



Plain Film Evaluation of Atraumatic Hip Pain in Adolescents and Young Adults

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Outline of Presentation

1. Initial evaluation of hip pain in adolescents/young adults
2. Differential diagnosis of atraumatic hip pain
3. Approach to reading plain films of the hip
4. Review causes of atraumatic hip pain, with characteristic XR findings
5. Review of clinical decision tree based on XR findings



22 yo M presents with R hip pain

HPI:

- no recent trauma
- history of knee and hip pain at age 16, resolved with cortisone injections and naprosyn
- recent recurrence of pain in L knee and R hip

PMH: as above

MEDS: motrin prn

PE: afebrile, decreased range of motion in R hip



Initial Evaluation of hip pain

- **Physical Exam**
- **Vital signs** (+/- fever)
- **Plain Radiographs:** AP and Frog Leg
- **Laboratory studies:** WBC, ESR, CRP, (RF, HLA B-27)
- **Other imaging** (U/S, MR, bone scan) as indicated



Differential Dx of Atraumatic Hip Pain in Adolescents and Young Adults

Developmental: slipped capital femoral epiphysis (SCFE)

Vascular: Avascular necrosis—idiopathic, steroid use, sickle cell disease

Infectious: septic arthritis, osteomyelitis

Neoplastic: aneurysmal bone cyst, osteoid osteoma, eosinophilic granuloma, Ewing's sarcoma, osteosarcoma, leukemia

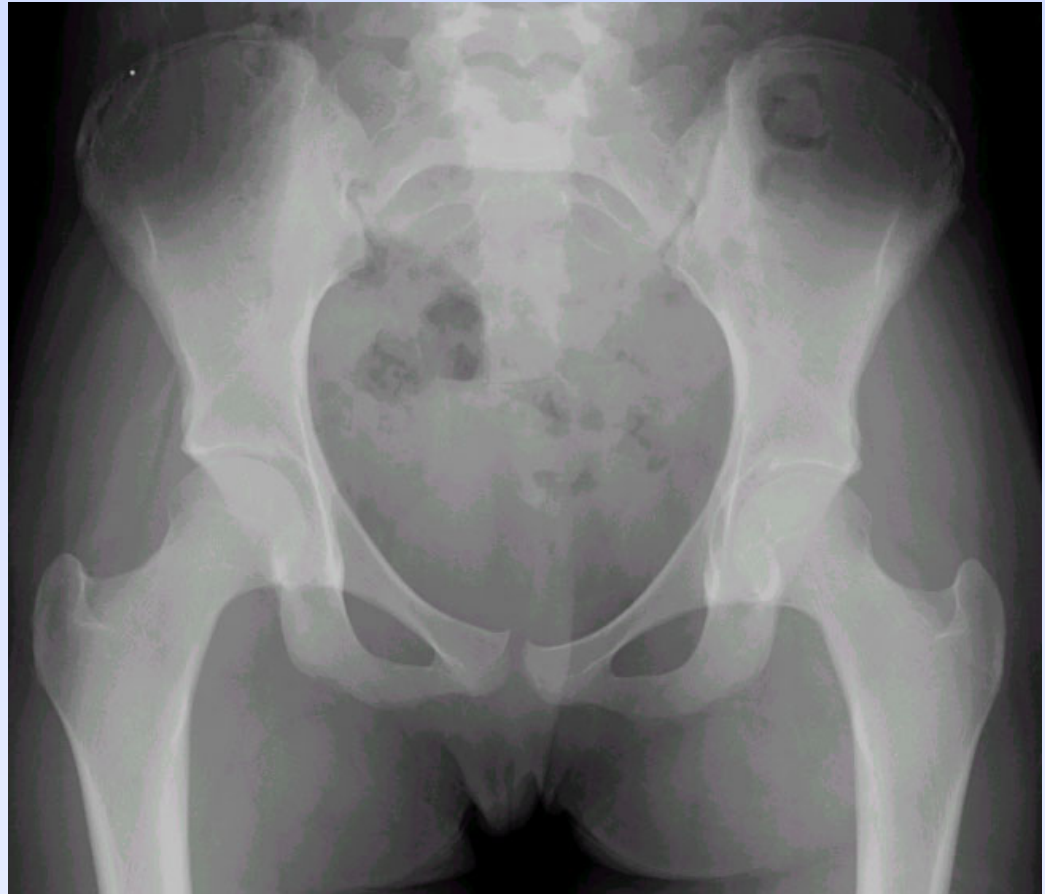
Inflammatory: toxic synovitis, bursitis, RA, Lyme arthritis, spondyloarthropathy,

