Musculoskeletal Infection

Dr. Tudor H. Hughes M.D., FRCR

Department of Radiology

University of California School of Medicine

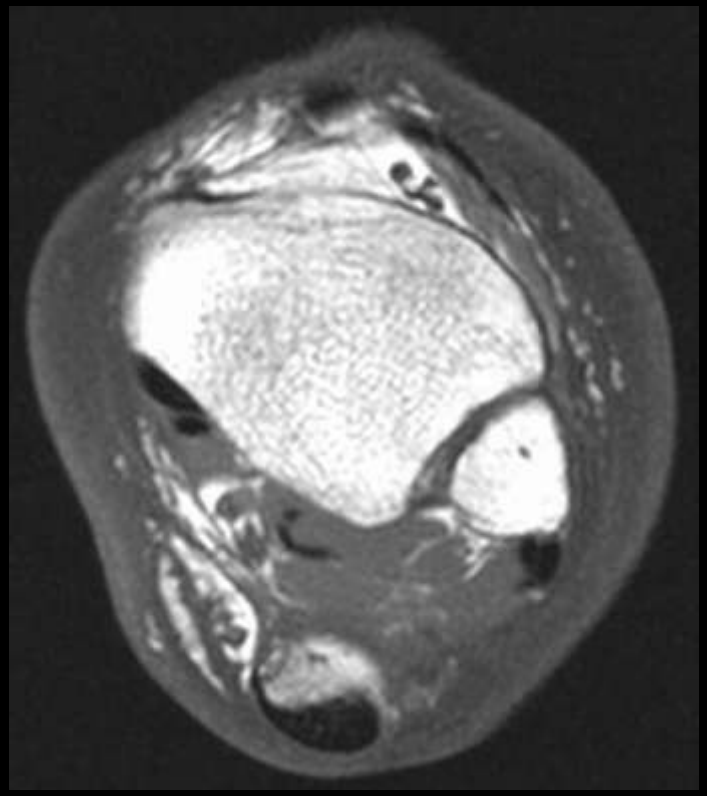
San Diego, California

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

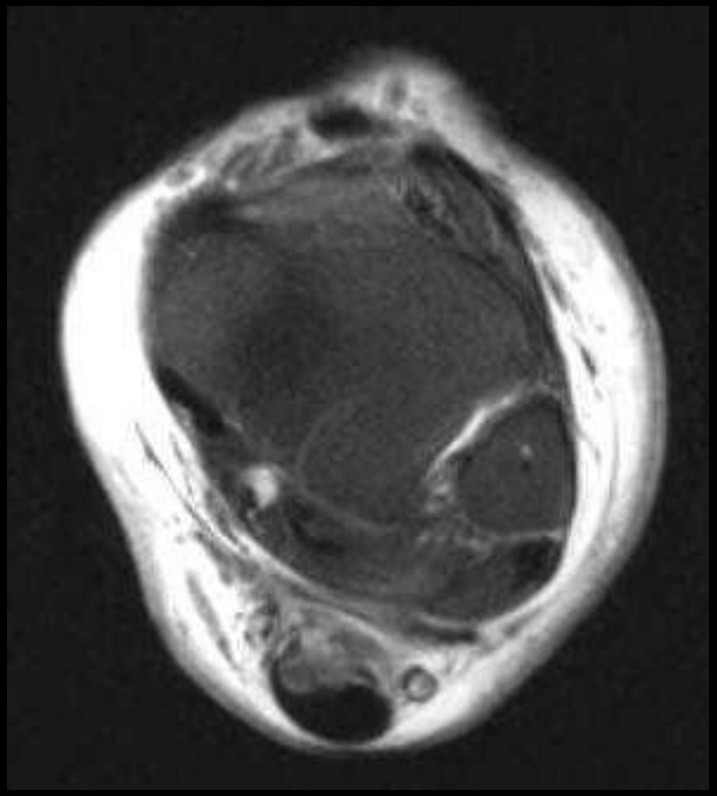
- Penetrating injury
  - Trauma
  - Retained foreign body
  - Postoperative
- Vascular insufficiency
- Immune compromised

Retained wood foreign body - Cor T2

Cellulitis



AxT1

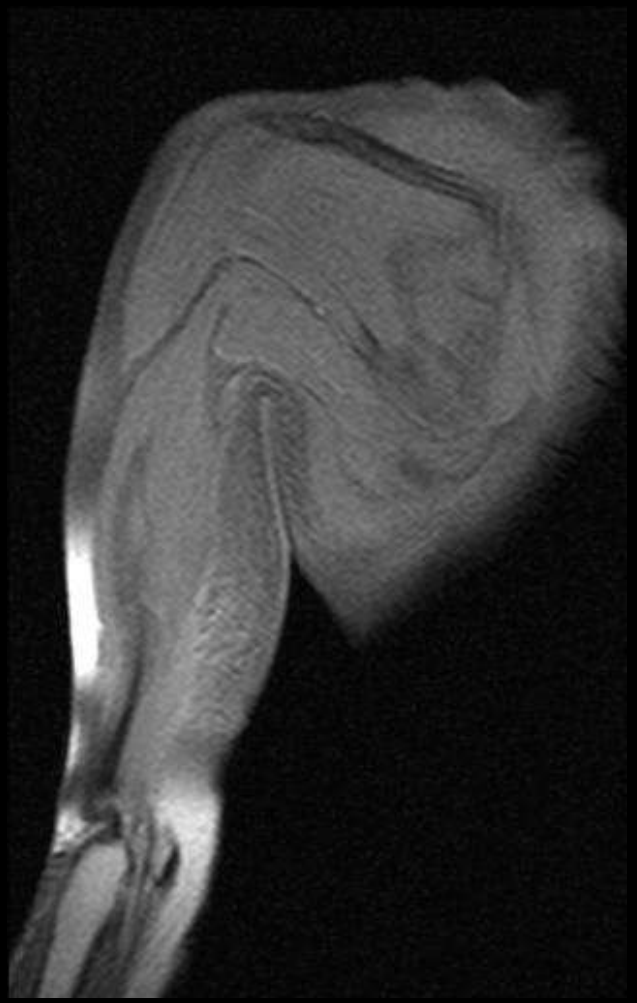


AxT2FS

- Skin thickening
- Soft tissue swelling
- Obliteration of superficial fat planes

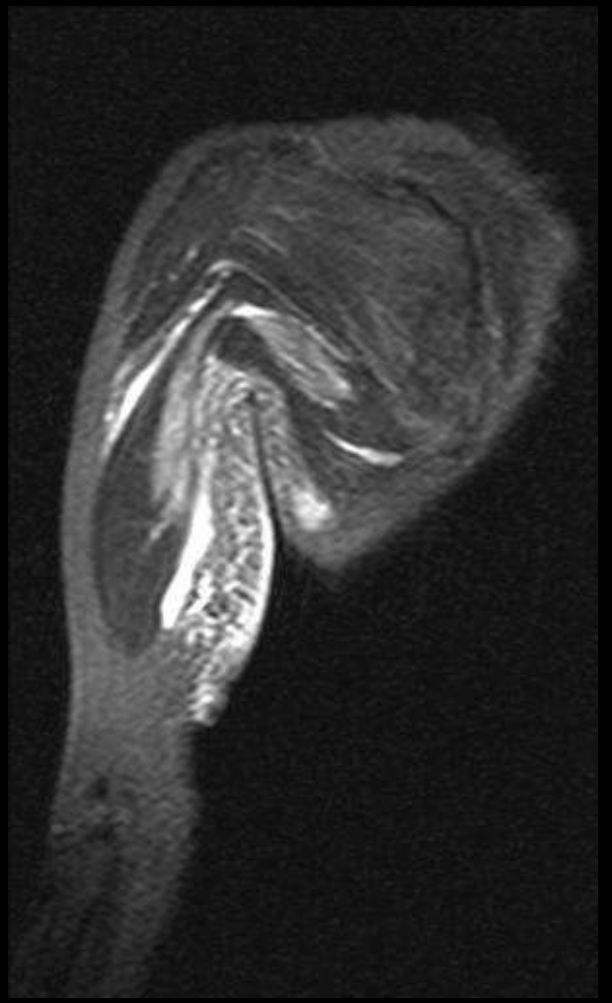
- Septic fasciitis
- Severe cases can progress to necrotizing fasciitis

