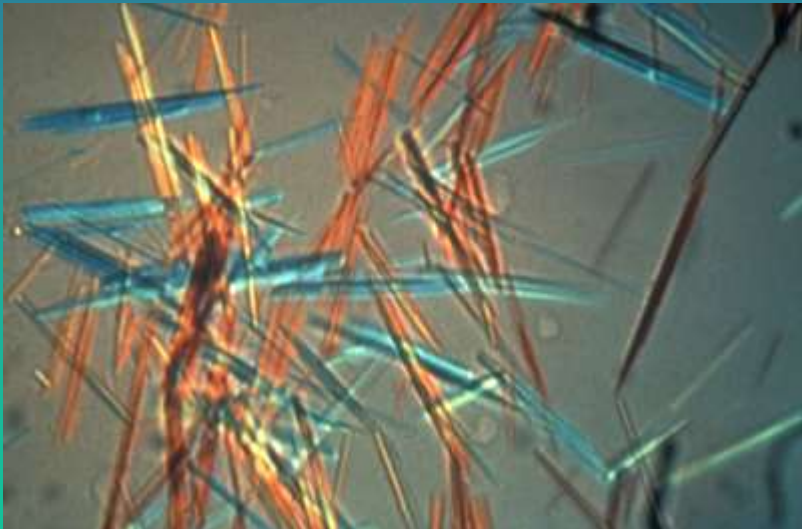
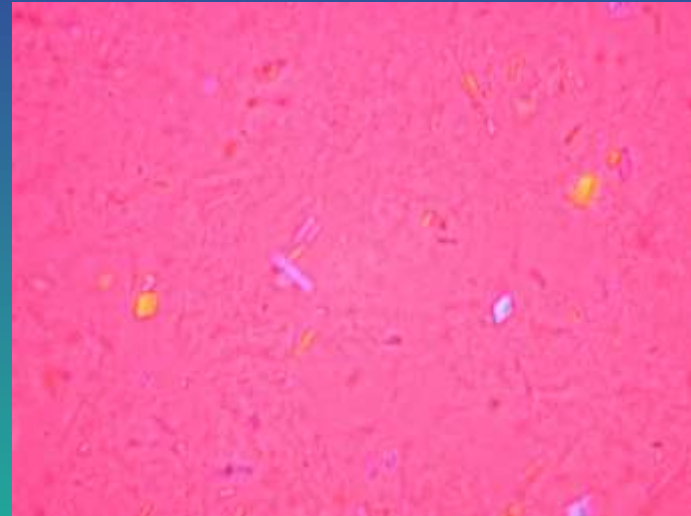
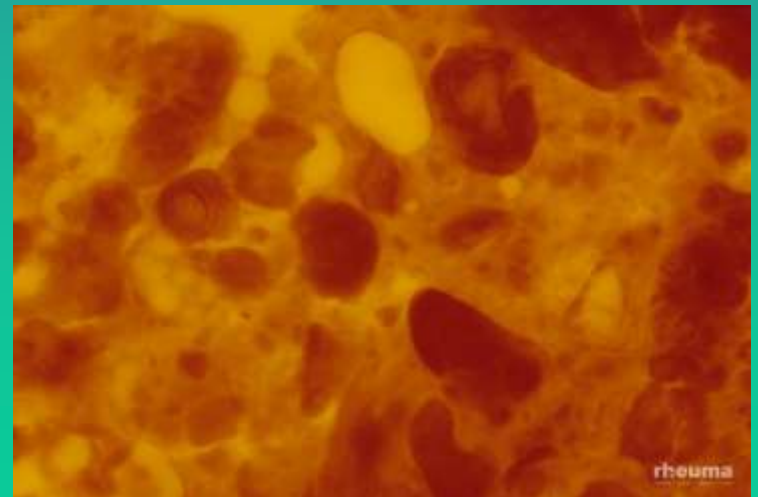
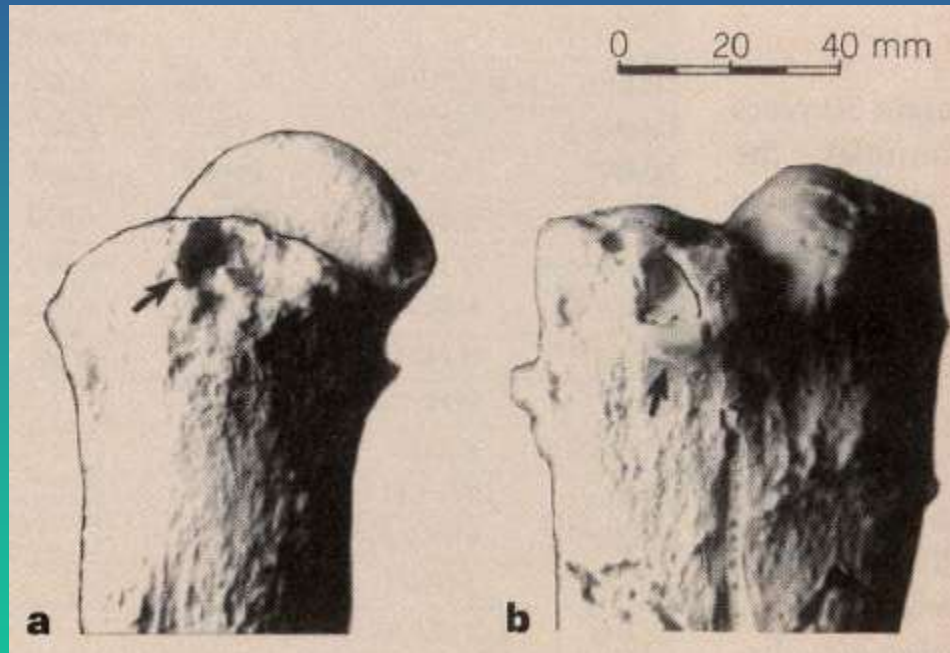


Crystal arthropathies



- Andreas Krebs

a look back...

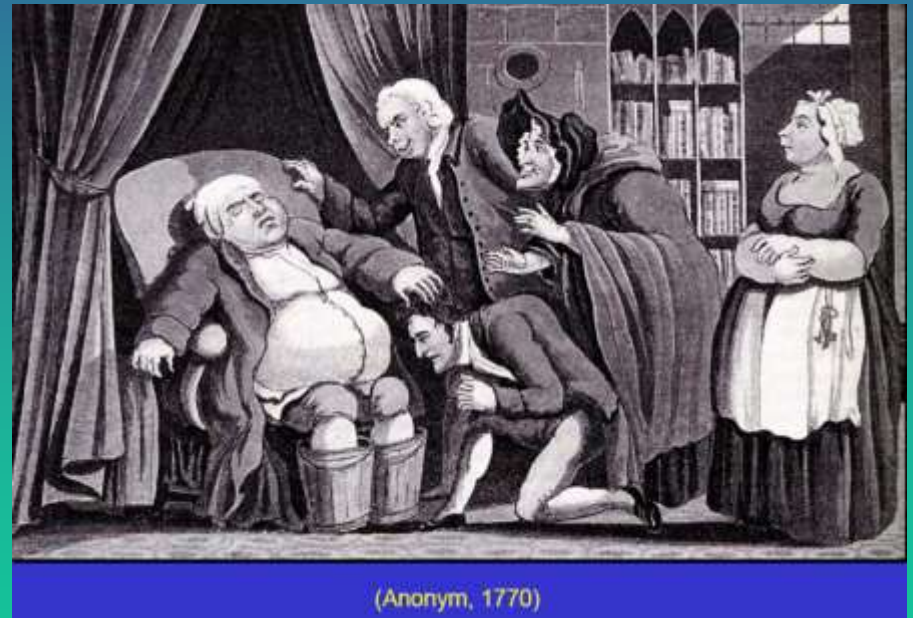


Nature 387, 357 (22 May 1997)



Gout

- oldest arthritis
- incidence increasing
- most common crystal-arthritis
- more frequent than rheumatoid arthritis in men



gout diagnosis

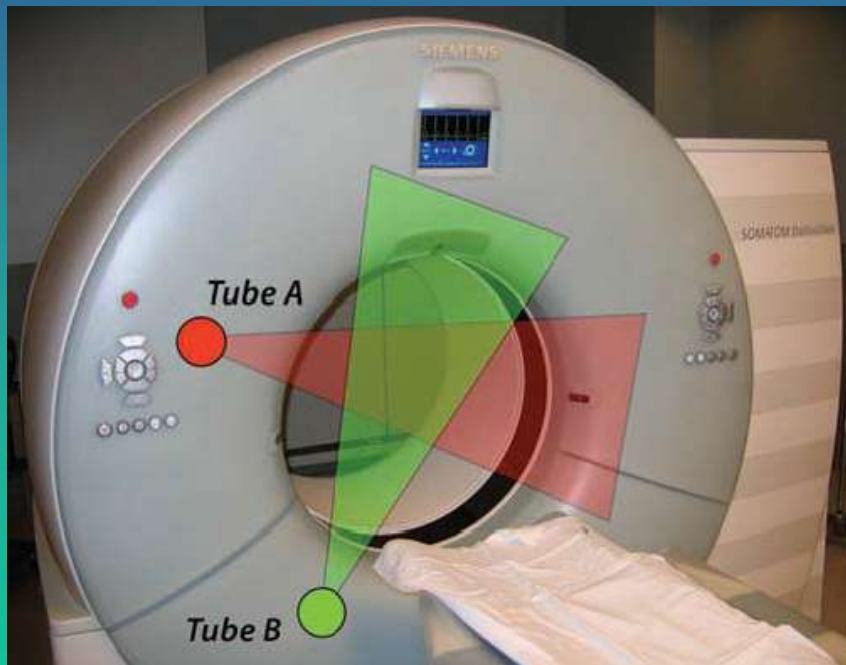
- **Key investigation:** arthrocentesis and microscopic urate-crystal identification
- **Clinically:** in very typical cases based on various criteria:
sensitivity/specificity about 80%
- **Lab:** not very helpful
- **Imaging:** X-ray, US, DE-CT, MRI

conventional X-ray

- high specificity, but only after a longer period of uncontrolled disease...

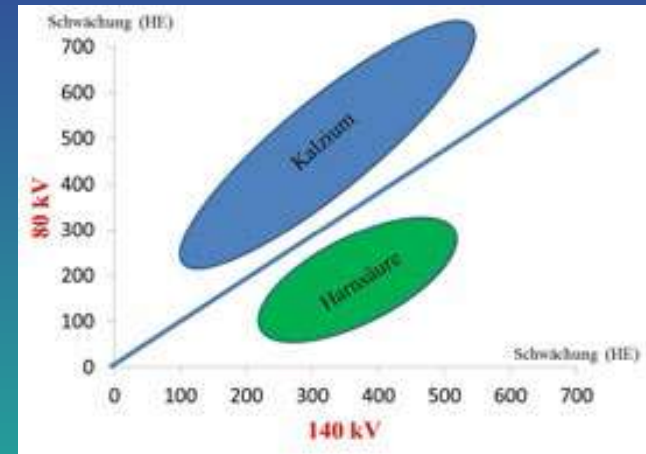
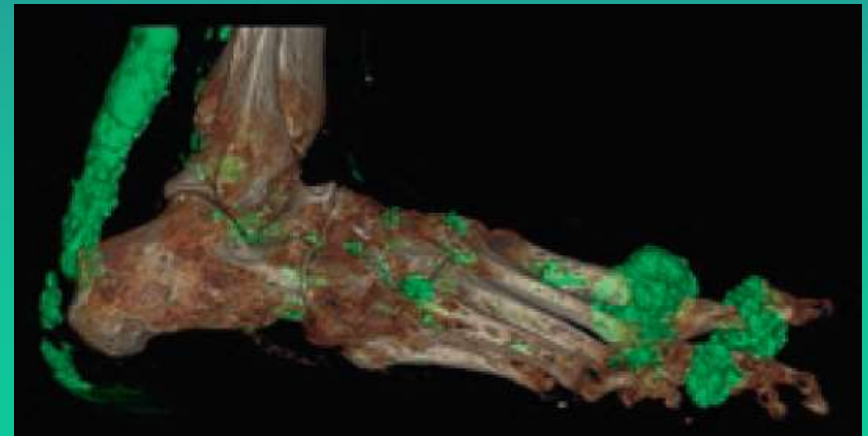


Dual-energy-CT (DECT)