Non-musculoskeletal: appendicitis, PID, inguinal hernia



Approach to reading hip XR's

1. **Soft tissues**
2. **Bone**—check bone mineral density, trabeculae, cortex
3. **SI Joints**
4. **Hip Joint**



AP VIEW
BIDMC PACS



Assessment of the Hip Joint



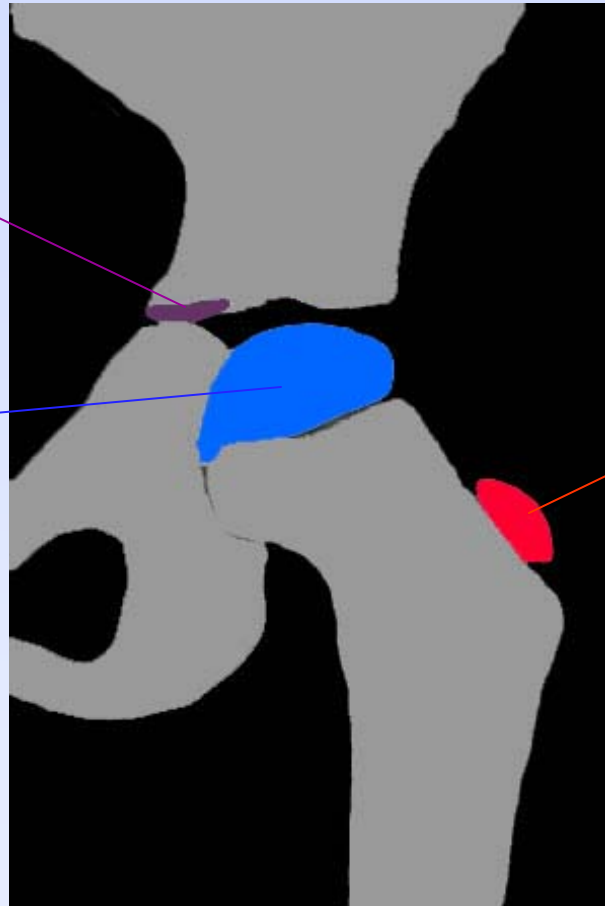
Klein's line,
shown here,
should intersect
femoral epiphysis
such that part of
the epiphysis lies
lateral to the line

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- Relationship of femoral head to acetabulum—check for subluxation or dislocation
- Medial joint spaces between acetabulum and most medial part of femoral head should be equal and $\leq 2\text{mm}$
- Shape and density of femoral heads (should be round and equal in appearance)
- Before fusion of femoral head, note relationship between epiphysis and metaphysis using Klein's line



