

Arthritis Imaging

John A. Carrino, M.D., M.P.H.

Associate Professor of Radiology
and Orthopaedic Surgery

Johns Hopkins University School of Medicine
Section Chief, Musculoskeletal Radiology
Russell H. Morgan Department of Radiology
and Radiological Science

Introduction

- **Imaging Modalities**
 - Radiography
 - CT imaging
 - Scintigraphy
 - Ultrasound
 - MR imaging

Arthritis - Basics

- Soft tissues
 - *Swelling, calcification*
- Joint narrowing
- Erosions
 - *Marginal, central, periarticular*
- Proliferation
 - *Osteophytes, “whiskering”*
- Deformity
- Distribution

BASIC RADIOGRAPHIC APPROACH TO ARTHRITIS

- soft tissues
- mineralization
- joint
- erosions
- proliferation
- deformity
- distribution
- subchondral bone



ALIGNMENT

BONE

CARTILAGE

DISTRIBUTION

SOFT TISSUES

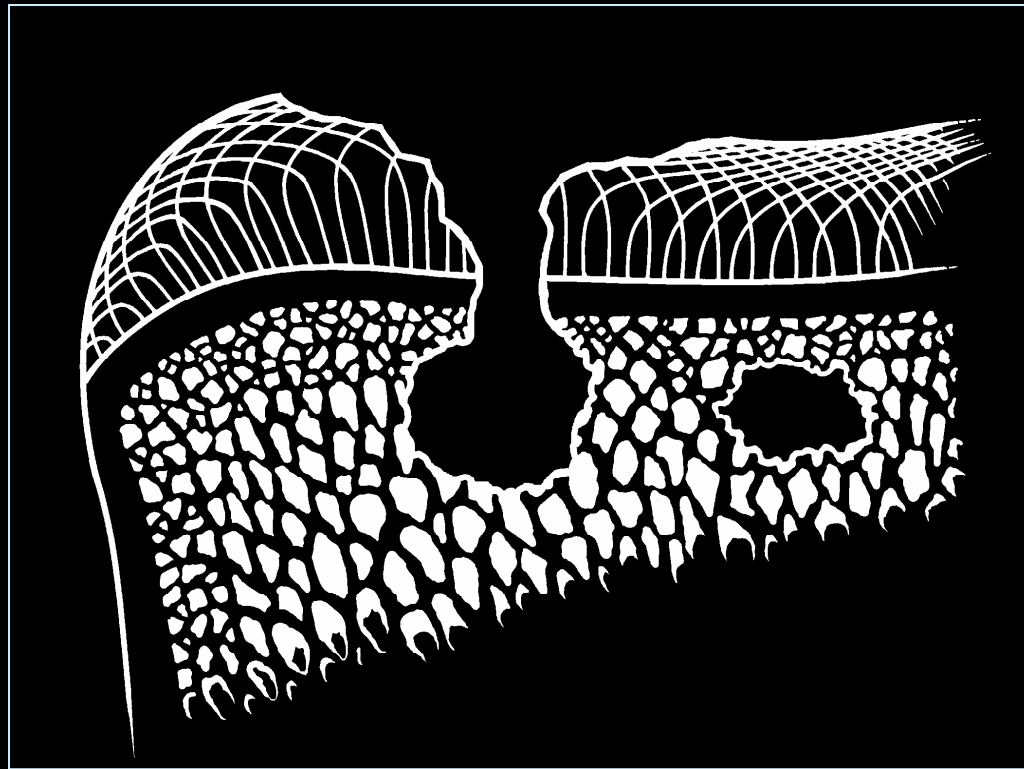
Osteoarthritis

- Hallmarks
 - Osteophytes
 - Joint narrowing
 - Subchondral sclerosis
 - Subchondral cysts

Osteoarthritis

- Primary
 - Primary cartilage degeneration / damage
 - Overuse, old age
- Secondary
 - Instability (e.g., rotator cuff tear)
 - Trauma (e.g., fracture with joint deformity)
 - Infection / inflammation (e.g., old RA)

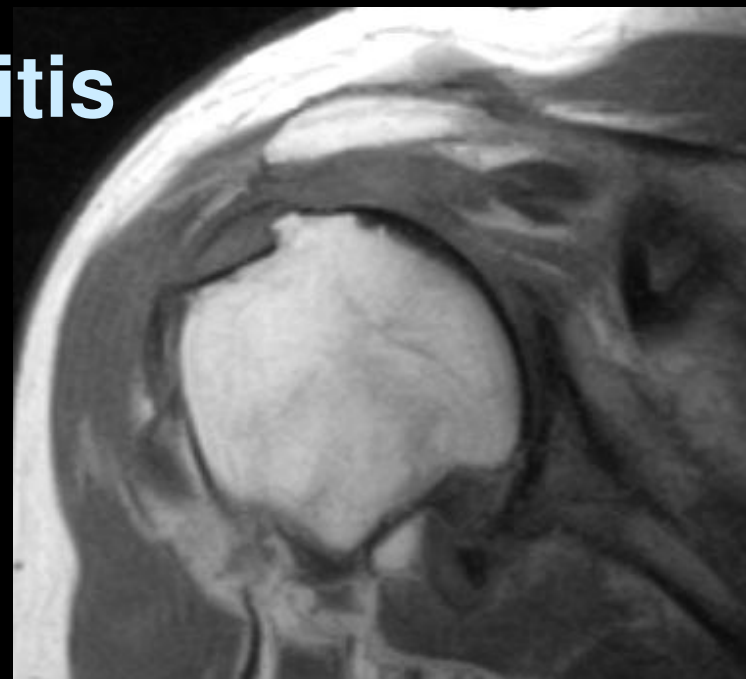
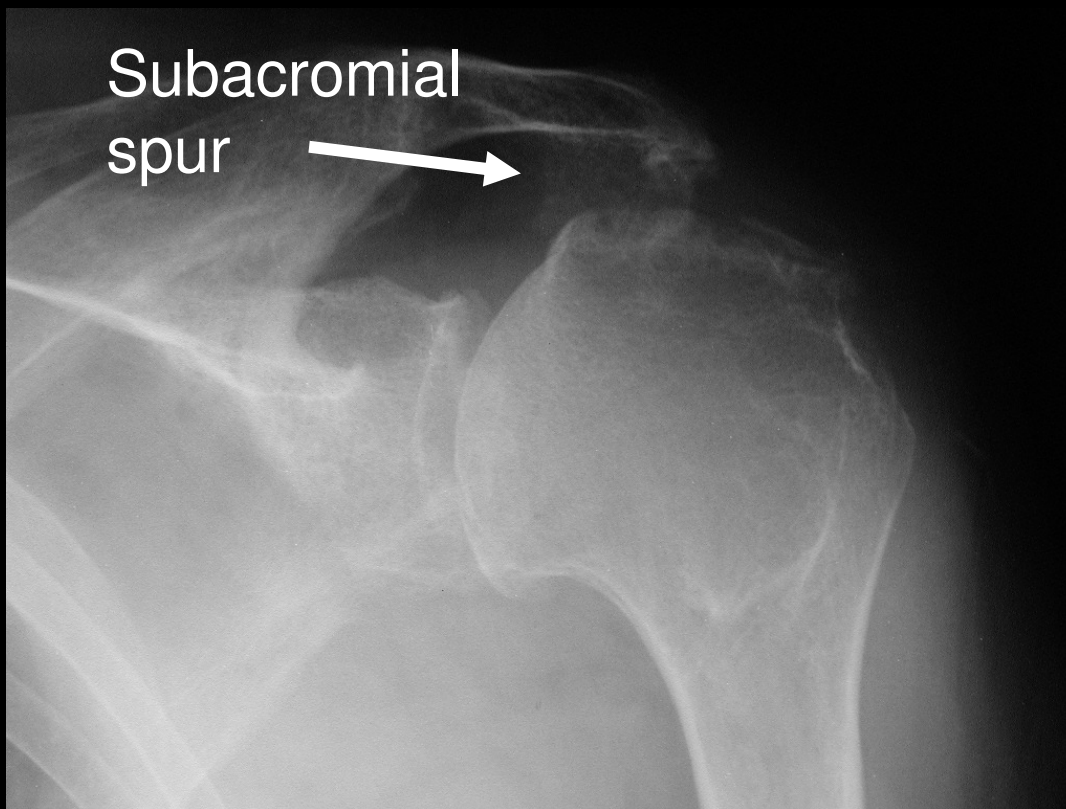
Cartilage Structure / Degeneration



I⁰ OA: DISTRIBUTION

- bilateral symmetric
- weight-bearing joints
 - spine
 - hips
 - knees
 - feet
- hands: dominant UE more severe

Glenohumeral Osteoarthritis -Rotator Cuff Arthropathy



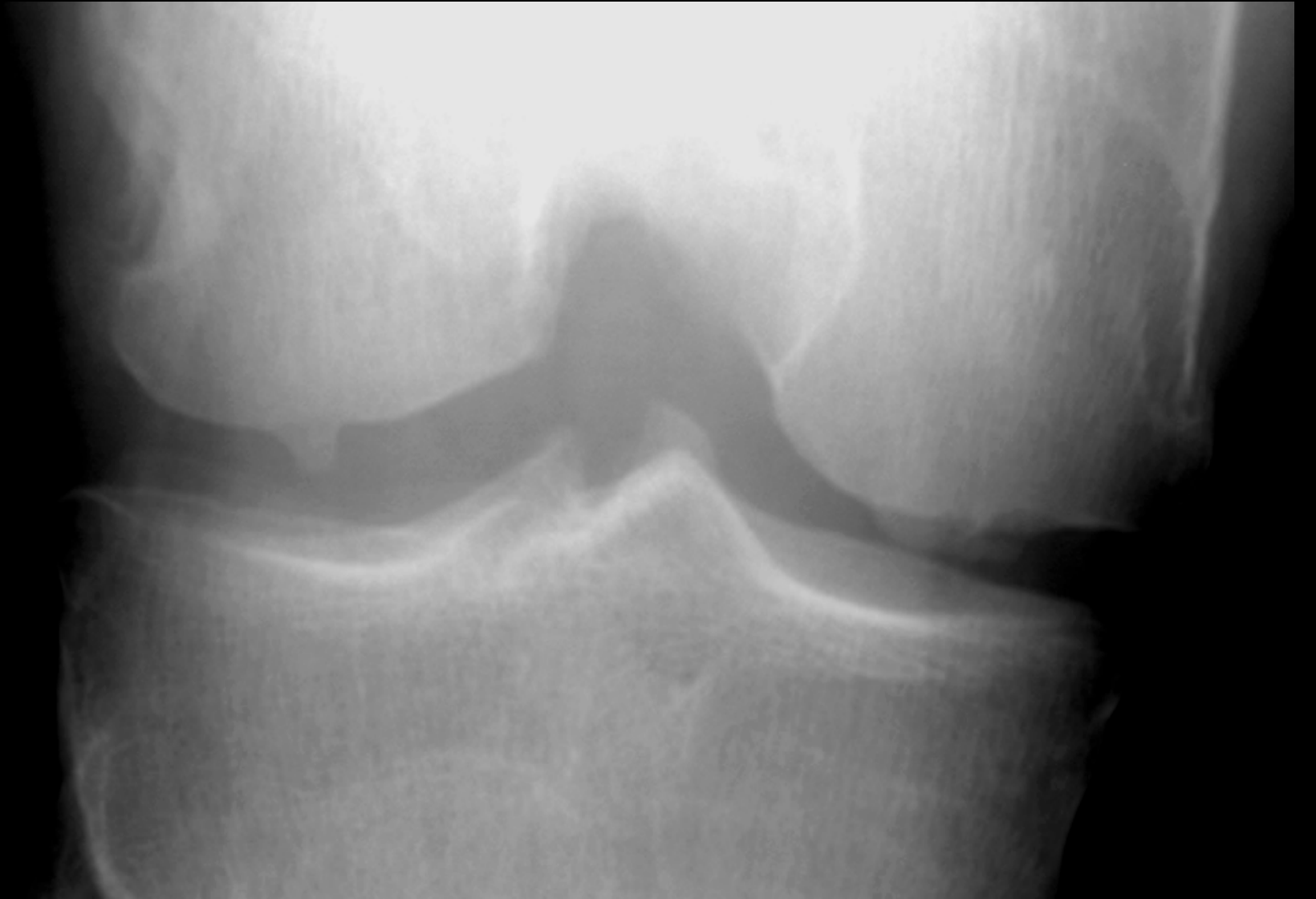
Osteoarthritis - Elbow



Osteoarthritis

- Hand/wrist
 - Classic distribution, Primary:
 - STT, 1st CMC (base of thumb)
 - 1st MCP
 - PIPs, DIPs
 - Secondary
 - Intercarpal, related to ligament tear, instability
 - SLAC, ulnar abutment

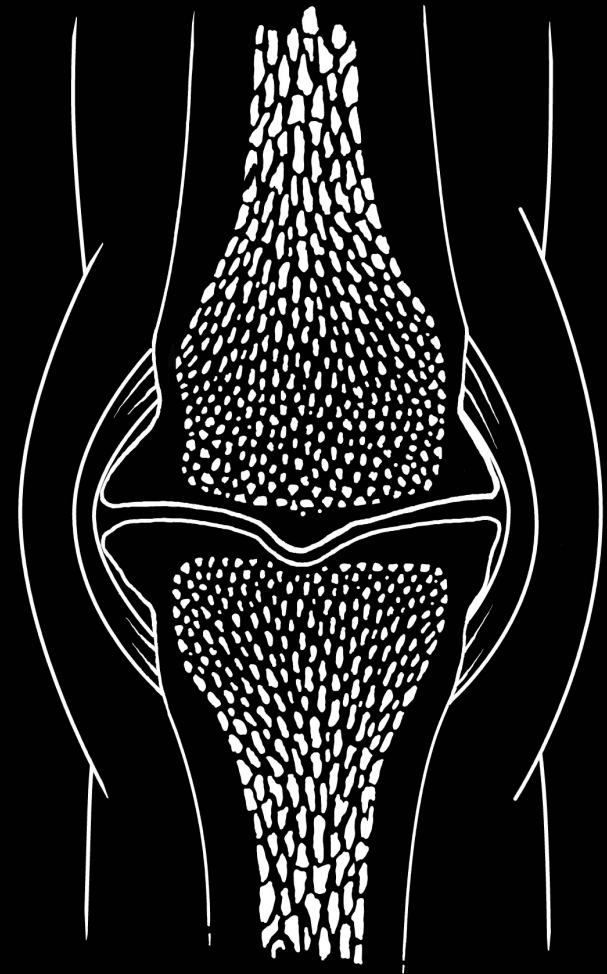


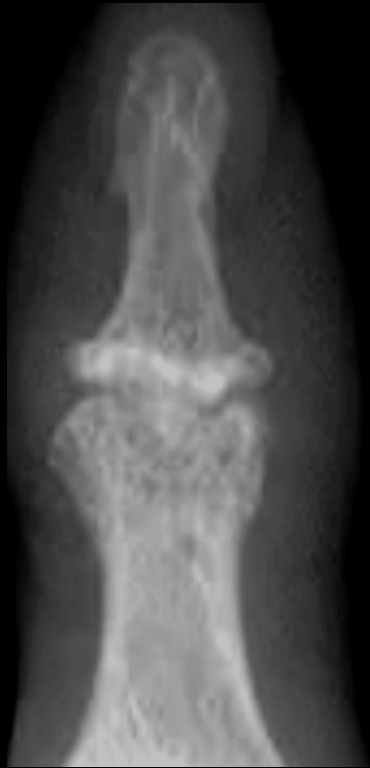




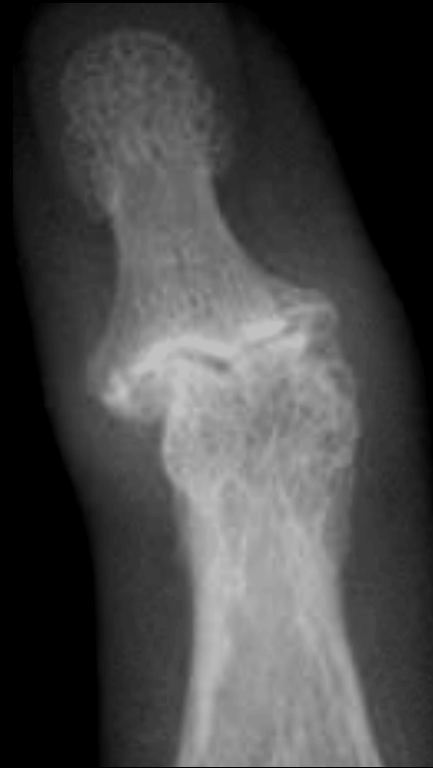
EROSIVE OA (EOA)

- subset of OA patients
 - intermittent soft tissue swelling (DIP > PIP)
 - elderly female
- characteristic radiographic appearance
 - marked joint narrowing
 - central erosions = 'seagull' pattern
 - later stages => ankylosis

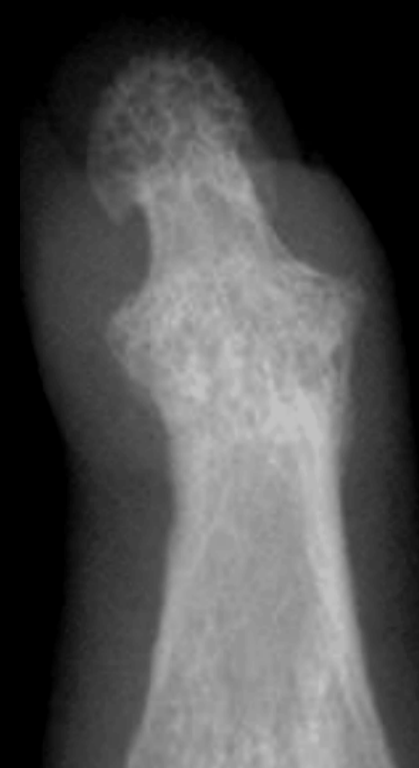




early



mid

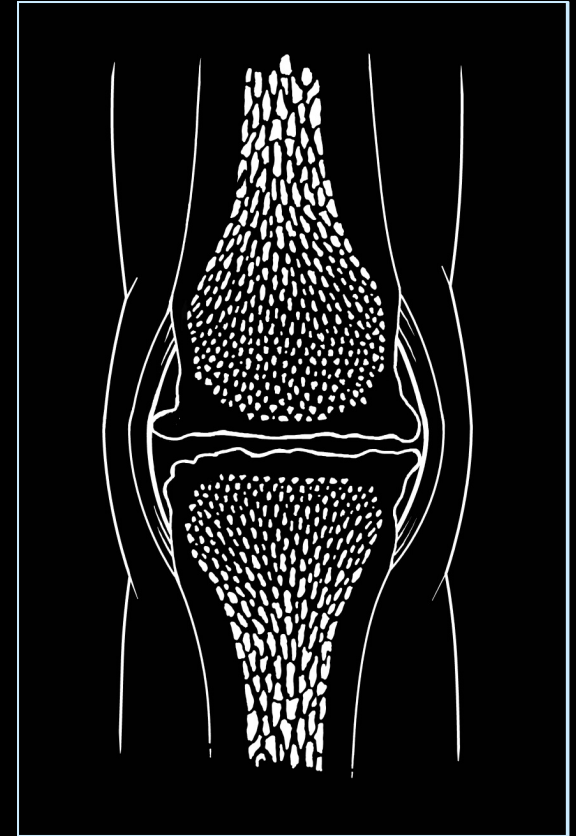


late

EROSIVE OA (EOA)

Rheumatoid Arthritis

- Usu symmetric
- Distribution:
 - Carpus, MCPs, PIPs, shoulder, elbow
- Early:
 - Effusion (digit- fusiform STS)
 - Marginal erosions
 - Juxtaarticular osteopenia
- Late:
 - Joint narrowing, secondary OA, cysts



Rheumatoid Arthritis - Erosions



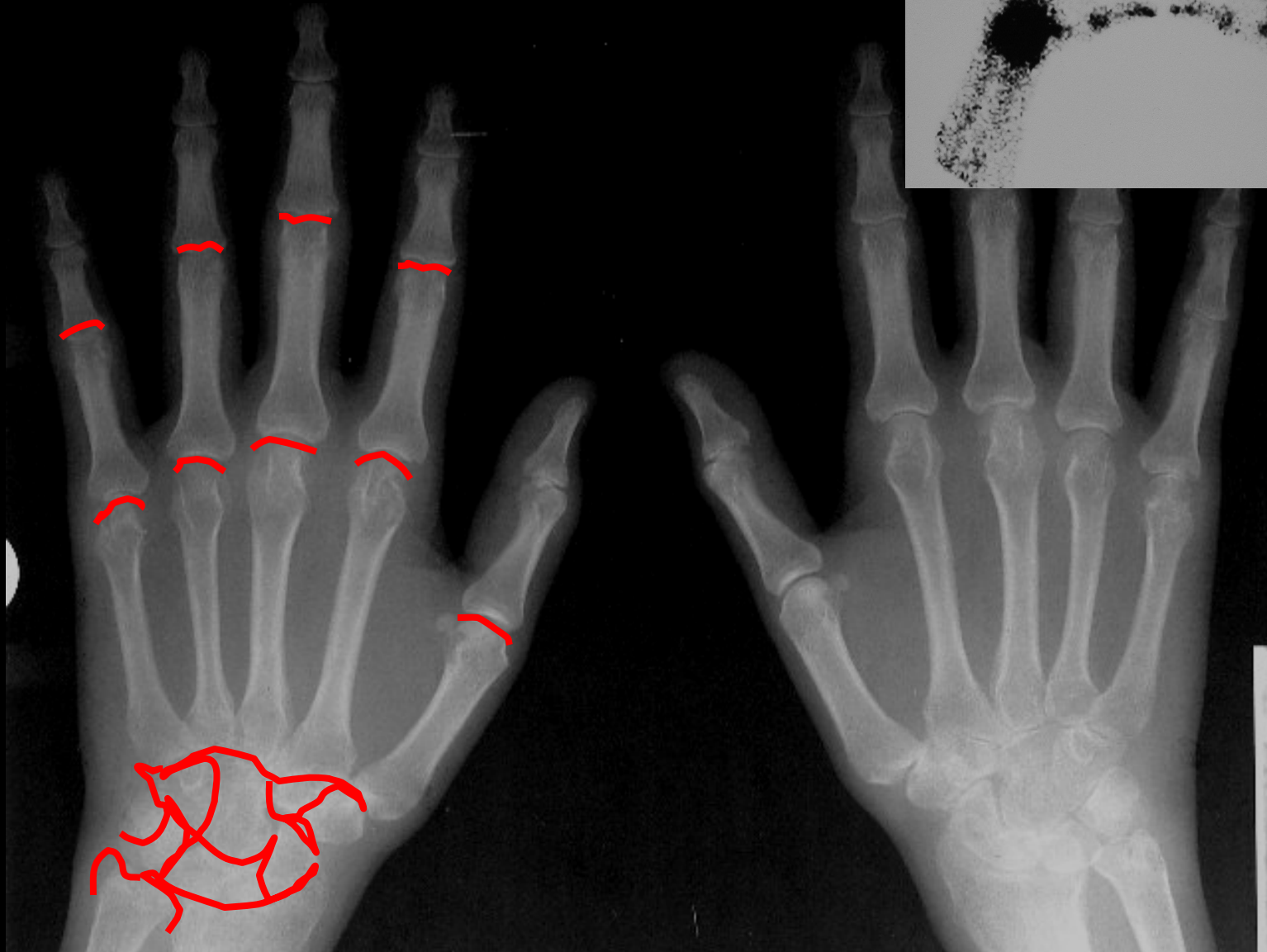
Early



Late

Oblique view: for early erosions at MCPs

RA - distribution



RA: MALALIGNMENT



Metacarpal deviation
“Windswept Hand”

