



Spectrum of Musculoskeletal Imaging Findings in HIV Infection

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HIV and AIDS

- World-wide epidemic
- More than 40 million people affected
- Destruction of T-cell lymphocytes predisposes to opportunistic infections
- Increases host susceptibility to immune-related neoplasms and inflammatory conditions

Musculoskeletal manifestation of AIDs

- Infectious

- Cellulitis
- Soft tissue abscesses
- Necrotizing fasciitis
- Pyomyositis
- Septic bursitis
- Septic arthritis
- Osteomyelitis
 - Pyogenic osteomyelitis
 - Bacillary angiomatosis osteomyelitis
- Mycobacterial infections
 - TB spondylitis
 - TB arthritis
 - TB osteomyelitis
 - TB tenosynovitis
- Atypical mycobacterial infections

- Inflammatory

- Reiter's syndrome
- Psoriatic arthritis
- Acute symmetric polyarthritis
- HIV-associated arthritis
- Painful articular syndrome
- Hoffitis
- Adhesive capsulitis
- Vasculitis

- Tumors

- Kaposi's sarcoma
- Non-Hodgkin's lymphoma

- Miscellaneous

- Osteonecrosis
- Hypertrophic osteoarthropathy
- Osteoporosis
- Rhabdomyolysis
- Hematopoietic marrow
- Zidovudine (AZT) myopathy
- Polymyositis
- Myositis ossificans circumscripta
- Neuropathy

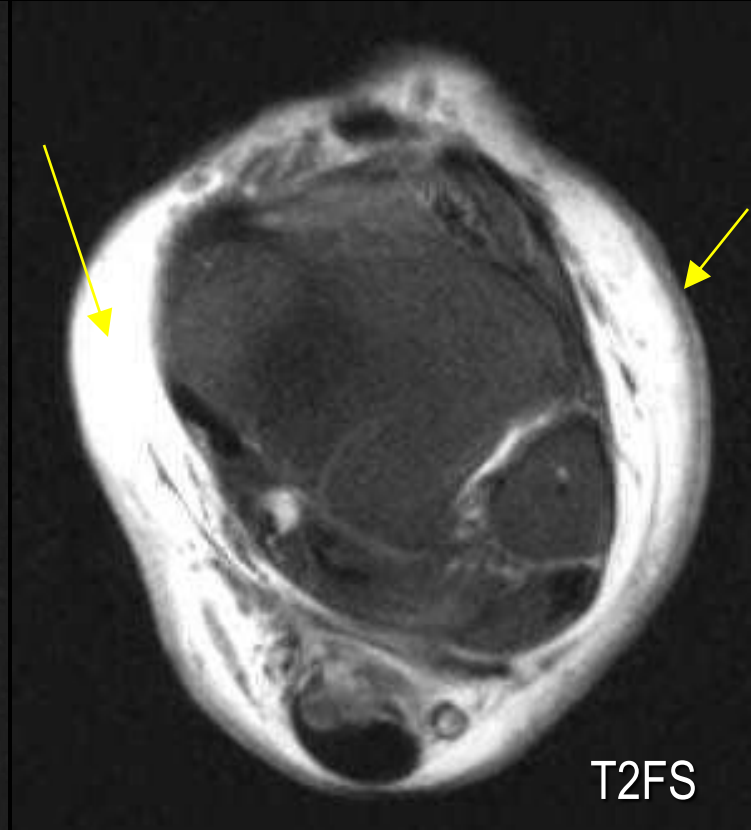
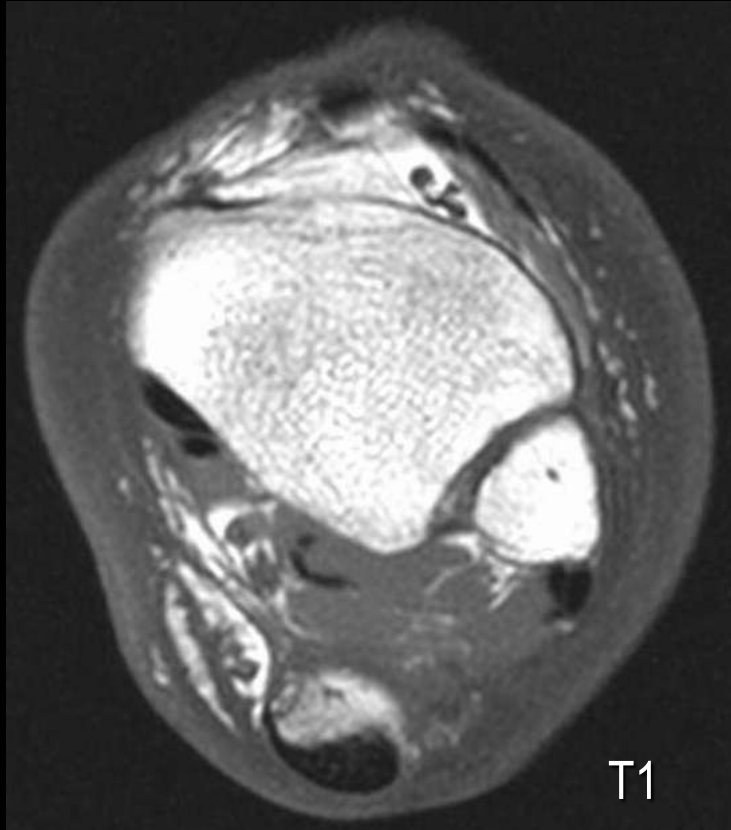
Musculoskeletal manifestation of AIDs

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Cellulitis

- Infection of the dermis and subcutaneous tissues
- *Streptococcus* and *Staphylococcus*, components of normal skin flora, are the most commonly involved organisms
- CT and MRI help distinguish superficial from deep infections

Cellulitis



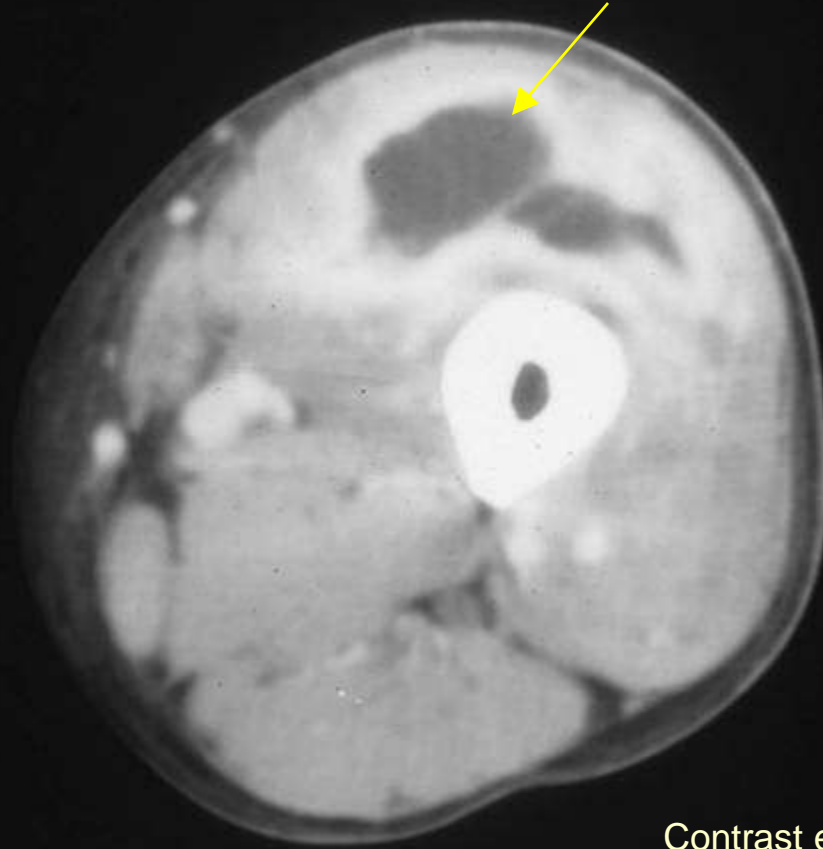
75 y/o female with cellulitis.

Soft tissue abscesses

- Collections of infected fluid
- Bacteria, predominantly *Streptococcus* and *Staphylococcus*, are frequently cultured from these collections

Quadriceps Abscess

Fluid filled mass with irregular, enhancing wall and surrounding inflammation consistent with an abscess.



Contrast enhanced CT

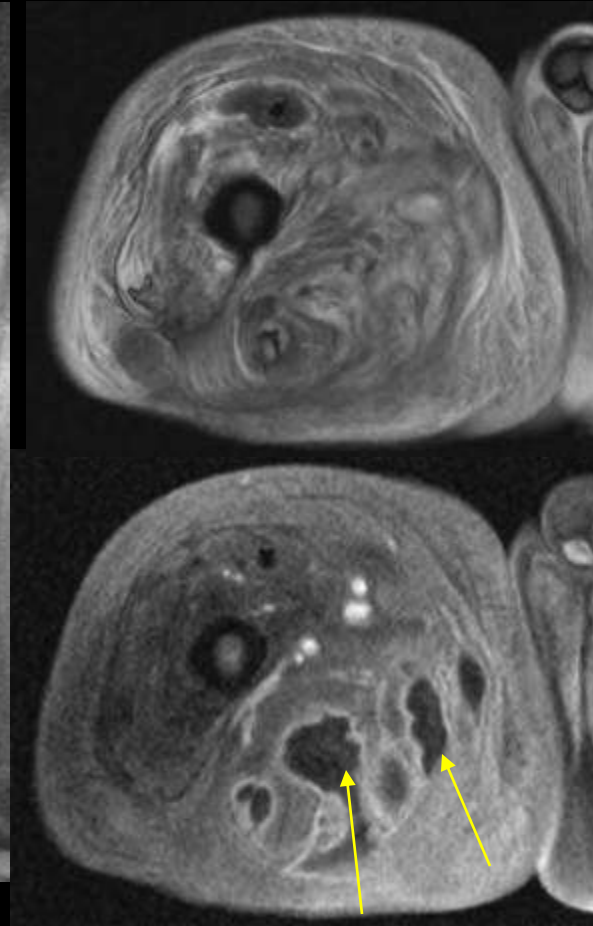
Loculated Thigh Abscess

Culture grew out propionibacterium.

