Crystal Deposition Diseases

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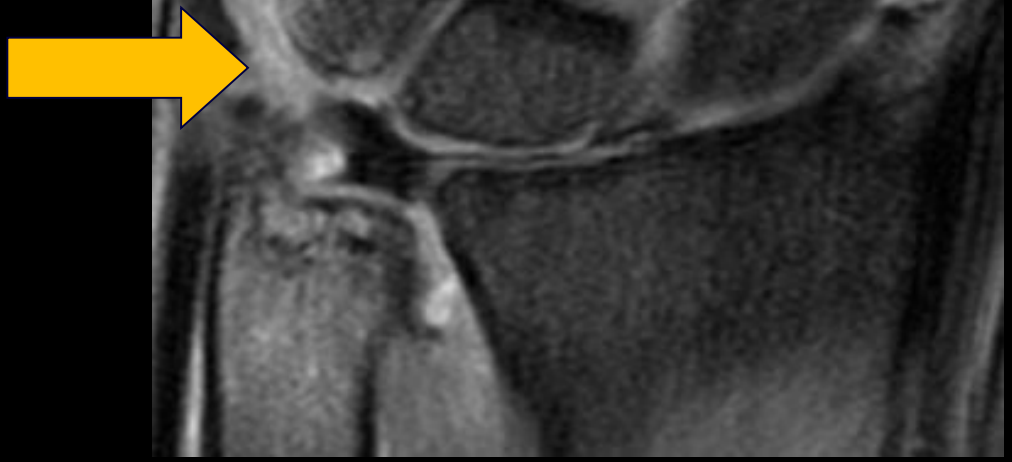
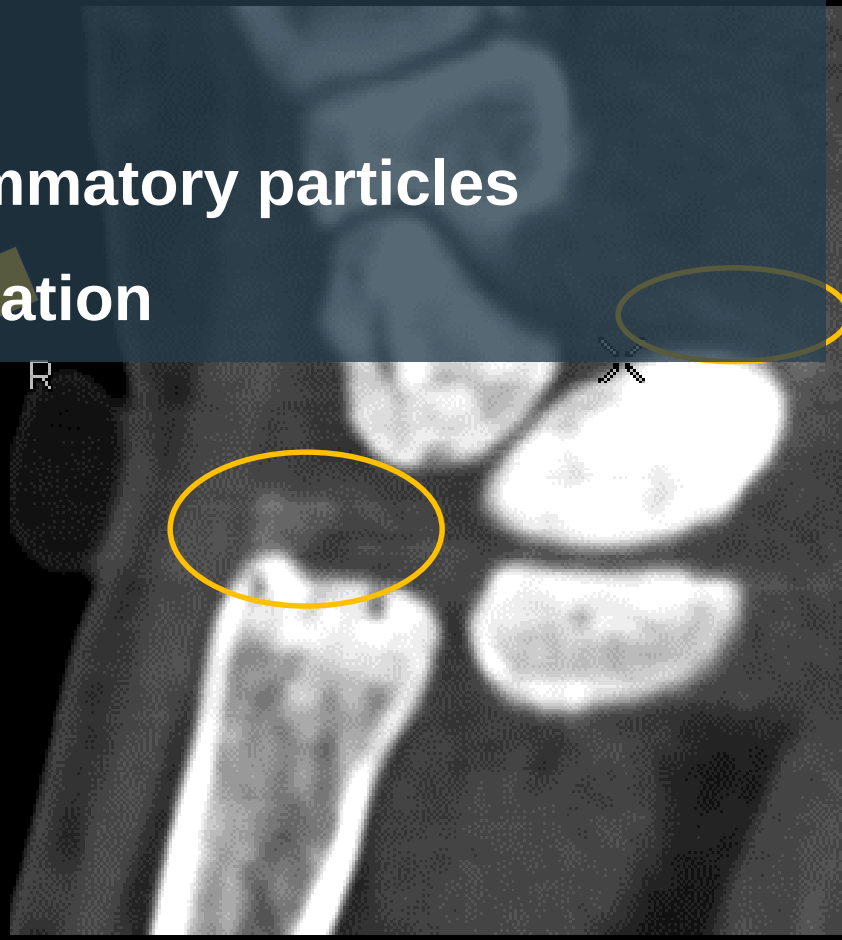
Case 1. 58y, F, wrist pain for 2 weeks.

Diagnosis: Pyrophosphate Arthropathy

- Inflammatory Arthritis
- CPPD crystals are pro-inflammatory particles
- Can cause synovial inflammation



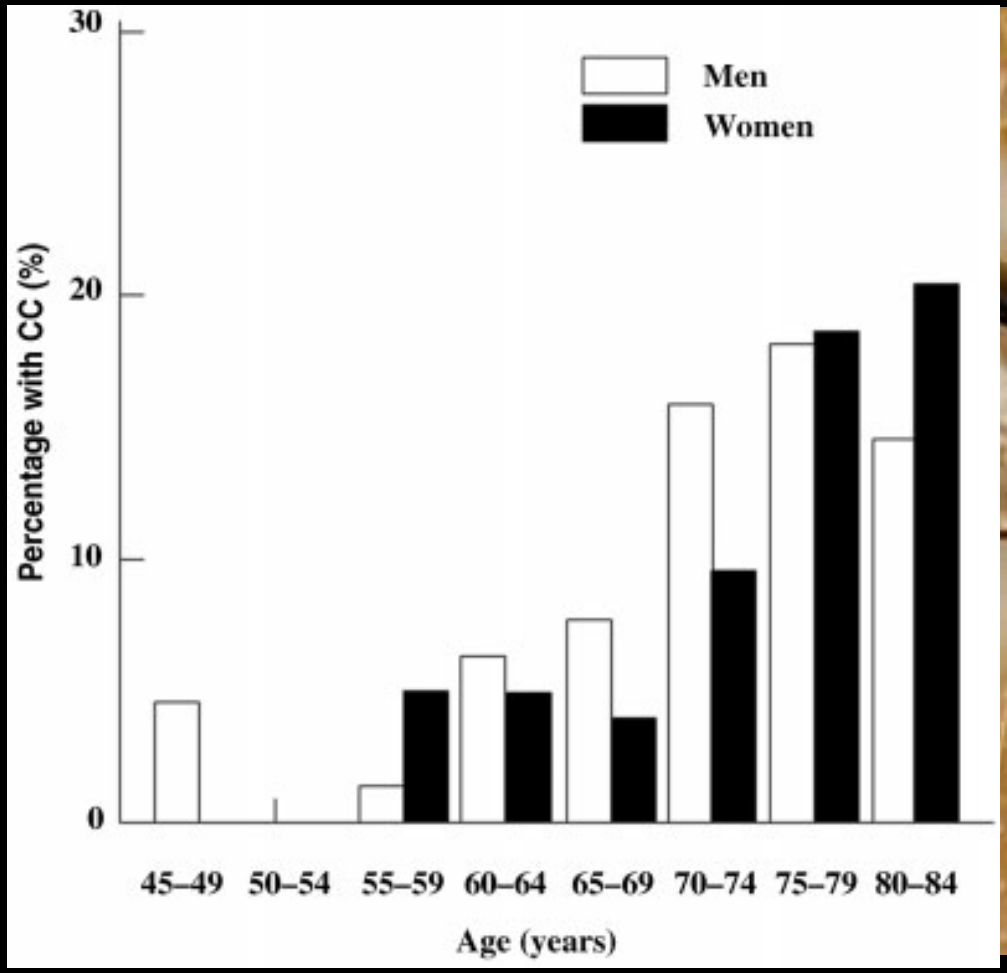
T2 fat saturation



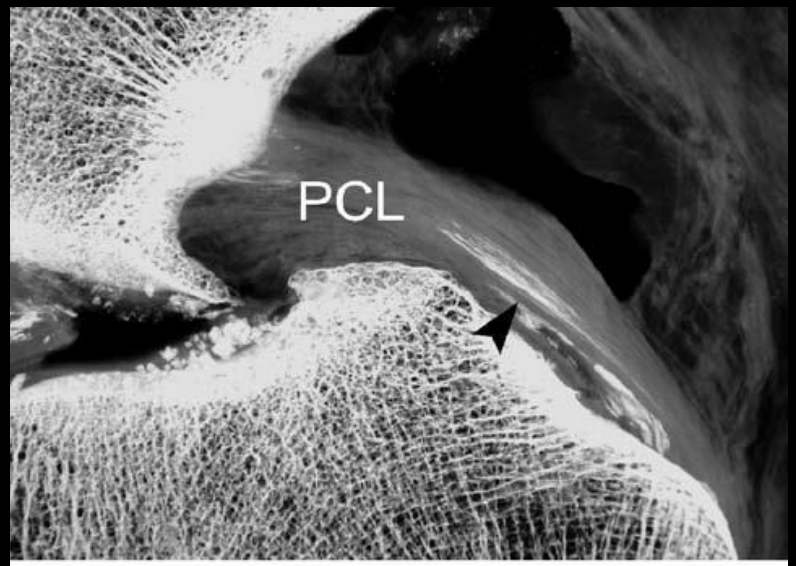
Calcium Pyrophosphate Dihydrate (CPPD) Crystals
Normally Deposit in MSK System

CPPD sporadic deposit of CPPD is a common condition in the Elderly

- 8-10% of people aged 60 years. 20-40% at age 80y

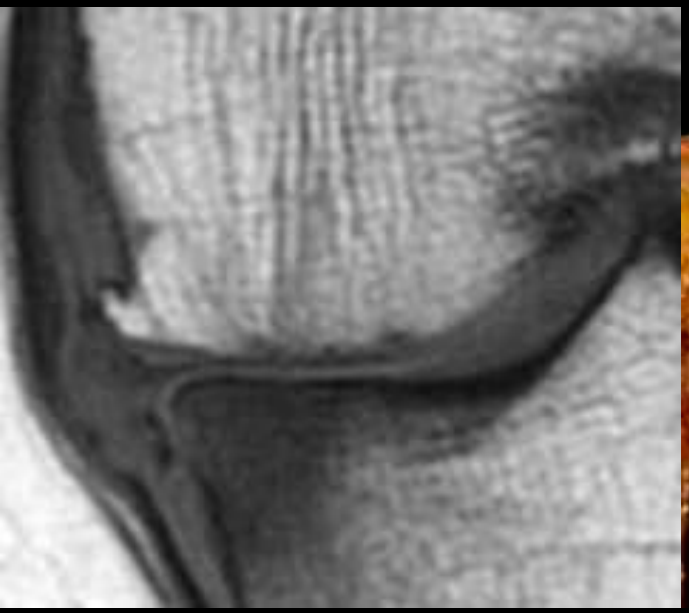


Picture from UCSD Research Lab 2002



Berna [1,2], Abreu[2], Resnick[2,] · UCSD sudy presented at ECR 2011

CPPD and OA
causative factor or consequence?



An association between OA and CPPD is well recognized however…

- the precise relationship is unclear!

- CPPD is a cause of OA or develops as a consequence of the cartilage changes that accompany OA?

From: UCSD research lab

CPPD and OA

causative factor or consequence?

