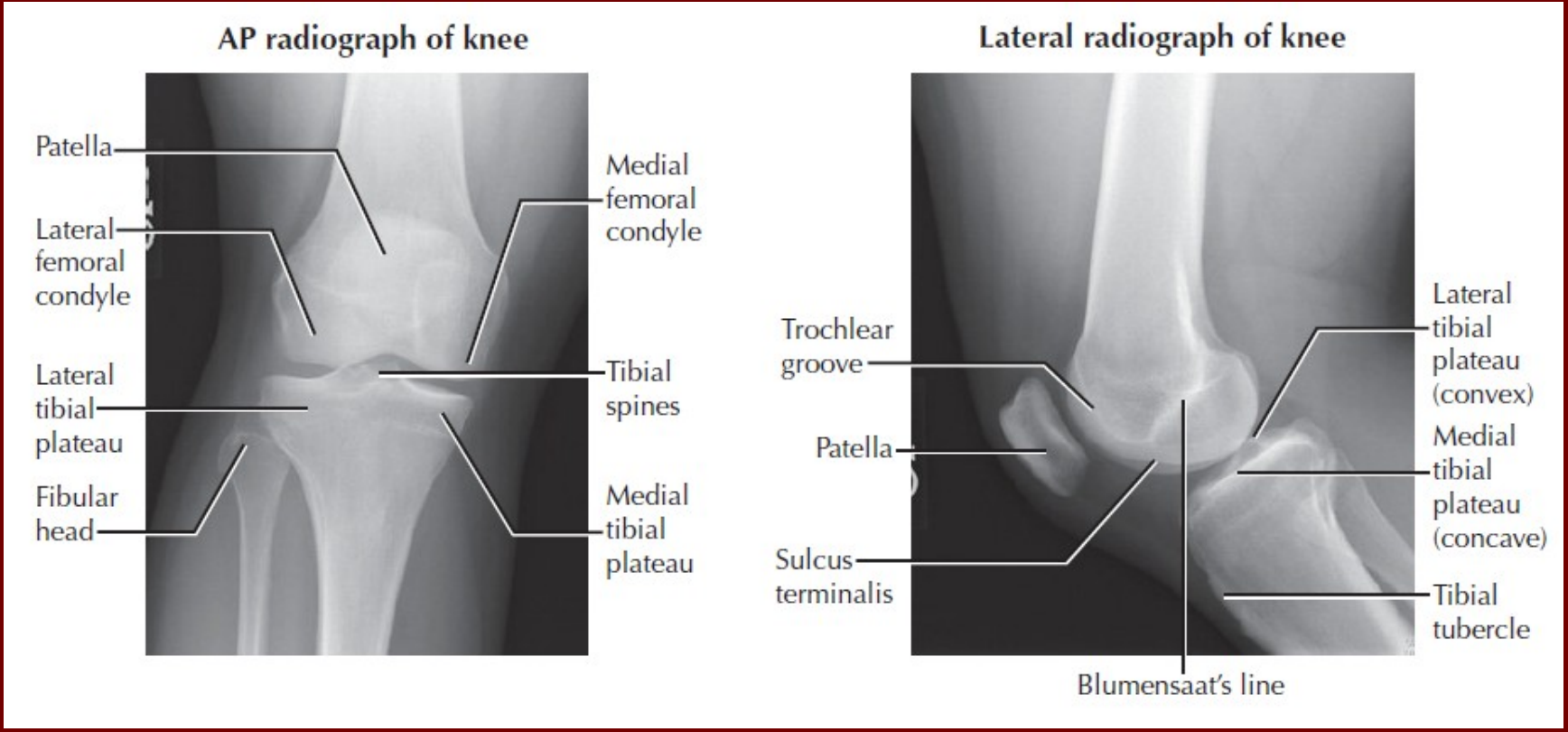
Distal femur anatomy



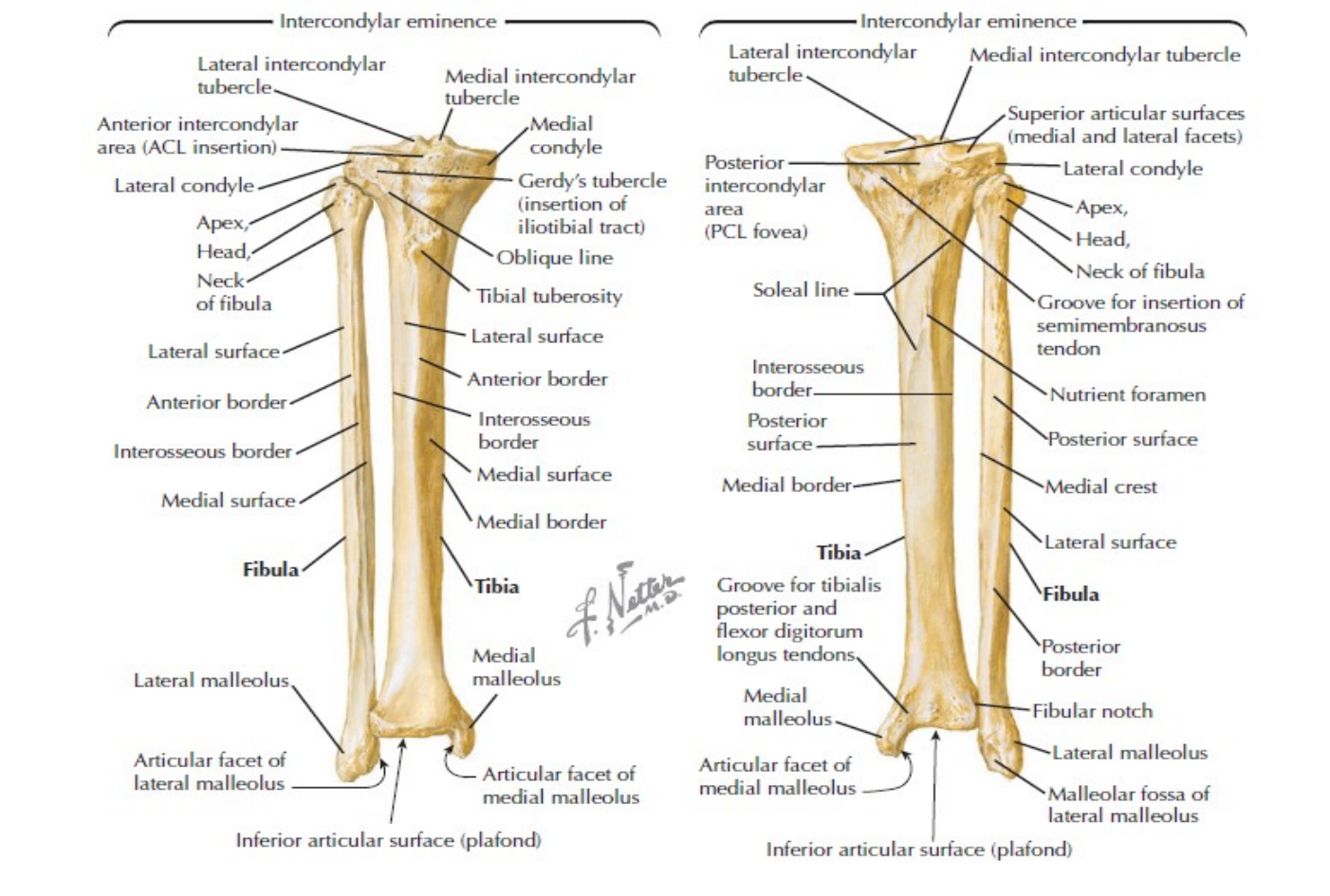
Patella anatomy



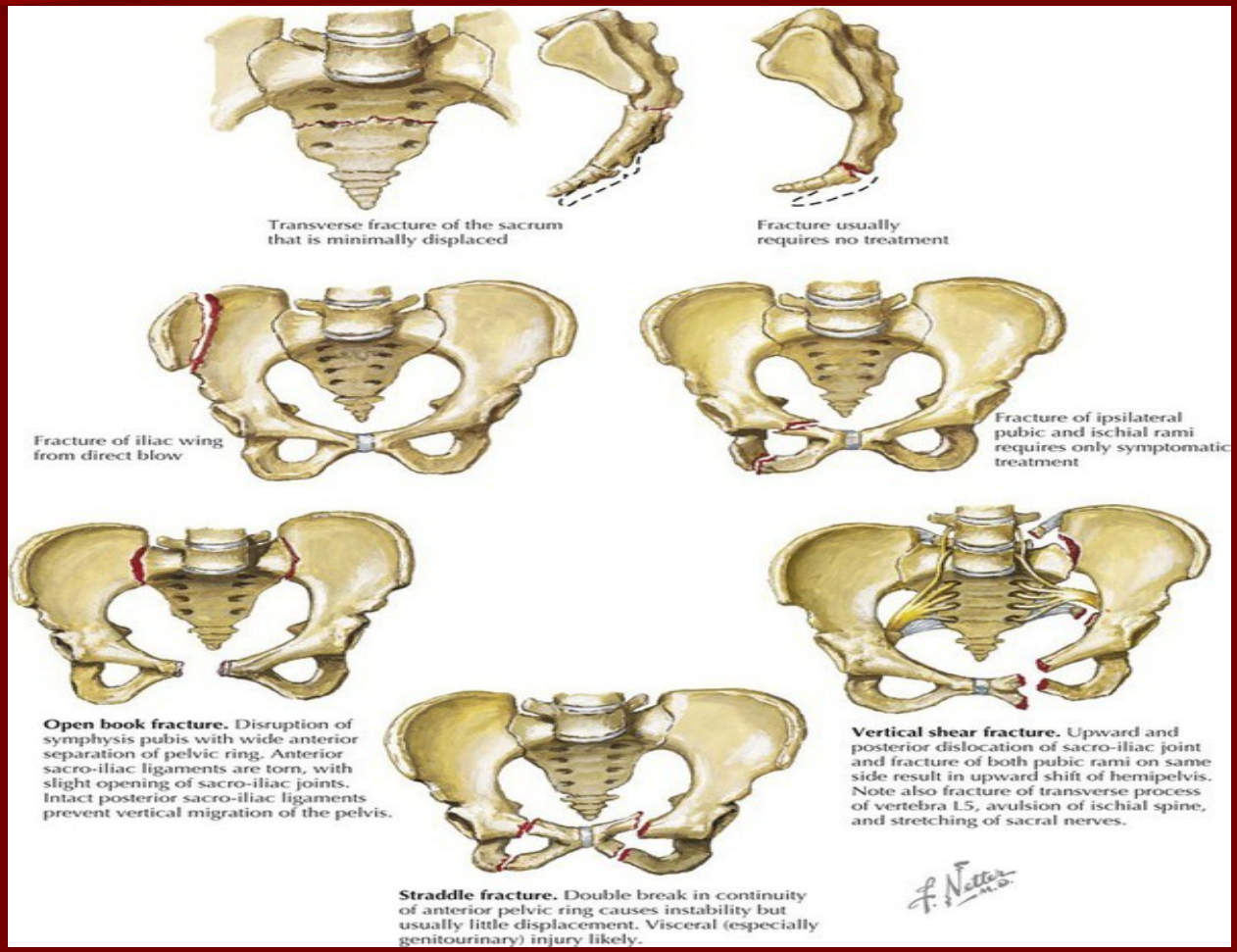
Knee radiology



Leg anatomy


Intercondylar eminence
Lateral intercondylar tubercle
Medial intercondylar tubercle
Anterior intercondylar area (ACL insertion)
Medial condyle
Lateral condyle
Gerdy's tubercle (insertion of iliotibial tract)
Apex,
Head,
Neck of fibula
Oblique line
Tibial tuberosity
Lateral surface
Anterior border
Interosseous border
Medial surface
Medial border
Fibula
Tibia
Medial malleolus
Lateral malleolus
Articular facet of lateral malleolus
Articular facet of medial malleolus
Inferior articular surface (plafond)
Intercondylar eminence
Lateral intercondylar tubercle
Medial intercondylar tubercle
Superior articular surfaces (medial and lateral facets)
Posterior intercondylar area (PCL fovea)
Lateral condyle
Apex,
Head,
Neck of fibula
Soleal line
Groove for insertion of semimembranosus tendon
Interosseous border
Nutrient foramen
Posterior surface
Posterior surface
Medial border
Medial crest
Lateral surface
Tibia
Fibula
