



## Musculoskeletal Infection

Dr. Mini N. Pathria M.D., FRCP(C)  
Department of Radiology  
University of California School of Medicine  
San Diego, California

## Musculoskeletal Infection

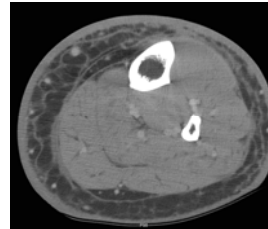
Site		Term
Superficial	Subcutaneous tissues	Cellulitis
	Fascia	Septic fasciitis
	Muscle	Pyomyositis
Synovial	Tendon sheath	Septic tenosynovitis
	Bursa	Septic bursitis
	Articulation	Septic arthritis
Bone	Cortex	Osteitis
	Bone marrow	Osteomyelitis

## Soft tissue infection

- Penetrating injury
  - Trauma
  - Retained foreign body
  - Iatrogenic
- Vascular insufficiency
- Immunocompromised



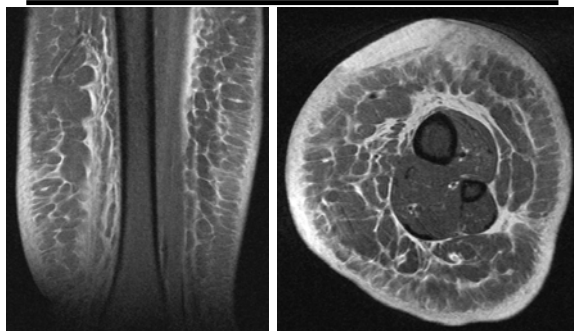
## Cellulitis



Soft tissue swelling  
Skin thickening  
Obliteration of superficial fat planes

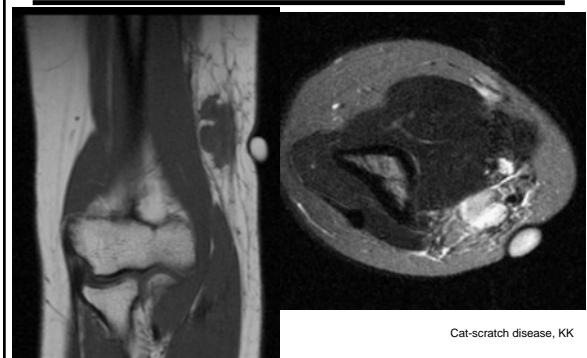


## Cellulitis



JL

## Subcutaneous nodes



Cat-scratch disease, KK

## Fascial infection

- Septic fasciitis
- Necrotizing fasciitis
  - Surgical emergency
  - Fascial biopsy is gold standard for diagnosis

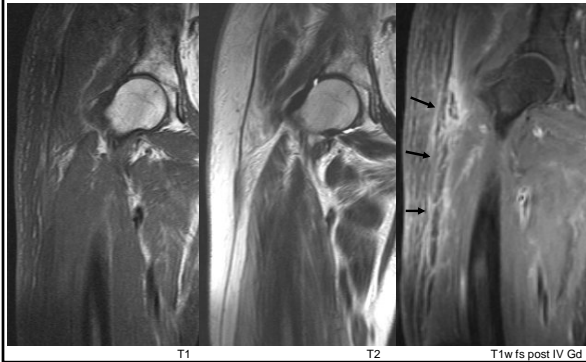


## Necrotizing fasciitis

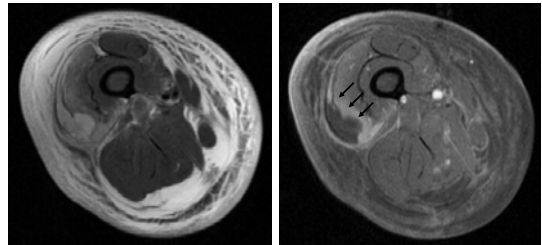
- Radiographs
  - Insensitive
  - Linear gas along fascial planes
- CT and MR
  - Gas and fluid along fascial plane
  - Fascial thickening and enhancement
  - Limited accuracy
- Fascial biopsy is gold standard for diagnosis