Ulnar translocation
Carpal collapse
DISI, VISI, SLAC

OSTEO

Rheumatoid Arthritis - MRI



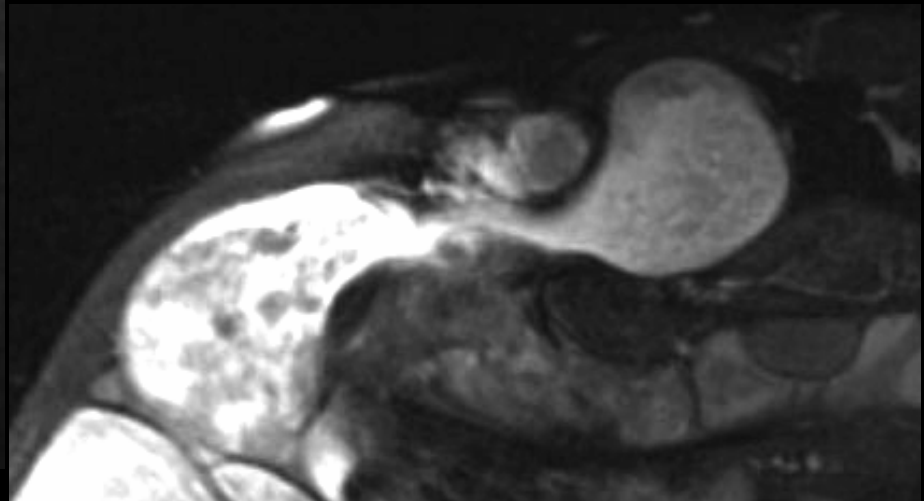
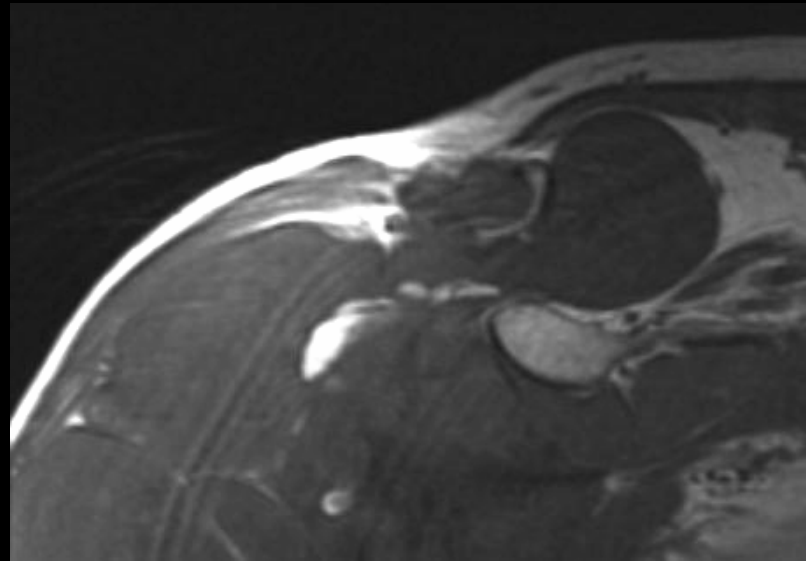
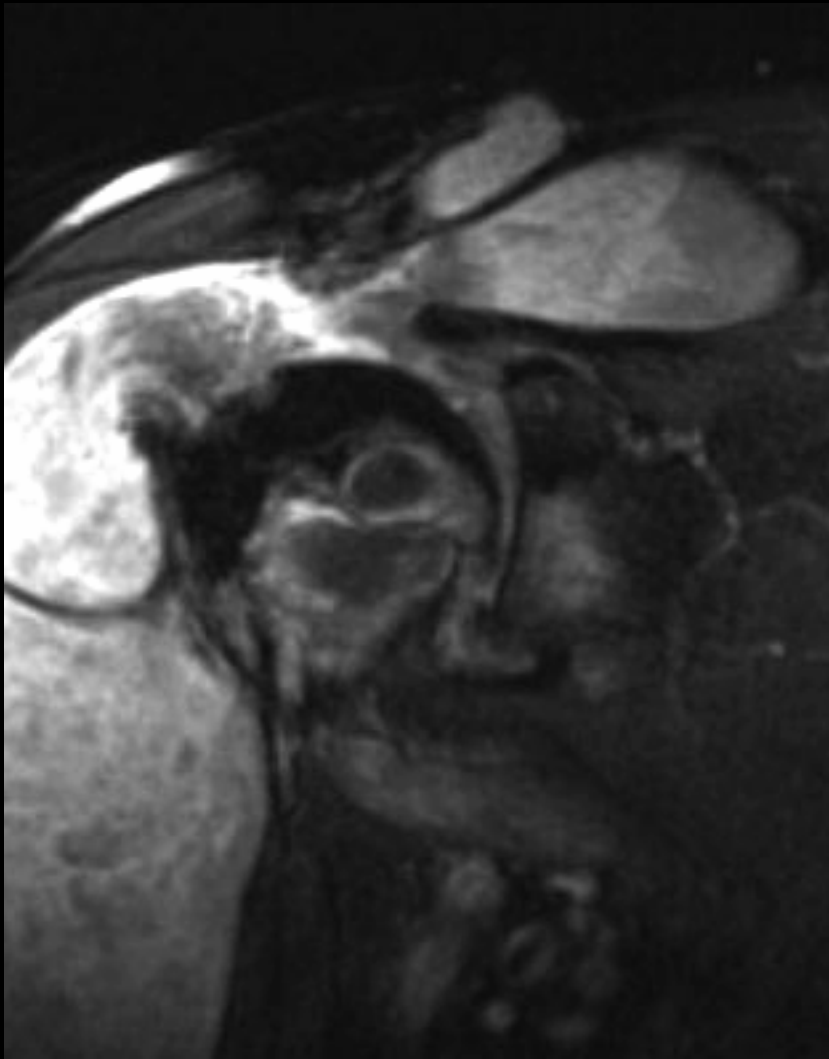
Rheumatoid Arthritis

- MRI – potential uses
 - Track response to drug therapy
 - Objectively test efficacy of new drugs
 - Joint effusions
 - Synovial proliferation
 - Early erosions, bone marrow edema
 - Ligament tears

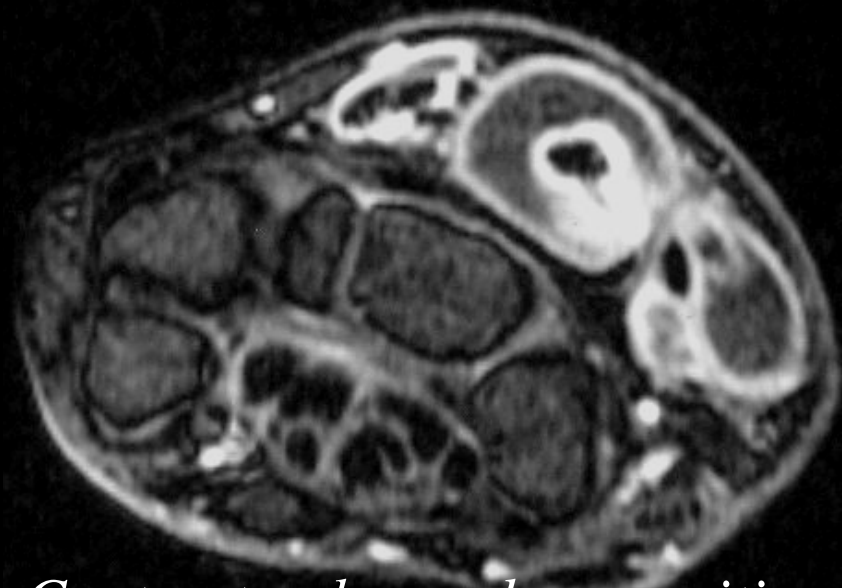
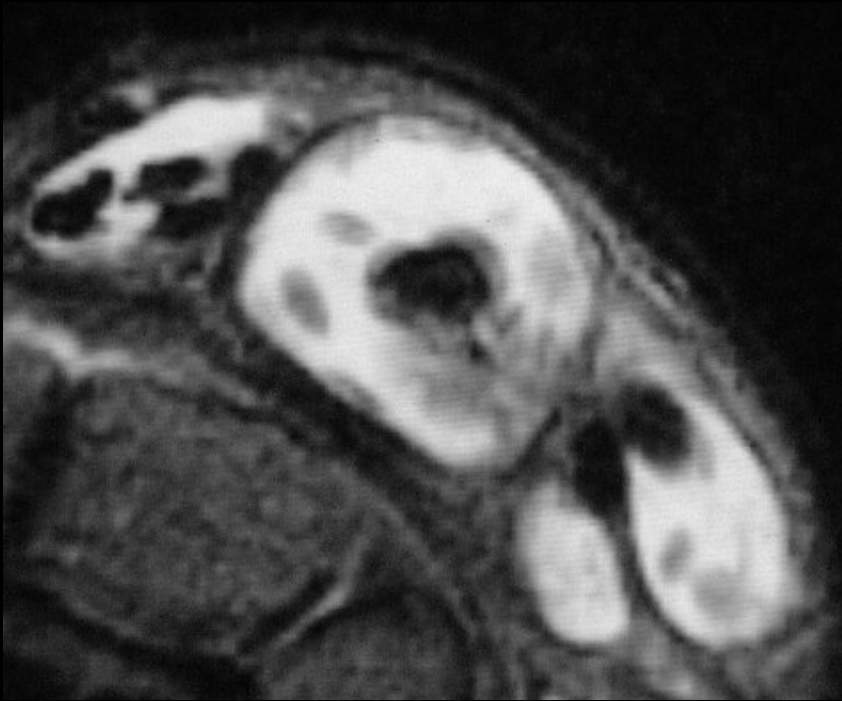


Contrast-enhanced MRI

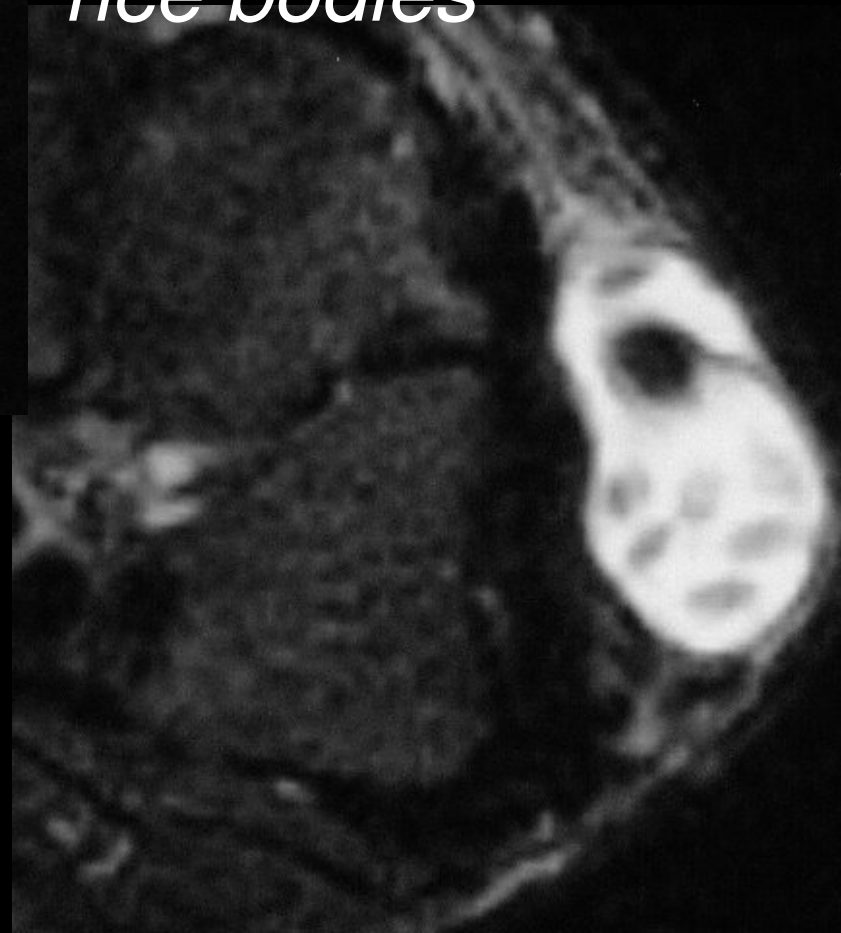
Rheumatoid Arthritis - Shoulder



Rheumatoid Arthritis
of the Wrist
*Tenosynovitis with
rice bodies*

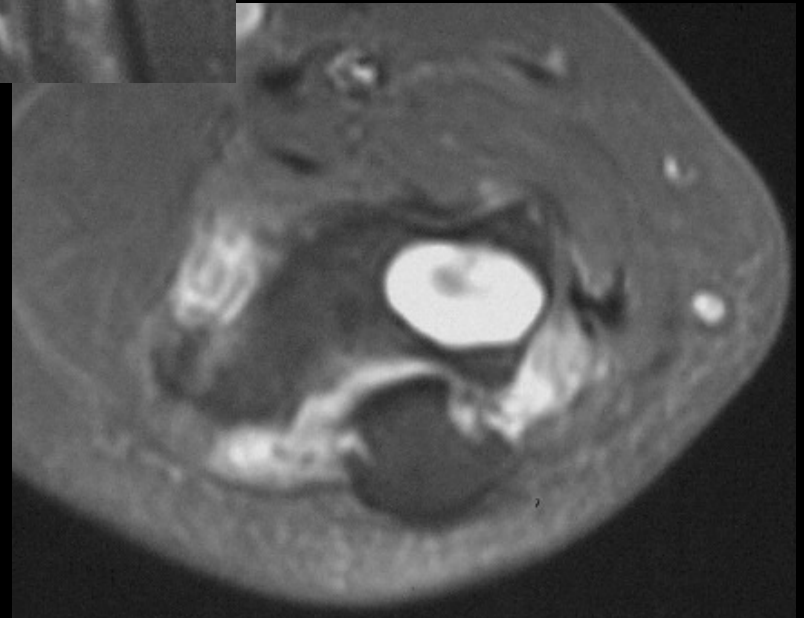


Contrast-enhanced - synovitis



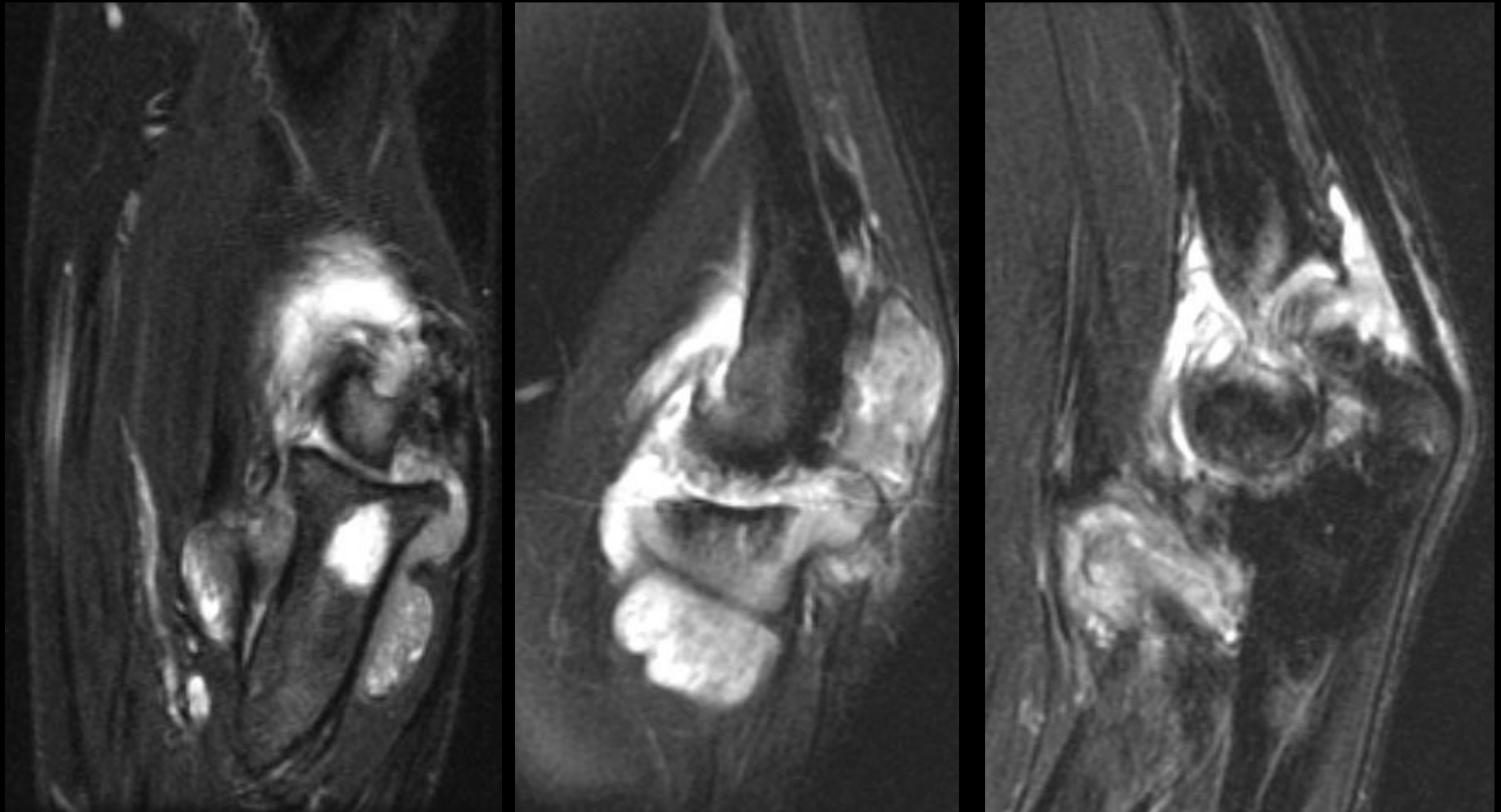


**Erosions
Effusion**



Rheumatoid Arthritis

Synovitis – “dirty fluid” on T2



SCLERODERMA

- SYSTEMIC SCLEROSIS (PSS)
- ST atrophy & calcifications
- acroosteolysis (pressure erosions)
- true arthritis occurs in 50% (DIP & PIP)
 - similar to RA, erosive
 - overlap disorder or MCTD
- CREST = limited form of scleroderma

CREST

Calcinosis

Raynauds

Esophageal dysmotility

Sclerodactyly

Telangiectasias



SYSTEMIC LUPUS ERYTHEMATOSUS

- ligamentous laxity & joint deformity (90%)
- Alignment: subluxations without erosions
 - DDX = Jaccoud's arthropathy (4% post RHD)
- Bone & Cartilage: I⁰ unaffected
- Distribution: similar to RA
 - MCPs bilateral symmetric

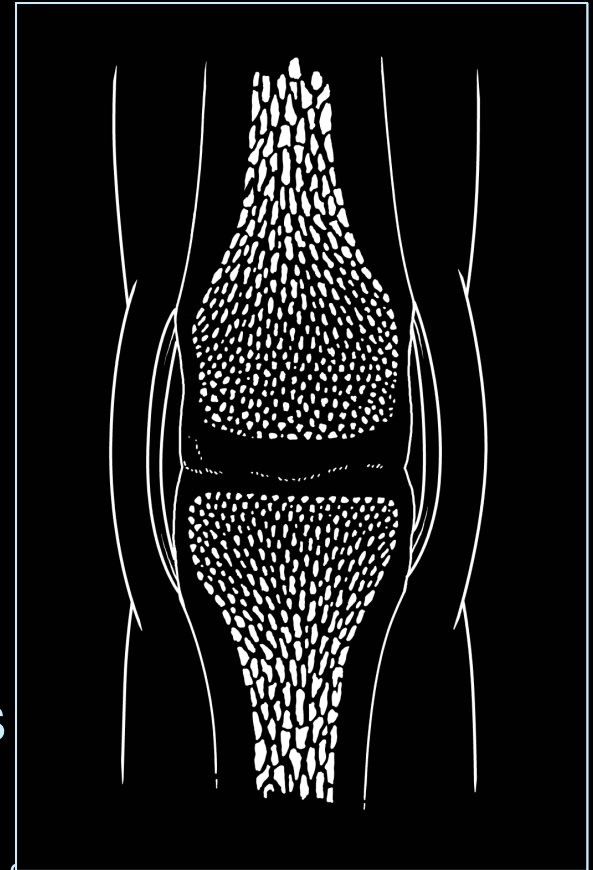
SLE

**SUBLUXATIONS
WITHOUT
EROSIONS**



Seronegative Spondyloarthropathies

- Psoriatic Arthritis
 - Diffuse soft tissue swelling – Digit
 - “sausage digit”
 - Marginal erosions
 - “whiskering” – fluffy phyttes/periostitis
 - Ray distribution
 - Occasional destruction/telescoping - “mutilans” or fusion
- Reiter’s Disease – (esp feet, SI)
- Ankylosing Spondylitis (esp spine, SI)

