



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

**Takara Stanley, MS4  
Gillian Lieberman, MD**



## 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

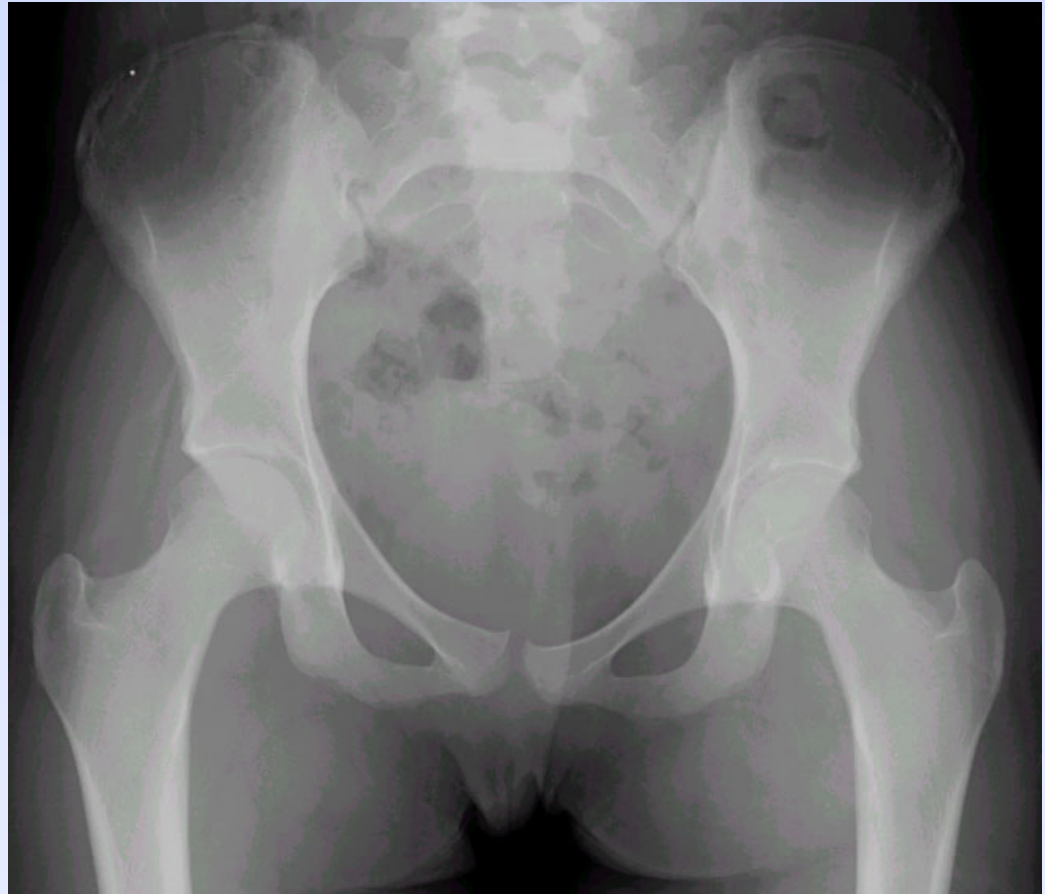
**Inflammatory:** toxic synovitis, bursitis, RA, Lyme arthritis, spondyloarthropathy,