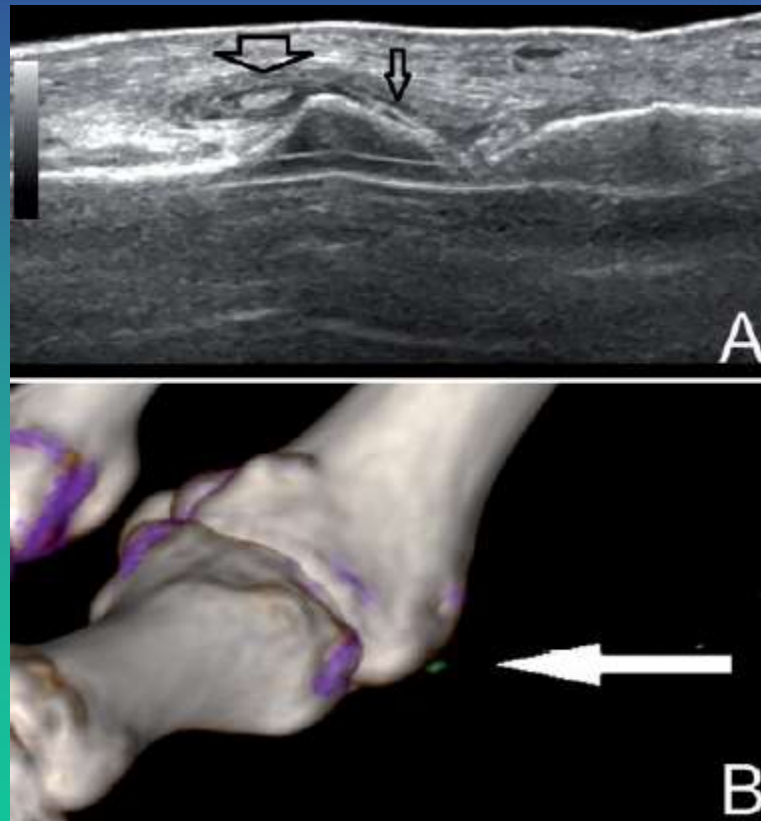


DE-CT

- Sens: 78%
- Spez: 93%
- false - :
 - no or very small tophi
- false +:
 - thick skin



Dual-energy computed tomography compared with ultrasound in the diagnosis of gout



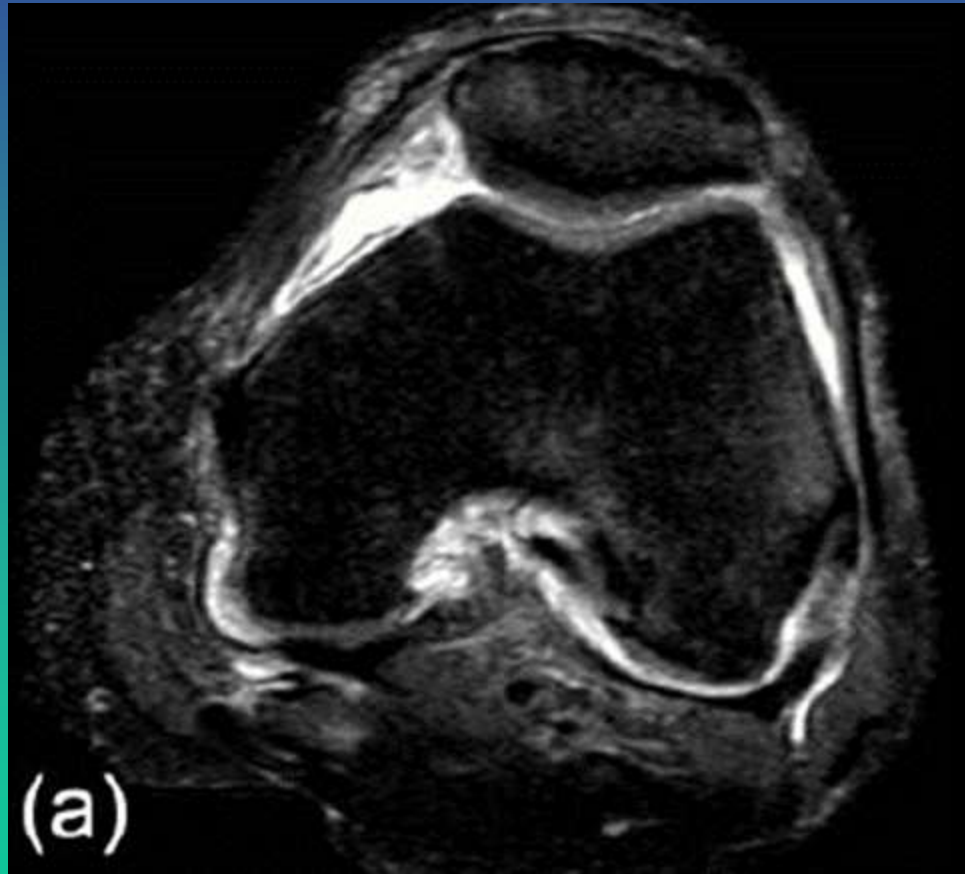
Rheumatology 2014;53:173-179

Dual-energy computed tomography compared with ultrasound in the diagnosis of gout

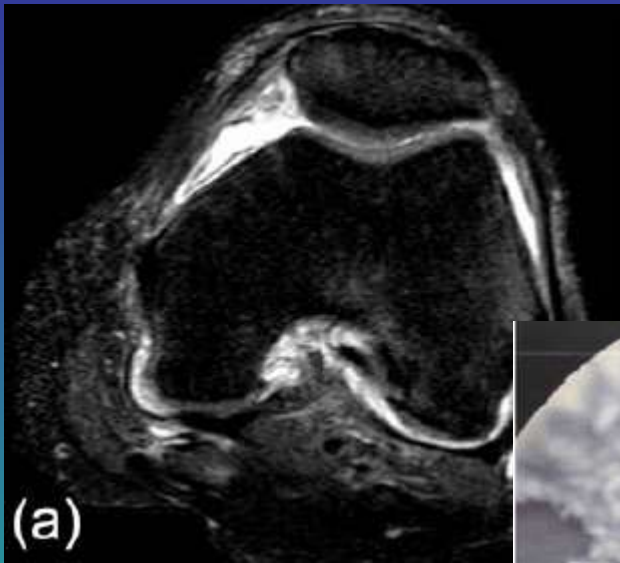
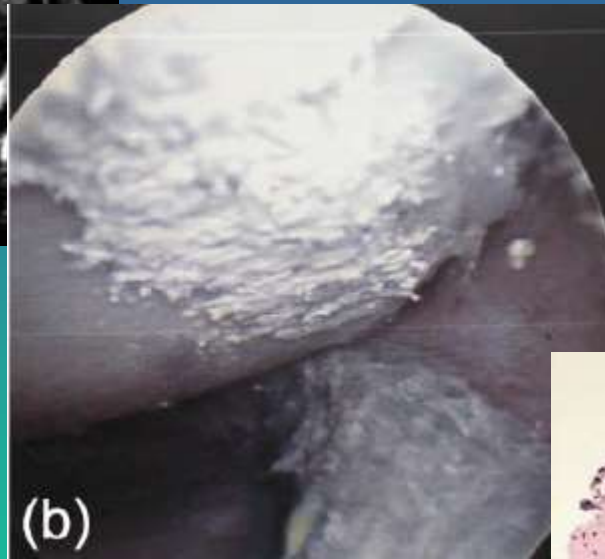
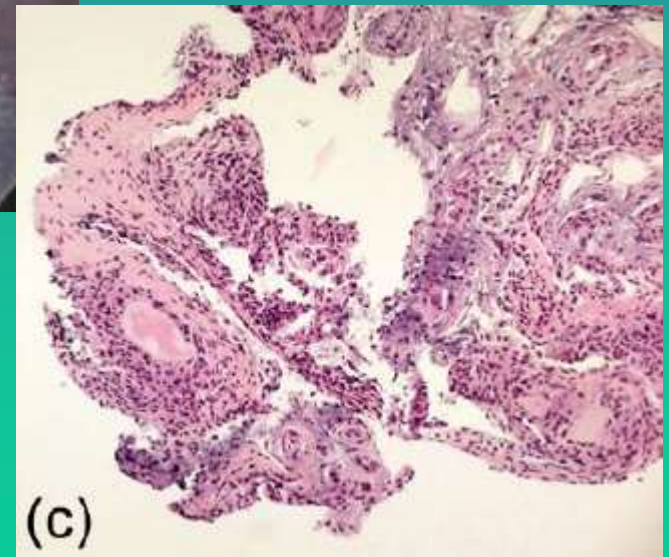
- 37 joints with clinical suspicion of gout
- DECT: + 25 / 37
- US: + 24 / 37
- 14 synovial fluid: 12 +
 - DECT: 12/14
 - US: 14/14
- Conclusion: DECT and US have comparable sensitivity



MRI?



MRI ?



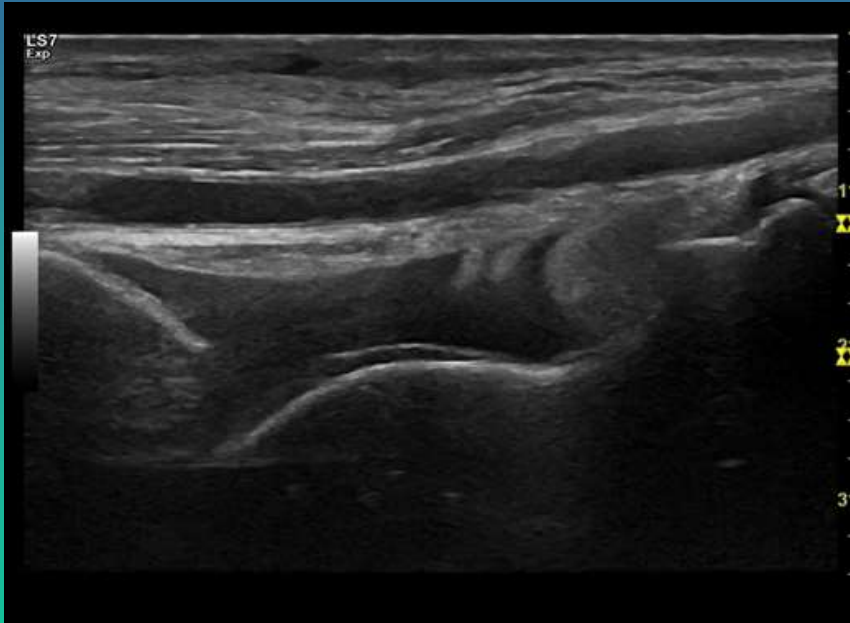
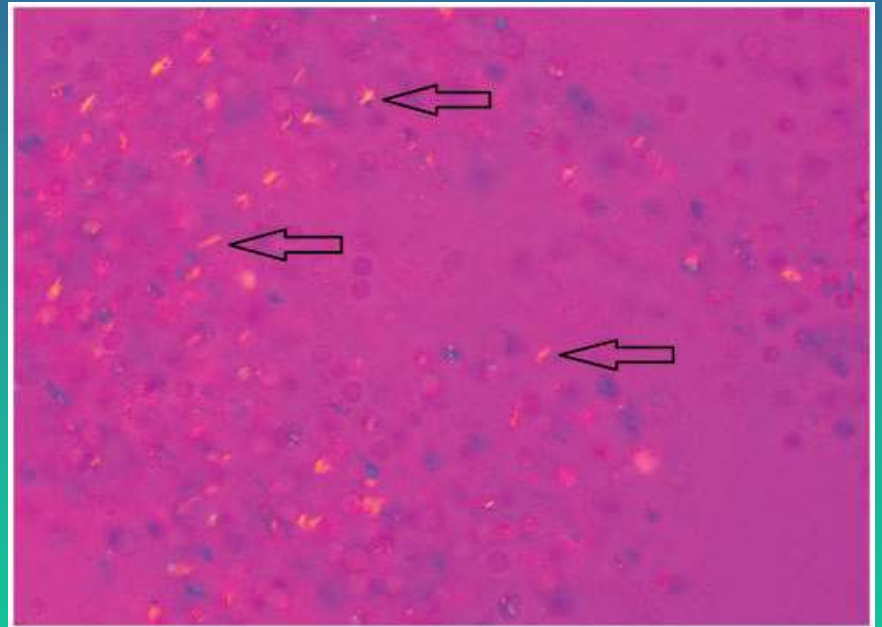
Therapeutic Advances in Musculoskeletal
Disease (2015) 7 (6): 225-233

US in gout

- non specific:
 - arthritis / synovitis
 - erosions
- specific:
 - tophus
 - double-contour