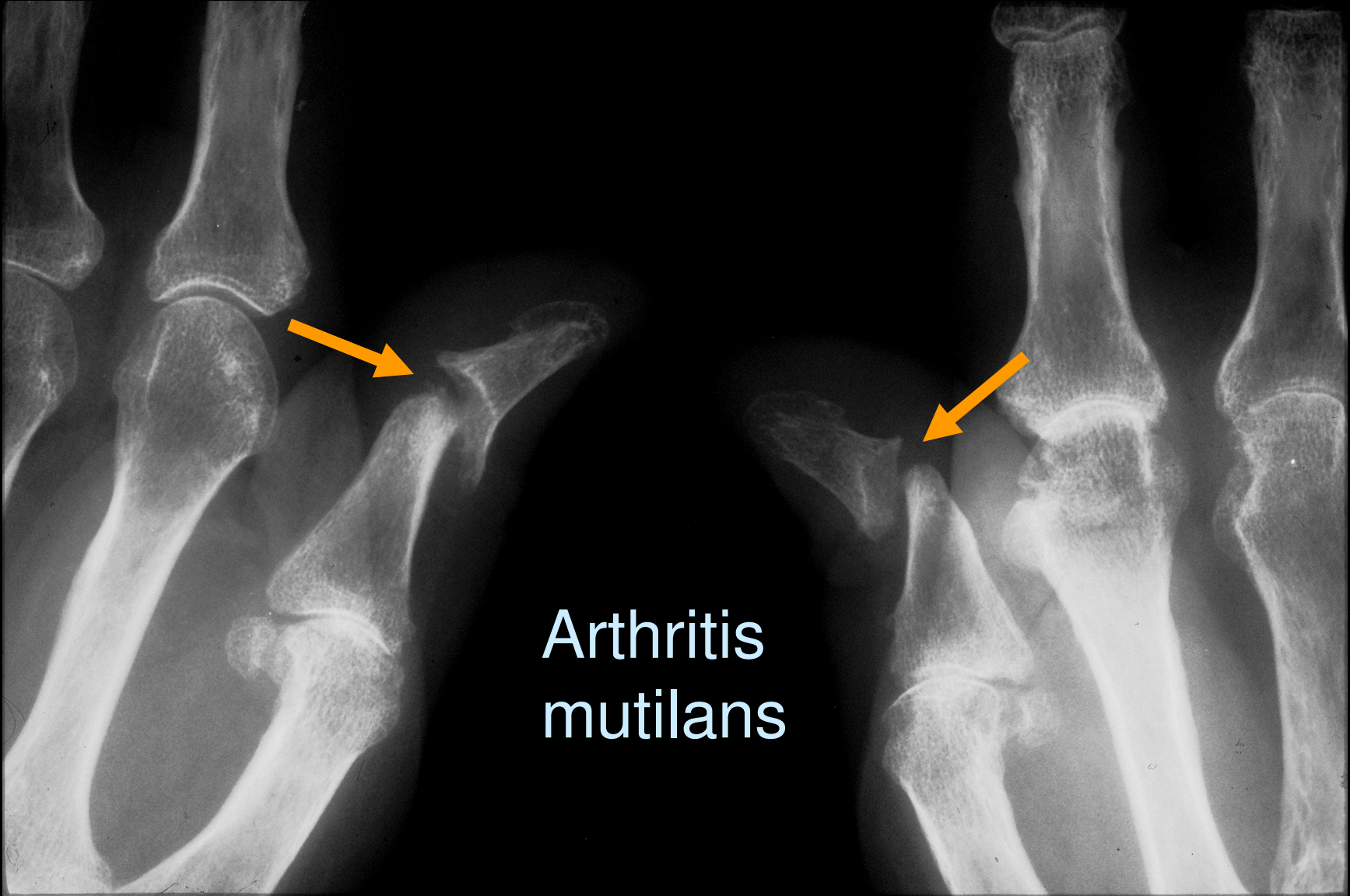


PSORIATIC ARTHRITIS

- 10-20% psoriasis patients => arthritis
 - 90% skin changes first
 - 10% arthritis first
- correlation
 - nail changes & DIP involvement
 - skin lesion & joint disease severity
- hand DZ predominates

Proliferative
erosions
“whiskering”



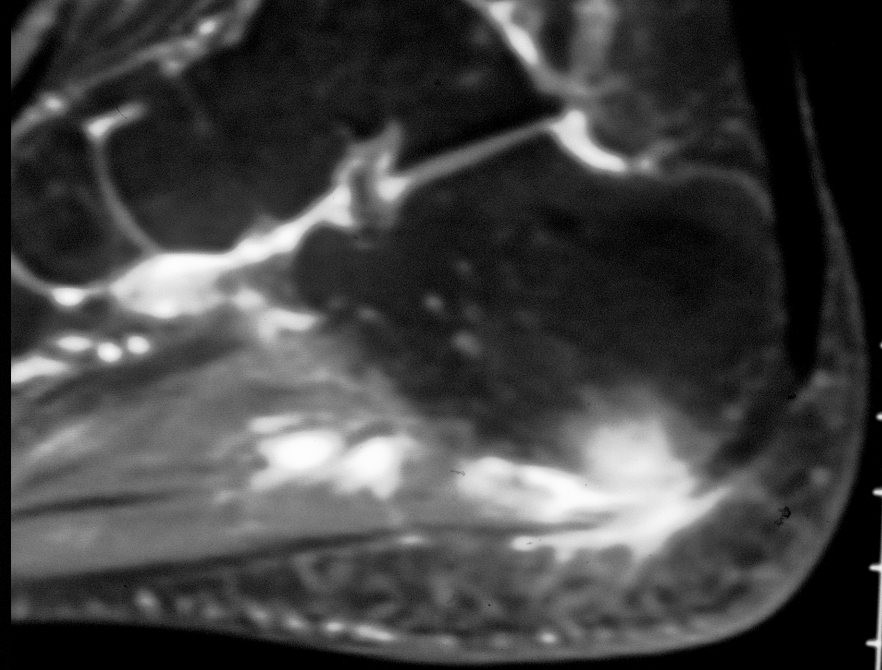
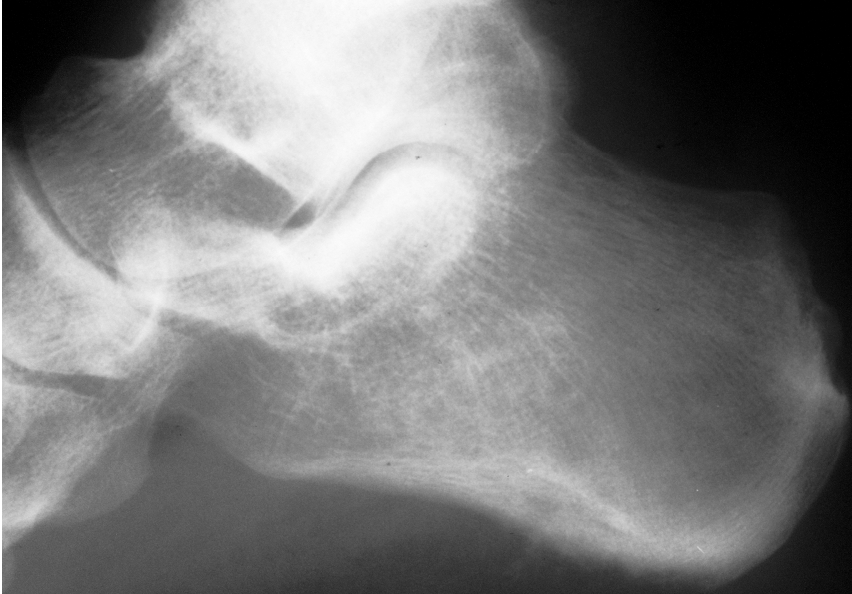


Arthritis
mutilans

REITER SYNDROME

- classic triad
 - arthritis, conjunctivitis, urethritis (cervicitis)
- males >> females
- “reactive arthritis” post GU/GI infection
 - nongonococcal urethritis
 - bacillary dysentery (*Shigella*, *Yersinia*, *Salmonella*)
- foot DZ predominates





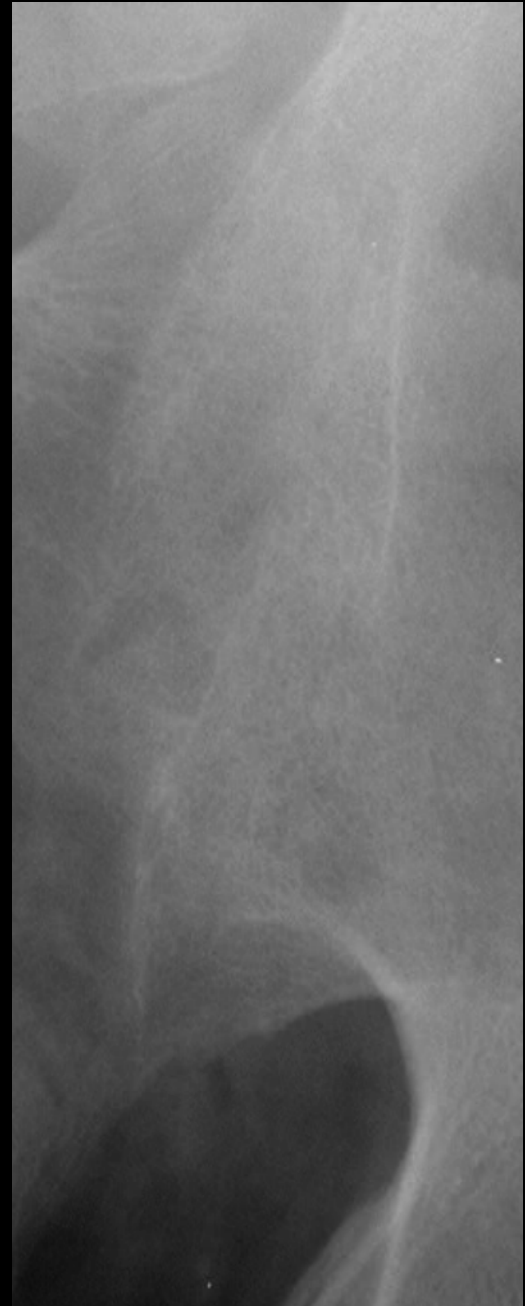
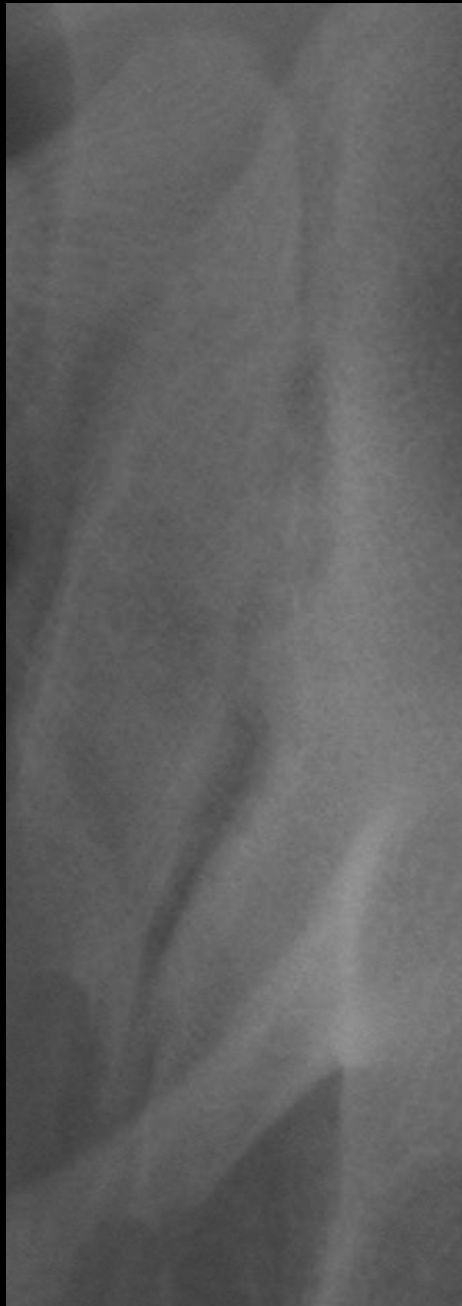
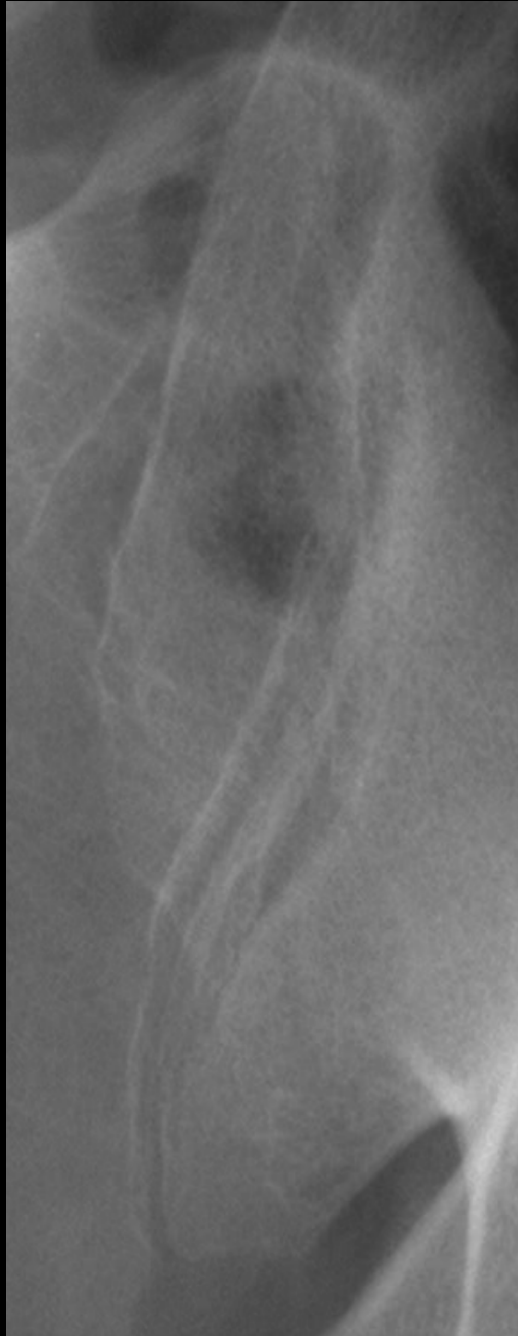
P
1
1
3

ANKYLOSING SPONDYLITIS

- males >> females
- young onset: 20 y.o.
- Distribution
 - axial skeleton
 - proximal large joints (hip > shoulder)
- CX: FX with pseudarthrosis formation

ANKYLOSING SPONDYLITIS

- sacroiliitis: bilateral & symmetrical
 - erosions => sclerosis => fusion
- vertebral body “squaring”: early osteitis
- “shining corners” (sclerosis)
- syndesmophytes (contiguous T-L)
- train track & saber calcification
- “bamboo spine”