T1FSGd



T2



T1FSGd

Necrotizing fasciitis

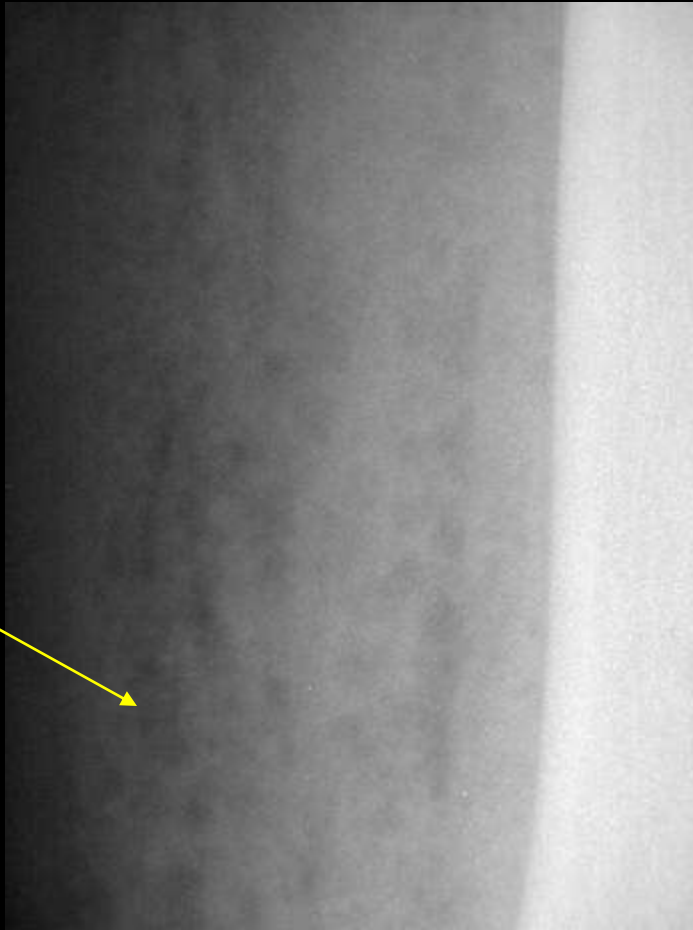
- Rapidly spreading soft tissue infection characterized by extensive necrosis of the fascia and subcutaneous fat is rare, but life-threatening
- Group A *Streptococcus*
- Definitive diagnosis is made by fascial biopsy

Features of Fascial Infection

- 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



Necrotizing Fasciitis

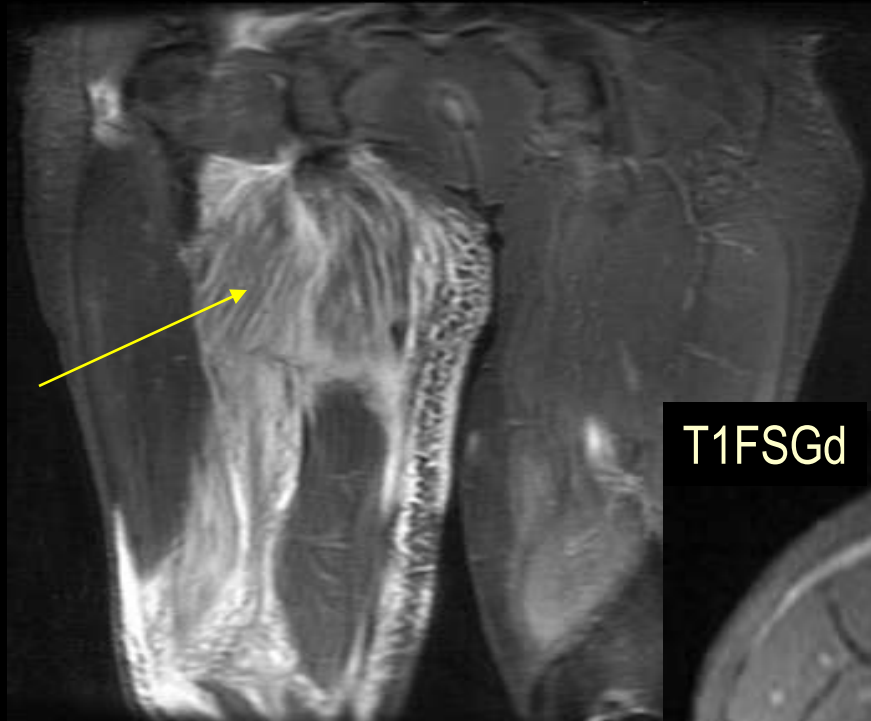


59 year old male.

Necrotizing Fasciitis



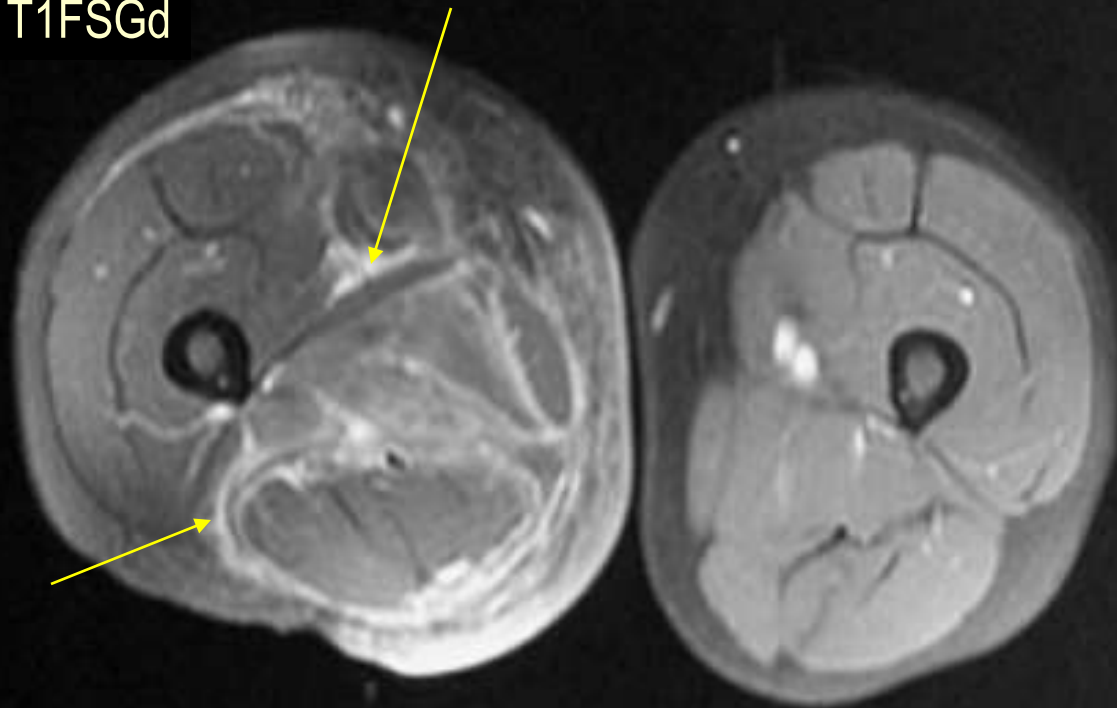
Necrotizing Fasciitis / Myositis



Enhancing inflammatory changes of the muscles

T1FSGd

Enhancement and thickening of the deep fascia



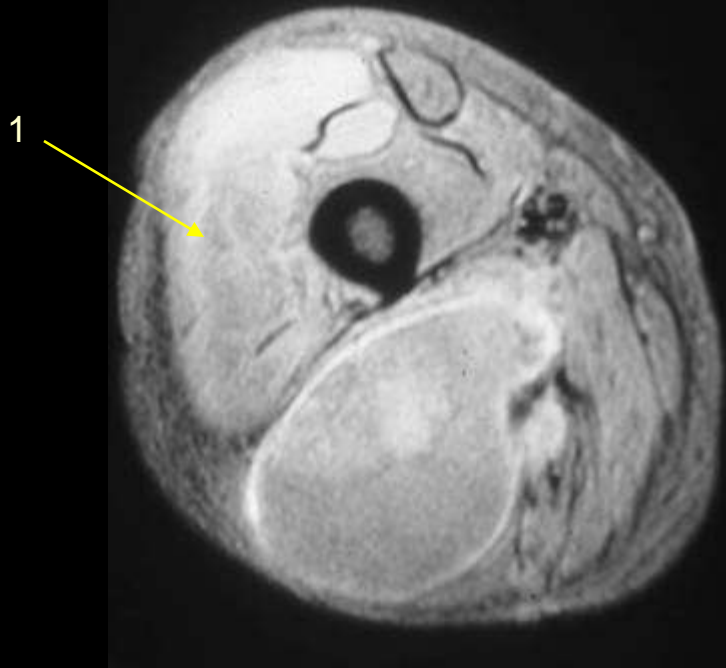
Pyomyositis

- Pyogenic infection and inflammation of the muscle
- *Staphylococcus aureus* is the primary pathogen

