Lower Extremity Trauma

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Lower Extremity Trauma

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

Hip Fractures

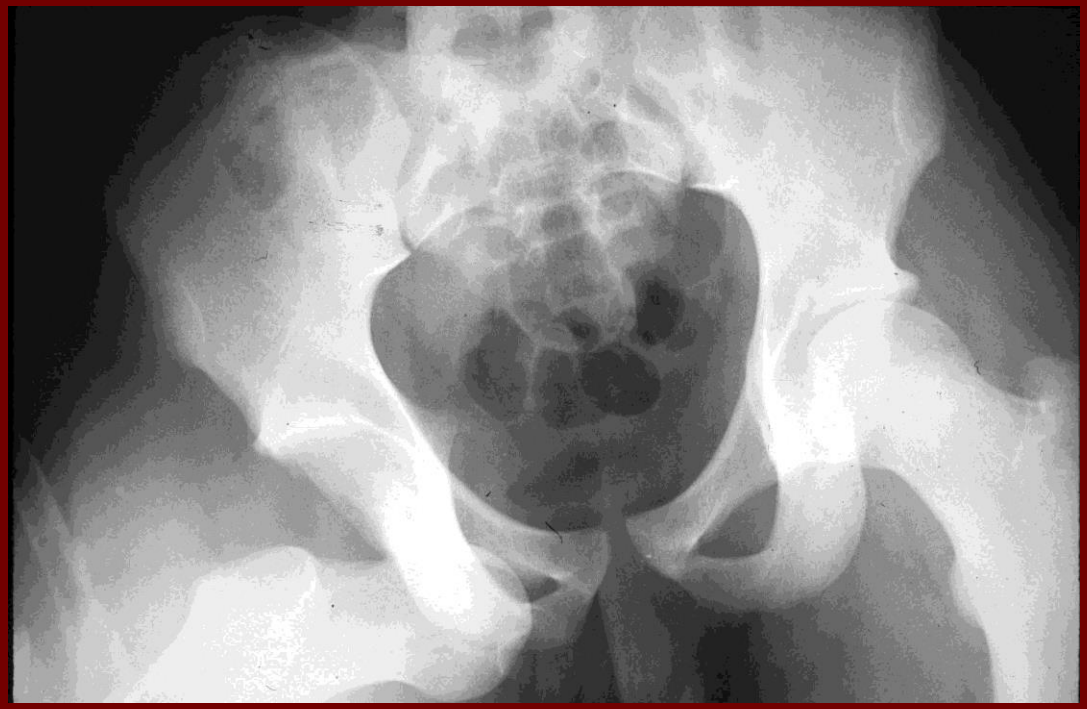
- Hip Dislocations
- Femoral Head Fractures
- Femoral Neck Fractures
- Intertrochanteric Fractures
- Subtrochanteric Fractures

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



Hip Dislocations

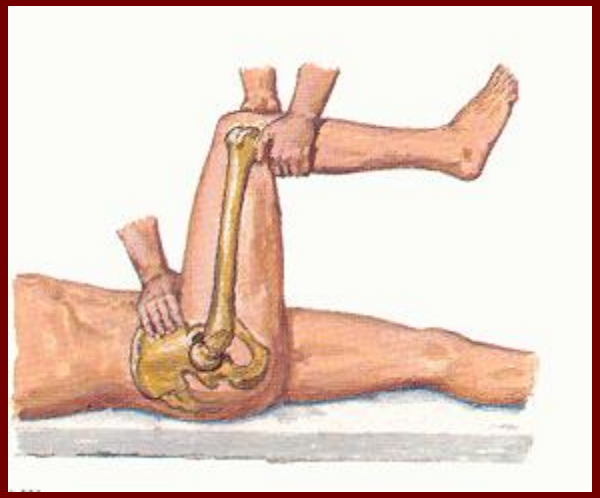
- Emergent Treatment: Closed Reduction
  - Dislocated hip is an emergency
  - Goal is to reduce risk of AVN and DJD
  - Allows restoration of flow through occluded or compressed vessels
  - Literature supports decreased AVN with earlier reduction
  - Requires proper anesthesia
  - Requires “team” (i.e. more than one person)

Hip Dislocations

- Emergent Treatment: Closed Reduction
  - General anesthesia with muscle relaxation facilitates reduction, but is not necessary
  - Conscious sedation is acceptable
  - Attempts at reduction with inadequate analgesia/ sedation will cause unnecessary pain, cause muscle spasm, and make subsequent attempts at reduction more difficult

Hip Dislocations

- Emergent Treatment: Closed Reduction
- Allis Maneuver
  - Assistant stabilizes pelvis with pressure on ASIS
  - Surgeon stands on stretcher and gently flexes hip to 90deg, applies progressively increasing traction to the extremity with gentle abduction + ext. rotation / adduction + internal rotation
  - Reduction can often be seen and felt



Hip Dislocations

- Following Closed Reduction
  - Check stability of hip to 90deg flexion
  - Repeat AP pelvis
  - Judet views of pelvis (if acetabulum fx)
  - CT scan with thin cuts through acetabulum
  - R/O bony fragments within hip joint (indication for emergent OR trip to remove incarcerated fragment of bone)

Hip Dislocations

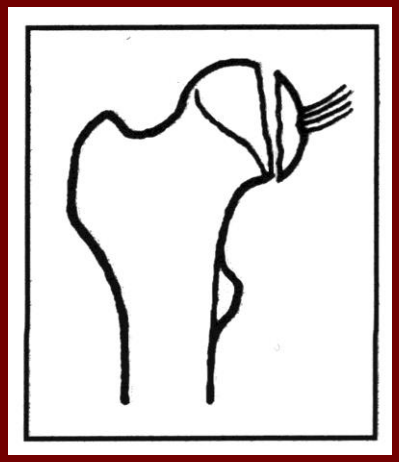
- Following Closed Reduction
  - No flexion > 60deg (Hip Precautions)
  - Early mobilization
  - TTWB for 4-6 weeks
  - MRI at 3 months (follow risk of AVN)

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

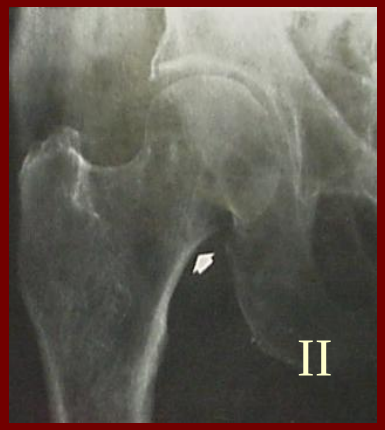


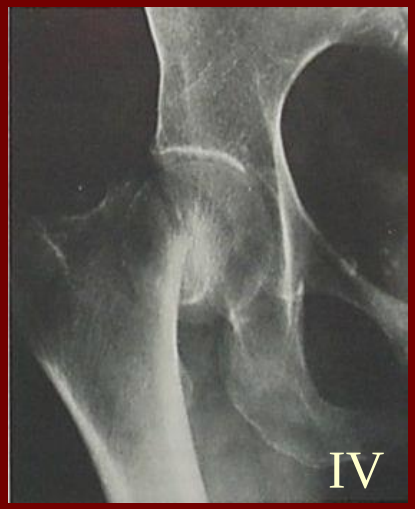
Femoral Head Fractures

- Treatment Options
  - Type I
    - Nonoperative: non-displaced
    - ORIF or extirpation if displaced
  - Type II: ORIF/TEP
  - Type III: TEP/ORIF of both fractures
  - Type IV: ORIF/hemiarthroplasty/TEP

