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Inaugural National Conference

December 3 – 5, 2020

VIRTUAL CONFERENCE



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Radiology Bootcamp for Rheumatology APPs and PharmDs:

A clinical guide to navigate and interpret imaging for rheumatologic
disease states

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- Speakers Bureau: Abbvie, Amgen, Boehringer Ingelheim, Pfizer, Radius, UCB
- Advisory Boards: Amgen, Avion, BMS, Gilead, Janssen, Scipher

Objectives

- Evaluate patient, order appropriate imaging to provide most information
- Interpret imaging and Radiologist report to accurately diagnose disease state
- Monitoring rheumatologic therapies with appropriate imaging choices
- Case-based studies for critical thinking

ABCDs of Interpretation - Where to Look, What to See

- **A**dequacy and **A**lignment – positioning, penetration, deviation, subluxation
- **B**one – mineralization, periarticular osteopenia, new bone formation, syndesmophytes, joint spaces, erosions, fractures
- **C**artilage – joint spaces, disruption of joint contours, signs of OA, RA, psoriatic, gout, calcifications
- **D**istribution of any changes – Joint patterns, symmetrical, asymmetrical, swelling, calcification
- **S**oft Tissues – Disruption, swelling, calcifications, effusions, foreign bodies

Common Joint Pathology

- **Osteoarthritis** – Loss of joint space, osteophytes, subchondral cysts, subchondral sclerosis
- **Rheumatoid arthritis** – Loss of joint space, peri-articular osteopenia, juxta-articular marginal) erosions-CLASSIC, soft tissue swelling
- **Psoriatic arthritis** – Central erosions (-> pencil in cup appearance)
- **Gout** – Punched out “rat bite” lesions in bone (-> peri-articular tophi)
- **Pseudogout** – Chondrocalcinosis

Osteoarthritis

- **Clinical Presentation**
 - Decreased function, pain, instability, stiffness
 - Worse with activity and better with rest; may be continuous in late stages
 - OA may be asymptomatic, though clinically apparent OA may not manifest radiographic changes
- **Disease Process**
 - Degeneration of articular cartilage
 - Bone remodeling, osteophyte formation, ligamentous laxity, periarticular muscle weakness, synovitis also involved
- May be secondary to inflammatory arthritis

Osteoarthritis (continued)

- **Distribution**

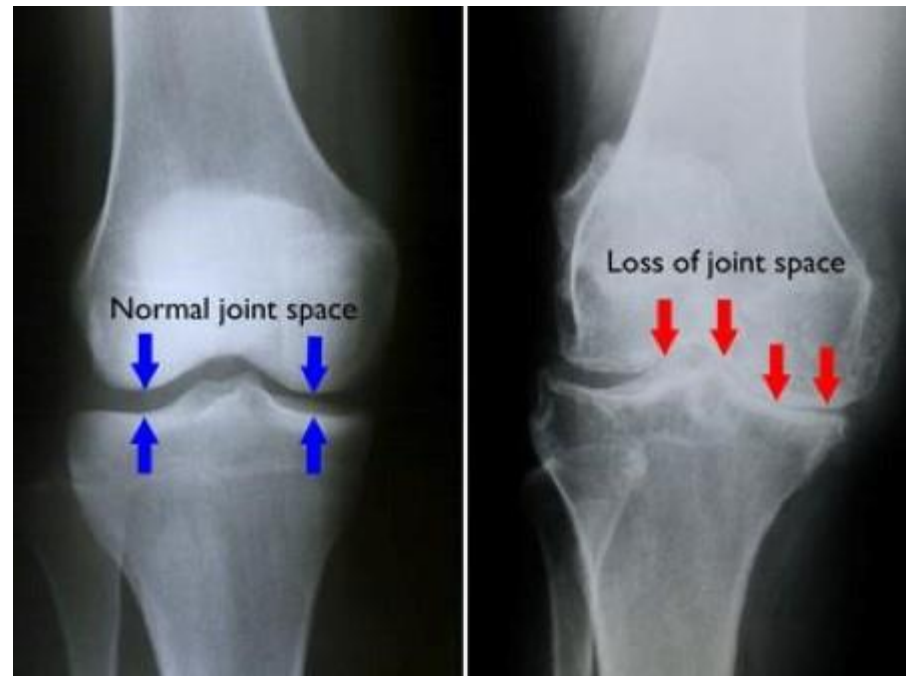
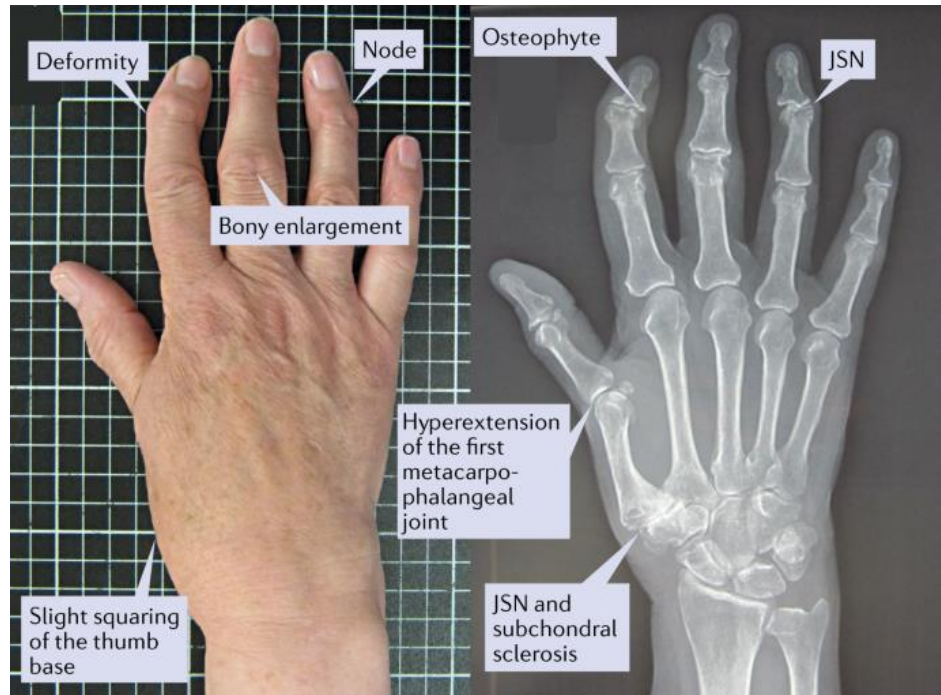
- Affects axial and appendicular skeleton with common peripheral joints, including hands (PIP & DIP joint), feet, knees, hips