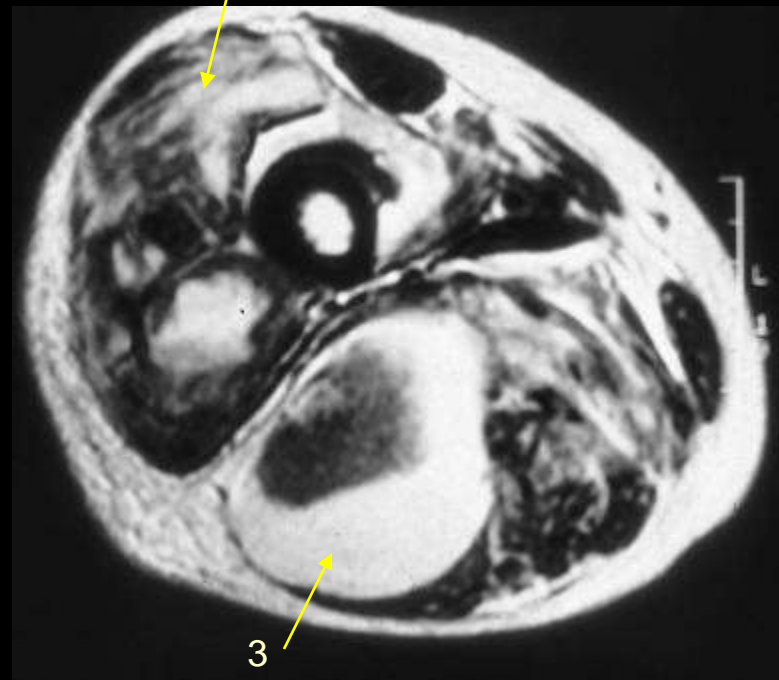
AIDS related Pyomyositis

Features of pyomyositis in this patient with AIDS include:

1. obliteration of intramuscular fat planes
2. muscle edema
3. fluid collections and/or gas within the muscle.
4. avid enhancement of the muscles and fascia (not shown)



T1FS



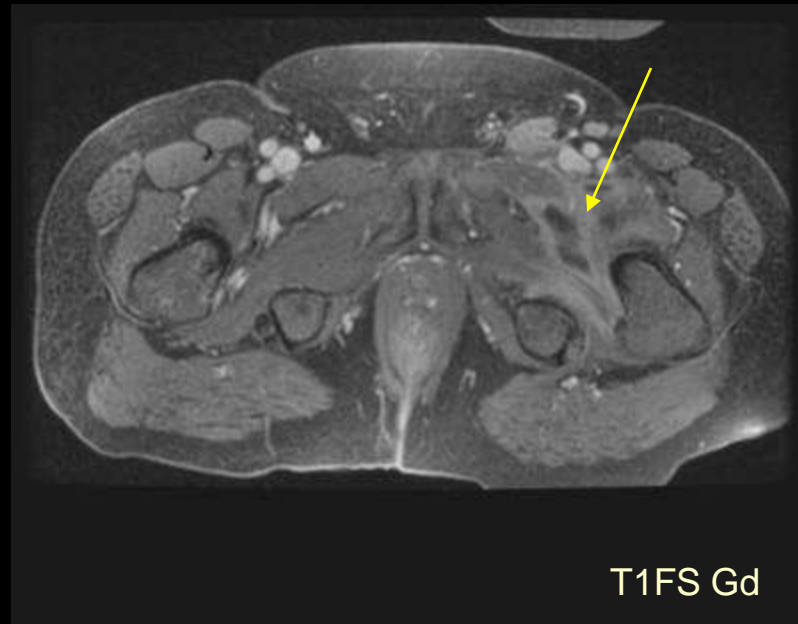
T2

Septic bursitis

- Often associated with direct trauma or systemic disease such as diabetes.
- Most frequent sites are the olecranon, prepatellar, and, less commonly, the subdeltoid bursae.
- *Streptococcus* and *Staphylococcus* are the most prevalent organisms in this disease.

Septic bursitis

47 year old HIV positive male with iliopsoas septic bursitis caused by multi-drug resistant *S. aureus*.

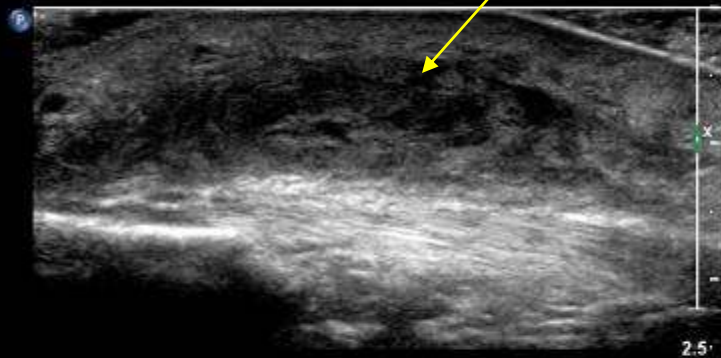


Septic bursitis

44 year old HIV-infected male with prepatellar bursitis on ultrasound examination.

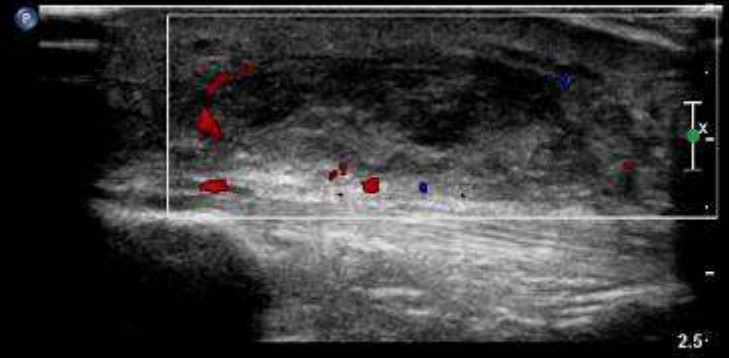
FR 34Hz
RS

Prepatellar bursal fluid



RT KNEE LONG

FR 11Hz
P1



M3 M3
+16.7
-16.7
cm/s

RT KNEE LONG

Septic arthritis

- The joints may become infected through hematogenous dissemination, contiguous spread, or direct implantation
- Most common musculoskeletal infection in the HIV population (23%)
- Most common pathogen is *Staphylococcus aureus* (78% of cases)

Septic arthritis

Radiographic features of septic arthritis include:

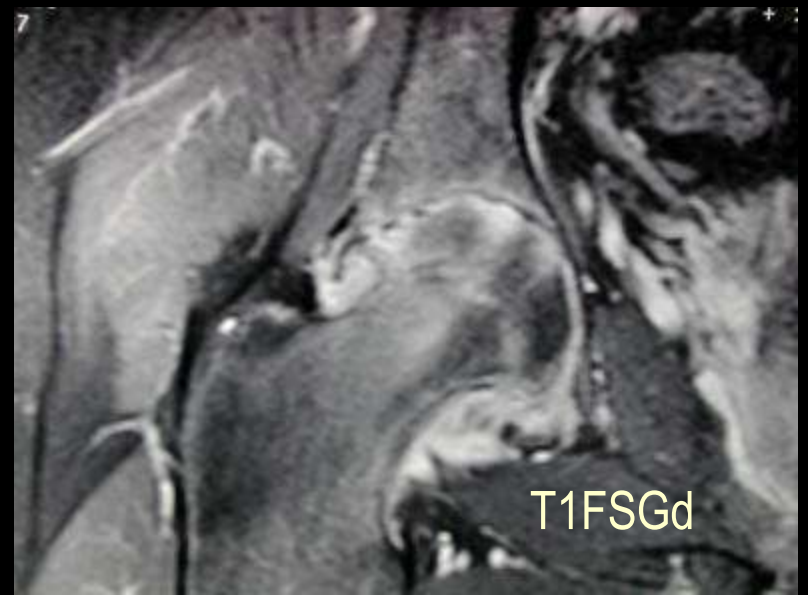
- Soft tissue swelling
- Joint effusion, which may widen the joint initially
- Rapid osteoporosis
- Rapid uniform joint space narrowing as cartilage destruction ensues
- Ill-defined marginal and central erosions
- Bony ankylosis in severe pyogenic arthritis



Septic arthritis

On MR imaging, the findings of septic arthritis include:

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



Right hip septic arthritis.

Fungal arthritis



Features include:

Osteoporosis

Slow rate of destruction

Less joint space narrowing

44 year old man with coccidiomycosis infection.

Osteomyelitis

- Routes of spread:
 - hematogenous, contiguous spread, or direct inoculation from trauma or surgery
- Second most common musculoskeletal infection after septic arthritis and is associated with mortality rates greater than 20%
- Wide variety of organisms including bacterial, fungal, and mycobacterial species
- Radiographs, CT, MR, and bone scan in context of clinical history aids the diagnosis
- Definitive diagnosis is made with needle biopsy

Pyogenic osteomyelitis



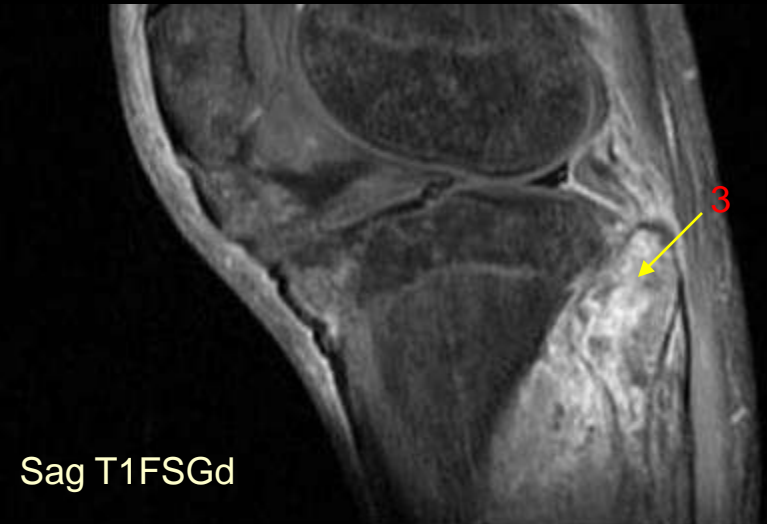
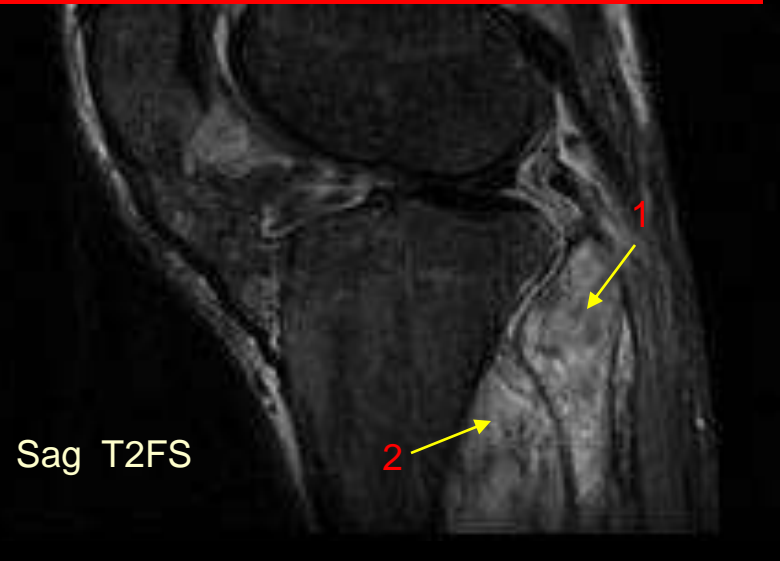
48 year old HIV positive male intravenous drug user with soft tissue ulcer and osteomyelitis.