Groove for tibialis posterior and flexor digitorum longus tendons
Posterior border
Medial malleolus
Fibular notch
Lateral malleolus
Articular facet of medial malleolus
Malleolar fossa of lateral malleolus
Inferior articular surface (plafond)

Pelvic ring fracture



Hip Fractures

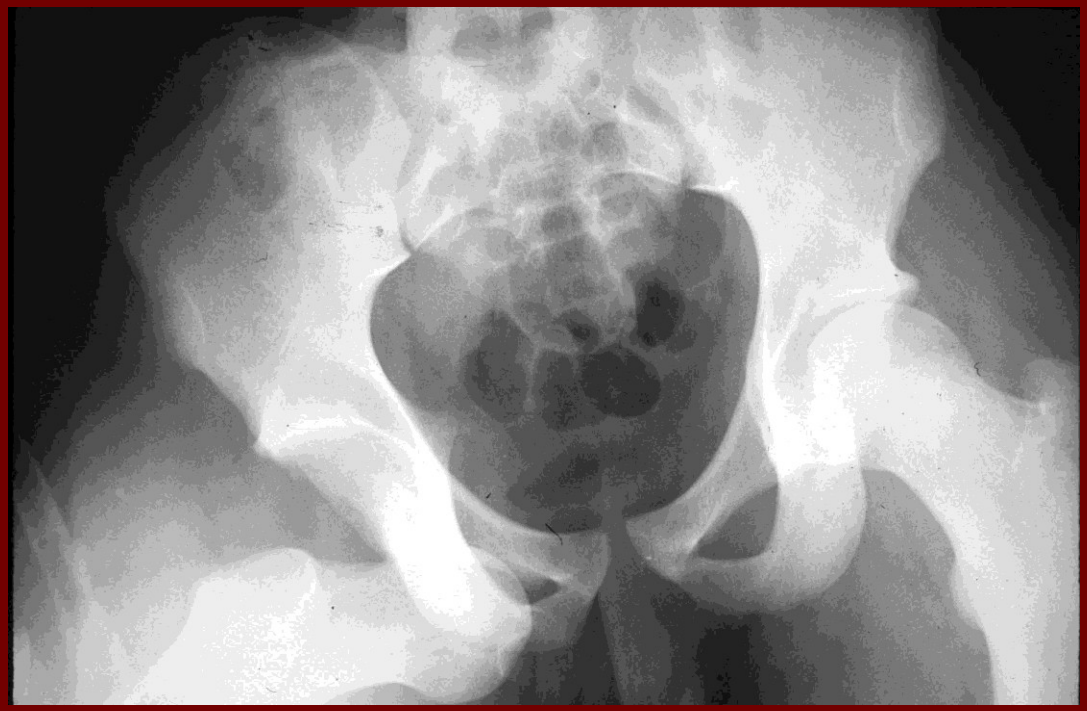
- Hip Dislocations
- Femoral Head Fractures
- Femoral Neck Fractures
- Intertrochanteric Fractures
- Subtrochanteric Fractures

Epidemiology

- 250,000 Hip fractures annually
  - Expected to double by 2050
- At risk populations
  - Elderly: poor balance & vision, osteoporosis, inactivity, medications, malnutrition
  - Young: high energy trauma

Hip Dislocations

- Significant trauma, usually MVA
- Posterior: Hip flexion, IR, Add
- Anterior: Extreme ER, Abd/Flex

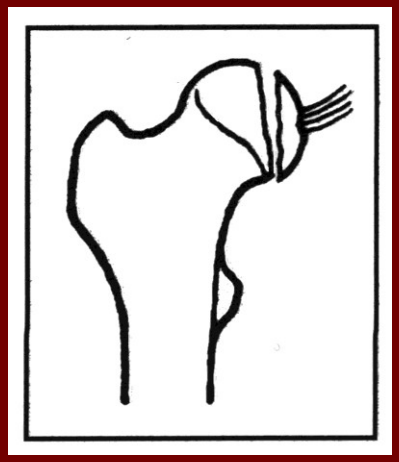


Femoral Head Fractures

- Concurrent with hip dislocation due to shear injury

Femoral Head Fractures

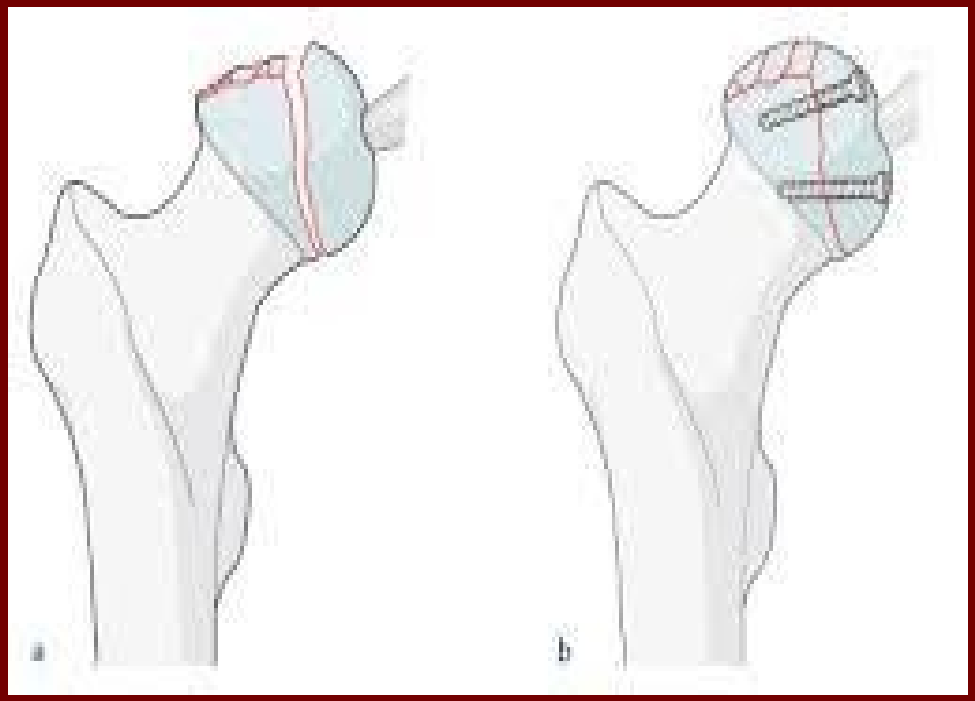
- Pipkin Classification
  - I: Fracture inferior to fovea
  - II: Fracture superior to fovea
  - III: Femoral head + acetabulum fracture
  - IV: Femoral head + femoral neck fracture