- **Radiographic features**

- Joint space narrowing that is characteristically asymmetric
- Sclerotic changes at joint margins
- Osteophytes (e.g. Heberden's/Bouchard's)
- Joint erosions
- Subchondral cysts (geodes) around joints

- **Imaging**

- Plain radiograph most common



Erosive Osteoarthritis

- **Clinical presentation**

- mimics inflammatory arthropathies, such as PsA or RA
- Patients complain of relatively acute or subacute onset of morning stiffness in fingers, bilateral hands
- Systemic symptoms absent
- Female: Male ratio – 12:1

- **Disease Process**

- Exhibits combination of degenerative changes and rheumatoid-like proliferative synovitis
- Erosive OA is subset of non-erosive OA rather than its own disease process

Erosive Osteoarthritis (continued)

- **Distribution**
 - Commonly hands, DIPs, PIPs, CMCs
- **Radiographic features**
 - Diffuse cartilage loss
 - Subchondral erosions (at least 2 central erosions affecting separate IP joints)
 - Typical central location of erosions produces classic “seagull-wing” appearance
 - Joint ankylosis.
 - Absence of marginal erosions, fusiform soft-tissue swelling, osteopenia
- **Radiology**
 - Plain radiograph

Erosive OA - Hand



Erosive OA



Rheumatoid Arthritis

- **Clinical presentation**

- Insidious or abrupt onset
- Features include fatigue, malaise, chronic multisystem disease
- Destructive, symmetrical inflammatory arthritis with a proximal distribution, primarily attacking synovial tissues, synovial joints, tendons and bursae

- **Disease Process**

- Genetic predisposition (HLA allele) with environmental trigger
- Autoimmune response causing accumulation T CD4 cells in synovium, leading to cascade of inflammatory responses resulting in pannus formation
 - Pannus is an edematous thickened hyperplastic synovium infiltrated by T and B lymphocytes, plasmocytes, macrophages, osteoclasts
- Pannus leads to erosion of articular cartilage, causing fibrous ankyloses which ossifies
- Osteoclast activation causes subchondral bone destruction

Rheumatoid Arthritis (continued)

