FROM THE ER TO THE OR: TIMELY ORTHOPAEDIC EMERGENCIES

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Personal Disclosures

- None

Objectives

1. Be able to identify musculoskeletal emergencies that require immediate orthopaedic consultation.

2. Differentiate from urgent and emergent conditions based on clinical presentation and diagnostics.

3. Discern vital information and relate findings to an orthopaedic specialist.

4. Understand first-line treatment options for common musculoskeletal emergencies.

DISLOCATIONS

SHOULDER

Shoulder Dislocation

- Make up 50% of all major joint dislocations
- Anterior dislocation in 95-97% of patients
- Posterior dislocation 2-4%
- Inferior dislocation 0.5%
- Axillary nerve is the most commonly injured nerve in shoulder dislocations

Anterior Shoulder Dislocation

- MOI:
  - Usually a blow to an abducted, extended and externally rotated arm
  - Less common, blow to posterior humerus or fall on extended arm

- Exam:
  - Typically arm is slightly abducted and externally rotated
  - Extreme discomfort with all movement
  - May be loss of rounded appearance of shoulder and prominent acromion
  - Thorough neurovascular exam : Distal pulses, axillary nerve function, deltoid muscle weakness (may resolve with reduction)

Anterior Shoulder Dislocation

- Imaging:
- Plain radiographs pre and post reduction: Confirm diagnosis and exclude fractures
- Routine films : AP, scapular and axillary view
- Fractures in up to 25% of dislocations
  - Observe for surgical neck fracture of the humeral head: reduction in this setting can result in avascular necrosis of the humeral head

- Evaluate for associated injuries:
  - Hill-Sachs deformity 35-40% of patients (cortical depression of humeral head)
  - Bankart lesion (disruption of glenoid labrum with avulsed bone fragment)
  - Greater tuberosity fractures

Anterior Shoulder Dislocation

Case courtesy of Dr Jeremy Jones, Radiopaedia.org, rID: 7132

Anterior Shoulder Dislocation

- Reduction:
  - Many different methods
- Scapular manipulation:
  - Typically quick and well tolerated by patient
  - Requires an assistant
  - Upright technique:
    - Head of bed at 90 degrees
    - Patient dangles legs over side of bed and rests uninjured shoulder against upright aspect of bed
    - Push tip of scapula medially and acromion inferiorly, rotating the scapula
    - Assistant gives gentle downward and forward traction on the arm at the elbow while stabilizing the wrist

Anterior Shoulder Dislocation

- External rotation:
  - Well tolerated
  - Requires one clinician
  - Success in 80-90% of patients
  - Patient lies supine, elbow flexed at 90 degrees
  - Elbow is grasped to maintain adducted position of arm
  - Ask patient to let arm fall to their side while clinician slowly externally rotates the arm (holding the hand of the patient)

Posterior Shoulder Dislocation

- MOI:
  - Blow to the anterior aspect of the shoulder
  - Axial loading of internally rotated and adducted arm
  - Violent muscle contraction secondary to electrocution or seizure activity

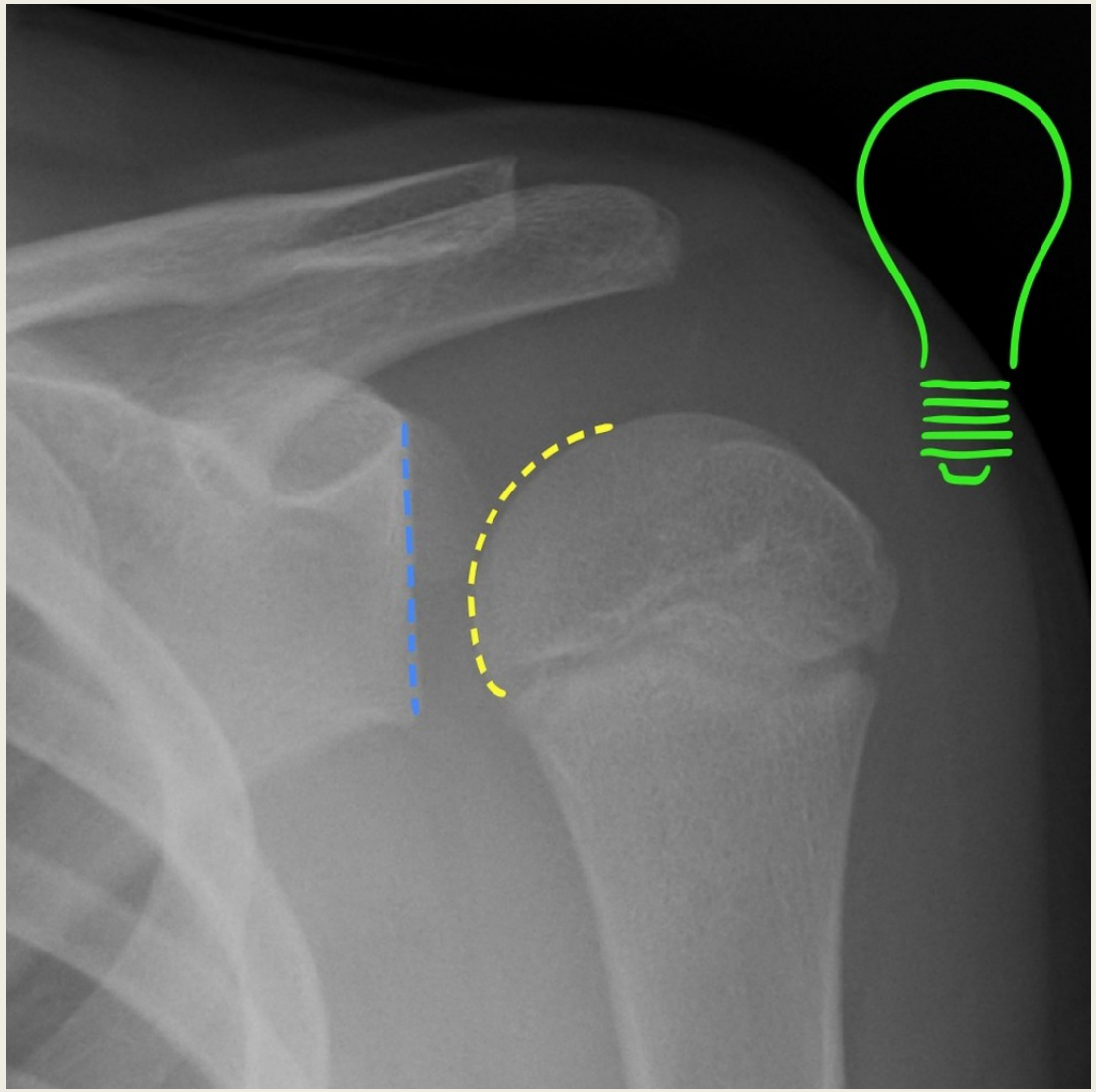
- Exam:
  - Patient holds arm in internal rotation and adduction
  - Inability to externally rotate the affected arm
  - Prominent posterior shoulder or flattening anteriorly
  - Coracoid process appears prominent

