

# Imaging for Arthritis

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# Outline

- Introduction to imaging modalities
- Focus on plain radiography
  - OA
  - RA
  - PsA
  - AS
  - Gout
  - Pseudogout

# X-rays

- Taking a 2-dimensional image of a 3-dimensional structure
- Superimposition of structures can thus obscure pathology
- Quality is also affected by patient positioning, exposure techniques
- Multiple views of the same area are useful
- Good for: fractures, bone lesions, osteophytes, joint space narrowing, erosions, cysts



# Computed Tomography (CT)

- Also uses x-rays, but is superior than plain radiographs
  - Improved contrast
  - 3-D imaging
- Attenuation of the x-ray beam travelling through tissues is measured from multiple angles
- Substantially increased patient exposure to radiation when compared to plain films
- Good for: fractures, subluxations, sclerosis, cystic bone lesions, evaluation of surgical hardware

# Ultrasound (US)

- Uses the interaction of sound waves with living tissue to produce an image
- Doppler modes allow the determination of the velocity of moving tissues (i.e., blood flow)
- User dependent, so requires an experienced technician who can make real-time measurements
- Difficult to assess all planes
- Good for: joint effusions, tenosynovitis, ganglia, erosions in RA, bursitis, tendonitis, and for guided injections/aspirations



# Magnetic Resonance Imaging (MRI)

- Based on the absorption and emission of energy in the radiofrequency range of the electromagnetic spectrum
- No ionizing radiation exposure, superior soft tissue contrast resolution, excellent for the assessment of soft tissues, can image in multiple planes
- Takes a long time to get access to scanner
- Good for: tenosynovitis, joint effusions, synovial proliferation, cysts, erosions, cartilage loss, reactive bone changes

# Nuclear Scintigraphy

- In addition to showing anatomy, also provides information about underlying physiology
- Most commonly used for MSK imaging: technetium-99m methylene diphosphate (Tc-MDP)
- Can detect synovial hyperemia on the blood pool phase and periarticular uptake on the delayed phase in joints affected by inflammatory arthritis
- VERY nonspecific, most rheumatologists consider the results to not be useful in clarifying the diagnosis
- Good for: determining total number and symmetry of joints involved



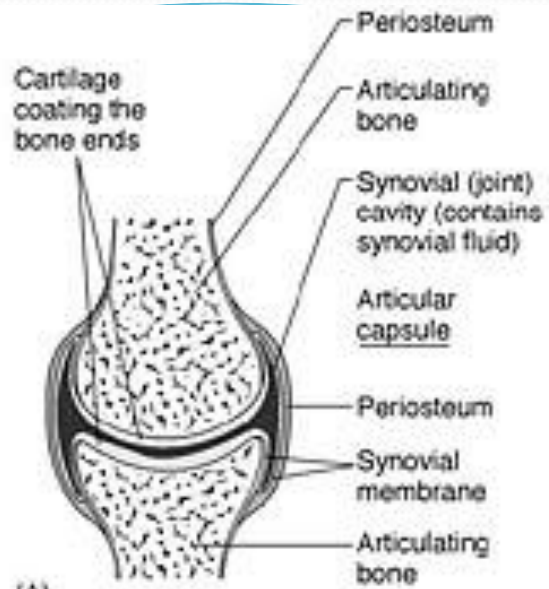
# Approach to an Image

- Soft tissues: effusions, calcification, masses
- Mineralization: diffuse demineralization, periarticular demineralization
- Joint narrowing and subchondral bone: narrowing, subchondral sclerosis, intraarticular bodies, ankylosis
- Erosions: central (articular surface), marginal (bare area), periarticular, mutilans
- Proliferation: osteophytes, periostitis
- Deformity: varus/valgus, flexion/extension, subluxation, dislocation, collapse
- Distribution: monoarticular, pauciarticular, polyarticular, symmetric/asymmetric



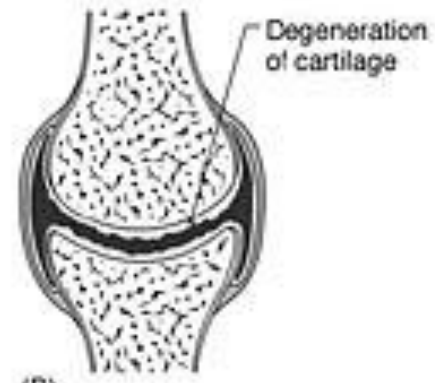
# Osteoarthritis

- Joint space narrowing, osteophytes, subchondral sclerosis, cysts
- Joint effusions are not uncommon
- Early osteophytes look like sharpening of the joint edges
- Distribution: weight bearing joints (hips, knees, back)
- In the hands: DIPs, PIPs, CMC of thumb
- Shoulder: glenohumeral OA usually secondary to rotator cuff disease



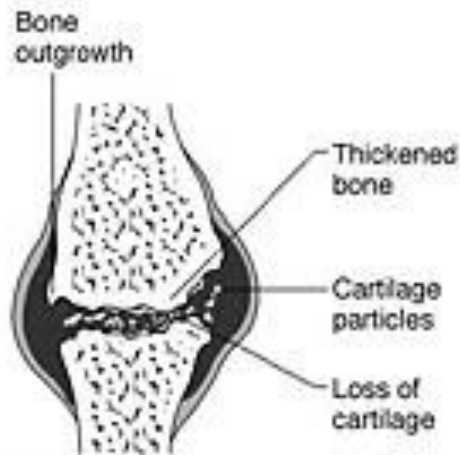
(A)

**Normal joint**



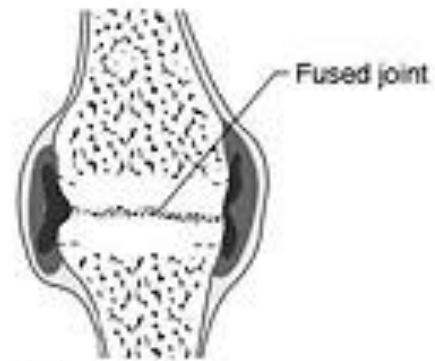
(B)