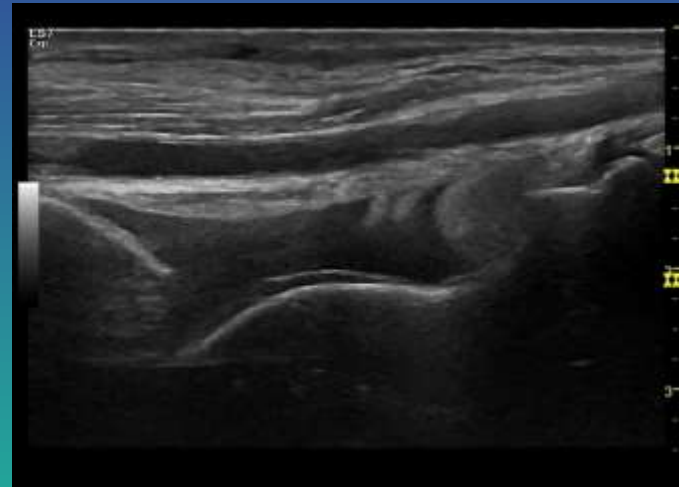
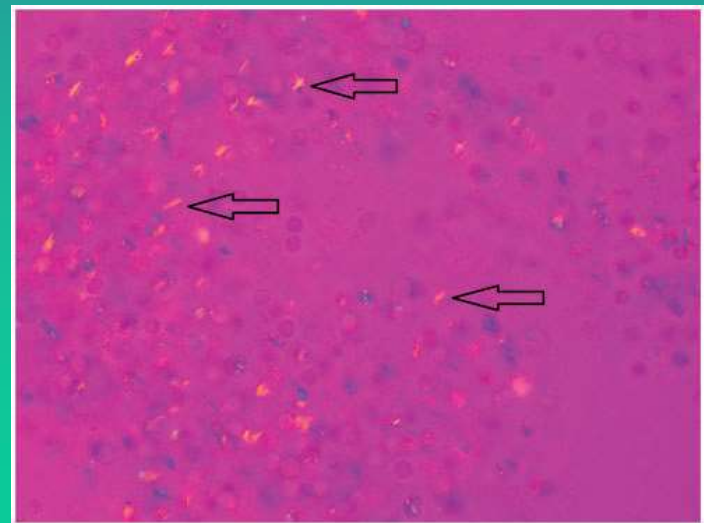


Arthritis



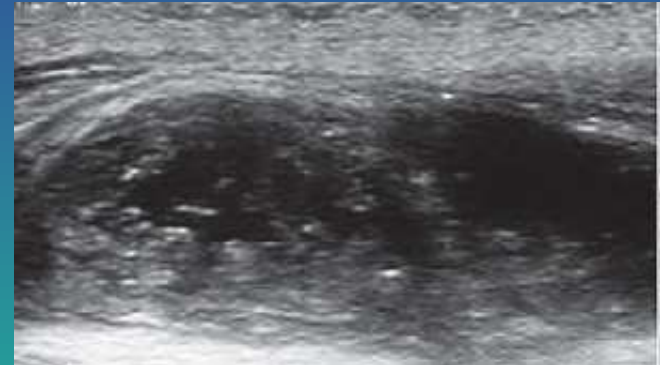
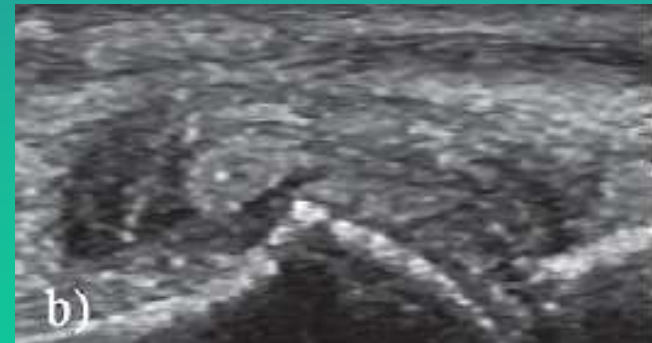
Arthritis

- per se non specific
- also powerdoppler non specific
- facilitates synovial fluid aspiration
- guided injection



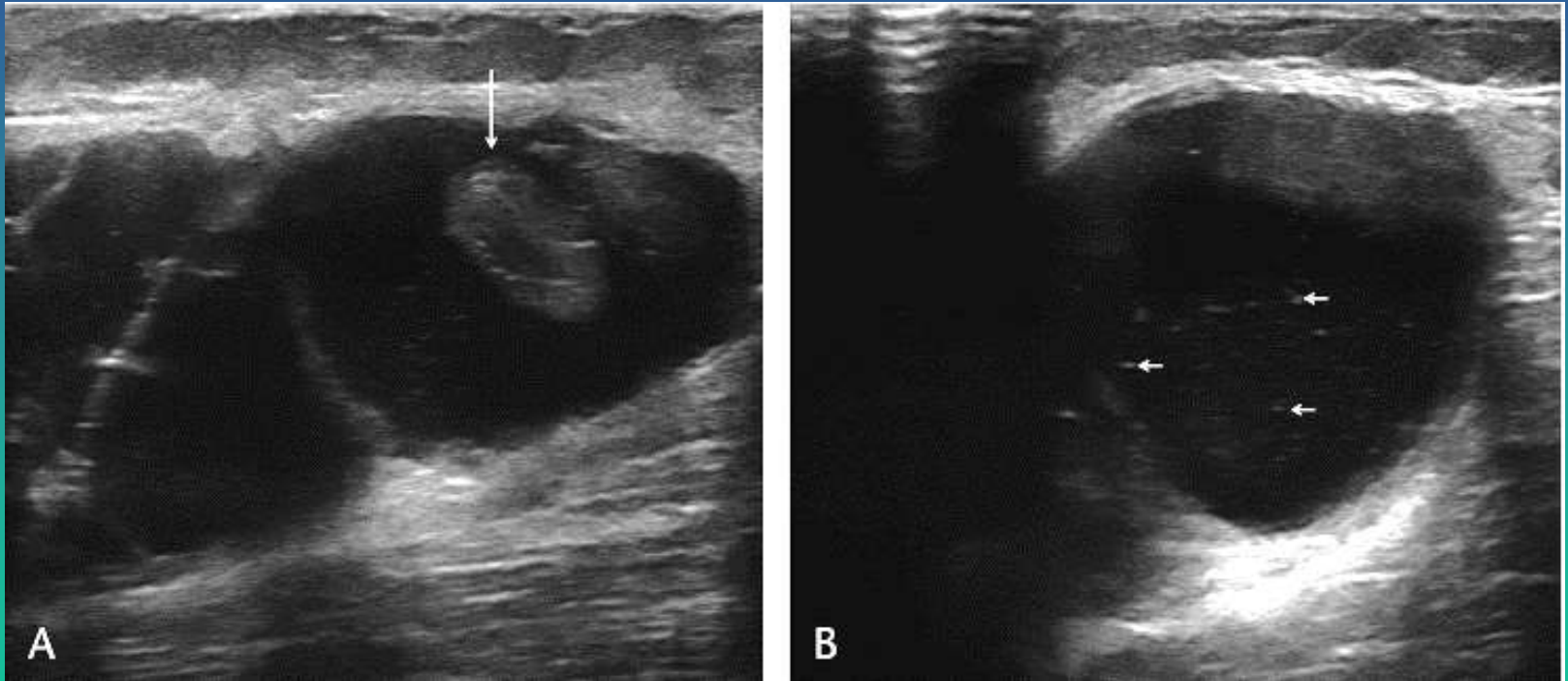
Aggregates in the synovial fluid?

- hyperechoic spots
- («snowstorm»)
- without change in deep gain and independent of the angel of insonation
- ? acoustic shadow



Floating Tophi in a Baker Cyst Secondary to Gout: Ultrasound Features and Differential Diagnosis.

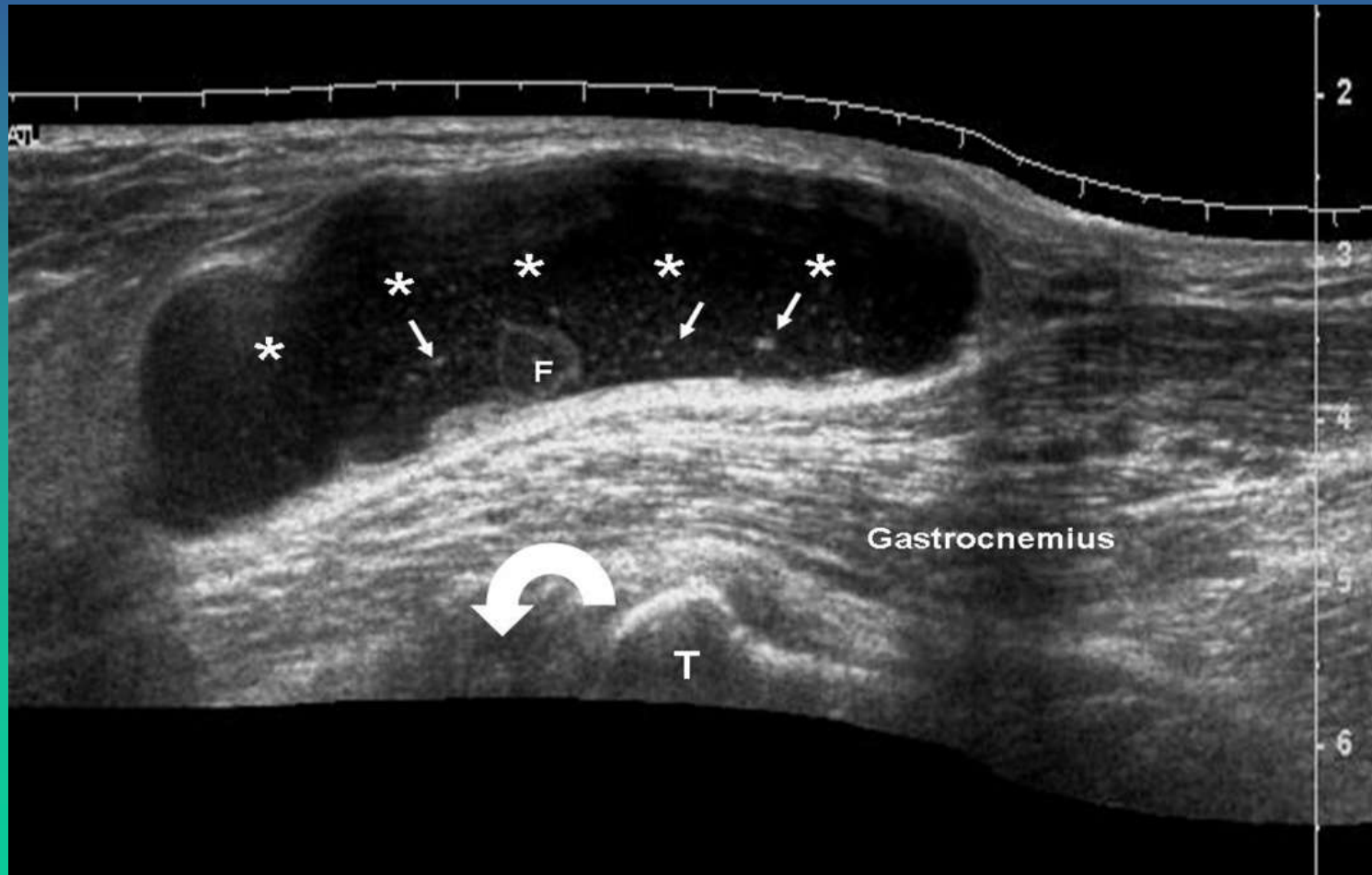
Derry, William; Motamedi, Kambiz; Ben-Artzi, Ami



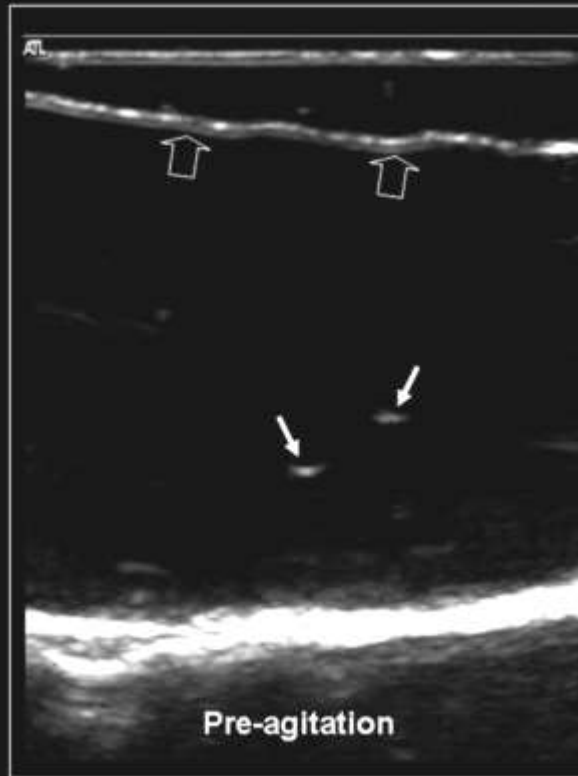
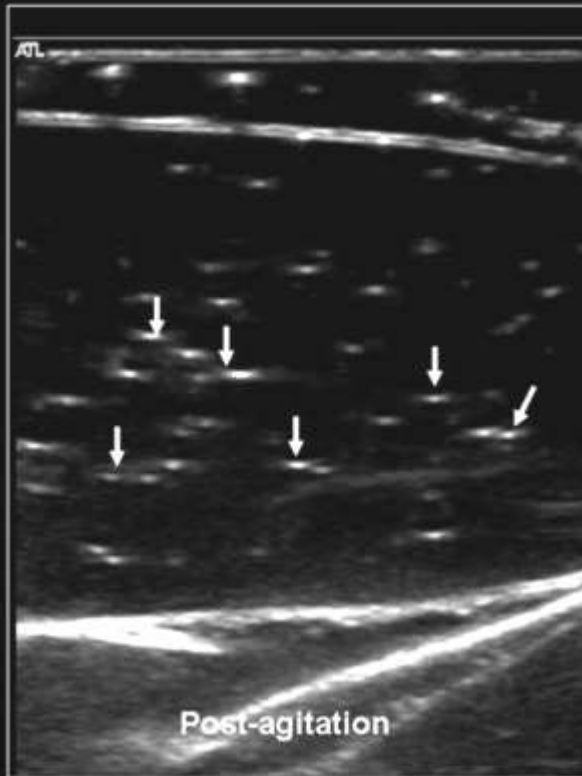
- Ultrasound Quarterly. 31(3):189-191, September 2015.