Posterior Shoulder Dislocation

- Imaging:
  - Radiographic evidence on AP view can be subtle (undetected in 50% of cases)
  - “Light bulb” sign: Internal rotation of humeral head results in tuberosities no longer projection laterally, gives humeral head a rounded appearance like a light bulb
- CT diagnostic if radiographs indeterminate
- US

- Evaluate for associated injuries:
  - Commonly associated with tuberosity and surgical neck fractures of the humerus
  - Reverse Hill-Sachs lesion (impaction fracture on the articular surface of the humeral head)
  - Injury to labrum/rotator cuff

Posterior Shoulder Dislocation



Case courtesy of Dr Alexandra Stanislavsky, Radiopaedia.org, rID: 10778

Posterior Shoulder Dislocation

- Reduction:
  - Axial traction on adducted arm with elbow flexed
  - While traction applied, internally rotate and adduct the arm
  - Direct pressure on posterior aspect of humeral head or looped sheet under the axilla to disengage the glenoid rim

  - Need for open reduction under general anesthesia:
    - Reverse Hill-Sachs deformity involving >25% of humeral head
    - Dislocations $\geq$ 3 weeks

Inferior Shoulder Dislocation

- MOI:
  - Most commonly axial load with arm fully abducted
  - Forceful hyperabduction of the arm

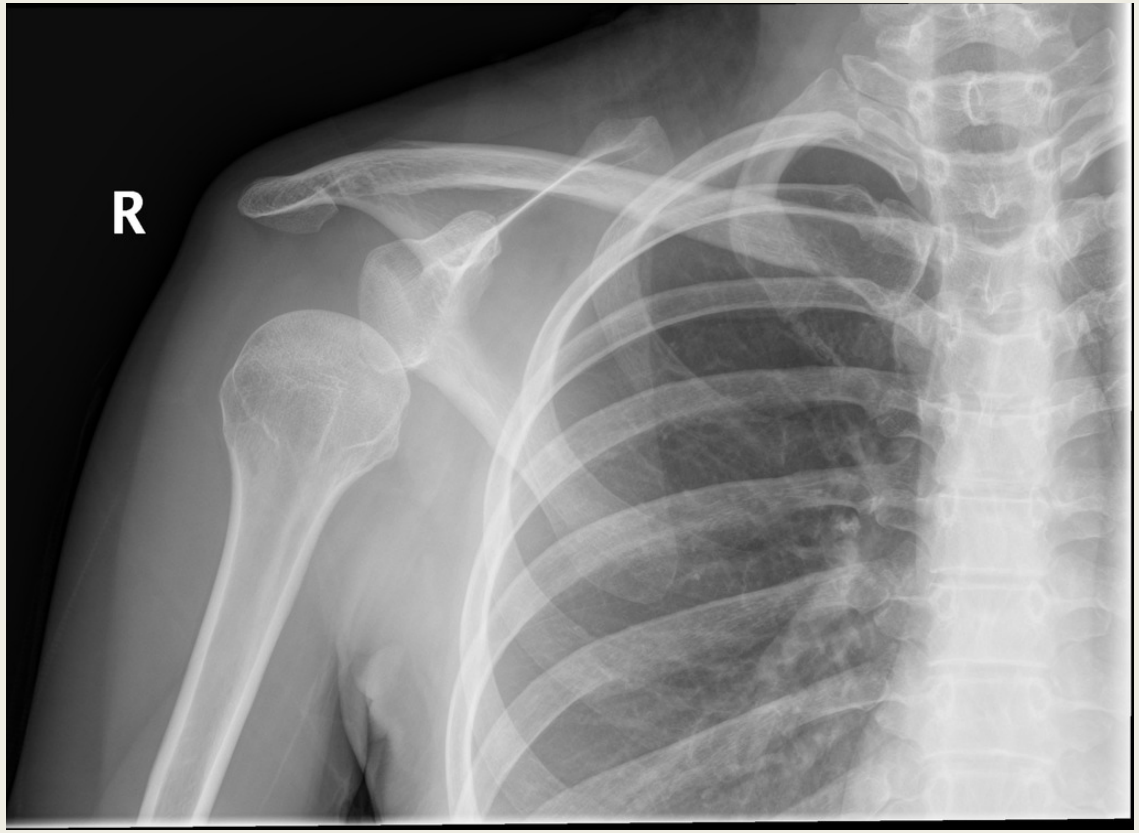
- Exam:
  - Patient will hold the injured arm above their head
  - Inability to adduct the arm, forearm pronated
  - Neurologic dysfunction in 60% of patients
  - Check distal pulses, concern for arterial injury