Femoral Head Fractures

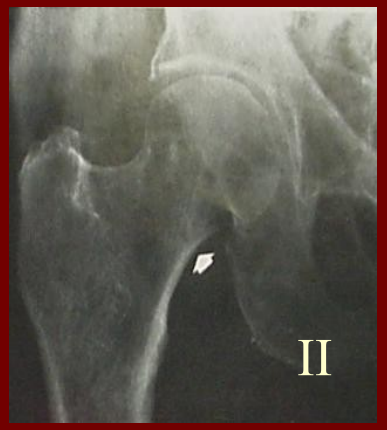
- Treatment Options
  - Type I
    - Nonoperative: non-displaced
    - ORIF if displaced
  - Type II: ORIF
  - Type III: ORIF of both fractures
  - Type IV: ORIF vs. hemiarthroplasty

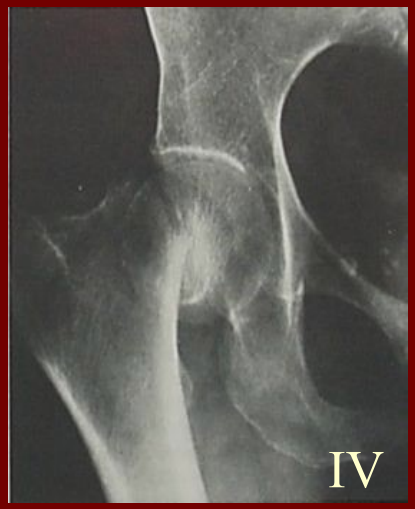
Femoral head fixation



Femoral Neck Fractures

- Garden Classification
  - I Valgus impacted
  - II Non-displaced
  - III Complete: Partially Displaced
  - IV Complete: Fully Displaced
- Functional Classification
  - Stable (I/II)
  - Unstable (III/IV)





Femoral Neck Fractures

- Treatment Options
  - Non-operative
    - Very limited role
    - Activity modification
    - Skeletal traction
  - Operative
    - ORIF
    - Hemiarthroplasty (Endoprosthesis)
    - Total Hip Replacement

ORIF

Hemi

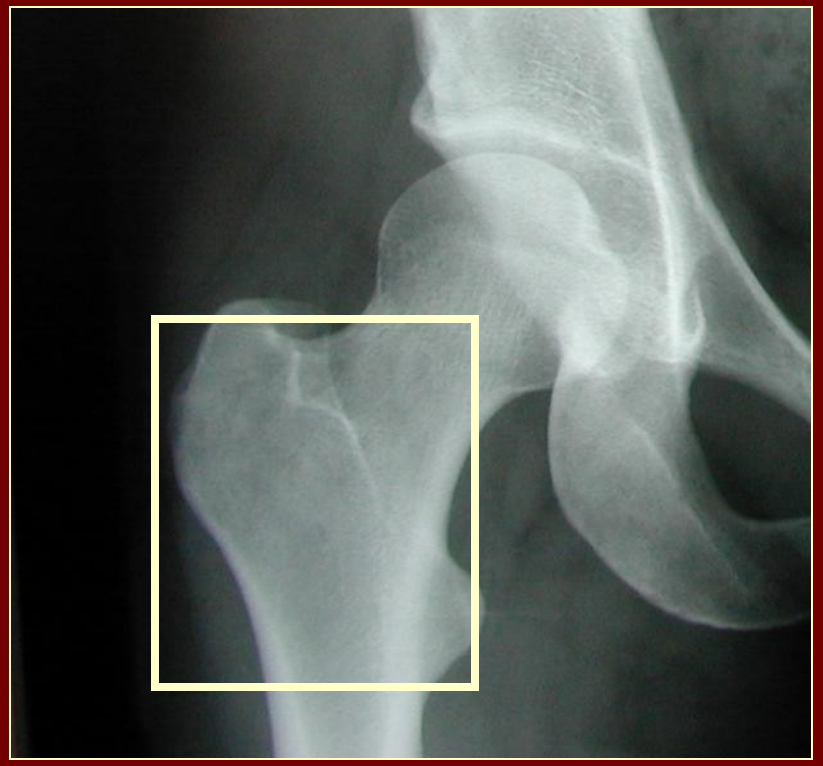
THR

Femoral Neck Fractures

- Young Patients
  - Urgent ORIF (<6hrs)
- Elderly Patients
  - ORIF possible (higher risk AVN, non-union, and failure of fixation)
  - Hemiarthroplasty
  - Total Hip Replacement

Intertrochanteric Hip Fx

- Intertrochanteric Femur Fracture
  - Extra-capsular femoral neck
  - To inferior border of the lesser trochanter



Intertrochanteric Hip Fx

- Intertrochanteric Femur Fracture
  - Physical Findings: Shortened / ER Posture
  - Obtain Xrays: AP Pelvis, Cross table lateral

Intertrochanteric Hip Fx

- Classification
  - # of parts: Head/Neck, GT, LT, Shaft
  - **Stable**
    - Resists medial & compressive Loads after fixation
  - **Unstable**
    - Collapses into varus or shaft medializes despite anatomic reduction with fixation
  - **Reverse Obliquity**

Intertrochanteric Hip Fx

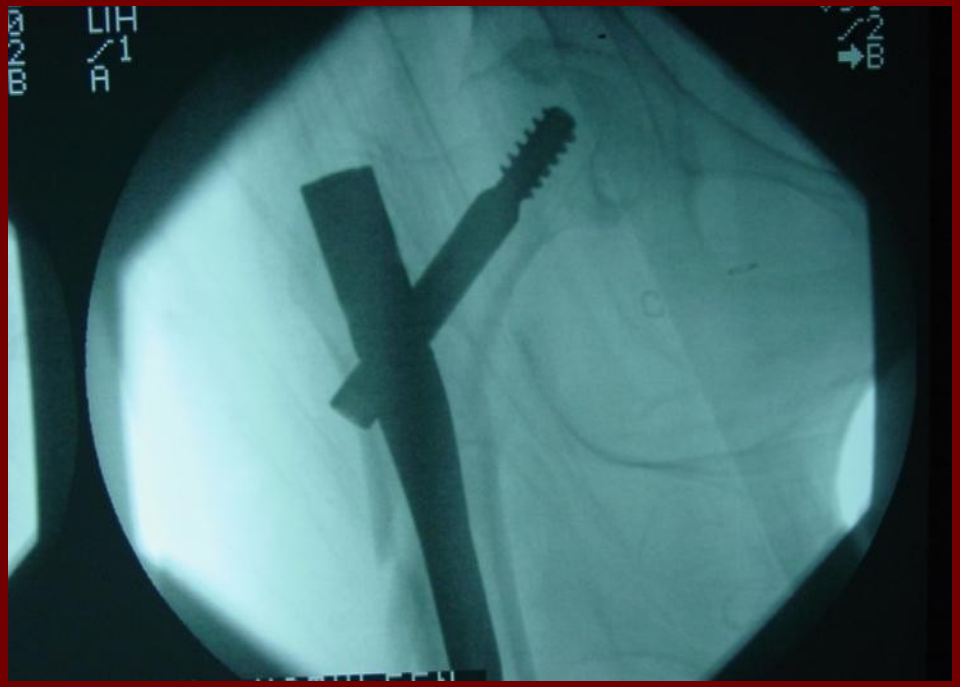
Stable

Unstable

Reverse Obliquity

Intertrochanteric Hip Fx

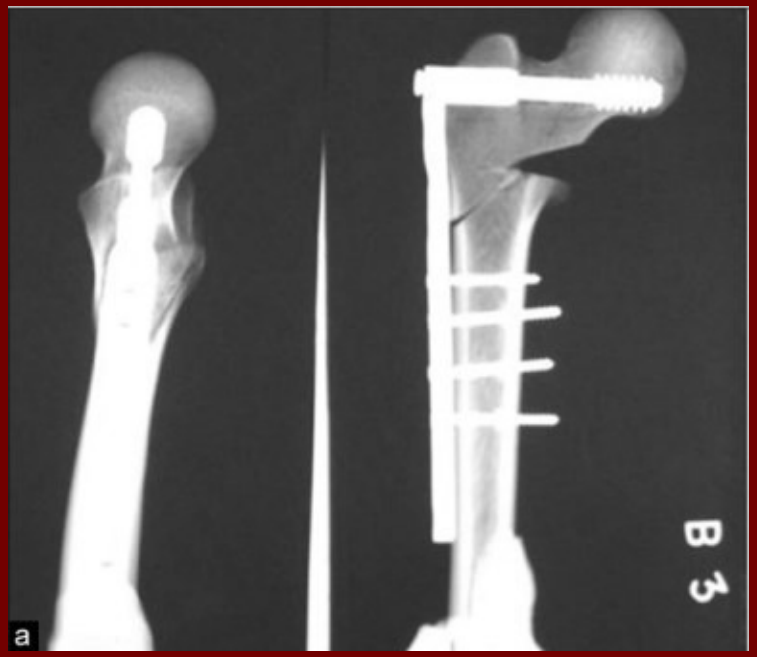
- Treatment Options
  - Stable: Dynamic Hip Screw (2-hole)
  - Unstable/Reverse: IM Recon Nail