- **Distribution**

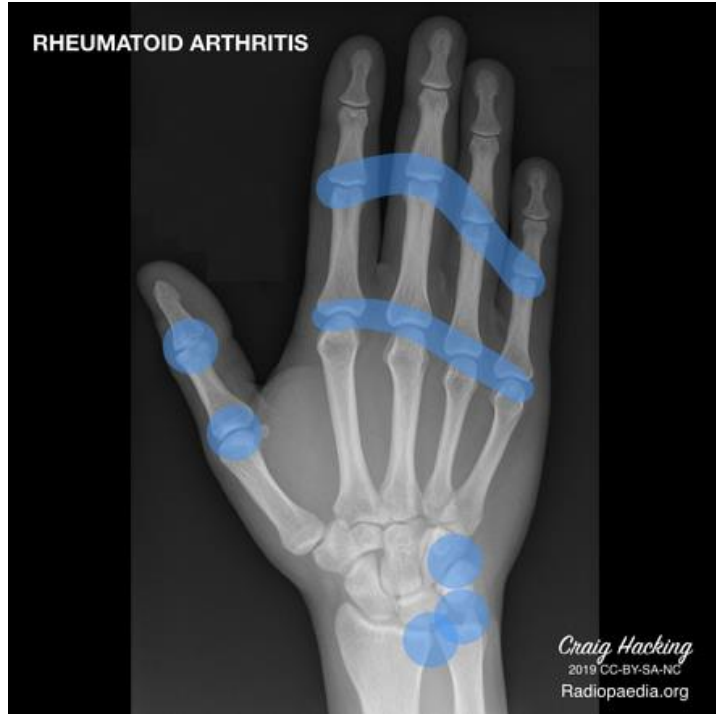
- Symmetrical
- **Hands:** PIPs, MCPs (2nd and 3rd worse), ulnar styloid, triquetrum
- **Feet:** PIPs, MTPs (4th and 5th more), subtalar, posterior calcaneal tubercle erosion, hammertoe deformity, hallux valgus
- **Shoulders:** erosion distal clavicle, marginal erosions of humeral head- superolateral aspect, reduction in acromiohumeral distance due to subacromial -subdeltoid bursitis and high incidence of rotator cuff tear
- **Hips:** concentric joint space loss, acetabular protrusio
- **Knees:** joint effusion, lateral non-weight bearing part of joint, 3 compartment joint space loss, prepatellar bursitis, cervical
- **Spine:** Involved in ~50% patients and features include erosion of dens, atlantoaxial subluxation, erosion and fusion of uncovertebral and facet joints, osteoporosis and osteoporotic fractures, erosion of spinous processes

Rheumatoid Arthritis (continued)

- **Radiographic features**

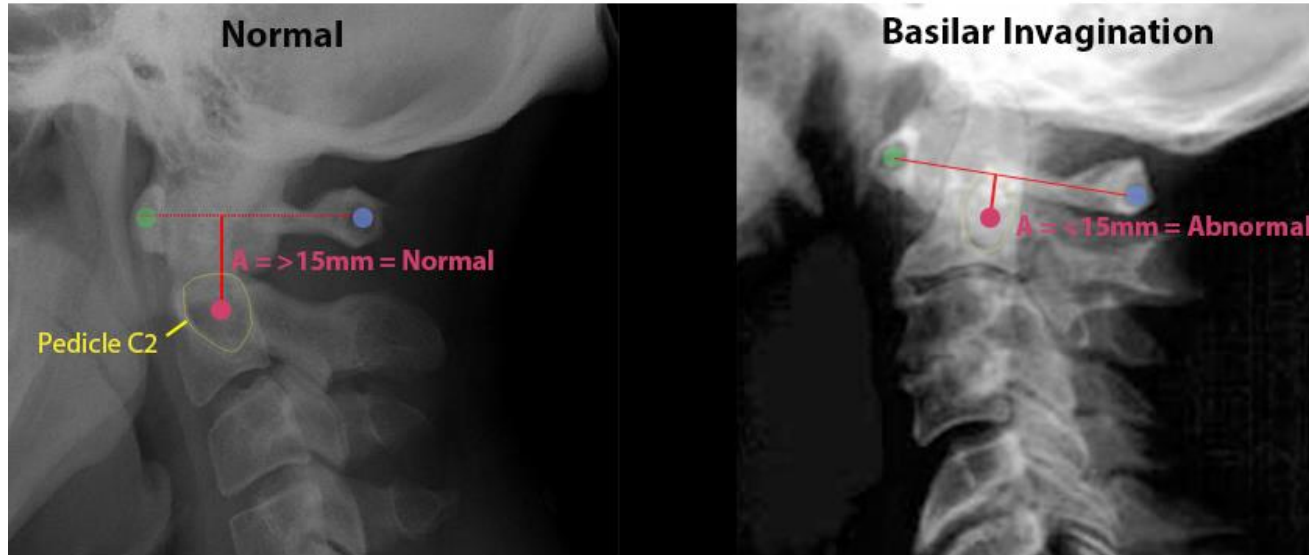
- Hallmark: erosions radial side of MCPs
- Soft tissue swelling-fusiform and periarticular, representing joint effusion, edema, and tenosynovitis
- Osteoporosis, initially juxta-articular or late-generalized
- Joint space narrowing-symmetric or concentric
- Late changes include subchondral cyst formation, subluxation causing ulnar deviation of MCPs, boutonniere, and swan neck deformities

RA - Hand



RA - Spine

Ranawat C1-2 Index (A)



The Ranawat index is used to assess vertical subluxation (VS) by detecting settling of C1 on C2. The measurement is made from the center of the pedicles of C2 to a line connecting the midpoint of the anterior and posterior arches of C1. Normal values are 15 mm or greater for men and 13 mm or greater for women. Anything less than this confirms VS.