CPPD may be a marker of a reparative process by metabolically active chondrocytes.

→ 100 patients who had undergone unilateral **meniscectomy** (20 year)
→ showed **CPPD in 20% of operated knees** compared with 4% of contralateral unoperated knee

the suggestion that CPPD could be a marker of poor prognosis in knee OA was **not confirmed** in several other longitudinal studies

Neogi T, et al. Arthritis Rheum 2006

How accurate is MR imaging for CPPD deposits?

Faxitron radiograph of cadaver specimen

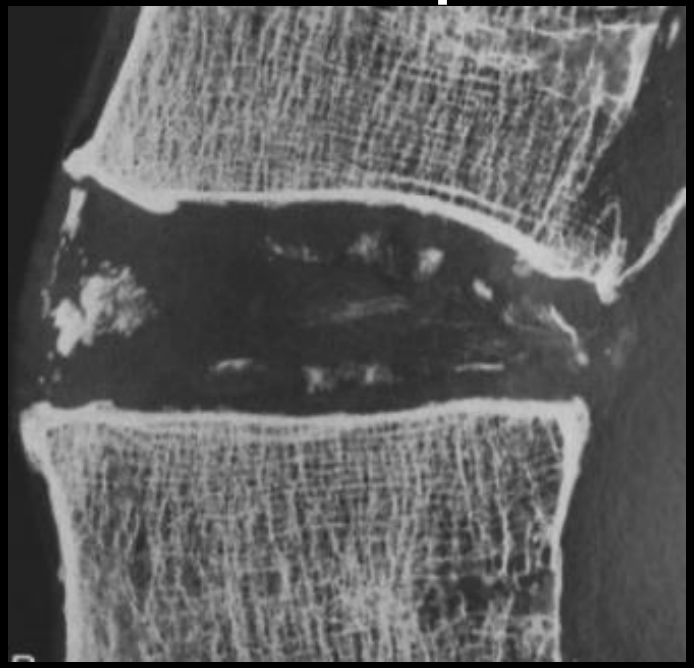
Sagittal PD-weighted MR image of same spec

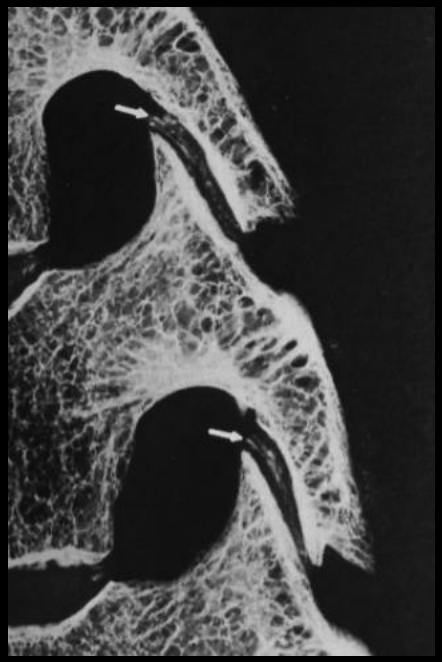
CHONDROCALCINOSIS

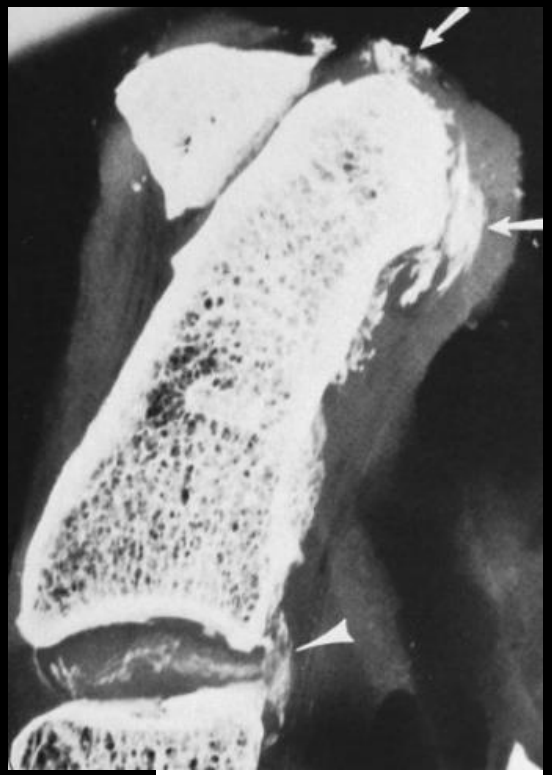
Abreu, Chung CB, Resnick D. CPPD crystalline deposits in the knee: anatomic, radiographic, MR imaging, and histologic study in cadavers. Skel Rad 2004

Calcium Pyrophosphate Dihydrate (CPPD)
Normally Deposits in SPINE (discs, lig., joints)

- **26% of autopsies studies.**







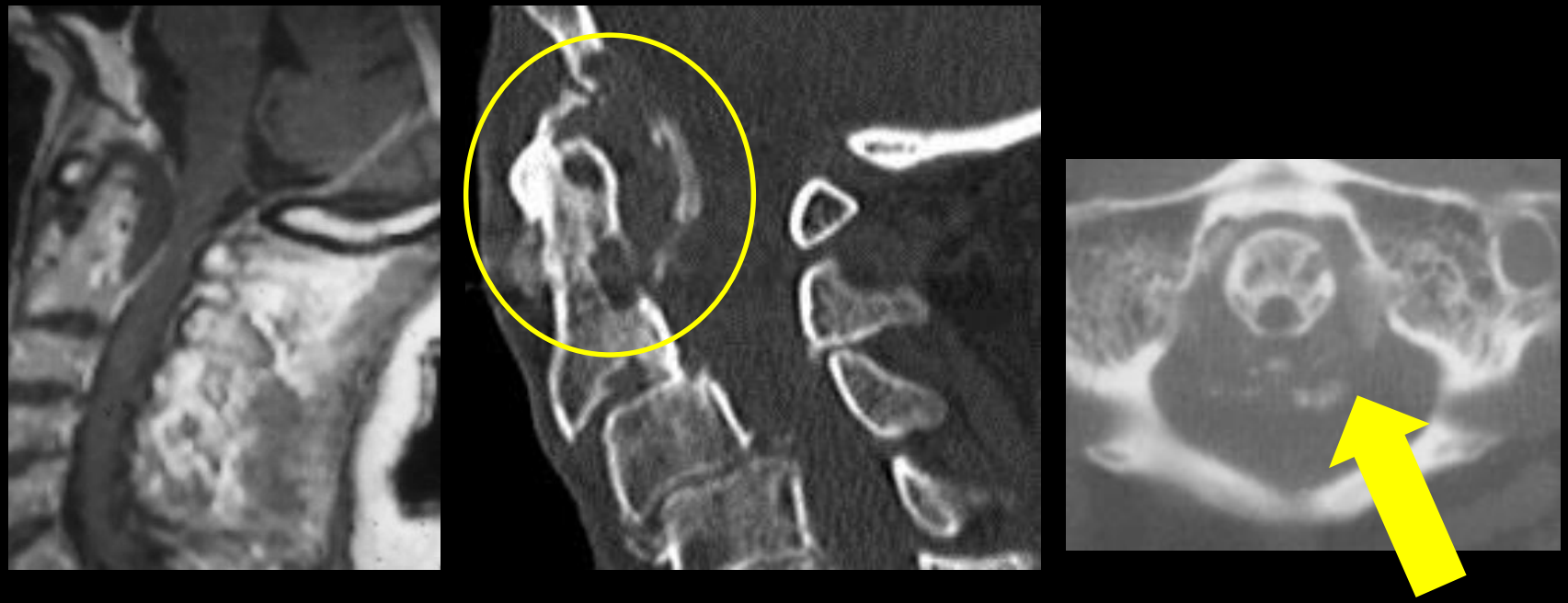
Resnik & Niwayama

- **In the <u>cervical</u> spine, serious complications have been reported**
  - **cervical myelopathy (calcification of cervical ligamentum flavum, transverse ligament of the atlas, odontoid fracture.**

(Pritzker.Orthop Clin North Am 1977;

Case 2. 77y , W, occipital pain, motion limitation, myelopathy

Crowned Dens Syndrome



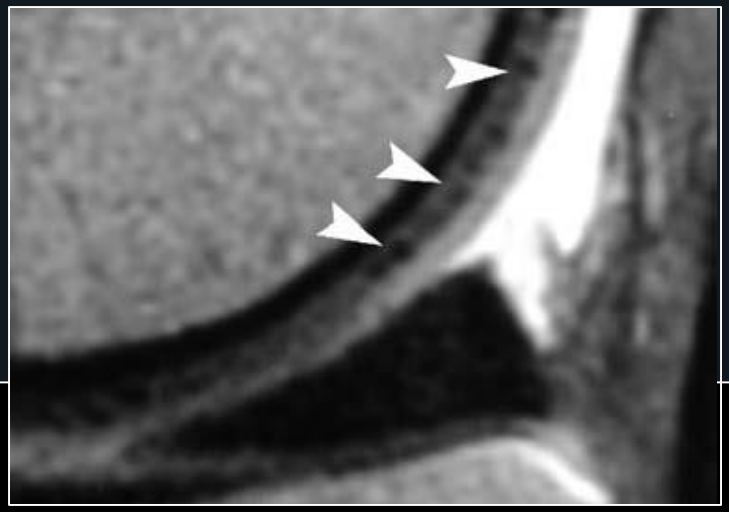
Exaggerated CPPD Deposition at C1-C2

MRI in CPPD

MR imaging diagnostic features in joint CPPD

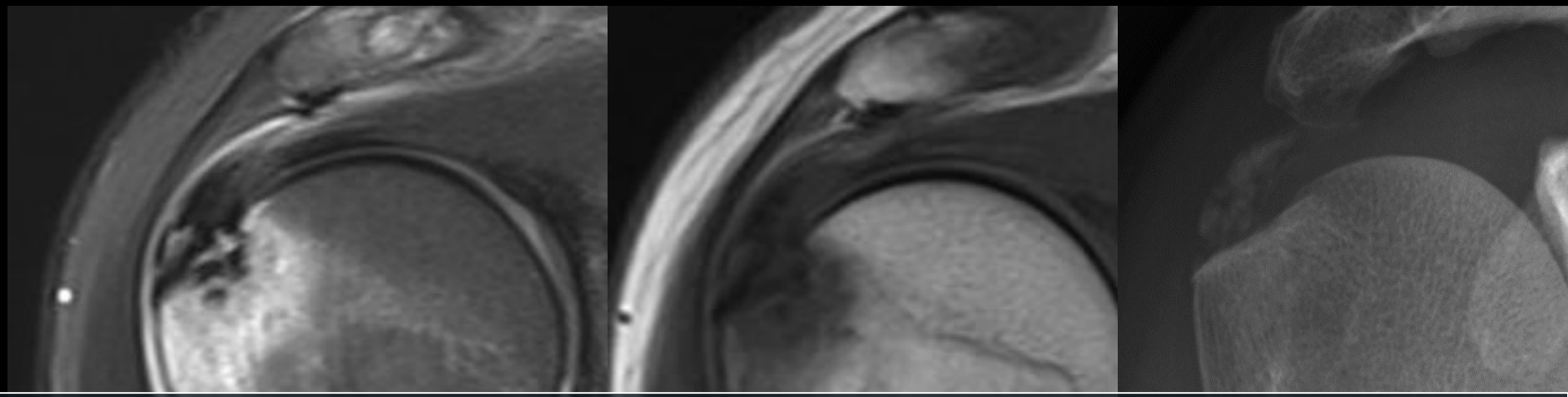
- CPPD commonly encountered in elderly asymptomatic
- MR has low accuracy for CPPD deposits

- MR detects Inflammatory Arthropathy (synovitis, pannus), but needs correlation with x-ray or CT for final diagnosis



Case 3. 40y, M, Shoulder pain for 1 week.