All that glimmers is not gold...

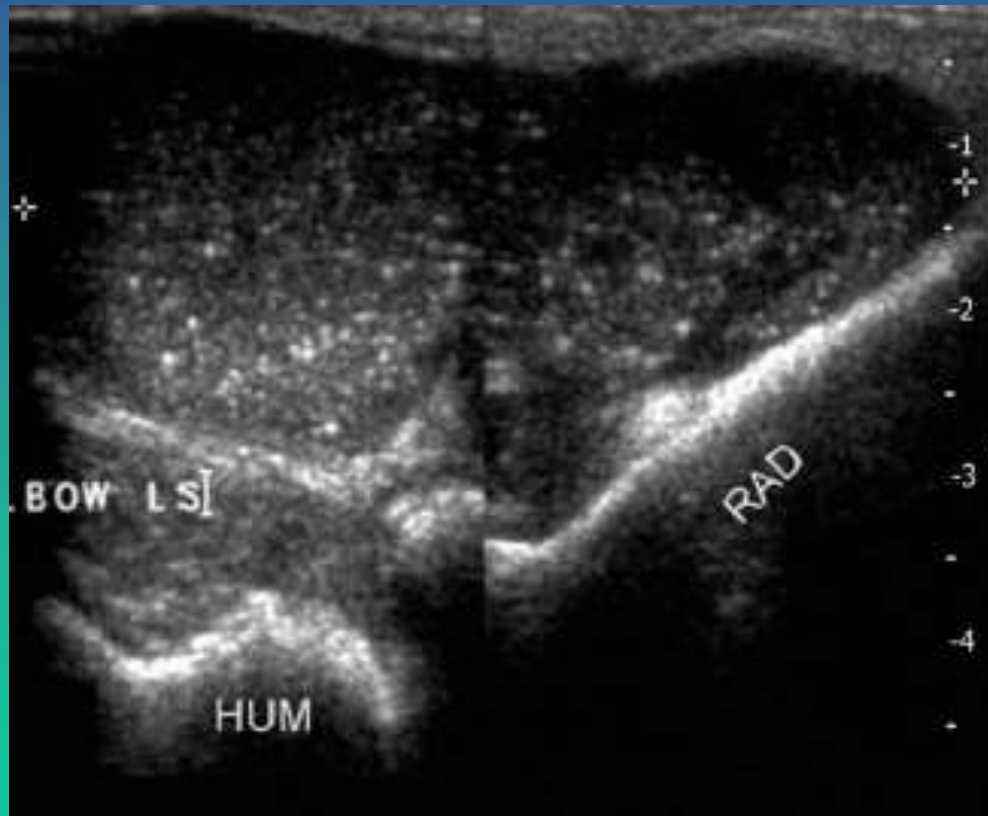
Seminars in Arthritis and Rheumatism, Volume 37, Issue 2, October 2007, Pages 133–134



gas bubbles...

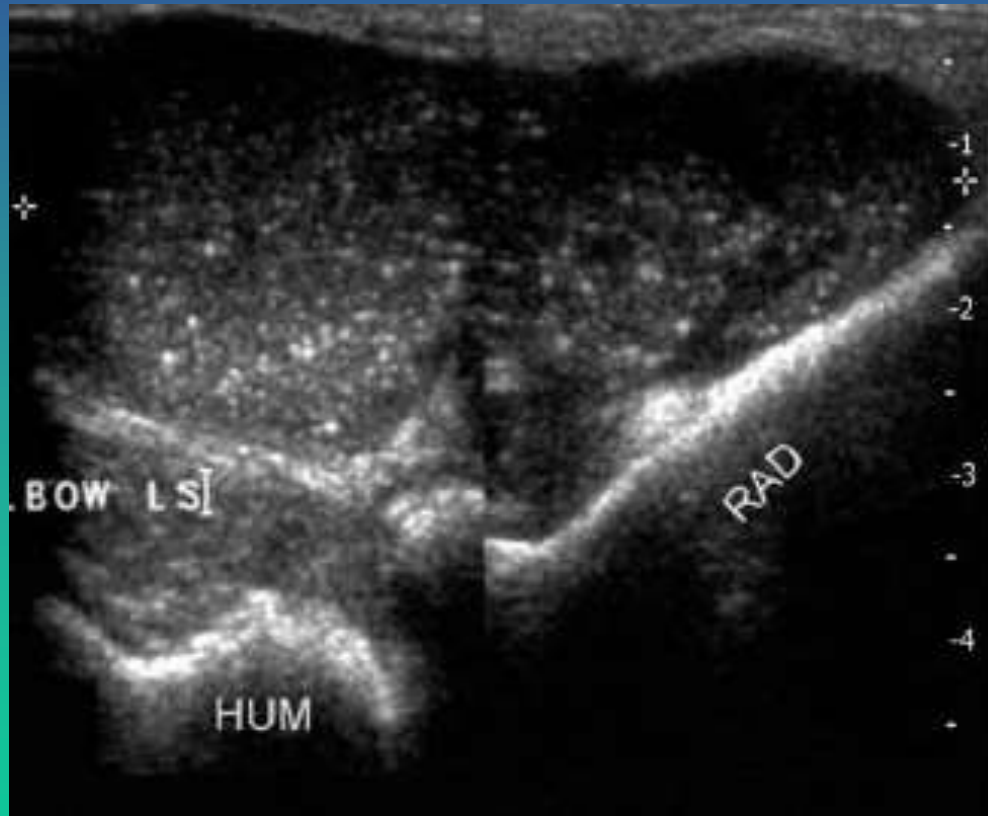


?



Musculoskeletal infections: ultrasound appearances

Chau, Griffiths. Clinical Radiology (2005) 60, 149–159



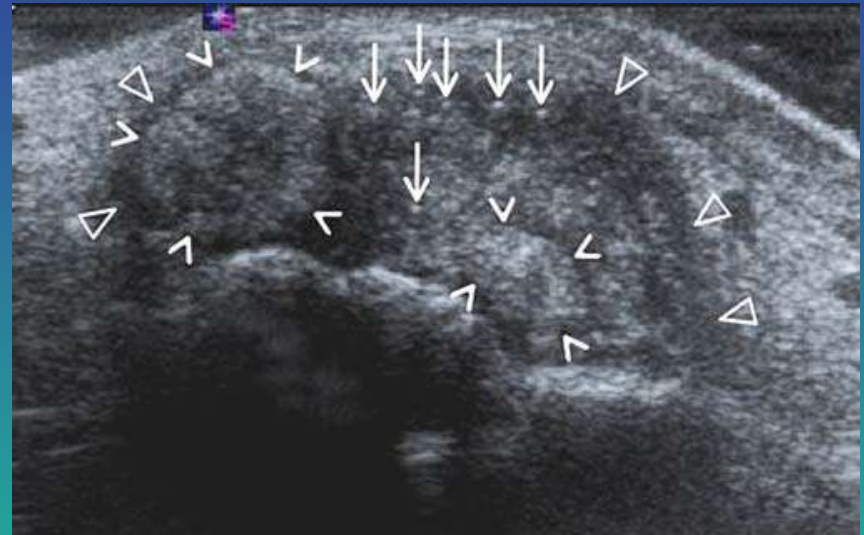
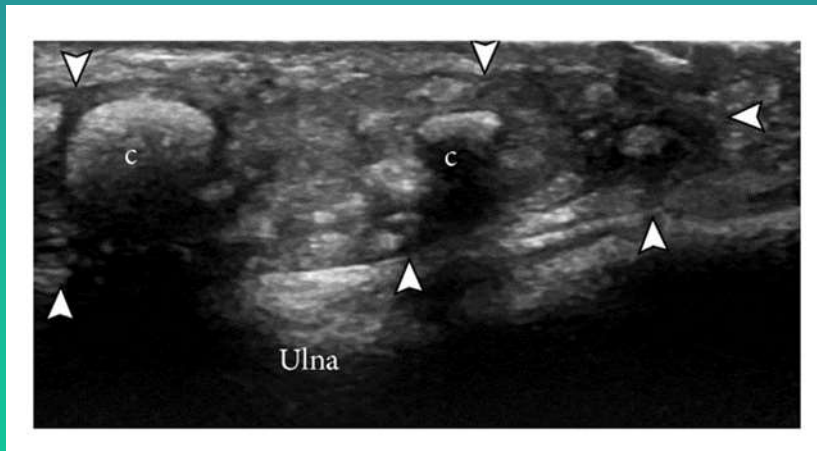
erosions

- higher sensitivity than conventional X-ray!
- but: often non specific



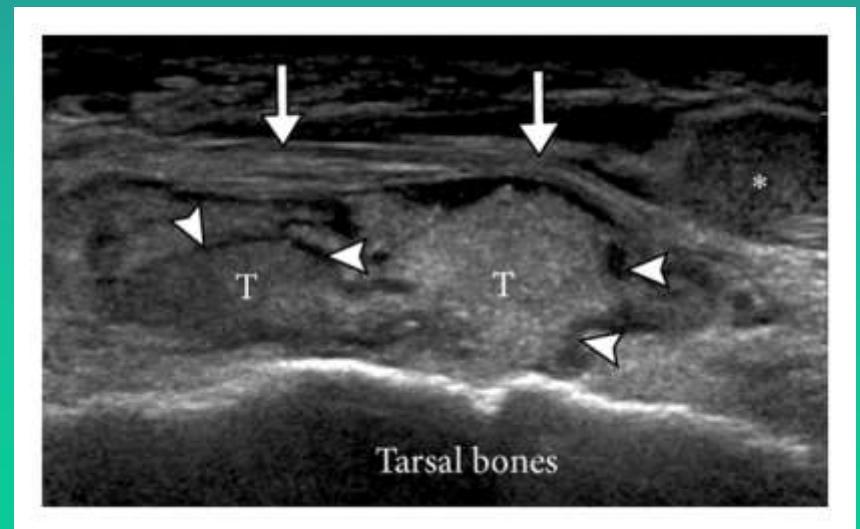
Tophus

- soft, hard or mixed
- more homogeneous or more heterogeneous
- hypoechoic margin
- tiny hyperechoic spots



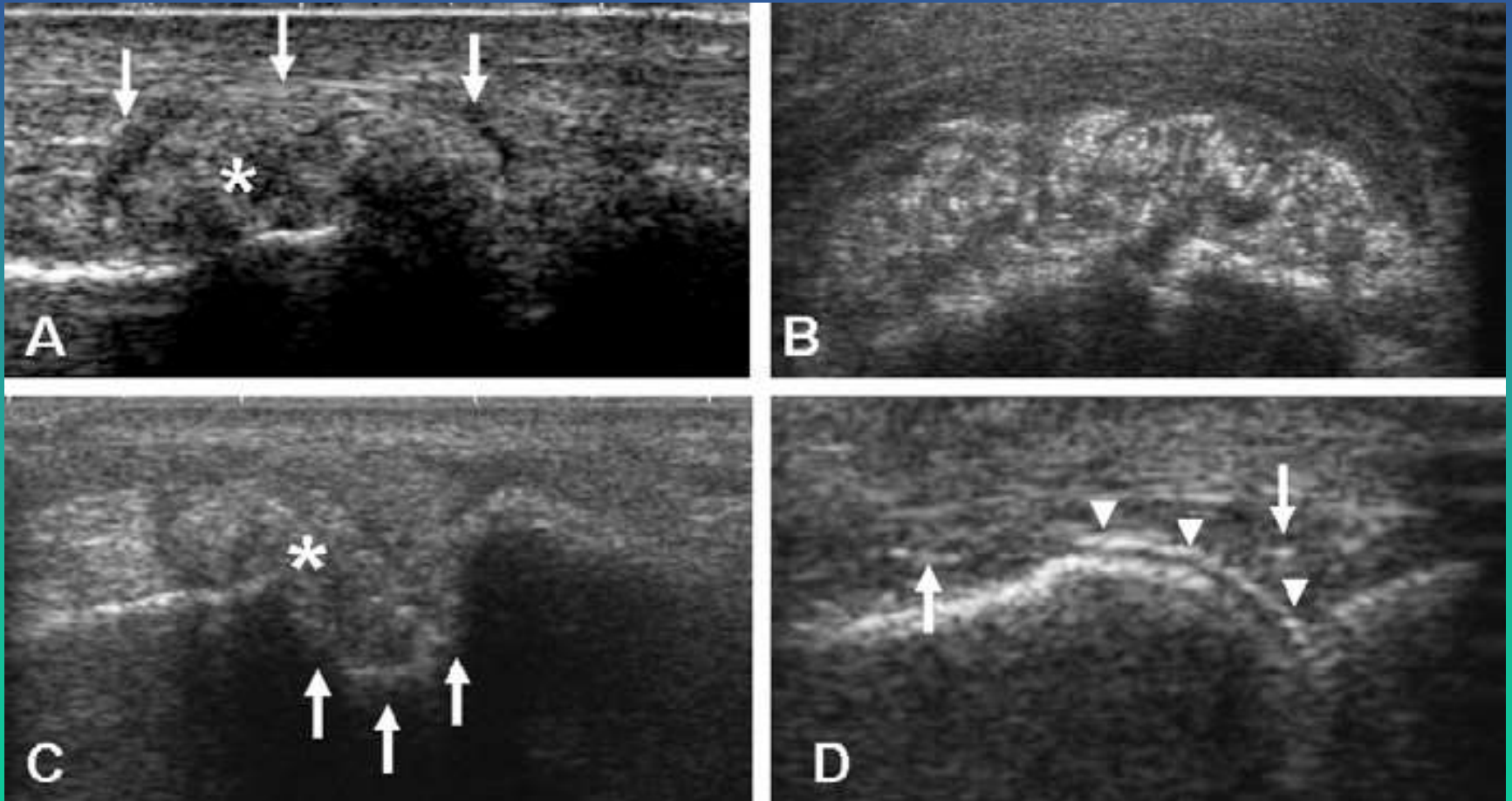
Ultrasound features of tophi in chronic tophaceous gout
Skeletal Radiol. 2011 Mar;40(3):309-15