Gout

- **Clinical presentation**

- More common over age of 40
- Male:Female – 20:1
- Monoarticular, red, inflamed, swollen joint, (podagra), usually 1 MTP
- Often manifests in sleep, later become oligoarthropathy, or rarely polyarthropathy
- Intercritical period between flares
- Chronic, uncontrolled hyperuricemia may develop chronic tophaceous gout, solid urate crystal collections (tophi) and chronic inflammatory and destructive changes in surrounding connective tissue.
- Tophi white/yellow, non-tender, located within articular structures, bursae, or ears

Gout (continued)

- **Disease process**

- Monosodium urate crystals deposition in joints/periarticular soft tissues
- Five stages of gout
 1. Asymptomatic hyperuricemia
 2. Acute gouty arthritis
 3. Intercritical gout (between attacks)
 4. Chronic tophaceous gout
 5. Gouty nephropathy

- **Distribution**

- 1st MTP joint most common
- Joint in hands and feet also common

Gout (continued)

- **Radiographic features**

- Effusions
- Punched-out erosions with sclerotic margins in a marginal and juxta-articular distribution, with overhanging edges, also known as rat bite erosions
- Periarticular soft tissue swelling (may be dense) due to crystal deposition in tophi around joints
- Calcified tophi

- **Imaging**

- **Plain radiograph**
- **Ultrasound:** tophi hyperechoic, heterogeneous, poorly defined contours. They can form multiple groups with surrounding anechoic haloes
- **CT-findings:** reflect same as plain radiograph

Gout Overview

rheumTutor.com

Radiographic Findings in Gout

rheumTutor.com



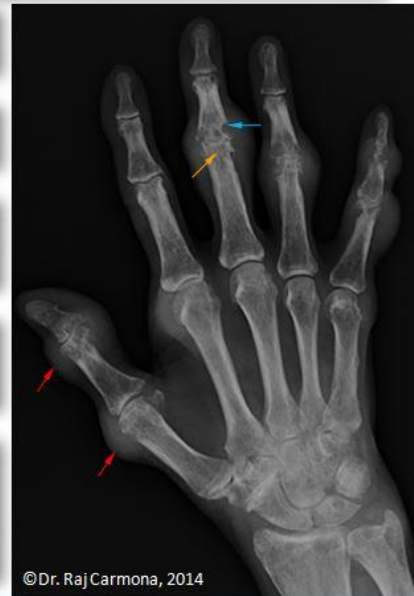
Large erosions
Random joints

Punched-out lesions
● Right 3rd PIP

● **Soft tissue tophi**
Multiple: left 5th DIP,
right thumb MCP/IP

● **Sclerotic overhanging edges**
Left thumb IP joint

● **Preserved joint spaces**
Joint spaces are generally preserved until late



● No periarticular osteopenia

Typically, there is no peri-articular osteopenia with gout. The contrast of this radiograph was adjusted to highlight the erosions and may create the impression that there is peri-articular osteopenia.

Calcium pyrophosphate dehydrate deposition disease (CPPD)

-Pseudogout, Chondrocalcinosis

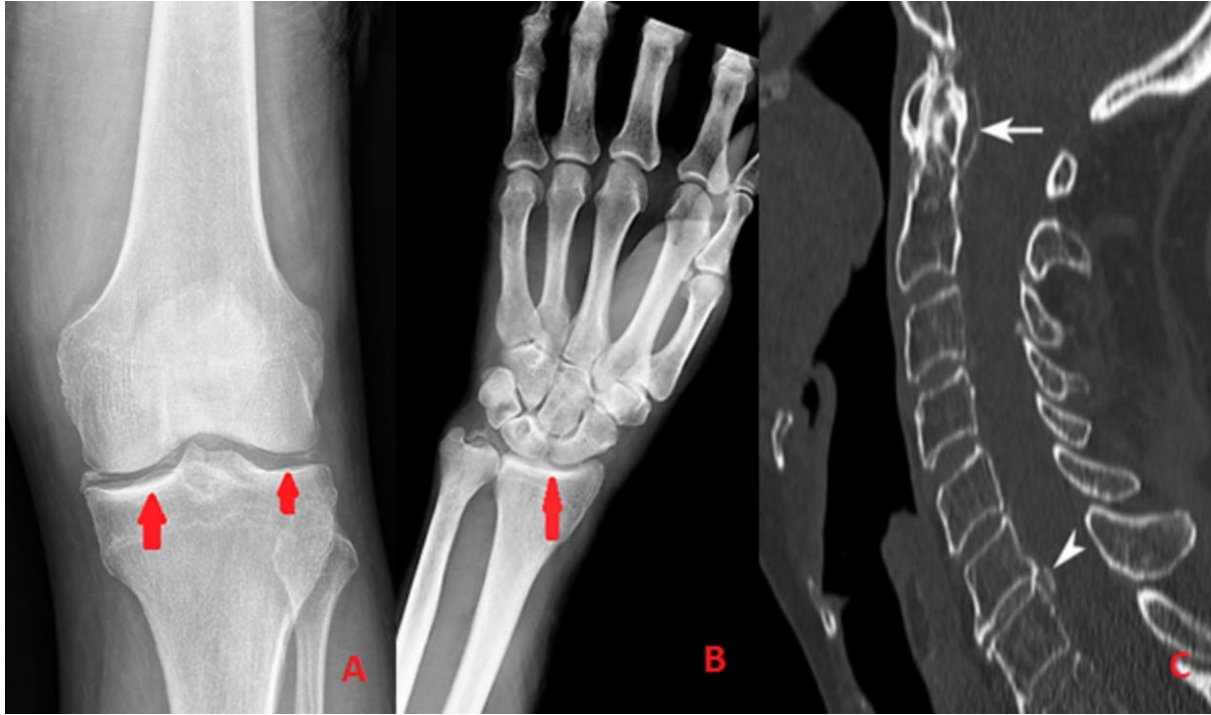
- **Clinical presentation**
 - Most patients with imaging findings are asymptomatic
 - Presents with severe acute or subacute pain, swelling, erythema, and warmth, one or more joints, usually self-limiting
 - Resembles acute gout attack
 - Chronic CPPD inflammatory arthritis presents with chronic, intermittent painful swelling in peripheral joints of upper and lower extremities
- **Disease process**
 - Crystals weakly positively birefringent, rhomboid shape