**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



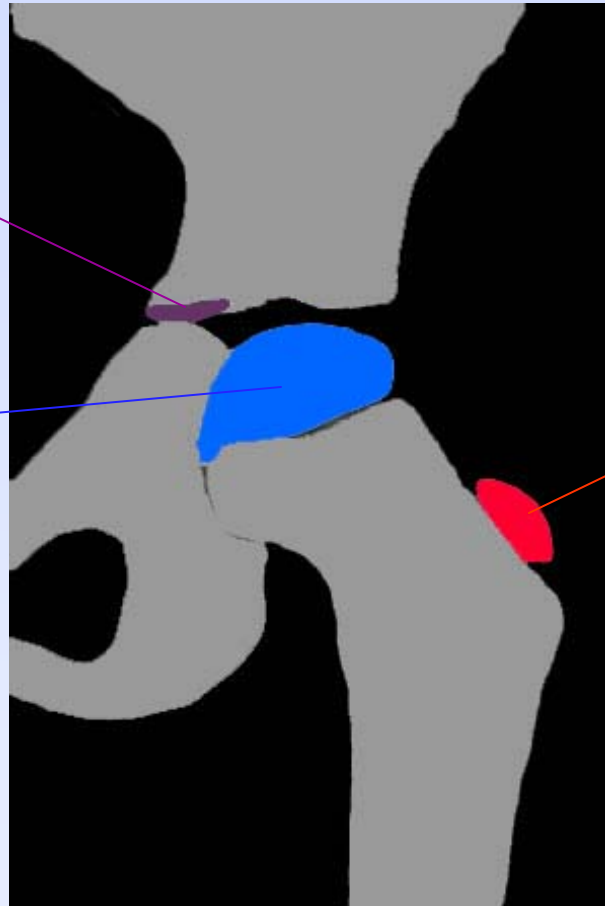
**Klein's line,**  
shown here,  
should intersect  
femoral epiphysis  
such that part of  
the epiphysis lies  
lateral to the line

## BIDMC PACS

- 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

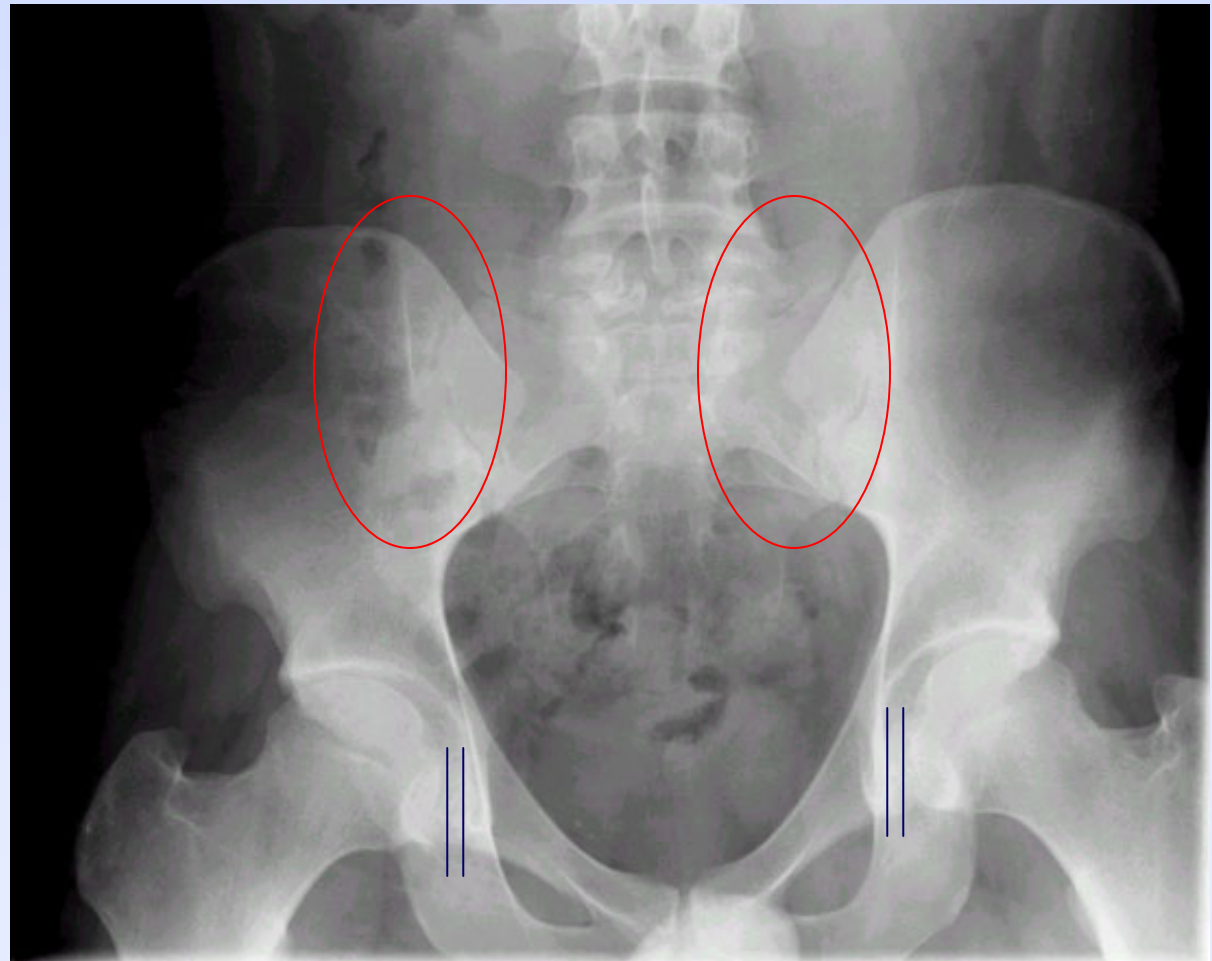
Ages from Chung (1981) as quoted from Flecker, H. Time of appearance and fusion of ossification centers as observed by roentgenographic methods. *American Journal of Roentgenology* 1942; 47:97