Calcific Tendinitis (Hydroxyapatite)



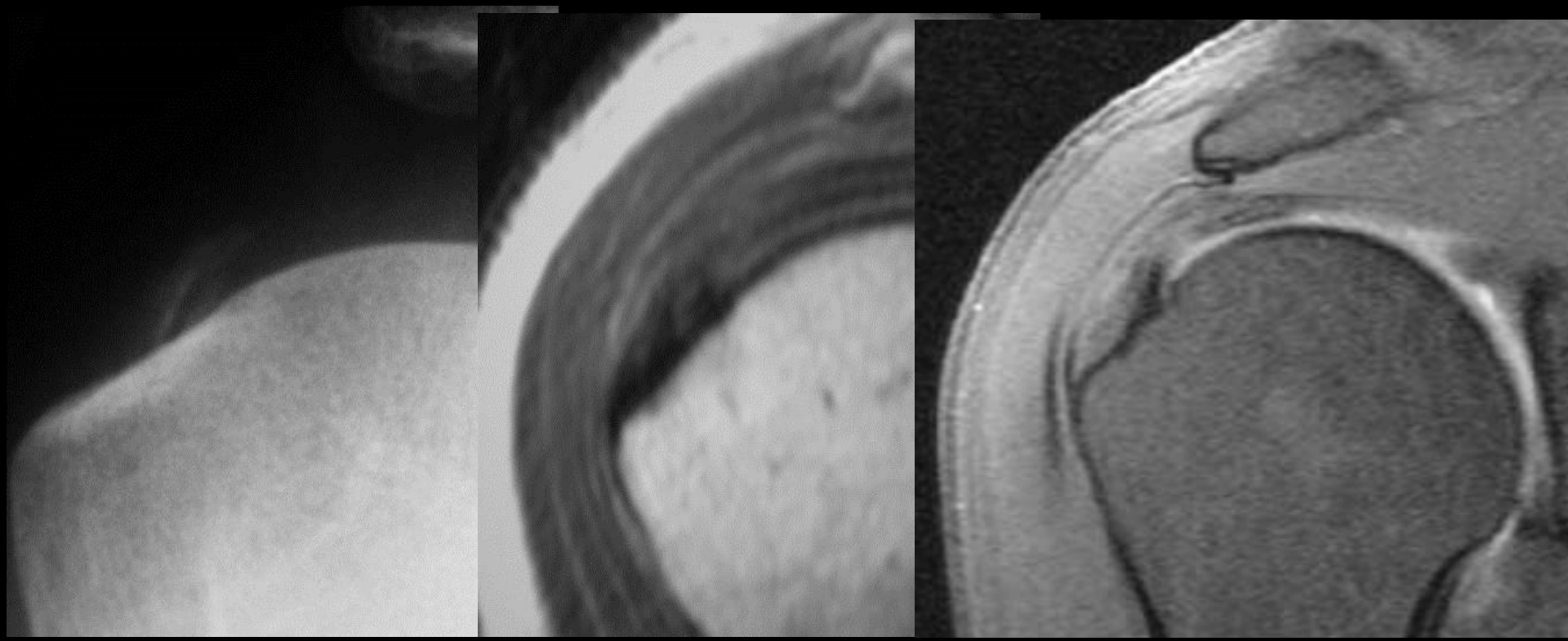
- **Common in asymptomatic persons (when confined)**
- **Most commonly: Supraspinatus tendon insertion**
- Less common: tendons of infraspinatus, subscapularis, deltoid, wrist, elbow, gluteus maximus, knee, and neck.
- Inflammation and edema can occur

T2 fat saturation

How accurate is MR imaging for Hydroxyapatite deposits?