Calcium pyrophosphate dehydrate deposition disease (CPPD)

-Pseudogout, Chondrocalcinosis

- **Radiographic features**
 - Many features of OA with unusual distribution
 - Tend to be symmetric and involve non-weight bearing joints, or in intercarpal and MCPs in hands
- **Imaging order**
 - **Plain radiograph**
 - **Ultrasound:** can differentiate CPPD from gout with echogenic monosodium urate crystals line surface of articular cartilage, where echogenic CPPD calcifications are located within cartilage

CPPD



Psoriatic Arthritis

- **Clinical presentation**

- Psoriasis precedes arthritis in 60-70%
- Arthritis precedes psoriasis 15-20%
- Strong association with nail involvement at DIPs
- Presents as asymmetrical mono or oligo-arthritis with spondylitis
- Can progress to polyarthritis
- Dactylitis and enthesitis

Psoriatic Arthritis (continued)

- **Disease process**

- Genetic (60% HLA-B27 positive), with environmental factors felt to be triggers of disease
- Extra-articular manifestations are common:
 - ocular-uveitis, conjunctivitis
 - GI-inflammatory bowel disease
 - cardiac-rhythm disturbance BBB
 - urogenital-urethritis, prostatitis, cervicitis, vaginitis

- **Distribution**

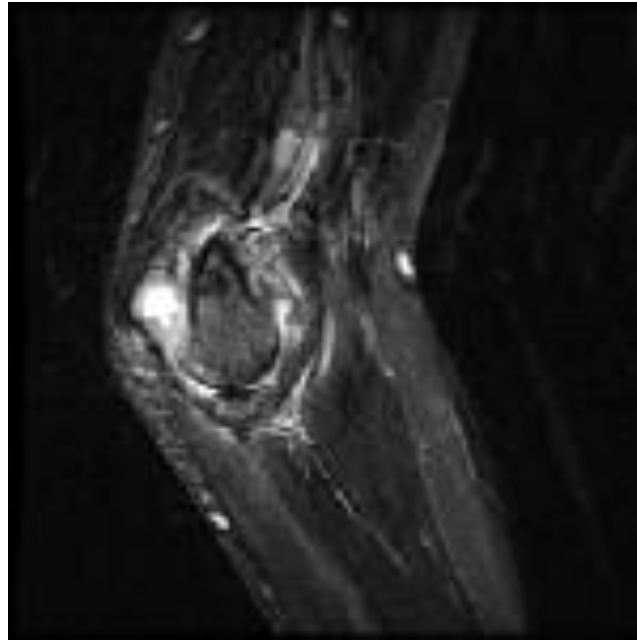
- hallmark combination of erosive change with bone proliferation in distal distribution
- More commonly affects hands, then feet (may be symmetrical or asymmetric)
- Can also affect sacroiliac joints and spine.