essed image:
1





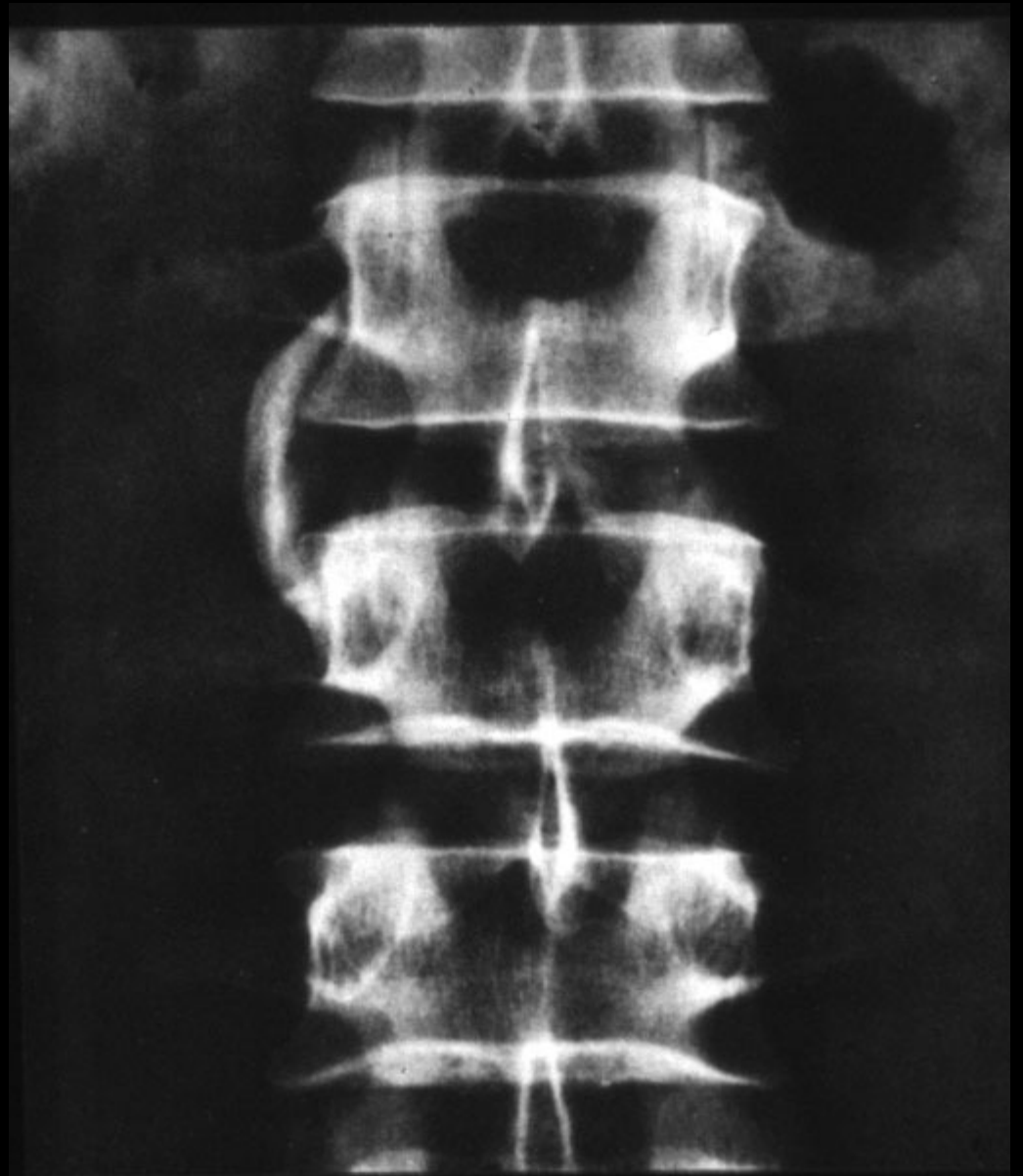
SPINE PHYTTES



SPINE PHYTTES



**PARAVERTEBRAL
CALCIFICATION
AND/OR
OSSIFICATION**



SAPHO

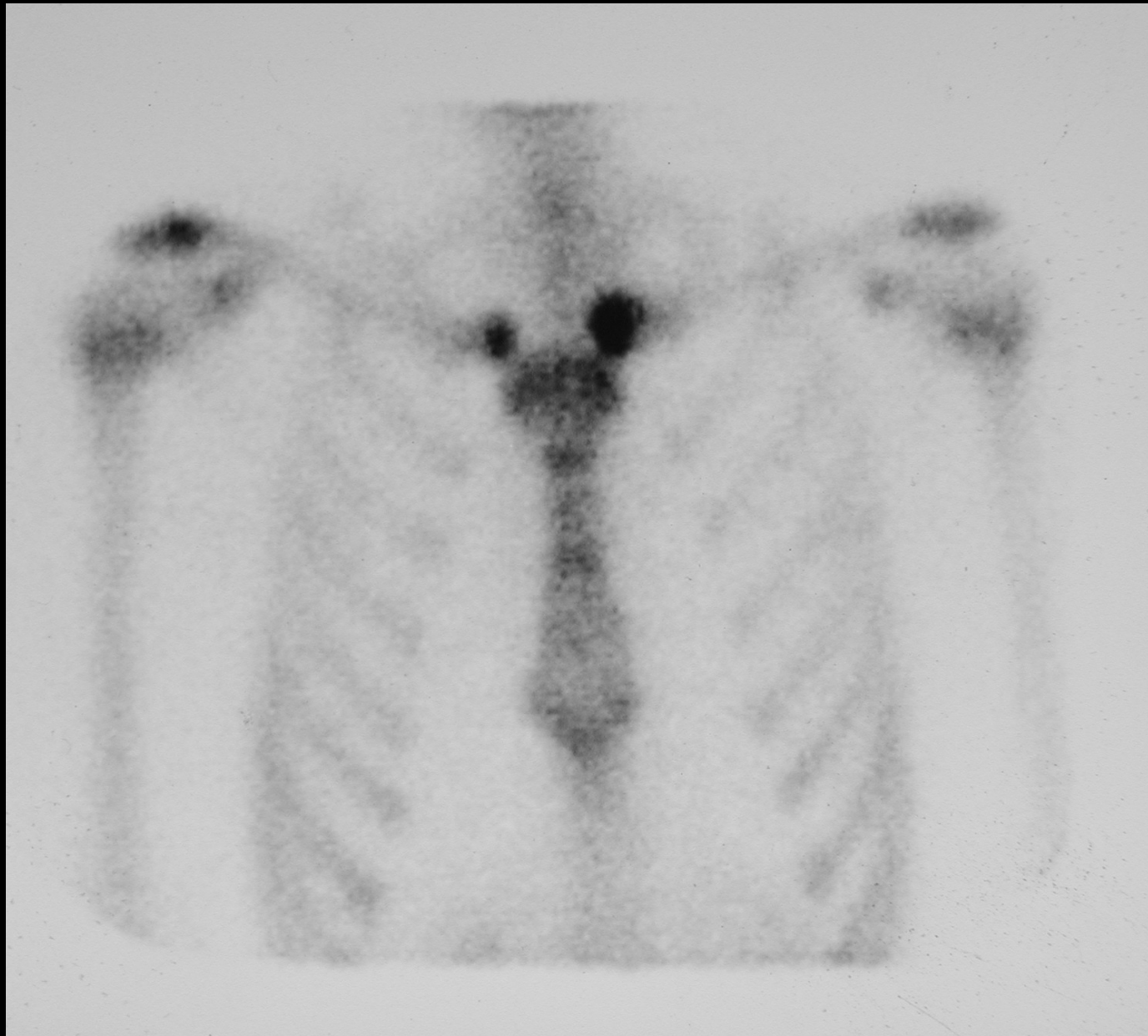
SYNOVITIS

ACNE

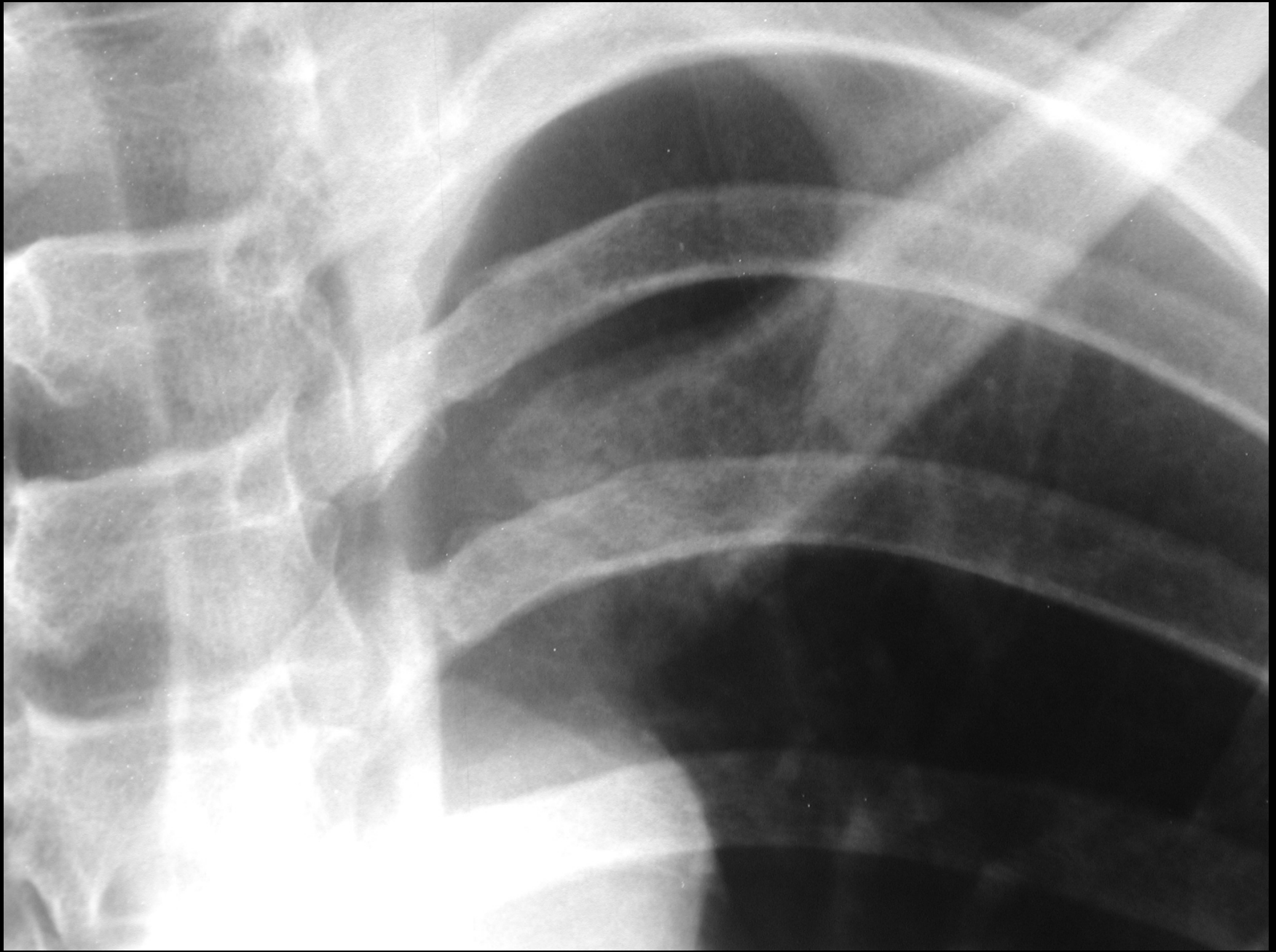
PUSTOLOSIS

HYPEROSTOSIS

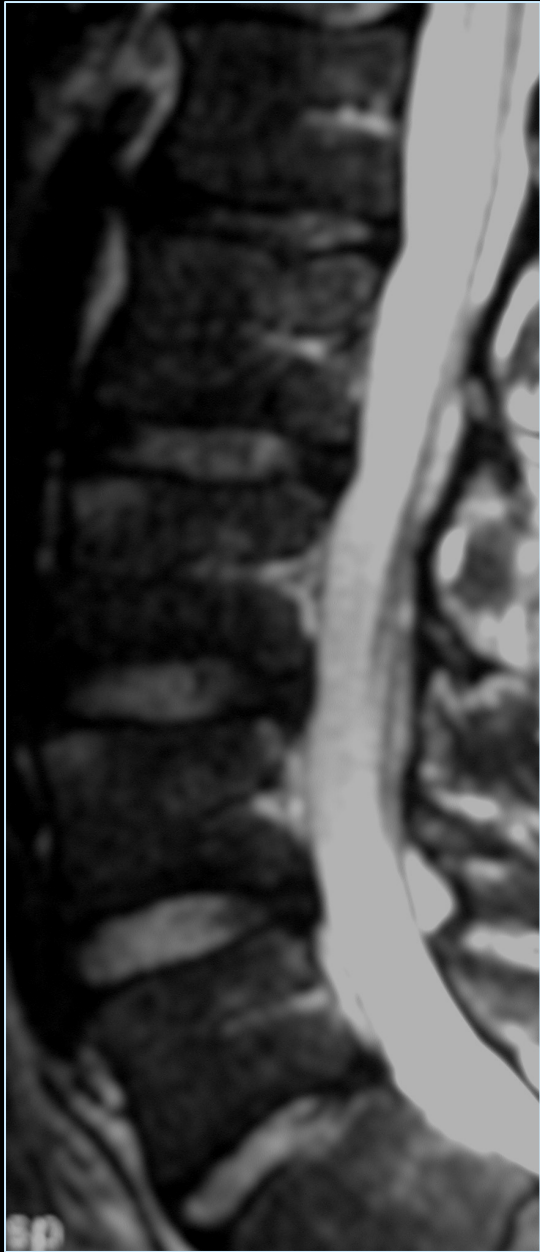
OSTEITIS



courtesy of Rob Epstein



courtesy of Rob Epstein



T2



T2



GAD

courtesy of Rob Epstein



courtesy of Rob Epstein

ENTEROPATHIC ARTHROPATHIES

- Arthritis similar to AS or Reiter's
 - peripheral joints respond
 - spine disease progresses
- Ulcerative colitis (10% => arthritis)
- Crohn's DZ
- Whipple's DZ
- Infectious (*Salmonella, Shigella, Yersinia enterocolitica*)

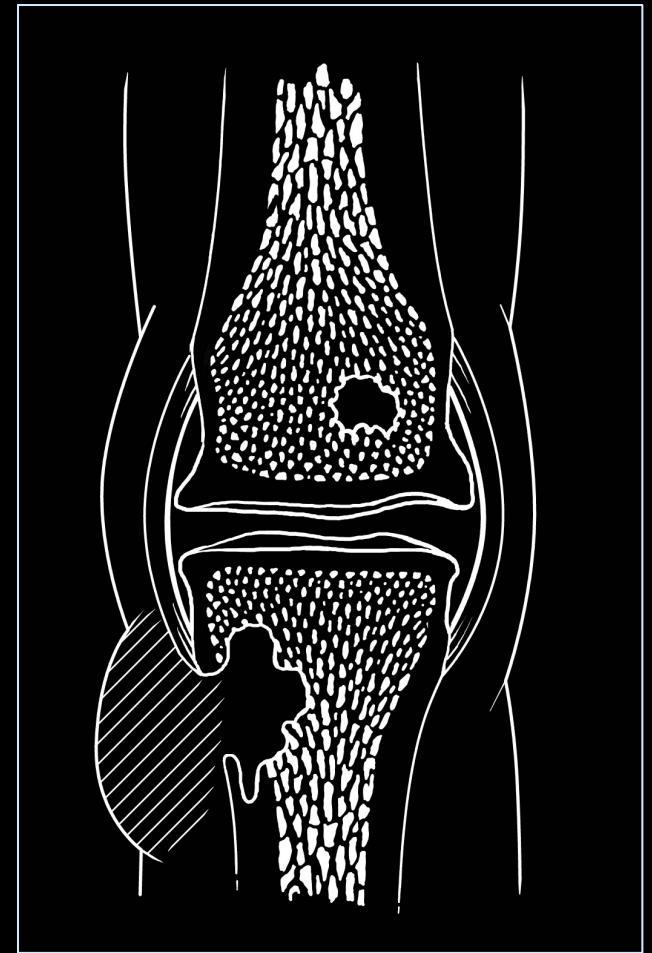
Crystal – Associated Disease

- Gout
- CPPD arthropathy
- HADD

Gout

Scattered distribution in hand, wrist, elbow

- Intraarticular deposition
 - Early: marginal/central erosions
 - Late: OA, cysts
- Tophaceous gout
 - Asymmetric soft tissue swelling (dense but usu not Ca^{++})
 - “rat bite” erosions
- Tendon deposition



GOUT

- monosodium urate monohydrate (MSUM)
- 3 distinct stages
 - 1) asymptomatic (chronic hyperuricemia)
 - 2) acute intermittent gout
 - 3) chronic tophaceous gout
- mixed group of predisposing disorders
- 5th decade; males > females

GOUT: DISTRIBUTION

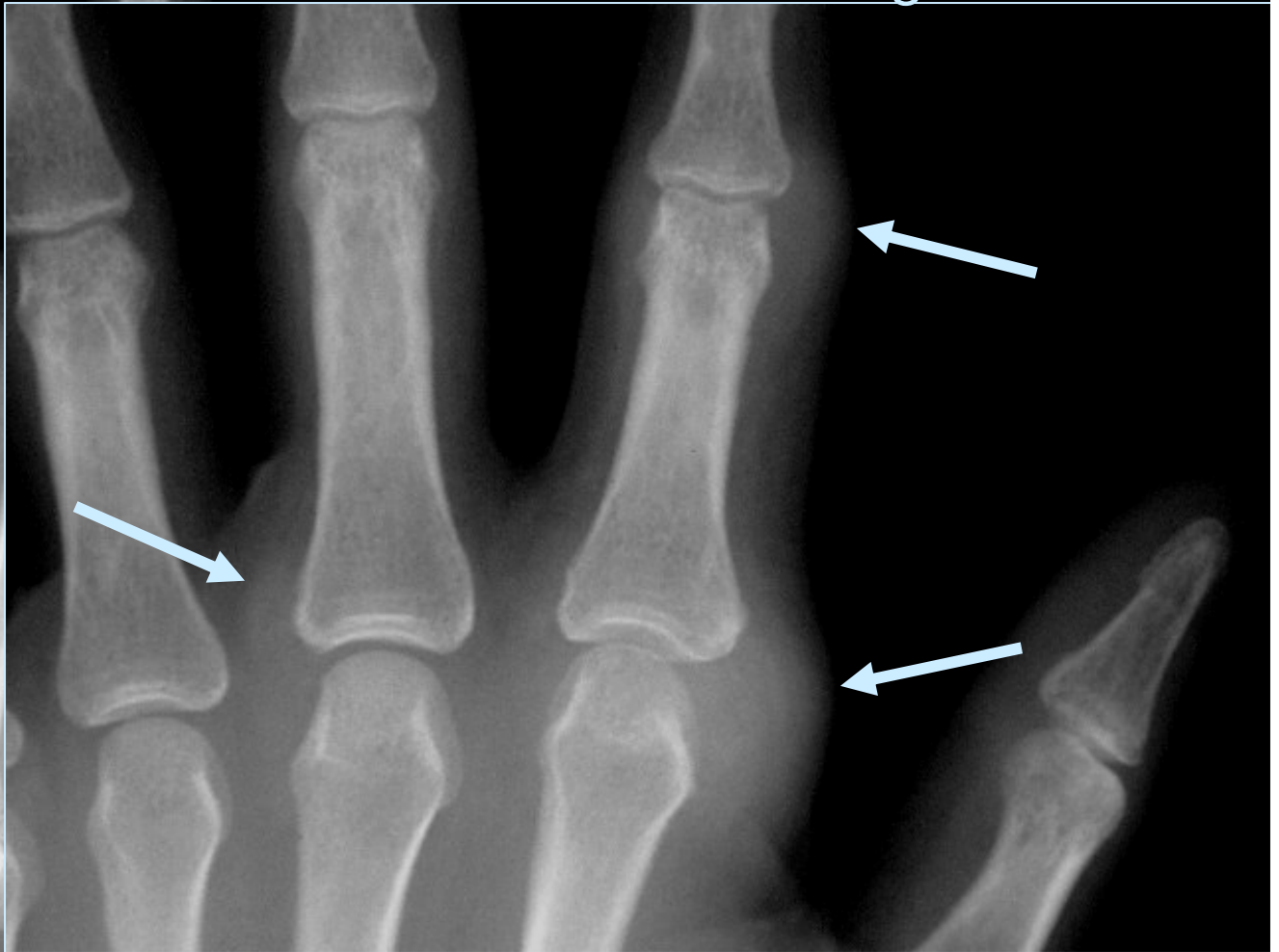
- predilection = distal appendicular skeleton
- asymmetric
- common sites
 - feet: 1st MTP 50%; TMT
 - carpus => 'spotty carpal bones'
 - bursitis: olecranon & pre-patellar
- shoulder, spine, pelvis & hip: uncommon

GOUT: IMAGING

- masses (dense from the MSUM crystal)
 - tophi in & near joints
- erosions
 - juxta-articular: 'overhanging' margin
 - intraosseous: rounded and well circumscribed
- deformity
 - early = ST masses
 - later = enlarging masses, erosions & arthritis

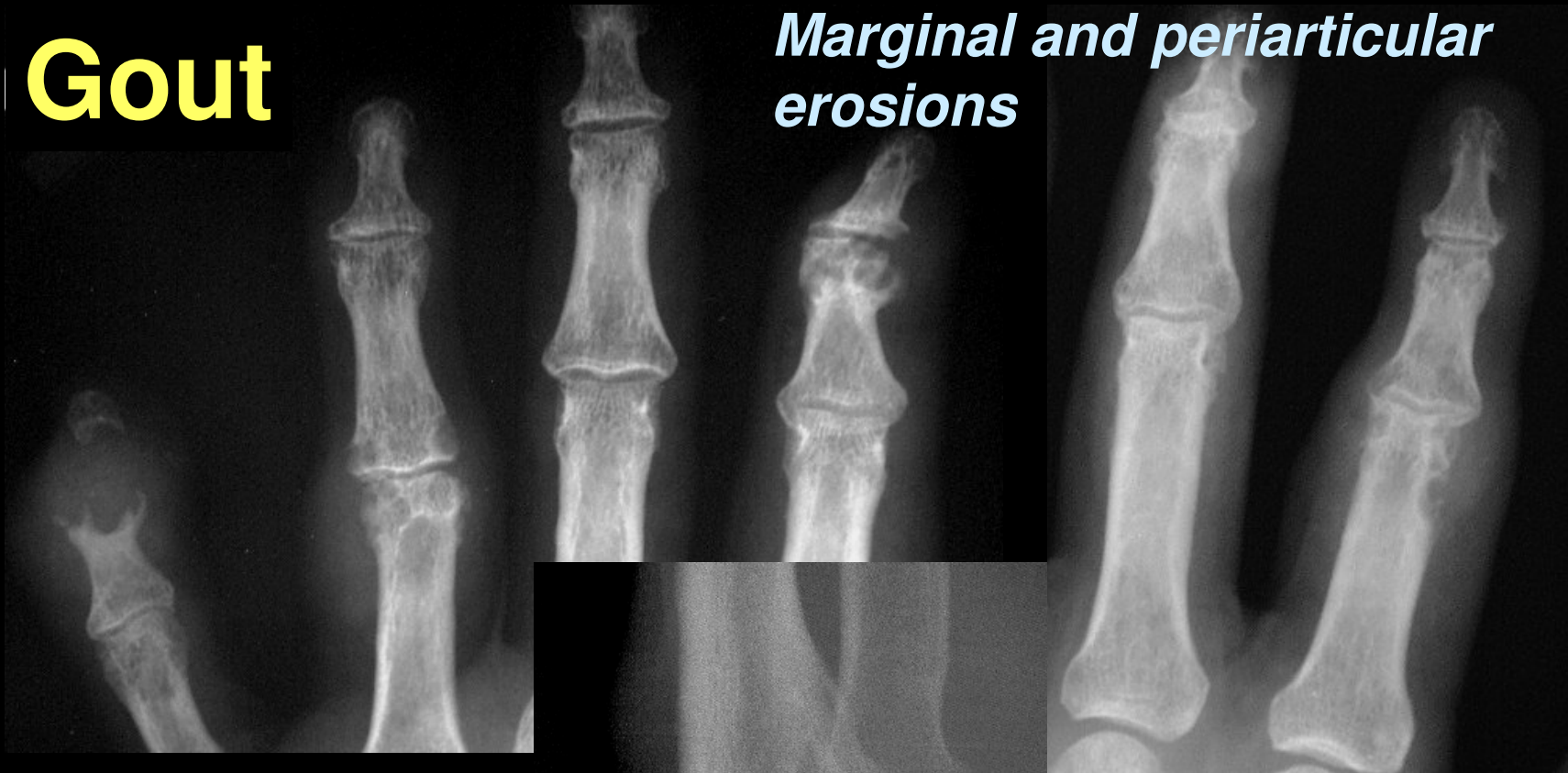
Gout

Asymmetric “lumpy bumpy”
soft tissue swelling



Gout

Marginal and periarticular erosions



Olecranon bursitis





CPPD

- calcium pyrophosphate dihydrate
 - $\text{Ca}_2\text{P}_2\text{O}_7 \times \text{H}_2\text{O}$
- Deposition
 - Cartilage, AKA “chondrocalcinosis”
 - hyaline (articular) or fibrocartilage (e.g., TFCC)
 - Other soft tissue
 - synovial, capsular, ligamentous
 - When seen on Xray, usually incidental
- Pseudogout” AKA, “CPPD arthropathy”
 - acute inflammatory presentation

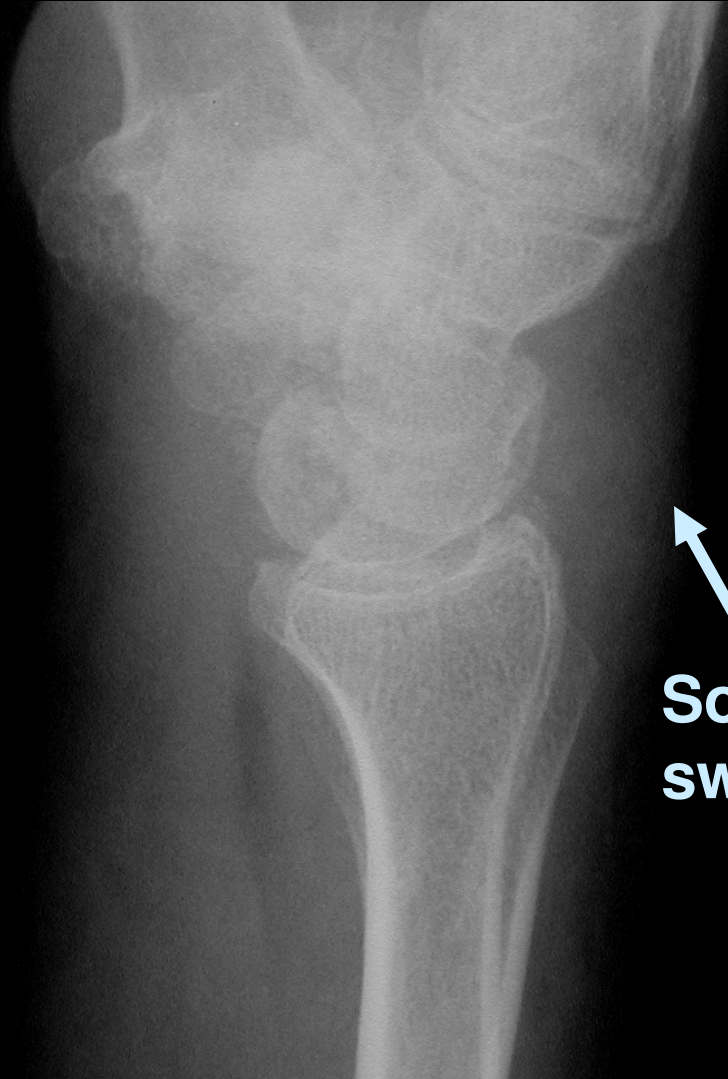
CPPD Arthropathy: Imaging

- Soft tissue swelling / joint effusion
- OA in an atypical distribution
- Subchondral cysts
- Involved joints usually show chondrocalcinosis or soft tissue Ca
- No erosions