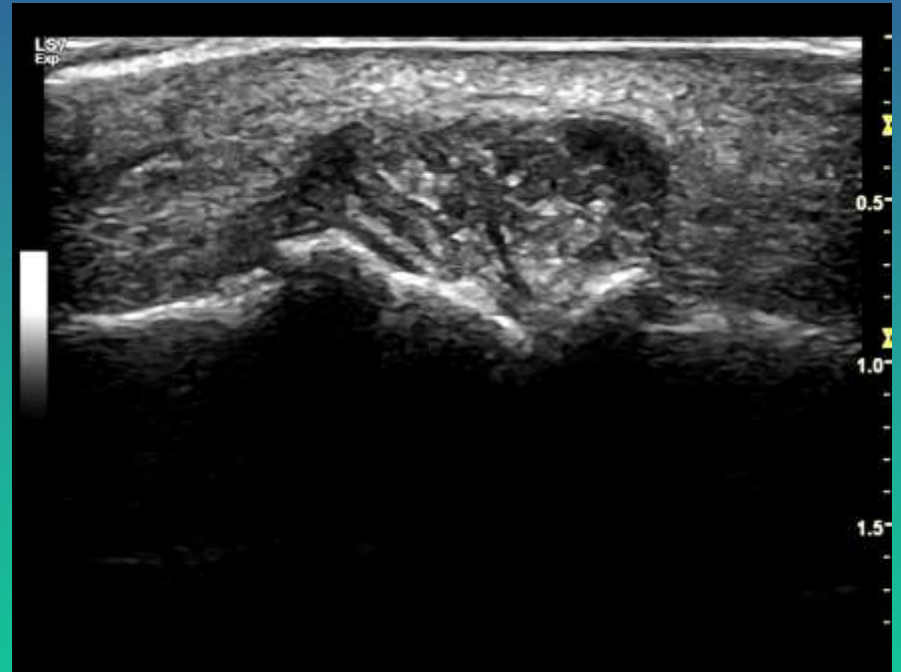
Imaging Appearances in Gout,
www.hindawi.com/journals/arthritis/2013/673401



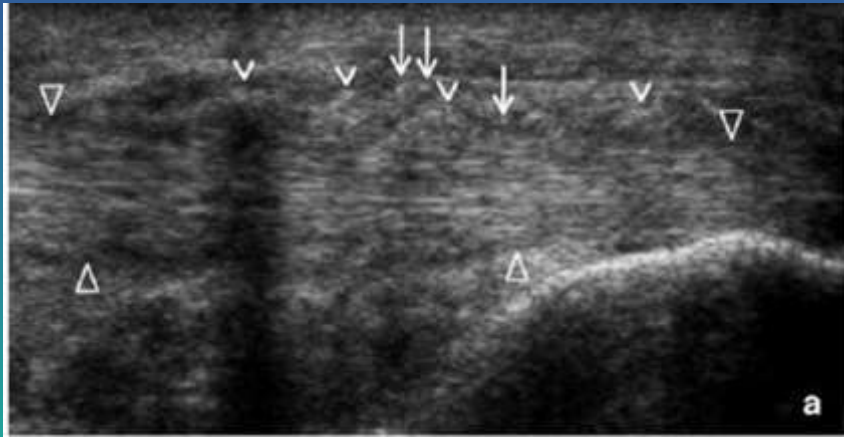
Intérêt de l'échographie dans la goutte

Ottaviani et al. Revue du rhumatisme 79 (2012); 301-305

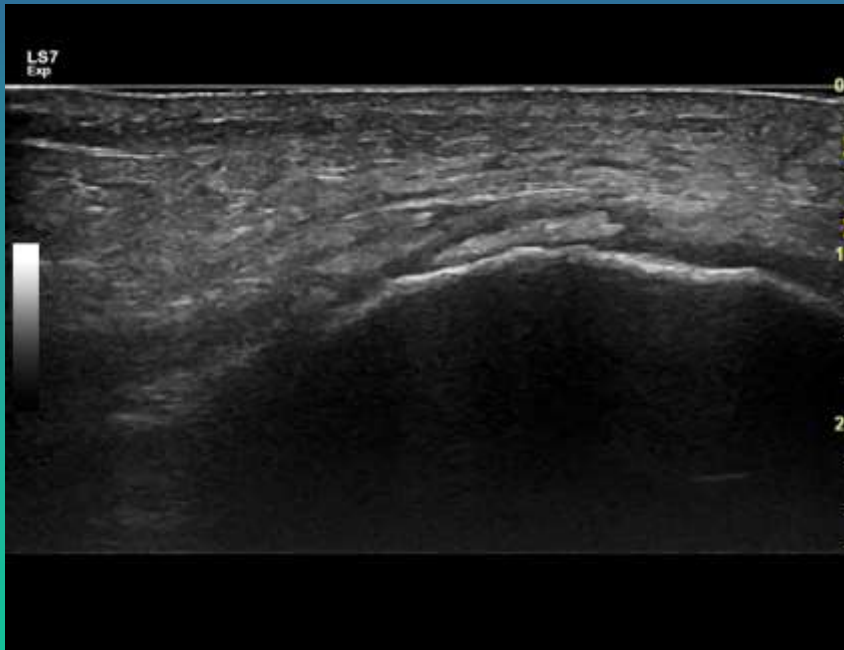
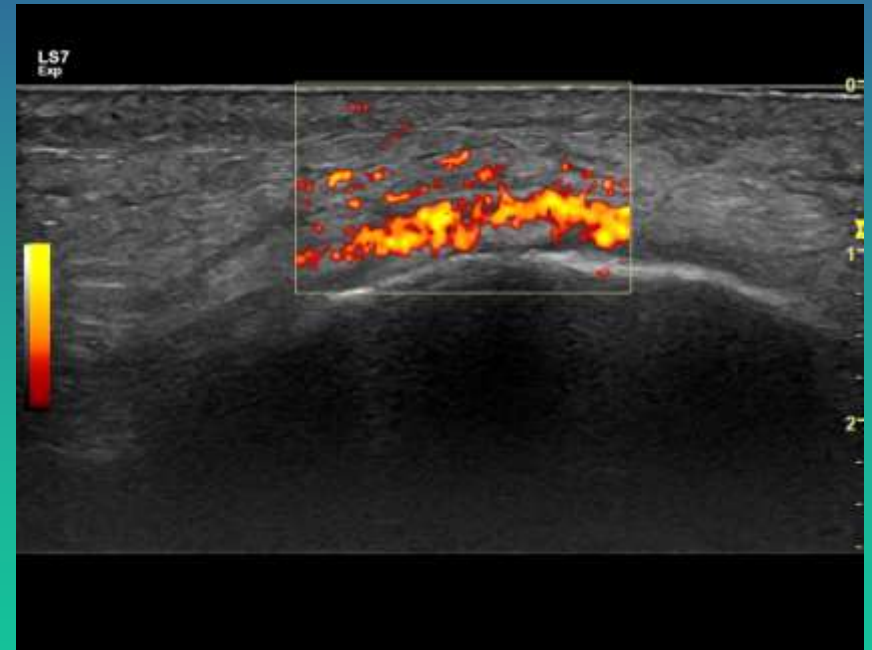