Hydroxyapatite Crystal Deposition

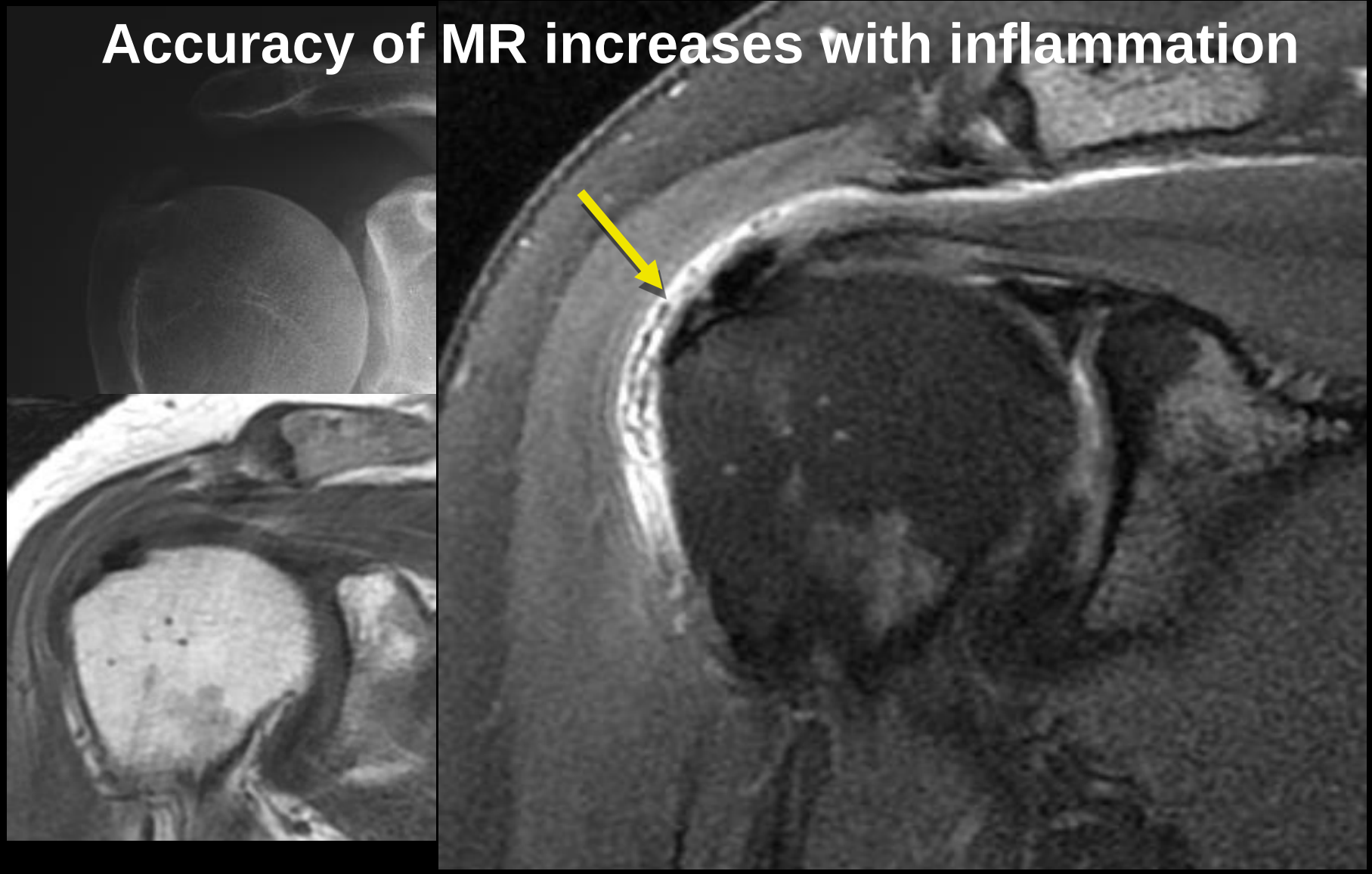
Low Accuracy of MR: 62%-66%

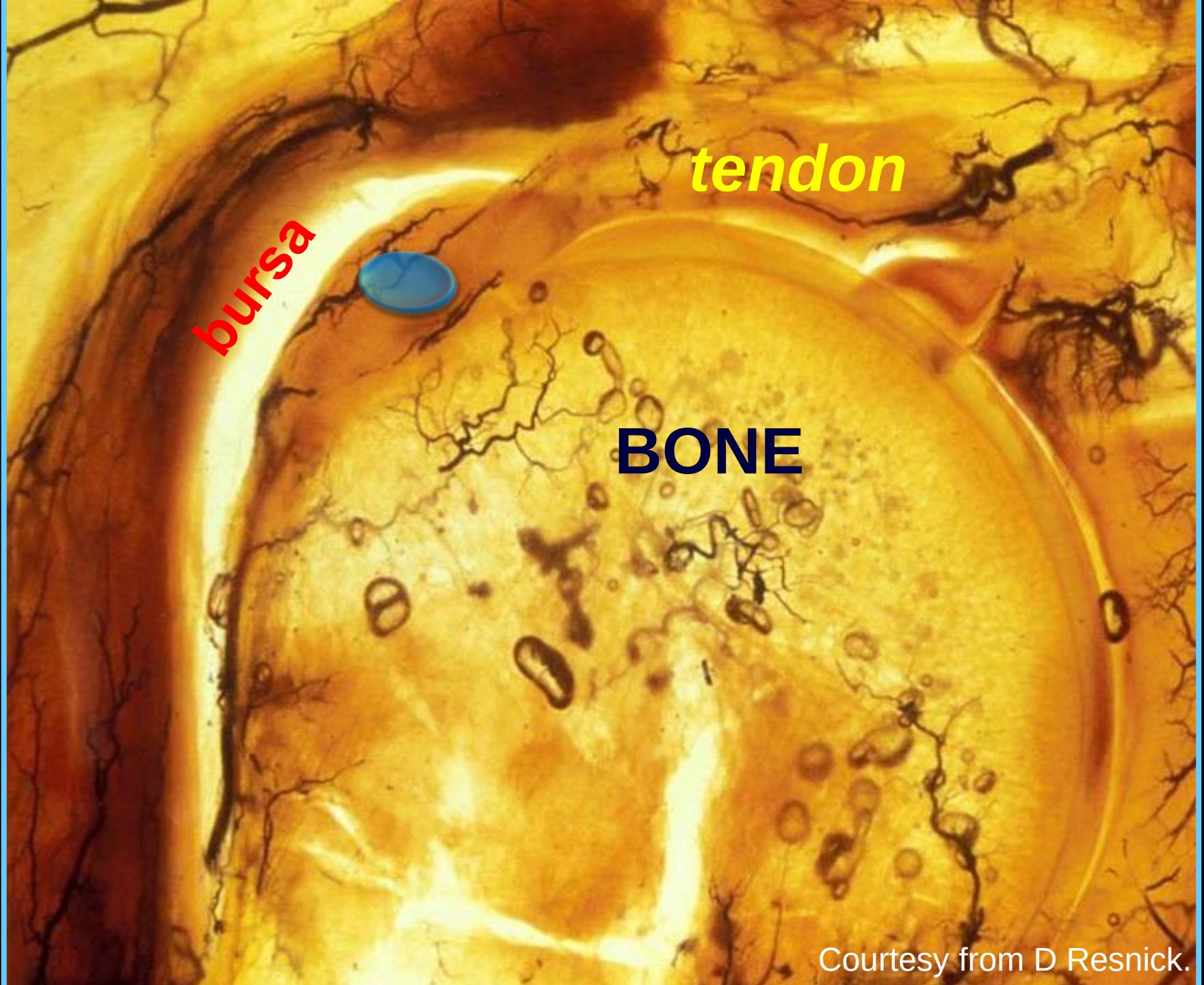


Manny False Negatives and False Positives of MR

Zubler et al. MRA in Calcific Tendinitis Eur Radiol 2006

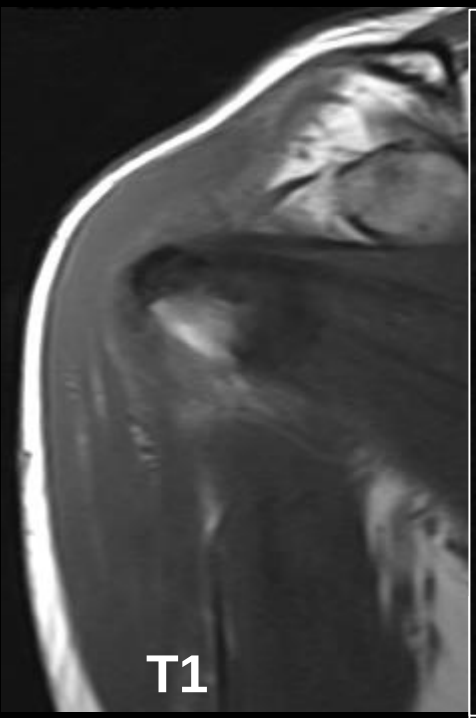
Hydroxyapatite Crystal Deposition

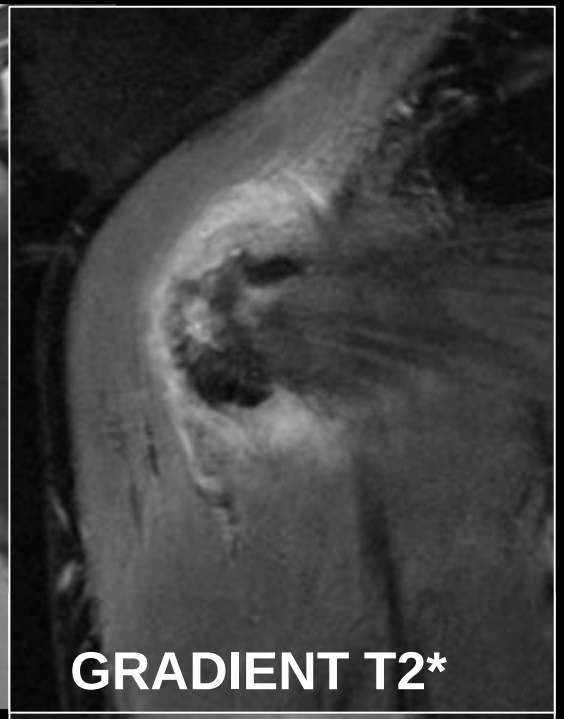




Courtesy from D Resnick.

Case 4. 47y, F, Shoulder pain for 3 weeks.

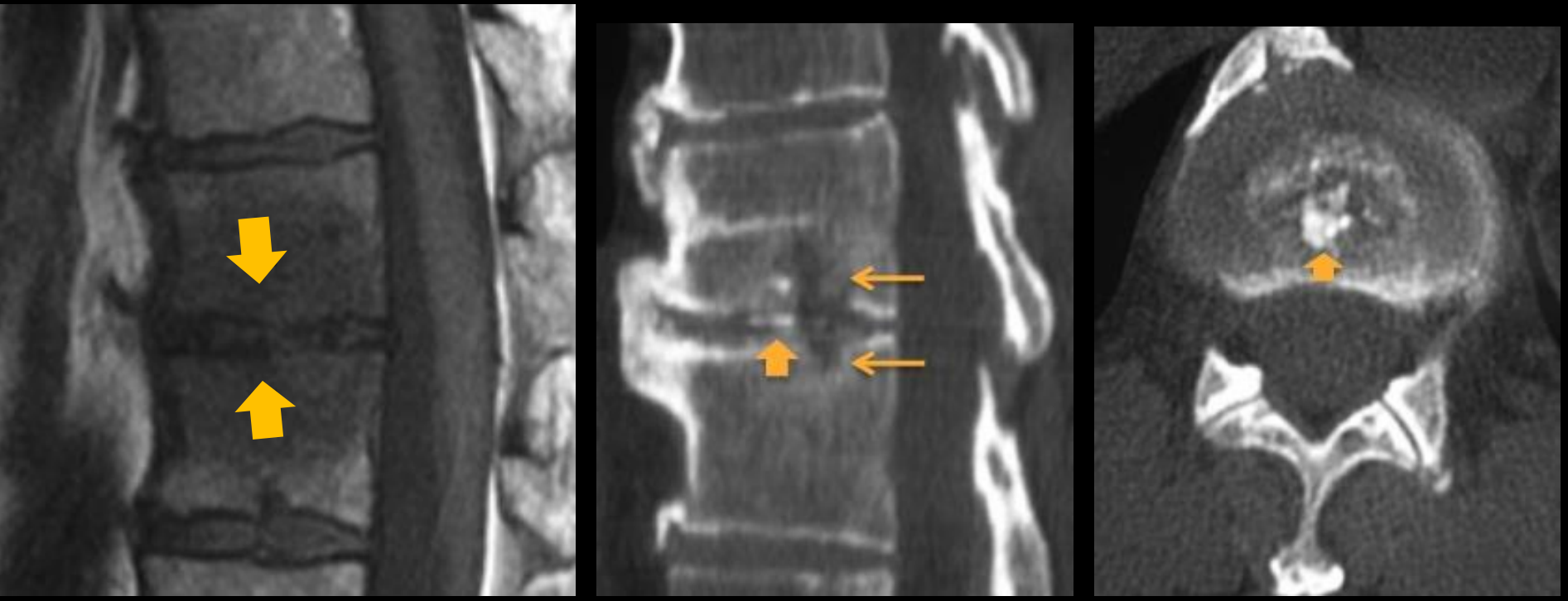




MR-Angio (GAD)