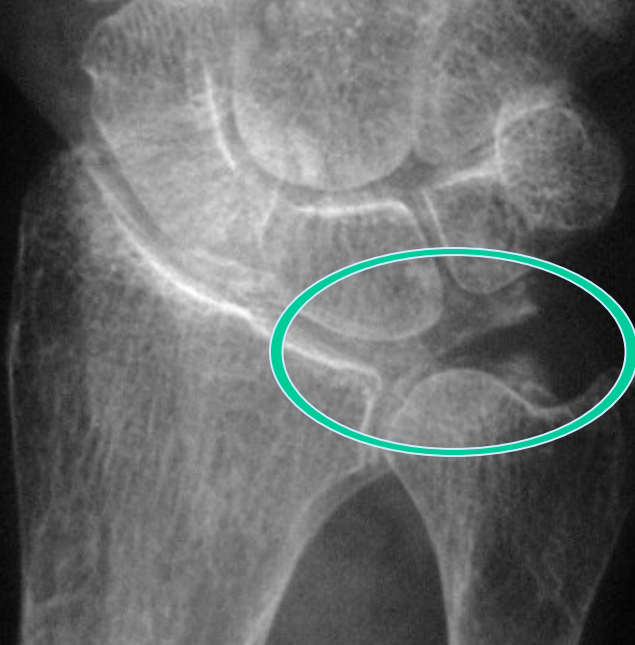
**Asymptomatic
chondrocalcinosis**



CPPD Arthropathy



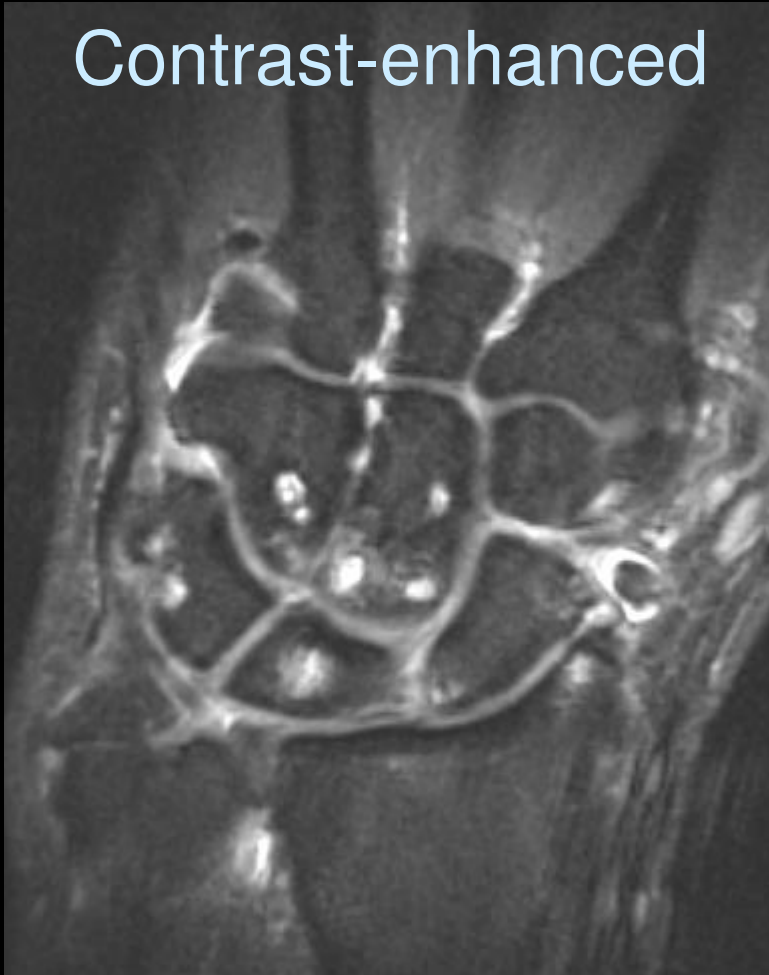
Soft tissue swelling



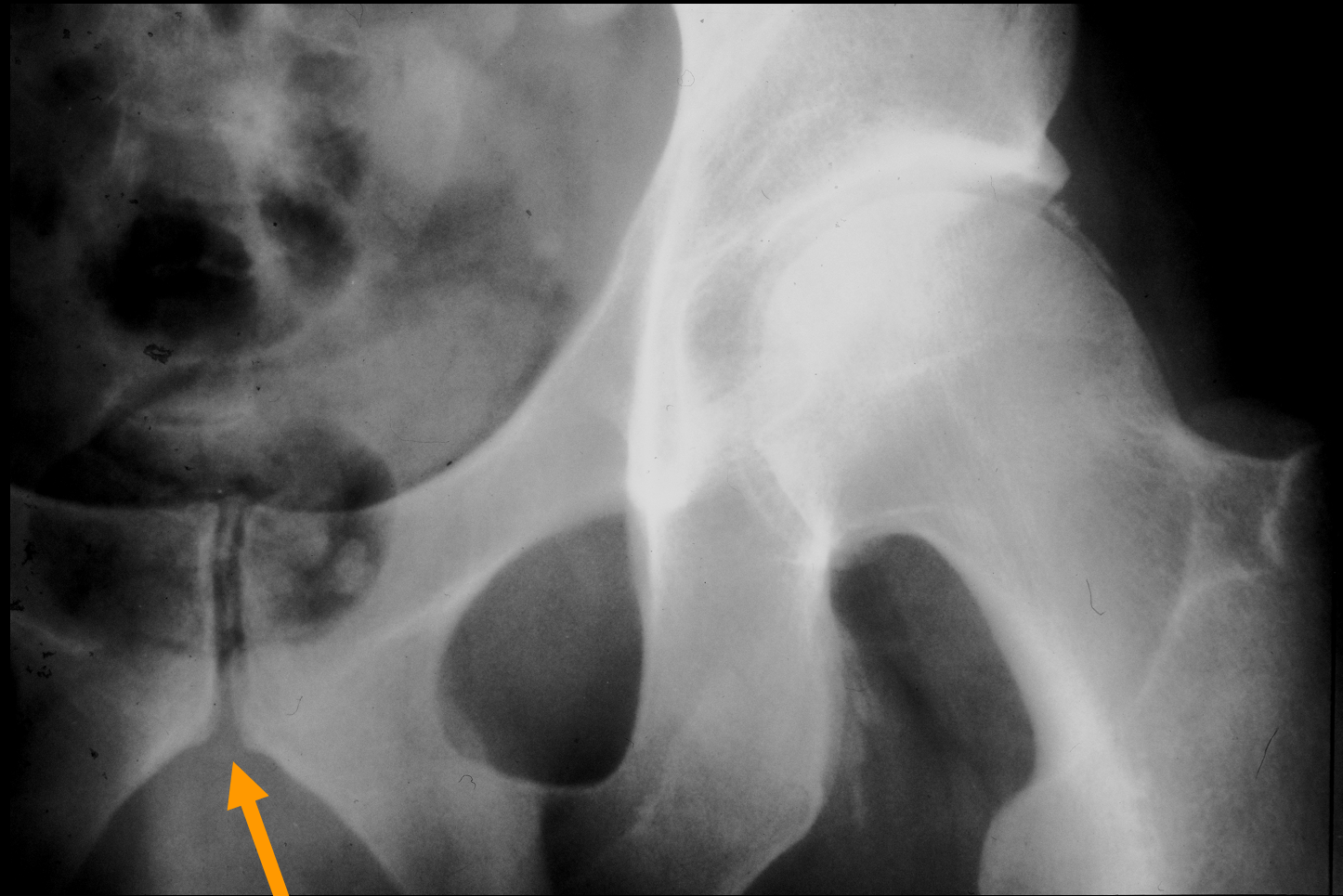
Chondrocalcinosis

CPPD Arthropathy - MRI

Contrast-enhanced



Synovitis, carpal cysts



CHONDROCALCINOSIS

- CPPD arthropathy (pseudogout)
- old age (senescent)
- gout
- osteoarthritis
- amyloidosis
- hyperparathyroidism
- hemochromatosis
- Wilson disease
- hypothyroidism
- hypomagnesemia
- hypophosphatasia

Hydroxyapatite Deposition Disease (HADD)

calcific tendinitis / bursitis

- most common locations
 - shoulder (rotator cuff) > elbow > wrist/hand
 - Usually asymptomatic
 - Burst out of tendon, causes acute inflammation
- atypical locations
 - May be misdiagnosed as infection

Patient presented with “cellulitis”

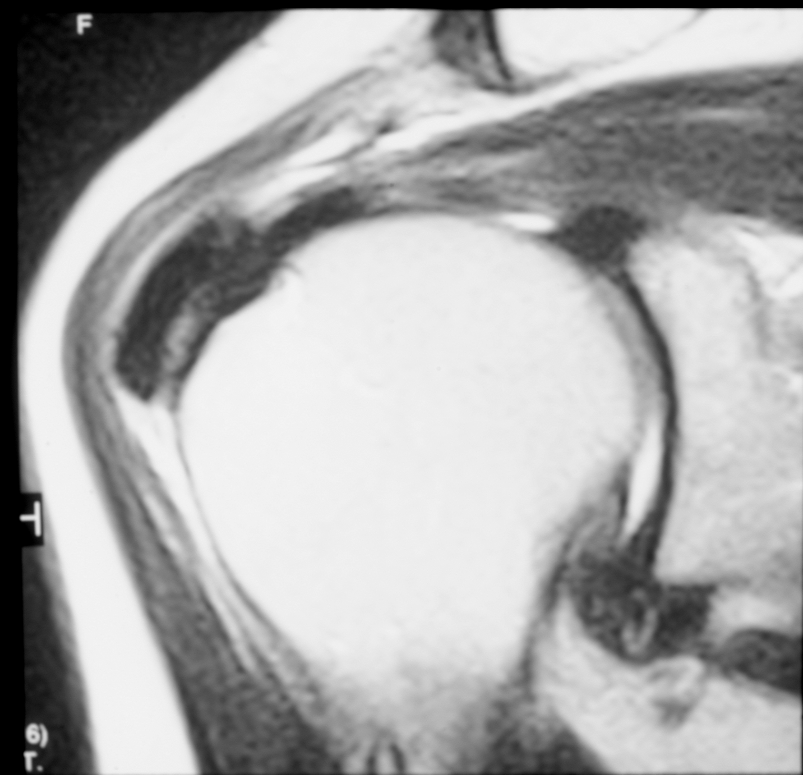
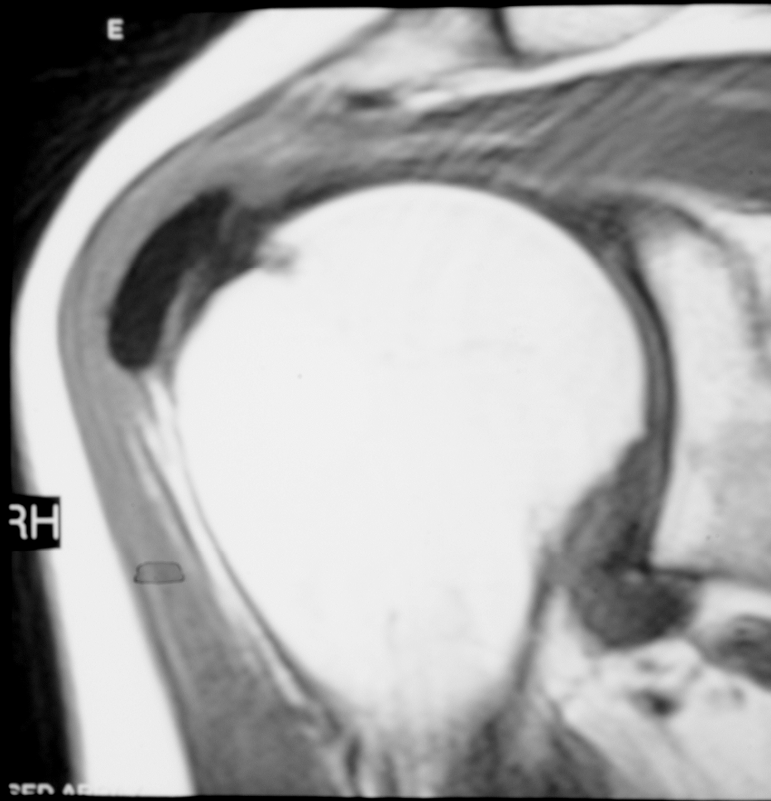
Tx: NSAIDS

aspiration (toothpaste consistency)

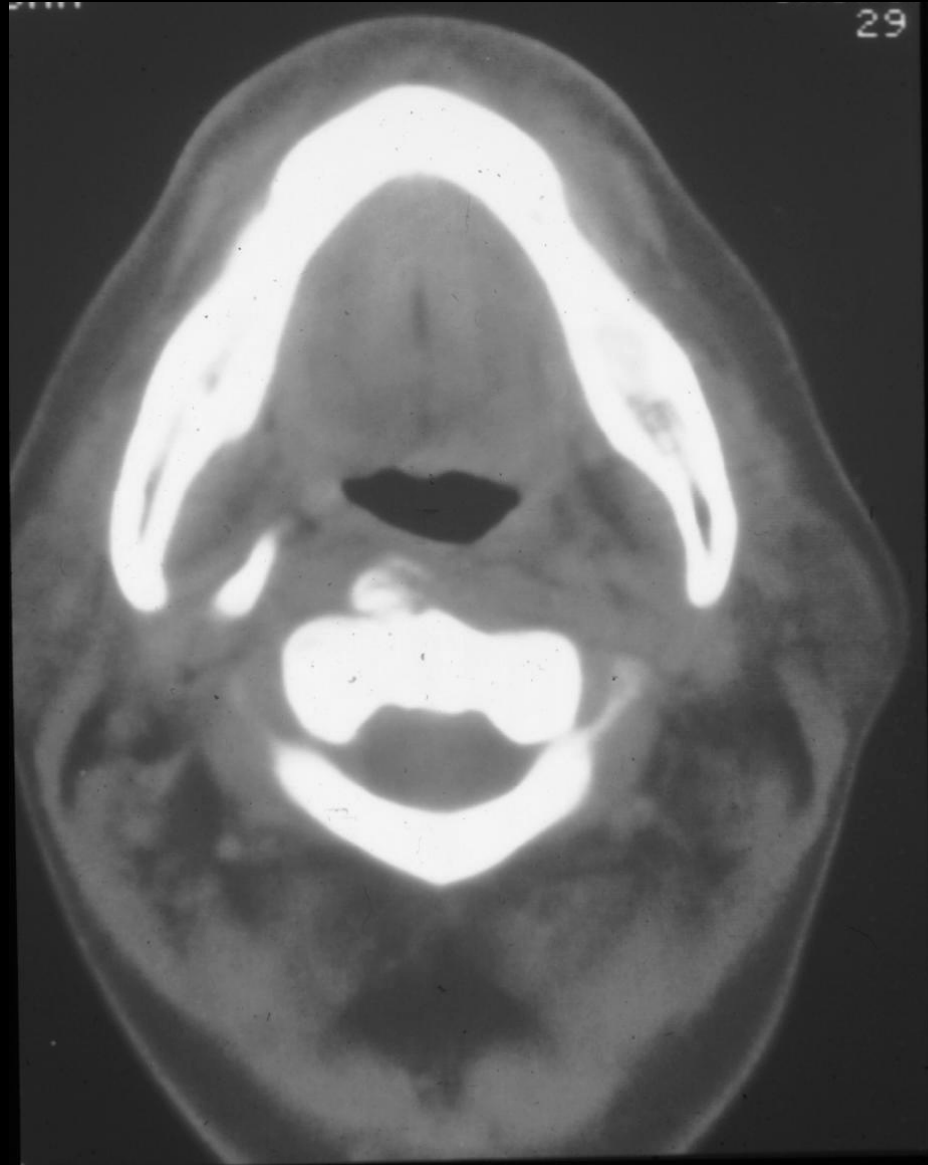
Rapid improvement

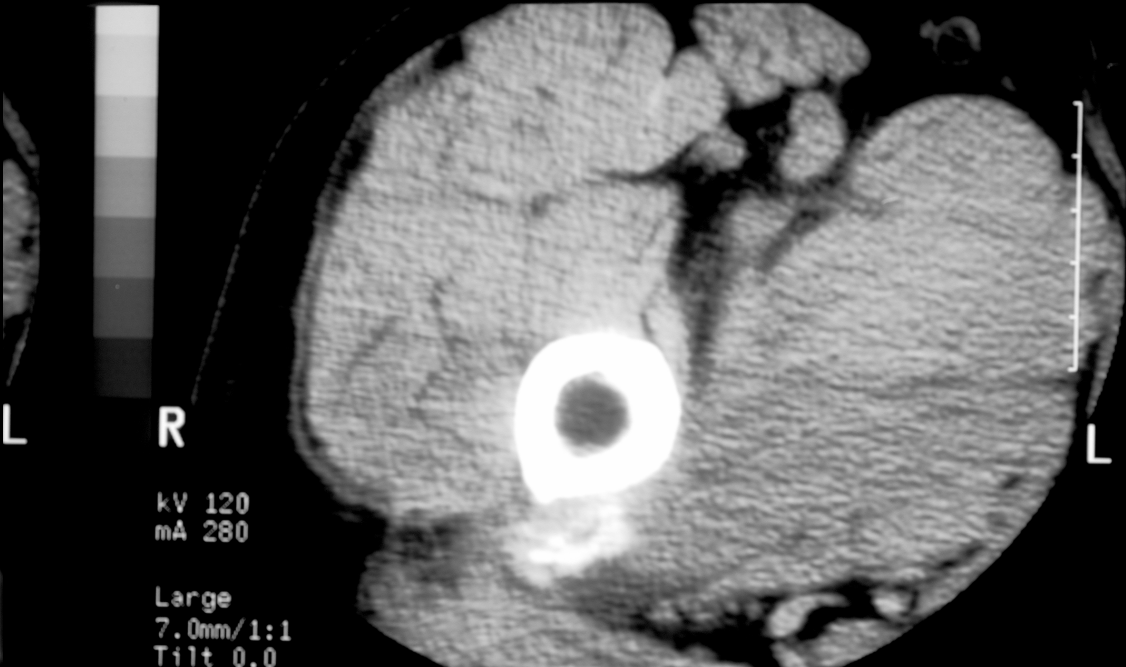






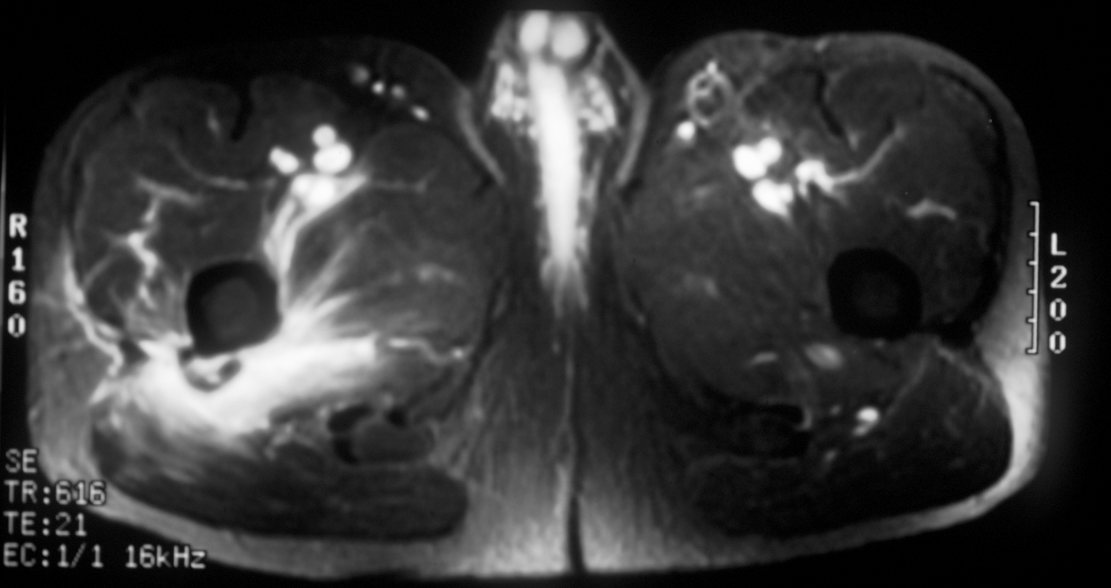
RETROPHARYNGEAL TENDINITIS





kV 120
mA 280
Large
7.0mm/1:1
Tilt 0.0
Ax S107.0+C

01/31/30
10:21



R
1
6
0

L
2
0
0

SE
TR:616
TE:21
EC:1/1 16kHz

BODY

Amyloid

- Primary, secondary forms look similar
- Shoulder, wrist most common sites
- Xray / CT
 - Focal periarticular bone lucencies – look like cysts
 - Focal soft tissue swelling
- MRI
 - Effusions / Periarticular fluid collections
 - Amyloid deposits: bone/soft tissues
 - Low signal T1, T2

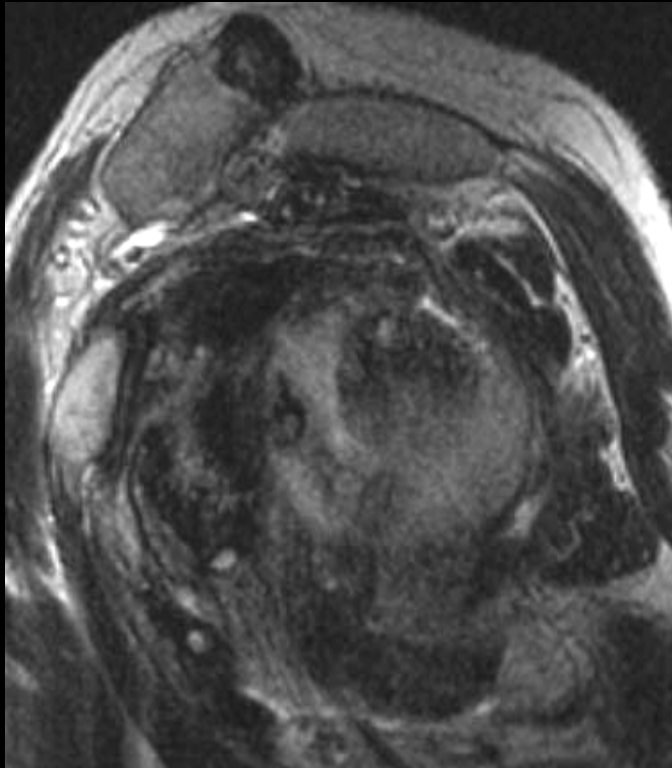




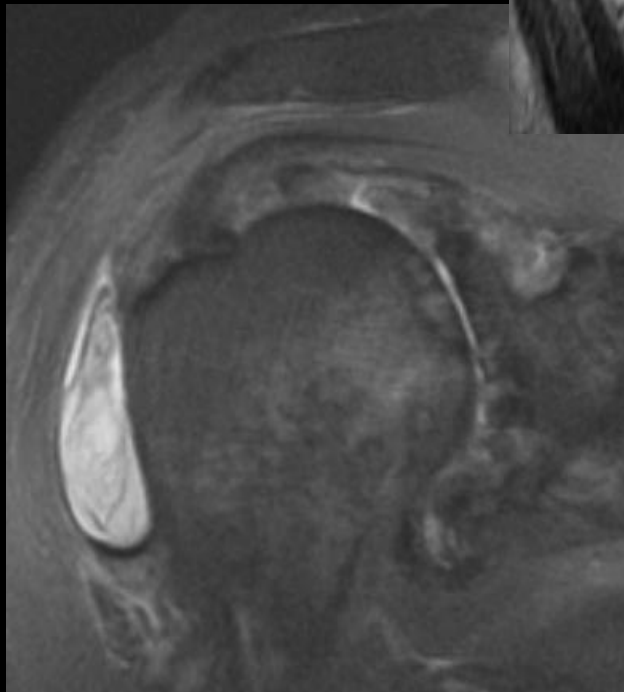
DDX: “spotty carpus”