Subtrochanteric Femur Fx

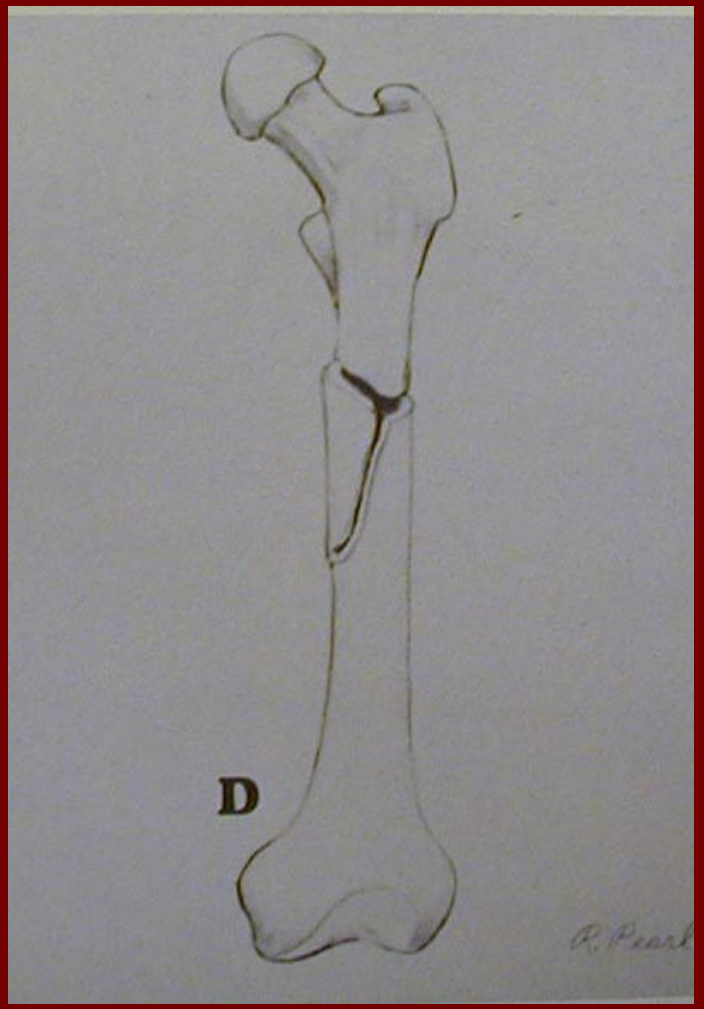
- Classification
  - Located from LT to 5cm distal into shaft
  - Intact Piriformis Fossa?
- Treatment
  - IM Nail
  - Cephalomedullary IM Nail
  - ORIF

Fixation



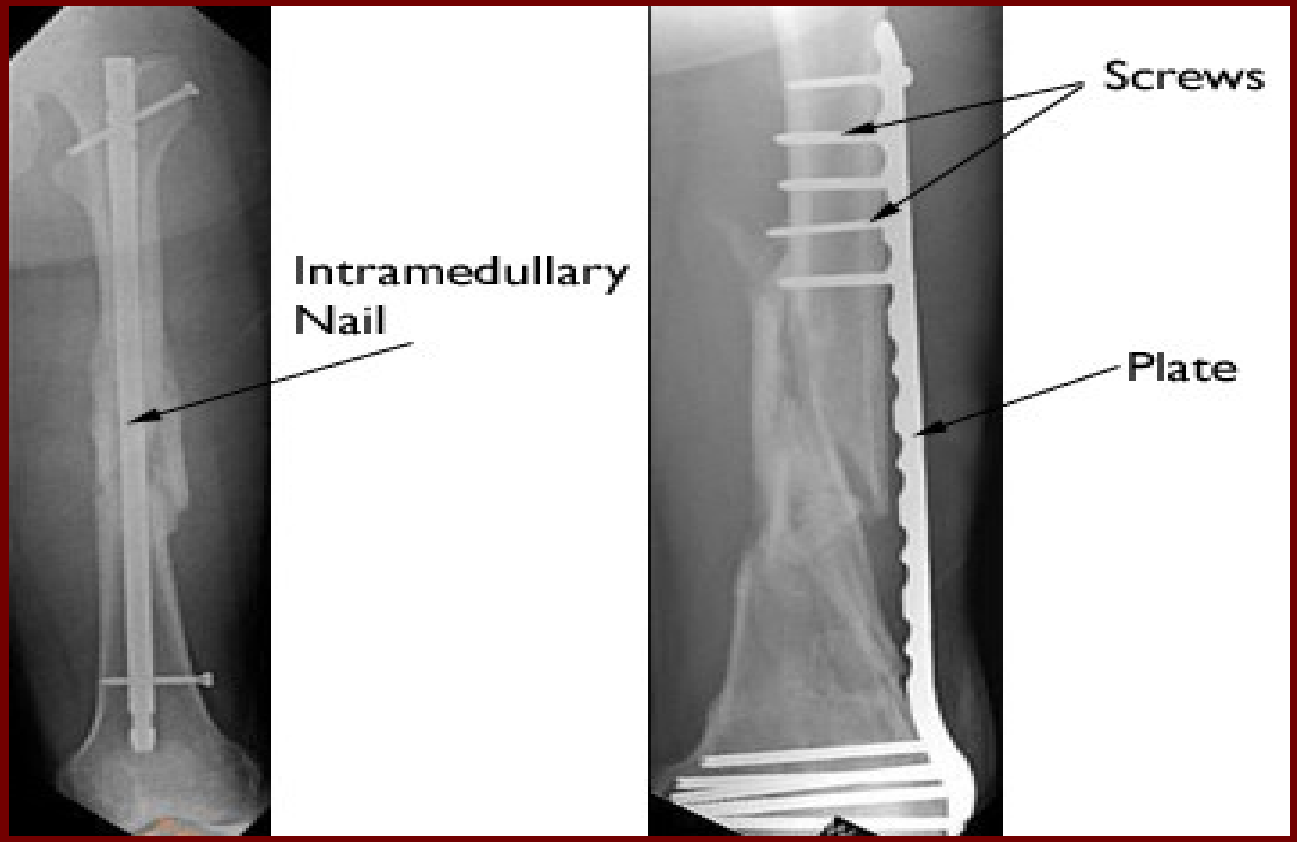
Femoral Shaft Fx

- Type 0 - No comminution
- Type 1 - Insignificant butterfly fragment with transverse or short oblique fracture
- Type 2 - Large butterfly of less than 50% of the bony width, > 50% of cortex intact
- Type 3 - Larger butterfly leaving less than 50% of the cortex in contact
- Type 4 - Segmental comminution
  - Winquist and Hansen 66A, 1984



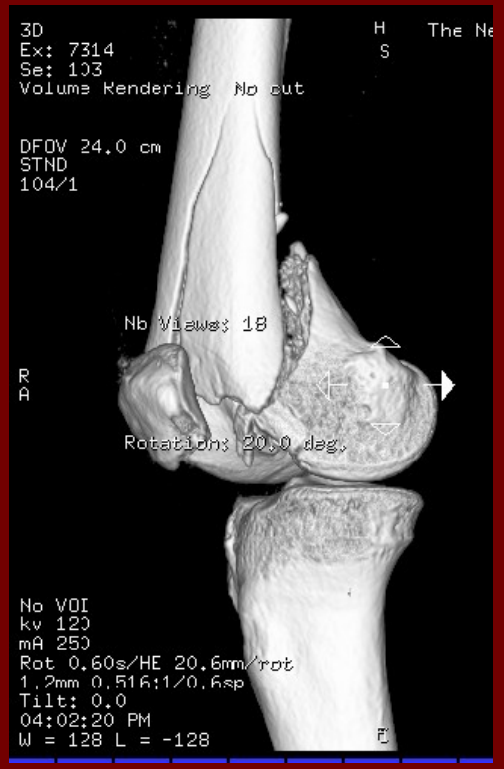
Femoral Shaft Fx

- Treatment Options
  - IM Nail with locking screws
  - ORIF with plate/screw construct
  - External fixation
  - Consider traction pin if prolonged delay to surgery


Intramedullary
Nail
Screws
Plate

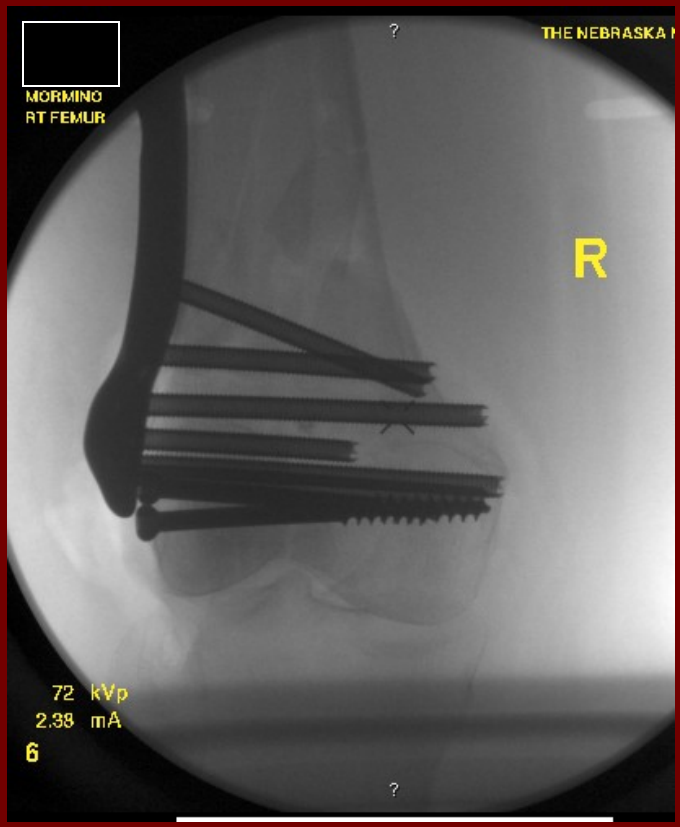
Distal Femur Fractures

- Distal Metaphyseal Fractures
- Look for intra-articular involvement
- Plain films
- CT