- Gas within fascia and along fascial planes
- Thickening of fascia
- Fluid collection on outside and inside of fascia



Cor T1FS

Cor T1FS IVGd



Cor PDFS

Nec fascitis path proven

- Rapidly progressive, highly fatal soft tissue polymycrobial infection deep to skin and superficial to muscle
- Immunocompromised + elderly at risk
- Tx: Surgical debridement + fasciotomy
- Distinguish from cellulitis
  - thickened subcutaneous tissues with enhancement
- XRAY- normal; cellulitis; soft-tissue gas, rare
- CT-soft-tissue gas, fascial fluid collections, fascial thickening + enhancement, abscesses
- MR- T2-bright signal and enhancement of deep fascial planes

39 year-old man with AIDS and upper extremity cellulitis now septic

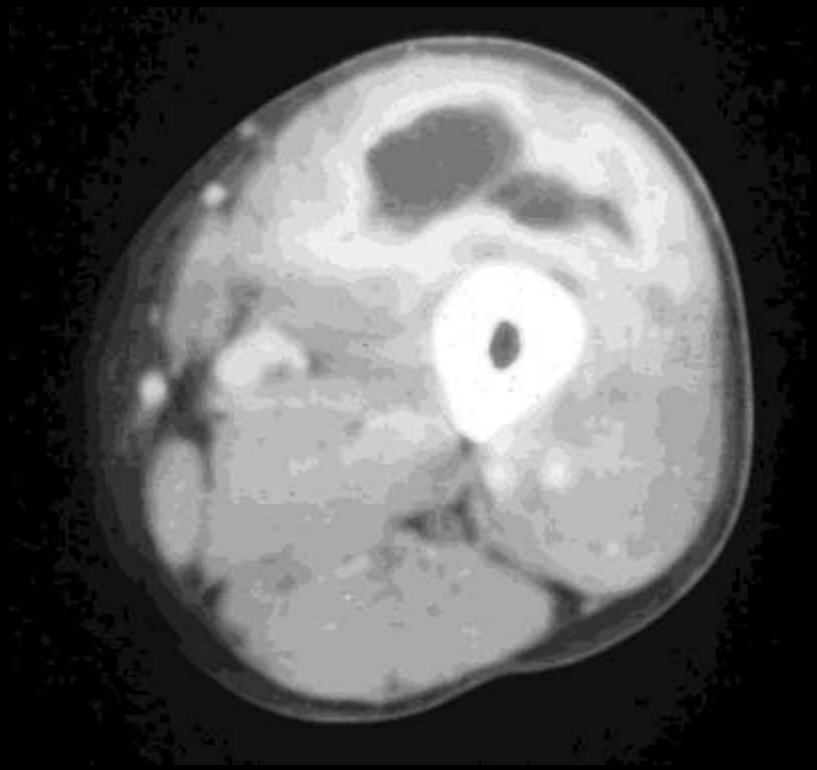
- Nonenhancing necrotic fluid collections or rim-enhancing abscesses
- Gas-T1 + T2 signal voids
- Overestimate disease
  - Noninfectious edema of neighboring fascia
- False positive
  - Recent prior IM steroid injection with muscular and investing fascial enhancement

39 year-old man with AIDS and upper extremity cellulitis now septic

- Penetrating trauma
- Postoperative
- Superficial ulcer
- Soft tissue infection
- Rapid tissue necrosis
- Barotrauma
- Hydrogen peroxide lavage
- Pneumatocyst
- Air gun Injury

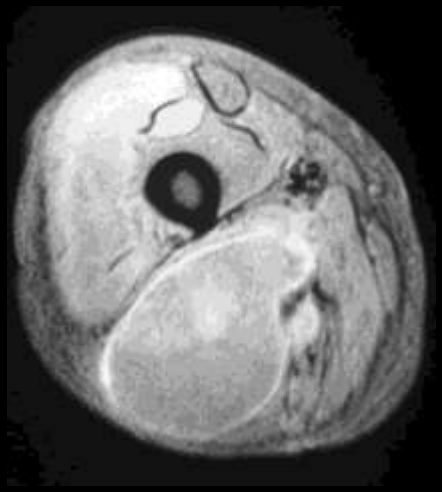
Gas gangrene

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

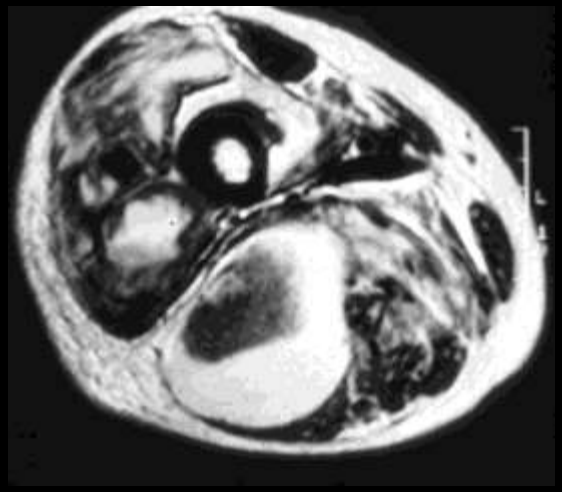


Quadriceps Abscess CT-C+

- Obliteration of intermuscular fat planes
- Muscle edema
- Fluid collections and/or gas within muscle



T1FS IVGd



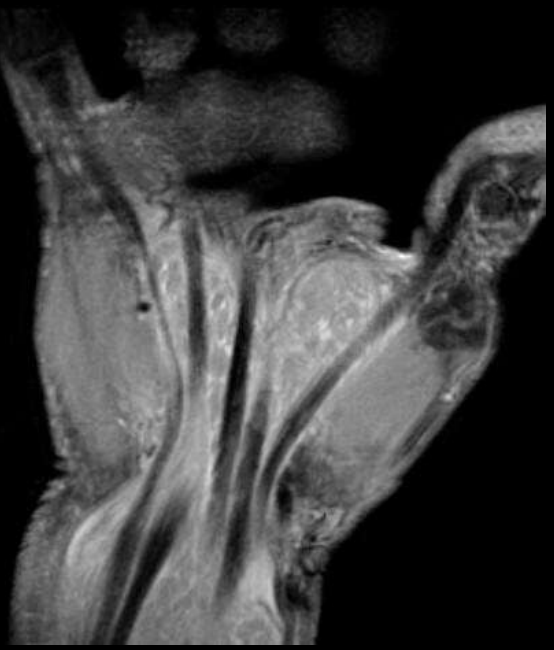
T2

- Rochalimaea henselae, a proteobacteria
- Lymphadenopathy within 1or 2 weeks after being scratched
- 75% are between 5 and 21 years old
- Adenopathy around the axilla, epitrochlear area, if scratched in hand or forearm.
- Diagnosis by a serologic test

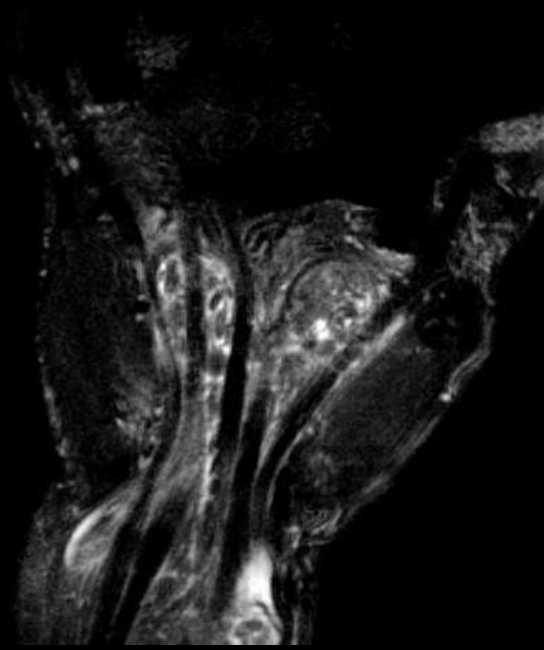
19 year old man with painful nodule above the elbow