**Early stage of osteoarthritis**



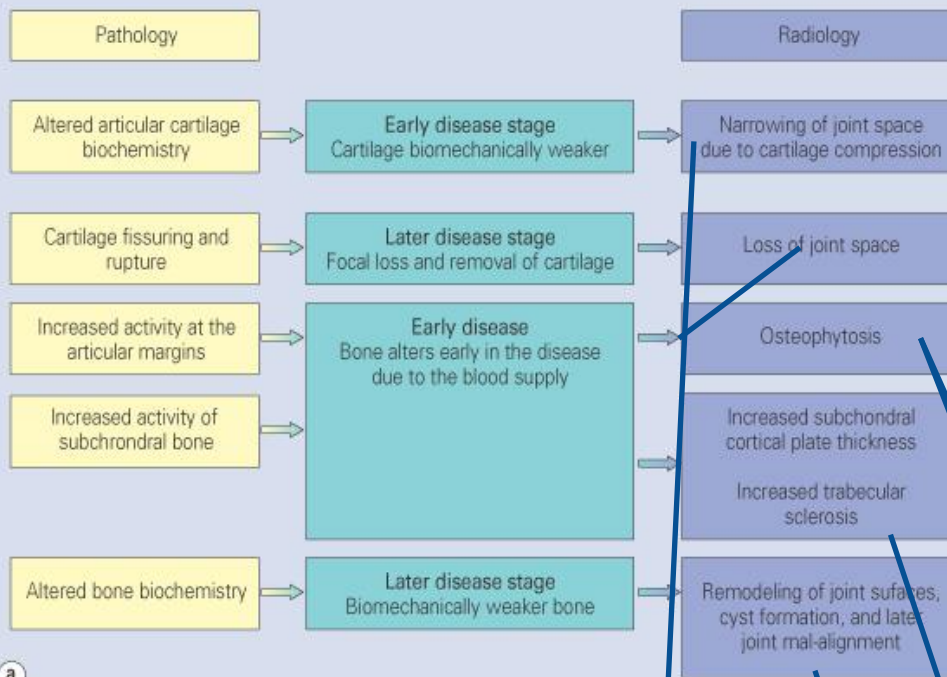
(C)

**Late stage of disease**

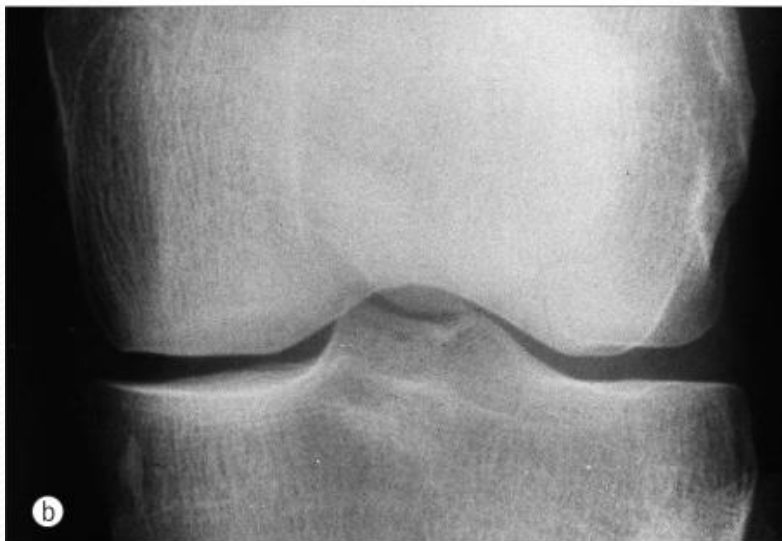


(D)

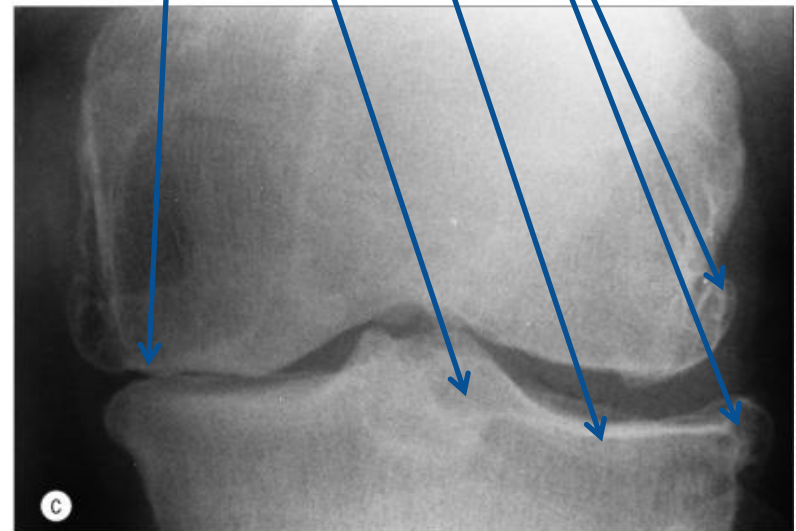
## THE PATHOLOGY OF OSTEOARTHRITIS DETERMINES THE CHARACTERISTIC RADIOGRAPHIC FEATURES



a



b



c



Normal  
joint space



Figure 1

Narrowed joint  
space from loss  
of cartilage



Figure 2

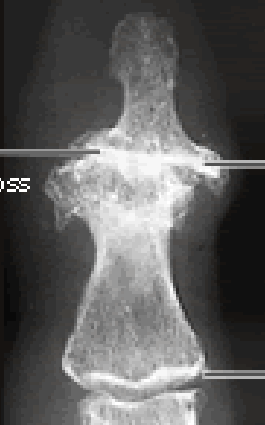


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Narrowing  
due to  
cartilage loss