Distal Femur Fractures

- Treatment:
  - Retrograde IM Nail
  - ORIF open vs. MIPO
  - Above depends on fracture type, bone quality, and fracture location




A
B

Patella Fractures

- History
  - MVA, fall onto knee, eccentric loading
- Physical Exam
  - Ability to perform straight leg raise against gravity (ie, extensor mechanism still intact?)
  - Pain, swelling, contusions, lacerations and/or abrasions at the site of injury
  - Palpable defect

Patella Fractures

- Radiographs
  - AP/Lateral/Sunrise views
- Treatment
  - ORIF if ext mechanism is incompetent
  - Non-operative treatment with brace if ext mechanism remains intact

Tibia Fractures

- Proximal Tibia Fractures (Tibial Plateau)
- Tibial Shaft Fractures
- Distal Tibia Fractures (Tibial Pilon/Plafond)

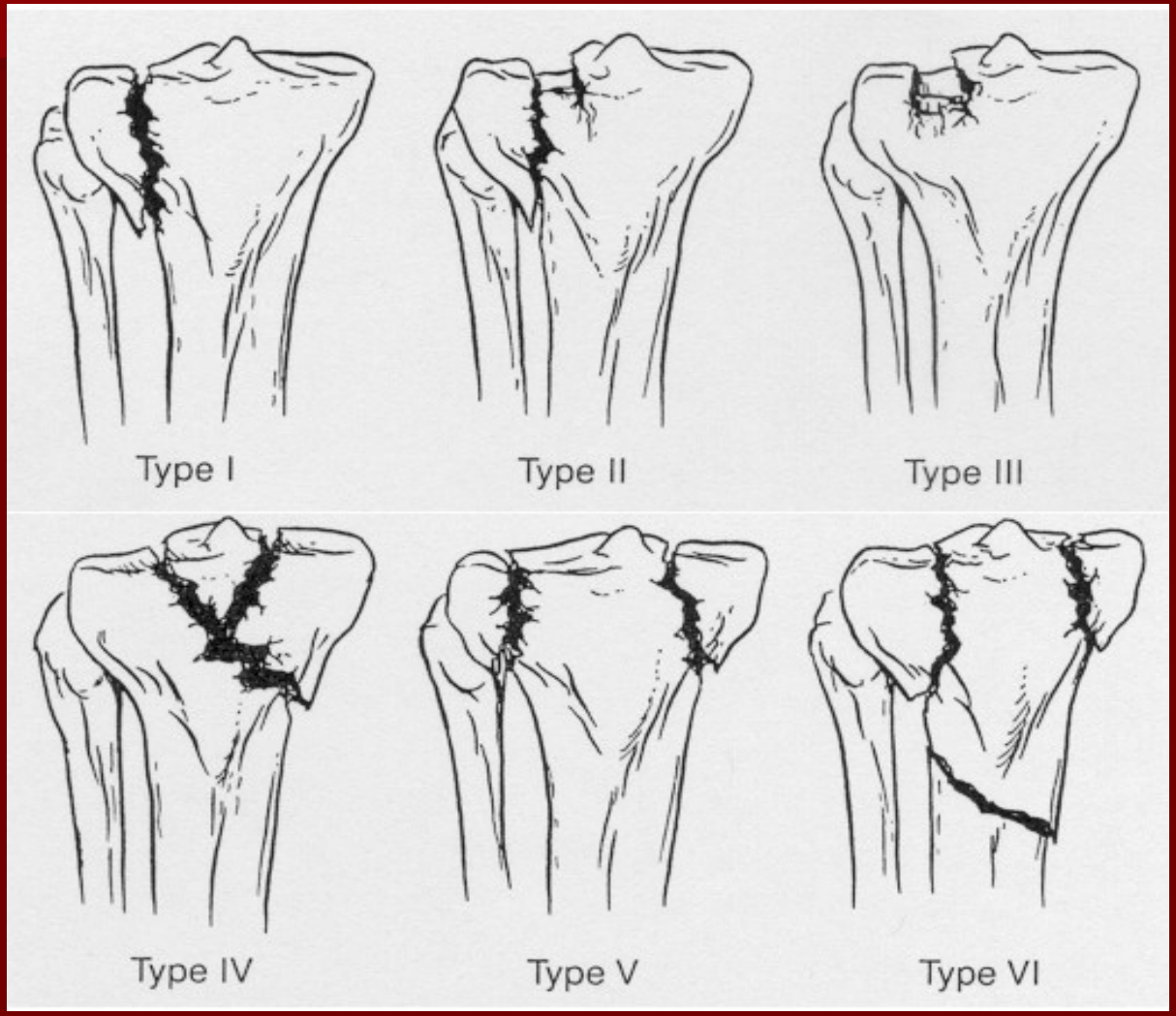
Tibial Plateau Fractures

- MVA, fall from height, sporting injuries
- Mechanism and energy of injury plays a major role in determining orthopedic care
- Examine soft tissues, neurologic exam (peroneal N.), vascular exam (esp with medial plateau injuries)
- Be aware for compartment syndrome
- Check for knee ligamentous instability

Tibial Plateau Fractures

- Xrays: AP/Lateral +/- traction films
- CT scan (after ex-fix if appropriate)

- Schatzker Classification of Plateau Fxs



Lower Energy

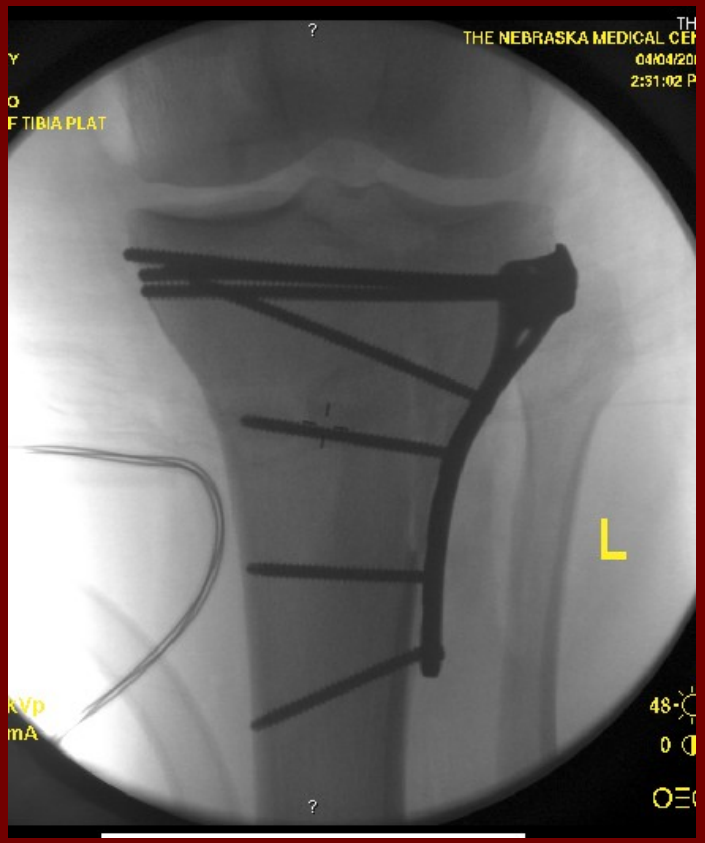
Higher Energy

Tibial Plateau Fractures

- Treatment
  - Spanning External Fixator may be appropriate for temporary stabilization and to allow for resolution of soft tissue injuries

Tibial Plateau Fractures

- Treatment
  - Definitive ORIF for patients with varus/valgus instability, >5mm articular stepoff
  - Non-operative in non-displaced stable fractures or patients with poor surgical risks



Tibial Shaft Fractures

- Mechanism of Injury
  - Can occur in lower energy, torsion type injury (e.g., skiing)
  - More common with higher energy direct force (e.g., car bumper)
  - Open fractures of the tibia are more common than in any other long bone

Tibial Shaft Fractures

- Open Tibia Fx
- Priorities
  - ABC'S
  - Associated Injuries
  - Tetanus
  - Antibiotics
  - Fixation

Tibial Shaft Fractures

- Gustilo and Anderson Classification of Open Fx
  - Grade 1
    - <1cm, minimal muscle contusion, usually inside out mechanism
  - Grade 2
    - 1-10cm, extensive soft tissue damage
  - Grade 3
    - 3a: >10cm, adequate bone coverage
    - 3b: >10cm, periosteal stripping requiring flap advancement or free flap
    - 3c: vascular injury requiring repair

Tibial Shaft Fractures

- Treatment Options
  - IM Nail
  - ORIF with Plates
  - External Fixation
  - Cast or Cast-Brace

Tibial Shaft Fractures

Tibial Shaft Fractures

- Advantages of IM nailing
  - Lower non-union rate
  - Smaller incisions
  - Earlier weightbearing and function
  - Single surgery

Tibial Shaft Fractures

- IM nailing of distal and proximal fx
  - Can be done but requires additional planning, special nails, and advanced techniques