- Septic tenosynovitis
- Septic bursitis
- Septic arthritis

T1FSGd



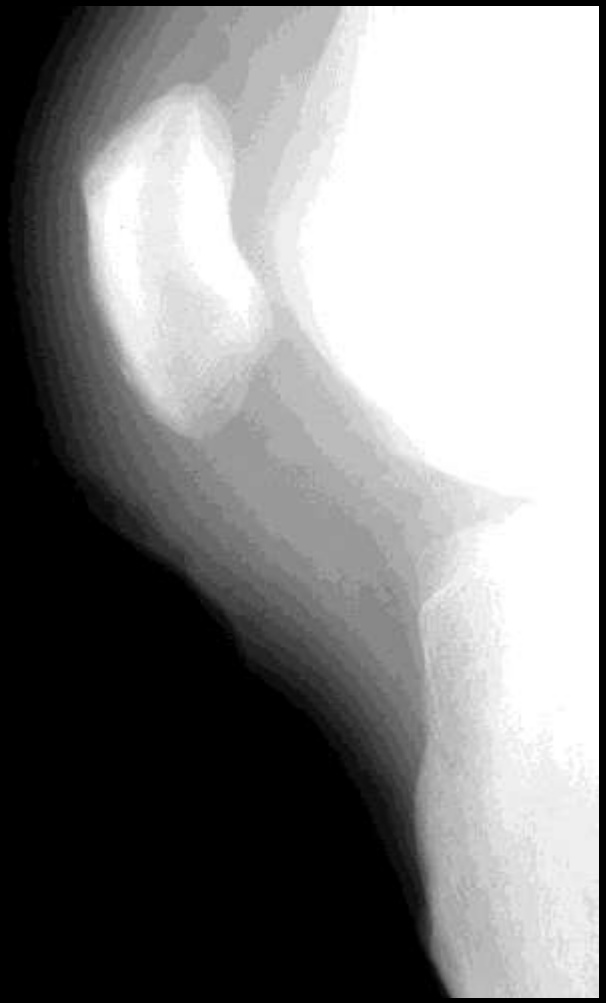
PDFS



T2FS

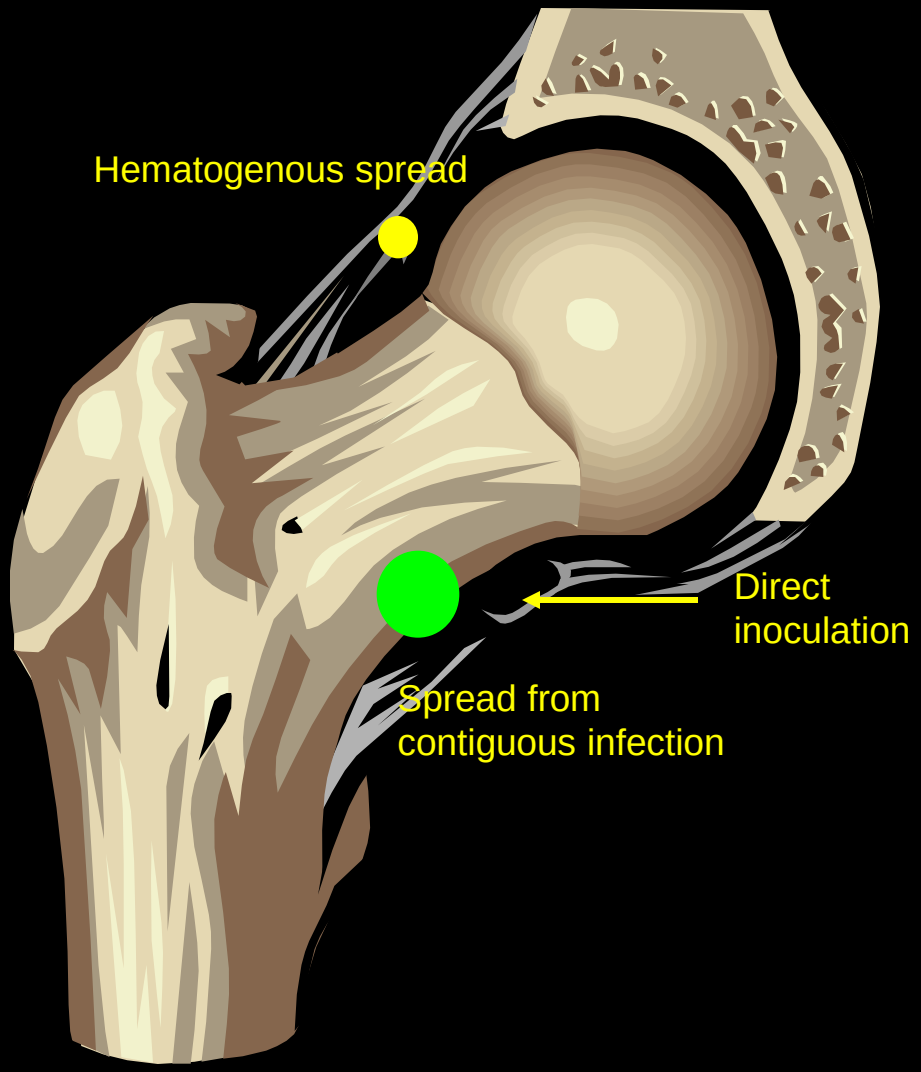
75M Alpha hemolytic strep viridans + cryptococcus

