



Red Flags in Orthopaedics: Pearls to Prevent Pitfalls

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Objectives

1. Identify musculoskeletal red flags that require immediate intervention or orthopaedic consultation.
2. Differentiate between urgent and emergent conditions based on clinical presentation and diagnostics.
3. Discern vital information and relate findings to an orthopaedic specialist.
4. Discuss first-line treatment options for common musculoskeletal emergencies.
5. Prevent common pitfalls in orthopaedic care.



Case #1

Patient: 36-year-old mountain biker
Mechanism of Injury: Fall from bike
Chief Complaint: Severe right leg pain

Exam Findings:
Laceration over tibia
Neurovascularly intact in right leg
Left leg uninjured

Imaging: Radiographs show comminuted tibia and fibula fractures

Other Notes: Patient was helmeted; no additional injuries identified

OPEN FRACTURE

Red Flags: Open Fracture



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

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

AO Foundation

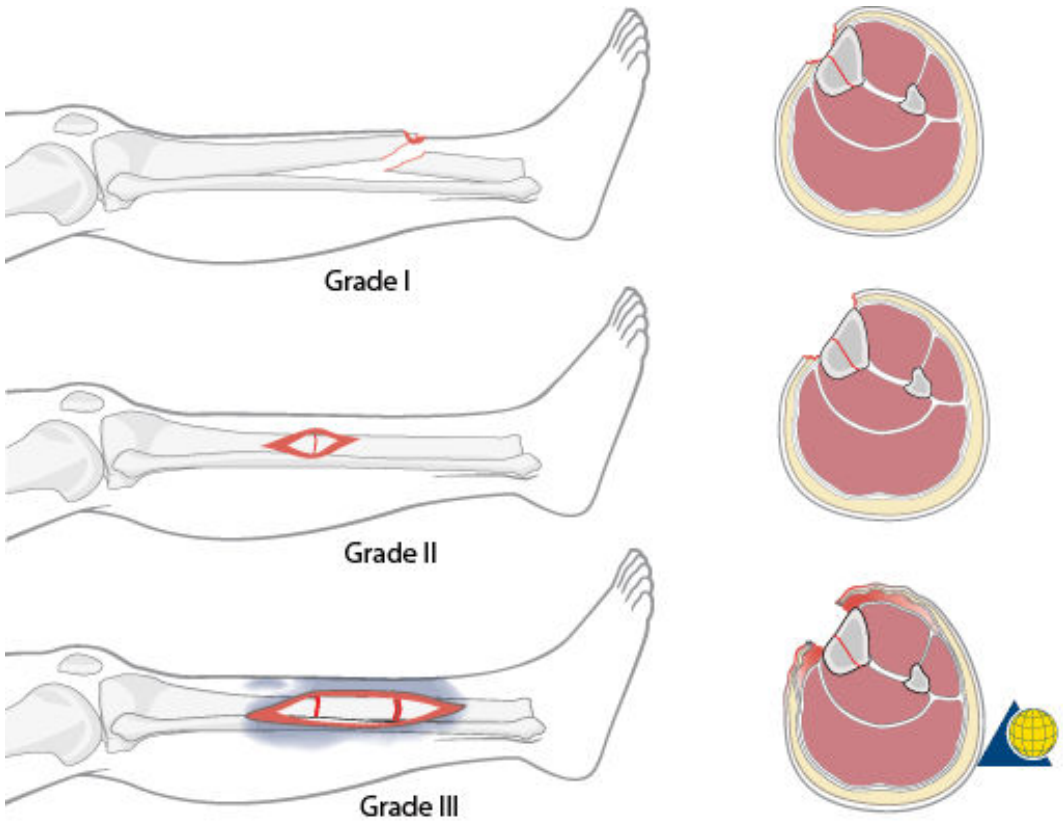
Key Diagnostic Steps: Open Fracture

- Document neurovascular status thoroughly
- Radiographs to confirm fracture pattern
- Assess wound size, contamination, and amount of soft tissue injury
  - Gustilo-Anderson classification