## 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



BIDMC PACS



# 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:

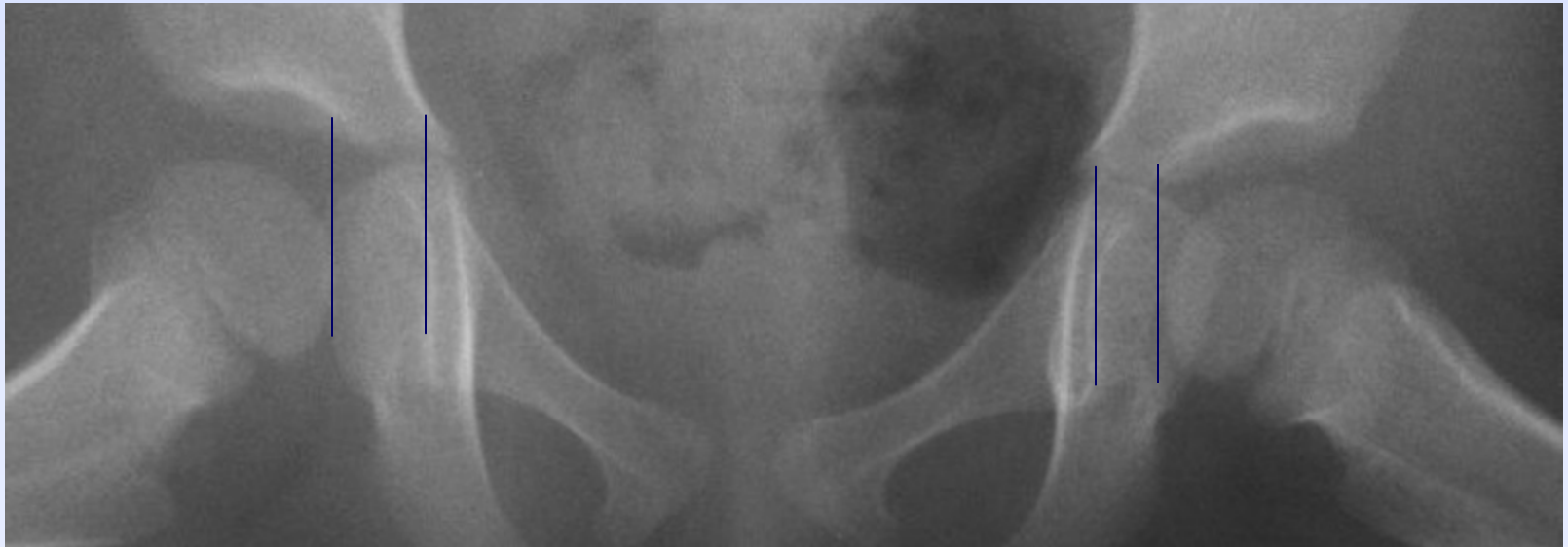
- Juvenile rheumatoid arthritis (Still's disease)
  - Knee is most commonly affected, then ankle and elbow. Hip usually involved later in the course of disease.
  - Systemic (fever, rash, anemia), Polyarticular, Pauciarticular
- Juvenile spondyloarthropathies:
  - Peripheral (esp. knee and ankle) and 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