Osteomyelitis

34 year old male with *Staphylococcus aureus* osteomyelitis of the proximal femur.

Features on MR imaging include :

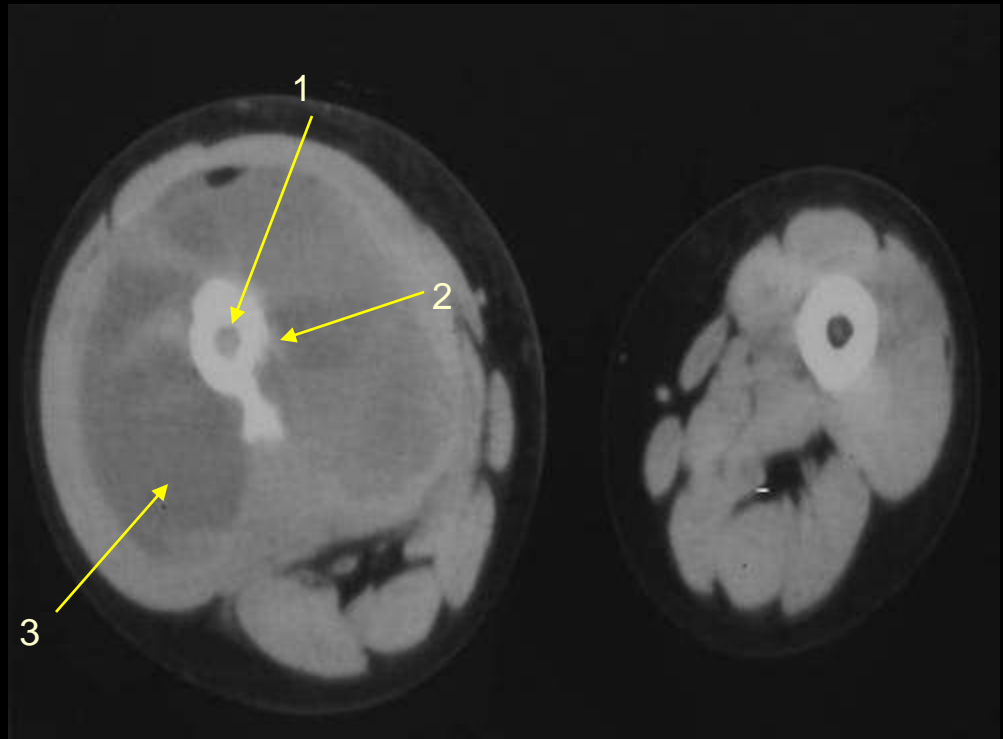
1. bone marrow edema
2. inflammatory soft tissue changes
3. avid enhancement in the bone and surrounding soft tissues.



Osteomyelitis

CT is insensitive for early marrow infection, but is excellent once trabecular or cortical bone is destroyed. Features of osteomyelitis on CT include:

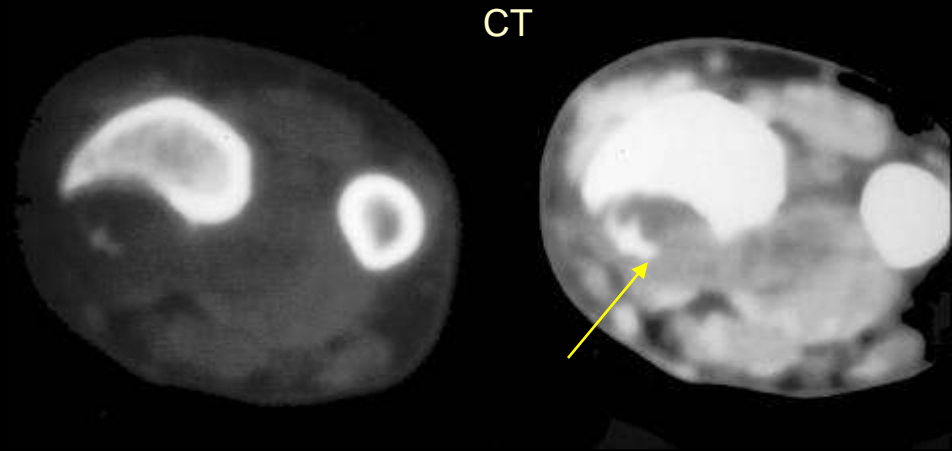
- Marrow attenuation (1)
 >20 HU compared
 to other side
- Trabecular and cortical
 destruction
- Periosteal proliferation (2)
- Subperiosteal and soft tissue abscess (3)



Bacillary angiomatosis

- Uncommon infectious disease seen in the AIDS population caused by the *Bartonella* species
- Characterized by vascular masses of the skin and soft tissues, osteolysis, lymphadenopathy, and visceral involvement

Bacillary angiomatosis



AIDS patient with bacillary angiomatosis

Case courtesy of Dr. Jamshid Tehranzadeh,
University of California Irvine Medical Center

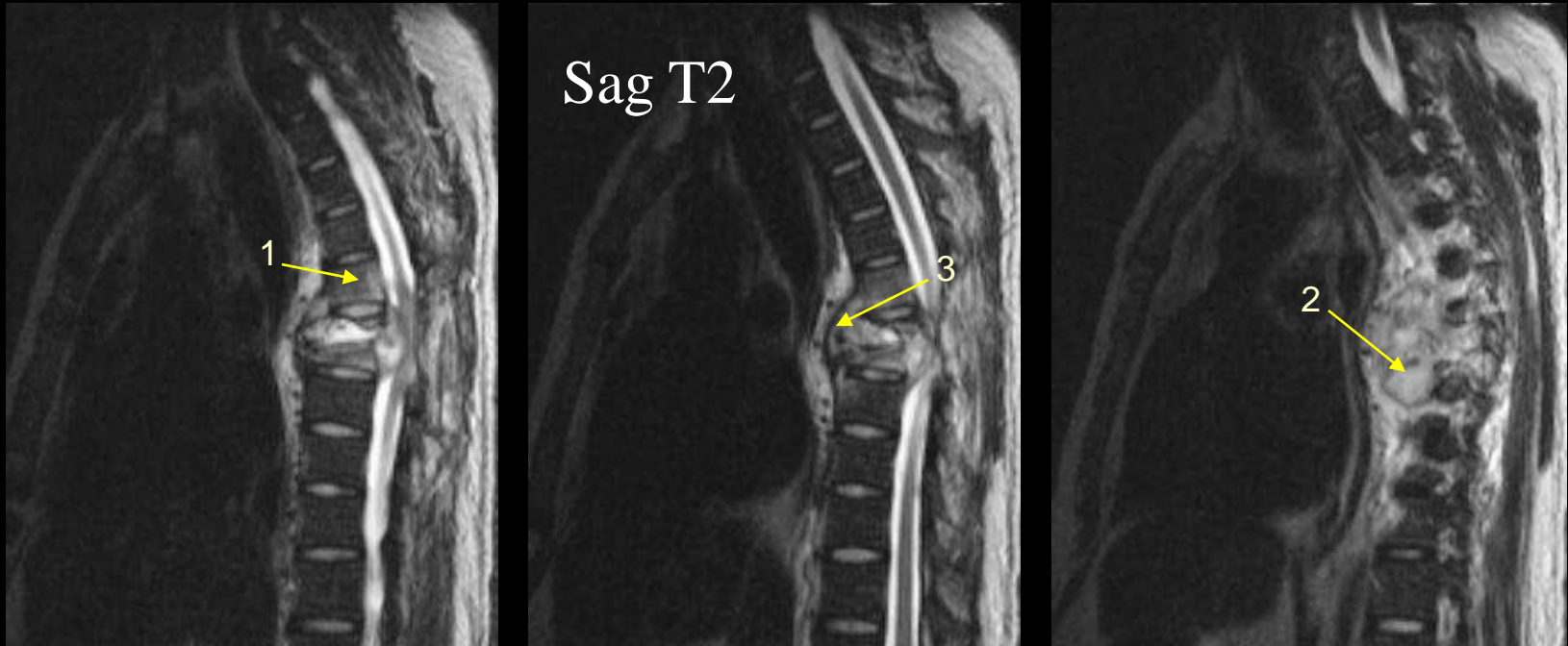
Mycobacterial infections

- HIV infected individuals are more susceptible to primary and reactivation tuberculosis
- Incidence of TB in AIDS patients has been reported to be almost 500 times that of the general population
- Hematogenous spread

TB spondylitis

- Spine is the most common site of infection in MSK TB (50% of cases)
- Associated with less disc space loss and less osseous sclerosis than pyogenic spondylitis
- Subligamentous spread of infection, focal or asymmetric erosions, and large abscesses

Granulomatous Spondylitis



42 year old male with TB spondylitis. Features include:

1. Bone edema and focal gibbus deformity
2. large paraspinal abscess
3. subligamentous spread of infection
4. disc spaces are relatively spared.