Grading: Open Fracture

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



Initial Management: Open Fracture



- Control bleeding with direct pressure
- Remove gross debris and sterile dressing
- Stabilize
- Immediate IV antibiotics within 1 hour
  *Infection rate increases if delayed by 2-3 hours
  - Type I/II: First-generation cephalosporin (cefazolin)
  - Type III: Add gram-negative coverage (gentamicin)
  - Duration: 24 hours post-operatively (up to 72 hours for severe contamination/Type III)
- Tetanus prophylaxis
- Urgent orthopedic referral
  - Surgical irrigation/debridement ideally within 24 hours

Pearls to Prevent Pitfalls: Open Fracture

- Small puncture wounds can communicate with fractures
  - Any fracture with a skin break = open fracture
- **Do not delay antibiotics** awaiting consultation
- Document baseline neurovascular exam and routinely reassess

Case #2



Patient: 8-month-old infant
History: 2 days of fussiness and poor feeding
Brought by mother's boyfriend
Reported mechanism: "rolled off the couch" (details vague)

Exam Findings:
Multiple bruises on upper arms
Small bruise on left cheek
Torn frenulum
Infant is pre-ambulatory and not yet pulling to stand

NON-ACCIDENTAL TRAUMA

Red Flags: Non-Accidental Trauma

Historical Red Flags

- History changes or is inconsistent between caregivers
- Delay in seeking care for a significant injury
- History incompatible with injury severity or type
- Vague or absent explanation for injury ("I don't know how it happened")
- Blame placed on sibling or the child

Key Diagnostics: Non-Accidental Trauma

Trauma-Informed History Taking:

- **Use non-accusatory, nonjudgmental language**
- Determine all caregivers
  - Obtain history from each caregiver separately when possible to assess for consistency
- Document exact quotes from caregivers regarding mechanism and timing

***Screen for intimate partner violence** when interviewing caregivers separately





Key Diagnostics: Non-Accidental Trauma

Trauma-Informed Physical Exam

- Emphasizes safety, choice, and trust
  - Explain each step in child-friendly language, involving caregivers when appropriate, minimizing exposure, and stopping immediately if the child shows distress
- Examine all skin surfaces including scalp, behind ears, and genitalia
  - Document size, shape, color, and location of all injuries with photographs when possible
  - Examine oral cavity thoroughly for frenulum tears, palatal bruising, dental trauma
  - Assess for subconjunctival hemorrhages
- Palpate entire head
- Complete neurologic examination including pupillary response, tone, reflexes
- Look for injuries in different stages of healing

Red Flags: Non-Accidental Trauma

Sentinel Injuries (Highest Clinical Predictive Value)

- Oral injury (torn frenulum, intraoral bruising)
  - Particularly concerning in pre-ambulatory infants
- Bruising on buttocks or neck
- Patterned bruising (handprints, loop marks, linear marks)
- Subconjunctival hemorrhage without clear accidental mechanism

**Any injury in a non-ambulatory infant (bruise, oral injury, or fracture) warrants evaluation for abuse

Key Diagnostics: Non-Accidental Trauma

For suspected physical abuse, obtain:

- Skeletal survey: AP and lateral views of the entire skeleton
  - All children <2 years and consider for ages 2-5 years
  - Identifies occult fractures in different stages of healing
- Neuroimaging (CT or MRI)
  - Concerns for head trauma, even with nonspecific symptoms (vomiting, fussiness, lethargy)

  *One-third of children with abusive head trauma had prior opportunities for diagnosis
- Abdominal imaging (CT)
  - Concerns for abdominal trauma or elevated liver enzymes

Consultation and Reporting: Non-Accidental Trauma

Ensuring child safety is paramount!