- **Amyloid**
- **Gout**
- **CPPD**
- **RA**
- **TB**

Metabolic Arthropathy



Renal failure
*Amyloid
deposition*



-effusion
-fluid collections
Amyloid: dark on
T1, T2



R
A

SE
TR:400
Im:8/15
OSag R155.2

65 F 165729
09/04/93
14:15

ET:8

A
L

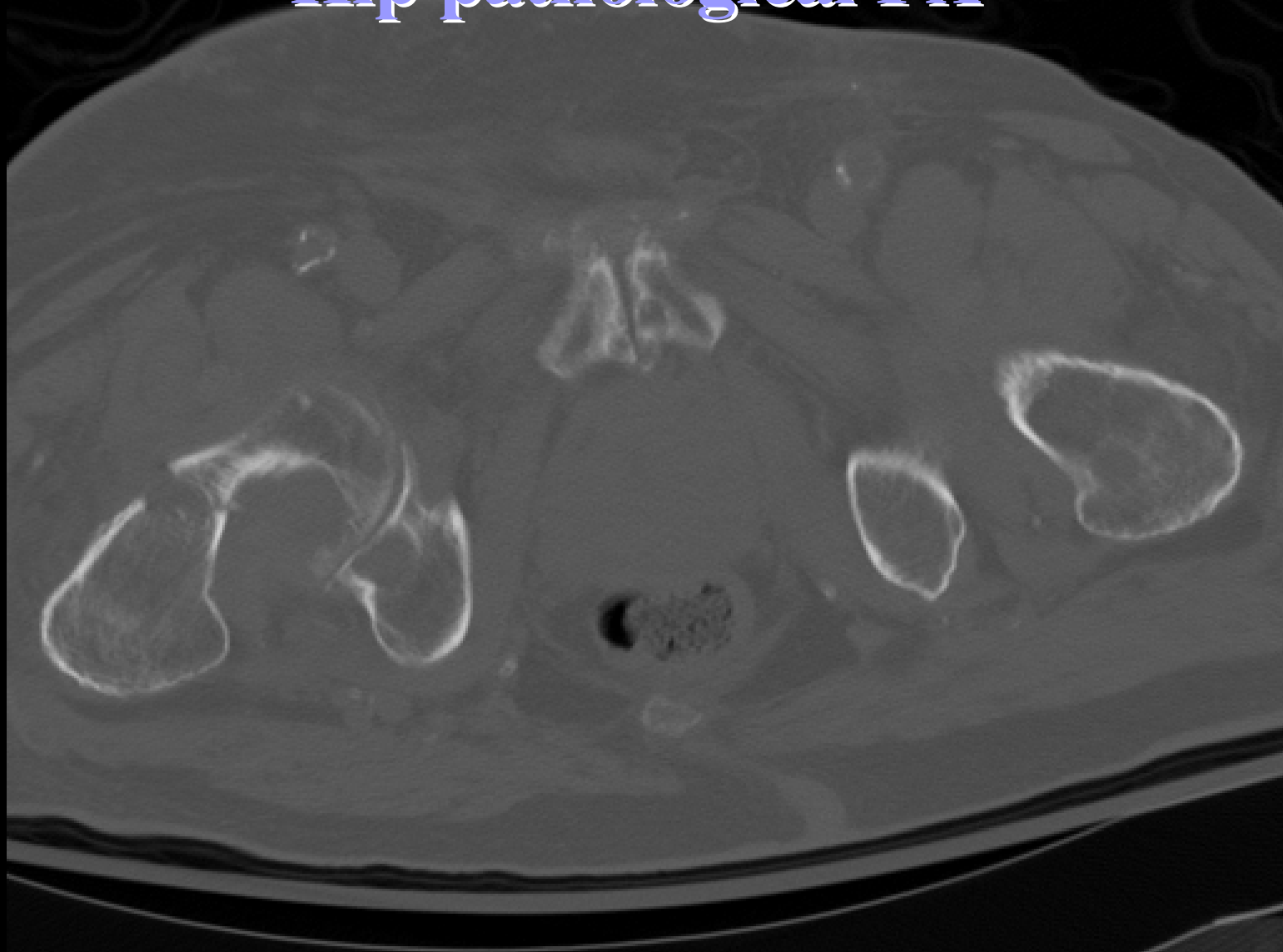
FSE
TR:4000
TE:96/Ef
EC:1/1 16kHz

SHOULDER
FOV:14
5.0thk/1.0sp
15/04:16
256x256/2 NEX
St:SI/NP
584 L = 253

P
R

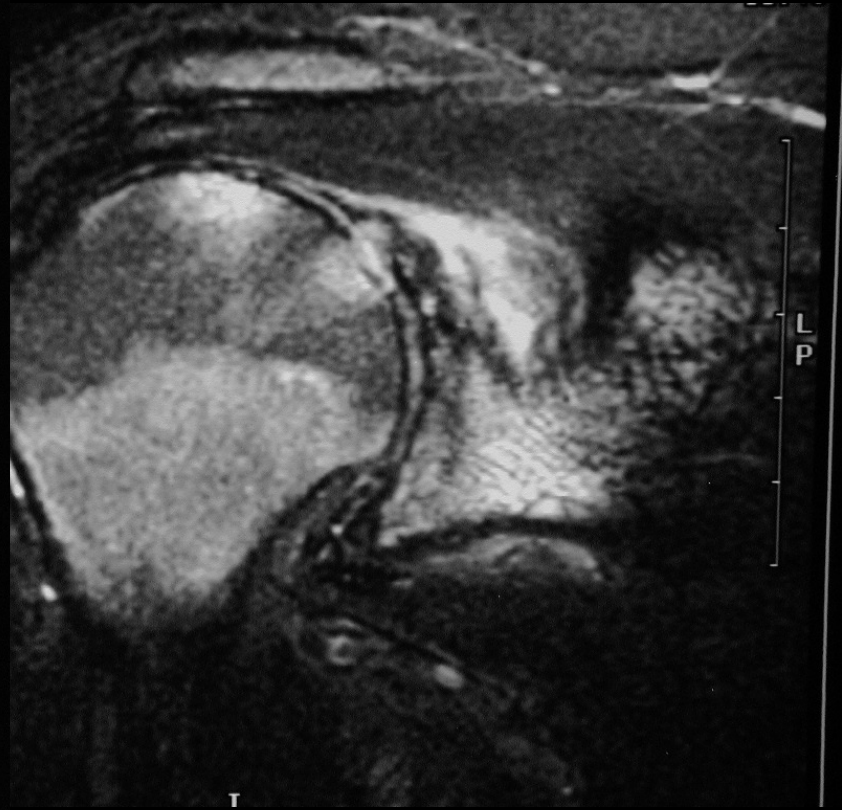
I
v ↑

ARTICULAR AMYLOID: Hip pathological FX

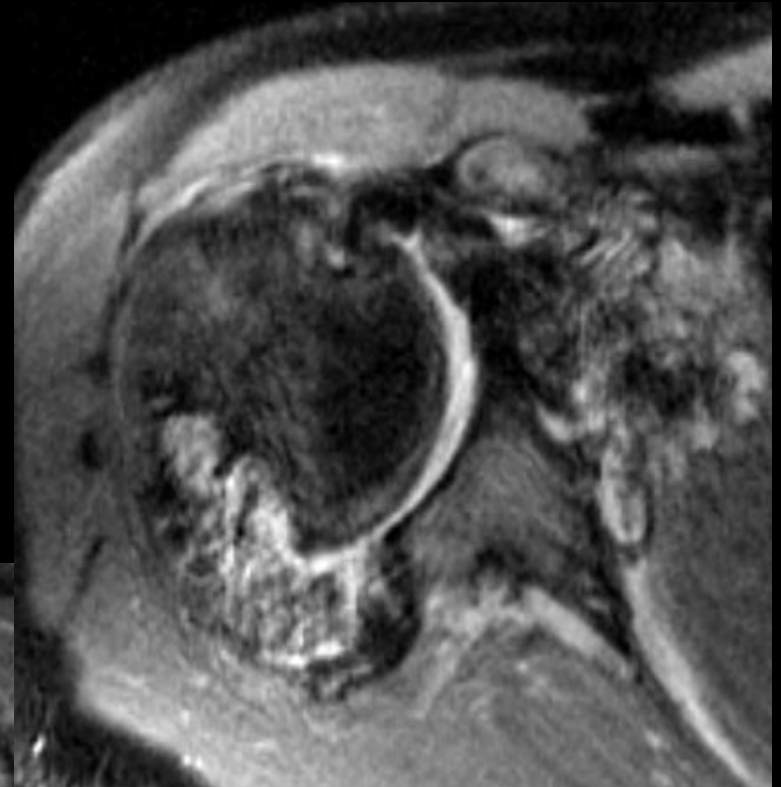
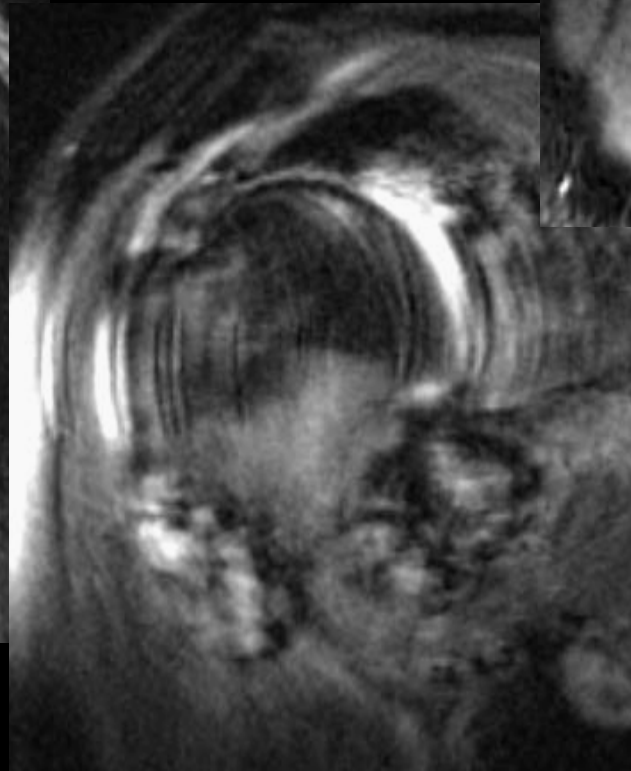
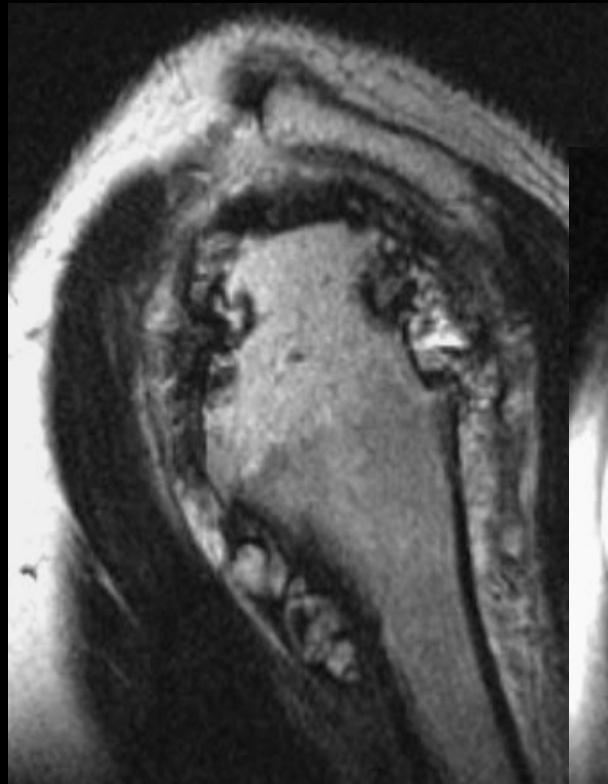


Hemophilia

- Xray /CT
 - Erosions, joint narrowing, cysts, dense effusion
 - Distribution: areas of trauma, esp elbow, digits
- MRI:
 - Hemarthrosis (effusion with higher signal than muscle)
 - Early: synovitis
 - Late: hemosiderin (dark signal on T2), cysts, diffuse cartilage loss



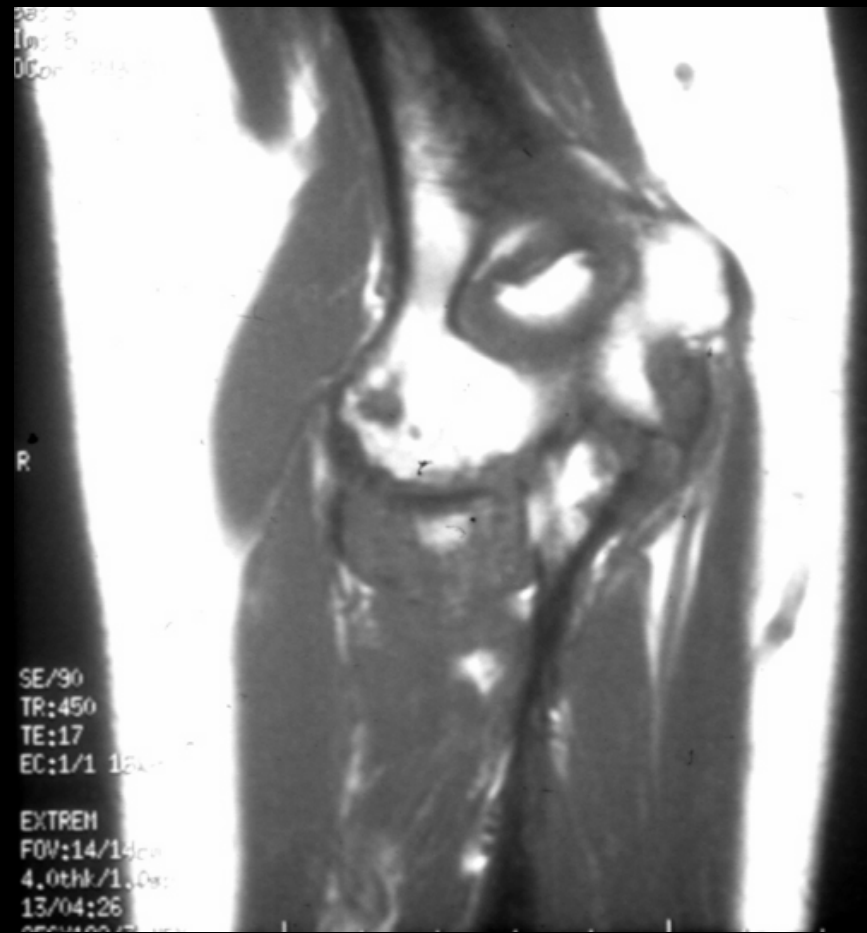
Hemophilic Arthropathy



- severe arthritis, erosions
- dark hemosiderin in joint
- "hatchet" deformity

Hemophilic Arthropathy

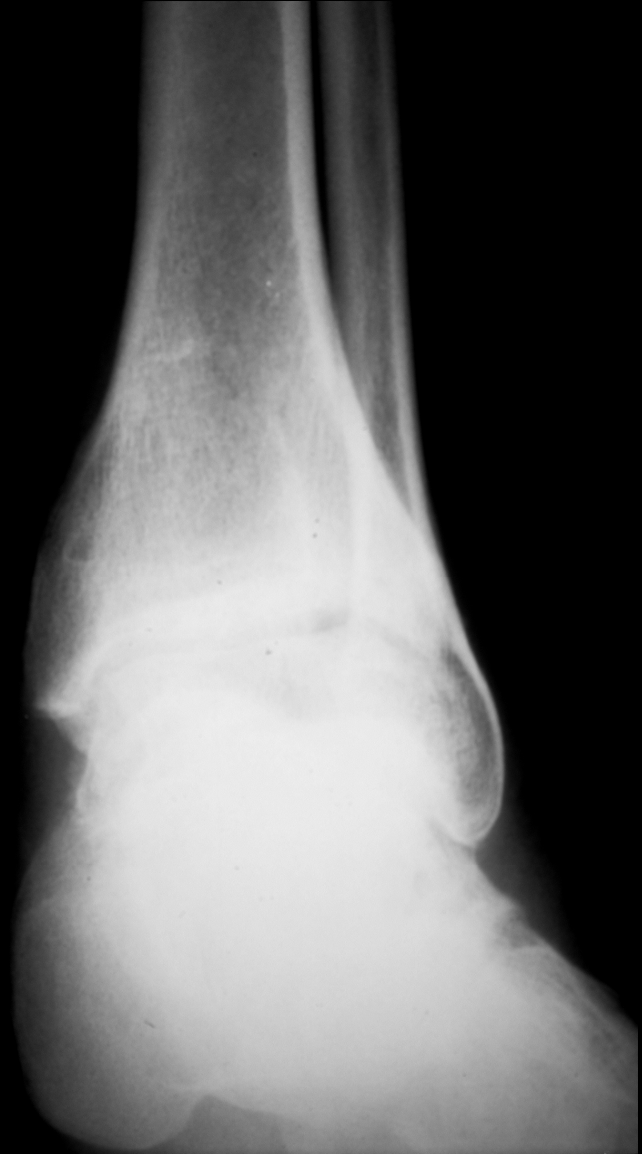
Erosions, subchondral cysts



HEMOPHILIC ARTHROPATHY:

Hemarthrosis =
opaque
joint
effusion

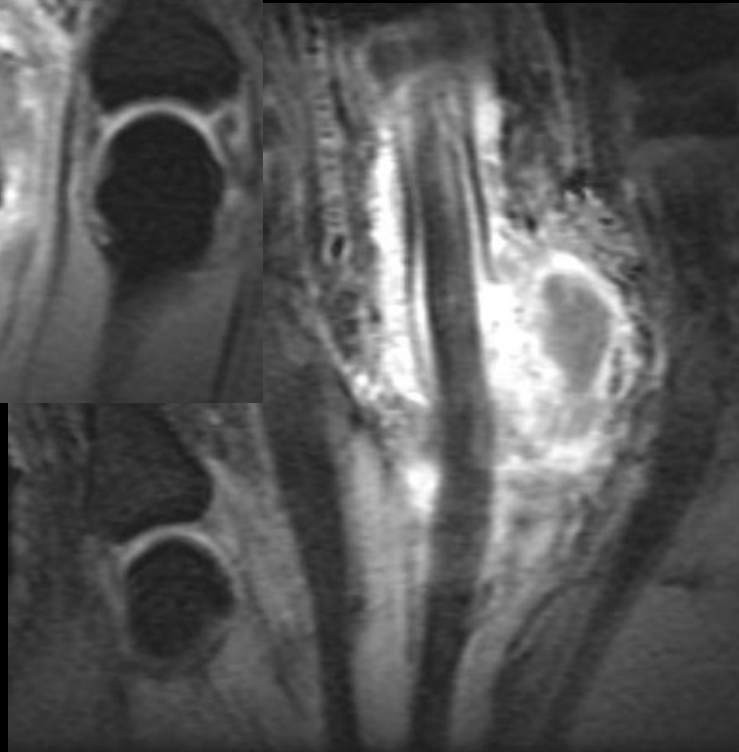
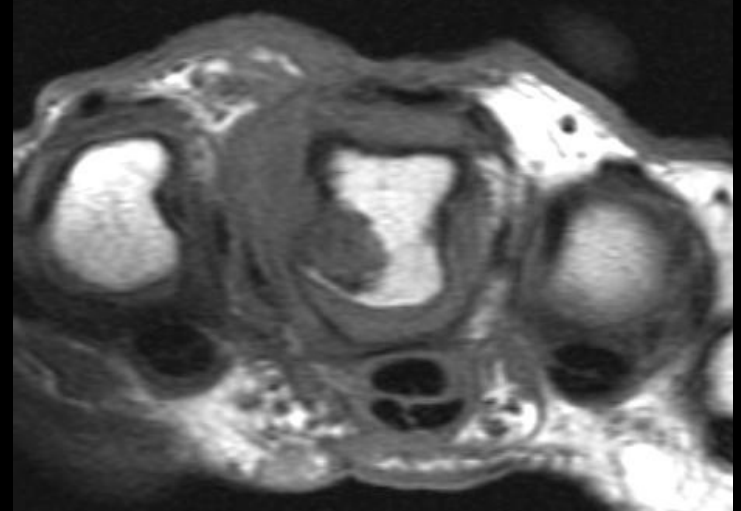
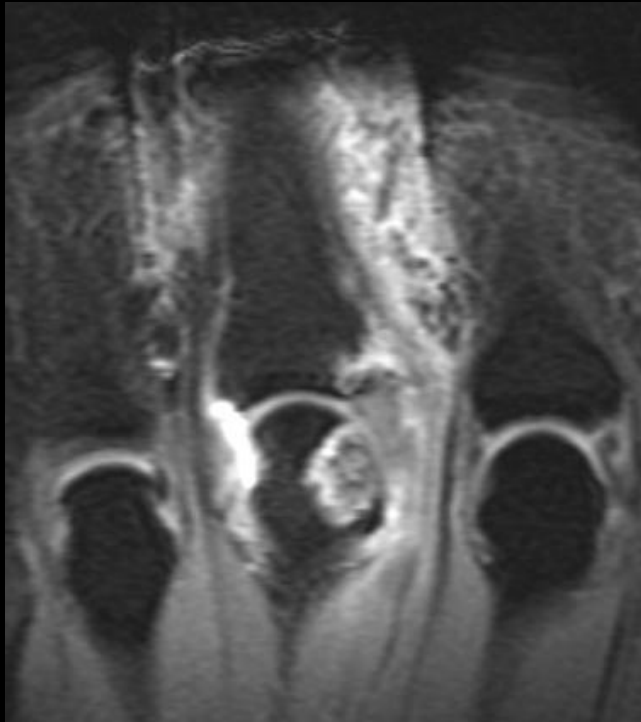