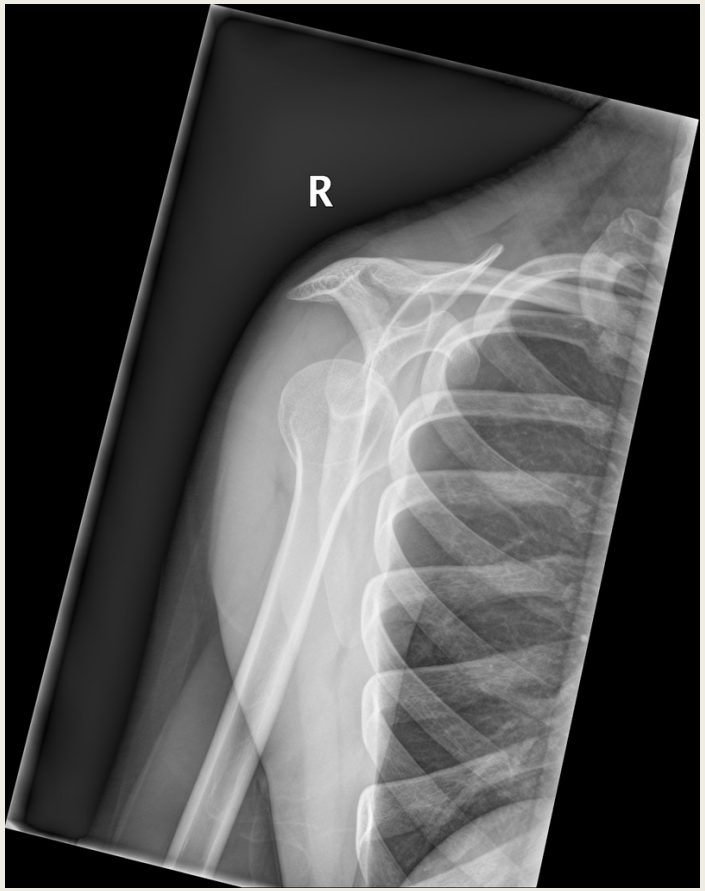
Inferior Shoulder Dislocation

- Imaging:
  - Radiographs will show humeral head beneath the coracoid or glenoid

- Evaluate for associated injuries:
  - Common fractures: greater tuberosity, acromion, scapula, humeral head, coracoid, glenoid
  - Axillary nerve damage 60%
  - Arterial injury 3%

Inferior Shoulder Dislocation





Case courtesy of Dr Henry Knipe, Radiopaedia.org, rID: 45991

Inferior Shoulder Dislocation

- Reduction:
  - Traction/counter-traction in line with the abducted humerus
  - Gentle, prolonged adduction of the arm
  - Closed reduction typically successful

  - Need for open reduction under general anesthesia:
    - Sometimes required if humeral head becomes confined in a tear in the inferior capsule

Reduction Procedure Considerations

- Recent/recurrent/nontraumatic ant. dislocations can often be reduced without analgesia
- Options for analgesia:
  - Intraarticular lidocaine
  - US guided interscalene block
  - Procedural sedation and anesthesia
- Procedural sedation and anesthesia
  - Done to relieve pain and reduce spasm, especially if significant traction will be utilized
  - Pulse oximetry
  - IV placement
  - Airway equipment at bedside
- Orthopedic consult prior to reduction attempts:
  - For elderly patients with subacute dislocations
  - If surgical neck fracture is identified

Shoulder Dislocation Follow-up Care

- Immobilization in adduction and internal rotation (sling, swathe, etc)
- Referral to Orthopedic specialist within one week with uncomplicated dislocation/reduction
  - Most common complication recurrent dislocation
- Consult Ortho emergently for possible operative treatment:
  - Irreducible dislocations
  - Fractures
  - Significant Bankart and Hill-Sachs lesions/fractures
- Physical therapy and rehabilitation

DISLOCATIONS

KNEE

Knee Dislocation

- Surgical emergency with high incidence of neurovascular injury
- MOI: typically high-energy trauma or may be low-energy trauma on sports-related activity or in obese patients
  - *Dashboard injury: posterior dislocations*
  - *Hyper extension: anterior dislocations (more common)*
  - *Medial or lateral: valgus or varus tibial forces*
- Associated injuries
  - *Peroneal > tibial nerve*
  - *Popliteal artery (20-40%)*
  - *Multiple ligament or tendon injury*
  - *Fractures (60%)*

Knee Dislocation: Clinical Presentation

- Obvious deformity or minimal signs of trauma
  - *50% spontaneously reduce*
- Grossly unstable joint
- Vascular exam
  - *Pulses present: Ankle-Brachial Index (ABI)*
    - >0.9: continue to monitor serially
    - <0.9: arterial duplex ultrasound or CT angiography
  - *Pulses absent: must confirm reduction*
    - Immediate surgical exploration
    - Risk for amputation significantly increases >8 hours

Knee Dislocation: Imaging

- Radiographs: pre and post reduction AP/Lat
- CT can better define fractures following reduction
- MRI needed following reduction prior to hardware placement to fully assess soft tissue involvement