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

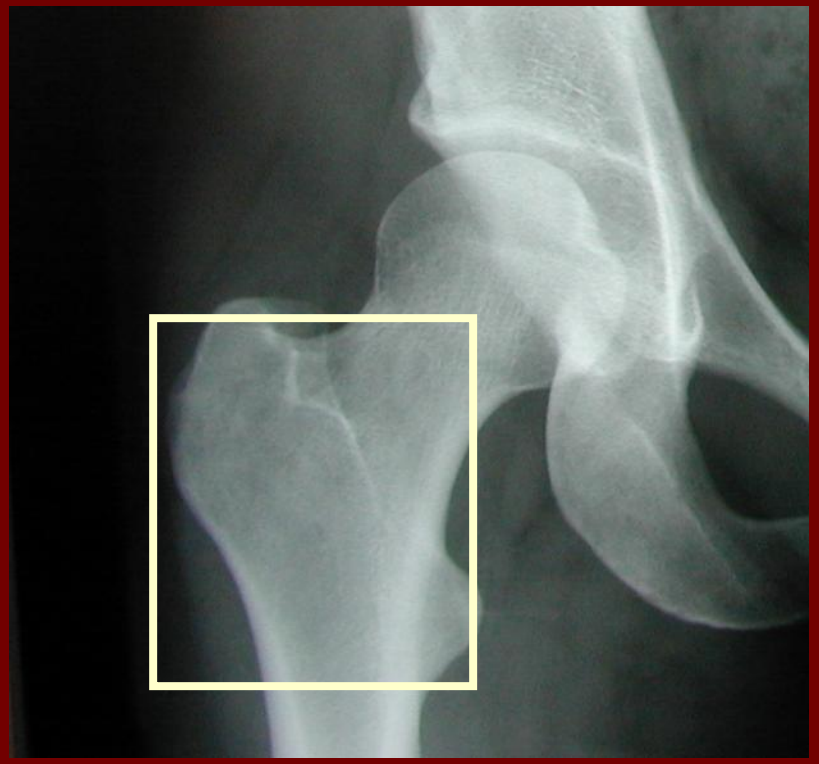
THR

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

Pertrochanteric Hip Fx

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



Pertrochanteric Hip Fx

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

Pertrochanteric 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**

Pertrochanteric Hip Fx

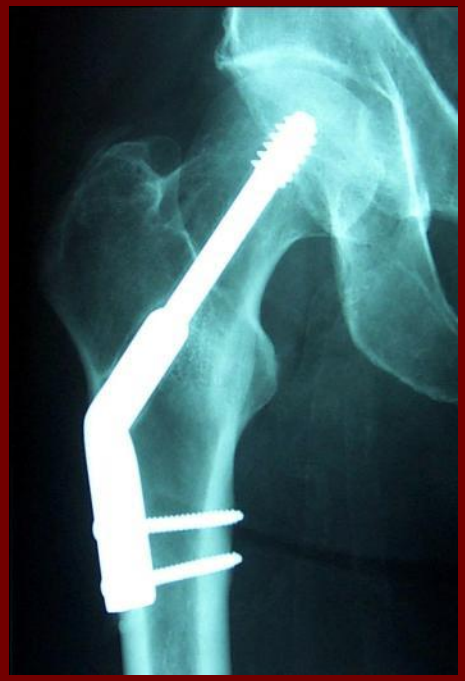
Stable

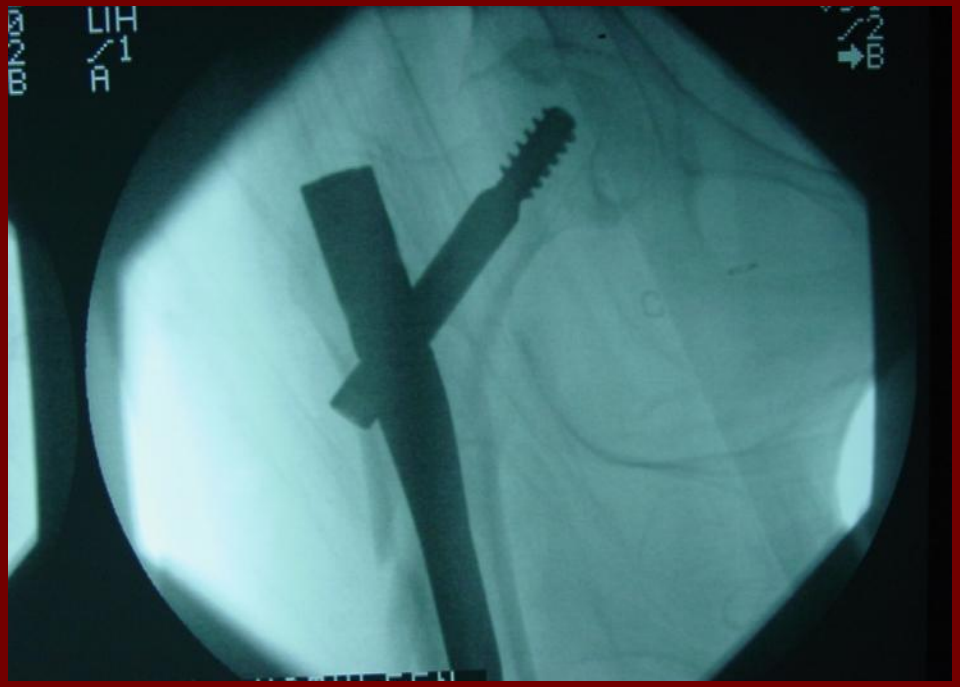
Unstable

Reverse Obliquity

Pertrochanteric Hip Fx

- Treatment Options
  - Stable: Dynamic Hip Screw
  - Unstable/Reverse: PFN, Gama Nail