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

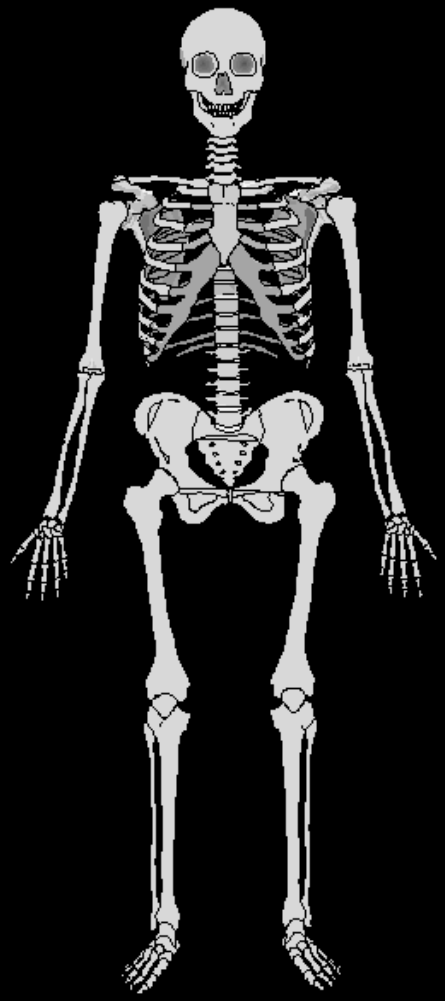


Penetrating soft tissue injury, knelt on object

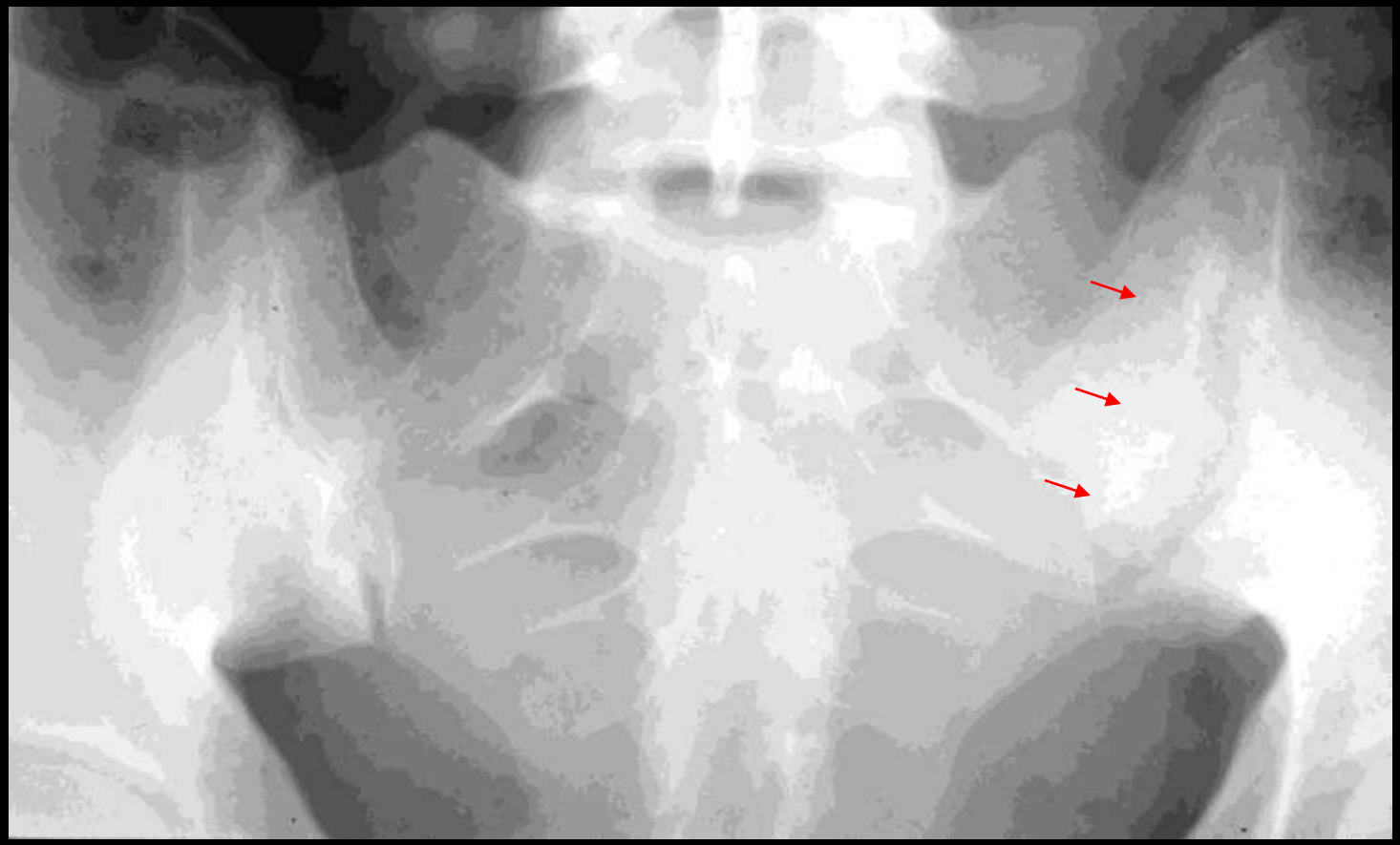
- Direct inoculation of joint
- Spread from contiguous soft tissue or bone infection
- Hematogenous spread to synovium



- Children –
  - hip, knee, shoulder
- Adults –
  - the five “S” joints
    - Sternoclavicular
    - Shoulder - ACJ
    - Spine
    - Sacroiliac
    - Symphysis



Any destructive mono-articular arthritis should be regarded as infection until proved otherwise.



- Soft tissue swelling
- Joint effusion
- Rapid osteoporosis
- Rapid uniform joint space narrowing
- Ill-defined erosions

- Indolent course

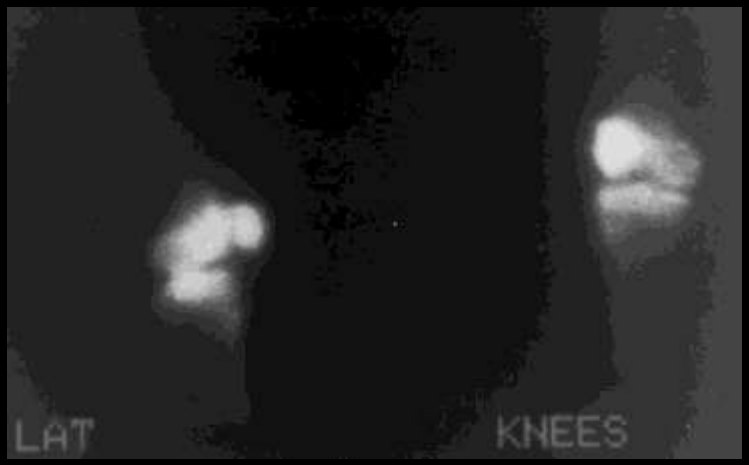
- Phemister's triad
  - Prominent osteoporosis
  - Slow loss of joint space
  - Ill-defined erosions

August

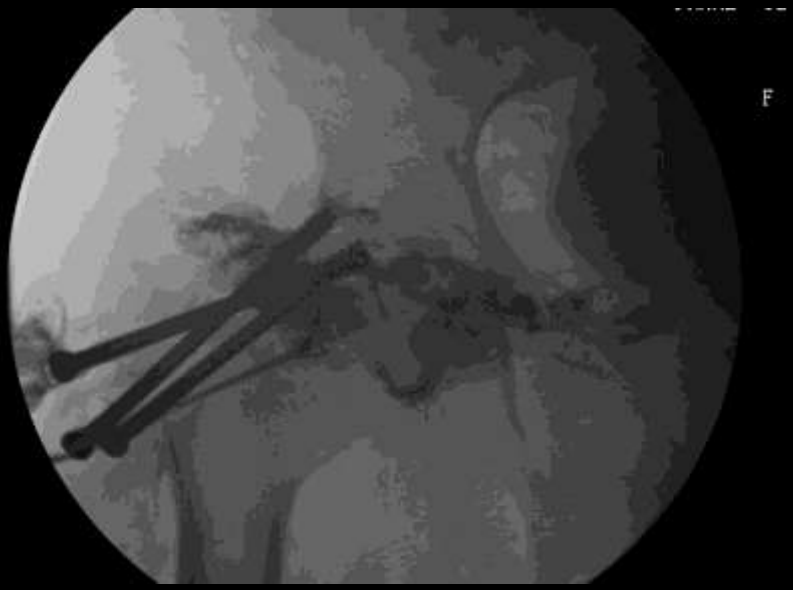
December

TB wrist 68M

- Increased periarticular flow and blood pool
- Decreasing or normal uptake on delayed images
- High pressure effusion may result in false negative study



- Contrast injected after aspiration to document needle placement
- Irregular synovial lining
- Intraarticular debris
- Rapid lymphatic filling
- Communication with abnormal bursae or soft tissue abscesses



Infected hip metal with abscesses 51M

- Nonspecific effusion
- Synovial thickening
- Intraarticular debris
- Periarticular edema
- Lymph nodes
- Periarticular abscess
- Joint space narrowing