Consult multidisciplinary team

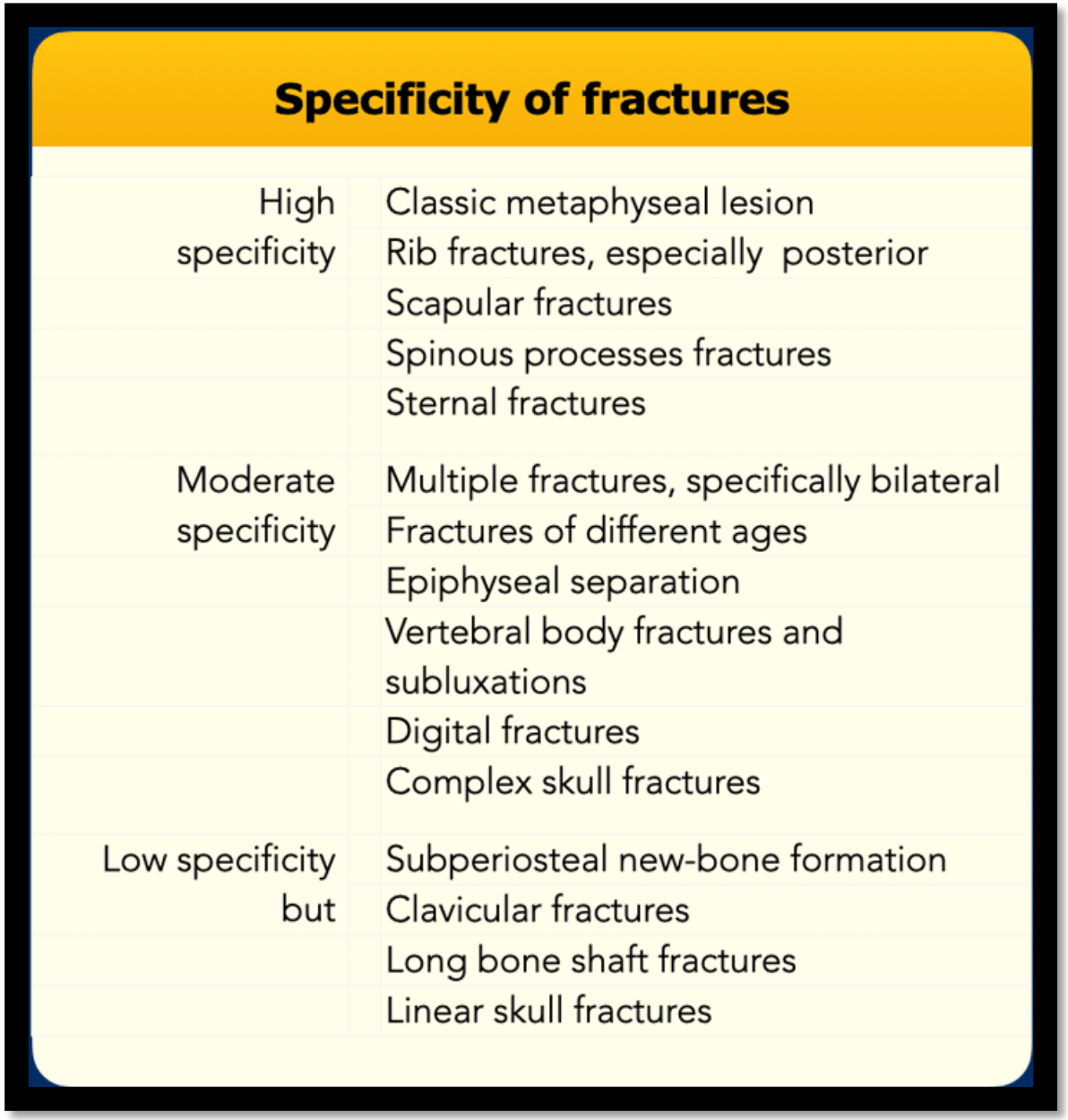
- Child-life specialist, if available
- Forensic specialist
- Social worker
- Pediatrician (child abuse pediatrician, if available)
- Medical specialists as indicated
- Child Protective Services (CPS) and Law enforcement

Mandatory reporting when reasonable suspicion exists

- Legal requirement

Abuse-Specific Orthopedic Injury Patterns

<2 years old are at the highest risk!