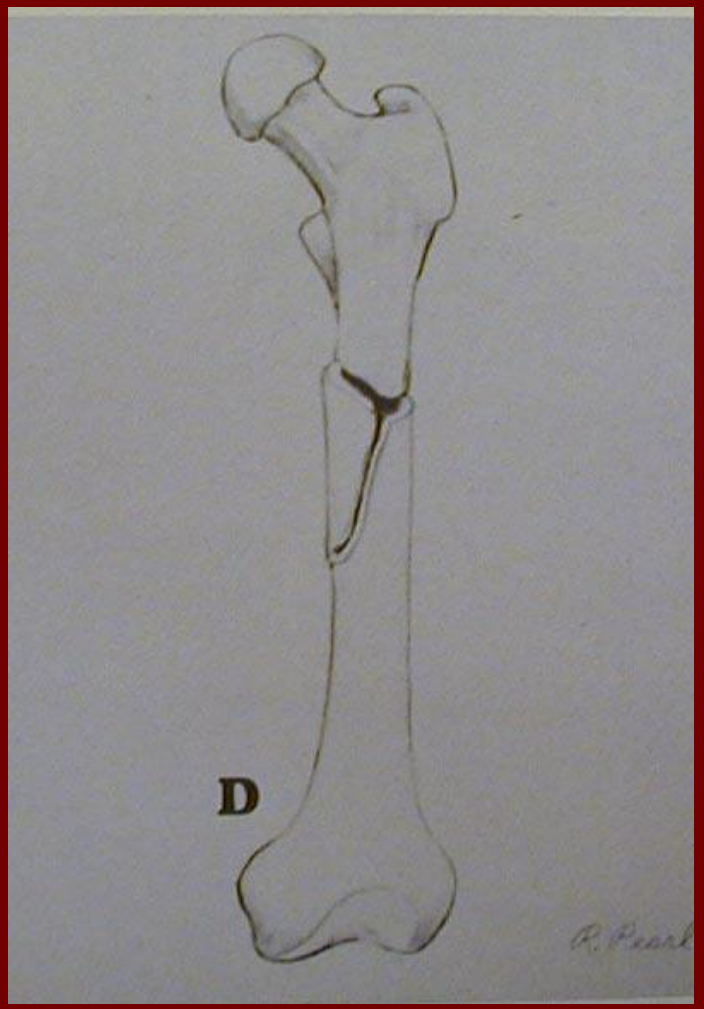


Subtrochanteric Femur Fx

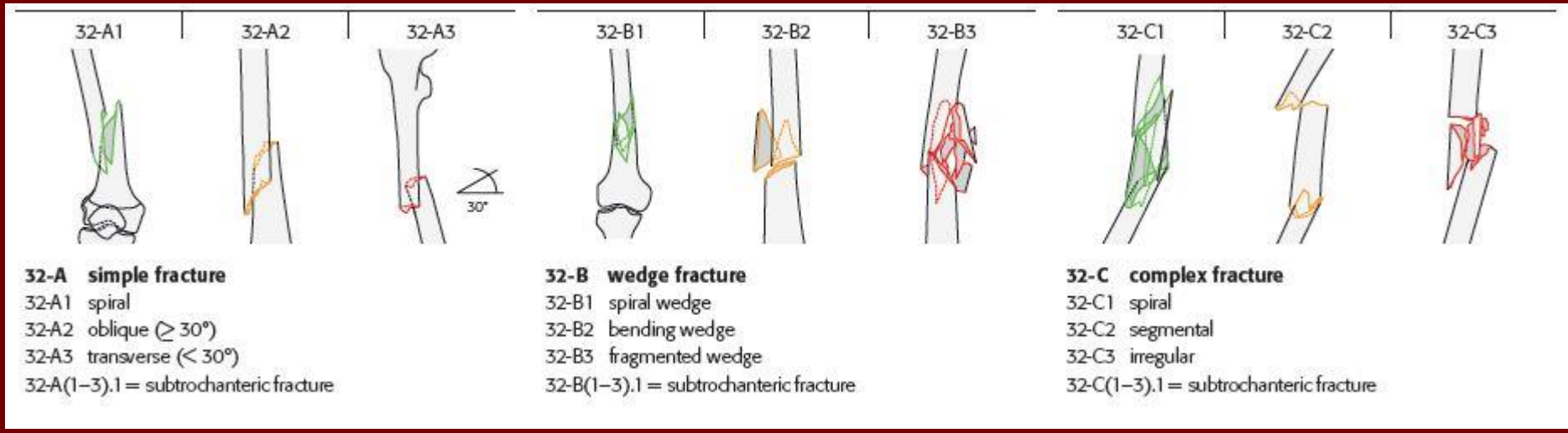
- Classification
  - Located from LT to 5cm distal into shaft
  - Intact Piriformis Fossa?
- Treatment
  - IM Nail
  - Cephalomedullary IM Nail
  - ORIF

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



32-A simple fracture
32-A1 spiral
32-A2 oblique (≥ 30°)
32-A3 transverse (< 30°)
32-A(1–3).1 = subtrochanteric fracture

32-B wedge fracture
32-B1 spiral wedge
32-B2 bending wedge
32-B3 fragmented wedge
32-B(1–3).1 = subtrochanteric fracture

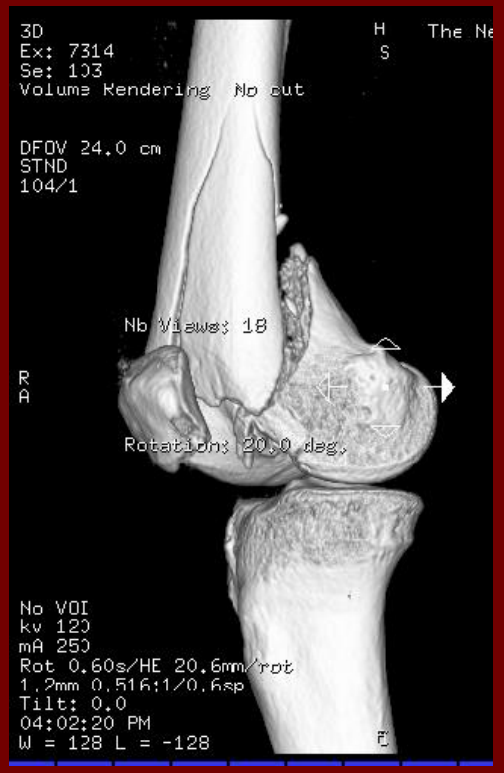
32-C complex fracture
32-C1 spiral
32-C2 segmental
32-C3 irregular
32-C(1–3).1 = subtrochanteric fracture

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

Distal Femur Fractures

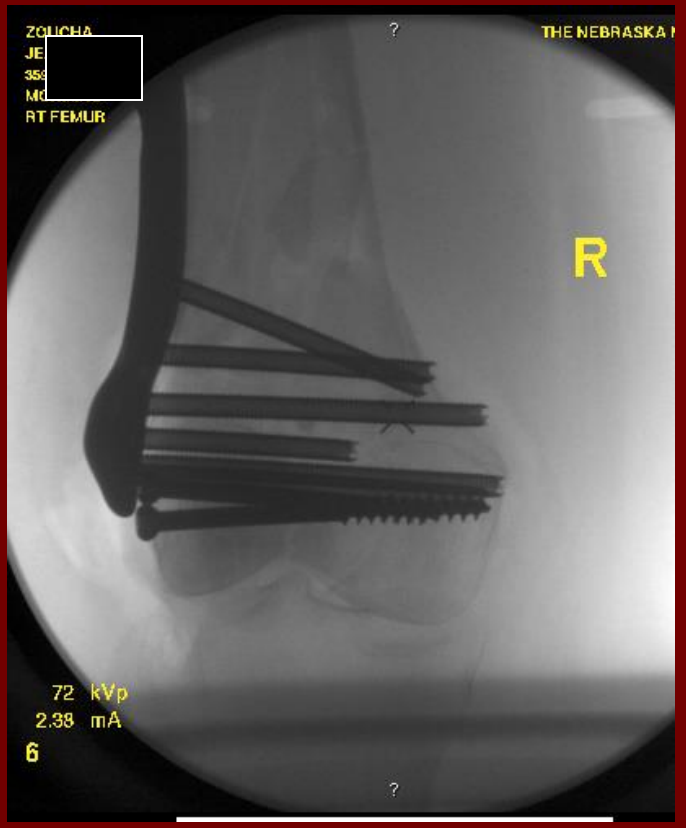
- Distal Metaphyseal Fractures
- Look for intra-articular involvement
- Plain films
- CT