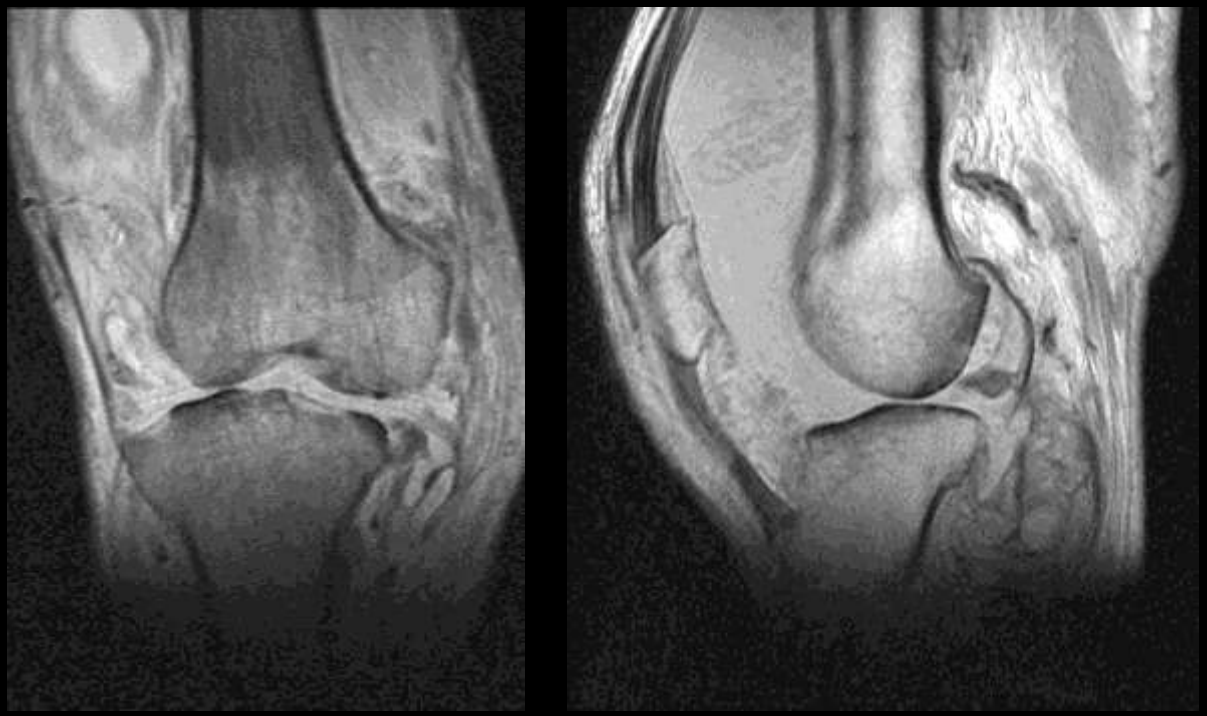
Cor PDFS

Cor T1FS IVGd

21 m F

- Premature physeal closure
- Avascular necrosis
- Premature osteoarthritis

- Internal derangement
- Osteomyelitis
- Ankylosis

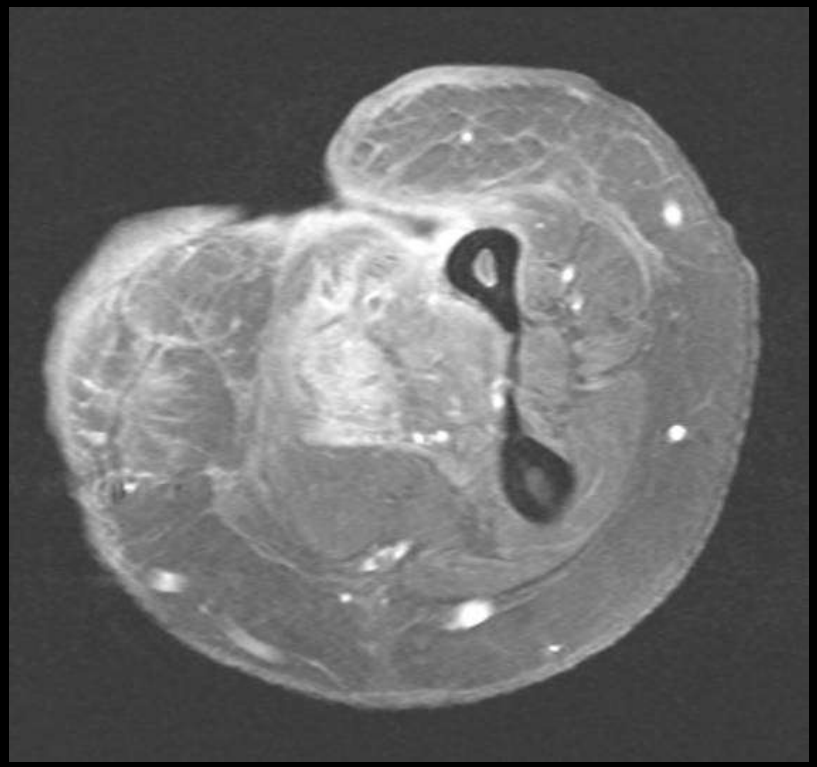


57M diabetic,septic knee with marrow oedema and internal derangement

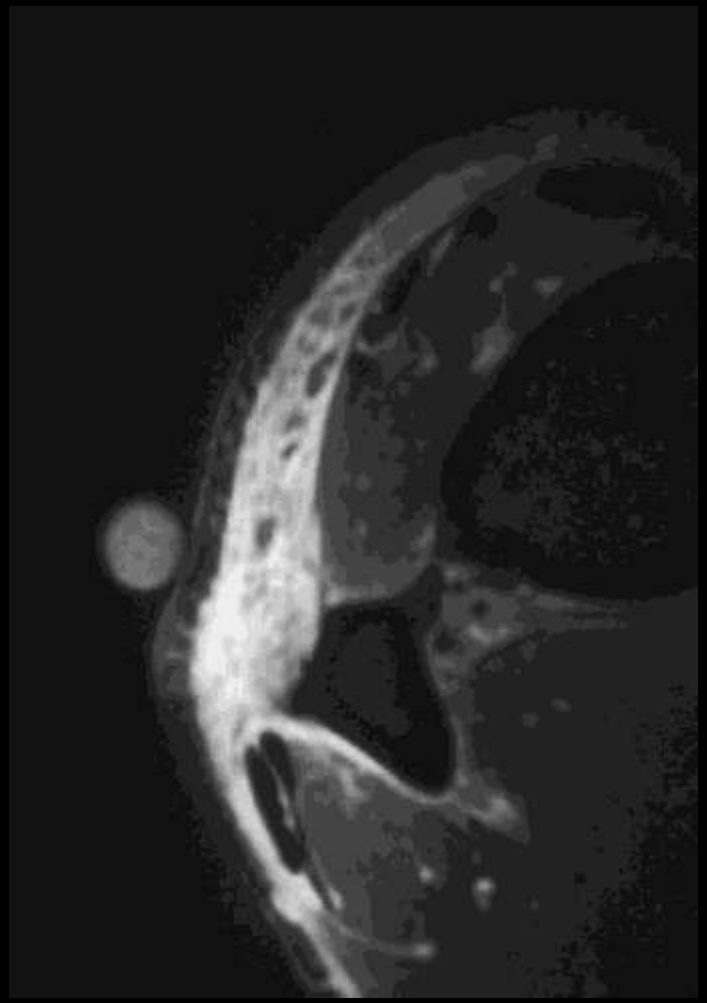
- Periarticular bone edema is not enough
- Cortical erosion
- Extensive marrow involvement
- Periosteal new bone
- Extraosseous fat fluid level

T1FSGd

- Hematogenous spread to periosteum or cortex
- Implantation - IVDA



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



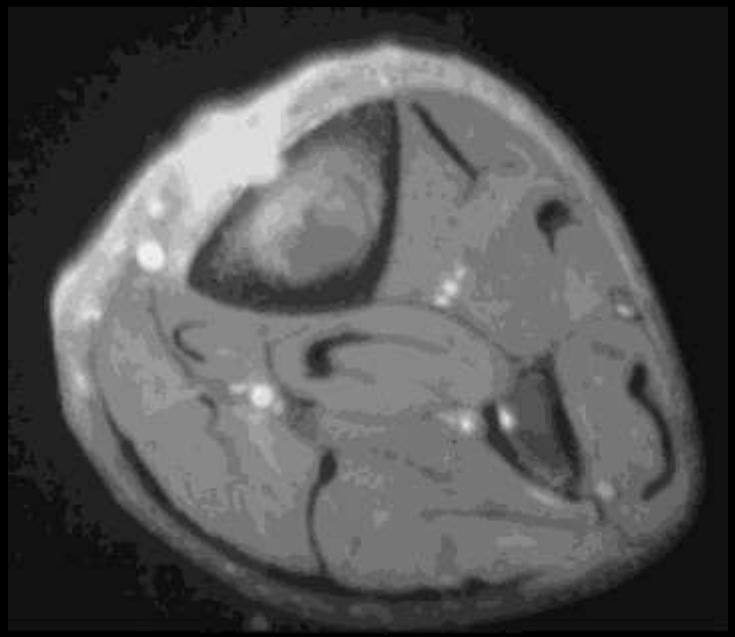
T2FS

- Bony proliferative response adjacent to chronic soft tissue infection
- Can mimic osteoma