Case 5. 63y, F, Pain for 1 month, high VSG and RCP

Hydroxyapatite Crystal Deposition



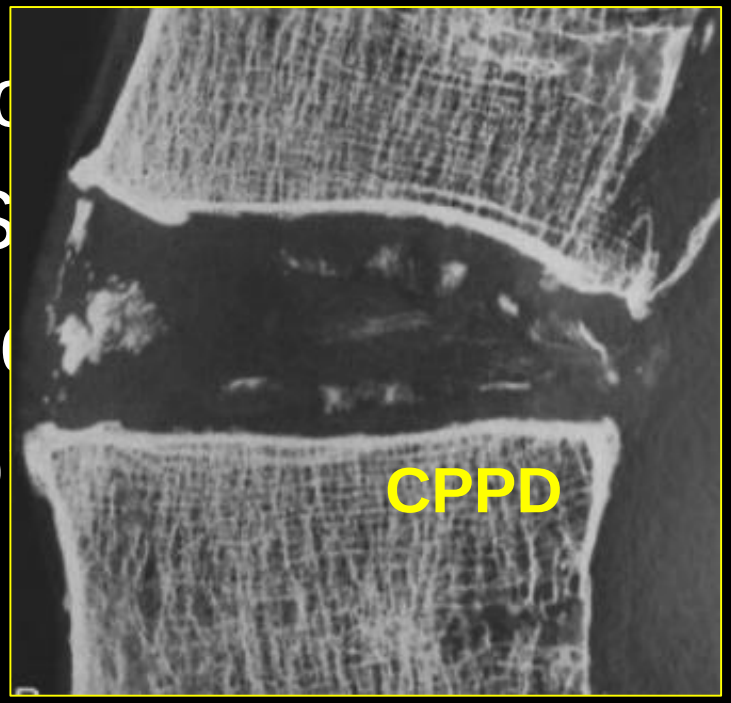
Bone migration, inflammatory response

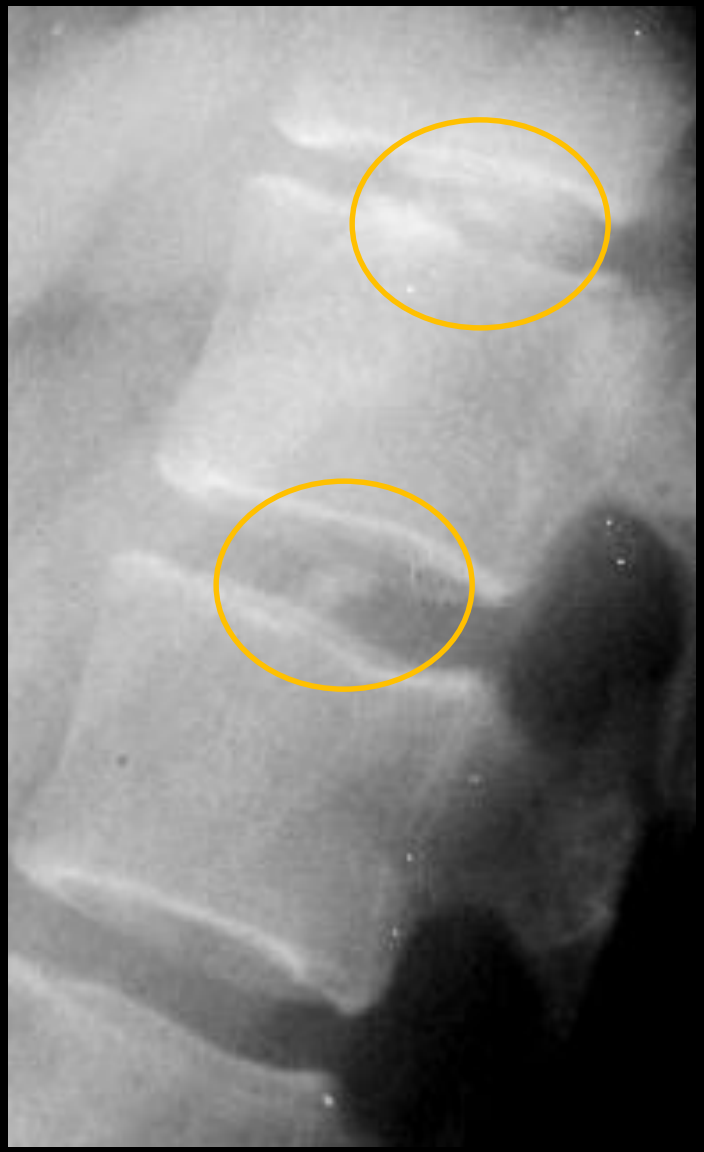
Disc Hydroxyapatite Crystal Deposition

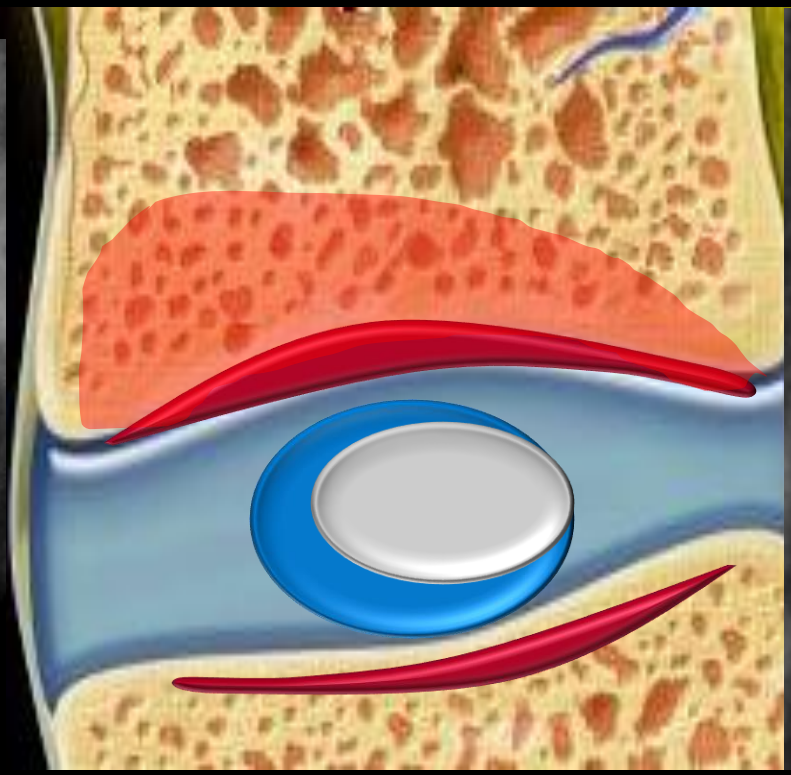
- ***Intervertebral Disc Apatite***
- ***Phosphocalcic Bruschite***
- ***Apatite Rheumatism***

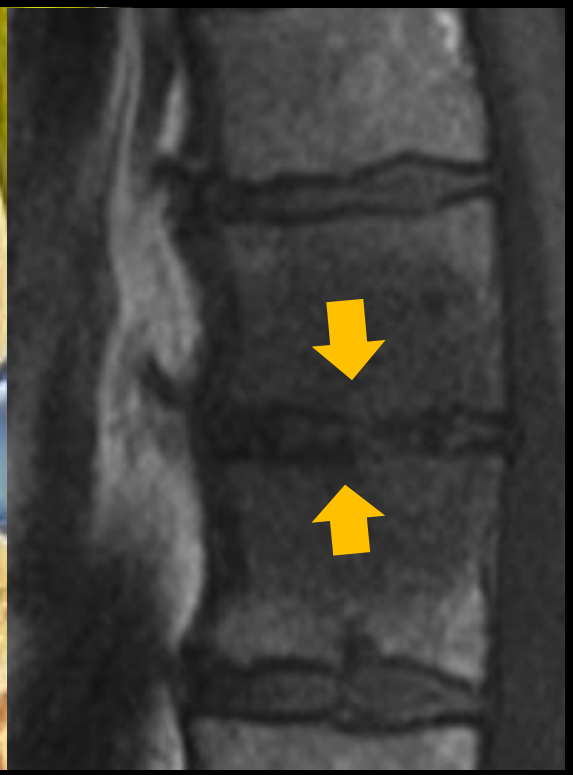
Can also

- Disc S
- Hemo
- Ochro



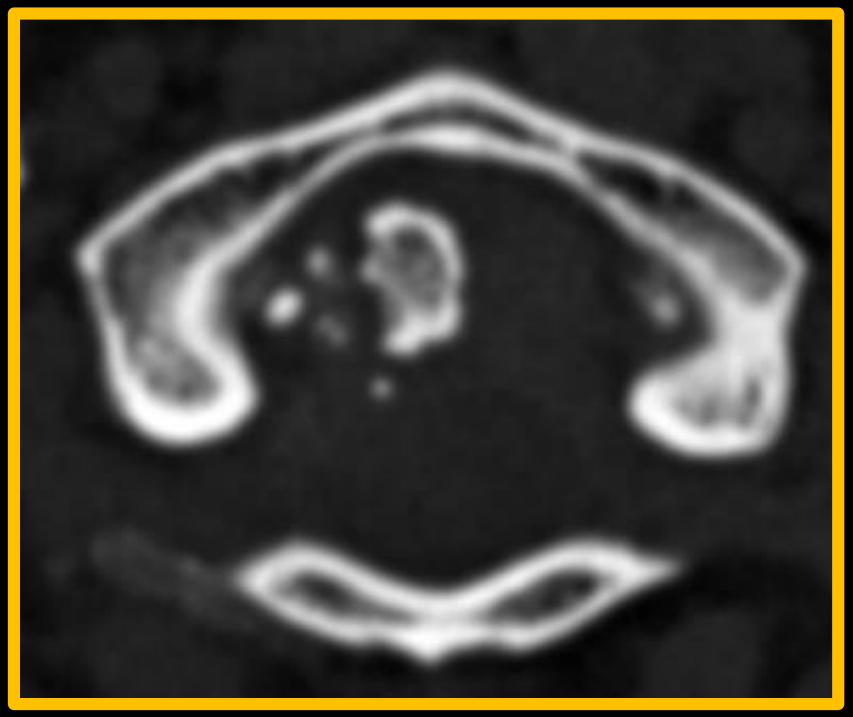




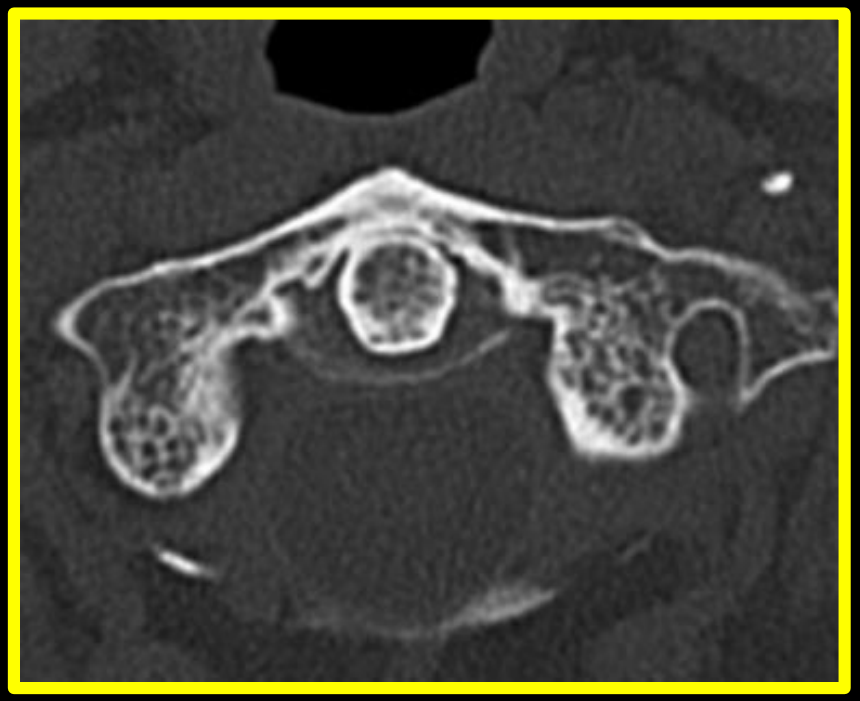


Apatite x CPPD

morphology of calcification

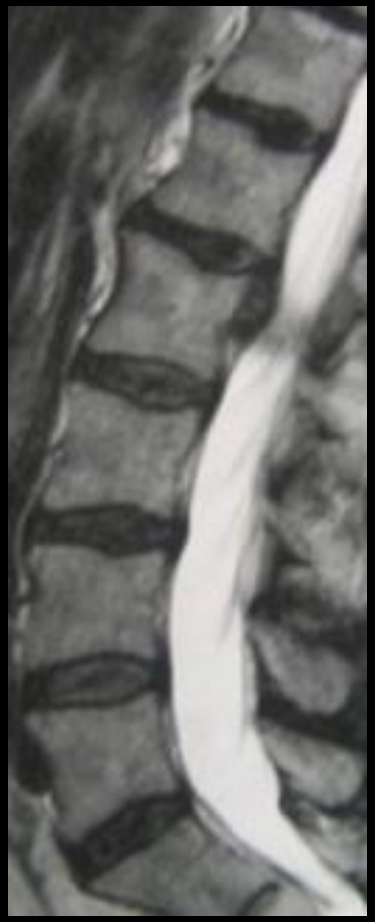


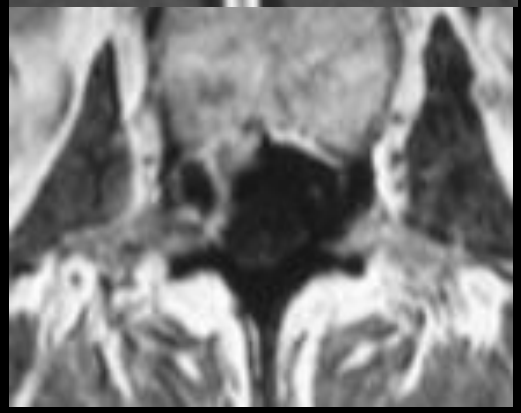
Round dense calcification
Cloud like appearance