Distal Femur Fractures

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

Distal Femur Fractures



Knee Dislocations

- High association of injuries
  - Ligamentous Injury
    - ACL, PCL, Posterolateral Corner
    - LCL, MCL
  - Vascular Injury
    - Intimal tear vs. Disruption
    - US → CT Angio
    - Vascular surgery consult with repair within 8hrs
  - Peroneal >> Tibial N. injury

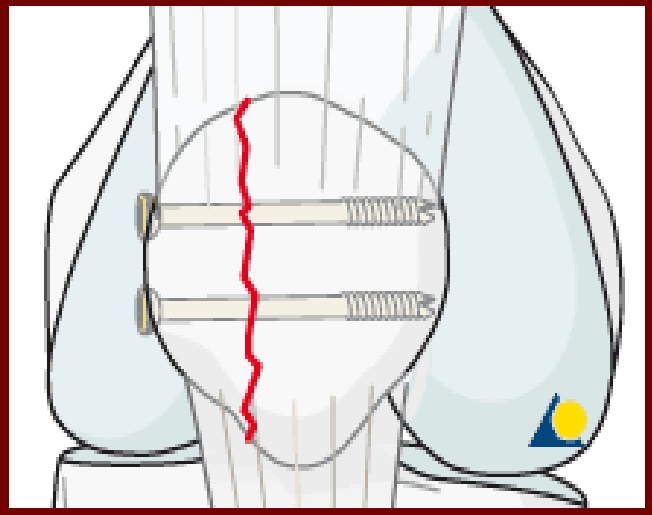
Patella Fractures

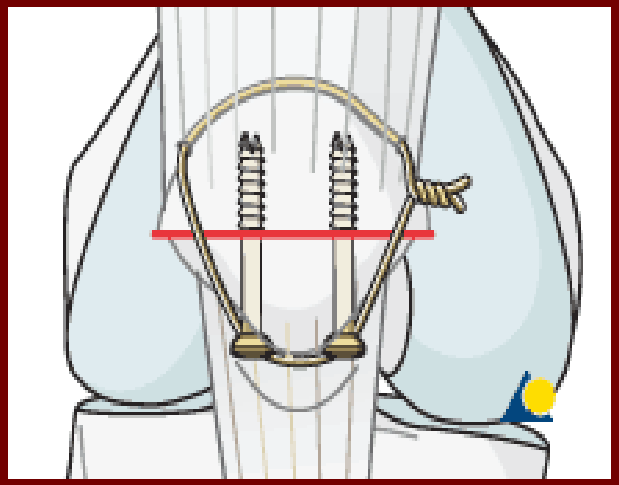
- History
  - MVA, fall onto knee, eccentric loading
- Physical Exam
  - Ability to perform straight leg raise against gravity (ie, extensor mechanism still intact?)
  - Pain, swelling, contusions, lacerations and/or abrasions at the site of injury
  - Palpable defect

Patella Fractures

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

Patella Fractures





Tibia Fractures

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

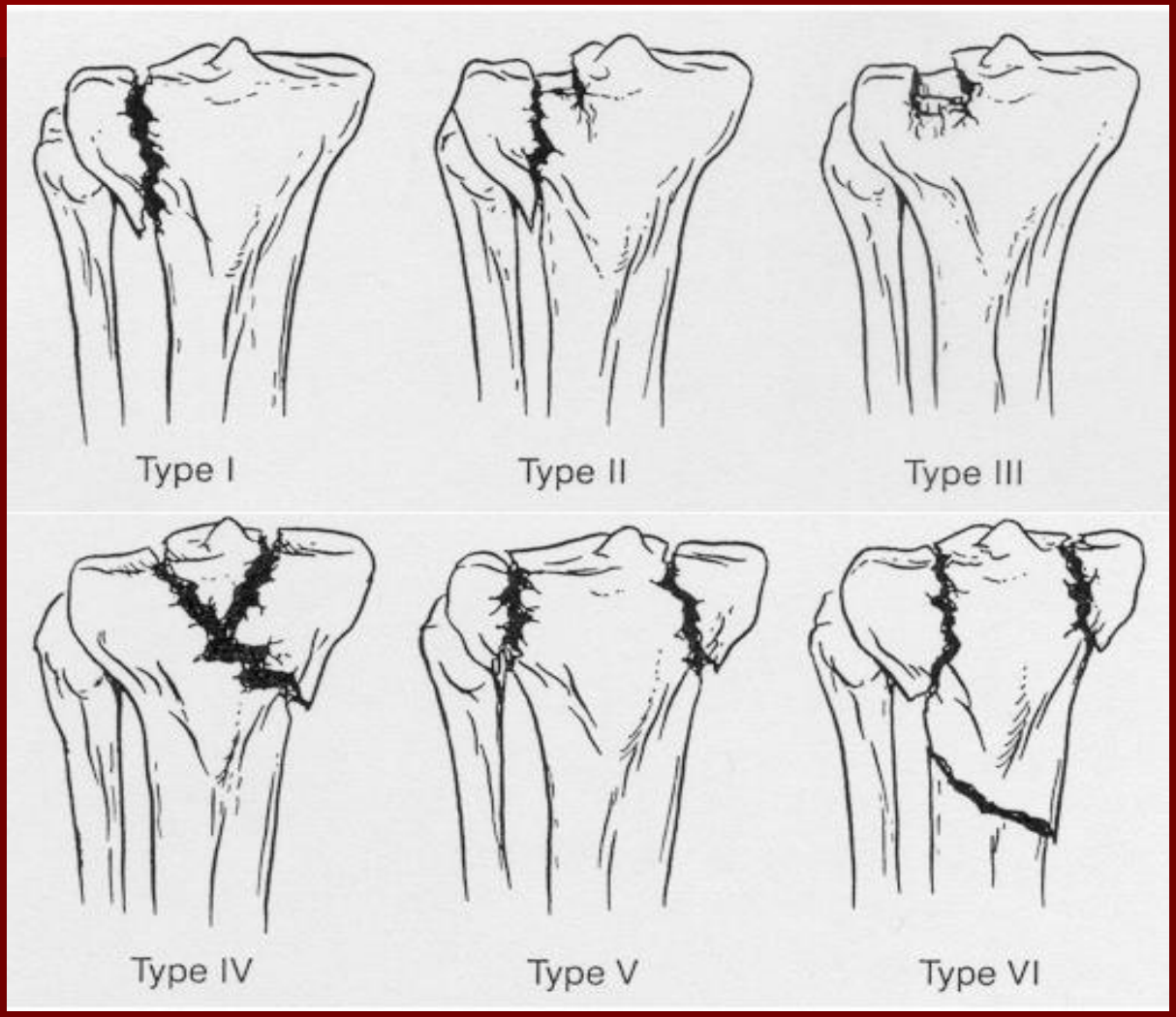
Tibial Plateau Fractures

- 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
- 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, >2-5mm articular stepoff
  - Non-operative rare, in non-displaced stable fractures or patients with GA contraindication

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
  - Soft tissues
  - 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