TB arthritis

- Joints are the second most common site of mycobacterial infection in HIV patients (20% of musculoskeletal TB cases)
- Large, weight-bearing joints and is a predominantly mono-articular
- May be indolent and long-standing.
- Phemister's triad of osteoporosis, slow loss of joint space, and ill-defined erosions has been classically used to describe TB arthritis

Tuberculous arthritis

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



Musculoskeletal manifestation of AIDs

- Inflammatory
 - Reiter's syndrome
 - Psoriatic arthritis
 - Acute symmetric polyarthritis
 - HIV-associated arthritis
 - Painful articular syndrome
 - Hoffitis
 - Adhesive capsulitis
 - Vasculitis

Reiter's syndrome

- One of the most common arthritides associated with HIV infection and occurs between 100 to 200 times more frequently in HIV-infected patients than the general population
- Can be initial presentation of AIDS
- It is important to know the HIV serology of patients with Reiter's syndrome as immunosuppressive therapy would be contraindicated in patients infected with HIV

Reiter's syndrome



Other radiographic findings associated with Reiter's syndrome are soft tissue swelling, enthesopathy, joint space narrowing, bone proliferation, hallux valgus, subluxation, retrocalcaneal bursitis, and osteochondritis.

Reiter's syndrome



Lateral view of the foot shows classic findings of Reiter's syndrome including enthesopathy (1), soft tissue swelling, joint effusion (2), and erosions. Enthesopathy can be painful. The plantar enthesophyte in this case shows erosive changes (3).

Psoriatic arthritis

- 10 to 40 times more prevalent in those infected with HIV than those who are not
- Radiographic features are similar to that seen in Reiter's syndrome

Psoriatic arthritis



In this patient with AIDS and psoriatic arthritis, there is soft tissue swelling and erosions of the fingers and wrist (arrows).

Painful articular syndrome

- Painful, asymmetric oligoarthritis commonly affecting the knees and less commonly, the shoulders and elbows
- While HIV-associated arthritis may last from 1 week to 6 months, painful articular syndrome usually lasts between 2 and 24 hours
- NSAIDs and narcotics may relieve pain

Painful articular syndrome



43 year old female with AIDS and painful articular syndrome. Radiographs of her hands demonstrate periarticular osteopenia.

Hoffitis

- Inflammation of Hoffa's fat pad on MR imaging in AIDS patient on HAART (highly active antiretroviral therapy) has been recently described
- Edema can extend to the quadriceps fat pad and bone
- Usually bilateral
- Non-specific knee pain

Hoffitis

Right Knee



Left Knee



45 year old HIV-infected male on HAART with knee pain.

Vasculitis

- With improvements in anti-retroviral therapy and increased survivorship, vascular dysfunction and vascular disease have become increasingly recognized as complications related to HIV infection.
- The mechanism of AIDS-associated vasculitis is unknown.

Vasculitis



34 year old HIV infected male with HIV-associated vasculitis of his toes with subsequent atrophy of the muscles and soft tissues of his great, second, and third toes.

Musculoskeletal manifestation of AIDs

- Tumors
 - Kaposi's sarcoma
 - Non-Hodgkin's lymphoma

Kaposi's sarcoma

- Most common neoplasm in HIV-infected patients with a prevalence of up to 20% of the worldwide AIDS population
- Hypervascular neoplasm that can involve any organ, but predominately affects the mucocutaneous tissues, lymph nodes, and visceral organs
- Imaging findings are non-specific and biopsy is needed for definitive diagnosis

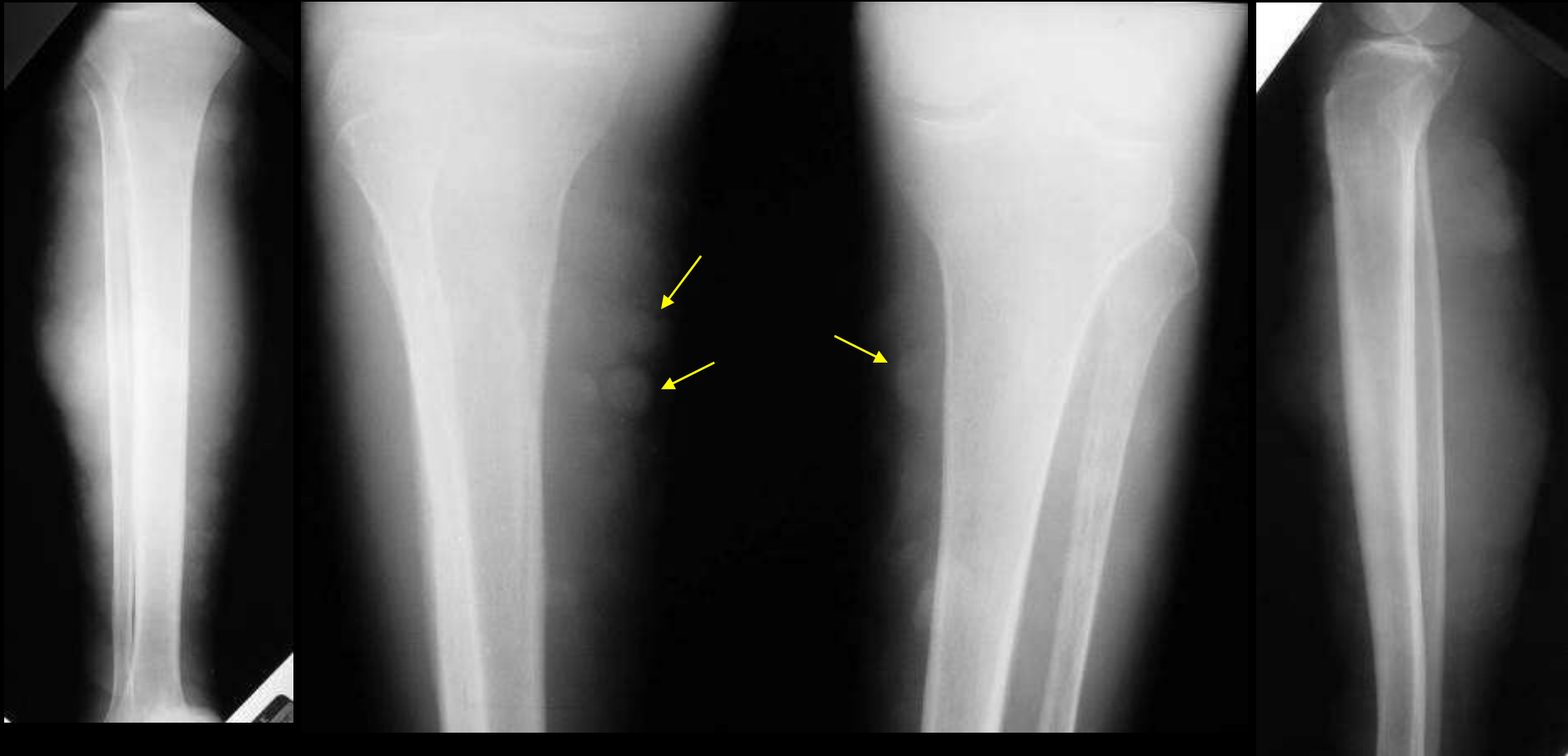
Kaposi's sarcoma

53 year old male with history of painful nodules on the hands and feet representing Kaposi's sarcoma.



Case courtesy of Dr. Donald Resnick.