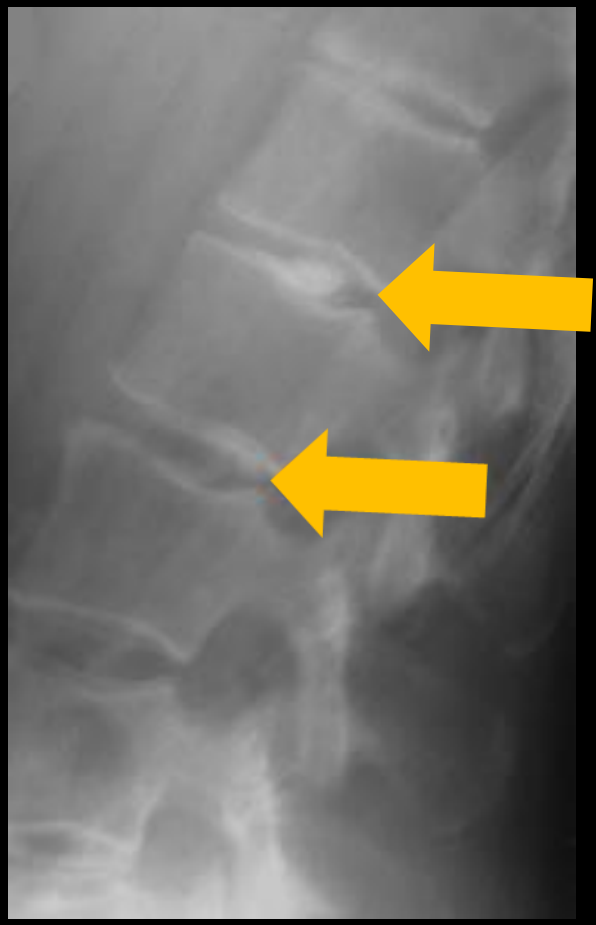


Linear ``CROWNED DENS´´

Disc Hydroxyapatite Crystal Deposition

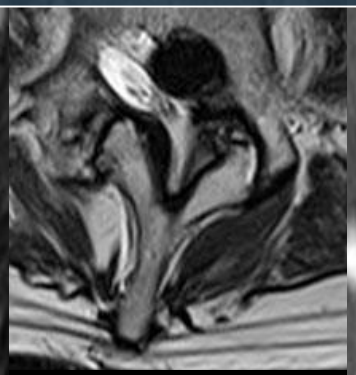


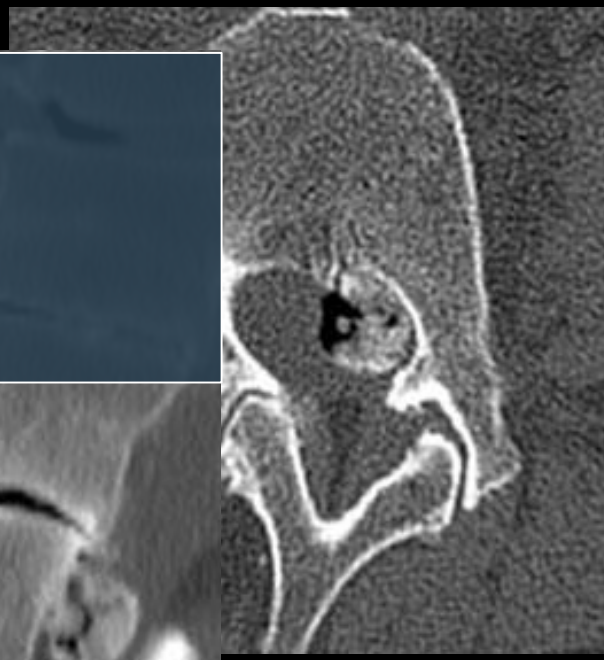




Differentiate from:
Destructive Discovertebral Deg Disease (DDDD)

Malalignment
Degenerative Disc Loss
End-plate failure
“bone sand” within the spinal canal.





Charran, Puliccino V. Destructive discovertebral degenerative disease of the lumbar spine. Skel Rad 2012

MRI in Hydroxyapatite

- MR detects Inflammatory changes when deposits migrate from quiescent stage to bone or soft tissue
- Spine cases can be more challenging
- CT correlation very helpful
- Need better MR sequence to se bone/calcium would help (Zero TE)

Wiesinger, et al. MRM (2015). Delso, et al. J Nuc Med (2015). Leynes, et al. Proc ISMRM 2016.

Case 6. 62y, M, Hallux pain and edema

Monosodium Urate Crystal Deposition (Gout)

- Cumulative crystal deposition is frequently clinically silent, as CPPD, Hydroxyapatite
- Genetic predisposition 1%–2% of the population.
- Crystal deposition in and around joints, and tendons.
- Serum urate exceeding the physiologic saturation threshold (380 mmol/L)

Acute gouty arthritis:

LOWER LOMB joints (85%–90% of cases)

FIRST MTP joint (PODAGRA)

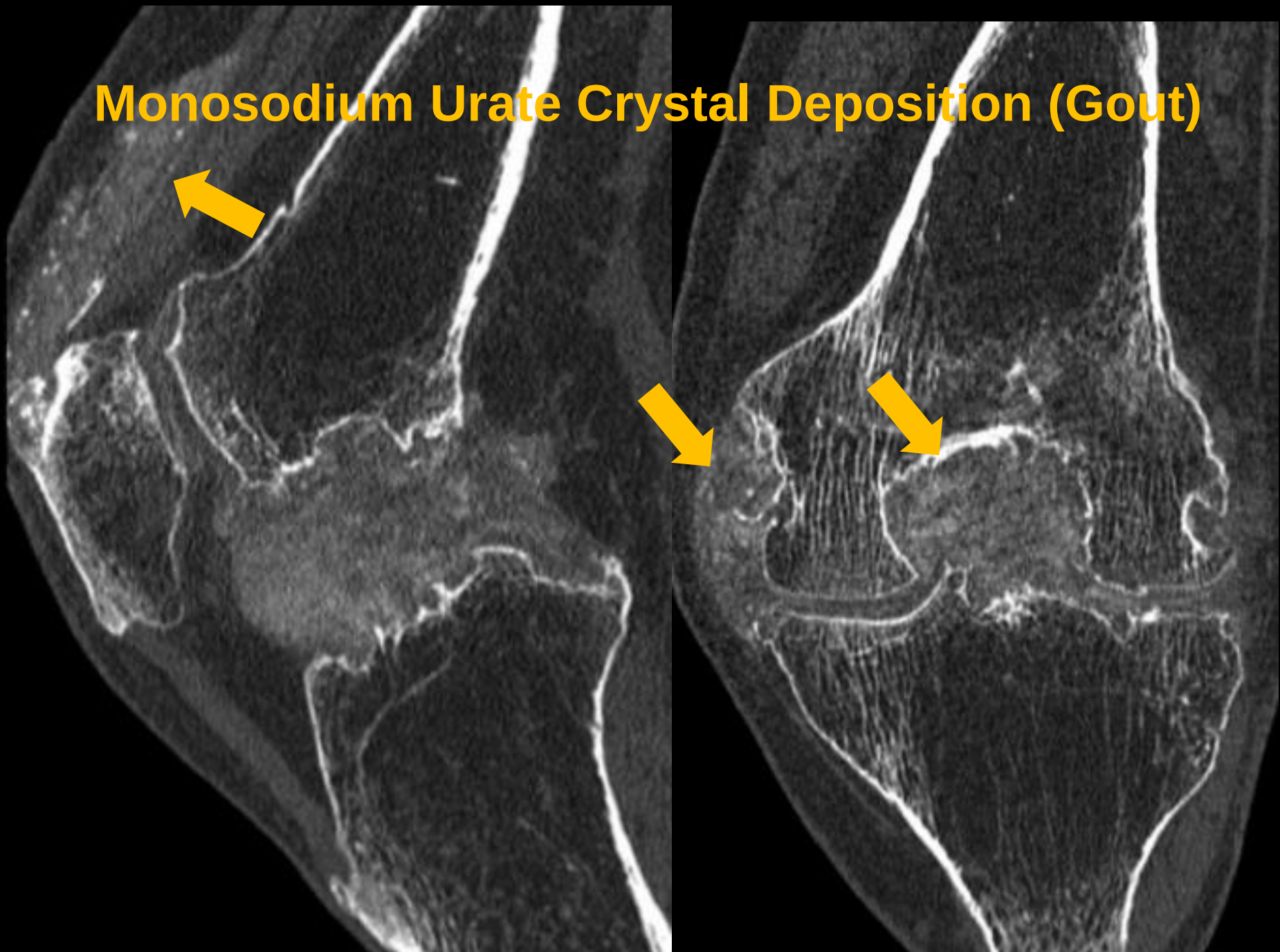
Gout: Clinical

- The disease has four phases:

1. Asymptomatic hyperuricemia
2. Acute
3. Intercritical
4. Chronic

Advanced Stage of Disease

Monosodium Urate Crystal Deposition (Gout)

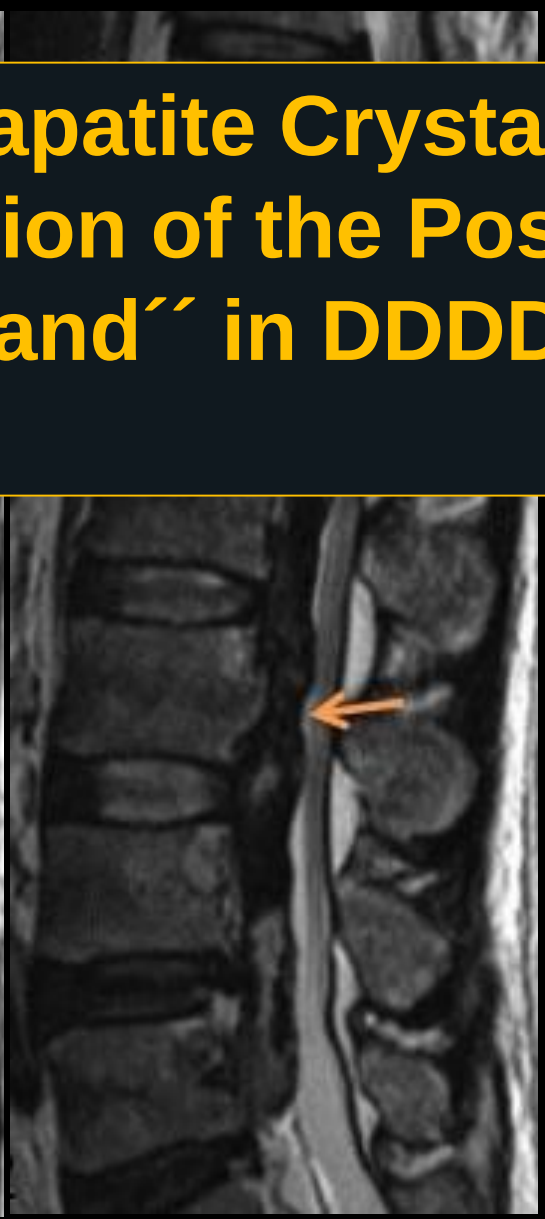


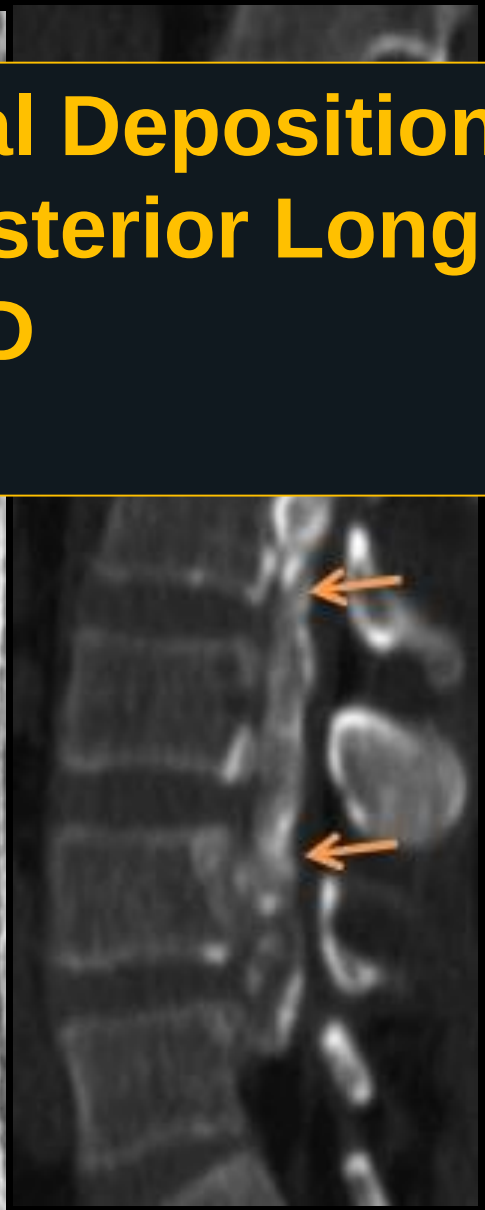
Case 9. 69y, M, back pain and radiculopathy.