Ulcer osteoma tib and fib 46F

T1FSGd

- Mimics osteoid osteoma
- Tends to be larger and more irregular
- May show serpiginous channel



- Infection involving bone marrow
- Location of infection varies with age, underlying disease, and status of overlying soft tissue
- Marrow replaced by inflammatory cells, pus, organisms and adjacent inflammation

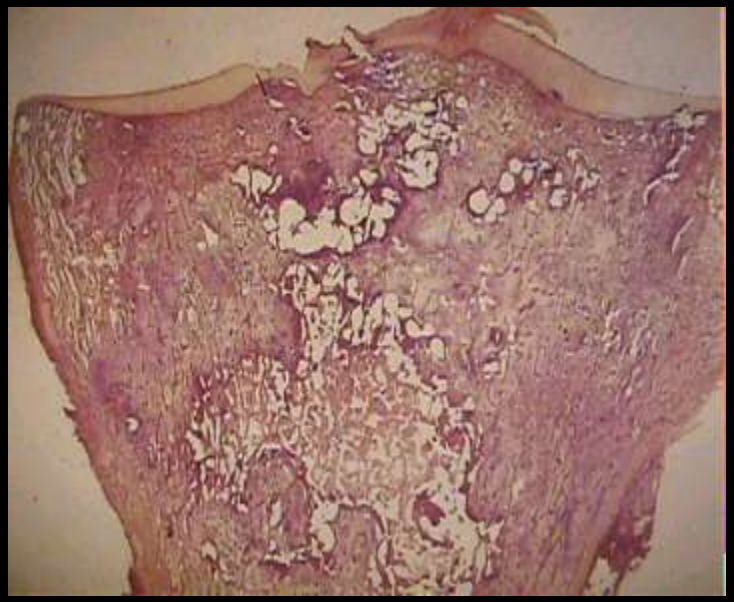
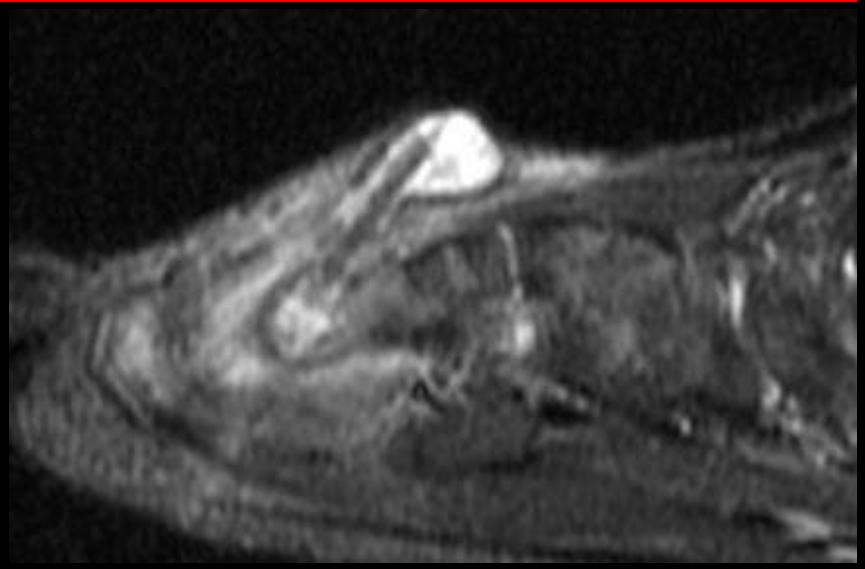
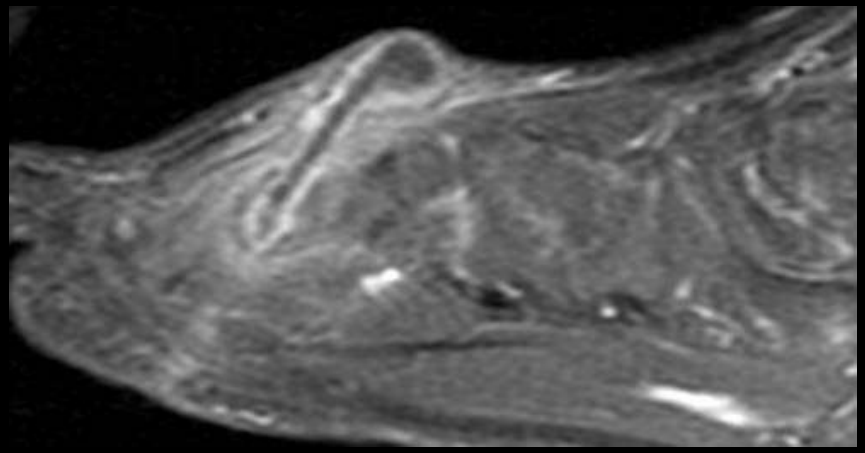


Illustration from Milgrim JW, Radiologic and Histologic Pathology of NonTumerous Conditions of Bones and Joints, Lea & Febiger

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





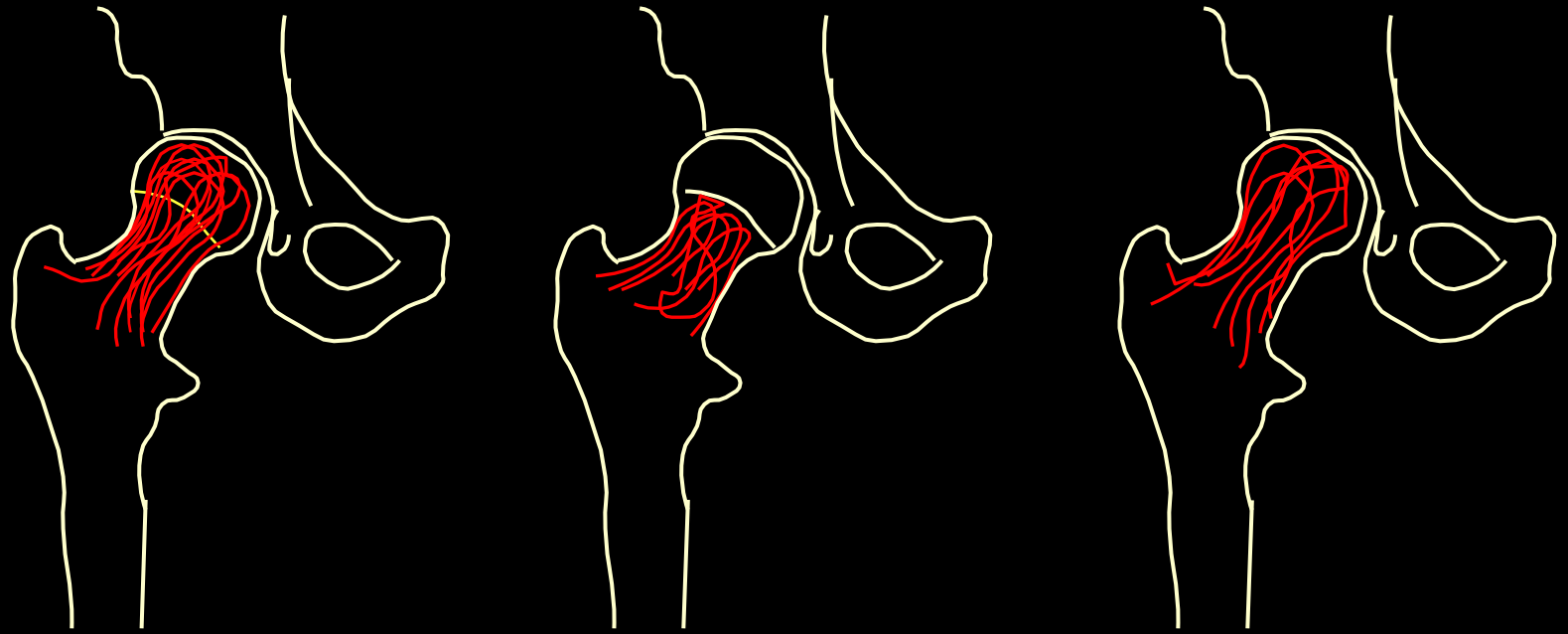
3yo presents with the complaint of “his brother stuck him with a toothpick”