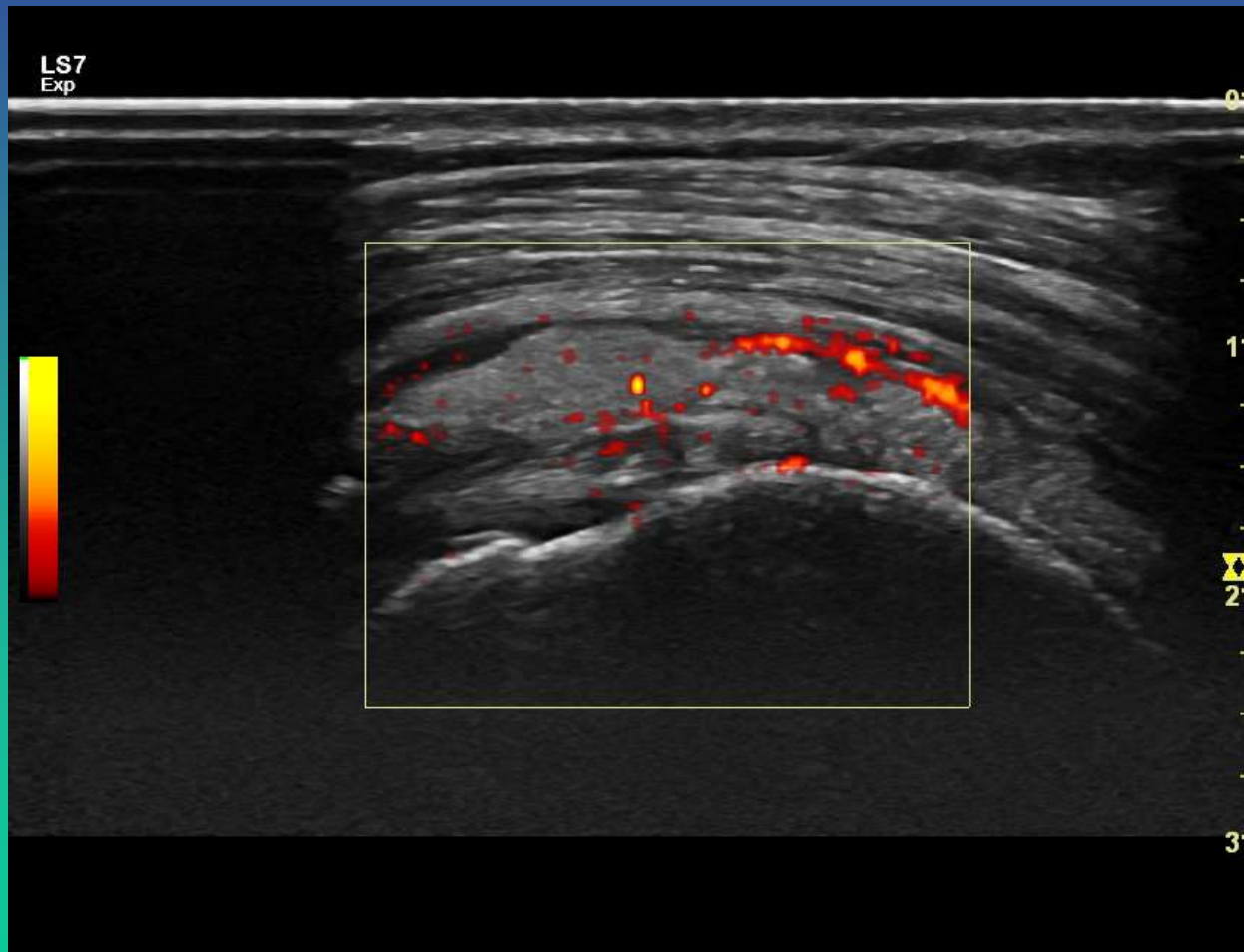
Peri-/intratendinous MSU-deposition

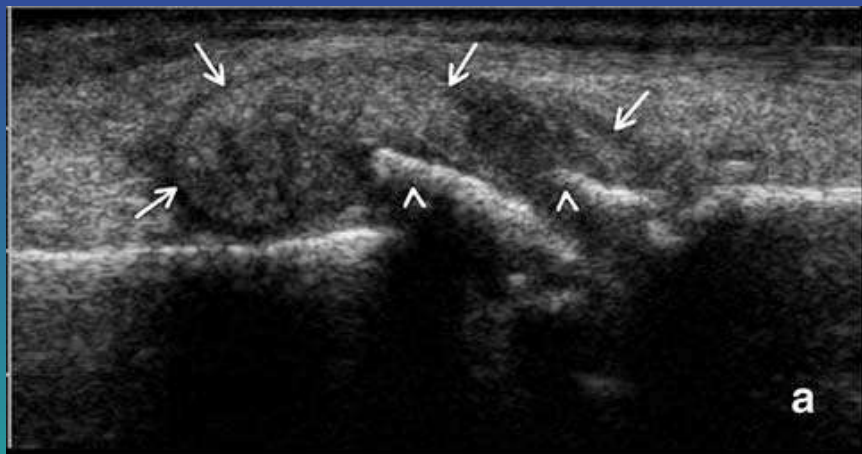
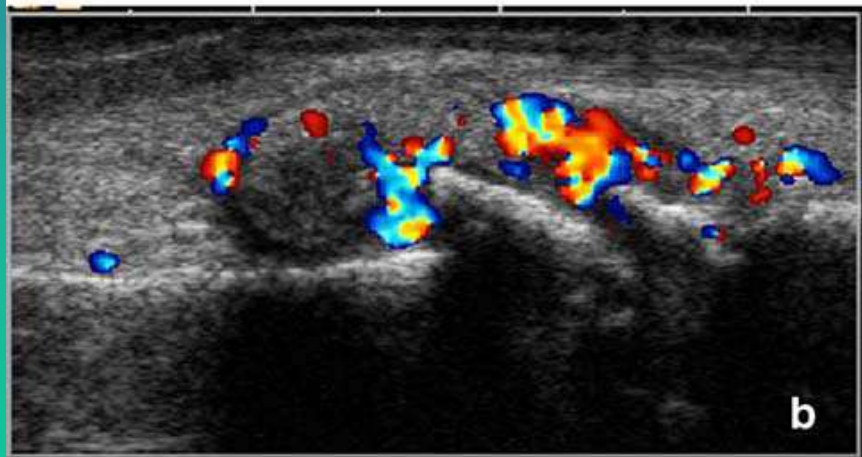


präpatellär



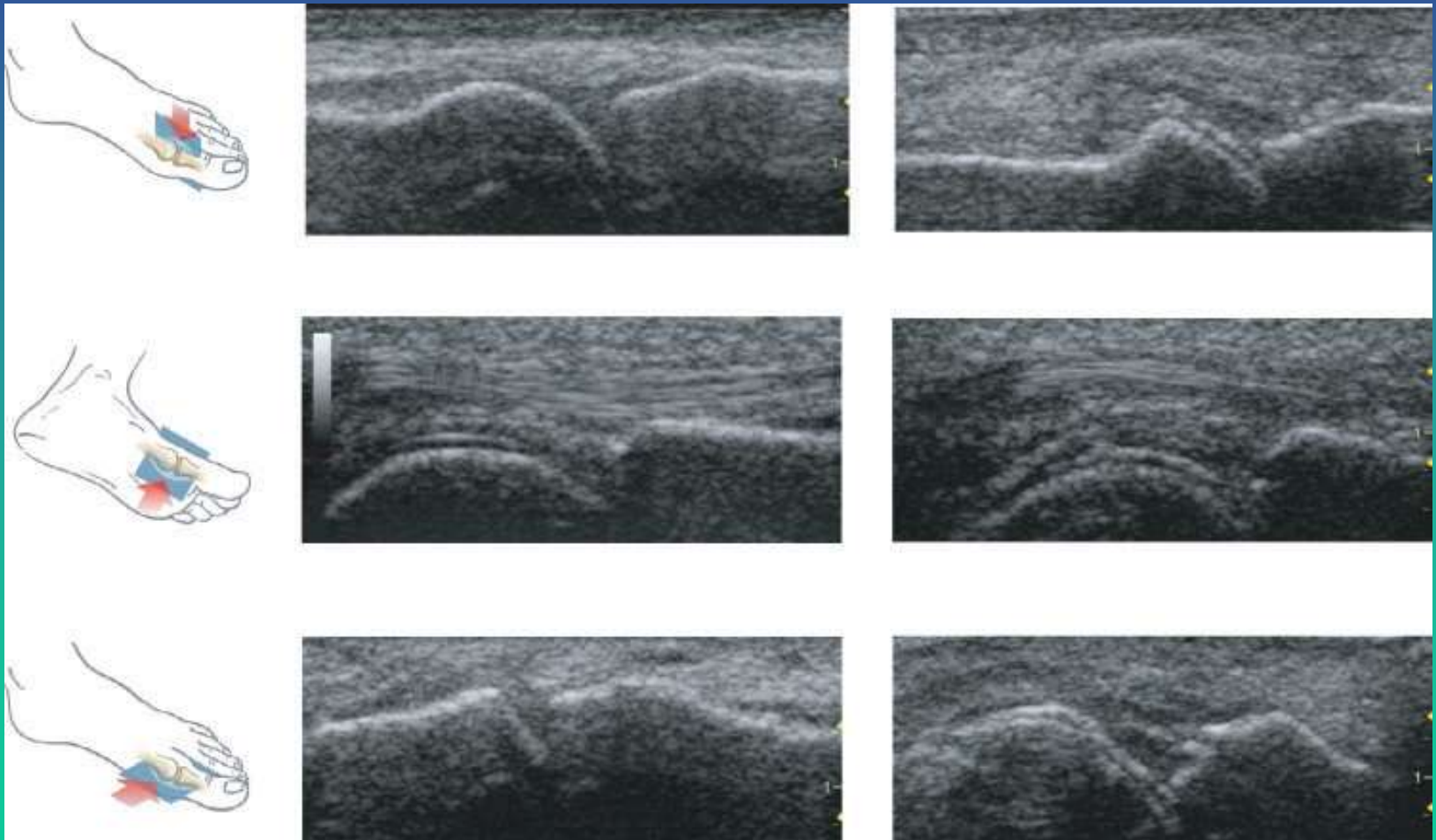
Hydroxyapatite acute...

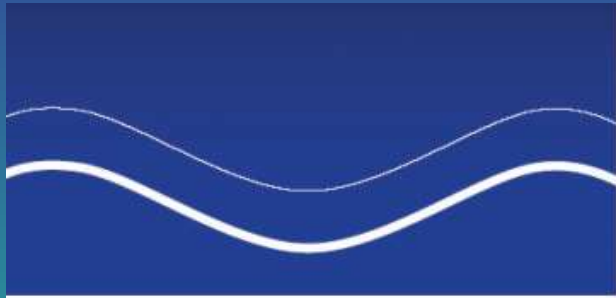
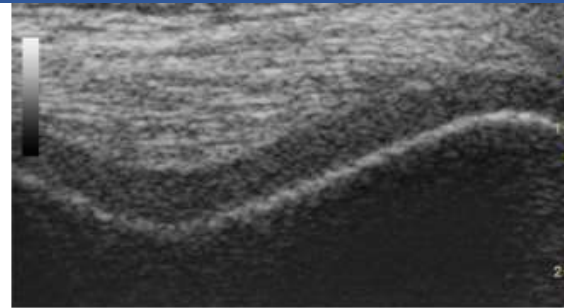
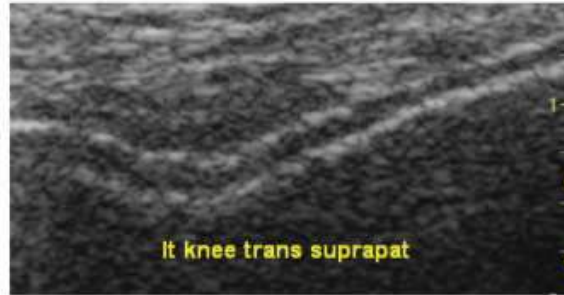
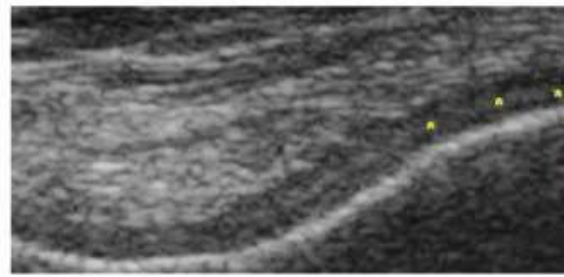




Diagnosis of gout by ultrasound

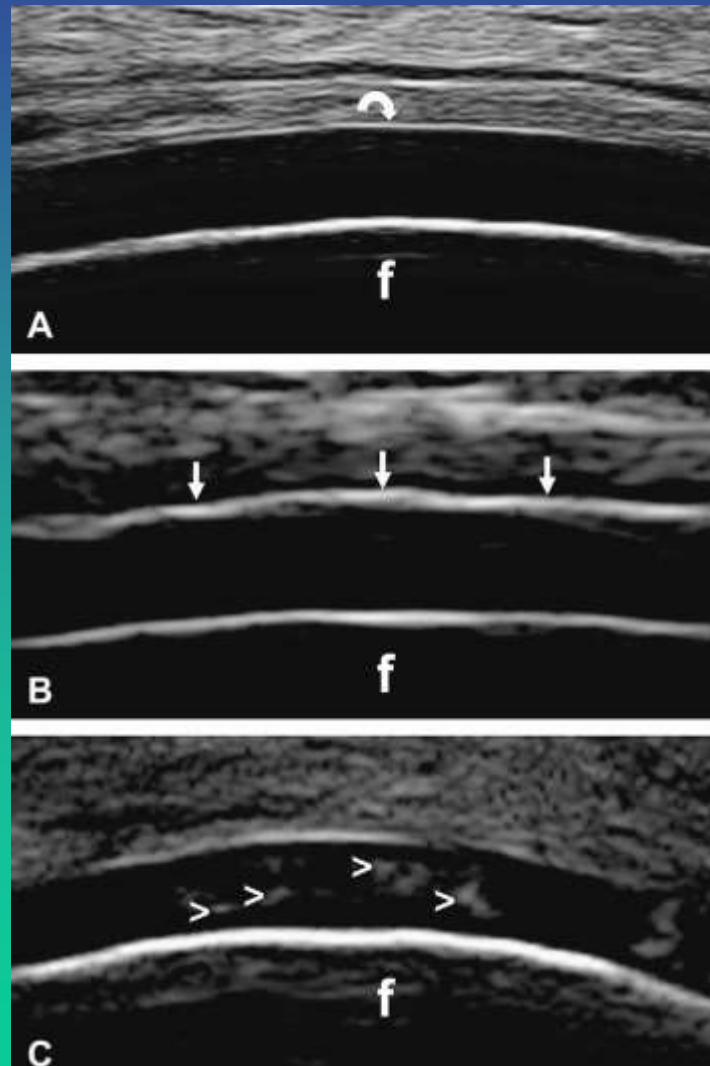
R. G. Thiele and N. Schlesinger, Rheumatology 2007;46:1116–1121