Case courtesy of Dr Craig Hacking, Radiopaedia.org, rID: 48246

Knee Dislocation: Management

- Emergent reduction with assessment of limb perfusion
  - *Often requires orthopaedic surgical fixation*
  - *+/- Vascular surgery*
- Thoroughly evaluate for possible spontaneous reduction for complete management
  - *Commonly missed or misdiagnosed*
- Serial vascular assessments

HIP DISLOCATION VS PROXIMAL FEMORAL FRACTURE

Hip Dislocation

- Survival of the femoral head requires reduction within 6-8 hours
- MOI: High energy trauma or fall
  - *MVA: dashboard injury*
  - *80% have other associated injuries*
- 90% of dislocations are posterior dislocations
  - *Simple: dislocation only*
  - *Complex: dislocation with associated fracture*

Proximal Femoral Fractures

- Increases risk of death and major morbidity in elderly
- Prognosis: mortality 25-30 % within the first year (10% within 1 month)
- MOI:
  - *Falls: Elderly with osteoporosis*
  - *High energy trauma*
  - *Stress and pathologic fx*
- Femoral neck fractures are intracapsular
  - *Retrograde blood requires emergent fixation if pt stable*

Hip Dislocation: Clinical Presentation

- Painful!
- Posterior Dislocation
  - *Fixed position: adduction and internally rotation*
  - *Inability to weight bear*
  - *Leg will appear shorter*
- Anterior Dislocation: Slight abduction and external rotation

- Neurovascular function check
  - *Focus on sciatic nerve distribution*

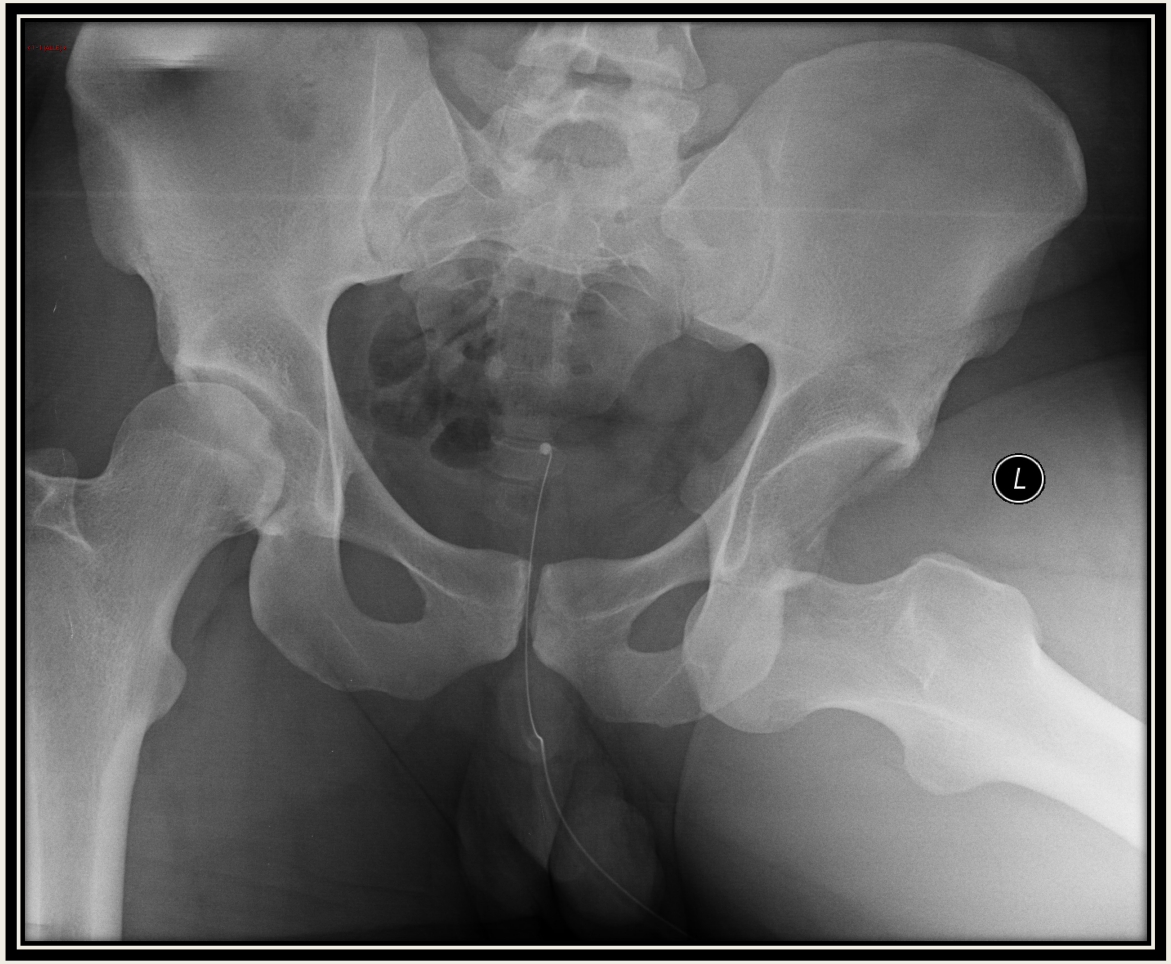
Proximal Femoral Fractures : Clinical Presentation

- Pain to groin and radiates to inner thigh
- Leg may appear shorter
- Will hold the leg in external rotation/abduction
- Difficulty with flexion and internal rotation

Hip Dislocation: Imaging

- Pre-reduction AP pelvis and lateral hip radiographs confirm dislocation and help to rule-out fx
- Post reduction may include additional views including inlet/outlet views and/or Judet view)
  - *CT scan needed for posttraumatic hip dislocations to assess for fracture/loose body*