- Vascular insufficiency
- Ulcer
- Soft tissue infection
- Cortical invasion
- Osteomyelitis

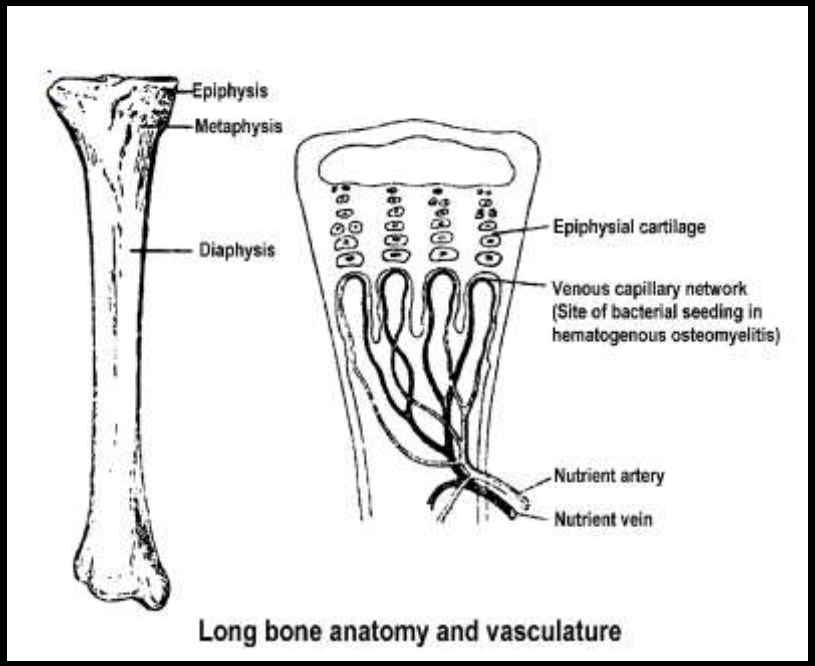
Univ of Utah Webpath

- Scintigraphy useful
- Literature suggests that inactive neuroarthropathy low signal on both T1 and T2 images

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



- Metaphyseal involvement in hematogenous osteomyelitis
- Slow blood flow in venous capillary network

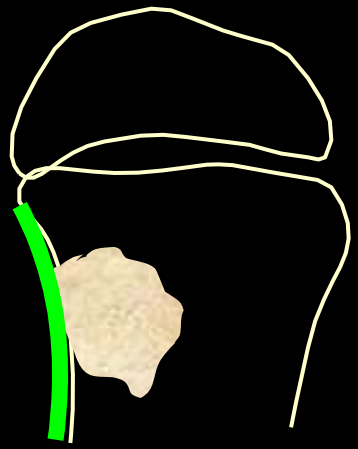


Long bone anatomy and vasculature

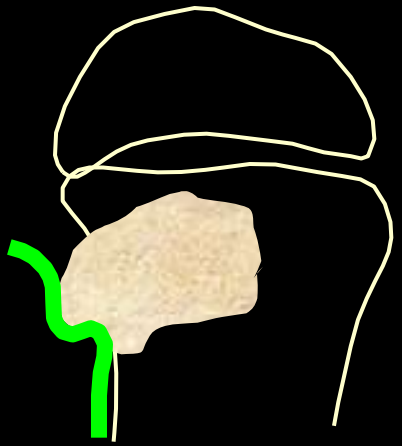
http://www.kcom.edu/faculty/chamberlain/Website/lectures/tritzid/osteo1

1. Intramedullary metaphyseal infection

2. Cortical destruction



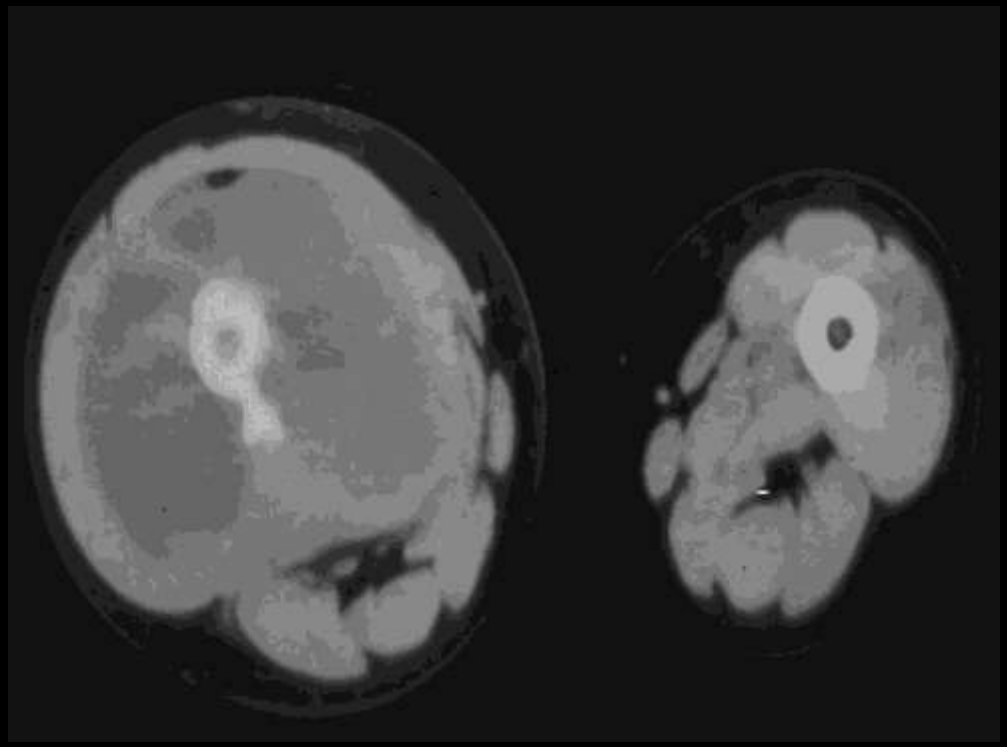
3. Periosteal elevation



4. Periosteal new bone formation

- Adjacent swelling and effusion
- Permeative osteolysis
- Cortical tunneling and splitting
- Immature, continuous periostitis

- Low sensitivity
  - Marrow attenuation >20 HU compared to other side
- Trabecular and cortical destruction
- Periosteal proliferation
- Subperiosteal and soft tissue abscess

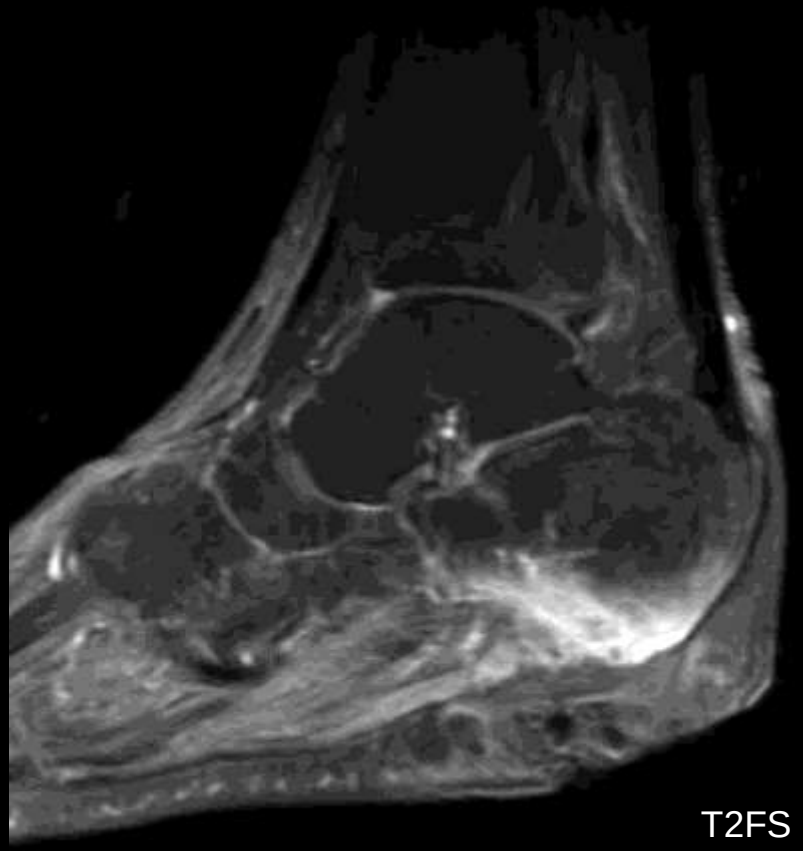


- More sensitive than radiography
- MDP routinely
- Gallium imaging useful in chronic osteomyelitis
- Indium-labeled WBC scan increases specificity
- Sulphur colloid to compare marrow with infection