Osteophyte

Normal joint



**Figure 8. An x-ray showing the finger of a person with nodal osteoarthritis**







# Rheumatoid Arthritis

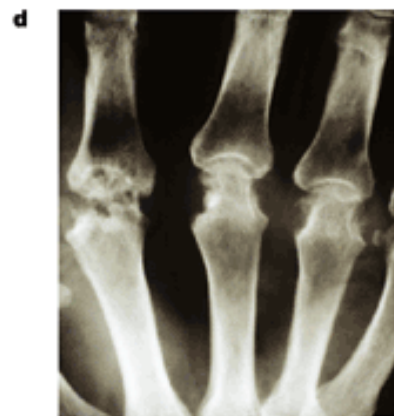
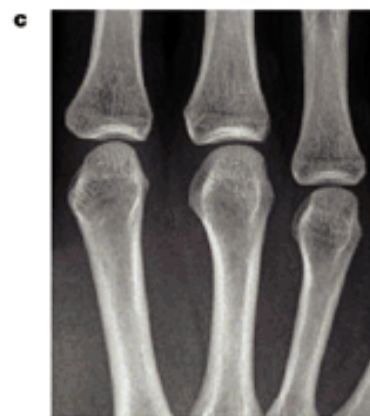
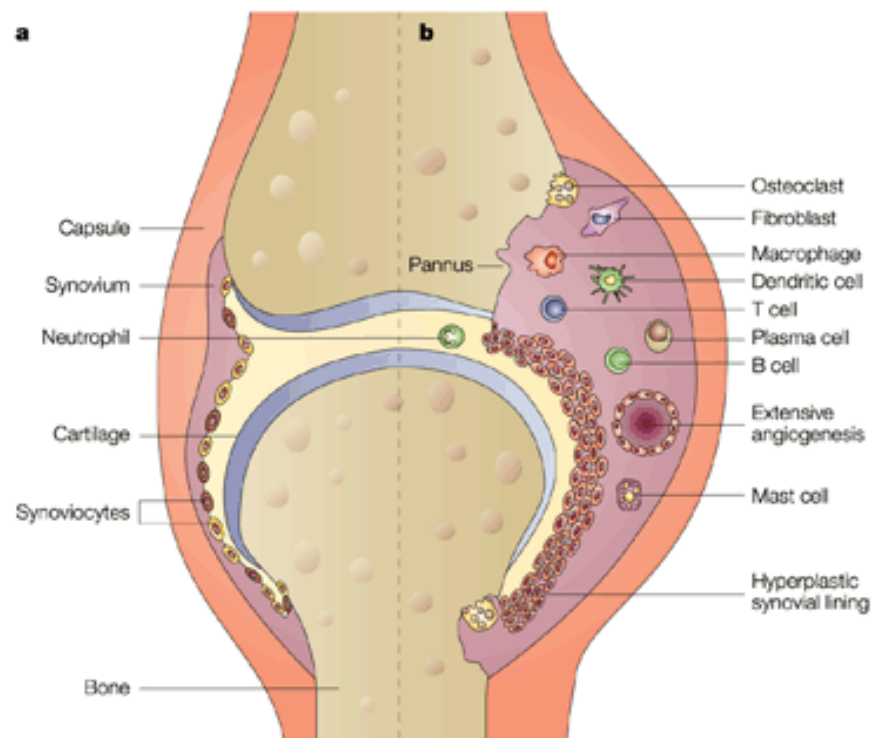
- RA characterized by synovial proliferation (pannus), bursitis and nodules
  - Can cause ill-defined soft tissue planes and prominences on plain films
  - Nodules appear as focal soft tissue masses especially at the olecranon bursa and areas of friction
- Tenosynovitis can appear as diffuse soft tissue swelling, commonly seen at the wrist
- Periarticular osteoporosis is an early finding , but can also see generalized osteoporosis



# Rheumatoid Arthritis

- Characteristic lesions are erosions in the marginal (bare) area
  - Pannus erodes the bone at the margin of the joint capsule where the redundant synovium exits, next to the articular cartilage
- Osseous proliferation is not commonly seen with RA, but can be seen with secondary OA in joints with RA
- Subchondral cysts may be large
- Earliest changes are usually in the hands and feet
  - Ulnar styloid soft tissue swelling, extensor carpi ulnaris tenosynovitis





Soft tissue  
swelling



Marginal erosion

Erosions





# Rheumatoid Arthritis

- Deformities
  - Subluxations at the MCPs and MTPs
  - Ulnar deviation of the digits
  - Swan-neck and Boutonniere deformities