Anterior Hip Dislocation



Case courtesy of Dr Sajoscha Sorrentino, Radiopaedia.org, rID: 14836

Posterior Hip Dislocation

Case courtesy of Dr Gagandeep Singh, Radiopaedia.org, rID: 7260

Proximal Femoral Fractures: Imaging

- Plain Radiographs: AP pelvis & lateral hip
  - *Consider visualization of the full femur to include the knee in trauma*
- CT helpful to evaluate displacement
- MRI if high suspicion and neg. x-rays

Case courtesy of Dr Benoudina Samir, Radiopaedia.org, rID: 22392

Hip Dislocations and Proximal Femoral Fractures: Management

- Non-weightbearing
- Adequate analgesia
- Prophylaxis for DVT
- Orthopaedic Consult

Potential Complications:

AVN

Infection

DVT/PE

Fx Nonunion

Post-traumatic arthritis

Osteonecrosis

Sciatic nerve injury

Hip dislocation: Emergent Reduction within 6 hours

- *Surgery reserved for complicated reductions or associated injuries*

Fracture: Emergent fixation when appropriate

- *ORIF vs arthroplasty*

OPEN FRACTURE

Open Fractures

- Soft tissue wound in proximity of a fracture should be considered open until proven otherwise!

- Osteomyelitis occurs in the setting of up to 25% of open fractures dependent on the following:
  - Severity of fracture and soft tissue involvement
  - Amount of bacterial contamination
  - Vascular supply
  - **Quality of surgical debridement**
  - **“Prophylactic” antibiotics**

Open Fractures: Clinical Presentation

- Open fractures may be obvious, or a subtle puncture wound
  - Entire limb must be closely inspected (smaller wounds can be missed)
- Isolated fracture or associated with multiple injuries
  - Treat as a trauma patient
  - Tibia is the most commonly involved
- Document neurovascular exam and maintain regular checks
  - Pulses, sensation, passive stretching

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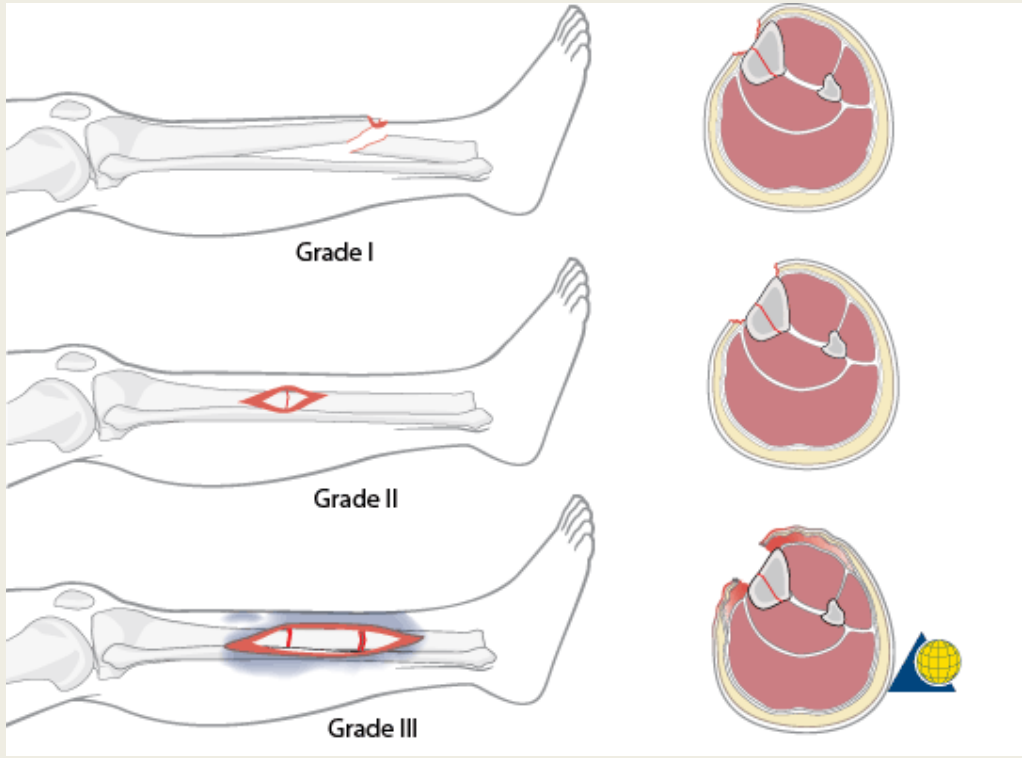
Open Fractures: Grading

- Gustilo-Anderson Grading
  - **Type I**: Wound < 1 cm with minimal contamination and adequate soft tissue
  - **Type II**: Wound 1-10 cm with moderate soft tissue injury and simple underlying fx
  - **Type III**: Wound > 10 cm with extensive soft tissue damage and multifragmental fx or crush injury
    - Subgrades A, B, C



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Open Fractures: Treatment

- Initiate antibiotics emergently
  - Infection rate increases if delayed by even 2-3 hours
- Tetanus prophylaxis: Provide in ED intramuscular
- Musculoskeletal treatment initiated after initial trauma survey
  - Control bleeding with direct pressure
  - Remove gross debris and place sterile saline-soaked dressing
  - Stabilize
  - OR for aggressive irrigation and debridement

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Open Fractures: Prophylactic antibiotics