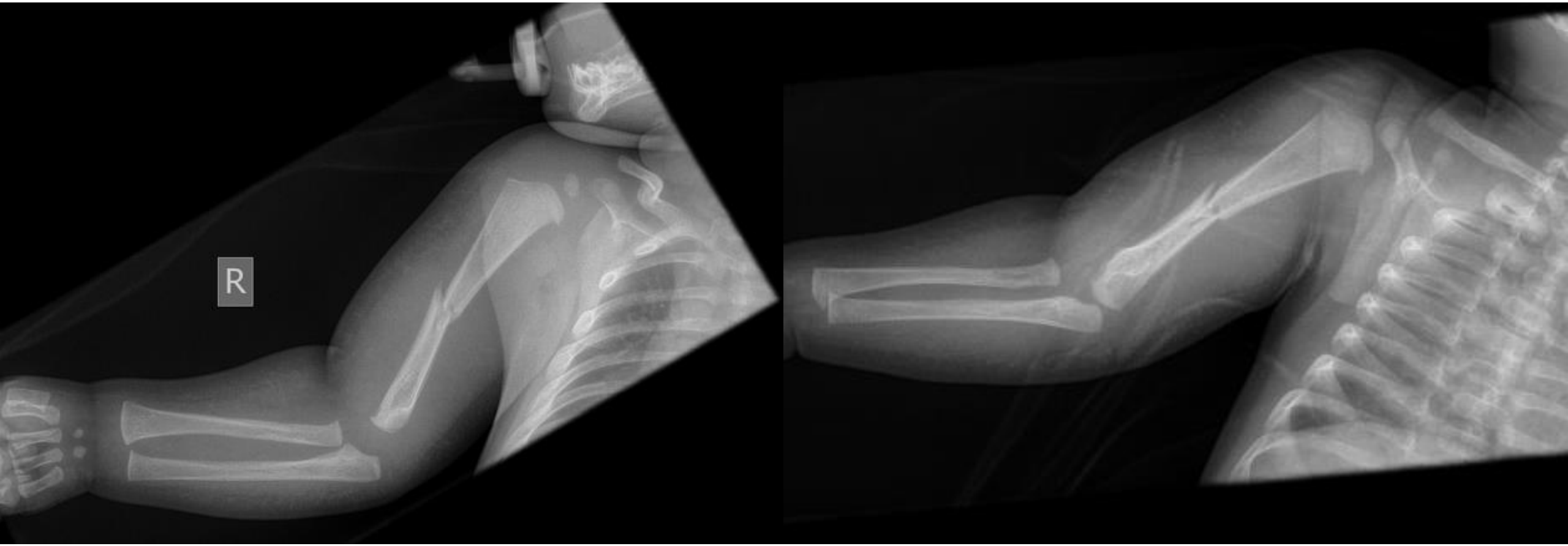


Radiology Assistant

Corner or Bucket Handle Fracture



Non-Ambulatory Fractures: Always Worrisome





Pearls to Prevent Pitfalls:
Non-Accidental Trauma

Identify the Red Flags EARLY

- *Any* fracture could be non-accidental trauma, so consider all the information…
- History incongruent with injury
  - Inconsistency
  - MOI does not correlate with the injury or denial of trauma
- Fractures at various stages of healing and/or delay in presentation
- Highly suspicious fractures must be reported and documentation is key!

Remember: "Those who don't cruise, don't bruise"



Case #3

Patient: 18-month-old

Chief Complaint: Refusal to walk

History:

Mother reports child was well yesterday

No reported trauma

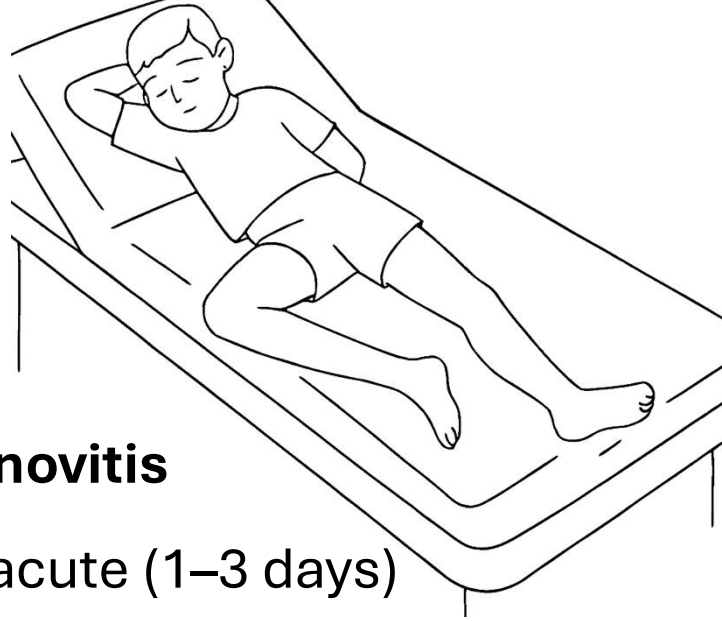
Exam Findings:

Right leg held flexed and externally rotated

Febrile: 38.9°C (102°F)

