WHEN TO WAKE YOUR ORTHOPAEDIC PROVIDER

Sarah Bolander, MMS, PA-C
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. Determine emergent order for diagnostics and management
4. Understand first-line treatment options for common musculoskeletal emergencies
DISLOCATIONS
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: 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
Tibiofemoral dislocation OR Knee with multiple ligamentous injuries

- Reduce joint immediately
  - Posterolateral dislocations not reducible
  - Procedural sedation as indicated

- Examine distal and popliteal pulses
- Obtain ankle-brachial index
- Perform bedside duplex ultrasound screen if available

**Strong distal pulses**
- Ankle-brachial index >0.9
- Normal duplex ultrasound

  - Admit for observation
  - Perform serial vascular examinations
  - Obtain orthopedic consultation for reconstructive surgery

**Well perfused limb, BUT:**
- Asymmetric pulses
- Ankle-brachial index <0.9
- Abnormal duplex ultrasound

  - Obtain urgent arteriogram or comparable vascular study (eg, CT angiogram) in consultation with vascular surgery

**Weak or absent pulses**
- Signs of ischemic limb or vascular injury

  - Emergency vascular surgery consultation
  - Operative repair

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Hip Dislocation

- Survival of the femoral head requires reduction within 6-8 hours of injury
- MOI: High energy trauma such as a MVA or fall
  - MVA: dashboard injury
    - 80% have other associated injuries
      - 25% ipsilateral knee injury
- 90% of dislocations are posterior dislocations
  - Simple: dislocation only
  - Complex: dislocation with associated fracture
Hip Dislocation: Clinical Presentation

- Painful!
- Posterior Dislocation: 90% of dislocations
  - 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
Pre-reduction AP and lateral radiographs confirm dislocation and help to rule-out fx

- CT scan needed if suspicious for fx that is not evident on x-rays
Hip Dislocation: Management

- Emergent Reduction within 6 hours
  - Emergency Department: simple dislocations with sedation, muscle relaxants, and analgesics
  - Operating Room: simple or complex dislocations with general anesthesia
  - Reduction techniques vary
- Non weightbearing
- Complications:
  - Post-traumatic arthritis
  - Femoral head osteonecrosis
  - Sciatic nerve injury
PROXIMAL FEMORAL FRACTURE
Proximal Femoral Fractures

Increases risk of death and major morbidity in elderly

- Mortality 25-30% within the first year
- Femoral neck fractures are intracapsular
  - Retrograde blood requires emergent fixation if pt stable
- MOI:
  - Falls: Elderly with osteoporosis
  - High energy trauma
  - Stress fx
  - Pathologic fx
Proximal Femoral Fractures: Clinical Presentation

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

- Plain Radiographs: AP/Lat and full femur
  - Include knee joint
- CT helpful to evaluate displacement
- MRI if high suspicion and neg. x-rays

Case courtesy of Dr Benoudina Samir, Radiopaedia.org, rID: 22392
Proximal Femoral Fractures: Treatment

- Adequate analgesia
- Prophylaxis for DVT
- Orthopaedic Consult: orthopaedic emergency in patients ≤ 55 yo
  - Surgery if medically stable
  - ORIF vs arthroplasty
- Complications:
  - AVN
  - Infection
  - DVT/PE
  - Nonunion
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:
  1. Severity of fracture and soft tissue involvement
  2. Amount of bacterial contamination
  3. Vascular supply
  4. Quality of surgical debridement
  5. “Prophylactic” antibiotics
Open Fractures: Clinical Presentation

- Open fractures may be obvious or a subtle puncture wound
  - * Entire limb must be closely inspected (posterior 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
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**
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*
# Antibiotic Treatment for Open Fractures

<table>
<thead>
<tr>
<th>Open Fracture Classification</th>
<th>Likely Organism</th>
<th>ABX Choice (IV)</th>
<th>Duration (following final wound closure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Gram Positive Cocci</td>
<td>1st Generation Cephalosporin</td>
<td>24 hrs</td>
</tr>
<tr>
<td>II</td>
<td>Gram Positive Cocci</td>
<td>1st Generation Cephalosporin + Gentamicin</td>
<td>24-48 hrs</td>
</tr>
<tr>
<td>IIIA</td>
<td>Gram Positive Cocci + Gram Negative Rod</td>
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* Any wound that is grossly contaminated with soil or 'barnyard' material should receive penicillin to cover anaerobic bacteria.
Open Fracture Complications

- Compartment Syndrome
  - *Open fracture does not decrease risk for compartment syndrome*

- Neurovascular compromise

- Limb salvage

- Osteomyelitis
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
    - $M \geq W$, 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 diagnose
  - *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
    - > 30 mm Hg is concerning and warrants fasciotomy
    - Higher the measurement, quicker the tissue damage occurs
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 Arthritis

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

■ Pathophysiology: hematogenous spread of infection (proteolytic enzymes)
  - Primary: *S. aureus* including MRSA, Secondary: *Streptococcus*
  - Others: Gram negative bacilli, anaerobic species, *pseudomonas*, polymicrobial, *N. gonorrhoeae* (young, sexually active)

■ Epidemiology:
  - Typically monoarticular but may be polyarticular
  - Knee (>50%), hip > shoulder, elbow, ankle, and sternoclavicular (IV drug users)

■ Risk Factors: IV drug users, diabetics, RA, recent joint surgery, joint prosthesis
  - *Neonates, elderly (>80 yo)*
Septic Arthritis: Clinical Presentation

- Clinical Presentation: red, hot, painful, and swollen joint
  - Febrile (60%)
  - May appear toxic