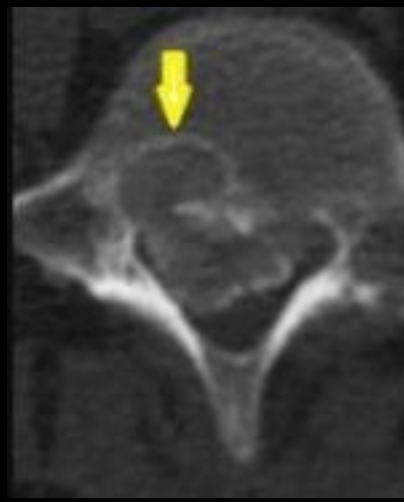
Rheumatological Protocol: T1, STIR 3 planes, and axial T1 and T2

Case 10. 47y F, *Cauda Equina Syndrome*

- **Hydroxyapatite Crystal Deposition**
- **Ossification of the Posterior Long Lig**
- **``Bone Sand´´ in DDDD**
- **<u>Gout</u>**

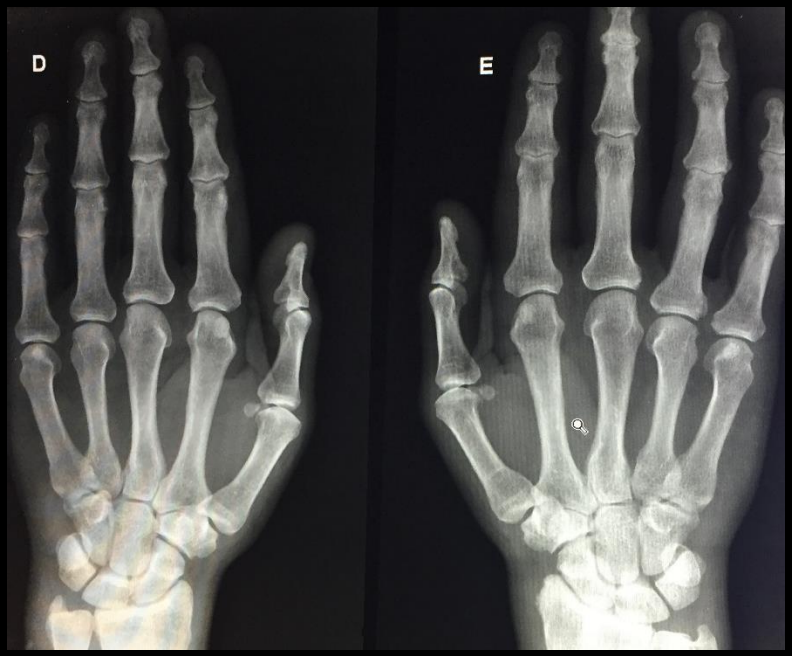






Monosodium Urate Crystal Deposition (Gout)

Early stage diagnosis of Inflammatory Arthropathy



STIR, MOST SENSITIVE

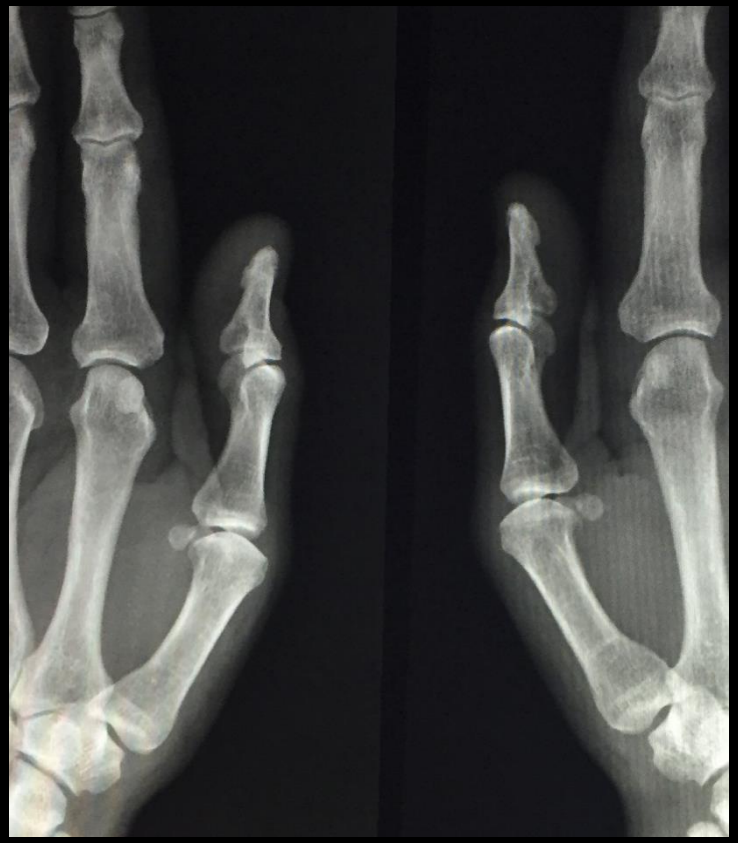
Monosodium Urate Crystal Deposition (Gout)

Early stage diagnosis of Inflammatory Arthropathy

MR-ANGIO, BETTER

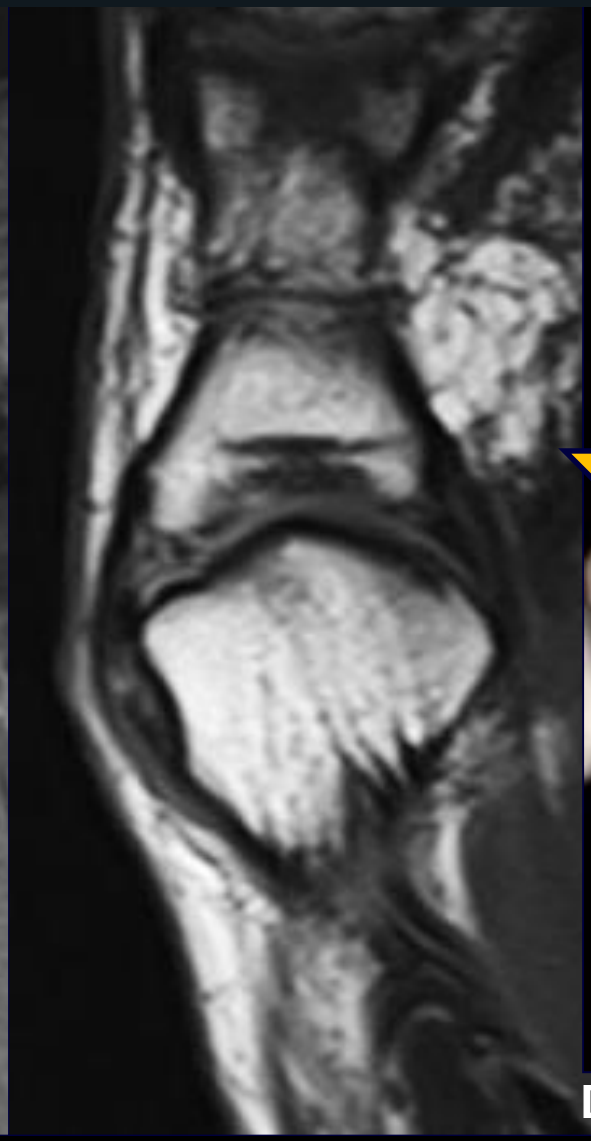
STIR, MOST SENSITIVE

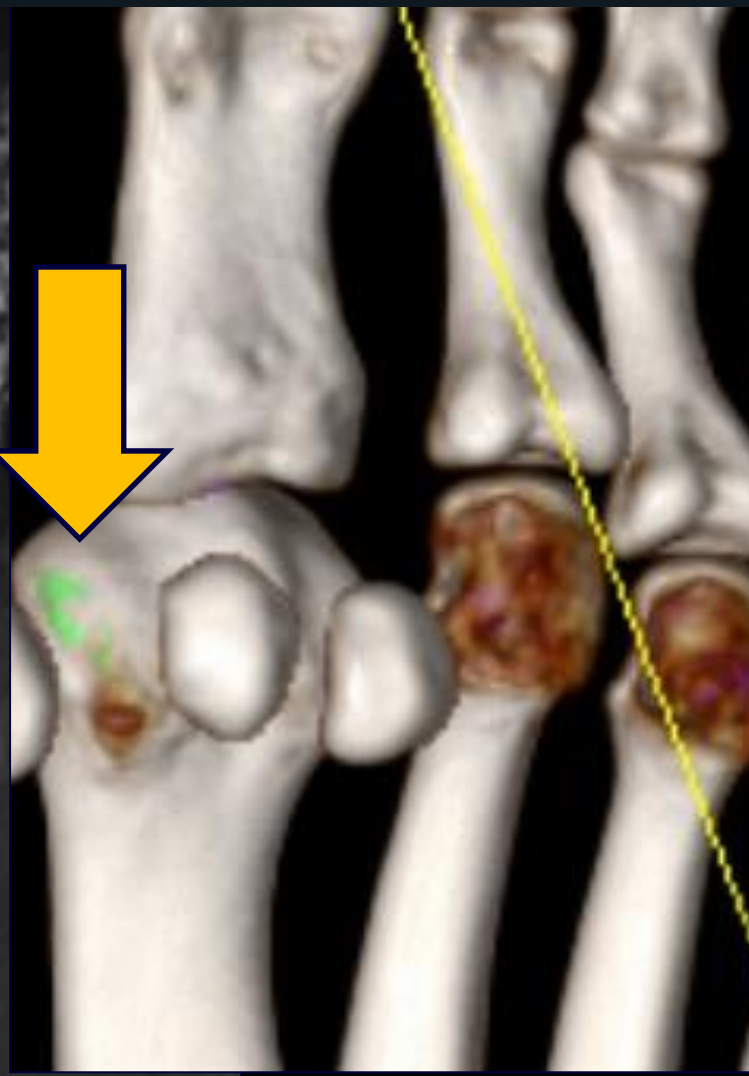
Early stage diagnosis of Inflammatory Arthropathy



Inverted MR-ANGIO

Case 7. 40, M, Local pain for 15 days.
No trauma or hiperuricemia.