Hip Ossification Centers: Average Age at Fusion



Triradiate Cartilage

M: 15yo

F: 13yo

Femoral Head

M: 17yo

F: 14yo

Greater
Trochanter

M: 16yo

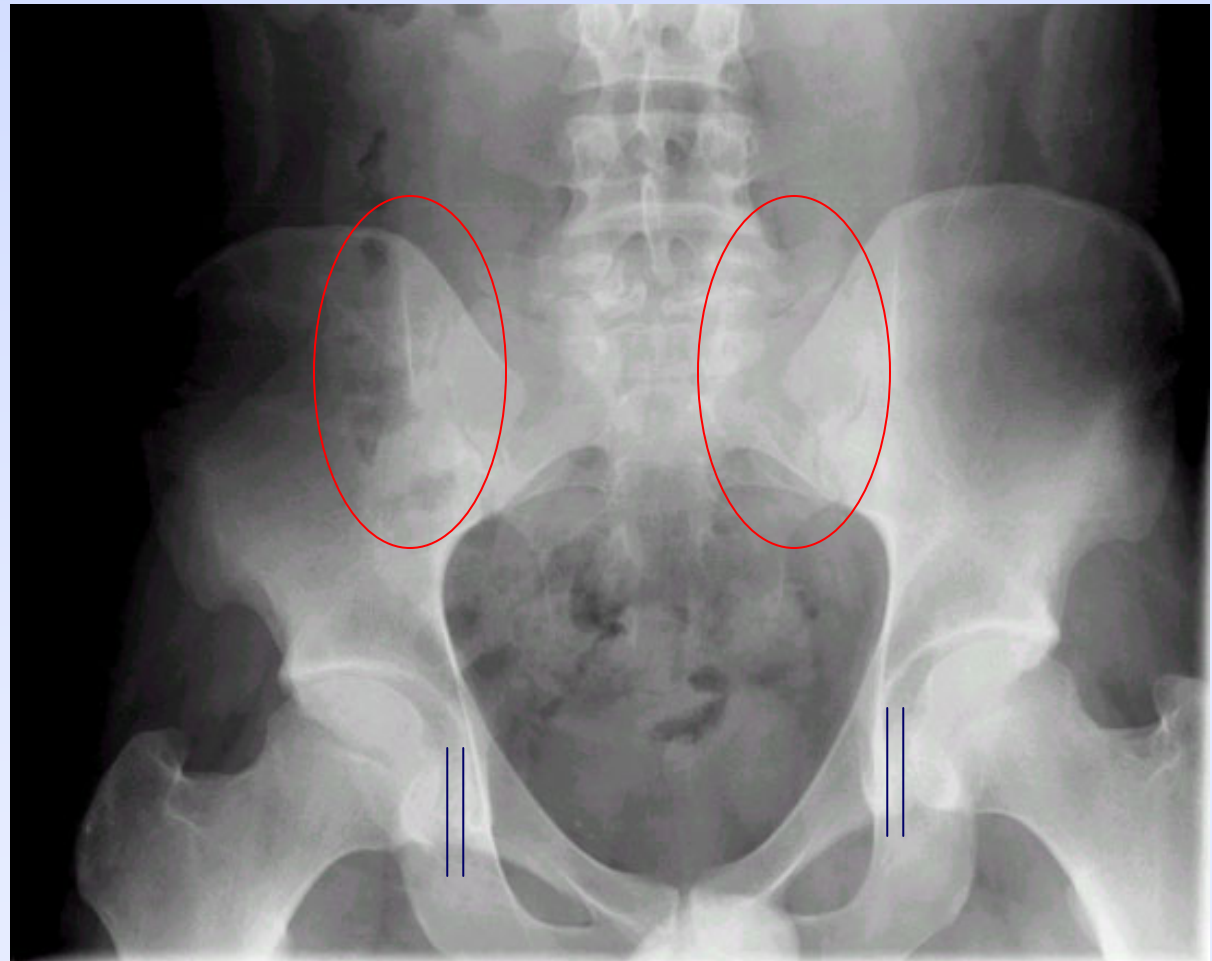
F: 14yo

Ages from Chung (1981) as quoted from Flecker, H. Time of appearance and fusion of ossification centers as observed by roentgenographic methods. *American Journal of Roentgenology* 1942; 47:97



Our Patient – 22yo M with R hip pain

- Soft tissues: nl
- Bones: nl
- SI joints: moderate narrowing with sclerosis
- Hip joints:
 - nl relationship between femoral head and acetabulum
 - normal and symmetric shape of femoral head
 - normal and symmetric joint space



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Arthritides of the Hip

Plain film findings:

- Decreased bone density secondary to local hyperemia
- Erosive bone and cartilage changes
- Secondary sclerosis
- Narrowed joint space or fused joints

Differential diagnosis:

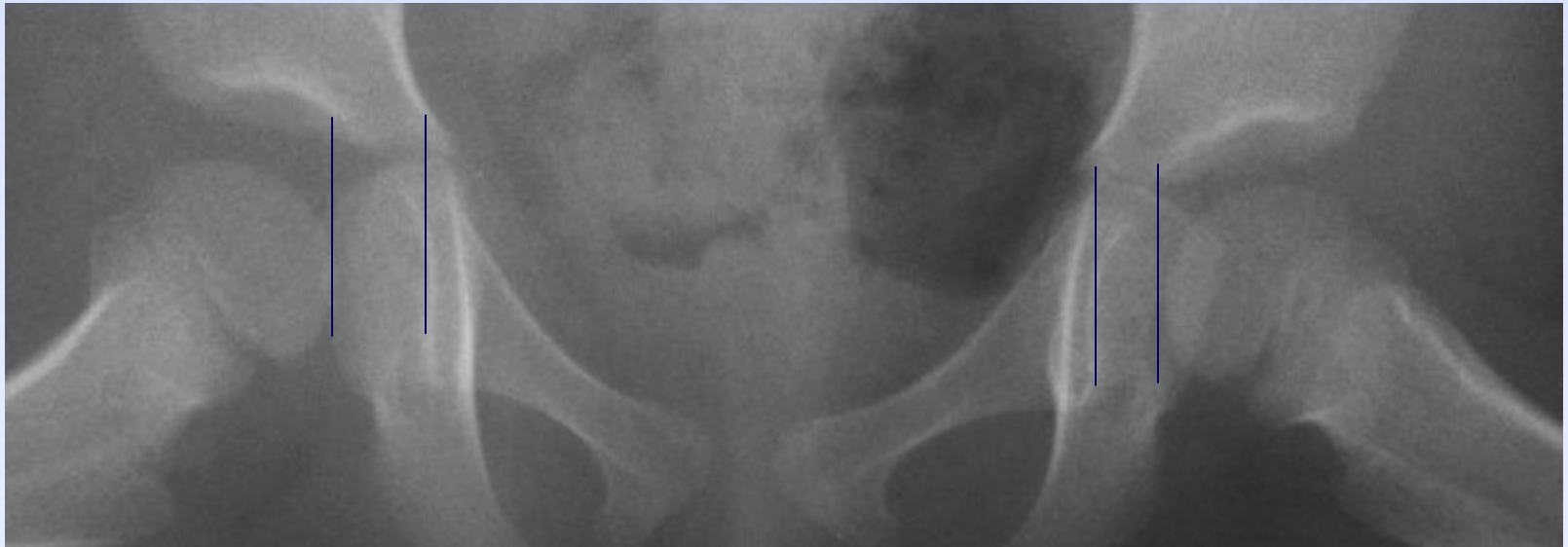
- Juvenile rheumatoid arthritis (Still's disease)
 - Knee is most commonly affected, then ankle and elbow. Hip usually involved later in the course of disease.
 - Systemic (fever, rash, anemia), Polyarticular, Pauciarticular
- Juvenile spondyloarthropathies:
 - Peripheral (esp. knee and ankle) and axial joints may be involved
 - Juvenile ankylosing spondylitis, Psoriatic arthritis, Reiter's syndrome, Inflammatory bowel disease
- Infectious arthritis: Lyme, TB, Gonococcal, Septic Arthritis



Infectious Arthritis

Patient with R Hip Pain and Fever

- nl relationship between femoral head and acetabulum
- normal and symmetric shape of femoral head
- Widened joint space on R compared with L: Joint space effusion



Film from University of Hawaii, Radiology in Pediatric Emergency Medicine Cases, Dr. Myron H. Rosen, <http://www.hawaii.edu/medicine/pediatrics/pemxray/v4c17.html> 11



Infectious Pathology of the Hip

Plain Film Findings:

- Most commonly no radiographic findings on XR
- May see joint space widening/effusion
- With associated osteomyelitis, may see bone destruction \pm subperiosteal new bone formation

Clinical findings:

- Nausea, vomiting, headache, h/o concurrent infection
- Local swelling, warmth, erythema
- Fever, \uparrow ESR, \uparrow CRP, \uparrow WBC

Differential Diagnosis:

- Septic arthritis secondary to systemic infection, local inoculation
- Toxic Synovitis (a.k.a. Transient Synovitis of the Hip), usually in younger age group
- Osteomyelitis