Gustilo-Anderson Fracture type	No soil or water contamination	Soil contamination, no water contamination	Water contamination
I or II	Cefazolin IV	Cefazolin IV **OR** Ceftriaxone IV **PLUS** Metronidazole IV	No modification needed for Type I and II
Type III	Ceftriaxone IV **OR** Cefazolin IV **PLUS** Gentamicin IV	Ceftriaxone IV **OR** Cefazolin IV **PLUS** Gentamicin IV **PLUS** Metronidazole IV	**Fresh Water:** Piperacillin-tazobactam **Sea water:** Piperacillin-tazobactam PLUS Doxycycline

Open Fracture: Prophylactic Antibiotics

- Prophylactic antibiotics:
  - For patients at risk for MRSA, vancomycin should be added to the regimen
  - Type I and II open fractures, antibiotics typically may be discontinued 24 hours after wound closure
  - Type III open fractures, antibiotics typically may be discontinued after 72 hours

Open Fracture: Complications

- Compartment Syndrome
  - Open fracture does not decrease risk for compartment syndrome
- Neurovascular compromise
- Non-union, mal-union
- Complex regional pain syndrome
- Post-traumatic arthritis
- Osteomyelitis

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ACUTE COMPARTMENT SYNDROME

Acute Compartment Syndrome

- Limb and life threatening emergency!
- Causes: Capillary beds collapse due to high compartment pressures preventing venous drainage and ultimately occluding arterial blood flow
- Increasing compartment pressure causes ischemia in muscle and nerve tissue leading to necrosis and permeant function loss
  - *M>W, Most common in the lower leg (anterior compartment)*
  - *May also occur in forearm, thigh, foot, or hand*
- MOI: high-energy trauma or crush injuries are at high risk
  - *May also occur with minor trauma, +/- fracture*
  - *Full thickness burns: contractures*
  - *Tight bandages, splints, or early casting also contribute to compartment syndrome*

Acute Compartment Syndrome: Clinical Presentation

- High index of suspicion is critical to prevent complications!

Symptoms:

- **Pain** out of proportion to the injury is the first sign
  - *No improvement with position change and worsening with passive stretching*
  - *Increasing need for analgesics*
- **Paresthesia**: nerve hypoxia
- Presence of pulse does not rule-out compartment syndrome
  - *Pressures rarely exceed systolic level*
- Unconscious or obtunded patient are more difficult to diagnosis
  - *Tachycardia, tissue swelling (measure asymmetry)*

6 Ps

Paresthesia

Pallor: Less Common

Pulselessness: Late

Poikilothermia: Late

Paralysis: 8-24 hours

Pain

Acute Compartment Syndrome: Diagnostics

- Intra-compartmental pressure measurements
  - *If diagnosis is obvious then pressures are of little benefit*
  - *If diagnosis unclear then measurements are confirmatory*
    - ACS delta pressure = diastolic blood pressure – measured compartment pressure
    - ACS delta pressure < 30 mm Hg is concerning and warrants fasciotomy

Acute Compartment Syndrome: Management

- Surgical release
- If diagnosed within 8 hours: emergent dermato-fasciotomy of compartments involved
- If diagnosed late: With extensive tissue death treatment options to become controversial
  - *Fasciotomy has high risk of infection*
  - *Amputation becomes more likely*
- Fracture fixation: Temporary external fixator vs terminal internal fixation
  - *Fasciotomy wounds remain open and eventually skin grafts needed*

Acute Compartment Syndrome: Complications

- Infection
- Amputation
- Volkmann's Ischemic Contracture
- Rhabdomyolysis
  - *CPK and urine myoglobin*

SEPTIC ARTHRITIS

Septic Joint: Background

- 20,000 cases in the US annually
- Increased use of prosthetic joints contributing
- Described as:
  - Gonococcal
  - Nongonococcal
- Spread via contiguous spread, hematogenous or via direct inoculation

Septic Arthritis: Background

- Nongonococcal:
  - Staph aureus (most common in adults)
  - Consider MRSA in IVDU, elderly, post-op
  - Strep spp. (second most common in adults)
- Gonococcal:
  - N. gonorrhea (most common in young adults who are sexually active)
- Others:
  - Fungal, mycobacterial, *R. rickettsia*

Septic Joint: Risk Factors

- Risk Factors:
  - Age >80
  - Newborns or very young
  - Skin ulcers, cellulitis
  - Interruption of joint capsule: Orthopedic surgery, Intra-articular injection, trauma
  - History of joint disease: RA (10X increased risk), osteoarthritis
  - Systemic disease: Diabetes, HIV, malignancy, immunosuppression
  - Hematogenous spread: IVDU, severe sepsis

Septic Arthritis: History

- Acute onset of swelling, joint pain, decreased ROM, warmth, erythema
- Fever (40-60%)
  - Nongonococcal:
    - Typically monoarticular but may be polyarticular
    - Knee (>50%), hip(20%)> shoulder, elbow, ankle
    - Axial joints (IVDU)
  - Gonococcal:
    - Bacteremia followed by monoarticular joint pain, fever

- **Irreversible cartilage destruction**
  - Destruction starts in as little as 8 hours with irreversible damage in 48 hours

Septic Arthritis: Physical Exam

- General:
  - Febrile
  - May appear ill
- Joint:
  - Erythema
  - Pain with passive ROM
  - Joint effusion and limited ROM
  - Warmth
  - Hip and shoulder, effusion may not be obvious

Septic Arthritis: Diagnostics

- **Prompt arthrocentesis with synovial fluid analysis: Gold standard**
  - Watery and cloudy
  - WBC > 50,000, >90% leukocytes
  - Gram stain positive 50% of the time
  - Microbial culture and sensitivity testing (50-70% positive)
- Labs: WBC with diff, ESR, **CRP (sensitivity of 92%),** blood culture (+ in 50%)
- Other considerations:
  - Gonococcal arthritis: culture cervix, urine, throat, blood in addition to synovial fluid analysis
  - Group A strep: throat culture, ASO titer
  - Serology for coccidioidomycosis, r. rickettsia