Tibial Pilon Fractures

- Fractures involving distal tibia metaphysis and into the ankle joint
- Soft tissue management is key!
- Often occurs from fall from height or high energy injuries in MVA
- "Excellent" results are rare, "Fair to Good" is the norm outcome
- Multiple potential complications

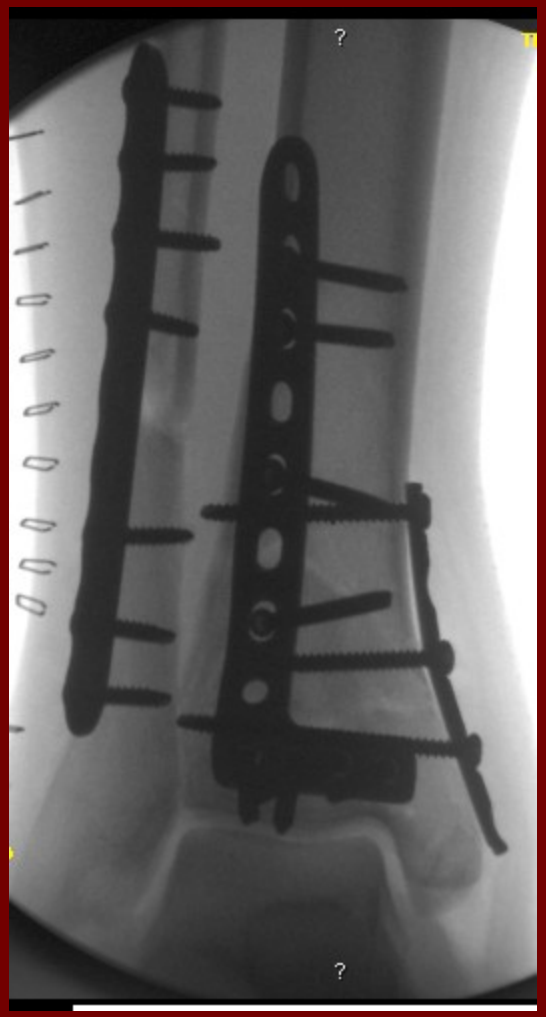
Tibial Pilon Fractures

- Initial Evaluation
  - Plain films, CT scan
  - Spanning External Fixator
  - Delayed Definitive Care to protect soft tissues and allow for soft tissue swelling to resolve



Tibial Pilon Fractures

- Treatment Goals
  - Restore Articular Surface
  - Minimize Soft Tissue Injury
  - Establish Length
  - Avoid Varus Collapse
- Treatment Options
  - IM nail with limited ORIF
  - ORIF
  - External Fixator



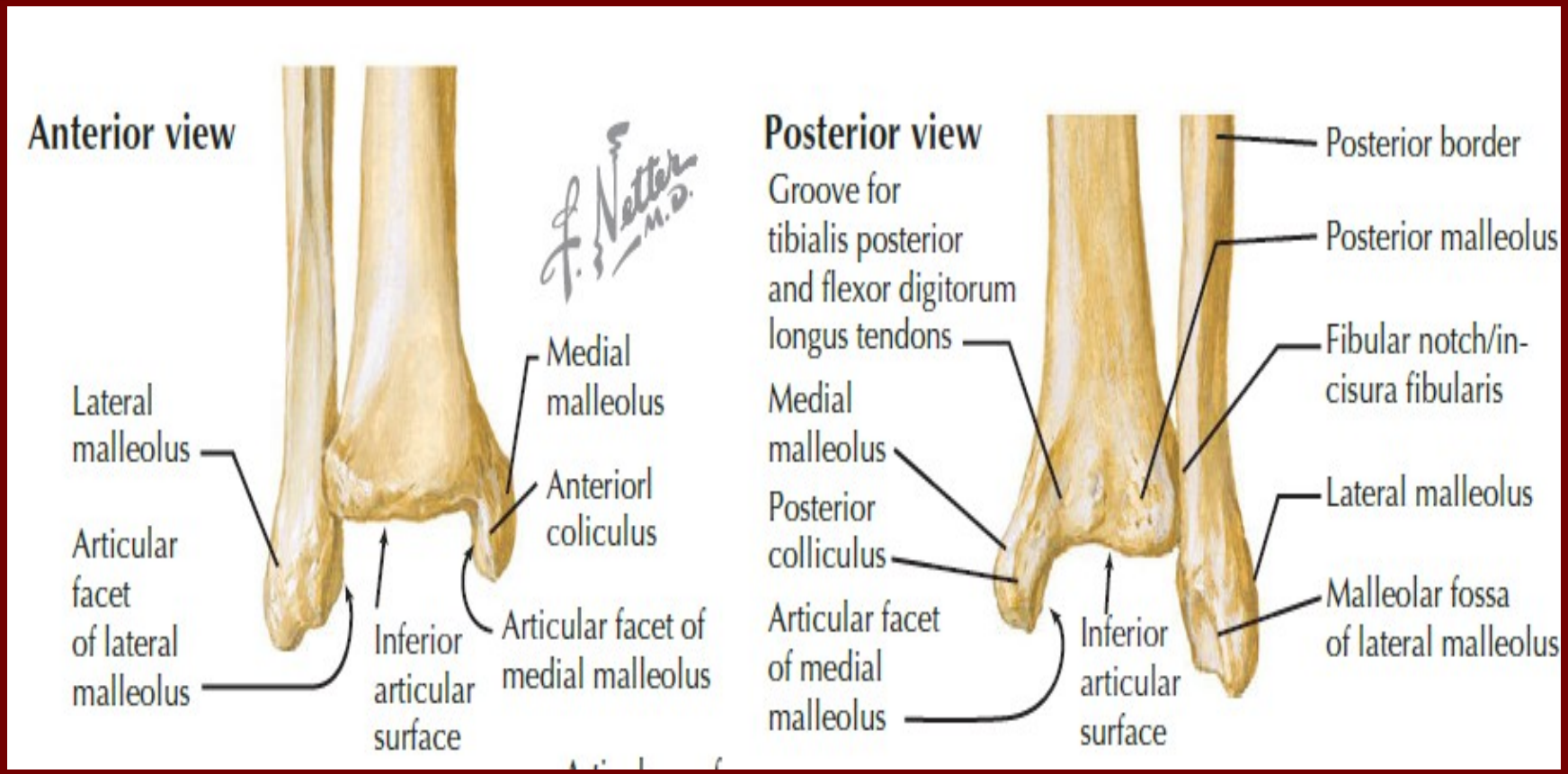
Tibial Pilon Fractures

- Complications
  - Mal or Non-union (Varus)
  - Soft Tissue Complications
  - Infection
  - Potential Amputation

Ankle Fractures

- Most common weight-bearing skeletal injury
- Incidence of ankle fractures has doubled since the 1960's
- Highest incidence in elderly women
  - Unimalleolar 68%
  - Bimalleolar 25%
  - Trimalleolar 7%
  - Open 2%

Anatomy

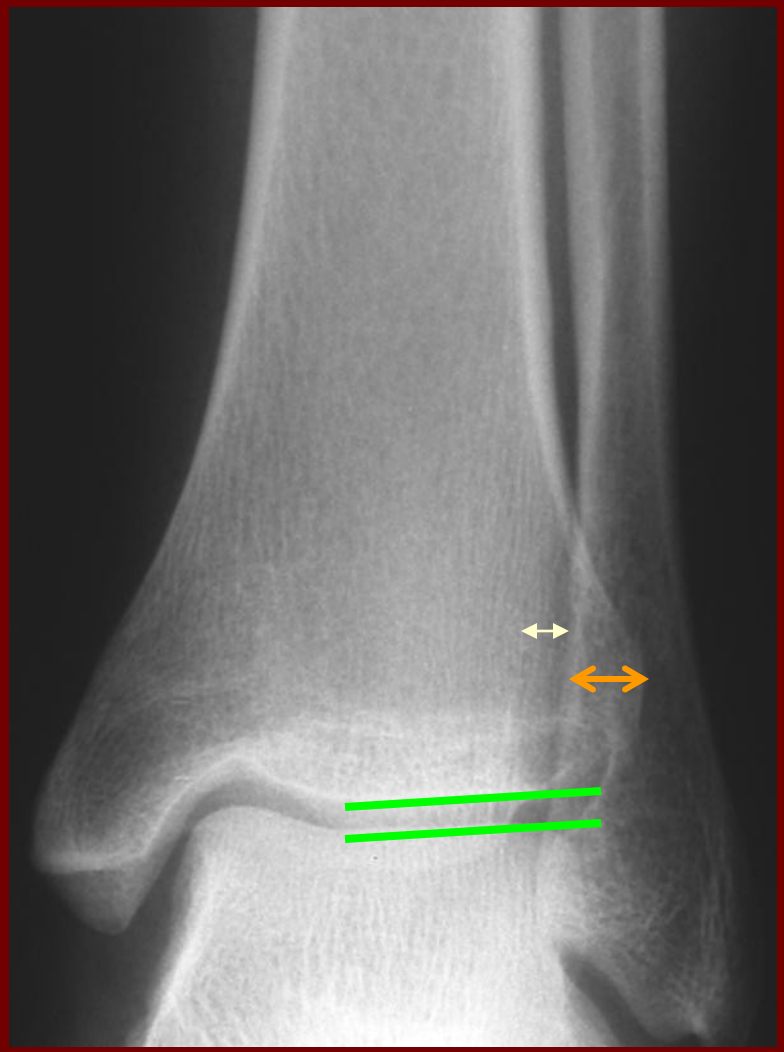

Anterior view
F. Netter M.D.
Lateral malleolus
Articular facet of lateral malleolus
Inferior articular surface
Articular facet of medial malleolus
Medial malleolus
Anteriorl coliculus
Posterior view
Groove for tibialis posterior and flexor digitorum longus tendons
Medial malleolus
Posterior colliculus
Articular facet of medial malleolus
Inferior articular surface
Posterior border
Posterior malleolus
Fibular notch/in-cisura fibularis
Lateral malleolus
Malleolar fossa of lateral malleolus