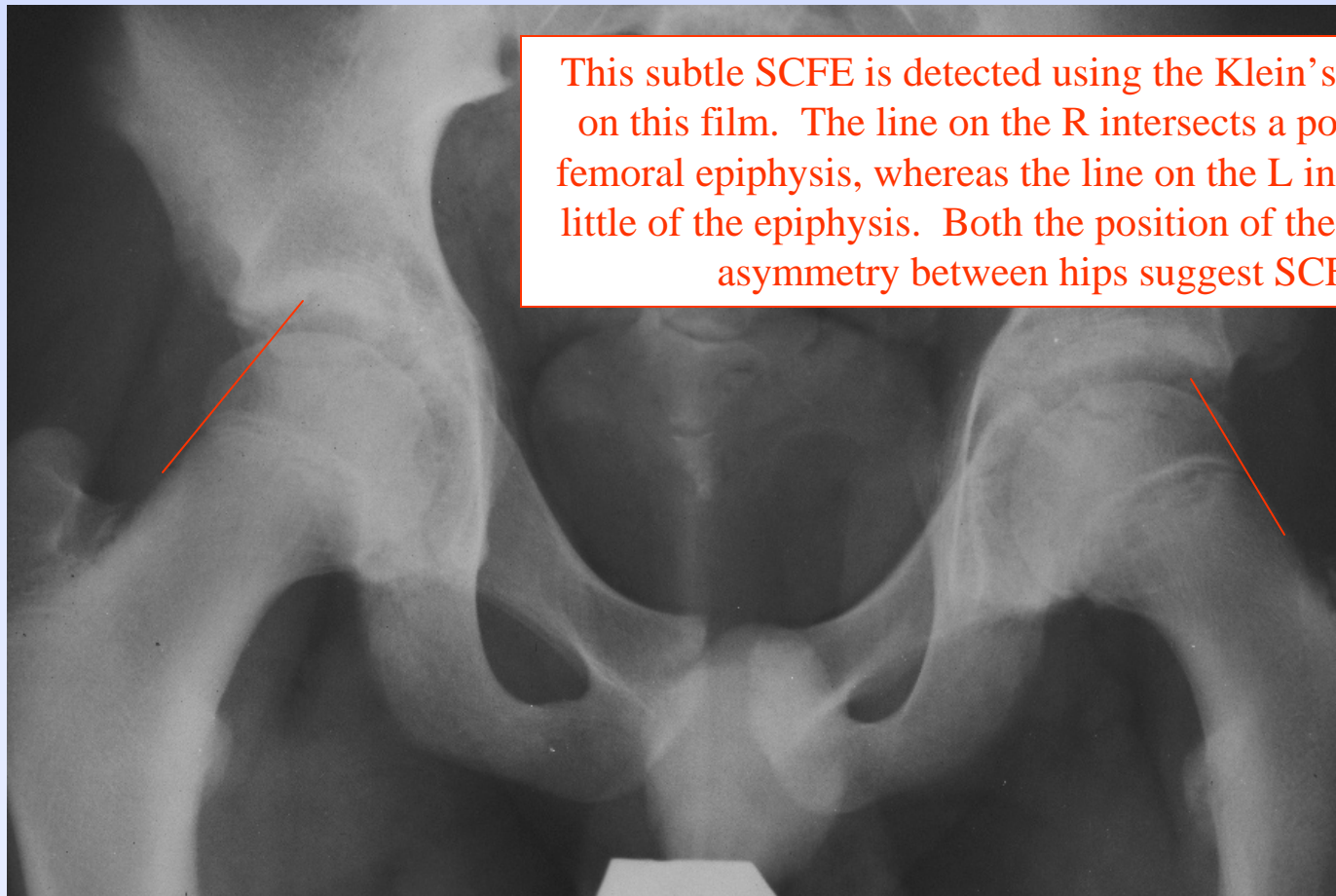
Management:

- In the presence of clinical suspicion for infection (esp. fever and CRP >20 mg/L), must proceed to U/S \pm bone scan regardless of XR findings.



Slipped Capital Femoral Epiphysis (SCFE)

12yo M with L hip pain, L leg ¼” shorter than R.