- Tscherne Classification of Soft Tissue Injury
  - Grade 0- Negligible soft tissue injury
  - Grade 1- Superficial abrasion or contusion
  - Grade 2- Deep contusion from direct trauma
  - Grade 3- Extensive contusion and crush injury with possible severe muscle injury

Tibial Shaft Fractures

- Management of Open Fx Soft Tissues
  - **ER**: initial evaluation → wound covered with sterile dressing and leg splinted, tetanus prophylaxis and appropriate antibiotics
  - **OR**: Thorough tratment undertaken within 6 hours with serial debridements as warranted followed by definitive soft tissue cover

Tibial Shaft Fractures

- Definitive Soft Tissue Coverage
  - Proximal third tibia fractures can be covered with gastrocnemius rotation flap
  - Middle third tibia fractures can be covered with soleus rotation flap
  - Distal third fractures usually require free flap for coverage

Tibial Shaft Fractures

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

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

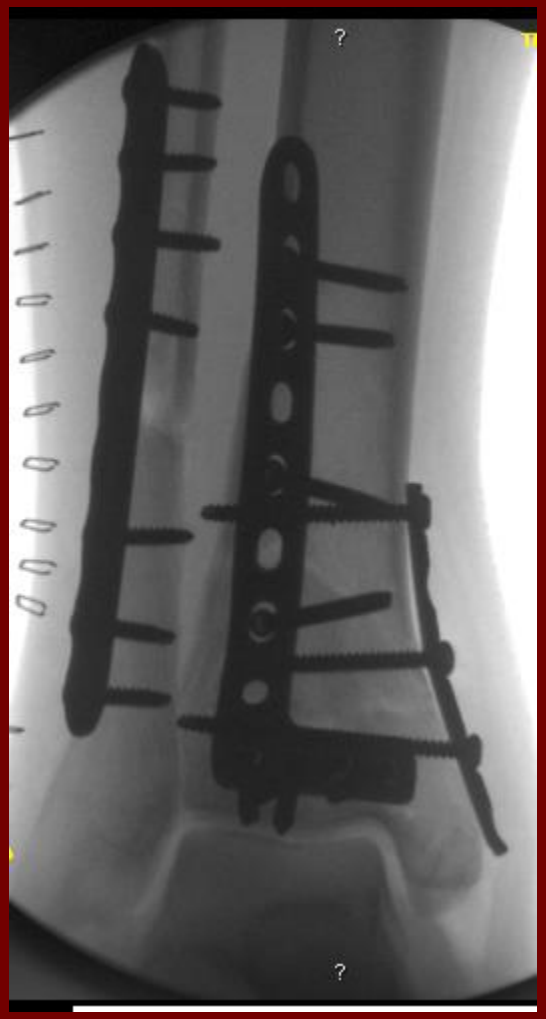
Tibial Pilon Fractures

- 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



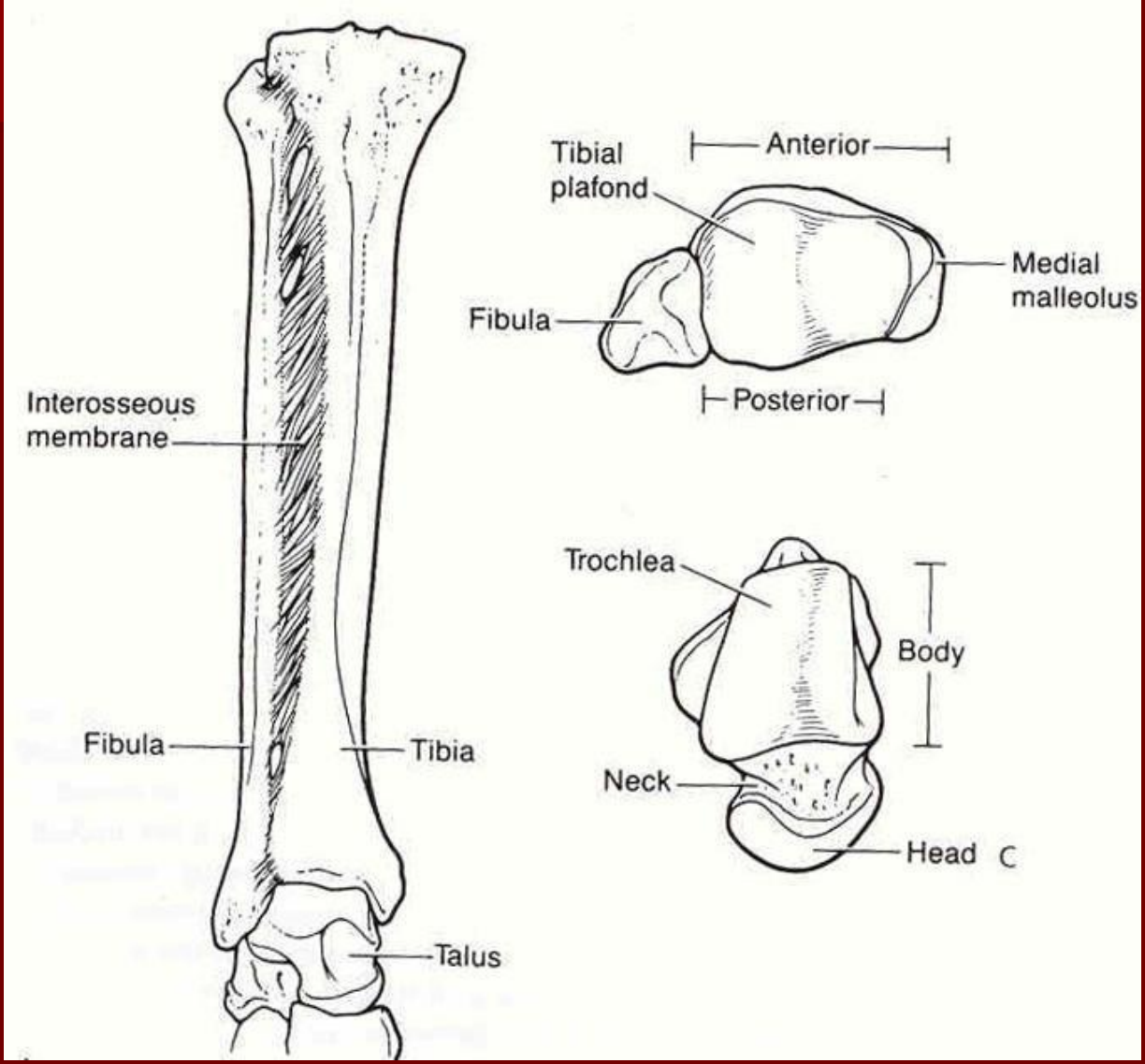
Tibial Pilon Fractures

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

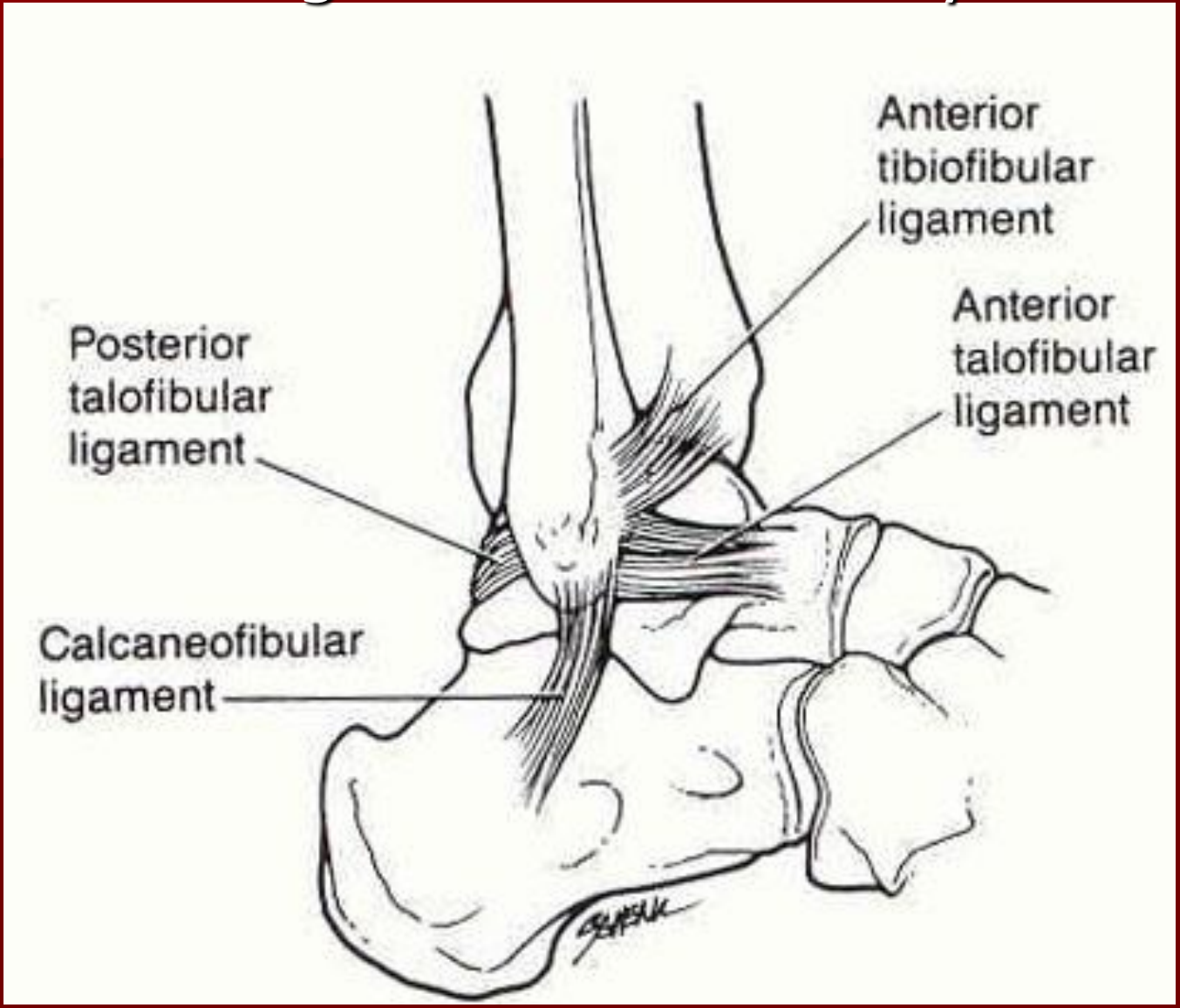
Ankle Fractures

- 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%

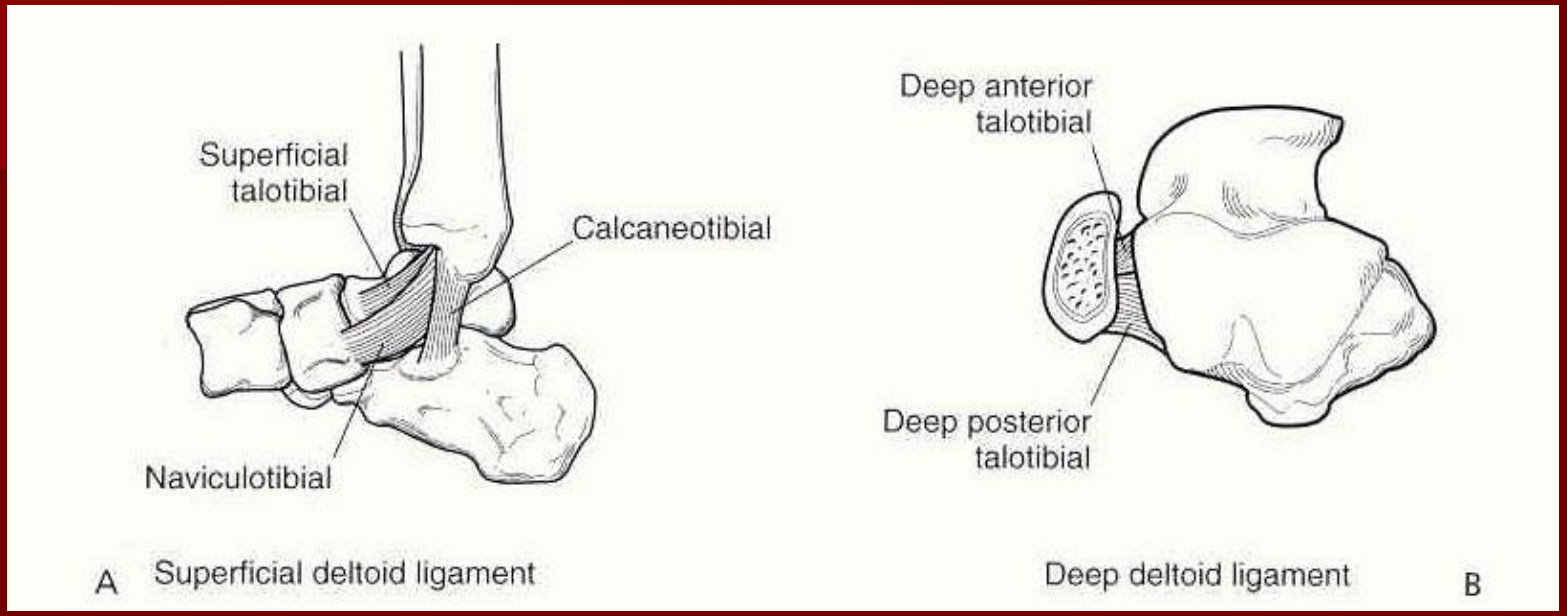
- Osseous Anatomy



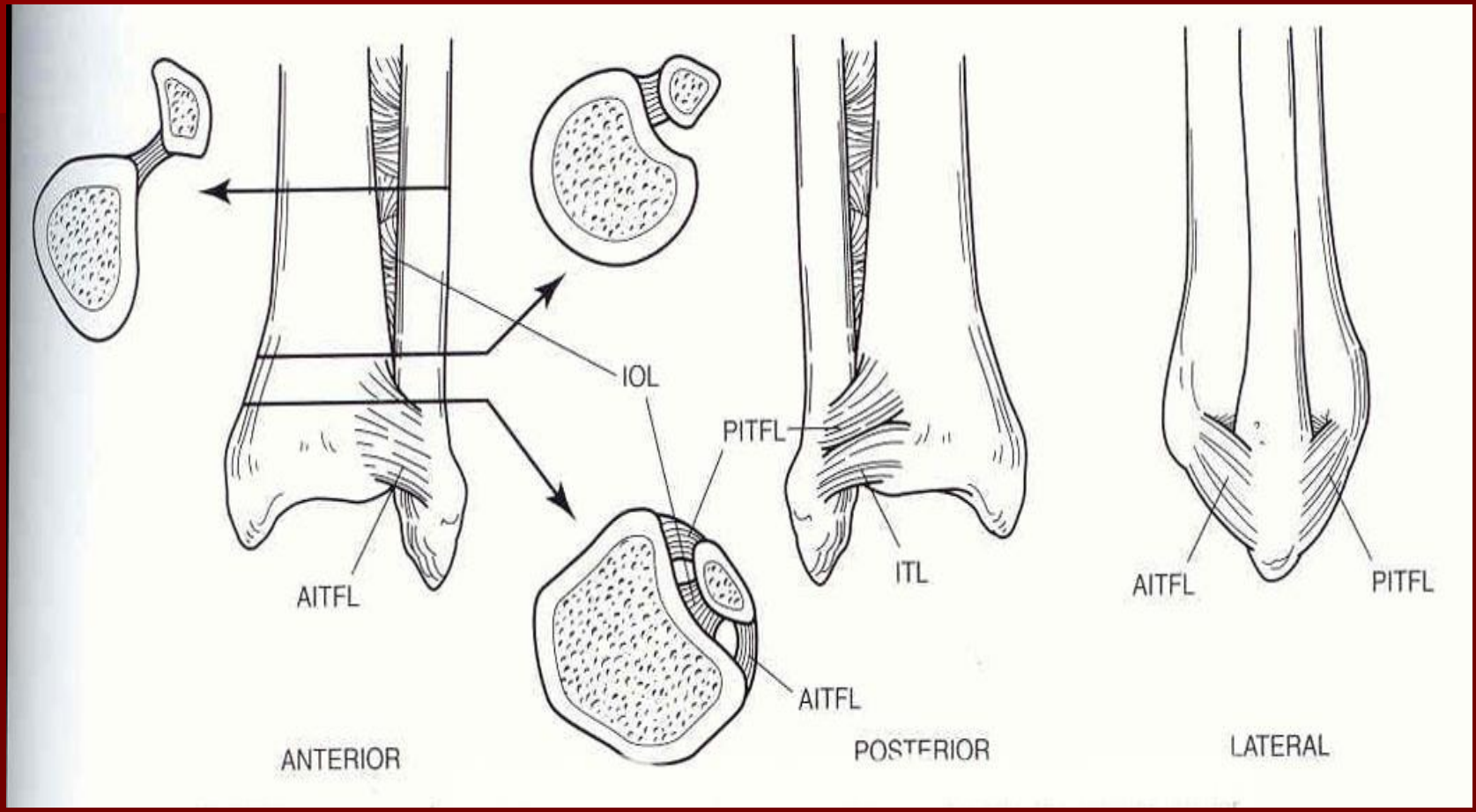
- Lateral Ligamentous Anatomy