Ankle Fractures

- Radiographic Studies
  - AP, Lateral, Mortise of Ankle (Weight Bearing if possible)
  - AP, Lateral of Knee (Maissaneve injury)
  - AP, Lateral, Oblique of Foot (if painful)

Ankle Fractures

- AP Ankle
  - Tibiofibular overlap
    - <10mm is abnormal and implies syndesmotic injury
  - Tibiofibular clear space
    - >5mm is abnormal - implies syndesmotic injury
  - Talar tilt
    - >2mm is considered abnormal

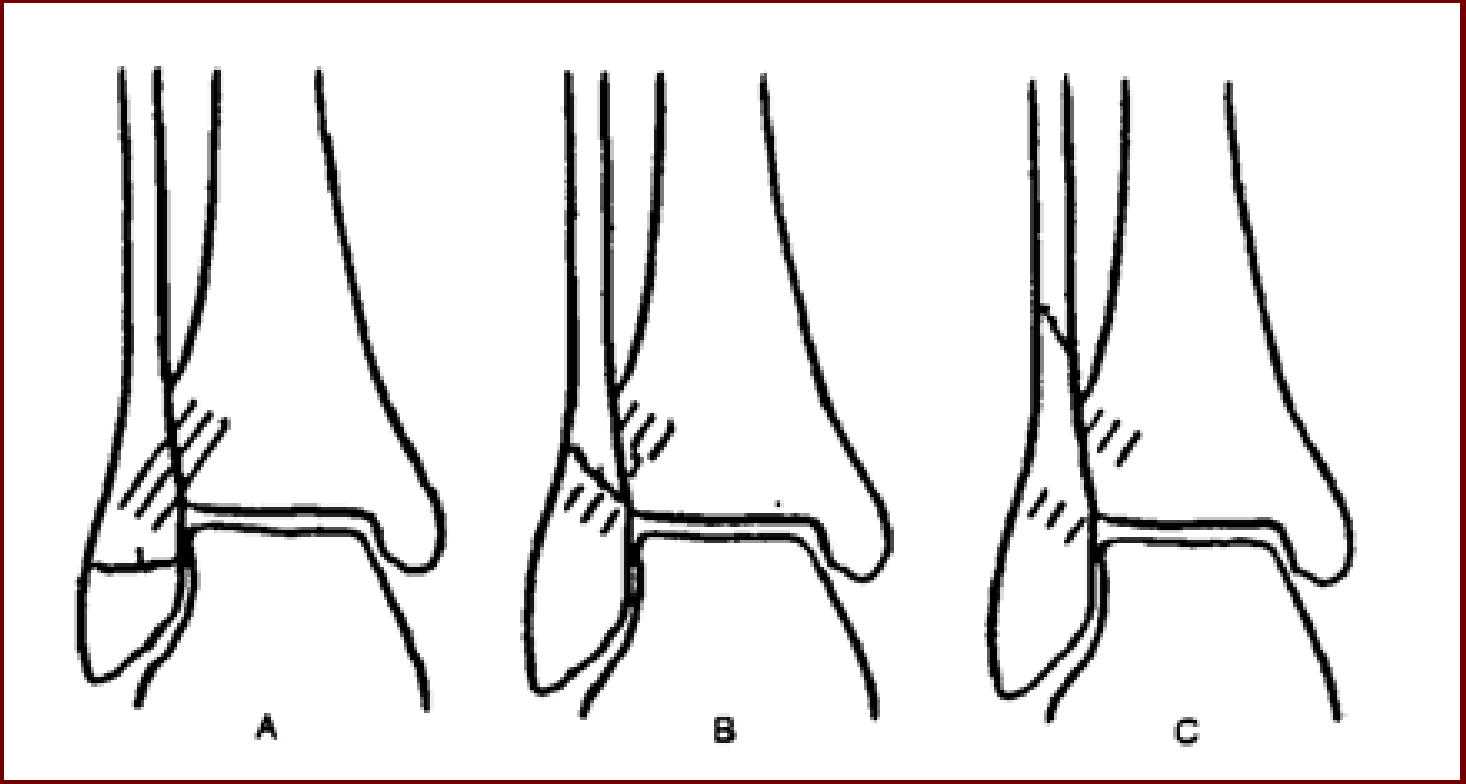


Ankle Fractures

- Lateral View
  - Posterior malleolar fractures
  - Anterior/posterior subluxation of the talus under the tibia
  - Displacement/Shortening of distal fibula
  - Associated injuries

Ankle Fractures

- Classification Systems (Weber-Danis)
  - A: Fibula Fracture distal to mortise
  - B: Fibula Fracture at the level of the mortise
  - C: Fibula Fracture proximal to mortise



Ankle Fractures

- Indications for non-operative care:
  - Nondisplaced fracture with intact syndesmosis and stable mortise
  - Less than 3 mm displacement of the isolated fibula fracture with no medial injury
  - Patient whose overall condition is unstable and would not tolerate an operative procedure
- Management:
  - WBAT in short leg cast or CAM boot for 4-6 weeks
  - Repeat x-ray at 7–10 days to r/o interval displacement

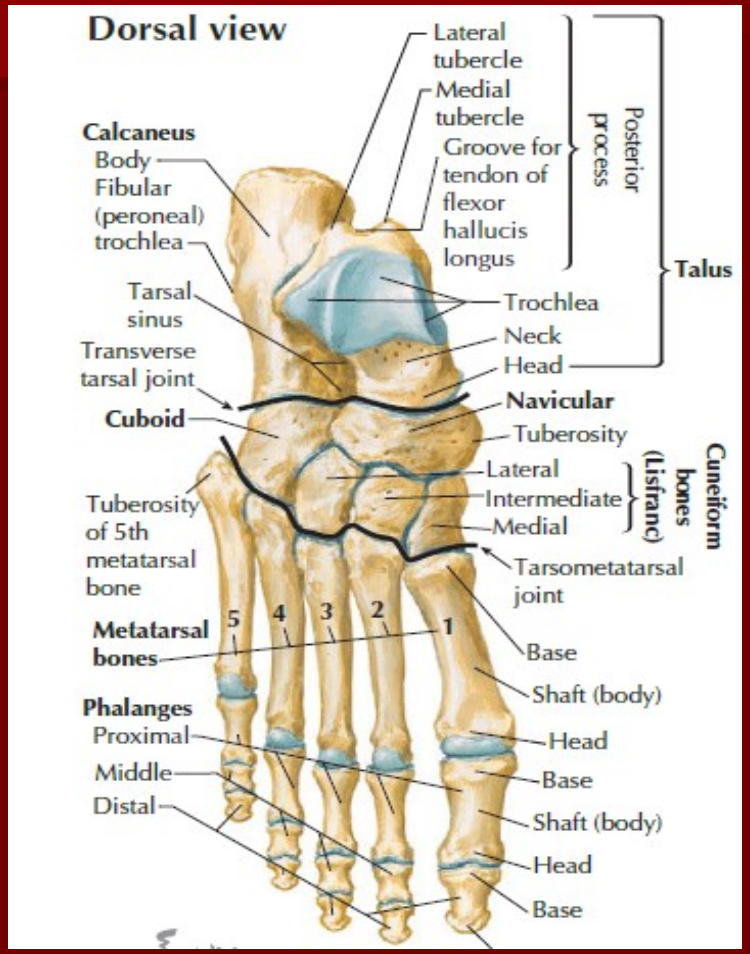
Ankle Fractures

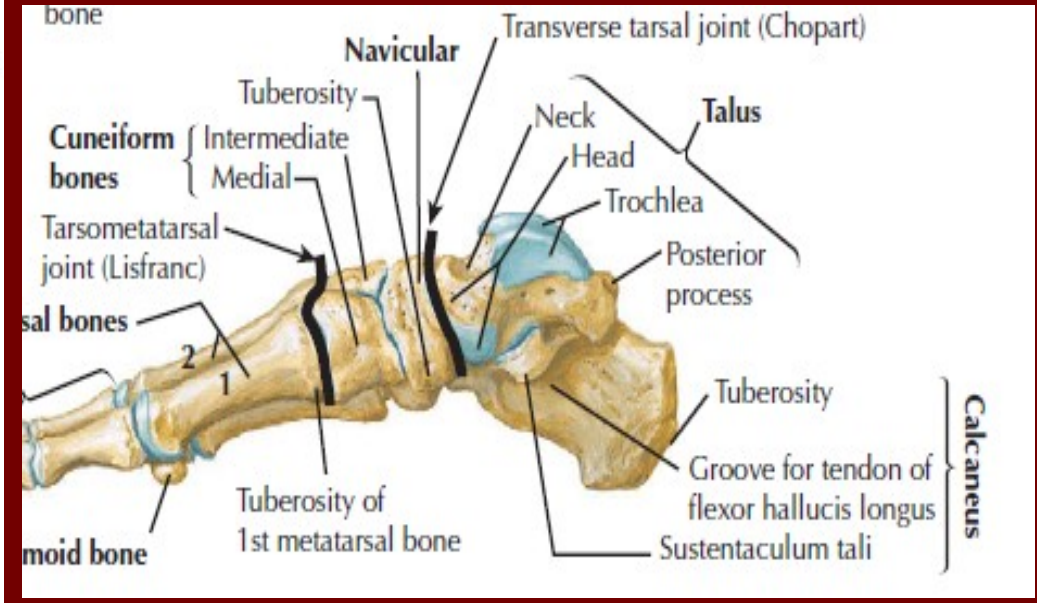
- Indications for operative care:
  - Bimalleolar fractures
  - Trimalleolar fractures
  - Talar subluxation
  - Articular impaction injury
  - Syndesmotic injury
    - Beware the painful ankle with no ankle fracture but a widened mortise… check knee films to rule out Maissoneuve Syndesmosis injury.