Severe ulnar deviation

Severe erosions of  
MCPs

Complete destruction  
of the wrist

Resorption of the  
carpals and the heads  
of the metacarpals

Radial deviation of the  
wrist





Boutonniere deformity  
of the thumb

Flexion with dislocation of  
the first MCP joint

Hyperextension of the  
IP joint

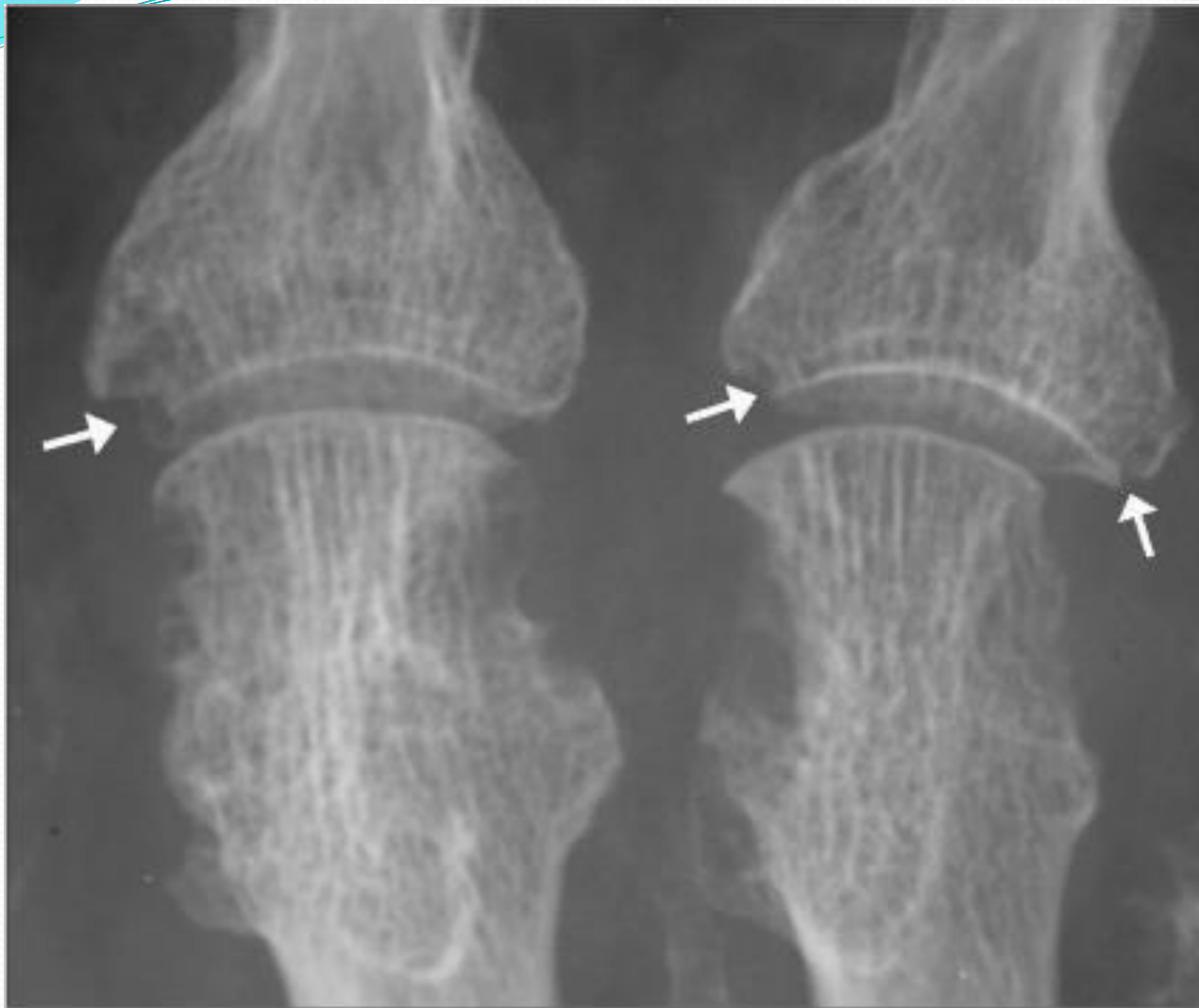


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Rheumatoid wrist: articular destruction, carpal fusion and carpal collapse.

Severe destruction of the distal radius and ulna.





## Rheumatoid foot

Multiple osseous erosions and defects at the medial and lateral margins of the metatarsal heads

Marginal erosions at the bases of the proximal phalanges (arrows)



Rheumatoid foot

Medial and lateral  
erosions of the 5<sup>th</sup>  
metatarsal head

Subluxation of the 5<sup>th</sup>  
MTP joint



## Rheumatoid foot

Subchondral cyst at the  
base of the distal  
phalanx

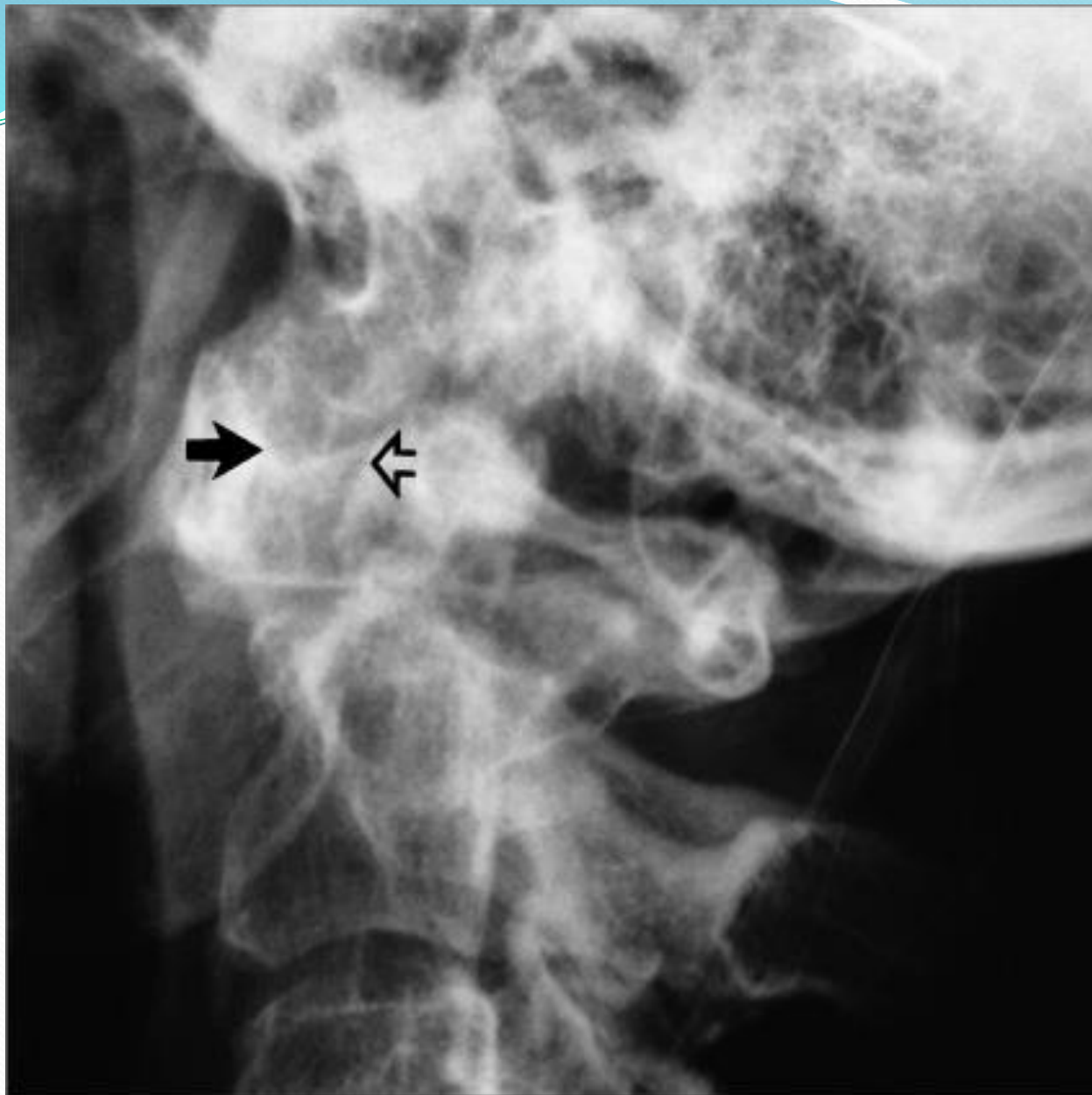
Characteristic erosion  
along the medial  
margin of the proximal  
phalanx of the great toe





Soft tissue findings  
in rheumatoid  
knee

Synovial effusion  
in the  
suprapatellar  
pouch and  
posterior recesses



Atlantoaxial  
subluxation in RA

Always a concern in  
patient with  
longstanding RA  
and neck pain or  
cervical neurological  
symptoms





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Order a view of the atlantoaxial articulation through an open mouth to fully assess. This shows lateral atlantoaxial subluxation of the odontoid process with respect to the lateral masses of the atlas.