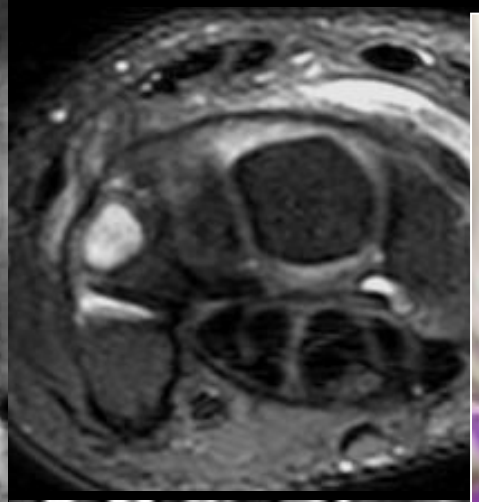




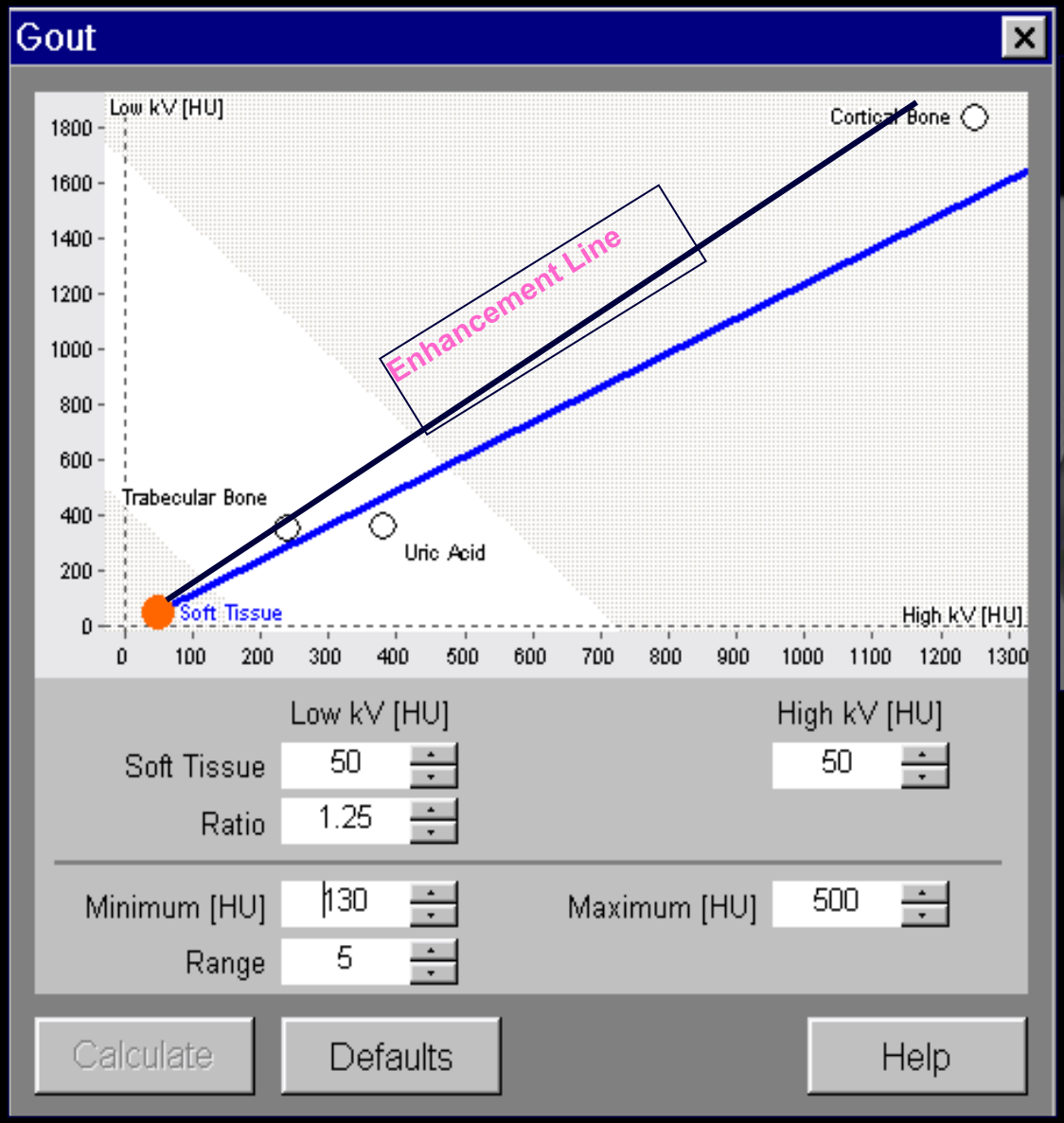
Dual Energy CT

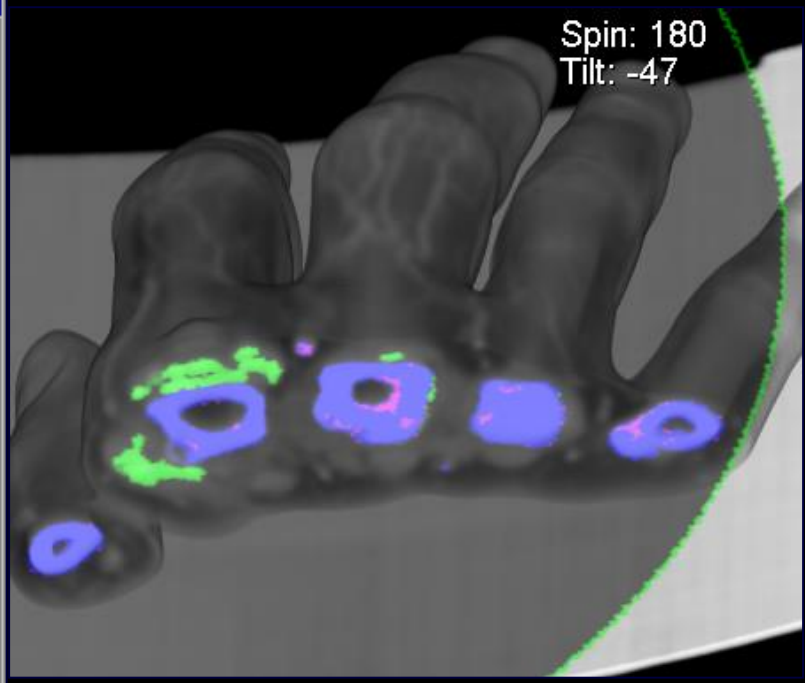
Courtesy of Dr Skaf A

Case 8. Wrist pain for 24 days. No trauma or hiperuricemia.



Dual Energy CT in GOUT





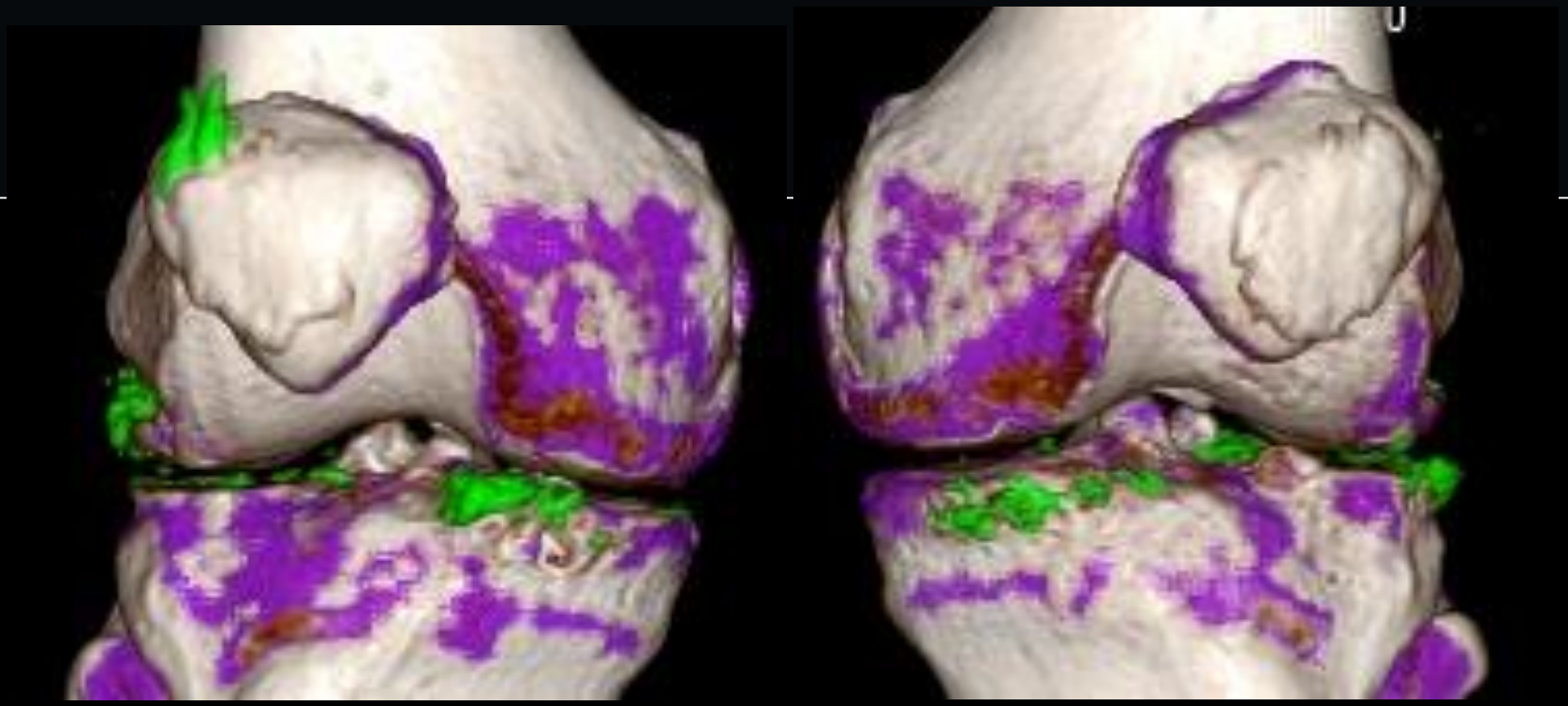
COTICAL BONE

URATE

IODINE

DUAL ENERGY CT in Gout

- Important Imaging Method for Diagnosis and Follow-up
- Very small Radiation Exposure: 0.5mSv/joint



1. S. Dhanda. Clinical Radiology 2011
2. Savvakis N. AJR 2010
3. Fernando Perez-Ruiz1Arthritis Research & Therapy 2009
4. Perez-Ruiz F et al. Adv Ther 2015

Courtesy of Dr Skaf A

Summary
Crystals Deposition Diseases

- **CPPD, Hydroxyapatite and Urate: *can be silent***

- **When activated, various clinical scenarios can be found:**
  - **Acute/Chronic/Intercritical Inflammatory Arthritis**
  - **Inflammatory Tendinopathy/Bursitis**
  - **Back Pain, Compressive Myelopathy**

MR imaging is a very useful imaging method for the diagnosis of those diseases, most of the time together with other methods like CT, DE-CT

Crystal Deposition Diseases

Thank You

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