## Necrotizing fasciitis

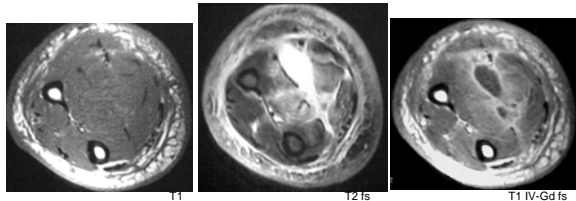


## Pyomyositis



Penetrating wound  
HIV  
Diabetes mellitus  
Tropical pyomyositis

## Pyomyositis in HIV

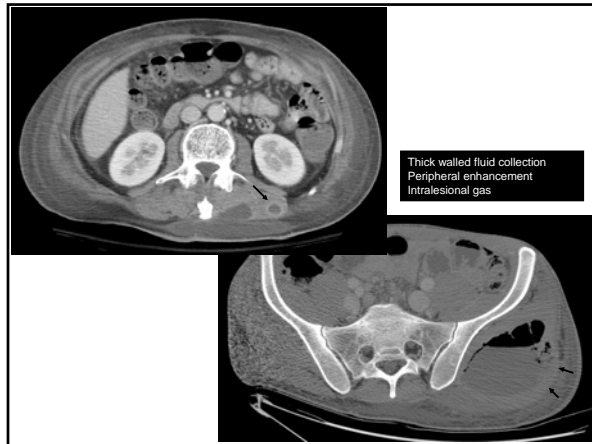


Increased risk of deep muscle infections in HIV  
Buttock and lower extremity  
Staph aureus or mixed organisms  
Fluid collections, abscess formation

## Soft tissue abscess

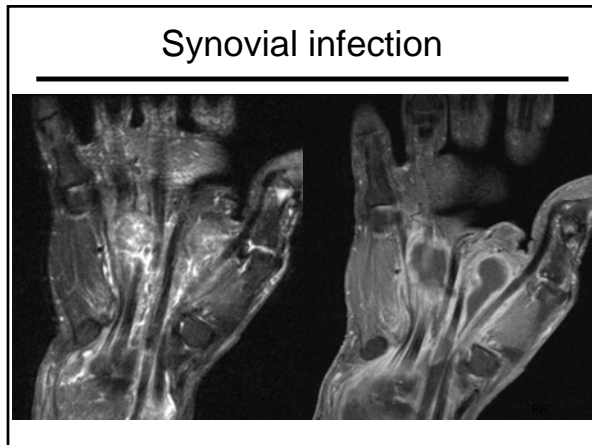
- Focal ill-defined mass surrounded by edema
- Thick enhancing wall
- Inner lining of cellular inflammation
- Central fluid collection
- Gas-fluid level or multiple bubbles





### Synovial infection

- Septic tenosynovitis
- Septic bursitis
- Septic arthritis



### Septic bursitis

- Superficial bursae
  - Prepatellar
  - Olecranon
  - Subacromial
- Fluid within bursa
- Synovitis, internal debris, or gas formation

### Septic arthritis

- Hematogenous spread to synovial membrane
- Direct inoculation of joint
- Spread from contiguous osteomyelitis or soft tissue infection

Hip Joint

Synovial Fluid

Articular Cartilage

Ligament and Joint Capsule

Direct inoculation

Femoral Head

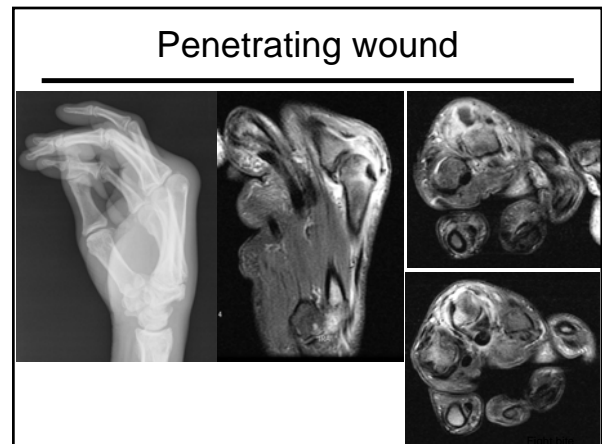
Hematogenous spread

Synovial Membrane


Spread from contiguous infection

Femur


Ligament and Joint Capsule



### Contiguous osteomyelitis



Epiphyseal osteomyelitis



Intracapsular metaphyseal osteomyelitis  
Shoulder, Hip  
Not knee

### Hematogenous septic arthritis

- Large joints in children -- hip, knee, shoulder



2 Y

Avascular necrosis  
Premature physseal closure  
Joint ankylosis  
Secondary osteoarthritis