Medial Ligamentous Anatomy



- Syndesmosis Anatomy



Ankle Fractures

- History
  - Mechanism of injury
  - Time elapsed since the injury
  - Soft-tissue injury
  - Has the patient ambulated on the ankle?
  - Patient's age / bone quality
  - Associated injuries
  - Comorbidities (DM, smoking)

Ankle Fractures

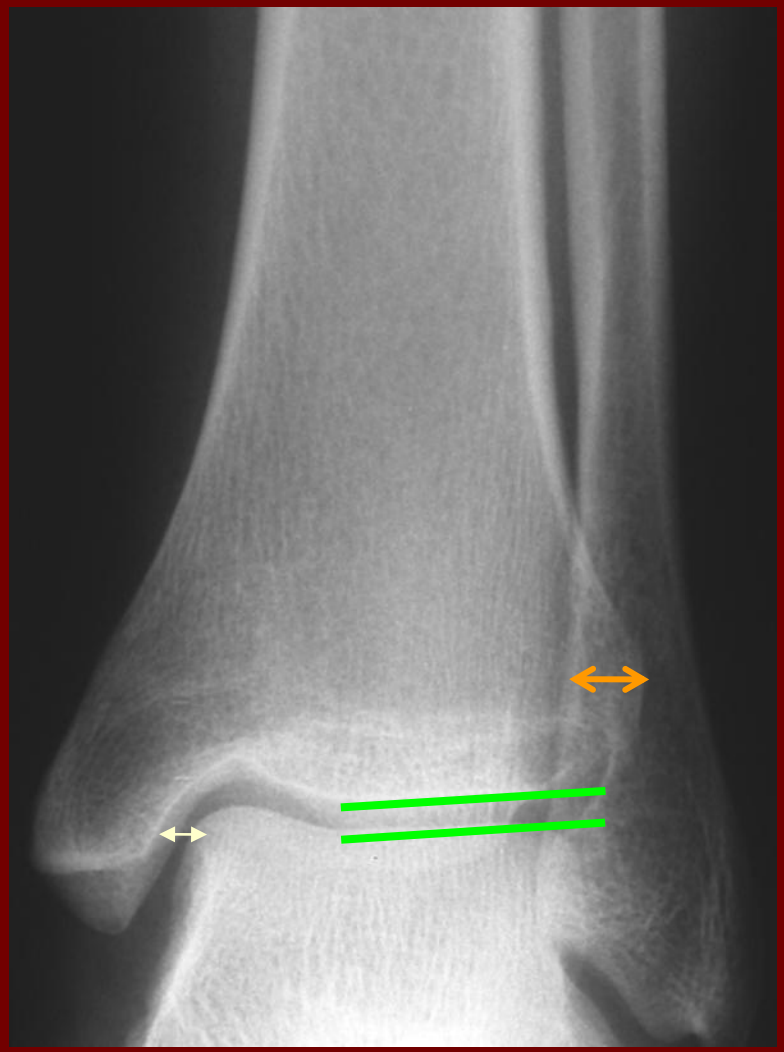
- Physical Exam
  - Neurovascular exam
  - Note obvious deformities
  - Pain over the medial or lateral malleoli
  - Palpation of ligaments about the ankle
  - Palpation of proximal fibula, lateral process of talus, base of 5^{th} MT
  - Examine the hindfoot and forefoot

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
  - Medial clear space
    - >4mm is abnormal - implies injury