SEPTIC ARTHRITIS

Red Flags:
Septic Arthritis vs. Transient Synovitis



	Septic Arthritis	Transient Synovitis
Onset	Acute (hours to 1–2 days)	Acute to subacute (1–3 days)
Preceding Illness	Recent infection or bacteremia	Often **recent viral URI**
Duration	Progressive worsening	Self-limited; improves in 1–2 weeks
Appearance	**Toxic, ill-appearing, Fever**	Well-appearing, playful, low grade or absent
Hip Position	Flexed & externally rotated, **markedly reduced ROM**	Similar, but less restricted ROM
Weight-Bearing	**Refusal to bear weight**	May limp

Image created by Co-Pilot



Next Step…

Labs: CBC with differential, ESR, CRP, blood cultures

Red Flags:
Septic Arthritis vs. Transient Synovitis

Kocher Criteria

- Fever >38.5°C (101.3°F)
- Non-weight-bearing status
- ESR ≥40 mm/hour
- WBC >12,000/mm^3

Probability of Septic Arthritis

- 0 predictors: <0.2%
- 1 predictor: 3%
- 2 predictors: 40%
- 3 predictors: 93.1%
- 4 predictors: 99.6%

*Additional Predictor: CRP >2.0 mg/dL

J. Bone Joint Surg. Am. 1999;81:1662-70

Initial Management:
Septic Arthritis vs. Transient Synovitis

Kocher Criteria:

- ≥3 Kocher criteria: **Emergent intervention with orthopaedic consultation**
- 1-2 criteria: Close observation/communication
  - Consider repeating labs in 24 hours, low threshold for referral
- 0 criteria with benign exam: May observe with close follow-up

- MRI vs ultrasound can identify effusion and assist with surgical planning
  - Definitive diagnosis requires arthrocentesis

- IV antibiotics following arthrocentesis if septic arthritis is suspected (do not delay)

Pearls to Prevent Pitfalls:
Septic Arthritis vs. Transient Synovitis

- **Septic arthritis is an orthopedic emergency!**
  - Cartilage damage occurs within hours
- Kocher criteria are key!
  - Fever may be absent in up to 25% of cases
- Hip pathology commonly presents as knee pain in children

Tip to help differentiate: Response to NSAIDs

- Significant improvement within 24-48 hours for transient synovitis and minimal improvement in septic arthritis





Image created by Co-Pilot

Case #4

Patient: 13-year-old

Chief Complaint: Increasing right hip, knee, and thigh pain

History:

3-week history of right hip and knee pain

Pain worsens with activity

No acute trauma reported

Exam Findings:

Overweight

Antalgic gait, externally rotated right leg

Limited internal rotation of hip

Knee exam normal

SLIPPED CAPITAL FEMORAL EPIPHYSIS (SCFE)



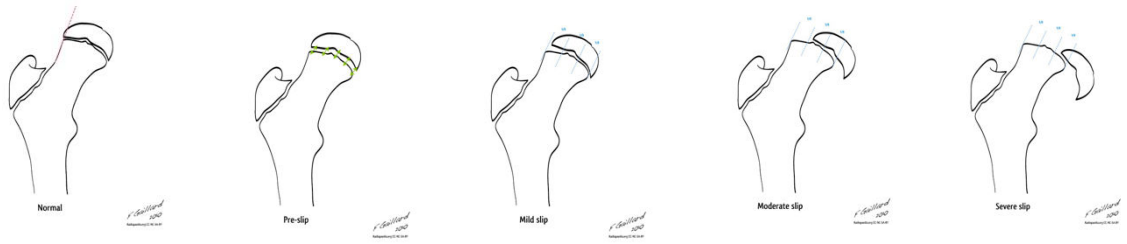
Red Flags: SCFE

- Adolescent age (10-16 years)
- Overweight/Obesity
- Atraumatic hip or knee pain with antalgic gait or non-weight bearing
- Limited internal rotation and abduction
- **Bilateral in 20-40% of cases**