### Hematogenous septic arthritis






Adults 5 "S" joints  
Sternoclavicular  
Shoulder  
Spine  
Sacroiliac  
Symphysis

### Septic arthritis




2 Y

Joint space widening  
may be seen in children,  
uncommon in adults




Periarticular swelling  
Periarticular osteopenia  
Uniform joint space loss  
Marginal erosions


### Tuberculous arthritis



2004




2007

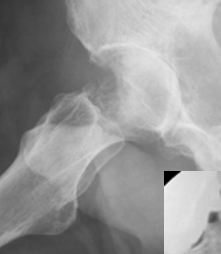



T2

- Indolent course
- Phemister triad
  - Prominent periarticular osteoporosis
  - Gradual narrowing of joint space
  - Peripherally located erosions

### Septic arthritis

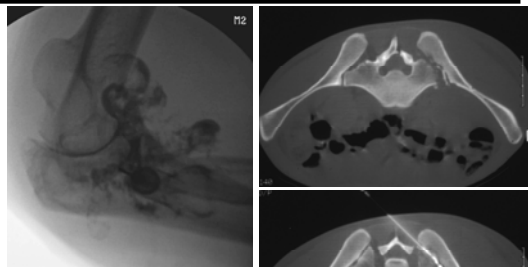






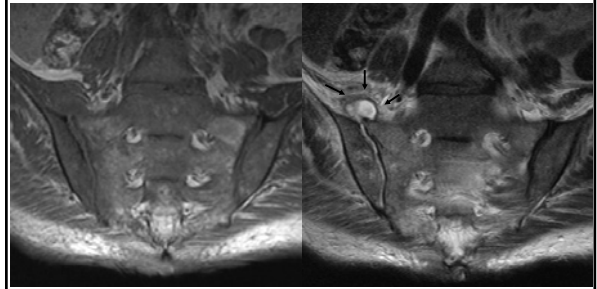
Any erosive monoarticular arthritis is infection until proven otherwise  
Aspirate the joint if you suspect infection

## Arthrography



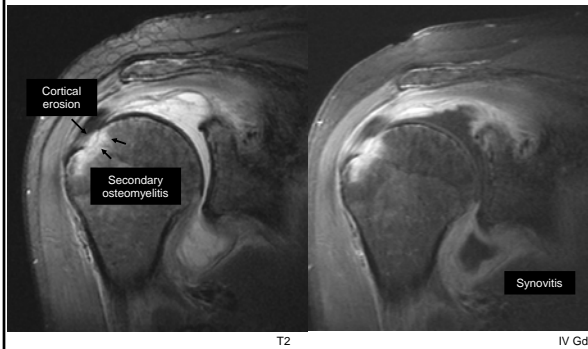
Fluoroscopic or US/CT guidance  
Obtain aspirate prior to injecting contrast  
Document needle placement with contrast  
Synovitis, tracking from joint

## Septic arthritis



JC

## Septic arthritis

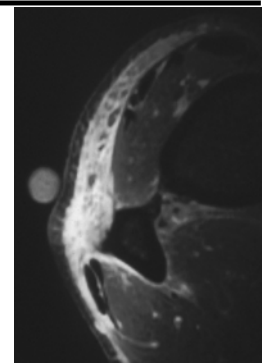


T2

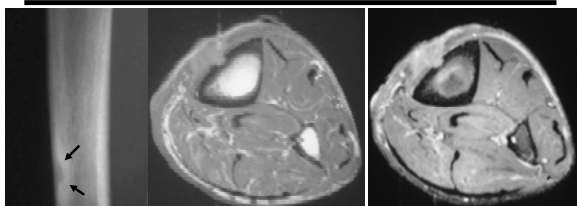
IV Gd

## Infectious osteitis

- Cortical infection
  - Spread from contiguous soft tissue infection or ulcer
  - Hematogenous spread to periosteum or cortex
- Infection rarely limited to cortex
- Difficult to distinguish from osteomyelitis