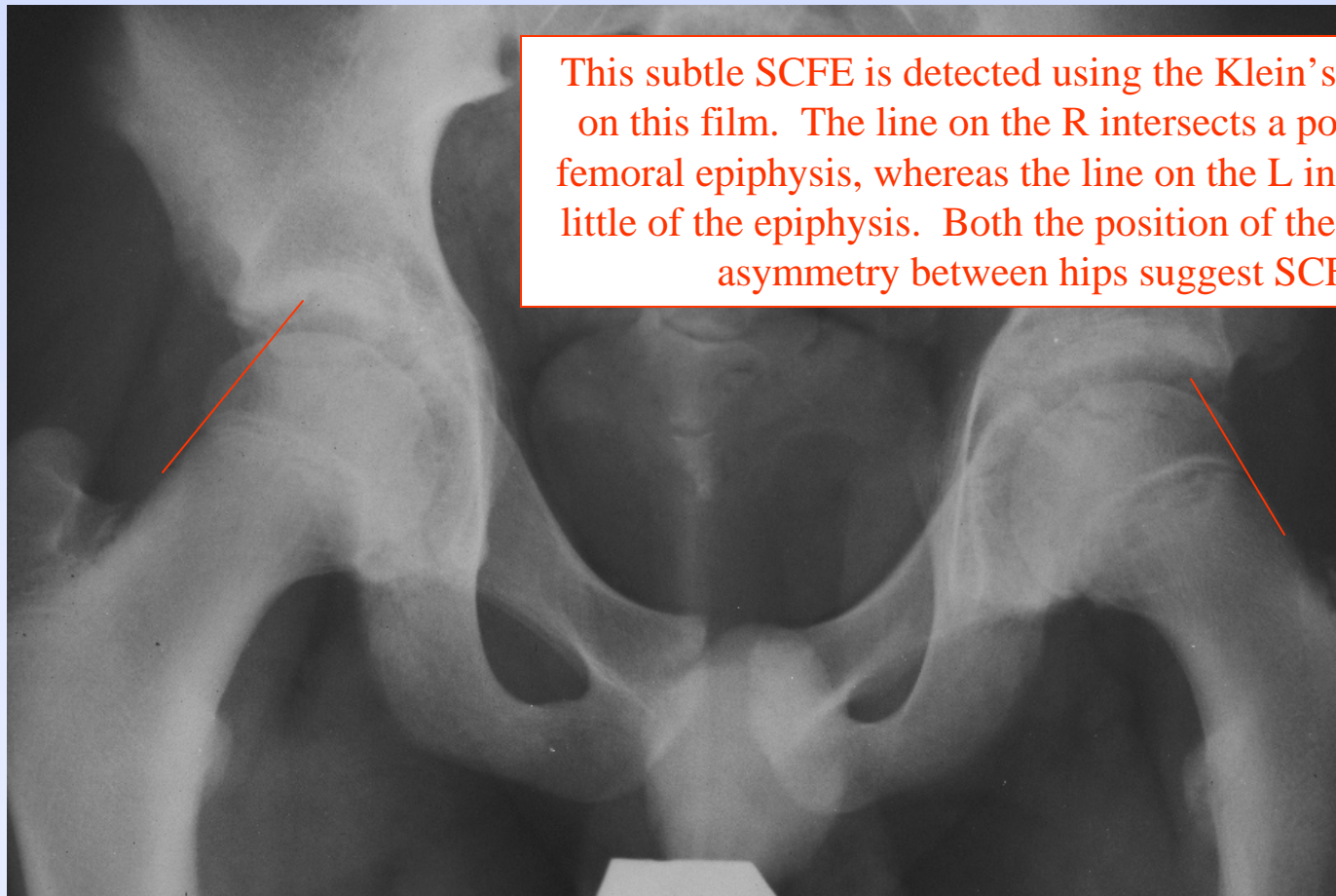
## Management:

- 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 1/4" shorter than R.