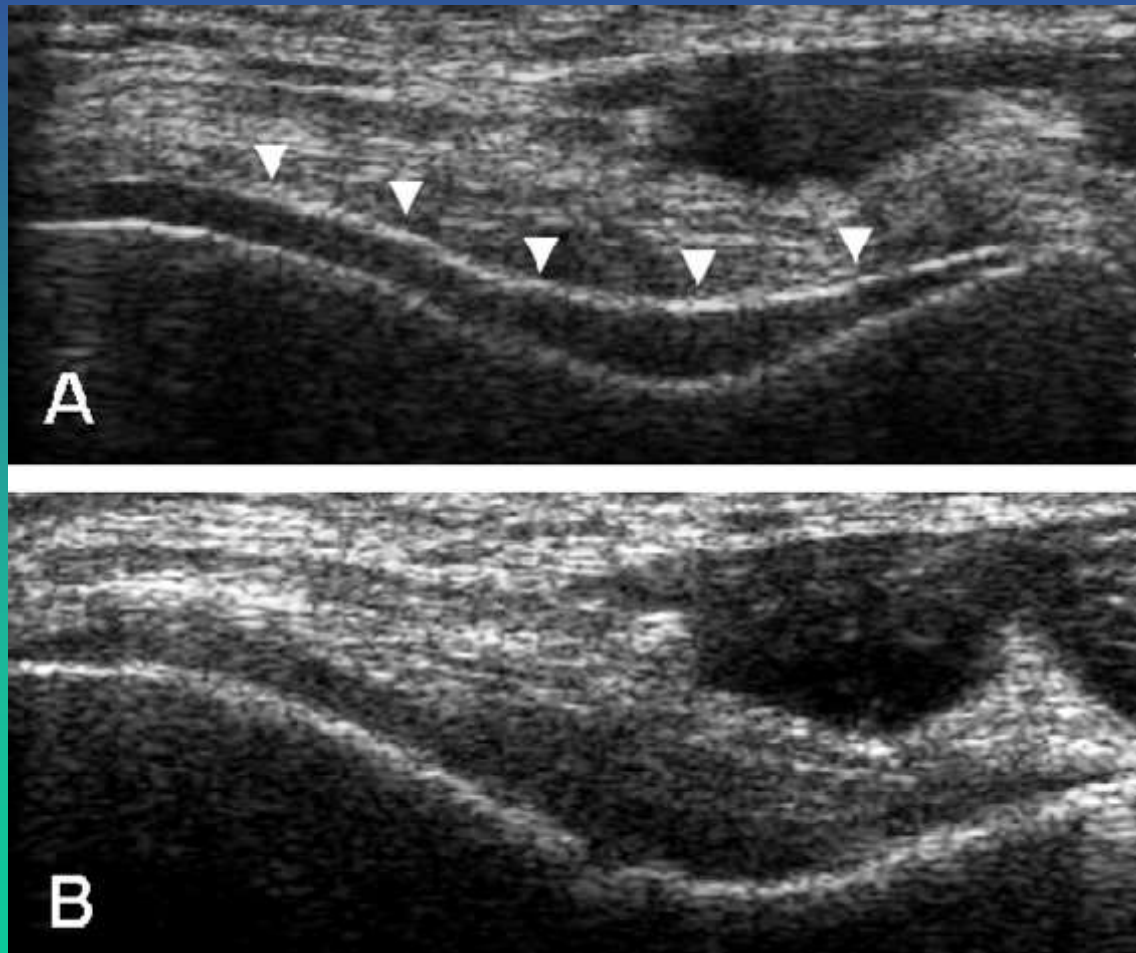


E. Filippucci et al.

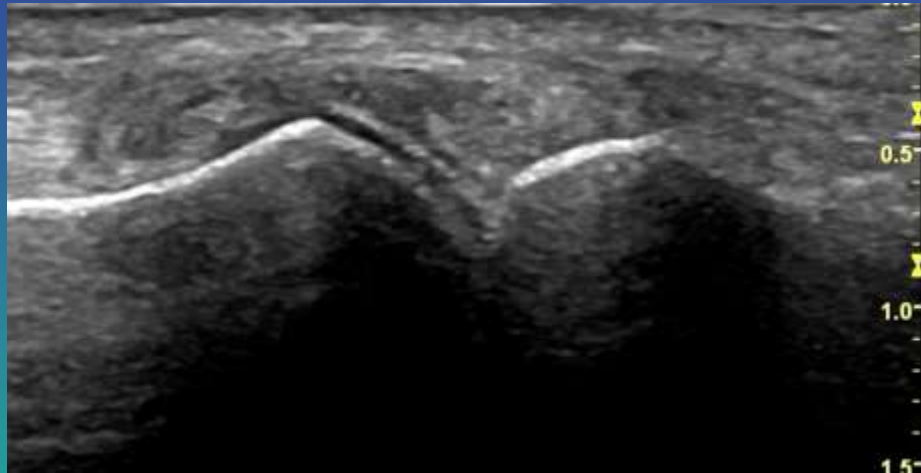
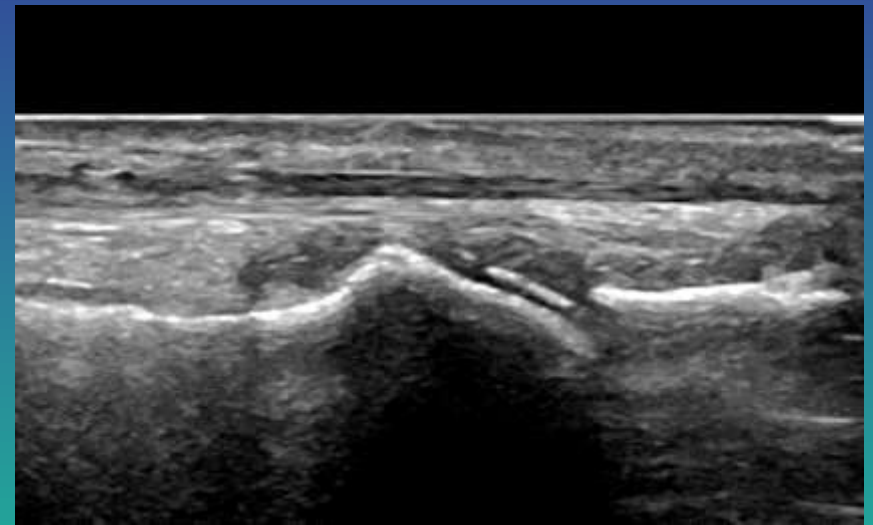
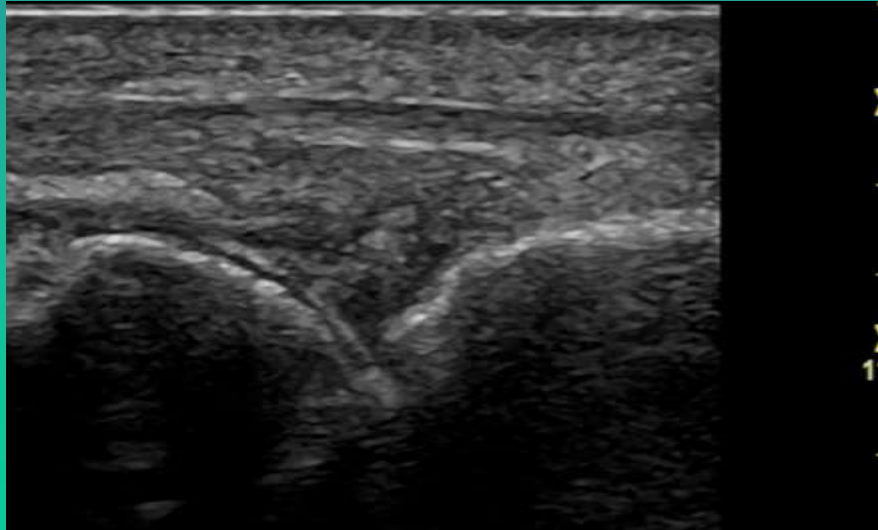
Osteoarthritis and Cartilage (2009) 17, 178-181



Gout – double contour (DC)



Gout – DC



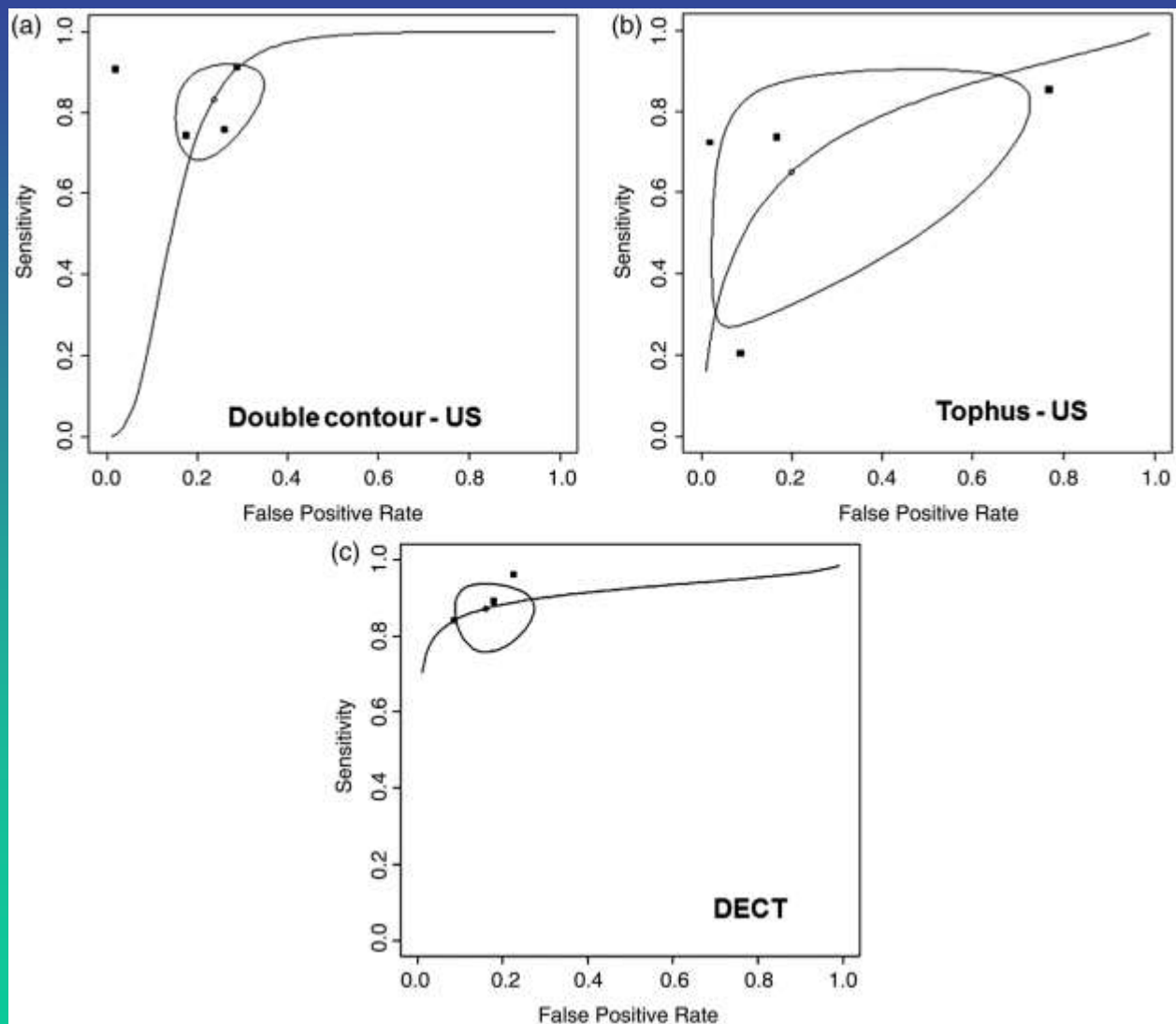
Imaging modalities for the classification of gout: systematic literature review and meta-analysis

Ogdie A, et al. Ann Rheum Dis 2014;0:1–7. doi:10.1136/annrheumdis-2014-205431

Table 3 Meta-analysis results

	Individual study parameters				Sensitivity	Specificity	Sensitivity	Specificity	AUC
	True positive	False positive	False negative	True negative					
Ultrasound: double contour sign									
Ottaviani <i>et al</i> ¹⁷	NR	NR	NR	NR	0.67	0.98	0.83 (0.72–0.91)	0.76 (0.68–0.83)	0.84
Lamers-Kamebeek <i>et al</i> ¹⁸	20	7	6	21	0.77	0.75			
Thiele <i>et al</i> ¹⁷	34	0	3	26	0.92	1.00			
Naredo <i>et al</i> ¹⁴	68	7	23	35	0.75	0.83			
Bongartz <i>et al</i> ²⁰	36	21	3	53	0.92	0.72			
Ultrasound: tophus									
Ottaviani <i>et al</i> ¹⁷	NR	NR	NR	NR	0.74	1.00	0.65 (0.34–0.87)	0.80 (0.38–0.96)	0.75
Lamers-Kamebeek <i>et al</i> ¹⁸	5	2	21	26	0.19	0.93			
Thiele <i>et al</i> ¹⁷	27	0	10	26	0.73	1.00			
Naredo <i>et al</i> ¹⁴	78	11	13	31	0.86	0.74			
Nalbant <i>et al</i> ¹³	15	3	5	17	0.75	0.85			
Dual energy computed tomography: MSU crystal deposition									
Glazebrook <i>et al</i> ¹²	12	4	0	15	1	0.79	0.87 (0.79–0.93)	0.84 (0.75–0.90)	0.90
Bongartz <i>et al</i> ¹⁹	36	7	4	34	0.90	0.83			
Choi <i>et al</i> ¹⁹	34	3	6	37	0.93	0.78			