- History:
  - Recent trauma or illness
  - Skin infection
  - Travel with exposures
  - Personal FHx of RA

- Physical Exam:
  - Erythema
  - Effusion
  - Warmth
  - Tender
  - Preferred position: FABER
    - Inability to WB or tolerate PROM
Septic Arthritis: Pediatric Considerations

- Knee and hip most commonly affected, polyarticular 10%
- Additional considerations for etiology: < 2 yo *S pneu*no, <3 months
  Group B *strep*
- Children and adolescents: Typically appear ill
  - Sx: Fever, constitutional symptoms, joint pain, NWB
  - Neonate: irritability and poor feeding, limited ROM, fever
- Physical exam: hip pain may refer to knee
  - Limited passive ROM of the hip
  - FABER position
- Risk: femoral venipuncture, JRA

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Pediatric DDX:
Transient Synovitis of the Hip

Most common cause of pediatric hip pain
- Appears well, typically afebrile
- Pain worse in am and improves during day
- Recent URI
- Etiology unclear, 3-8 years-old, M>F

Management: NSAIDs
- *Improves in 24-48 hours with resolution within 1 week*
- *Must rule out septic arthritis, hospitalize if suspicious*
Septic Hip Vs Transient Synovitis

- **Kocher Criteria**
  1. WBC > 12,000
  2. ESR > 40
  3. Fever > 101.3
  4. Non-weight bearing on the affected side
     - 2/4 criteria warrants joint aspiration

- **CRP independent risk factor**
  - CRP >2.0

Probability based on # of Kocher Criteria Met:
- None: 0.2%
- 1/4: 3%
- 2/4: 40%
- 3/4: 93%
- 4/4: 99.6%

Septic Arthritis: Diagnostics

■ Prompt arthrocentesis: Gold standard
  - Watery and cloudy
  - WBC > 50,000, >90% leukocytes
  - Gram stain only identifies organism 1/3 of the time and not definitive
  - Microbial culture and sensitivity testing (50-60% positive)

■ Labs: WBC with diff, ESR, CRP, blood culture

■ Other considerations:
  - Gonococcal arthritis: culture
  - Group A strep: throat culture, ASO titer
  - Serology for coccidioidomycosis
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
Septic Arthritis: Treatment

1. Prophylactic antibiotics
   - Prophylactic coverage for gram-positive including MRSA and gram-negative
     ■ Gram-positive: Vancomycin
     ■ Gram-negative: 3rd generation cephalosporin
     ■ Tailor coverage based on culture

2. Arthrocentesis/surgical irritation and drainage

3. NSAIDs are beneficial

Goal: prevent complications in a timely manner
   Bone destruction, deformity, LLD
CAUDA EQUINA
Cauda Equina Syndrome

- Spinal root compression below the conus
  - *Disc herniation is most common cause*
  - *Spinal stenosis, tumors, trauma, infection, epidural hematoma*
- Surgical decompression less than 24 hours has best outcomes
Cauda Equina Syndrome: Clinical Presentation

- Back pain with unilateral or bilateral radicular leg pain
- **Saddle anesthesia**
- Bladder, bowel, and/or sexual dysfunction
  - Urinary retention followed by overflow incontinence
- Physical Exam: Bilateral LE weakness and sensor dysfunction
  - Diminished or absent LE DTRs
CAUDA EQUINA SYNDROME: DIAGNOSTICS

Immediate MRI: compression of cauda equina
Cauda Equina Syndrome: Diagnosis and Management

- Clinical Diagnosis
  - *Imaging is not diagnostic but supports the underlying cause*

- Orthopaedic consult for emergent surgical decompression
  - *Surgery and steroids*
  - *Prevent paralysis, permanent bladder/bowel dysfunction, loss of sexual dysfunction*
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:

- **Stable slip**: patient able to walk or weight bear
- **Unstable slip**: unable to bear weight even with crutches due to pain and displacement, pain severe
SCFE: Imaging

Radiographs are typically sufficient for diagnosis

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

MRI is better to detect pre-slips

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

Case courtesy of A.Prof Frank Gaillard, Radiopaedia.org, rID: 7984
<table>
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<tr>
<th>Classification Patterns</th>
<th>Symptoms</th>
<th>Imaging</th>
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<tr>
<td><strong>Pre-slip</strong></td>
<td>Pain present</td>
<td>Physeal widening (-) Displacement</td>
</tr>
<tr>
<td><strong>Acute</strong></td>
<td>Sx &lt; 3 weeks Severe pain Limited ROM</td>
<td>(+) Joint effusion (-) Metaphyseal remodeling</td>
</tr>
<tr>
<td><strong>Acute-on-chronic</strong></td>
<td>Sx ≥ 3 weeks Acute increase in pain Decreased ROM</td>
<td>(+) Joint effusion (+) Metaphyseal remodeling</td>
</tr>
<tr>
<td><strong>Chronic</strong></td>
<td>Sx ≥ 3 weeks Vague, intermittent pain</td>
<td>(-) Joint effusion (+) Metaphyseal remodeling</td>
</tr>
</tbody>
</table>
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
  - Moth involve the articular surface
- MOI: supination and external rotation

- Clinical Presentation: Pain and inability to WB

Emergent/Urgent & highly missed
Adolescent Ankle Fractures: Imaging

- Radiographs:
  - AP, Lateral, and Mortise View
  - Amount of displacement should be measured
  - Assess for associated lateral malleolus fx

- CT scans better defines fracture pattern

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

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

Thank you!
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
References