- Note: Obtain synovial fluid prior to empiric antibiotics when reasonable

Septic Arthritis: Diagnostics

- Radiographs: AP/Lat may show increased joint space (effusion) or narrowing (destruction)
- Ultrasound: detect effusion and guide aspiration
- MRI : detects effusion, bone involvement, or associated concerns
  - Pediatric patients require sedation
- Bone scan: If concern for osteomyelitis

Case courtesy of Dr Ahmed Abdrabou, Radiopaedia.org, rID: 27744

Septic Arthritis: Treatment

- Empiric antibiotics – immediately after arthrocentesis
  - Non-gonococcal:
    - Gram-positive cocci: Vancomycin
    - Gram-negative bacilli: 3rd generation cephalosporin
    - Parenteral 2 weeks, po 2-4 weeks dependent on course
    - Tailor coverage based on culture
  - Gonoccocal:
    - Ceftriaxone IV/IM daily for 1-2 weeks (at least 24-48 after symptoms resolve)
- Arthrocentesis/surgical irritation and drainage
- NSAIDs are beneficial

Septic Arthritis: Pediatric Considerations

- Knee and hip most often affected, polyarticular 10%
- Additional considerations for etiology:
  - <3 months, Group B strep, *N. gonorrhea*
- Children and adolescents: Typically appear ill
  - Sx: Fever, constitutional symptoms, joint paint, NWB
  - Neonate: irritability and poor feeding, limited ROM, fever
- Physical exam:
  - Limited passive ROM of the hip
  - May hold joint flexed, slight abduction, external rotation
- Risk: femoral venipuncture, JRA

CAUDA EQUINA SYNDROME

Cauda Equina syndrome

- Surgical emergency!
- Compression of lumbar, sacral, coccygeal nerve roots
- Diagnosis can be challenging early in course
- Presentation can vary based on level of compression
- No one symptom or sign can provide 100% predictive value
- Hx extremely important, especially malignancy

Cauda Equina Syndrome: Causes

- Intervertebral disc herniation
- Epidural abscess
- Tumor
- Lumbar spinal stenosis
- Metastatic disease
- Infectious
- Autoimmune

Cauda Equina Syndrome: Clinical signs/PE

- LBP with radiation into one or both legs
- Leg weakness multiple distributions (L3-S1)
- Weakness plantar flexion, loss of ankle reflex (S1-S2)
- Perineal sensory loss (S2-S4):
  - “Saddle anesthesia” - Most commonly: buttocks, perineal region, posterior/superior thighs
  - Urinary retention with or w/o overflow incontinence
  - Decreased anal sphincter tone (60-80% of pts)
  - Sexual dysfunction

Cauda Equina Syndrome: Treatment

- If clinical suspicion: Dexamethasone 10mg IV x 1 immediately
- Assessment of spinal stability (best done by spinal surgeon)
- **Emergent** MRI w/wo contrast: scan entire spine
  - If not available: CT myelogram
- Treatment dependent on etiology of cord compression
- Urgent Orthopedic surgical consult for decompression and/or radiation if metastatic tumor
  - Goal to prevent permanent paralysis, sexual and bladder/bowel dysfunction
- Prognosis variable

PEDIATRIC ORTHOPAEDIC EMERGENCIES

SLIPPED CAPITAL FEMORAL EPIPHYSIS (SCFE)

SCFE

Also referred to as slipped upper femoral epiphysis (SUFE)

- Slipping along the femoral physis
  - *“Ice cream slipping off the cone”*
- Peak incidence is 10-16 years old, M>F
- Bilateral in 20-40% of patients
- Obesity is significant risk factor

SCFE:
Clinical Presentation

- Typical presentation: obese adolescent with dull, achy hip pain and difficulty with ambulation
  - *May be associated with history of minor trauma*
  - *Isolated knee or thigh pain in 15% of cases*

SCFE:
Physical Exam

- Decreased hip ROM
  - *Limited internal rotation, abduction, and flexion*
  - *Pain may be present*
- Positive Trendelenburg may be seen in chronic presentation

Stability:

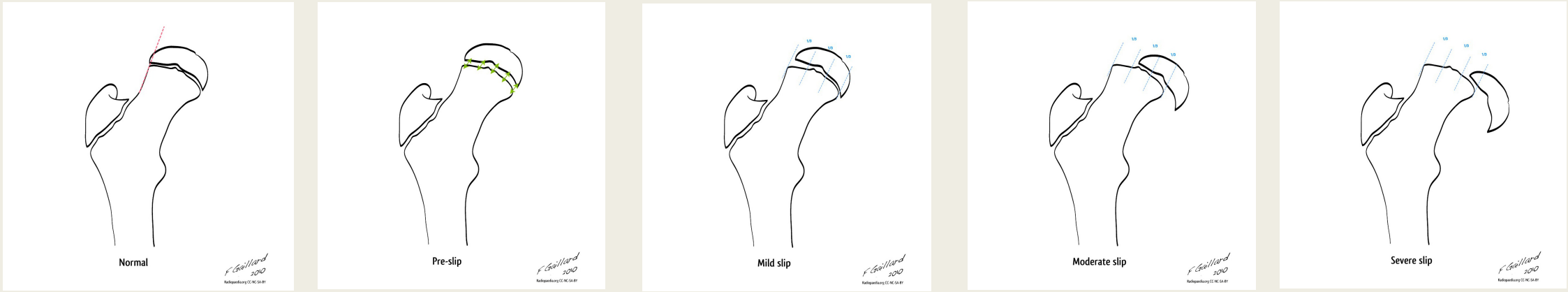
- *<u>Stable slip</u>: patient able to walk or weight bear*
- *<u>Unstable slip</u>: unable to bear weight even with crutches due to pain and displacement, pain severe*