Kaposi's sarcoma



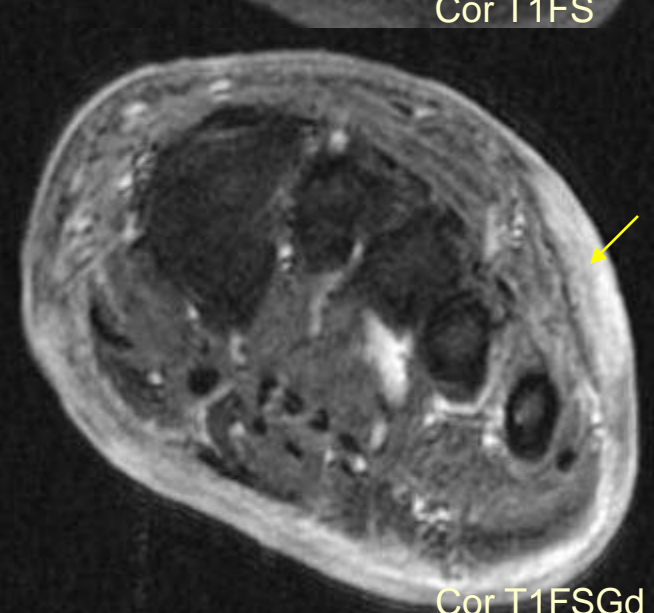
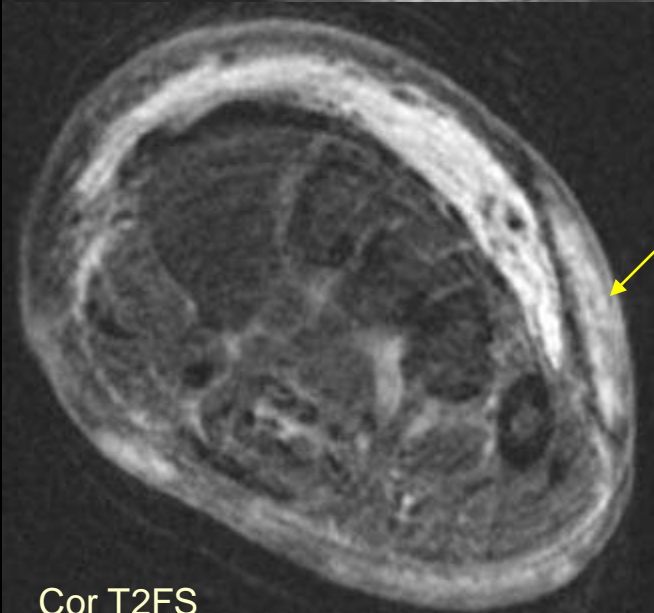
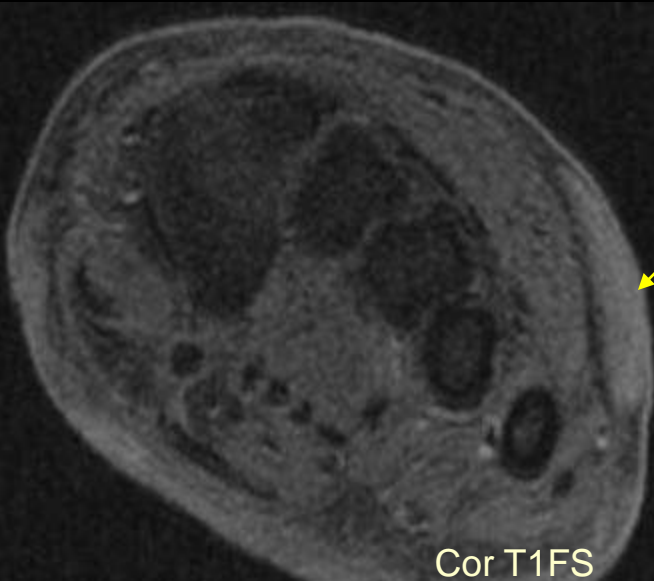
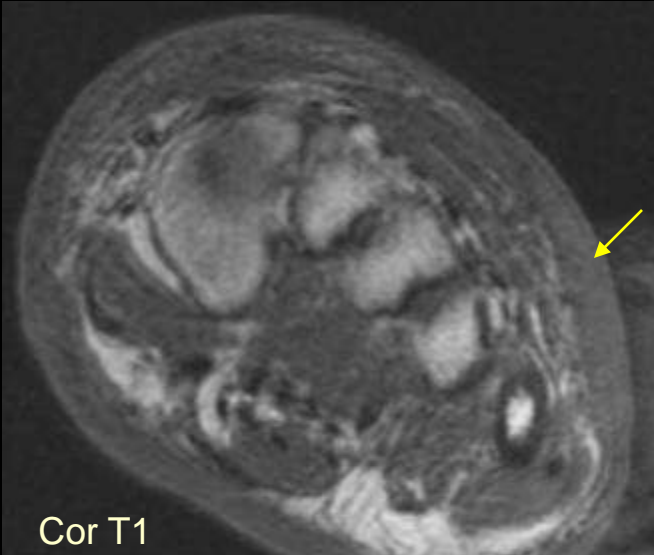
In this patient with Kaposi's sarcoma, multiple soft tissue densities correlate with hypervascular, nodular lesions on the lower leg.

Kaposi's sarcoma



46 y/o male w/ AIDS and Kaposi Sarcoma of the foot. Note the prominent soft tissue density at the dorsum of the foot (arrow). MRI was also performed (next slide).

Kaposi's sarcoma



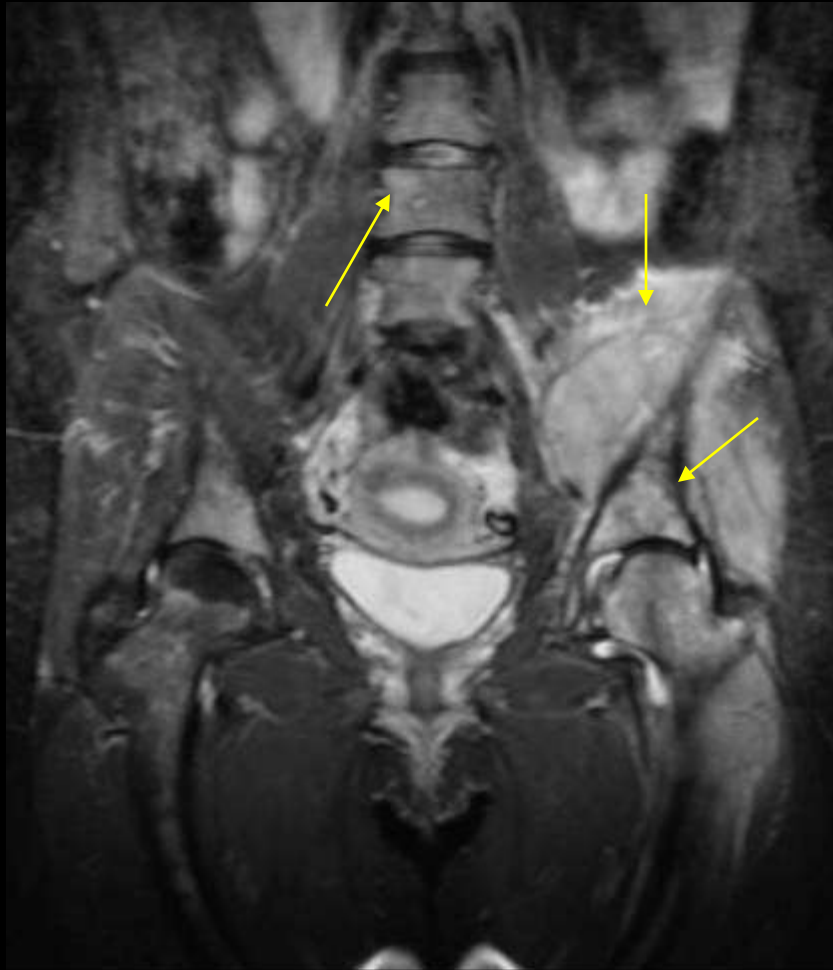
46 year old male with Kaposi's sarcoma of the foot. MR images show a subcutaneous hypervascular mass (arrow) with intermediate T1-weighted signal, hyperintense T2-weighted signal and avid enhancement with IV gadolinium.

Case from Naval Medical Center San Diego

Non-Hodgkin's lymphoma

- Second most common neoplasm in AIDS patients, occurring 60 times more frequently in AIDS patients
- Often occurs in advanced stage disease with CD4 counts below 200 cells per microliter
- Aggressive and multifocal in the AIDS population with wide dissemination of disease and extranodal involvement at presentation

Lymphoma



Cor T2FS



Cor T2FS

51 year old female with lymphoma. In AIDS patients, disease is often widespread at presentation. This patient had neoplasm in her pelvis, spine, and muscles as well as femurs.

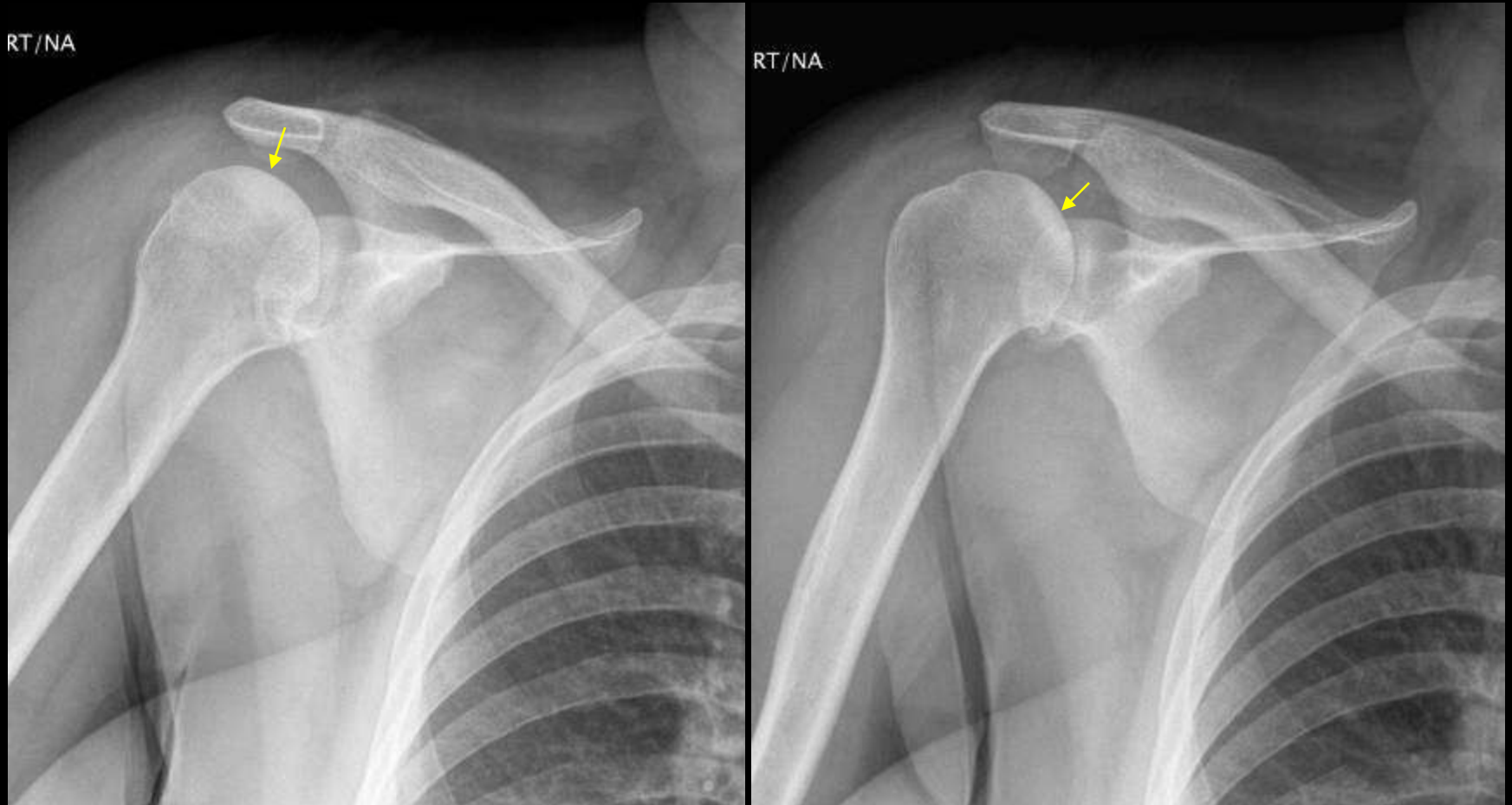
Musculoskeletal manifestation of AIDs

- Miscellaneous
 - Osteonecrosis
 - Hypertrophic osteoarthropathy
 - Osteoporosis
 - Rhabdomyolysis
 - Hematopoietic marrow
 - Zidovudine (AZT) myopathy
 - Polymyositis
 - Myositis ossificans circumscripta
 - Neuropathy

Osteonecrosis

- Although debated, osteonecrosis is thought to stem from vascular insufficiency to the bone with resultant ischemia and bone death
- Occurs with higher frequency in AIDS patients
- ? use of highly active antiretroviral therapy contributes to the increased incidence
- Pain and difficulty bearing weight

Osteonecrosis



46 year old HIV-infected female with osteonecrosis of the humeral head. A geographic area of sclerosis is seen at the superior aspect of the humeral head consistent with early osteonecrosis (arrow).