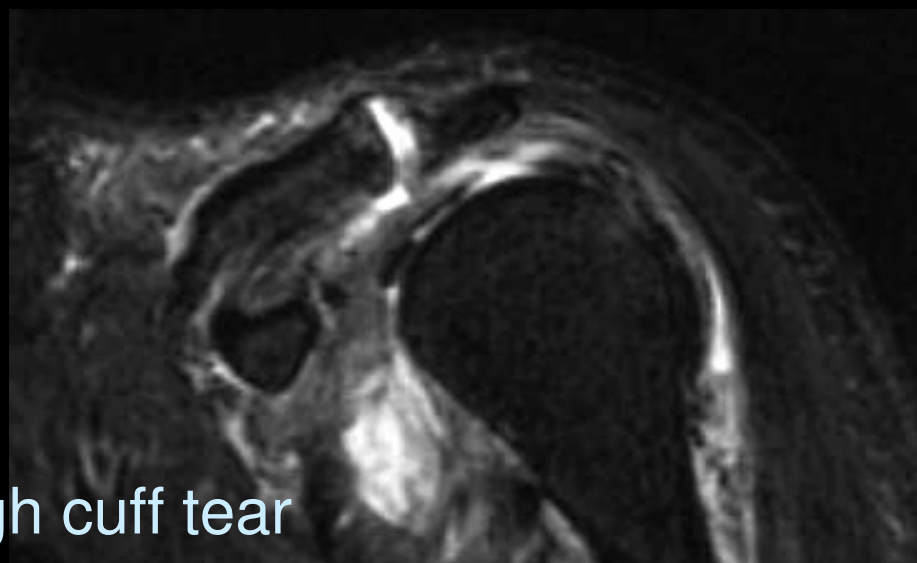
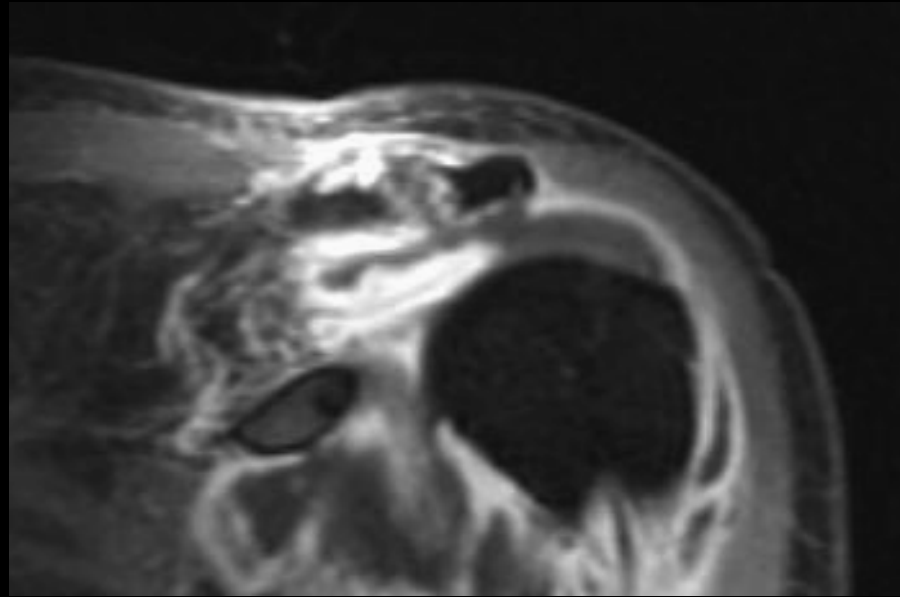
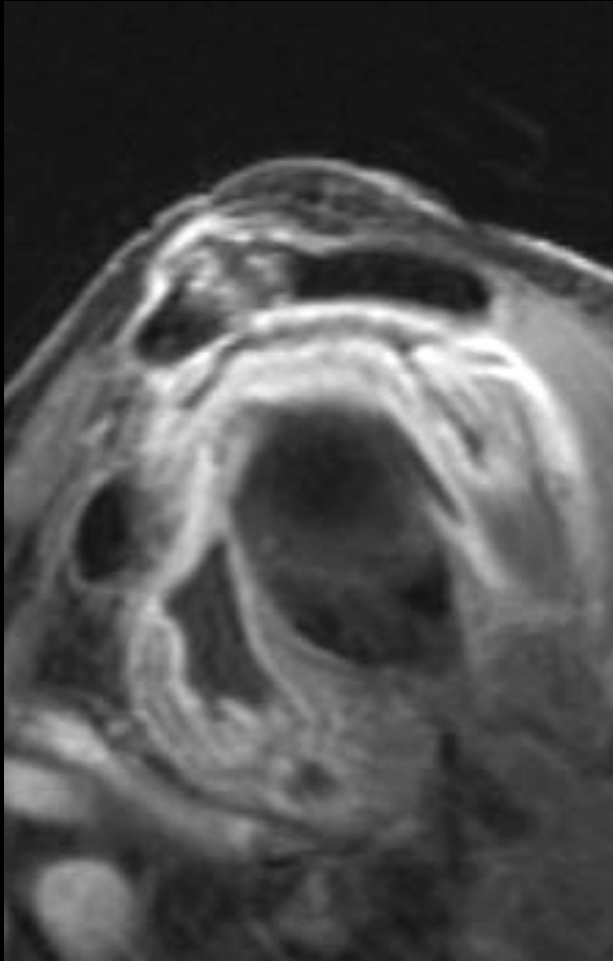
Septic Arthritis

- Radiology
 - Effusion
 - Joint narrowing
 - Synovial proliferation
 - Marginal erosions progressing to destruction
 - Radiologically resembles RA
 - But single joint, rapid progression

Septic Arthritis / Tenosynovitis



Septic Arthritis



Thick rim-enhancement
Spread to AC joint through cuff tear

Neuropathic Arthropathy

- Insensate joint
- Destructive arthropathy
- Various joints, etiologies
- Lower extremity >> upper
- Upper extremity: esp shoulder, secondary to syrinx in cervicothoracic spinal cord

NEUROPATHIC ARTHROPATHY

<u>common associations</u>	<u>occurrence</u>
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rate

diabetes mellitus

5-10%

syringomelia

40 %

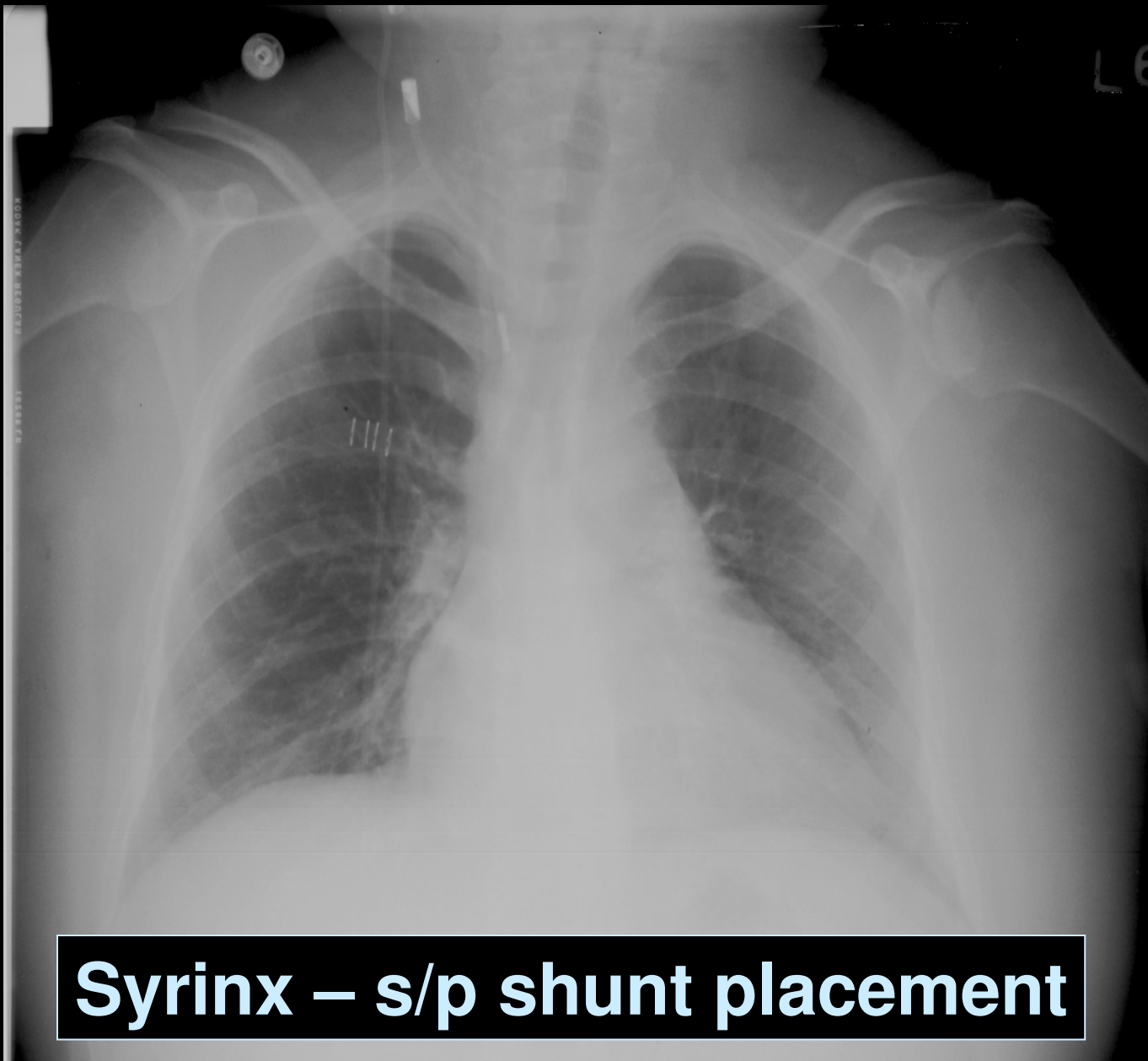
tabes dorsalis

25%

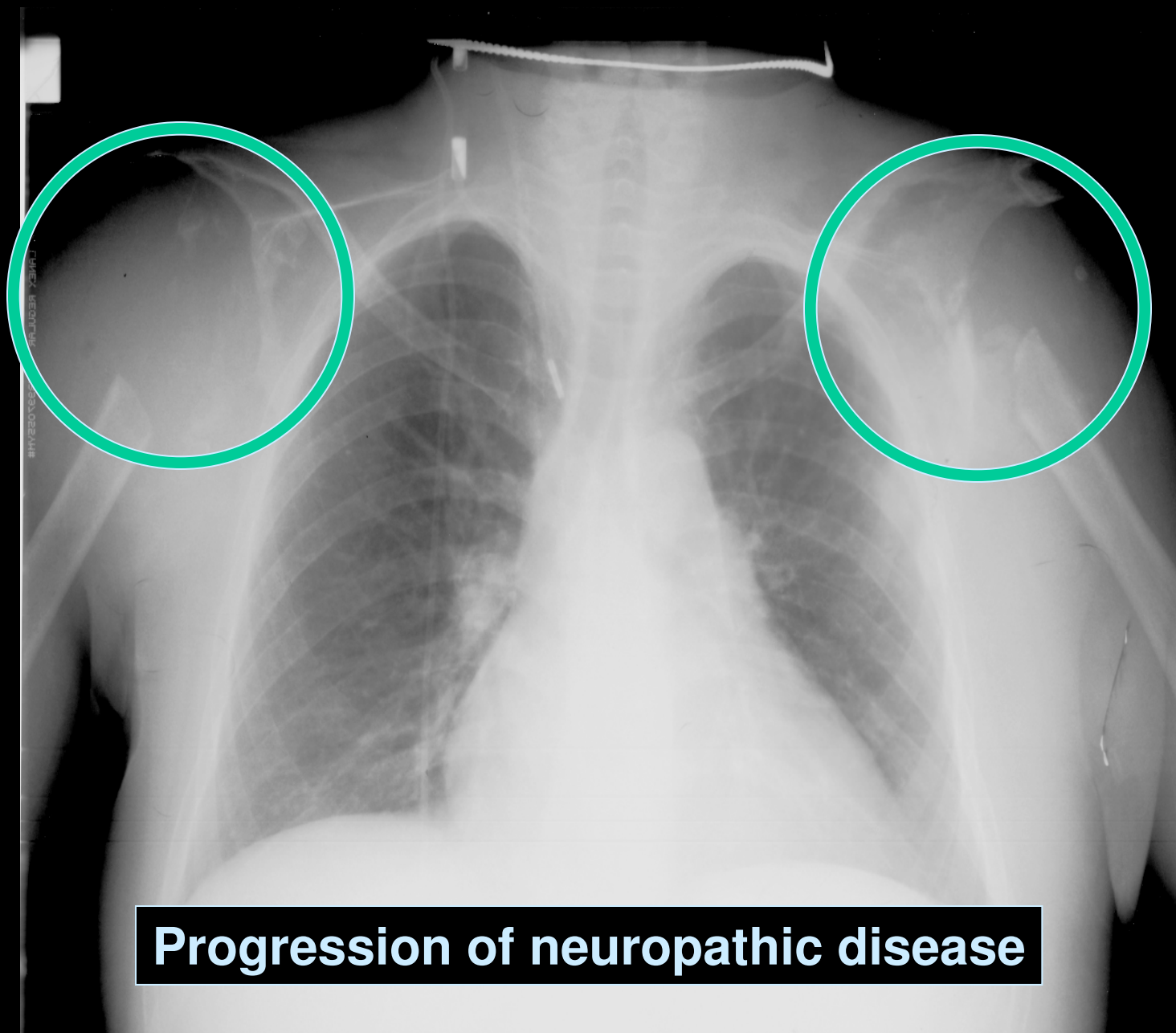
(tertiary syphilis)

NP: Imaging Patterns

- The D's
 - Disorganization
 - Dislocation / deformity
 - Density
 - Debris
 - Destruction
- Patterns
 - Atrophic – esp shoulder
 - “surgical like” margins
 - syrinx
 - hypertrophic
 - fragmented & reactive bone
 - mixed (combined) pattern