SCFE: Imaging

MRI is better to detect pre-slips

Radiographs are typically sufficient for diagnosis

- AP and <u>lateral views</u> of **both** hips
  - *Line of Klein: line drawn along lateral edge of femoral neck on AP view should intersect the epiphysis*



Case courtesy of A.Prof Frank Gaillard, Radiopaedia.org, rID: 8004

SCFE: Imaging

Case courtesy of Dr Hani Salam, Radiopaedia.org, rID: 9297

Classification Patterns	Symptoms	Imaging
Pre-slip	Pain present	Physeal widening (-) Displacement
Acute	Sx < 3 weeks Severe pain Limited ROM	(+) Joint effusion (-) Metaphyseal remodeling
Acute-on-chronic	Sx $\geq$ 3 weeks Acute increase in pain Decreased ROM	(+) Joint effusion (+) Metaphyseal remodeling
Chronic	Sx $\geq$ 3 weeks Vague, intermittent pain	(-) Joint effusion (+) Metaphyseal remodeling

SCFE: Management

- **Non-weight bearing**
- Admit to hospital on bed rest
- Emergent operative stabilization
  - *Goal: prevent further slippage and avoid potential complications*

UNSTABLE ANKLE FRACTURES

Adolescent Ankle Fractures

- Tillaux: SH-III of anterolateral tibia
  - *Avulsion of anterior inferior tibiofibular ligament*
- Triplane: SH-IV of distal tibia
  - *SH-III on AP views and SH-II on lateral views*

- Etiology: Occurs nears nearing skeletal maturity
  - *Triplanes are younger than Tillaux*
  - *Both involve the articular surface*
- MOI: supination and external rotation

- Clinical Presentation: Pain and inability to WB

Adolescent Ankle Fractures: Imaging

- Radiographs:
  - *AP, Lateral, and Mortise View (+/- int/ext oblique views)*
  - *Amount of displacement should be measured*
  - *Assess for associated lateral malleolus fx*

- CT scans better defines fracture pattern

- Consider Ottawa Ankle Rules

Imaging

- X-Ray: AP, mortise, lateral, internal and external oblique
- Consider occult fractures in kids

Ottawa Ankle Rules

- Malleolar tenderness AND
  - *Posterior fibula pain*
  - *Posterior distal tibia pain*
  - *Inability to WB (at injury & current)*

Include foot films if:

- Midfoot pain AND
  - *Navicular bone pain*
  - *5^{th} MT base pain*
  - *Inability to WB (at injury & current)*

Case courtesy of Dr Charlie Chia-Tsong Hsu, Radiopaedia.org, rID: 30224

Tillaux Fracture

Case courtesy of Dr Yasser Asiri, Radiopaedia.org, rID: 64779 Hsu, Radiopaedia.org, rID: 30224

Triplane Fracture

Adolescent Ankle Fractures: Management

- Emergent/Urgent ortho referral for stabilization:
  - *Maintain non-weightbearing*
  - *Stable (<2 mm displacement): reduction and casting*
  - *Unstable: (>2mm post reduction): surgical fixation*

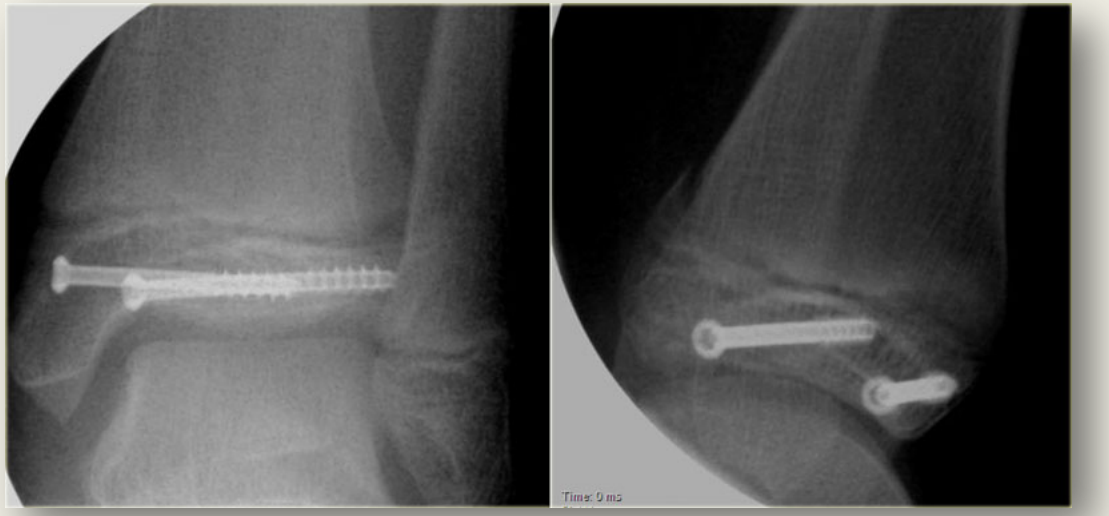


Image from Robin Smithuis

The Radiology Assistant

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Resources

- AAOS: http://www.aaos.org/
- POSNA: https://posna.org/
- Radiopaedia: http://radiopaedia.org/
- Radiology Assistant: http://www.radiologyassistant.nl
- OrthoBullets: https://www.orthobullets.com

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