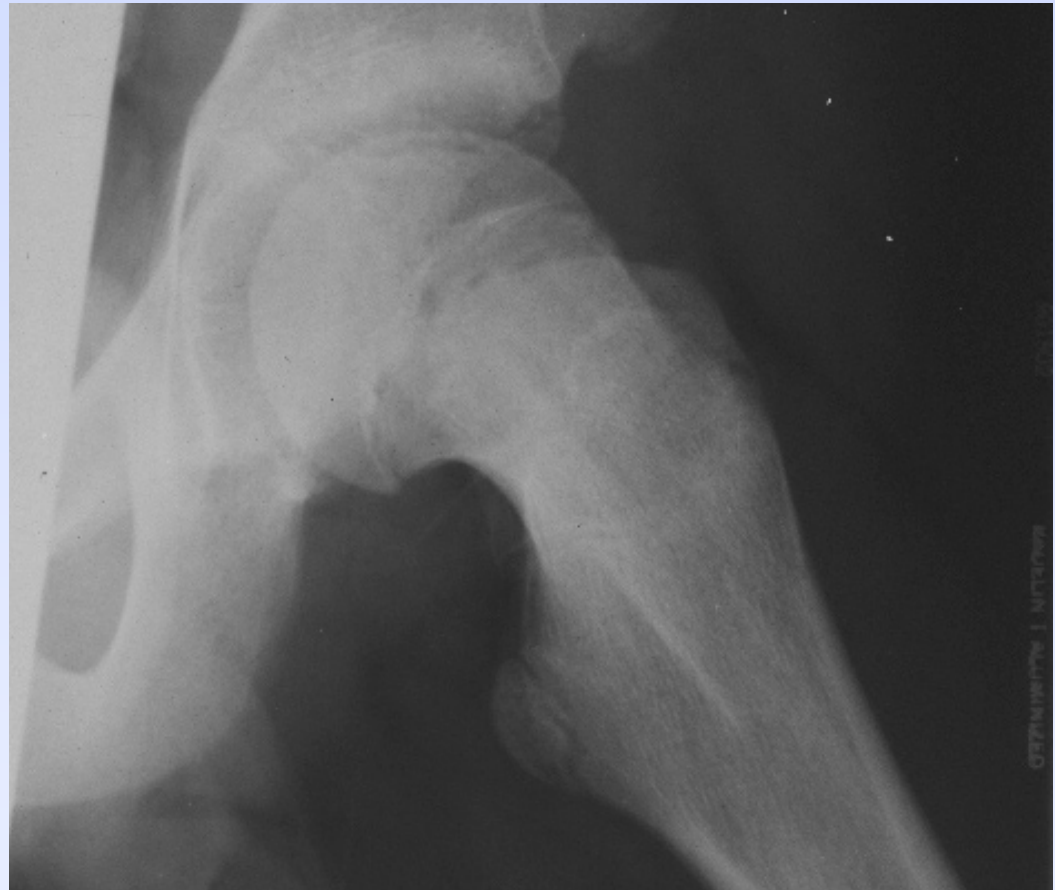
This subtle SCFE is detected using the Klein's lines drawn on this film. The line on the R intersects a portion of the femoral epiphysis, whereas the line on the L intersects very little of the epiphysis. Both the position of the line and the asymmetry between hips suggest SCFE.