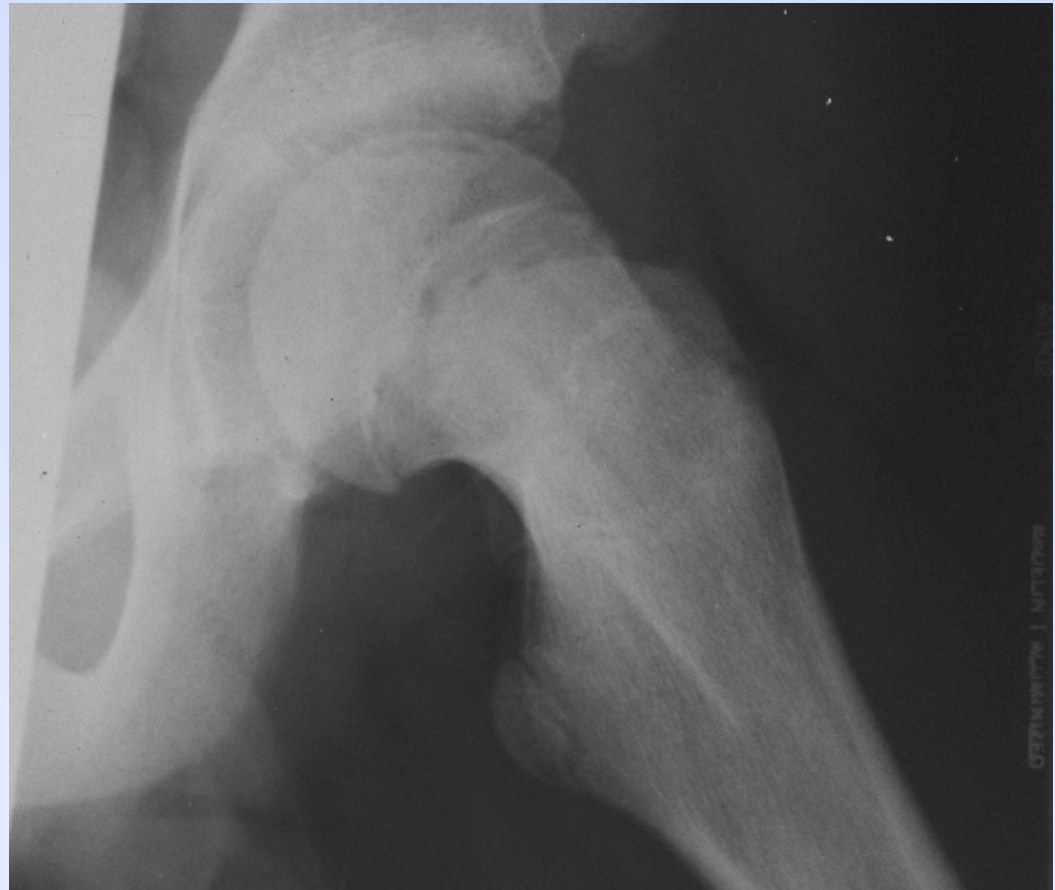
This subtle SCFE is detected using the Klein's lines drawn on this film. The line on the R intersects a portion of the femoral epiphysis, whereas the line on the L intersects very little of the epiphysis. Both the position of the line and the asymmetry between hips suggest SCFE.



Slipped Capital Femoral Epiphysis

Same patient, L lateral view

Lateral view confirms subtle radiographic diagnosis of SCFE: femoral epiphysis is slipped slightly medially and inferiorly.



ACR Teaching File



Slipped Capital Femoral Epiphysis

Plain Film Findings

- May be subtle; best seen on lateral/frog leg view
- Line drawn tangent to lateral femoral metaphysis (Klein's line) intersects very little or none of the epiphysis.
- Bilateral in up to 25% of cases
- Plain film appearance—Salter 1 fx at physis of femoral head—is diagnostic

Clinical Findings

- New onset hip pain or knee pain with little or no associated trauma
- Often in obese patients, more common in boys
- Usual ages 10-13 for girls, 12-15 for boys
- Hip that externally rotates on passive flexion; decreased range of motion

Management

- **Requires urgent orthopedic consultation**

SCFE is the most common hip disorder of adolescence!



Avascular Necrosis of the Femoral Head

12 yo M with R hip and leg pain

- Relationship between femoral head and acetabulum relatively normal
- **Abnormal, flattened shape of femoral head with subchondral fissure seen, representing bone destruction**
- Normal or slightly widened joint space
- Epiphyseal/metaphyseal relationship distorted by epiphyseal necrosis





Avascular Necrosis of the Femoral Head

Plain Film Findings:

- Initial phase: no findings (“dead” bone indistinguishable from healthy bone)
- Early phase (beginning revascularization, bone breakdown, new bone deposition): increased joint space, subchondral fissure, focal lucencies, focal sclerosis, abnormal shape of femoral head
- Late phase (resorption slows and deposition predominates): increased density, abnormal shape of femoral head may persist

Differential Diagnosis:

- Idiopathic (including Legg-Calve-Perthes disease ~ages 4-12)
- Sickle cell disease
- Steroid use
- Gaucher disease
- Untreated osteomyelitis
- Untreated SCFE

Management:

- Controversial: self-reparative in most cases, but deformity may persist.
- Orthopedic and radiologic follow-up required



Neoplastic Hip Pathology: Ewings Sarcoma

12 yo patient with L hip pain



ACR Teaching File



Neoplastic Hip Pathology

Plain Film Findings:

- Vary according to pathology

Clinical Findings:

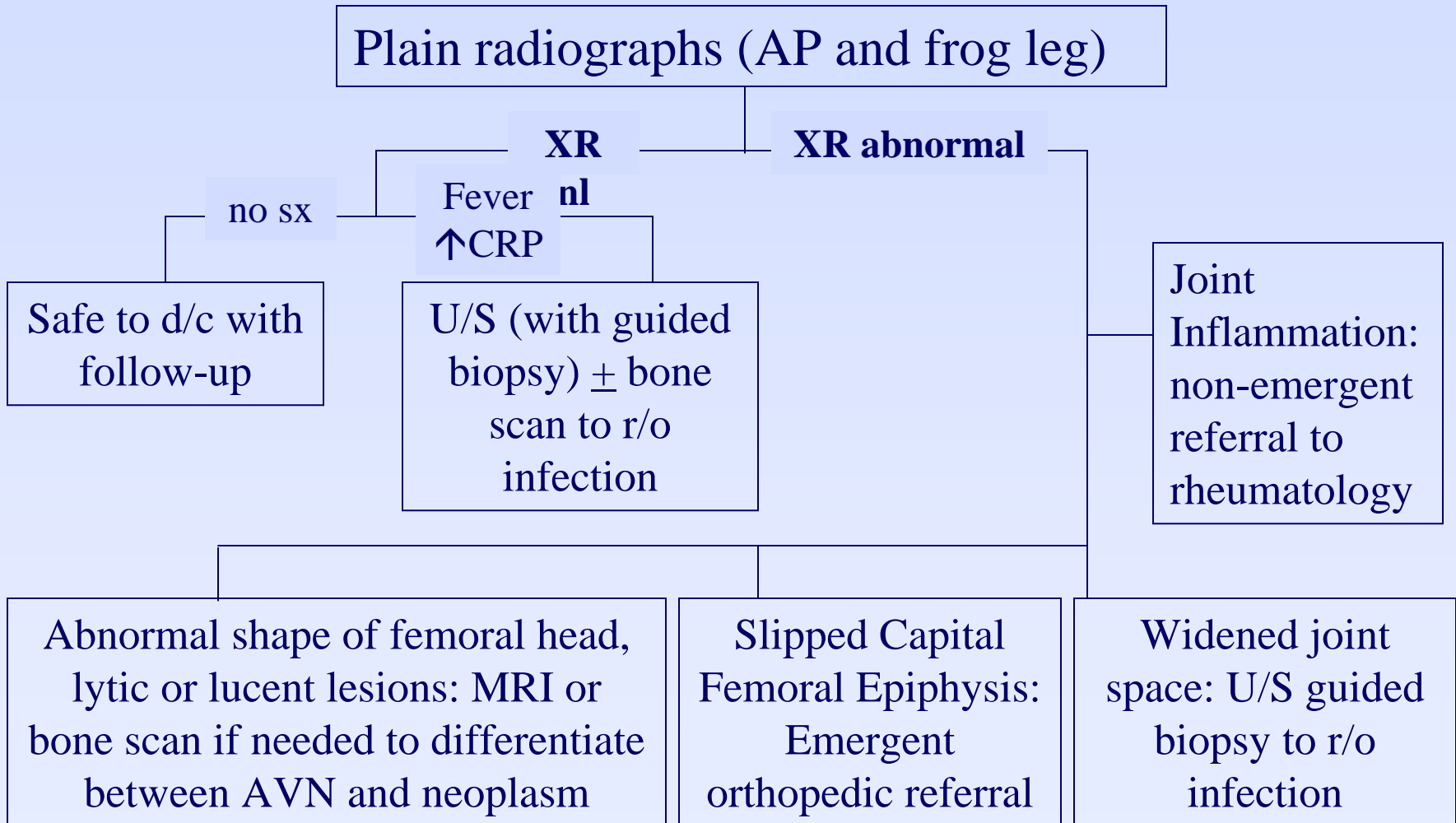
- Extremity pain at night or at rest
- Systemic symptoms
- Pathologic Fractures

Differential Diagnosis:

- Benign
 - Osteoid osteoma
 - Eosinophilic granuloma
 - Solitary bone cyst
 - Aneurysmal bone cyst
- Malignant
 - Ewing's Sarcoma
 - Osteosarcoma
 - Leukemia



Decision Tree in Evaluation of Atraumatic Hip Pain





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University of Hawaii, Radiology in Pediatric Emergency Medicine Website,
<http://www.hawaii.edu/medicine/pediatrics/pemxray/v4c17.html>.



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