# Psoriatic Arthritis

- Characterized by erosions and bony proliferations
  - RA does not typically have new bone formation
- Asymmetric distribution
- Typical “ray” distribution (involves several joints along a single digit)
- Can involve the axial skeleton, as in ankylosing spondylitis (AS)
- Soft tissue findings: fusiform soft tissue swelling around the joints; can progress so the whole digit is swollen (sausage digit or dactylitis)
- “Fluffy” periostitis at the entheses
- Marginal erosions also often show fluffy periostitis from new bone formation

# Psoriatic Arthritis

- Deformities
  - Pencil and cup – end of bone looks like it has been through a pencil sharpener, reciprocating bone becomes cupped
  - Telescoping of one bone into another
  - Complete destruction of bone (arthritis mutilans)





Psoriatic hands

Erosive changes  
at the DIPs and  
PIPs

Sparing of  
MCPs and  
wrists

## Arthritis mutilans

Pencil and cup deformity

Pencilling



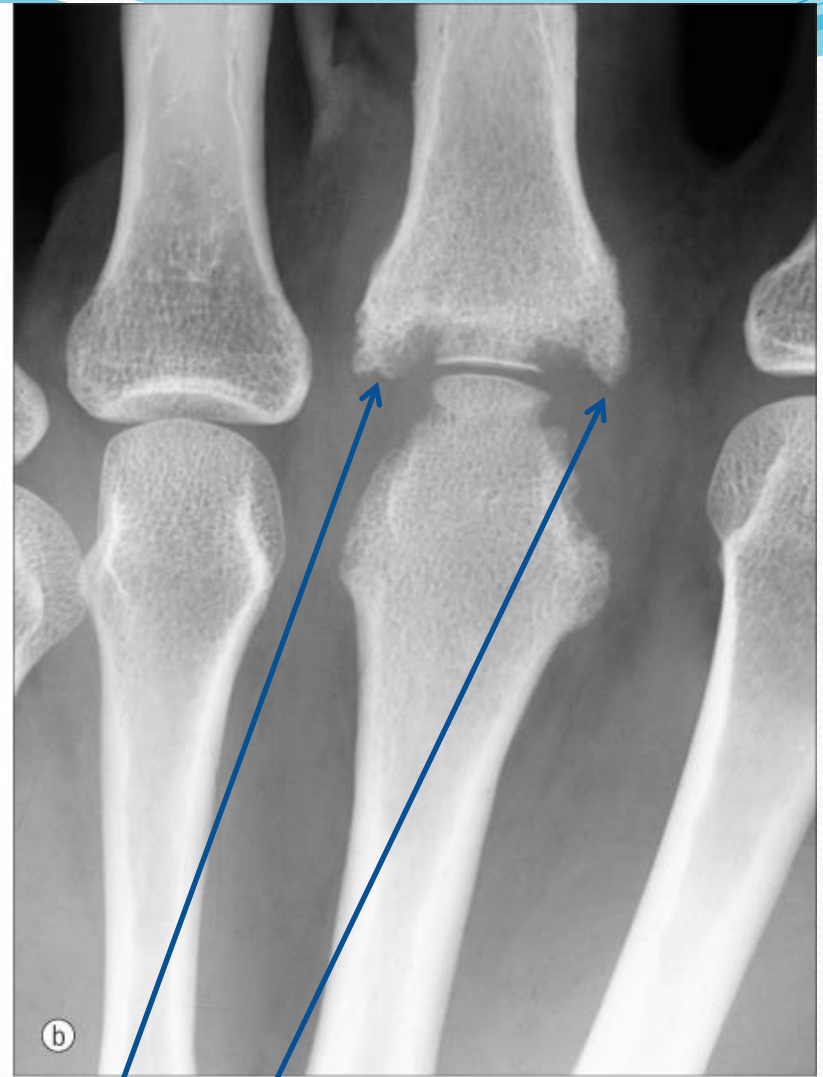


Psoriatic  
arthritis

Asymmetric  
involvement

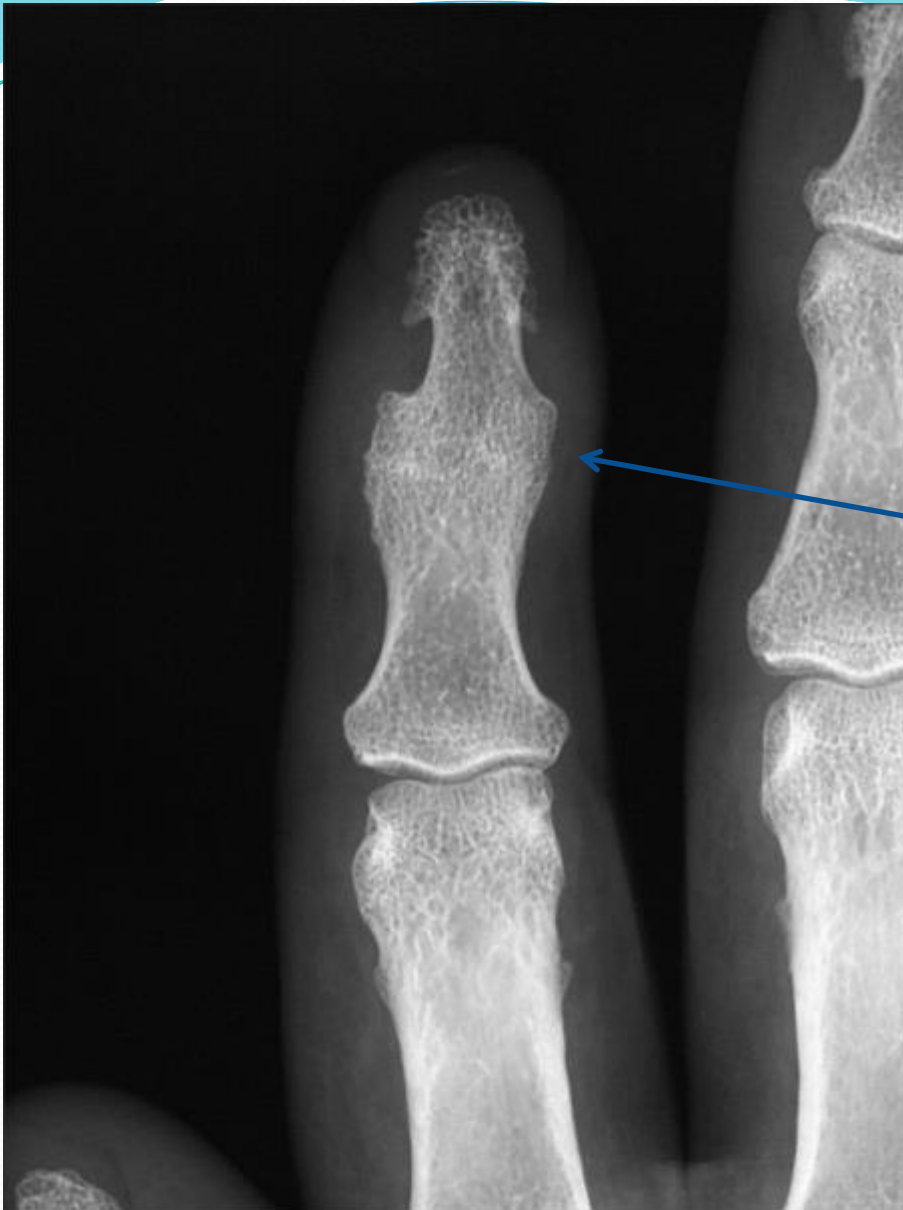
Soft tissue  
swelling and  
periosteal  
reaction in  
2<sup>nd</sup> and 3<sup>rd</sup>  
fingers