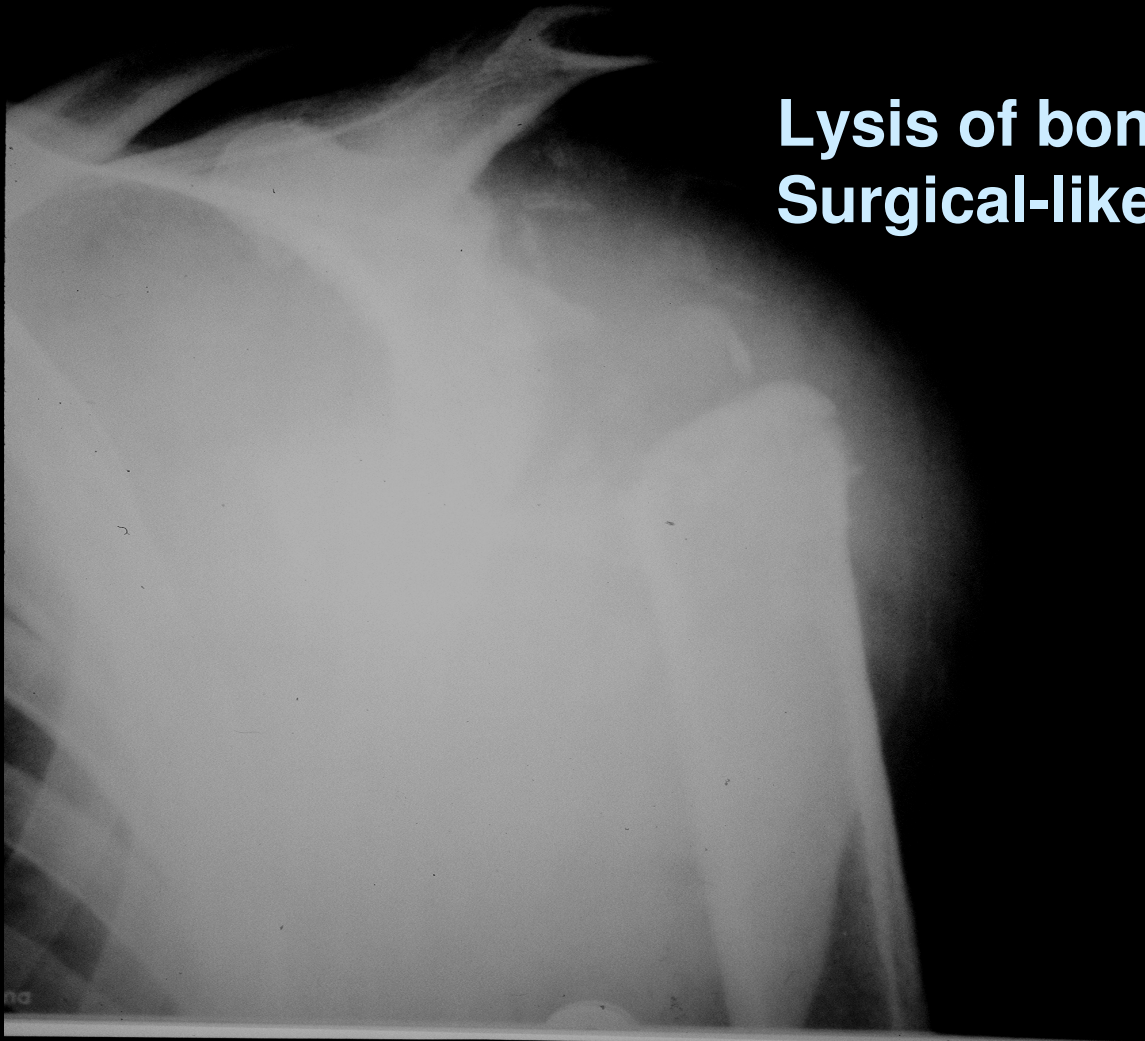


Syrinx – s/p shunt placement



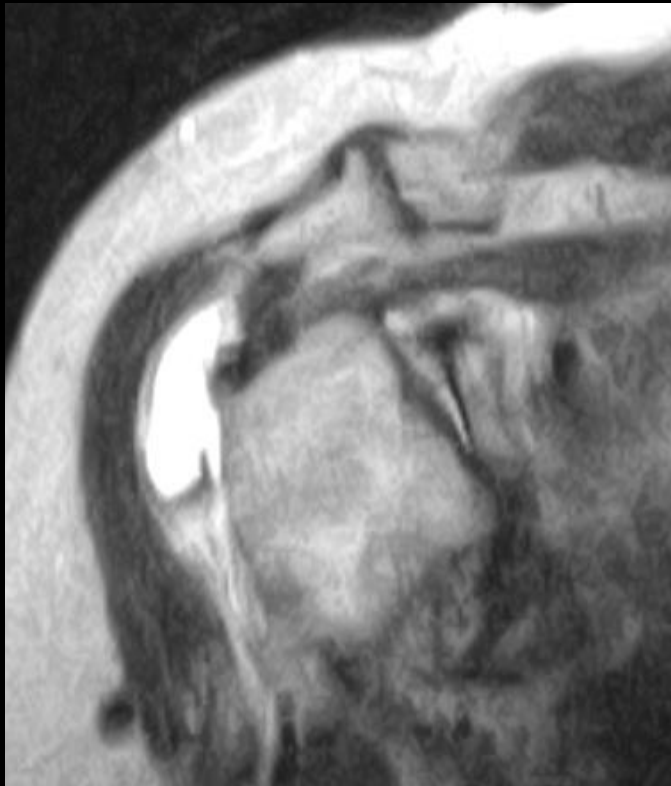
Progression of neuropathic disease

Neuropathic Arthropathy



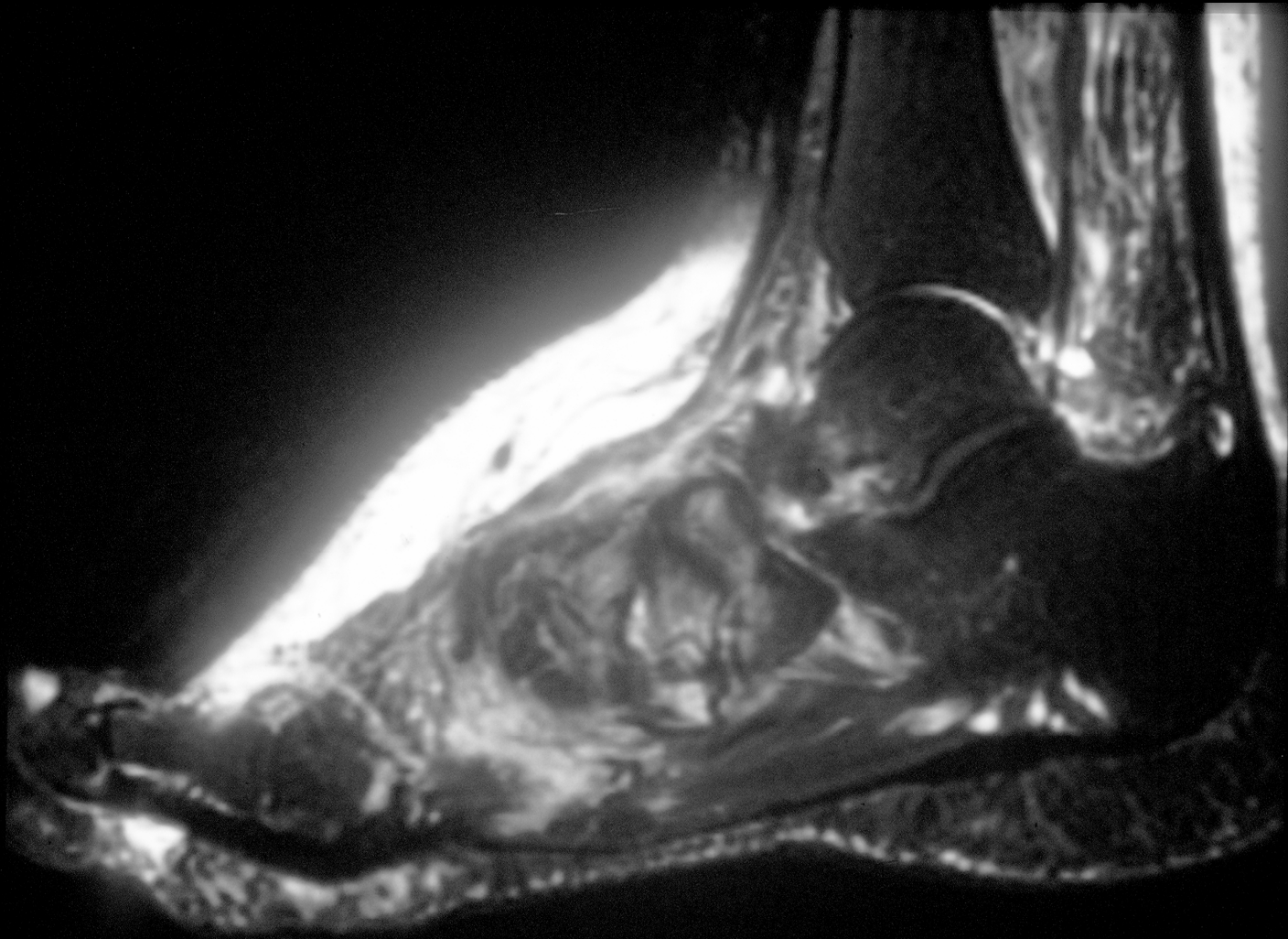
Lysis of bone
Surgical-like margins

Neuropathic Arthropathy - MRI





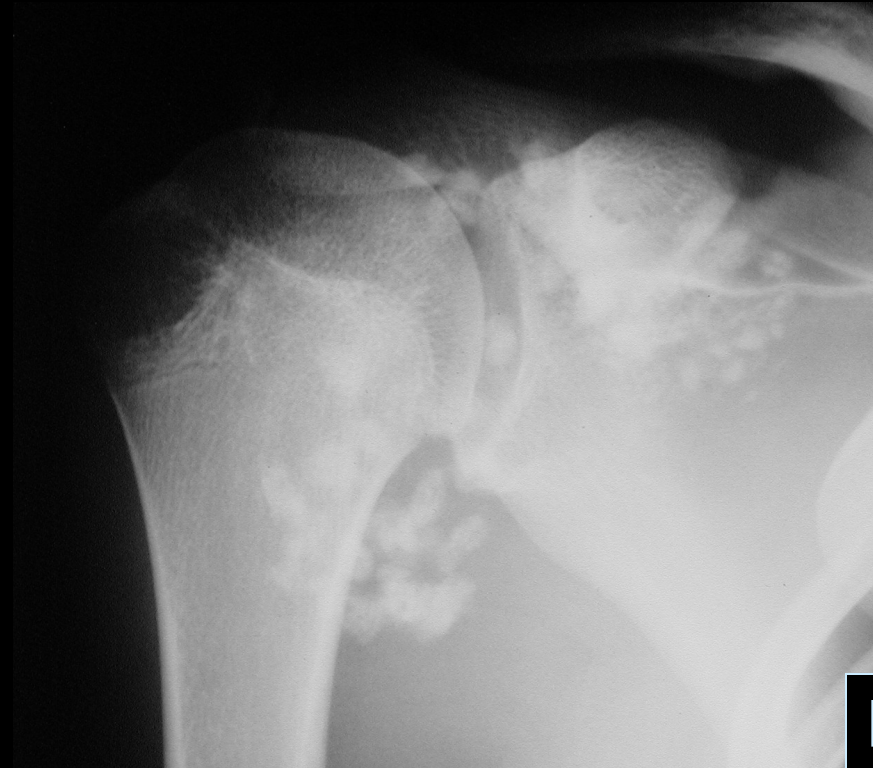




Synovial Osteochondromatosis

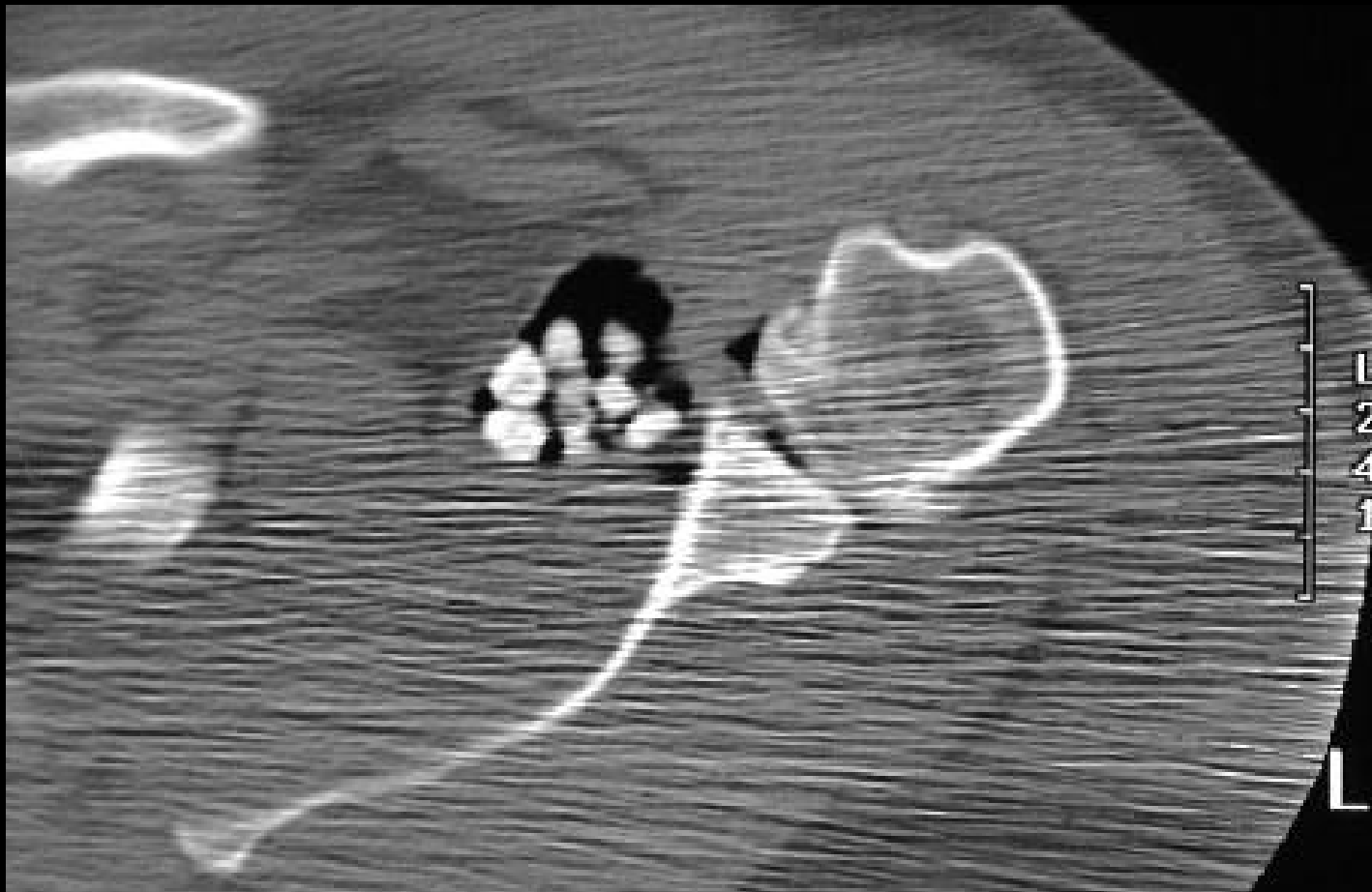
- Rare
- Synovial metaplasia – synovium forms cartilage, may calcify
- Results in secondary OA
- Xray:
 - joint effusion
 - If calcified, multiple bodies of similar size
- MRI:
 - Useful to identify non-calcified bodies

SOC Shoulder



Numerous IA bodies
Similar size
Disproportionate to degree of OA

CT Shoulder – SOC with Secondary OA



Synovial Osteochondromatosis - Elbow

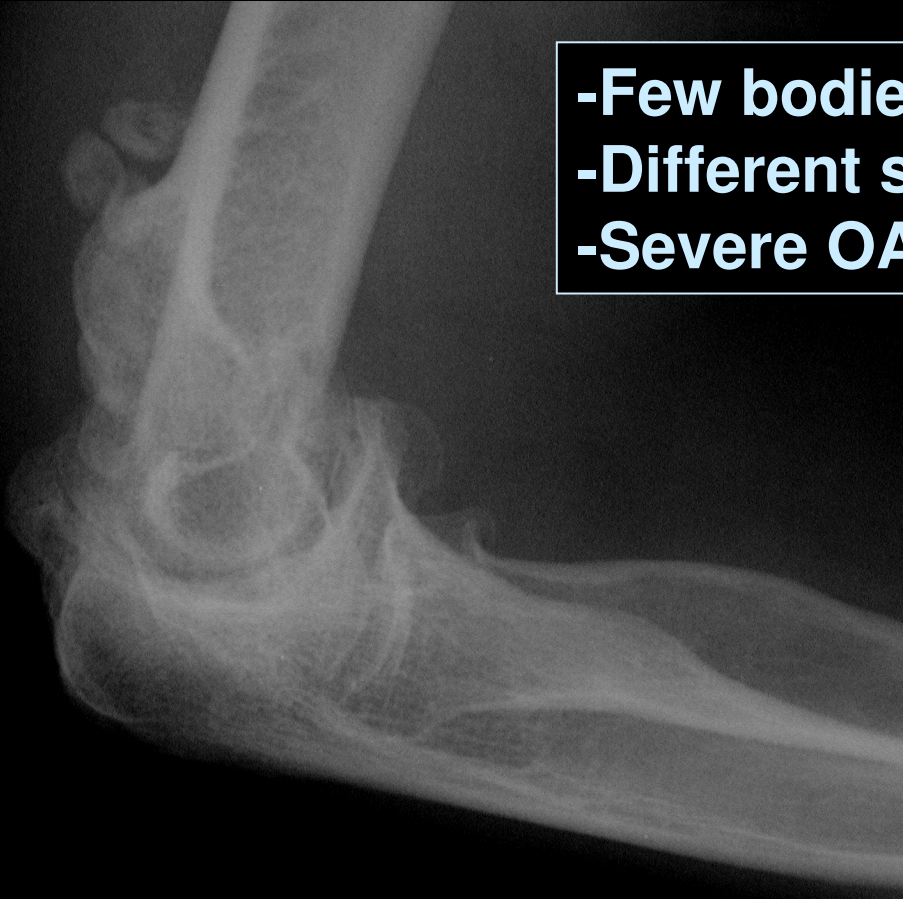
Primary form



“Secondary” SOC

OA with IA bodies

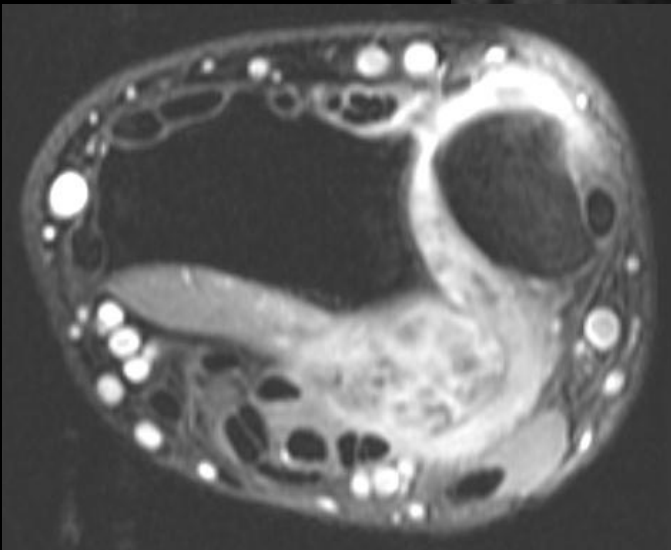
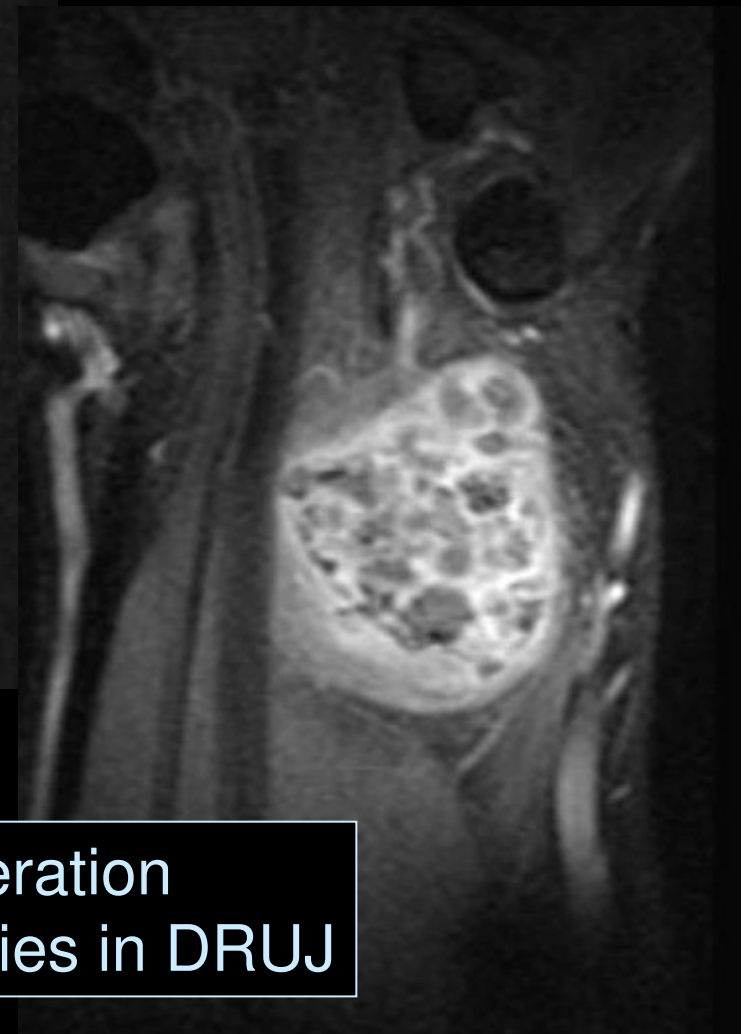
- Few bodies**
- Different sizes**
- Severe OA**



MRI of SOC

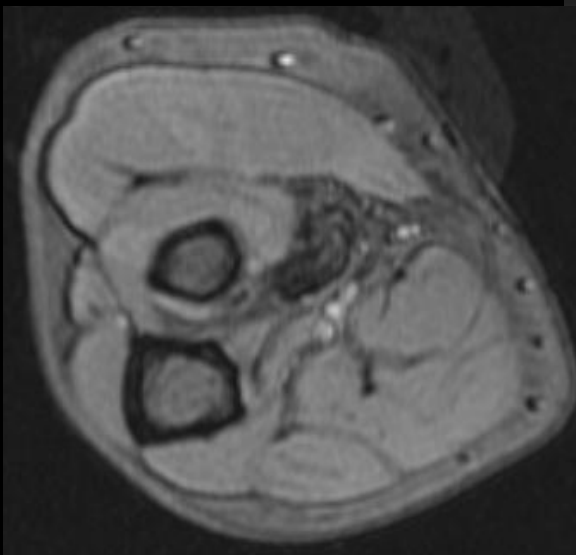


Contrast-enhanced

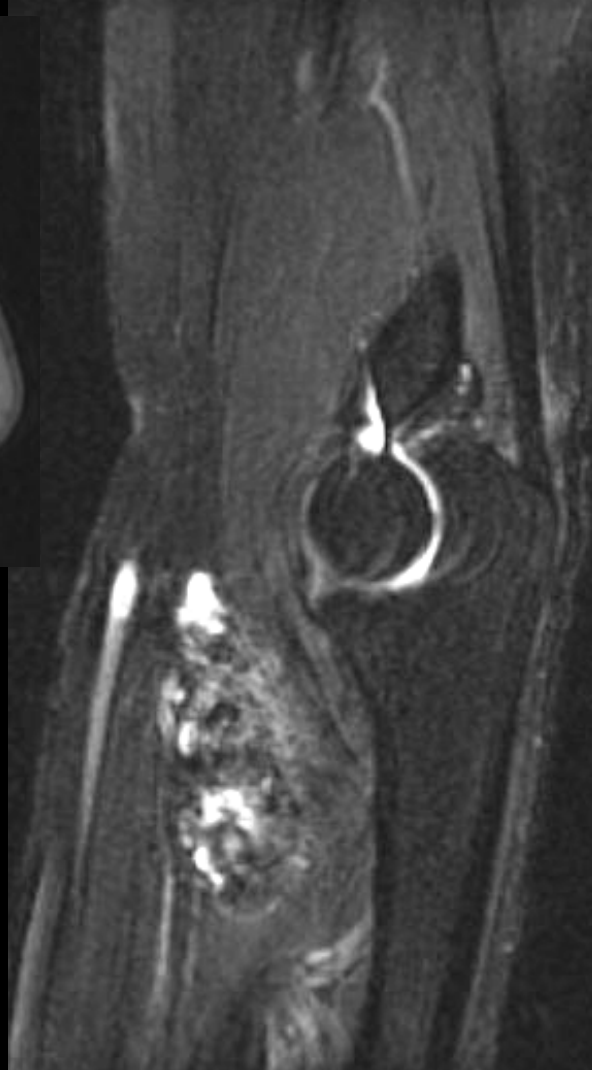


Synovial proliferation
Numerous bodies in DRUJ

Synovial Osteochondromatosis – Bursal Involvement



*Bicipitoradialis
bursa*

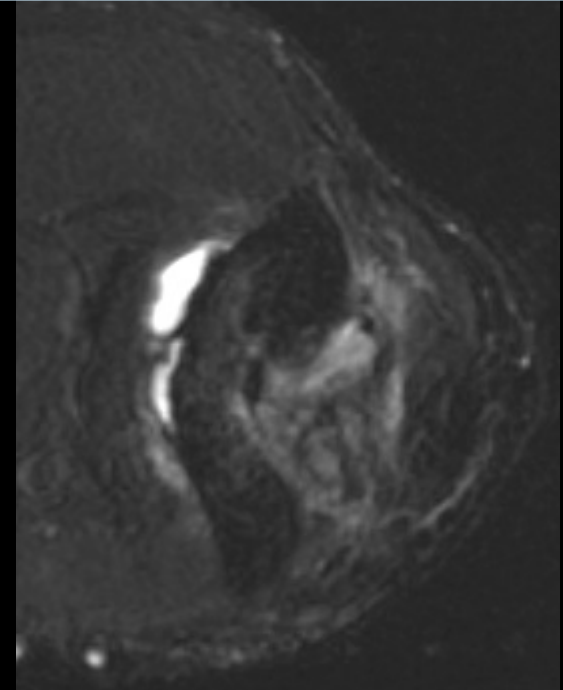
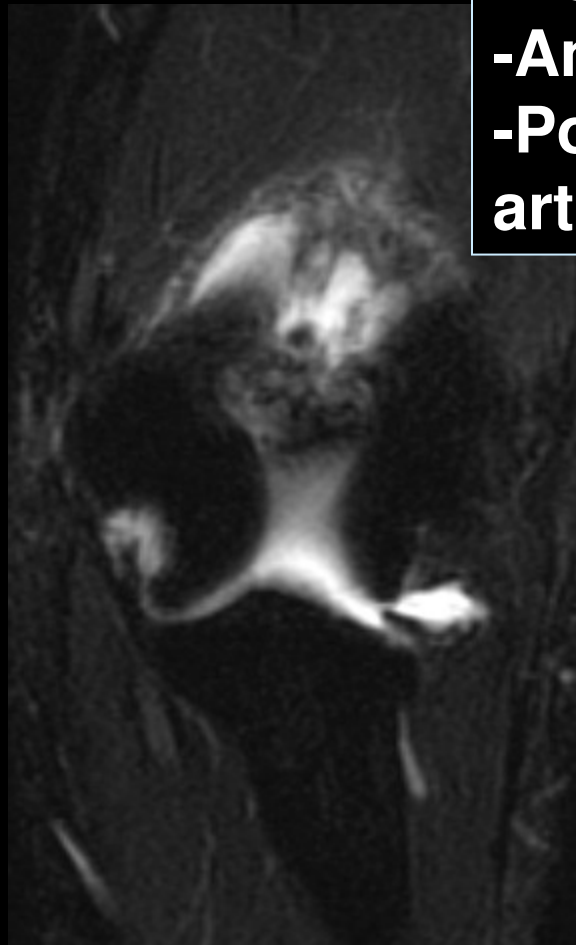
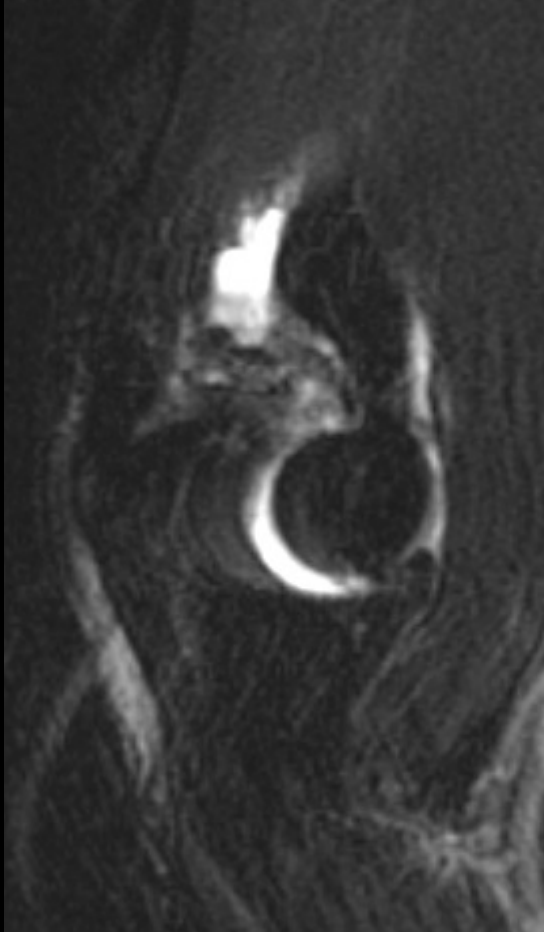


Pigmented Villonodular Synovitis (PVNS)

- Knee > hip > ankle > upper extremity
- Synovial proliferation with hemosiderin deposition
- Effusion / Erosions
 - Extent depends on joint capacity
 - Small joint capacity – prominent erosions

PVNS

Masslike low signal synovium
Erosions / effusion



DDx: 'dark synovium'

- PVNS
- SOC
- Gout
- Hemophilia
- Amyloid
- Post-op, chronic arthropathy

Summary

- Radiographs usually adequate for imaging arthropathies
- Know patterns, review images systematically
- MRI useful for evaluation of synovitis, early erosions, hemosiderin deposition, underlying bone marrow