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

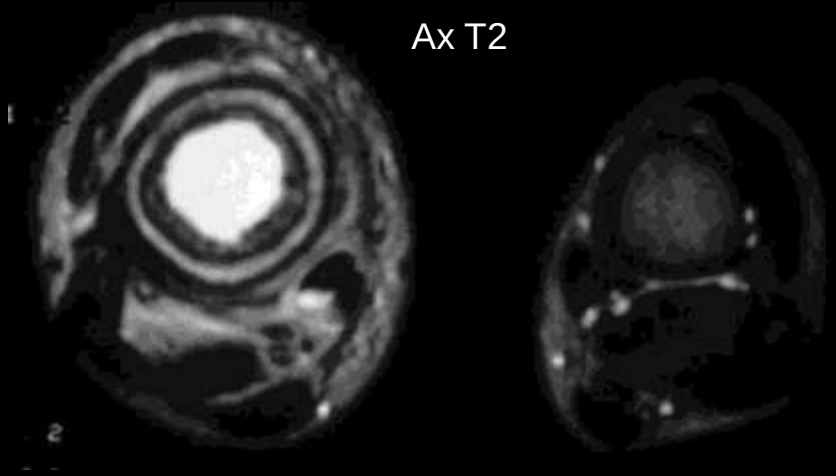
Ax T1FS Gd

- Very sensitive
- Not very specific
- Often overestimate extent of infection
- Difficult to differentiate infected marrow from edema



- Chronic active osteomyelitis, typically due to S. aureus
- Most common in distal tibial metaphysis
- 1-4 cm lytic oval lesion with surrounding sclerosis
- Connection to epiphyseal plate or cortex by serpiginous lucent channel

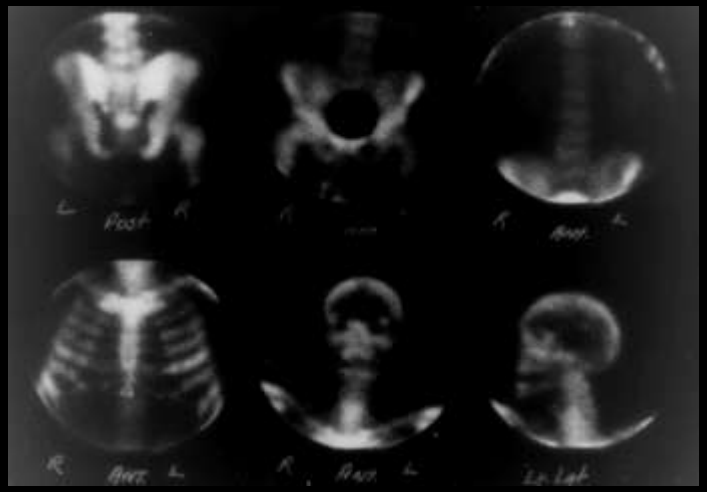
Ax T2



Sag T1

- 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 recurrent multifocal osteomyelitis
- Part of SAPHO syndrome
- Organisms usually not cultured



- Most common in children
- Palmar and plantar pustulosis
- Clinical course self-limited
- Symmetric sclerotic metaphyseal lesions, clavicular involvement

- Symmetric sclerotic metaphyseal lesions
- Clavicular involvement

Antibiotics

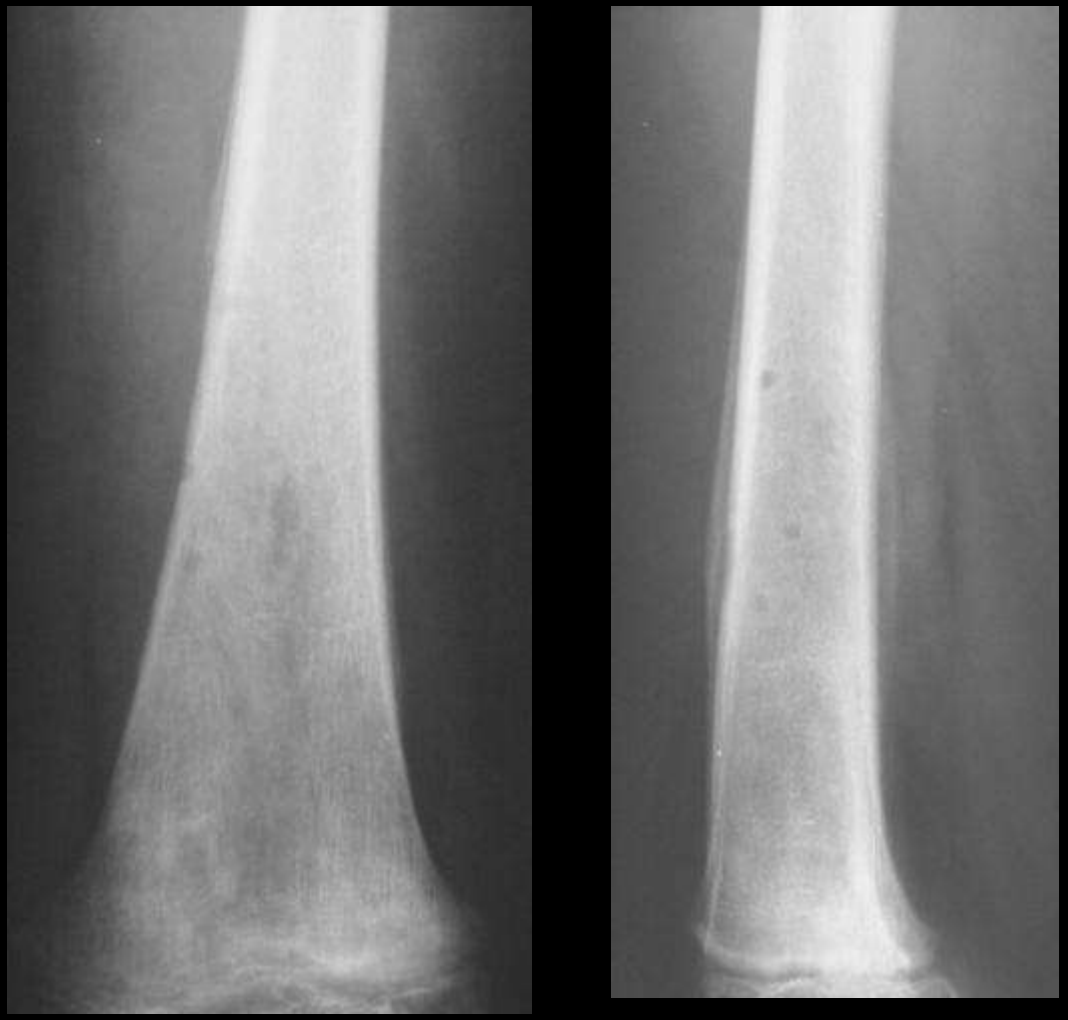
Decompression

Curettage

Hyperbaric O2

Amputation

Osteoset



Hematogenous osteomyelitis with surgical burr holes

- Chronicity
- Deformity
- Fracture
- Amyloid
- Neoplasm
- Fistula
- Growth disturbance
- Spread to adjacent tissues

Osteomyelitis tibia with fibula hypertrophy