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Periosteal reactions



Bony ankylosis of DIP joint

# Psoriatic Arthritis

- Spine
  - Asymmetric sacroiliitis
  - Chunky, asymmetrical syndesmophytes (bony bridges between vertebrae)







Chunky, non-marginal  
syndesmophytes typical of  
psoriatic arthritis



Asymmetric  
sacroiliitis  
with left sided  
erosions and  
sclerosis





# Ankylosing Spondylitis

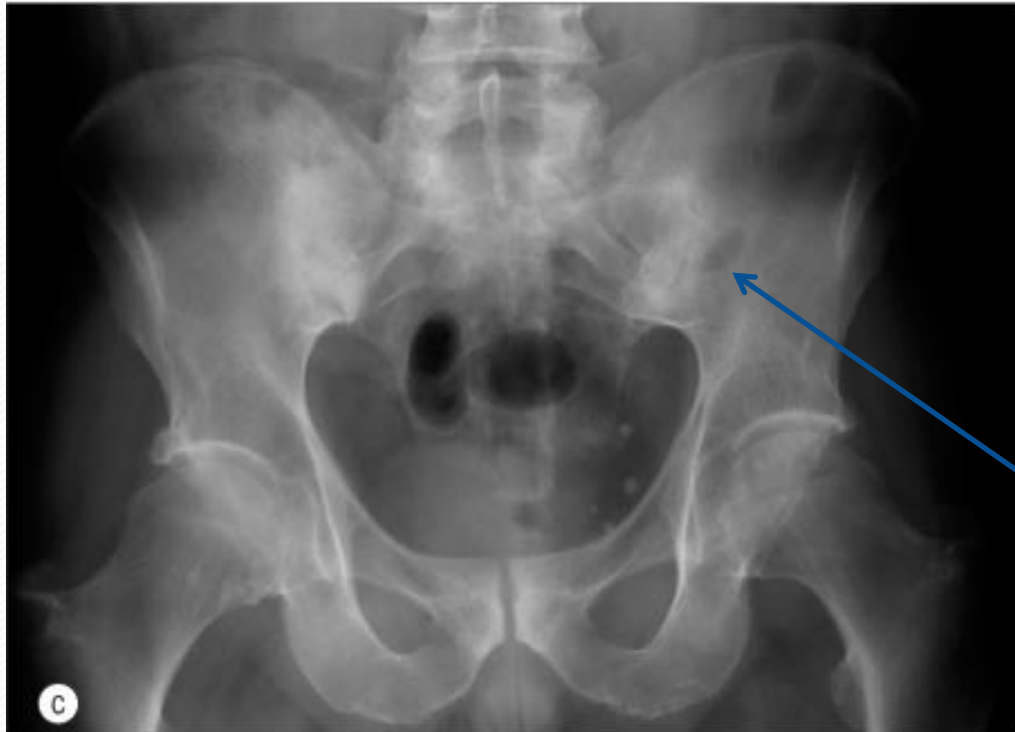
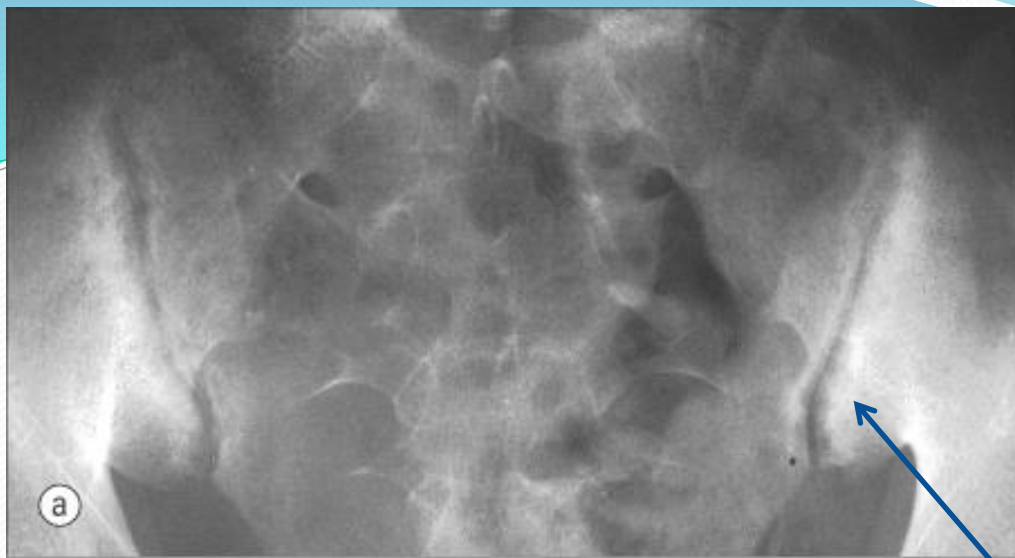
- Changes begin at SI joints and lumbosacral junction, then typically move up the spine
- SI joints:
  - Initially subchondral sclerosis
  - Then, small erosions cause “pseudowidening” of the SI joints
  - Erosions occur first at iliac side, which has thinner cartilage
  - Remember that the synovial part of the SI joint is the anterior, inferior portion
  - Reactive sclerosis with eventual fusion



# Ankylosing Spondylitis

- Spine
  - Early changes include squaring of the anterior vertebral body
  - Enthesitis (whiskering) and sclerosis (shiny corners) where Sharpey's fibres mineralize
  - Progressive mineralization of Sharpey's fibres to form osseous bridging syndesmophytes
  - Ossification of the interspinous ligaments
- Most commonly involved peripheral joint is the hip