## Intracortical abscess

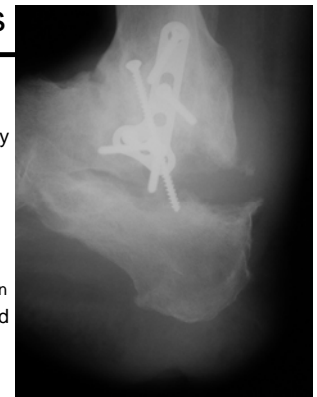


Can be confused with osteoid osteoma  
Abscess tends to be larger, more irregular and has tendency to form tracks within and beyond cortex

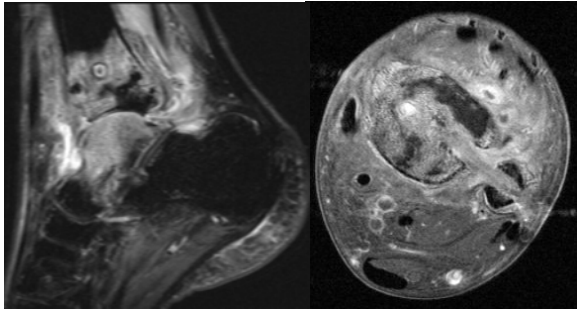
AQ

## Osteomyelitis

- Postsurgical
- Penetrating trauma
- Vascular insufficiency
  - Diabetes mellitus
  - Sickle cell disease
- Closed trauma
- Bacteremia
  - IV drug abuse
  - Other sites of infection
- Immunocompromised



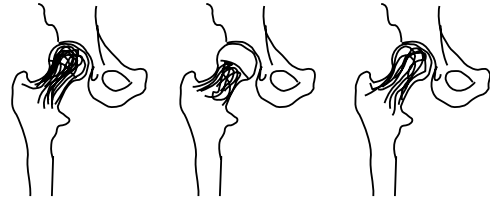
## Iatrogenic osteomyelitis



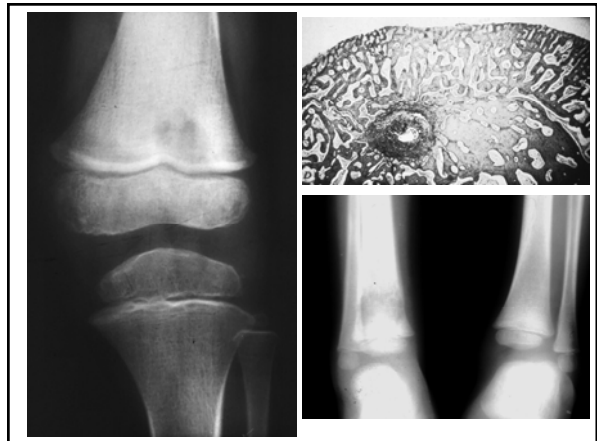
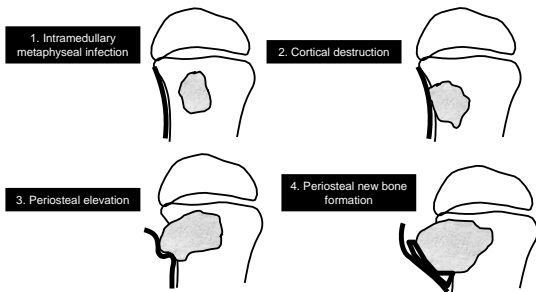
MO

## Hematogenous Osteomyelitis

Infant	Child	Adult
Epiphyseal	Metaphyseal	Axial, epiphyseal
Hip, knee	Hip, knee	Spine, SI joint
S. aureus, Group D Strep	S. aureus, H. influenza	S. aureus, Gram negative

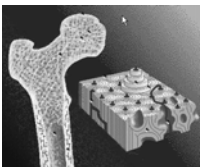


## Stages of osteomyelitis

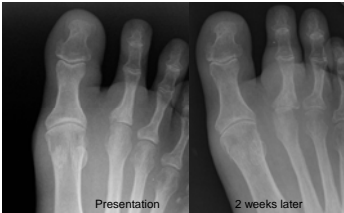


## Osteomyelitis

- Adjacent swelling and effusion
- Permeative or moth-eaten osteolysis
- Cortical tunneling and splitting
- Continuous periostitis



### Scintigraphy



Presentation      2 weeks later

More sensitive for early osteomyelitis  
 Positive flow, blood pool  
 Persistent or increased activity on delayed phase  
 Gallium for chronic infection  
 In-WBC increases specificity

54F JS

FOOT

ANT. ANK.