Osteonecrosis



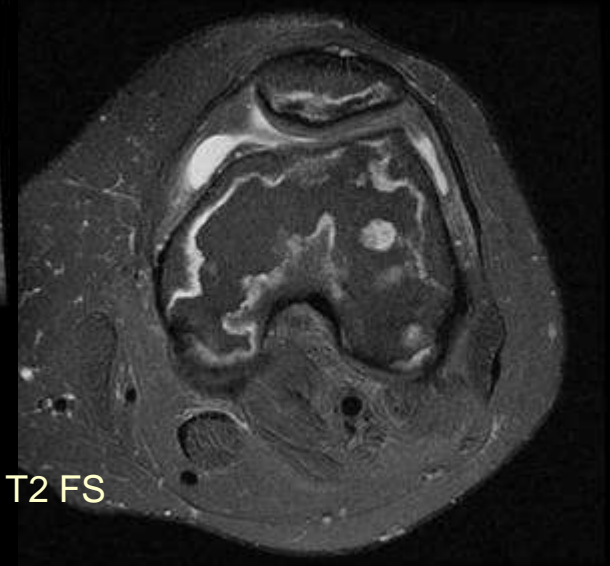
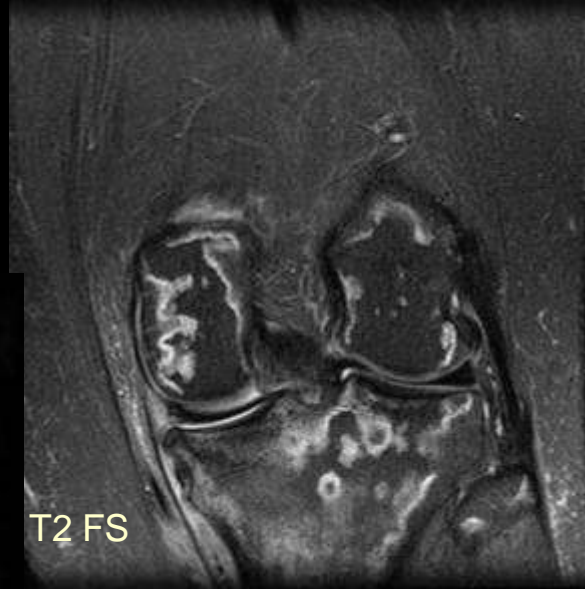
Bilateral femoral head osteonecrosis is manifest by bone edema and subchondral sclerosis on MR in a young HIV patient.

Osteonecrosis



57 year old female with HIV and bone infarcts of the knees bilaterally.

Osteonecrosis



On MR, abnormal serpentine signal representing extensive bony infarcts are seen in this HIV –infected patient.

Osteoporosis

- A high percentage of patients with HIV have low bone mineral density
- Unknown etiology, but is likely multi-factorial to include:
 - antiretroviral therapy, lipodystrophy, nutritional factors, AIDS-related wasting, hematopoietic dysfunction, and direct affects of the virus.
- Increased risk of fractures

Bilateral Calcaneal insufficiency fractures



47 year old male with HIV and bilateral heel pain. Radiograph of the foot shows diffusely demineralized bone and an insufficiency fracture at the calcaneus (arrow). MRI was also performed (next slide).

Bilateral Calcaneal insufficiency fractures



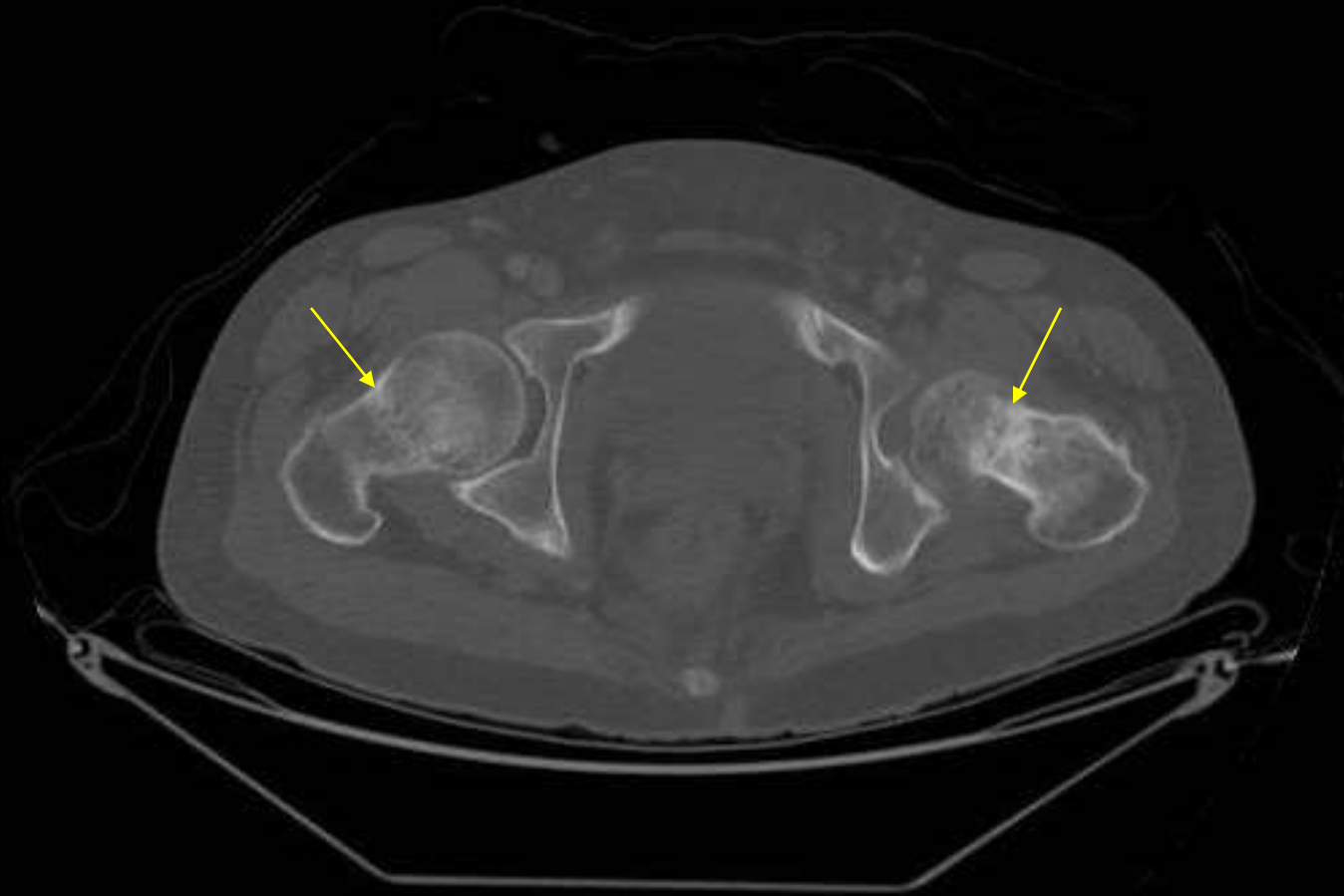
Sag T1



Sag PDFS

47 year old HIV-infected male with bilateral heel pain. MR shows bone edema and insufficiency fracture of the calcaneus (arrows).

Bilateral Femoral neck insufficiency fractures



45 year old man with AIDS. CT show osteopenia and bilateral hip fractures (arrows).

Hematopoietic marrow

- Hematopoietic marrow is also known as “hypointense marrow”
- Anemia of chronic disease, infection, neoplasm, and pharmaceutical therapy can result in hematopoietic dysfunction
- Serum iron and iron-binding protein (TIBC) are low and marrow iron stores are increased
- Paramagnetic nature of the marrow iron stores is postulated to account for the T1 hypointense bone marrow on MRI

Hematopoietic marrow



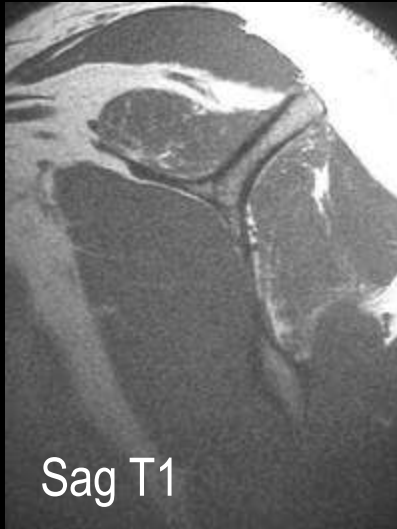
AIDS patient with hypointense bone marrow on T1- weighted sagittal image. Note that the intervertebral discs are brighter than the vertebral bodies.