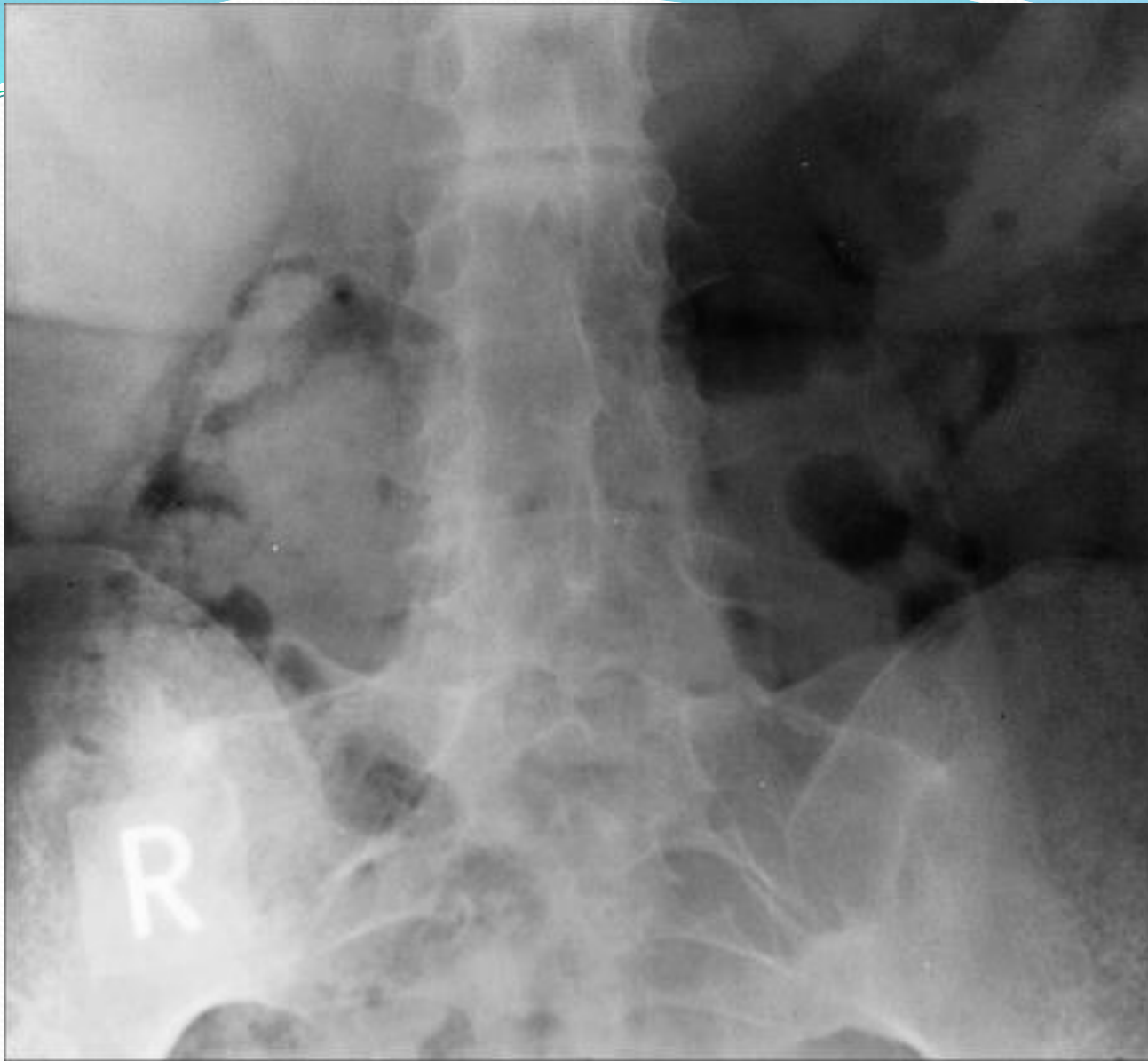




Erosions and sclerosis on iliac side

Bilateral sacroiliitis with erosions, bony sclerosis and joint width abnormalities

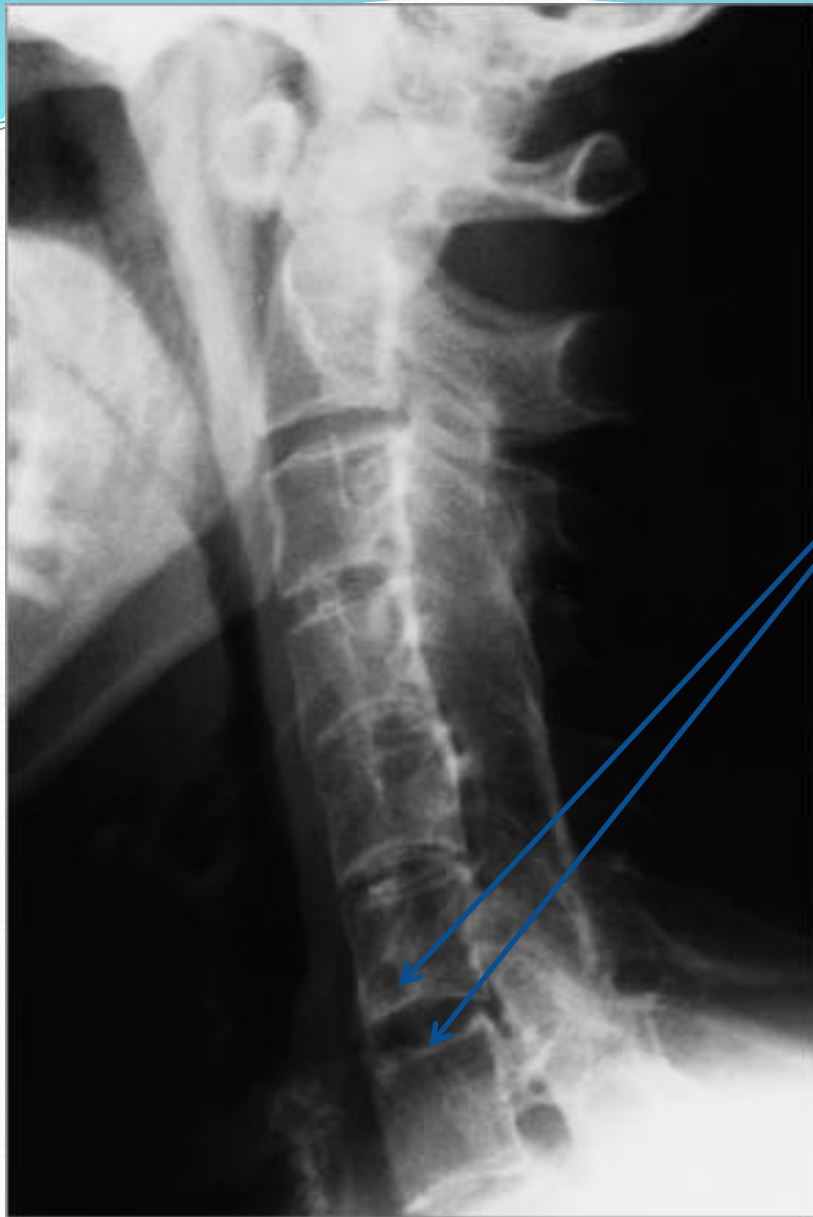
Bilateral sacroiliitis, definite erosions, severe juxta-articular bony sclerosis and blurring of the joint