# 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:

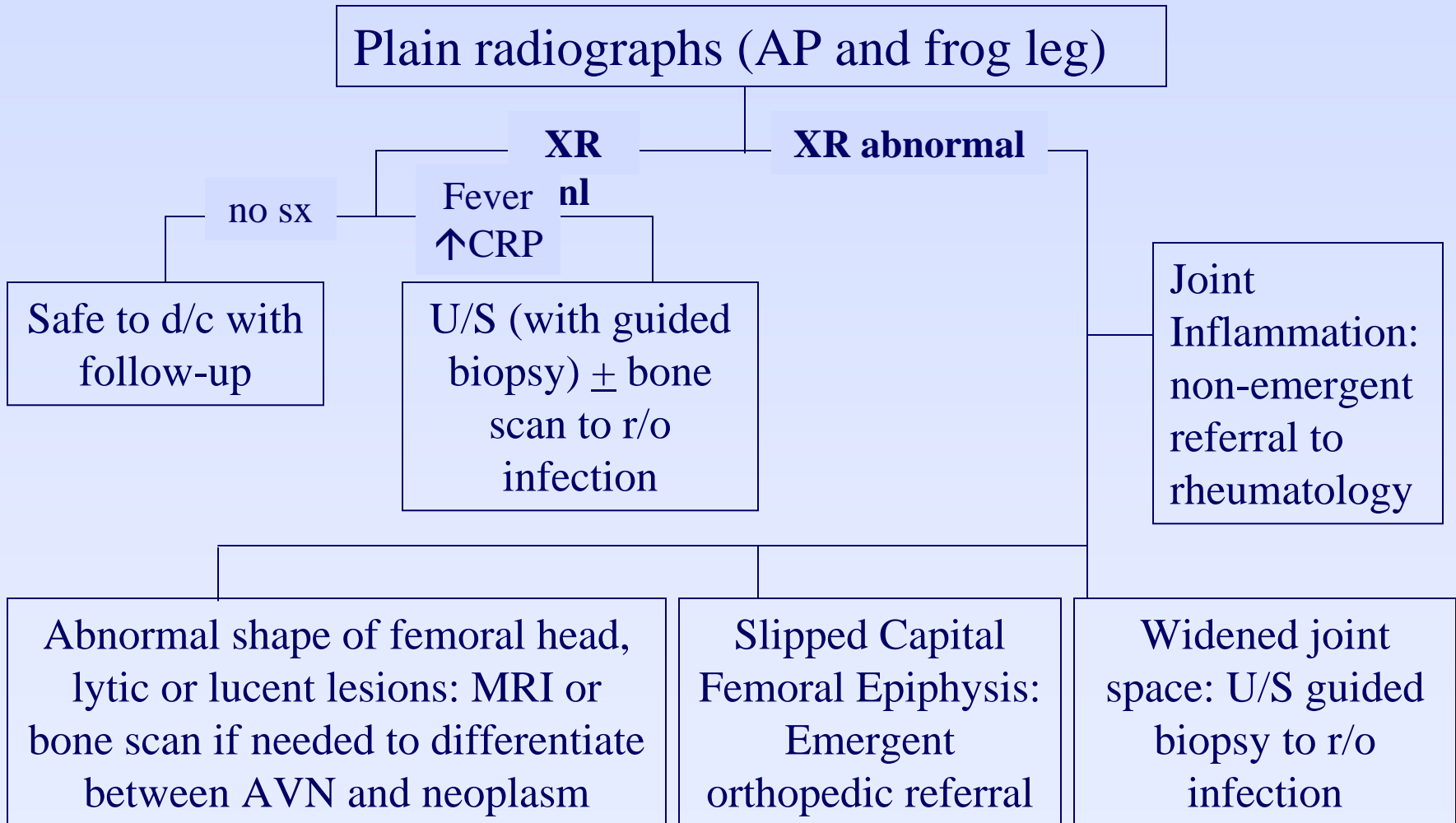
- Extremity pain at night or at rest
- Systemic symptoms
- Pathologic Fractures

## 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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