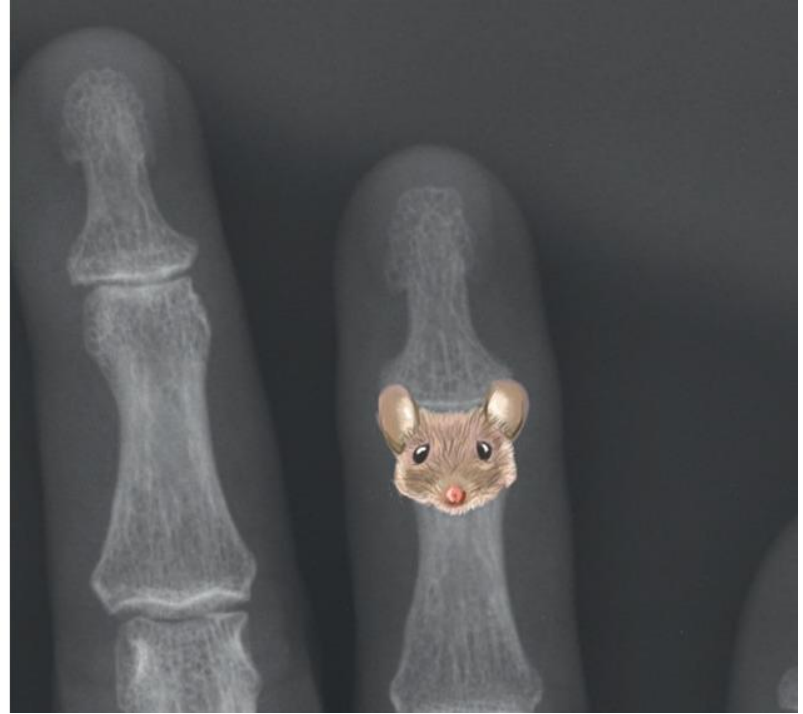
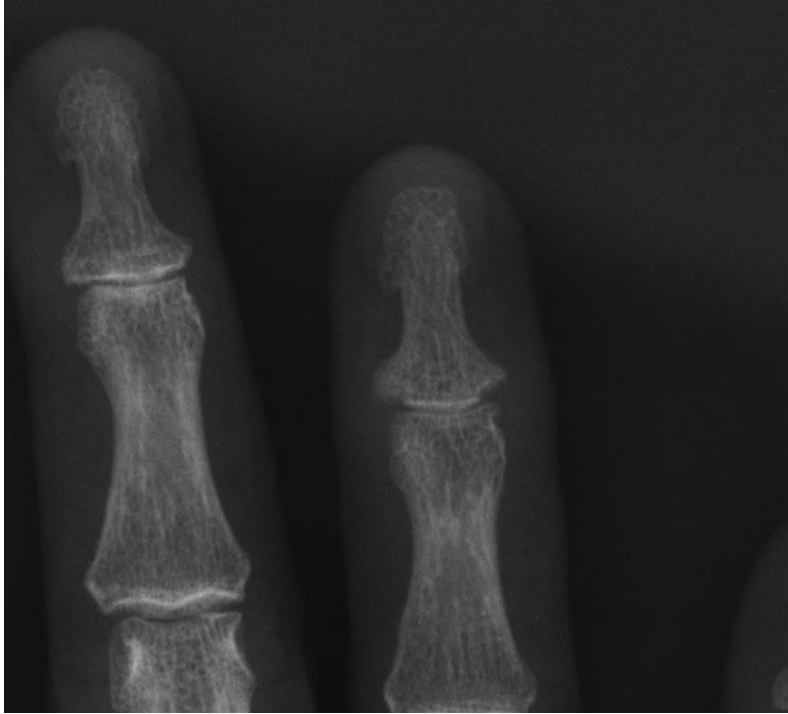
Psoriatic Arthritis (continued)