Key Diagnostic Steps: SCFE

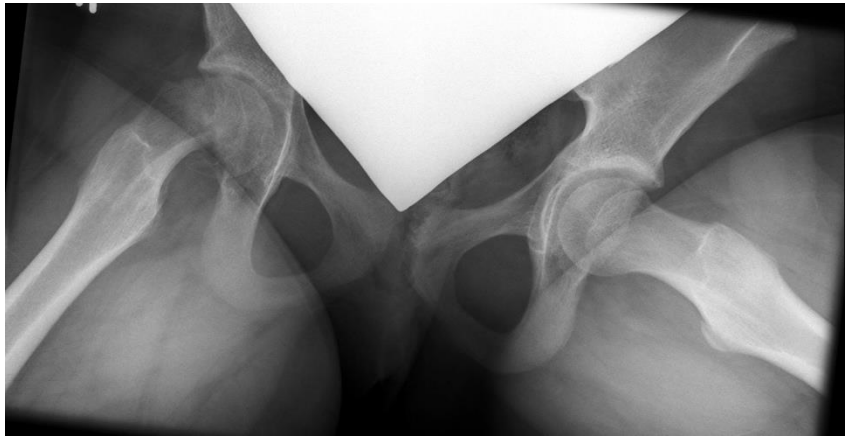
- AP and **frog-leg lateral radiographs of BOTH hips**
  - Widened, irregular physis

Klein's line: draw line along superior femoral neck, should intersect femoral head





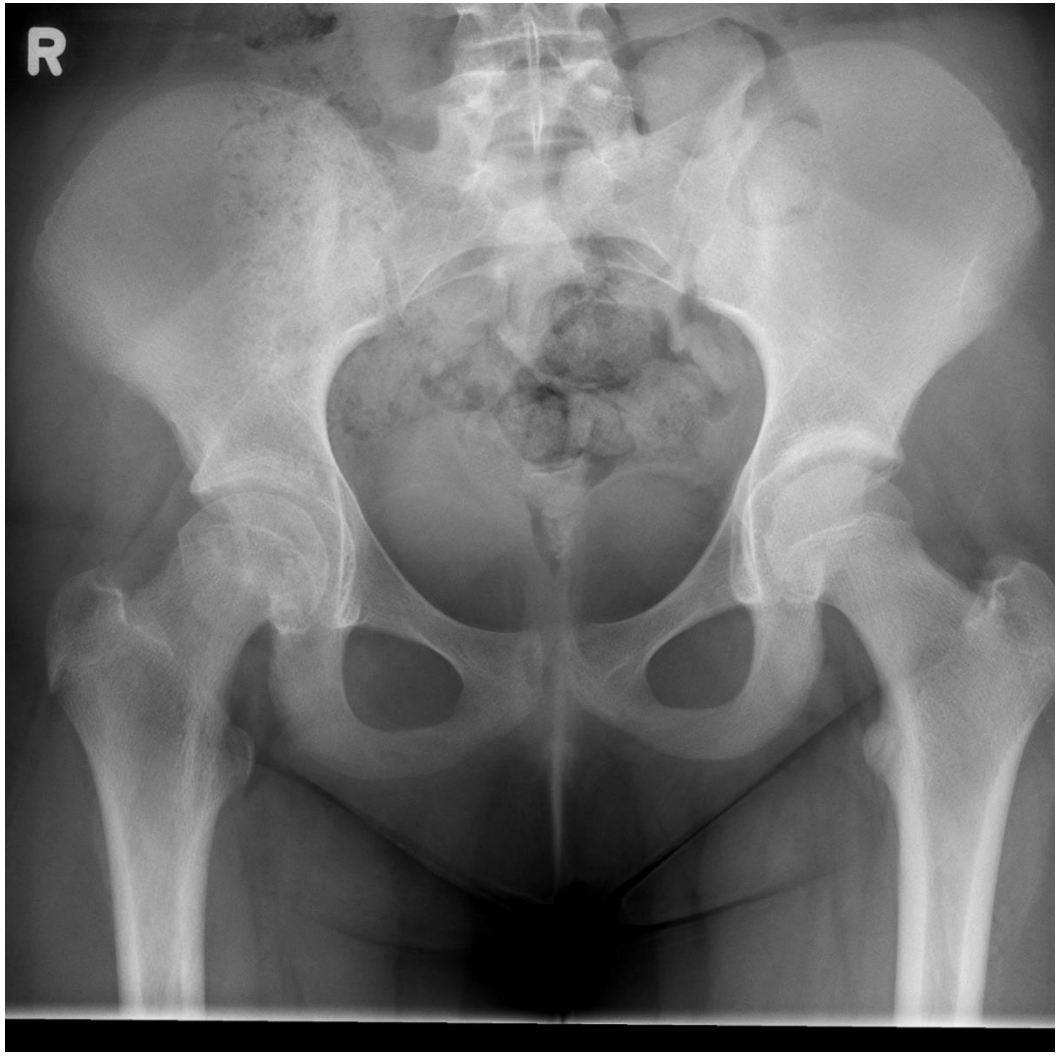
"Ice cream falling off cone" appearance on lateral view