POST. CLAV.

POST. CLAV.

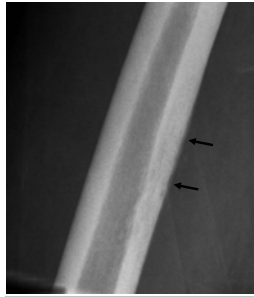
LYMB. PLAT.

SABD. PLAT.

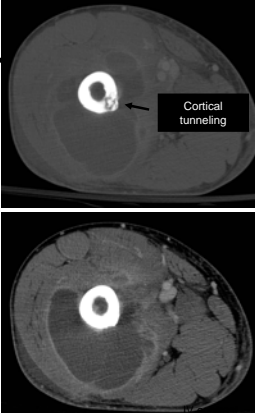
ANT. SKELL.

POST. SKELL.

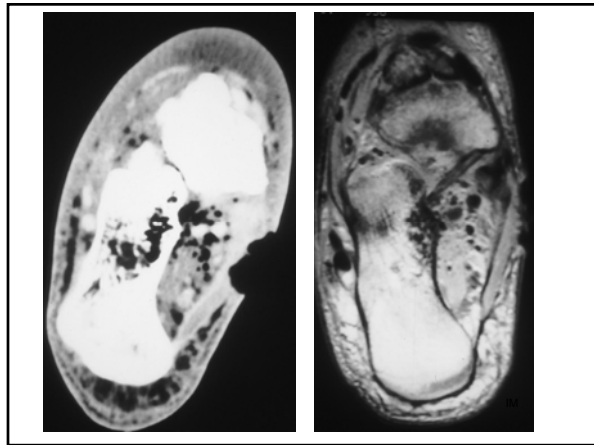
### CT




Sensitive for cortical destruction  
 Insensitive for medullary involvement  
 Marrow attenuation >20 HU compared to contralateral side




Cortical tunneling




### Intramedullary gas



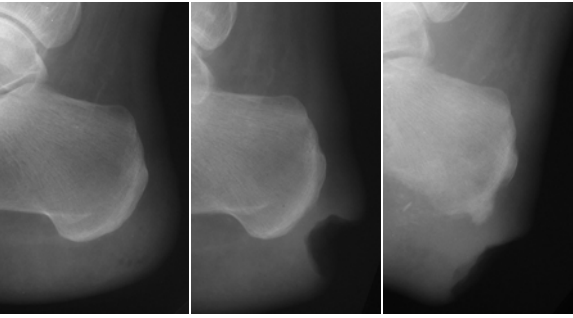


### MR of osteomyelitis

- Decreased signal on T1w
- Increased signal on T2w and STIR
- Gadolinium enhancement



### Diabetic foot



Diabetic ulcer complicated by Osteomyelitis, May-June-July, CC

## Diabetic foot



## Neuroarthropathy

- Scintigraphy
  - In-WBC
- MR of neuroarthropathy
  - Inactive neuroarthropathy: low signal on T1 and T2 images
  - Active neuroarthropathy: low signal on T1 and high signal on T2