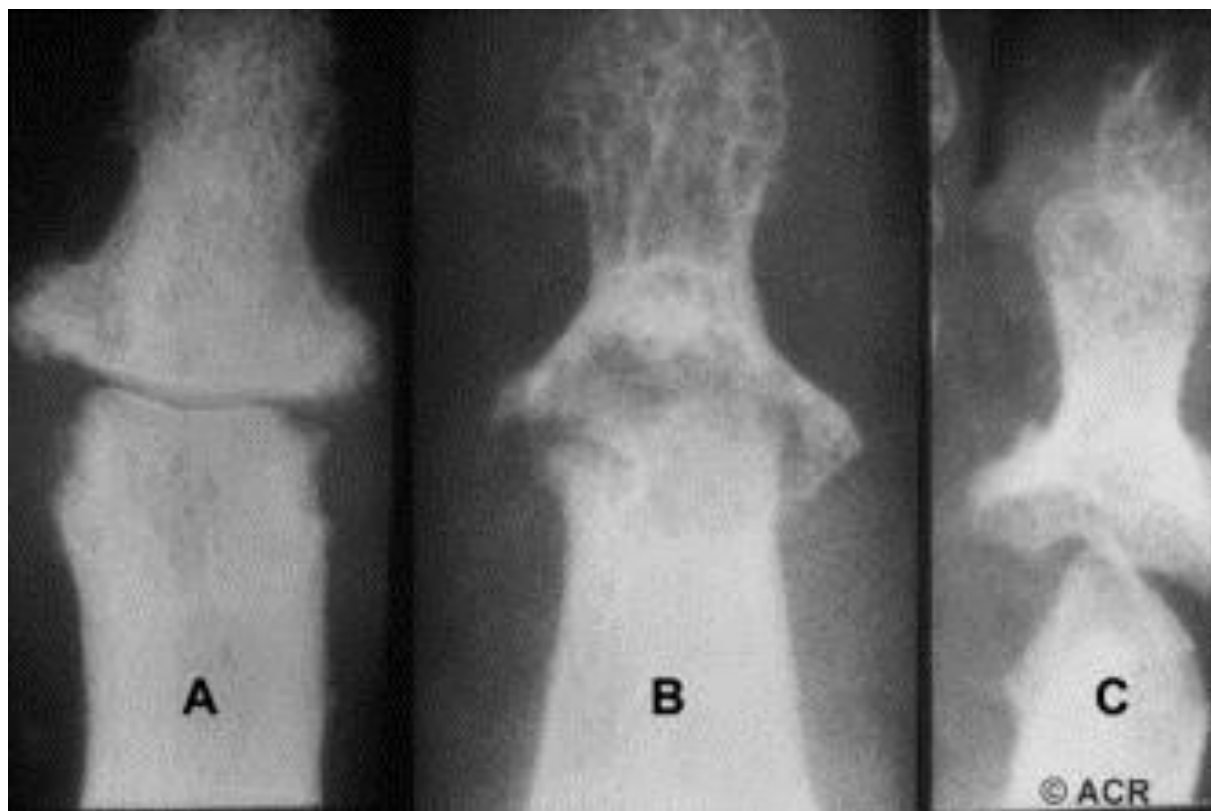
- **Radiographic features**

- Enthesitis and marginal bone erosions and “pencil in cup” deformities
- Bone proliferation results in “whiskering” appearance to bone around affected joint
- Joint subluxation or IP ankyloses may be present
- Periostitis: may appear as periosteal layer of new bone, or as irregular thickening of cortex
- Dactylitis: “sausage digit” soft tissue swelling entire digit
- Acro-osteolysis
- Arthritis mutilans: osteolysis and articular collapse causes “telescoping fingers”
- Sacroilitis often asymmetrical
- Spondylitis: asymmetric paravertebral ossifications with relative sparing of facet joints

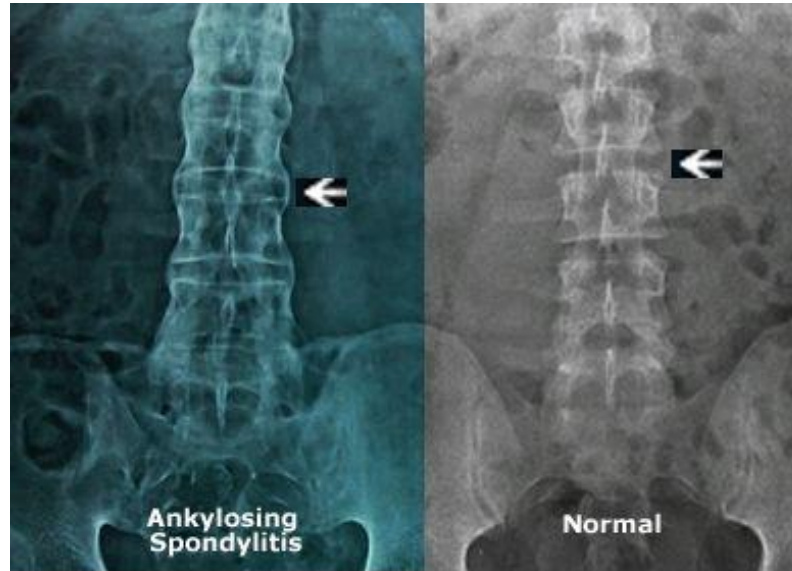
Plain radiograph, ultrasound, MRI







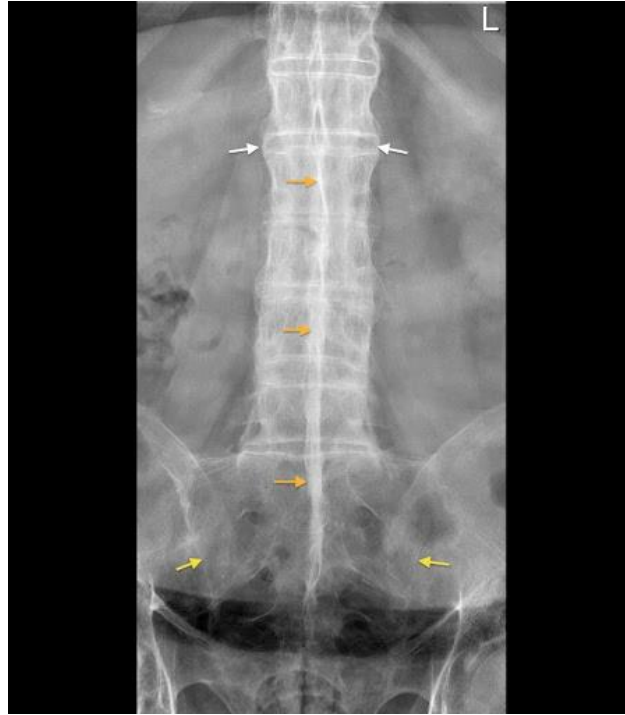
Ankylosing Spondylitis



There is a ligament (arrow head) on sides of the vertebrae. It is flexible & not normally seen in a normal person. It gets calcified & thick in Ankylosing Spondylitis & is seen.