Case courtesy of Dr. Jamshid Tehranzadeh,
University of California Irvine Medical Center

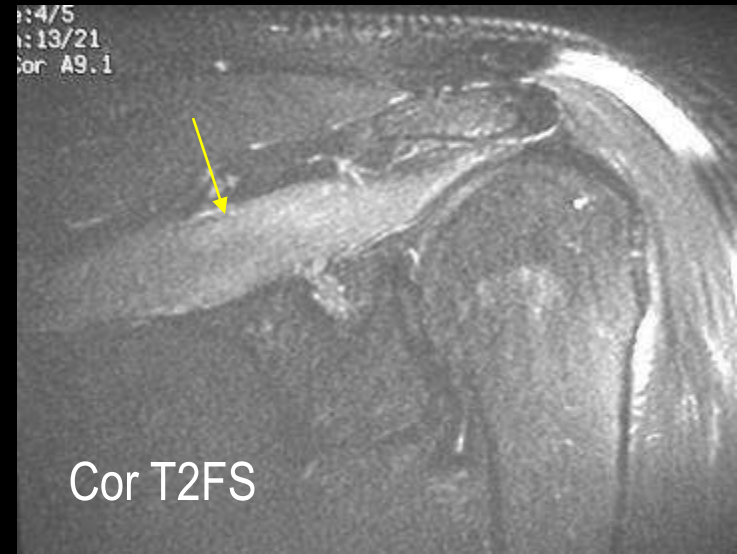
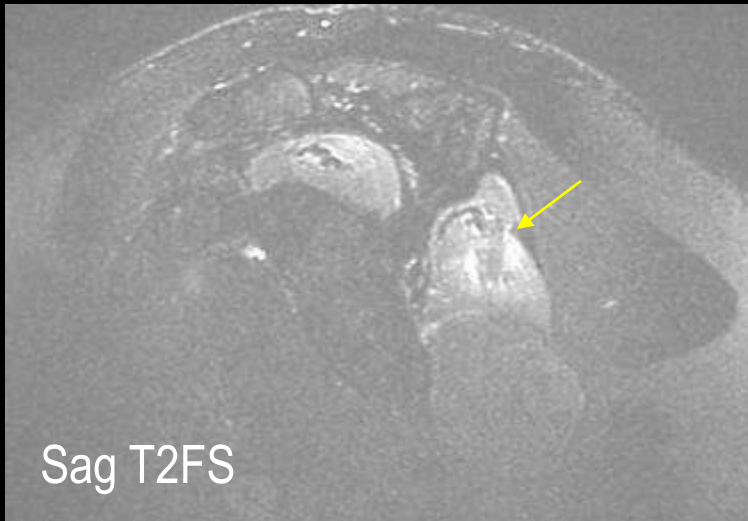
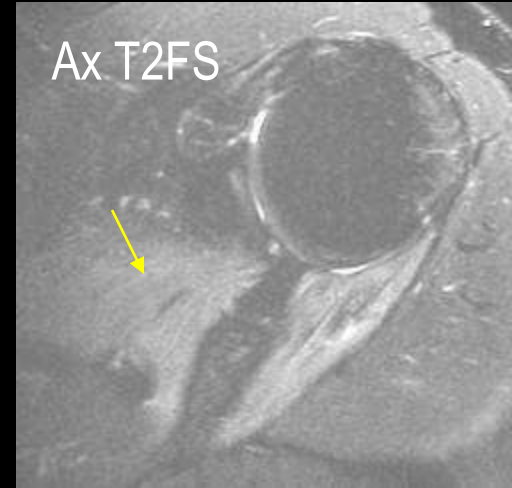
Zidovudine (AZT) myopathy

- Patients present with fatigue, muscle pain, and proximal muscle weakness, especially after a life time dose greater than 200 grams
- MR imaging findings include T2 hyperintense muscle signal without rim enhancement, similar to the appearance of polymyositis

Zidovudine (AZT) myopathy



35 year old male
with hyperintense T2 muscle
signal compatible with edema
and myopathy (arrows).



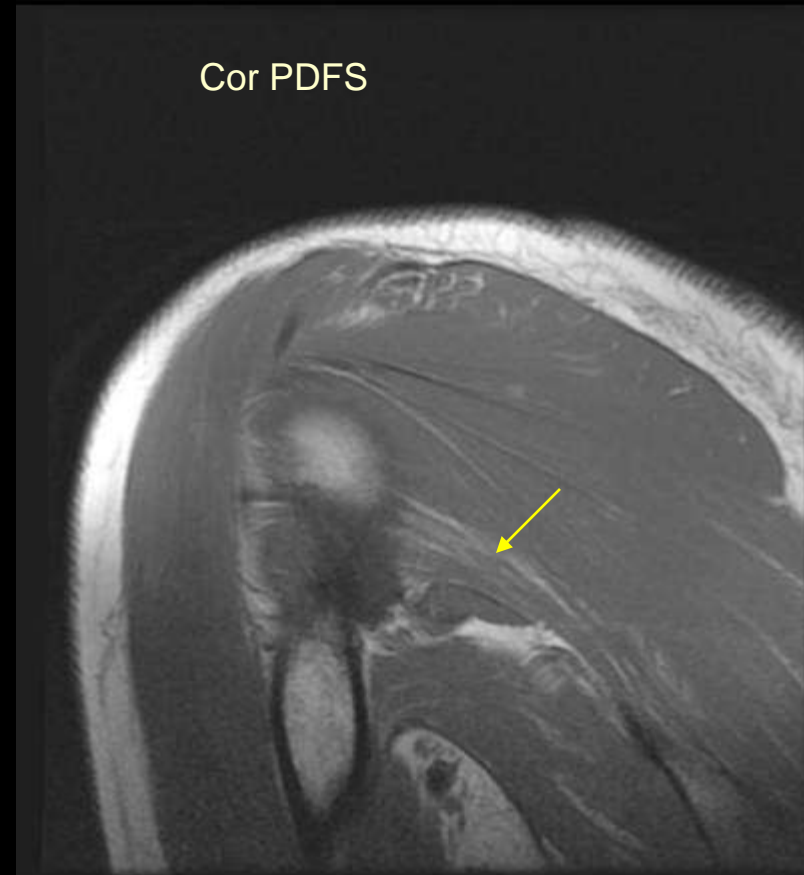
Teres Minor Atrophy in HIV

13



W 1647 : L 533

3



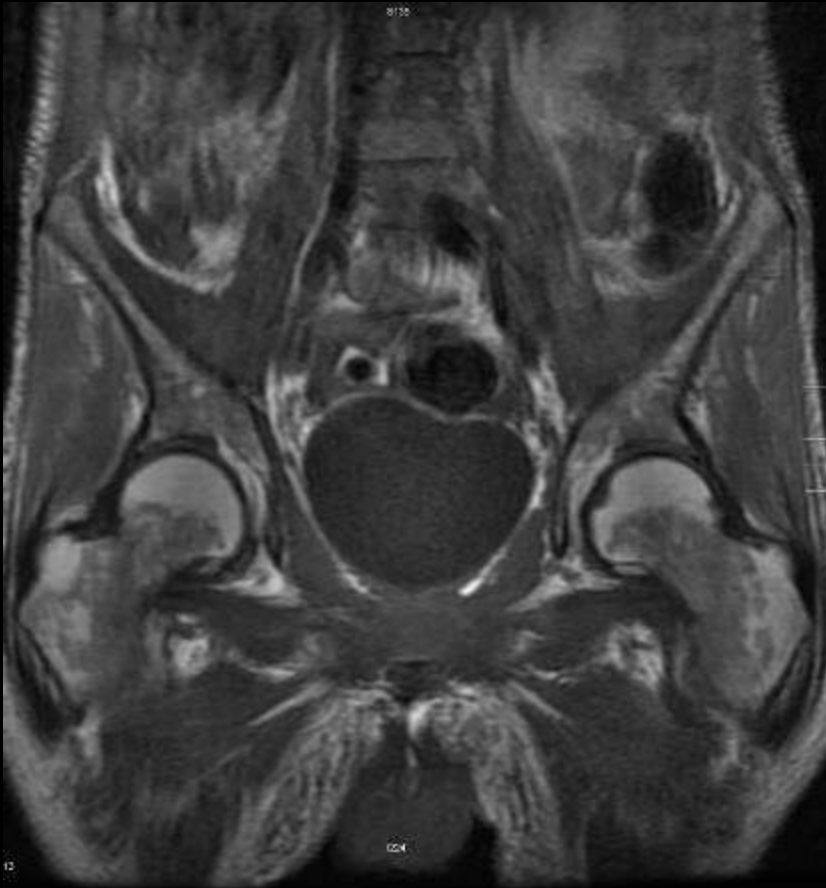
W 1628 : L 573

50 year old male with AIDS presents with shoulder pain. Sag T1 MR images show isolated atrophy of the teres minor muscle (arrow) thought to be related to HIV infection. There was no evidence for tendon tear.

HIV polymyositis

- Inflammatory process of the muscles of unknown etiology, hypothesized to be either immune-mediated or a result of direct viral effects
- Patients have proximal muscle weakness and elevated creatine kinase levels
- HIV polymyositis is characterized by T2 hyperintense muscle signal on MR without rim enhancement, distinguishing this entity from pyomyositis

HIV Polymyositis



SE T1



STIR

43 year old male, HIV positive. Coronal MR images through the pelvis demonstrate diffuse patchy muscle edema compatible with polymyositis.

Conclusion

- Musculoskeletal manifestations of HIV infection and AIDS encompasses a wide spectrum of disease ranging from infectious and inflammatory etiologies to neoplasm.
- Recognition of these entities is important in early diagnosis and treatment.