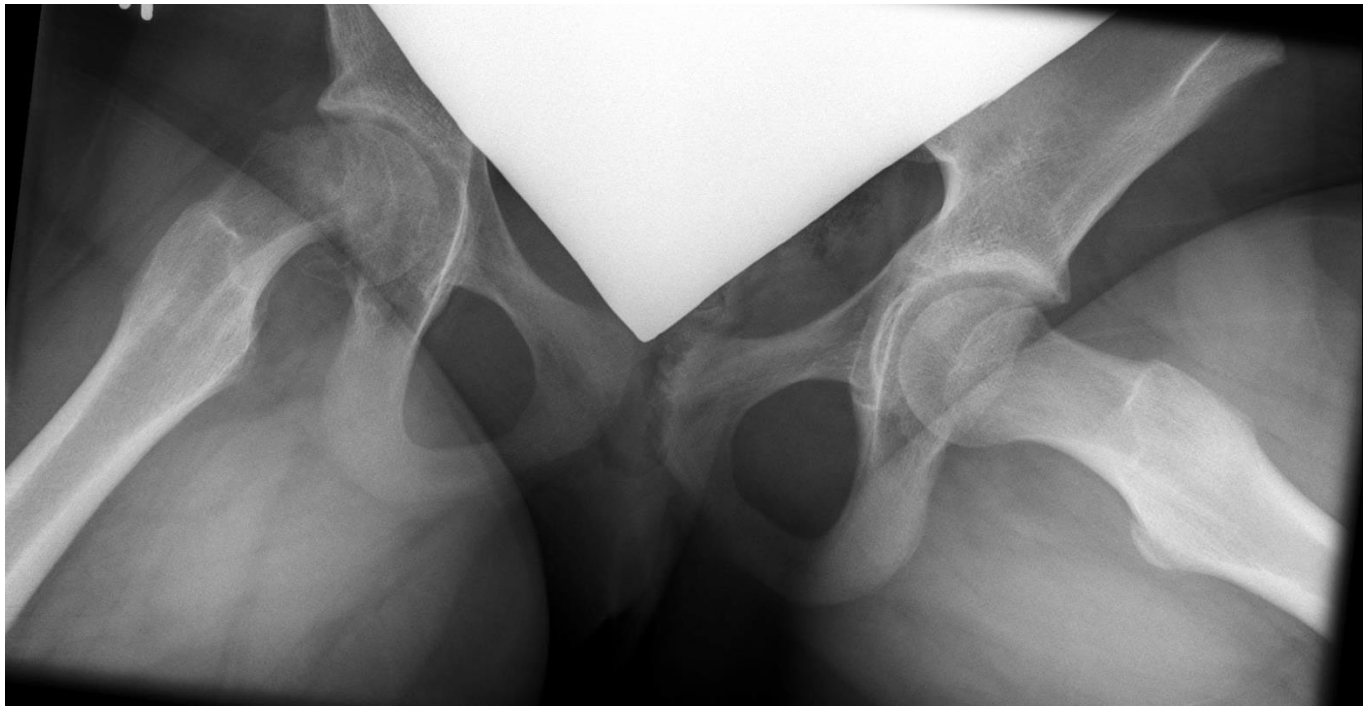


Cases courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 10357 and 8004



SCFE: Imaging





Case courtesy of A.Prof Frank Gaillard, Radiopaedia.org, rID: 10357

Initial Management: SCFE

Non-weight-bearing immediately

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

- **Urgent orthopedic referral** (same day)
  - Emergent surgical fixation

SCFE 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 ≥ 3 weeks Acute increase in pain Decreased ROM	(+) Joint effusion (+) Metaphyseal remodeling
Chronic	Sx ≥ 3 weeks Vague, intermittent pain	(-) Joint effusion (+) Metaphyseal remodeling