Ankle Fractures

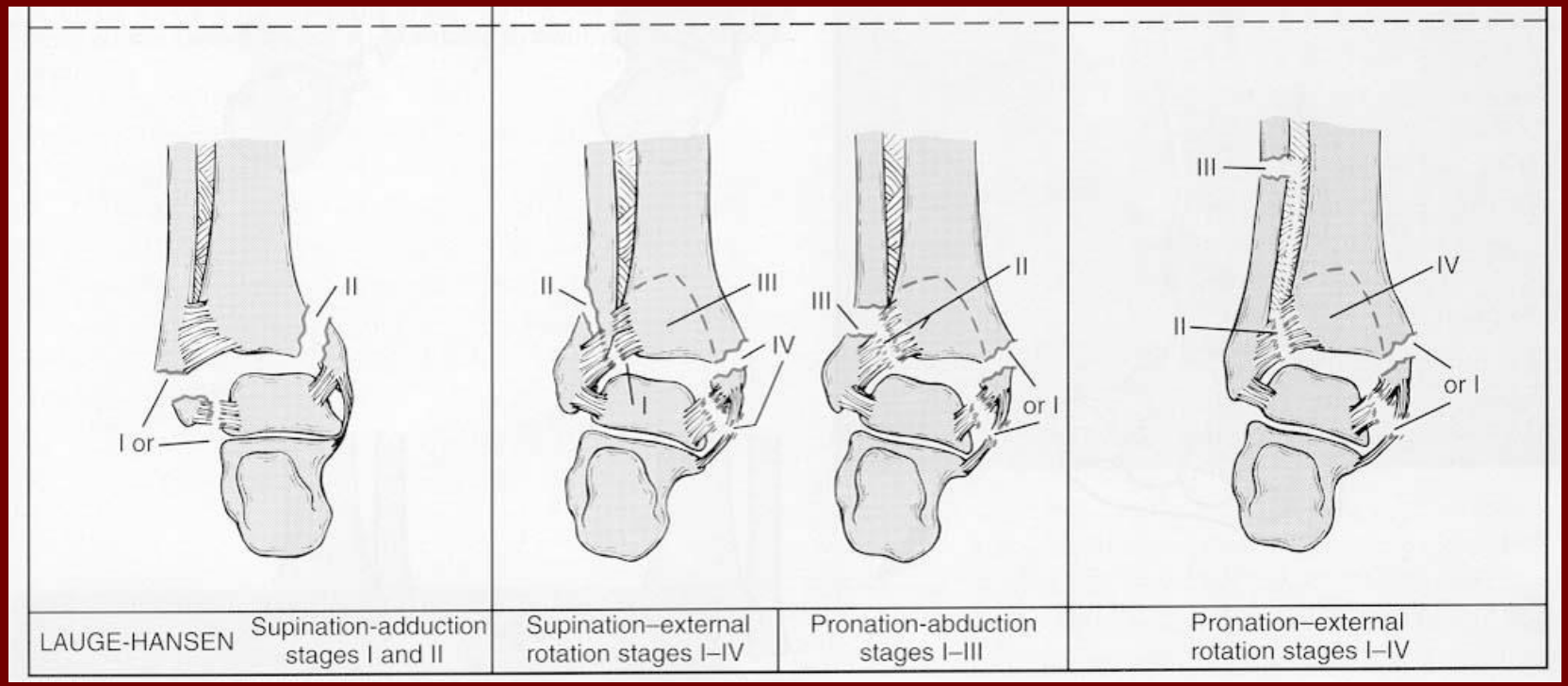
- Ankle Mortise View
  - Foot is internally rotated and AP projection is performed
  - Abnormal findings:
    - Medial joint space widening
    - Talocural angle <8 or >15 degrees (compare to normal side)
    - Tibia/fibula overlap <1mm

Ankle Fractures

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

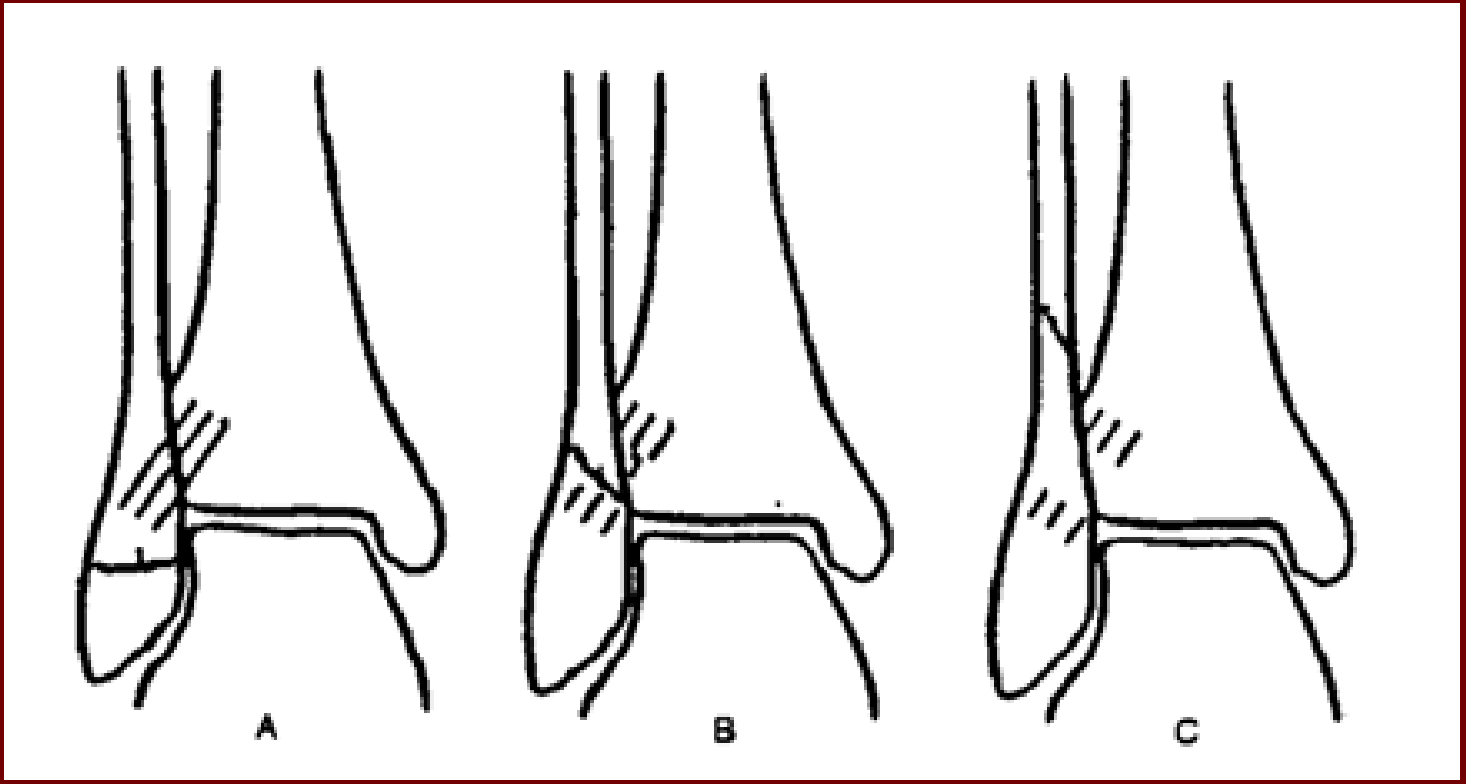
Ankle Fractures

- Classification Systems (Lauge-Hansen)
  - Based on cadaveric study
  - First word refers to position of foot at time of injury
  - Second word refers to force applied to foot relative to tibia at time of injury



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

- Initial Management
  - Closed reduction (conscious sedation may be necessary in pediatrics)
  - AO splint
  - Delayed fixation until soft tissues stable
  - Pain control
  - Monitor for possible compartment syndrome in high energy injuries

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:
  - NWB 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