Ankle Fractures

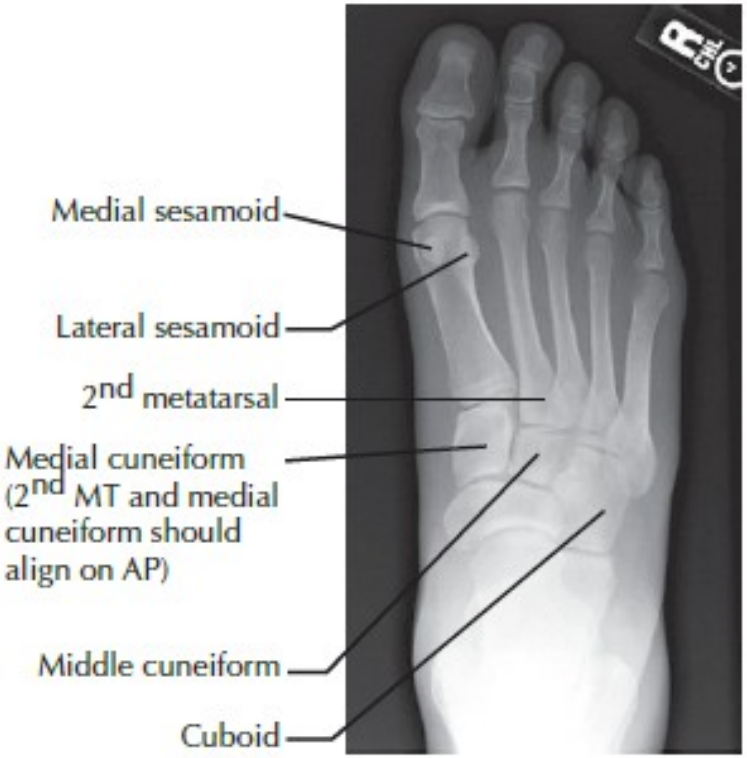
- ORIF:
  - Fibula
    - Lag Screw if possible + Plate
    - Confirm length/rotation
  - Medial Malleolus
    - Open reduce
    - 4-0 cancellous screws vs. tension band
  - Posterior Malleolus
    - Fix if >30% of articular surface
  - Syndesmosis
    - Stress after fixation
    - Fix with 3 or 4 cortex screws

Foot anatomy

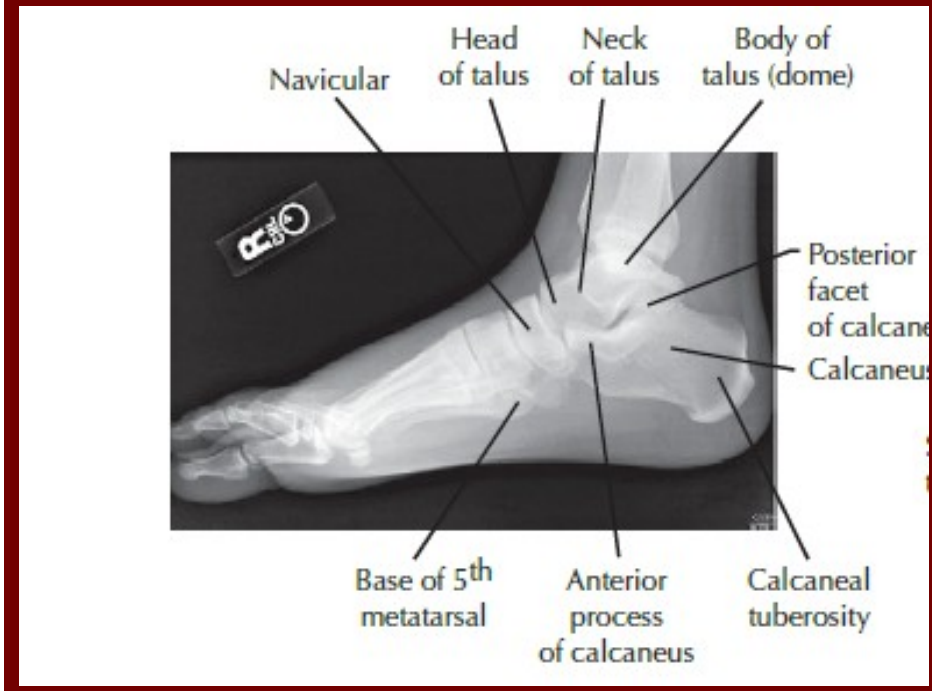




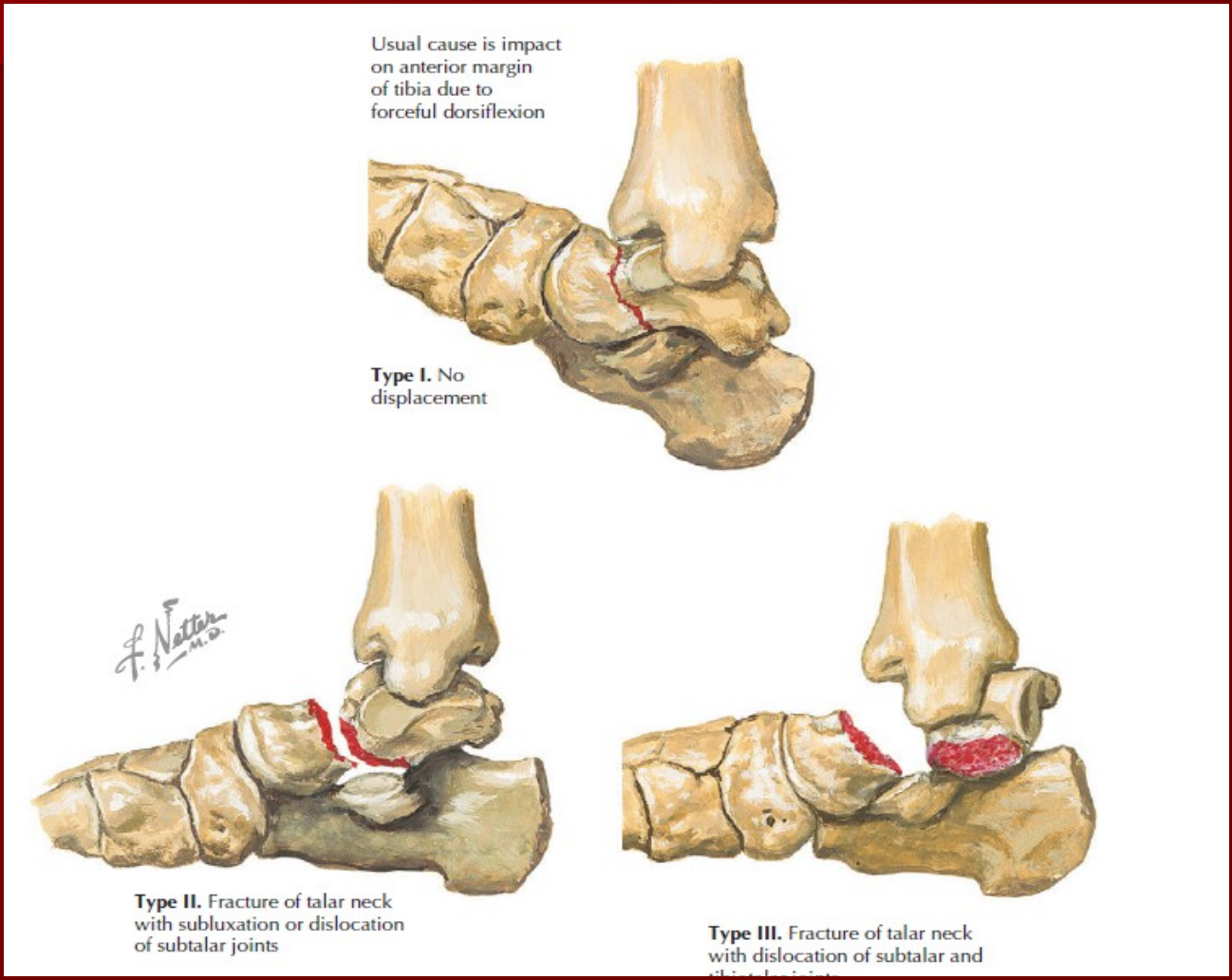
Foot anatomy



Foot x-ray, AP



Talus fracture



Talus fracture


a
b


R

REVIEW OF DEVICES

External fixator

IMN

Plate

Devices

Devices