Pearls to Prevent Pitfalls: SCFE

- Knee pain may be only presenting symptom
  - Evaluate hip abduction and internal rotation
- Always obtain bilateral hip radiographs
  - Contralateral hip at risk and able to compare
- Frog-leg lateral view is essential!
  - May be only view showing slip
- If suspicion is high, MRI is sensitive for pre-slip
- Do not allow weight-bearing
  - Risk of converting stable to unstable slip



Case #5

Patient: 52-year-old man
History:
3 days of worsening lower back pain
Pain radiates to both legs
Chronic back pain history, no trauma

New Symptoms (this morning):
Difficulty urinating
“Numbness between my legs on both sides”

CAUDA EQUINA

Red Flags:
Cauda Equina Syndrome





Classic presentation could all be red flags!

- Bilateral neurogenic sciatica/leg pain (most common presenting symptom)
- Saddle anesthesia (reduced perineal sensation)
- Bladder dysfunction: retention leading to overflow incontinence
- Loss of anal sphincter tone
- Sexual dysfunction
- Lower extremity motor weakness (variable)
- Absent or reduced lower limb reflexes (especially bilateral ankle reflexes)



Pause for Critical Pearls

- **Most patients do NOT present with all symptoms**
  - **S**ymptoms may occur suddenly or gradually. Diagnosis is often delayed because early signs are subtle.

- **High-risk clinical combinations**:
  - **Bilateral leg pain + absent bilateral ankle reflexes**

- Markedly reduced range of motion increases suspicion

Management:
Cauda Equina



Immediate Actions:

- Do NOT delay imaging if suspecting cauda equina!
  - Urgent MRI of lumbosacral spine (preferred imaging)
    - Should be performed within 1 hour of suspicion being raised

- **Emergent neurosurgery/spine surgery consultation**
  - Decompressive surgery should occur as soon as possible
  - Keep patient NPO

Pearls to Prevent Pitfalls:
Cauda Equina Syndrome

- Surgical Emergency: Damage occurs continuously and progressively
- Bilateral symptoms are key!

- Urgent MRI within 1 hour of suspicion, regardless of time of day

- Emergent neurosurgical consultation immediately
  - Do not wait for MRI results



Back to Case #1...

Patient now has increasing leg pain despite adequate analgesia

ACUTE COMPARTMENT SYNDROME

Red Flags: Acute Compartment Syndrome

- **Pain** out of proportion to injury
- Pain with passive stretch (earliest reliable sign)
- Progressive paresthesias
- Tense, swollen compartment
- Late findings: pulselessness, paralysis, pallor

6 Ps

- Paresthesia
- Pallor: Less Common
- Pulselessness: Late
- Poikilothermia: Late
- Paralysis: 8-24 hours

Pain

Key Diagnostics: Acute Compartment Syndrome

- Serial clinical examinations (every 2-4 hours in high-risk patients)
- Assess all "6 P's" but don't wait for late signs
- Compartment pressure measurement if diagnosis uncertain
  - Suspected when the delta pressure (diastolic BP minus compartment pressure) is ≤30 mmHg

Initial Management: Acute Compartment Syndrome

- Remove all constrictive dressings/casts immediately
- Elevate limb to heart level
- **Emergent orthopedic consultation**
  - Maintain NPO status
  - Likely needs emergent fasciotomy

Pearls to Prevent Pitfalls:
Acute Compartment Syndrome

- Presence of pulses does NOT exclude compartment syndrome
- Pain control should not mask worsening symptoms (maintain high suspicion)
- Any high-energy fracture (especially tibia) warrants close monitoring
- Document serial neurovascular exams



Final Pearls to Prevent Orthopaedic Pitfalls

Combination of red flags is more reliable than a single sign.

- Open fractures need **immediate antibiotics,** surgical consult, and detailed neurovascular checks.
- Suspect acute compartment syndrome with worsening **pain** even if pulses are present.
- Septic hip is an emergency! **Kocher criteria** helps distinguish it from transient synovitis.
- SCFE may present as knee pain, so **always examine hips** and get pelvis/bilateral hip X-rays.
- Suspicion of cauda equina syndrome requires immediate MRI and **urgent neurosurgical consultation**.

Early recognition and documentation of musculoskeletal red flags are essential!


QUESTIONS?

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
- OpenEvidence: https://www.openevidence.com/

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