Advanced AS

Fused sacroiliac  
joints

Ankylosis of the  
lower lumbar  
spine (bamboo  
spine)



## Cervical spine in AS

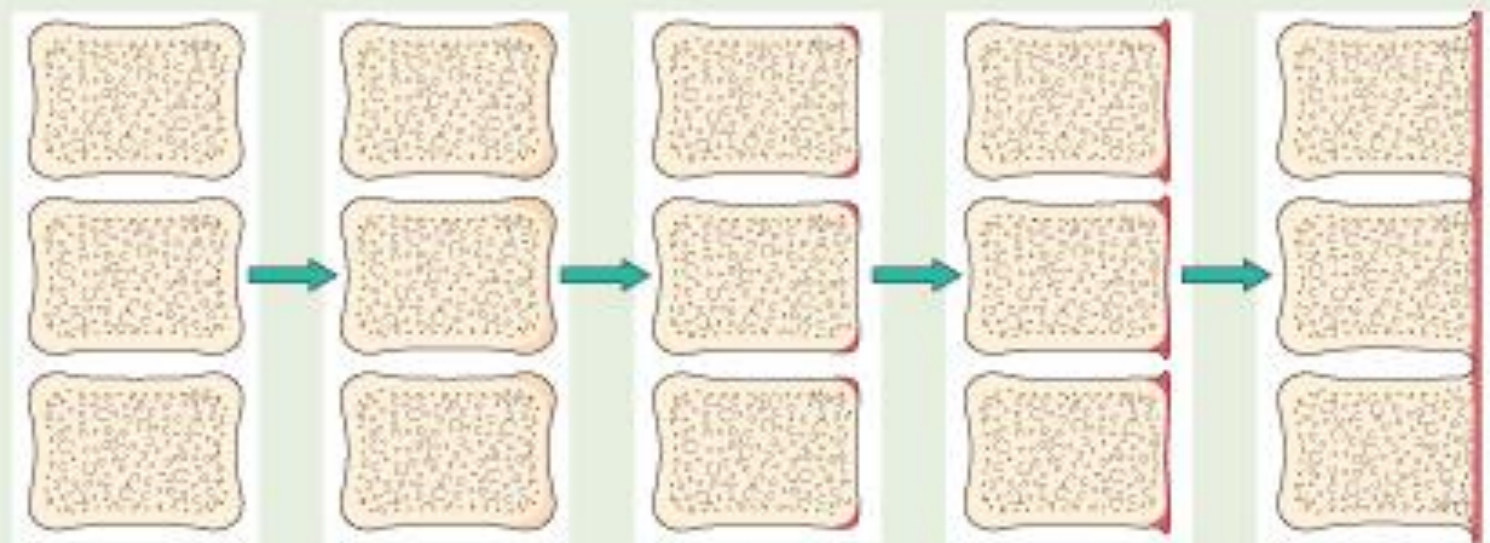
Shiny corners

Squaring of the vertebral  
bodies

Syndesmophytes



## EVOLUTION OF SYNDESMOPHYTES

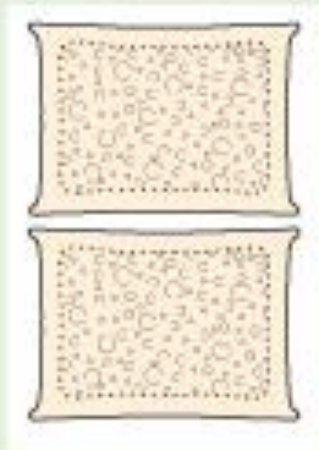


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## BONY CHANGES IN VERTEBRAL COLUMN



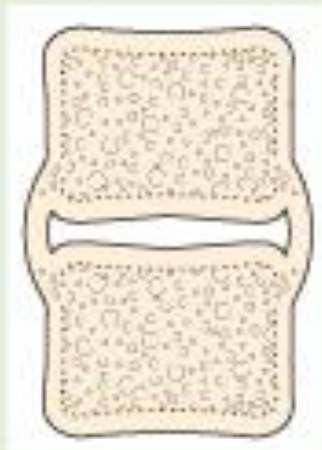
Normal



Osteophytes



Syndesmophytes



Nonmarginal  
syndesmophytes



# Gout

- Erosions and masses, especially in the peripheral joints
- Masses may be dense, due to crystals or associated calcification
- Erosions are juxtaarticular from adjacent soft tissue tophi or intraosseous crystal deposition
  - Appear rounded with a well circumscribed sclerotic margin
- Deformity occurs early
- Olecranon and prepatellar bursitis may calcify





Gouty changes in the big  
toe

Erosions due to tophi



Olecranon  
bursitis with  
erosions due to  
gout



Large, destructive tophus of first MTP



# Pseudogout (CPPD)

- Usually manifests as OA in an unusual distribution
- Prominent osteophytes
- Soft-tissue calcification in the joint capsule, synovium, bursa, tendons, ligaments, periarticular soft tissues
- Chondrocalcinosis (cartilage calcification)
  - Linear and regular deposits in articular cartilage, coarse deposits in fibrocartilage
- No erosions
- Subchondral cysts are prominent
- No periosteal reaction or new bone formation



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Chondrocalcinosis



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Calcifications at the MCPs





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Chondrocalcinosis of the  
triangular ligament

Multiple cysts



# Summary

- Knowing the typical radiographic features of the various rheumatic diseases is important
  - Can help you pare down your list of differentials
- Always a good idea to look at images yourself
  - Often imaging is done with preconceived notions
    - “No fractures”
  - Ask specifically for evidence of inflammatory arthritis if that is what you suspect