Dr. S. Akerkar <http://doctorakerkar.wordpress.com/>

AS Dagger Sign



Diffuse idiopathic skeletal hyperostosis (DISH)

- **Clinical Presentation**

- Often an incidental finding
- Spine stiffness and decreased mobility
- Usually affects elderly 6th to 7th decades. Frequency ~10%.

- **Disease process –**

- Common condition characterized by bony proliferation with periosteal new bone formation on anterior surface of vertebral bodies at sites of tendinous and ligamentous insertion of the spine.
- Associated with ossification of posterior longitudinal ligament, hyperglycemia, and ~1/3 patients are positive for HLA-B27

- **Distribution**

- Cervical and thoracic spine (T7-T11), enthesopathy in pelvis and extremities

Diffuse idiopathic skeletal hyperostosis (DISH)

- **Radiographic features**

- Spine

- Flowing ossifications along anterior or right anterolateral aspects of at least 4 contiguous vertebrae
 - Disc space well-preserved
 - Ankylosis more common in thoracic spine and is frequently incomplete
 - No sacroiliitis or facet joint ankylosis.

- Extra spinal features

- enthesopathy of iliac crest, ischial tuberosities, greater trochanters
 - Spur formation in appendicular skeleton (olecranon, clacaneum, patellar ligament)
 - “whiskering” enthesophytes

DISH



Radiology Bootcamp Case Study

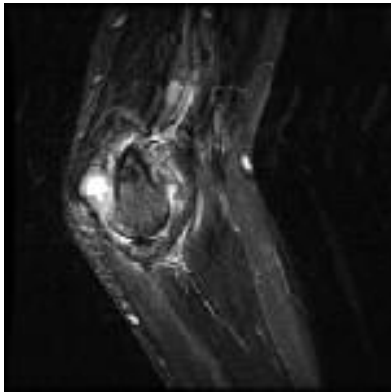
- 52-year-old petite white female presents 4/2019 for evaluation for symmetrical inflammatory arthritis
- Patient is very active, runs half marathons, enjoys paddle boarding
- Baseline of mild generalized osteoarthritis. Hashimoto thyroid disease, stable.
- On 7/2018, developed acute onset of foot pain and stiffness. She is evaluated by orthopedics, prescribed heat and NSAID
- Patient discontinued running. Further developed pain, swelling, stiffness in feet, hands, knees elbows, with morning stiffness lasting 45 minutes- 1 hour, worse in the morning, better with activity, gelling

Case Study (continued)

- On 4/2019, prescribed Mobic 7.5 mg po qd, while completing evaluation
- Evaluated in rheumatology, 4/2019, Hct 34.7/Hgb 11.6, normal CMP, ESR 16, CRP 17.9, positive RFIgA and RFIgM, negative RFIgA, positive anti-CCP, negative Hep B/C panel, uric acid 3.7
- Imaging, clear CXR
- Diagnosed 5/20/2019, seropositive RA, “hesitant” to proceed with DMARDs, agreed and started Plaquenil 200 mg po bid, continued Mobic 7.5 mg po qd
- Returned 6/20/2019, in tears, uncontrolled symptoms, discontinued Plaquenil started Methotrexate 15 mg po q week, folic acid supplements
- Returned 7/2019, improved without symptoms

Case Study (continued)

- Patient remained stable on Methotrexate
- On 5/28/2020, during COVID-19, patient called into practice with acute onset of right elbow, pain, swelling, flexion deformity thought to be secondary to staying inside and doing increase plank exercises. Brought into office, without signs of trauma or infections, labs normal CBC with diff, ESR 25, CRP 59. Referred for MRI and upper extremity orthopedic consultation



- MRI, right elbow, severe synovitis throughout elbow raising concern for inflammatory polyarthropathy such as RA. Reactive bone marrow edema without fracture. Moderate superimposed osteoarthropathy at the trochlear joint

Case Study (continued)

- Increased Methotrexate 20 mg po q week
- Patient underwent right elbow tenosynovectomy 7/2020, increased Methotrexate 20 mg po q week, and discussing on initiating TNF or JAK therapy

References

- *American College of Rheumatology Imaging Library*
- www.ncbi.nlm.nih.gov *Imaging in rheumatology: Reconciling Radiology*
- www.radiopaedia.org *Musculoskeletal Radiology*
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- *Cureus.com*



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Thank you

Questions?