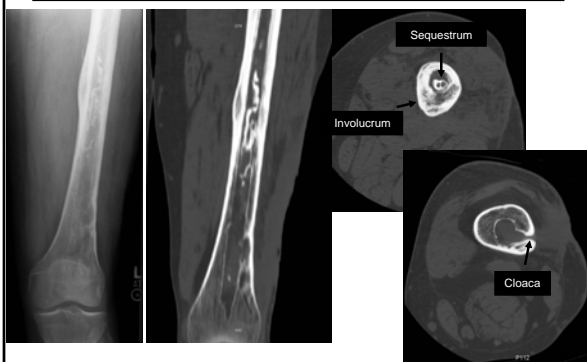


## Chronic osteomyelitis

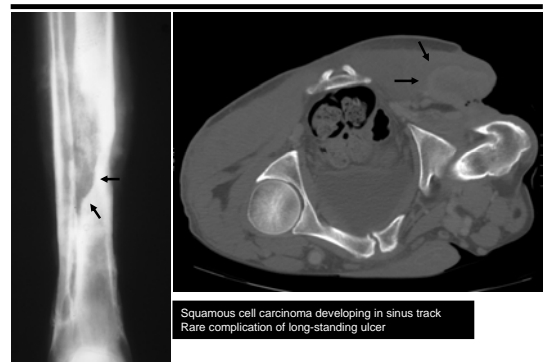
- Sequestrum: Necrotic bone separated from living bone by inflammatory tissue
- Involucrum: Layer of living bone deposited around the necrotic fragment
- Cloaca: Opening within involucrum which allows drainage or extrusion



## Chronic osteomyelitis



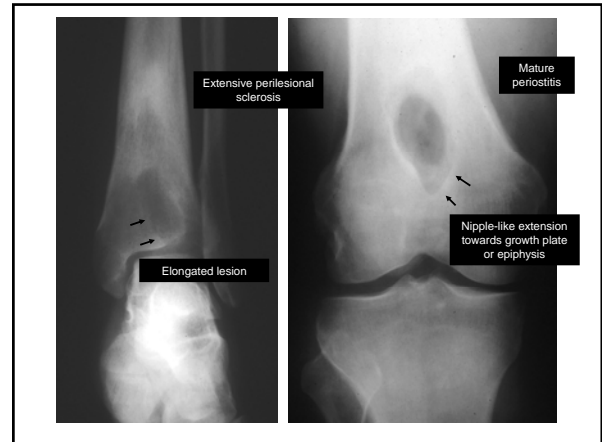
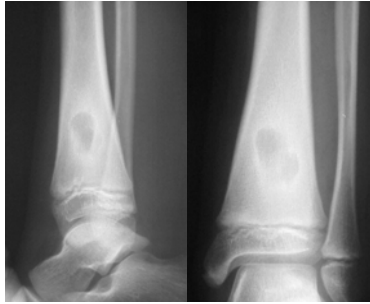
## Marjolin's ulcer



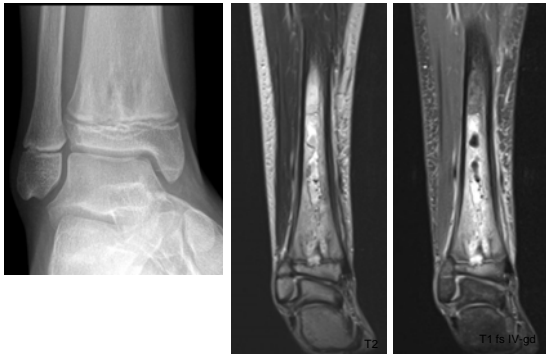


## Brodie's abscess

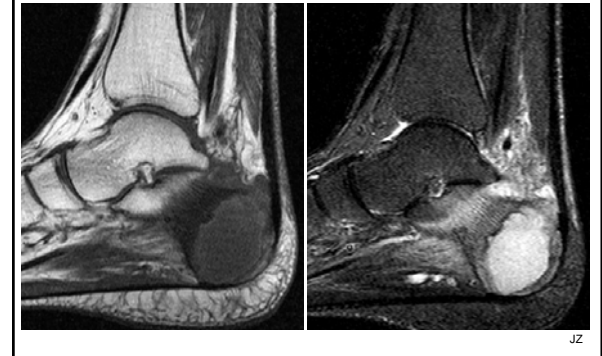
- Chronic active osteomyelitis
- Staph aureus
- Most common in distal tibial metaphysis



## Brodie's abscess



## Brodie's abscess



## Musculoskeletal Infection

Dr. Mini N. Pathria M.D., FRCP(C)  
Department of Radiology  
University of California School of Medicine  
San Diego, California