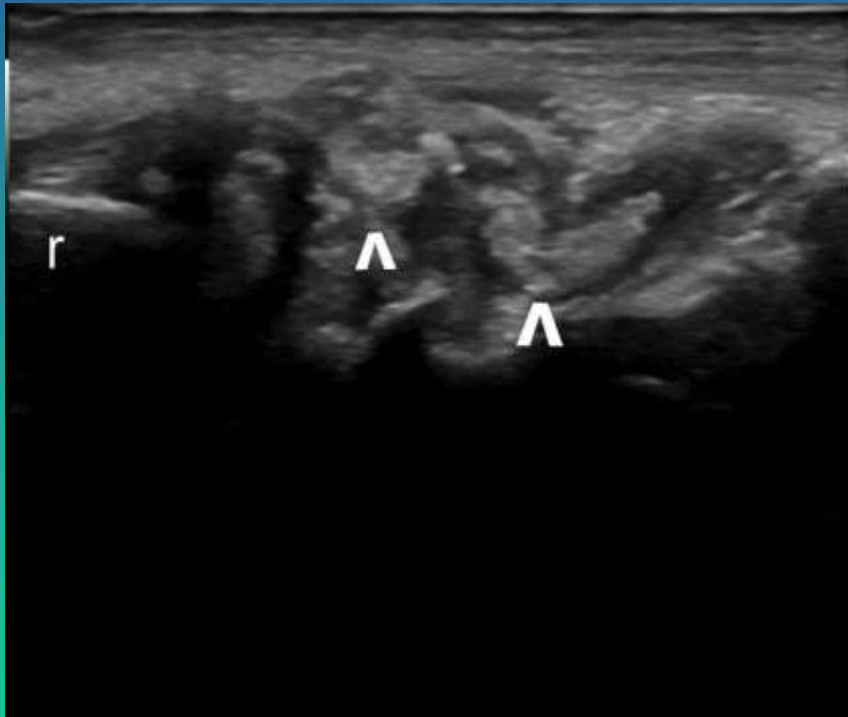
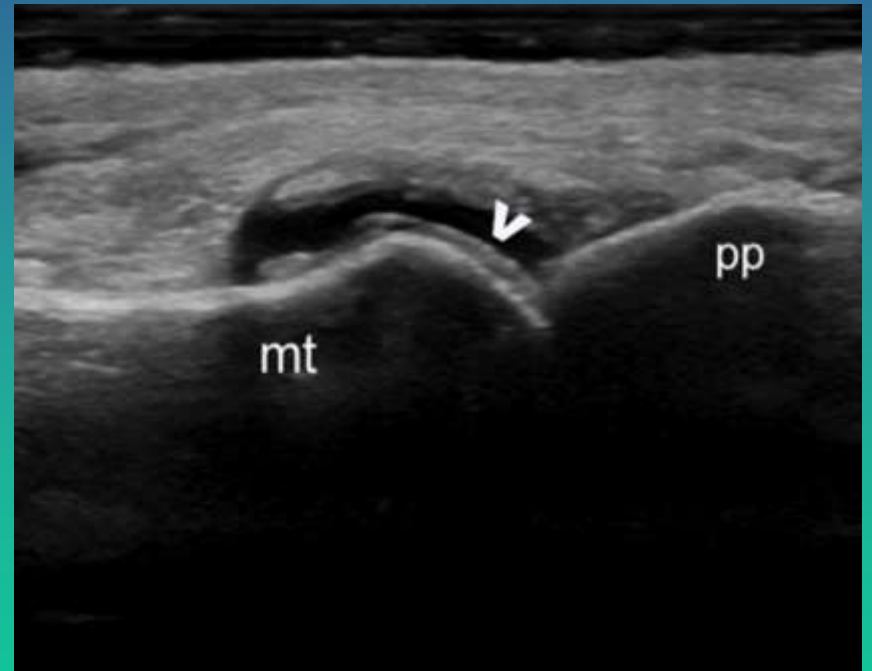
AUC, area under the curve; MSU, monosodium urate, NR, not reported.

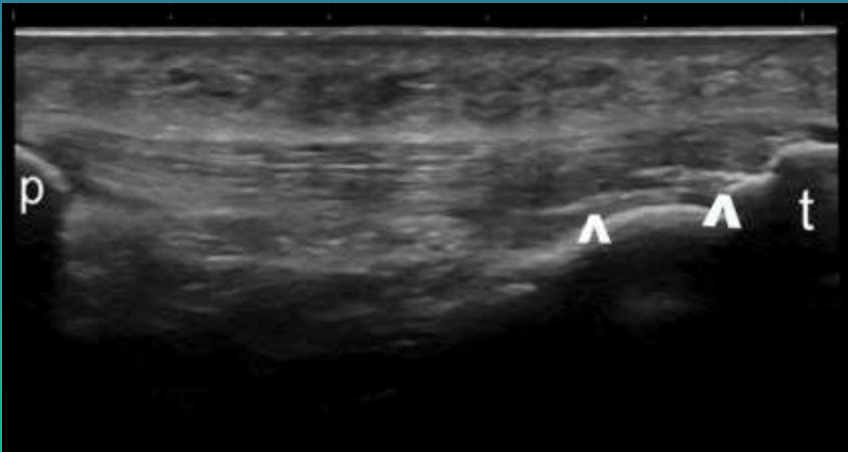


Ultrasounddetected musculoskeletal urate crystal deposition: which joints and what findings should be assessed for diagnosing Gout?

- bilateral 1 joint (hyperechoic aggregates?), 3 articular cartilages (DC?), 2 tendons
- -> sensitivity 85% and specificity 83%
- higher sensitivity: 3 joints
- mostly affected joints: wrist, knee, MTP I
- mostly affected tendons: Lig patellae, triceps-tendon, achilles-tendon

- Naredo et al. Ann Rheum Dis 2014; 73: 1522-1528.





2015 Gout Classification Criteria: An American College of Rheumatology/European League Against Rheumatism Collaborative Initiative

ARTHRITIS & RHEUMATOLOGY Vol. 67, No. 10, October 2015, pp 2557–2568

Table 2. The ACR/EULAR gout classification criteria*

	Categories
Step 1: Entry criterion (only apply criteria below to those meeting this entry criterion)	At least 1 episode of swelling, pain, or tenderness in a peripheral joint or bursa
Step 2: Sufficient criterion (if met, can classify as gout without applying criteria below)	Presence of MSU crystals in a symptomatic joint or bursa (i.e., in synovial fluid) or tophus
Step 3: Criteria (to be used if sufficient criterion not met)	

Step 3: Criteria (to be used if sufficient criterion not met)

Clinical

Pattern of joint/bursa involvement during symptomatic episode(s) ever†

Ankle <i>or</i> midfoot (as part of monoarticular or oligoarticular episode without involvement of the first metatarsophalangeal joint)	1
Involvement of the first metatarsophalangeal joint (as part of monoarticular or oligoarticular episode)	2

Characteristics of symptomatic episode(s) ever

- Erythema overlying affected joint (patient- reported or physician-observed)
- Can't bear touch or pressure to affected joint
- Great difficulty with walking or inability to use affected joint

One characteristic	1
Two characteristics	2
Three characteristics	3

Time course of episode(s) ever

Presence (ever) of ≥ 2 , irrespective of antiinflammatory treatment:

- Time to maximal pain < 24 hours
- Resolution of symptoms in ≤ 14 days
- Complete resolution (to baseline level) between symptomatic episodes

One typical episode	1
Recurrent typical episodes	2

Clinical evidence of tophus (Figure 2)

Draining or chalk-like subcutaneous nodule under transparent skin, often with overlying vascularity, located in typical locations: joints, ears, olecranon bursae, finger nodes, tendons (e.g., Achilles)

Present	4
---------	---

Laboratory

Serum uric acid: Measured by uricase method.

Ideally should be scored at a time when the patient was not receiving urate-lowering treatment and it was > 4 weeks from the start of an episode (i.e., during intercritical period); if practicable, retest under those conditions. The highest value irrespective of timing should be scored.

< 4 mg/dl (< 0.24 mmol/liter)‡	-4
6-8 mg/dl (0.36- < 0.48 mmol/liter)	2
8- < 10 mg/dl (0.48- < 0.60 mmol/liter)	3
≥ 10 mg/dl (≥ 0.60 mmol/liter)	4

Synovial fluid analysis of a symptomatic (ever) joint or bursa (should be assessed by a trained observer)§

MSU negative	-2
--------------	----

Imaging (Figure 3)¶

Imaging evidence of urate deposition in symptomatic (ever) joint or bursa:

ultrasound evidence of double-contour sign# or DECT demonstrating urate deposition**

Present (either modality)	4
---------------------------	---

Imaging evidence of gout-related joint damage: conventional radiography of the hands and/or feet demonstrates at least 1 erosion††

Present	4
---------	---

Table 3. Performance of the gout classification criteria in the Study for Updated Gout Classification Criteria validation data set, in comparison with existing published criteria

Criteria set (ref.)	Area under the curve*	Sensitivity at published threshold	Specificity at published threshold
ACR/EULAR criteria	0.95	0.92	0.89
ACR/EULAR criteria (clinical-only)†	0.89	0.85	0.78
ACR 1977 criteria (full) (9)	0.83	1.00‡	0.51‡
ACR 1977 (survey) (9)	0.83	0.84‡	0.62‡
Rome (12)	0.95	0.97	0.78‡
Rome (clinical) (12)	NA	0.77‡	0.78‡
New York (13)	0.83	1.00‡	0.78‡
New York (clinical) (13)	NA	0.79‡	0.78‡
Mexico (11)	0.84	1.00‡	0.44‡
Mexico (clinical) (11)	NA	0.95	0.44‡
Netherlands (10)§	0.87	0.95	0.59‡

US as relevant criterion!

Imaging (Figure 3)[¶]

Imaging evidence of urate deposition in symptomatic (ever) joint or bursa:
ultrasound evidence of double-contour sign[#]
or DECT demonstrating urate deposition^{**}

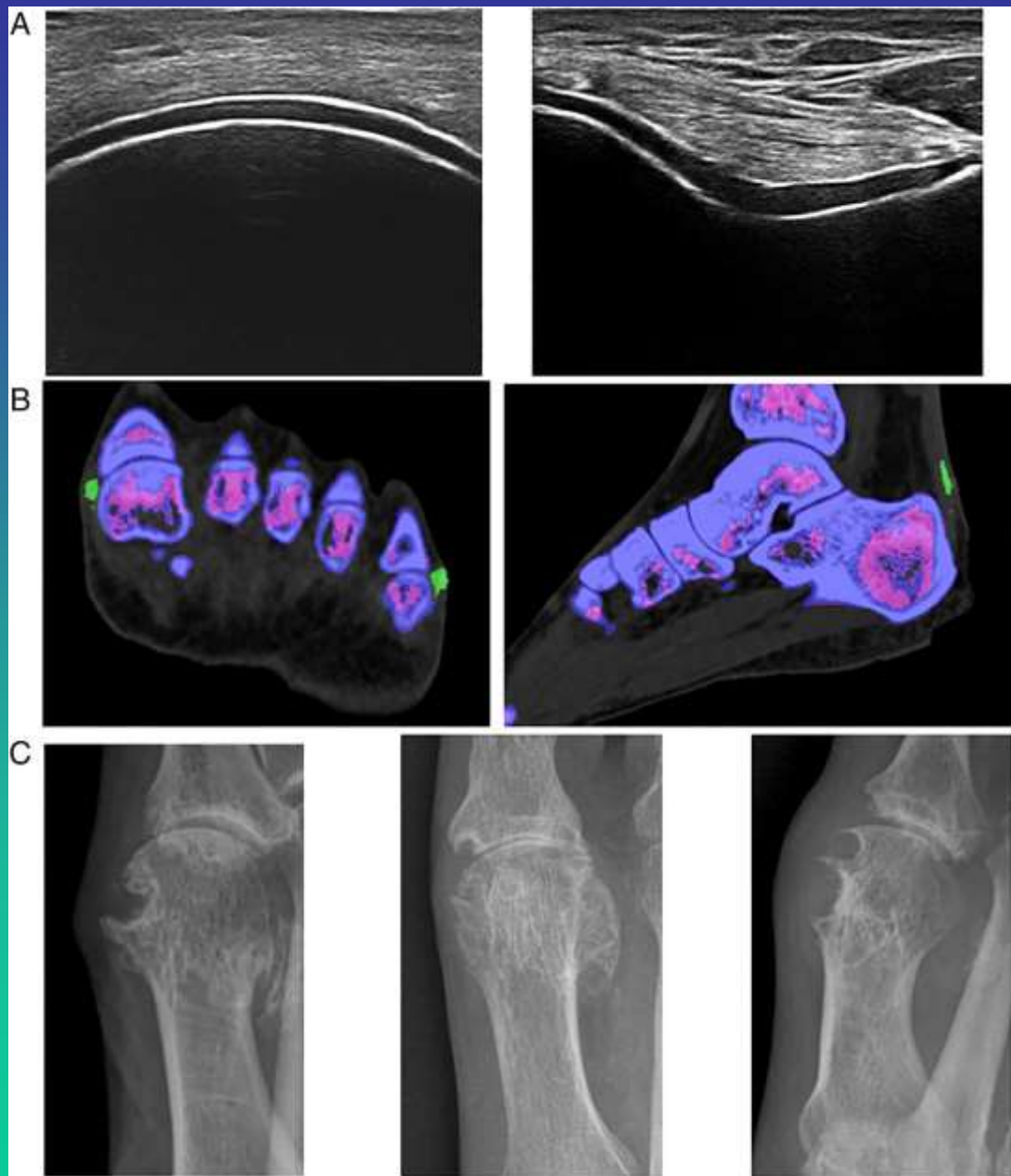
Present (either modality)

4

Imaging evidence of gout-related joint damage:
conventional radiography of the hands
and/or feet demonstrates at least 1 erosion^{††}

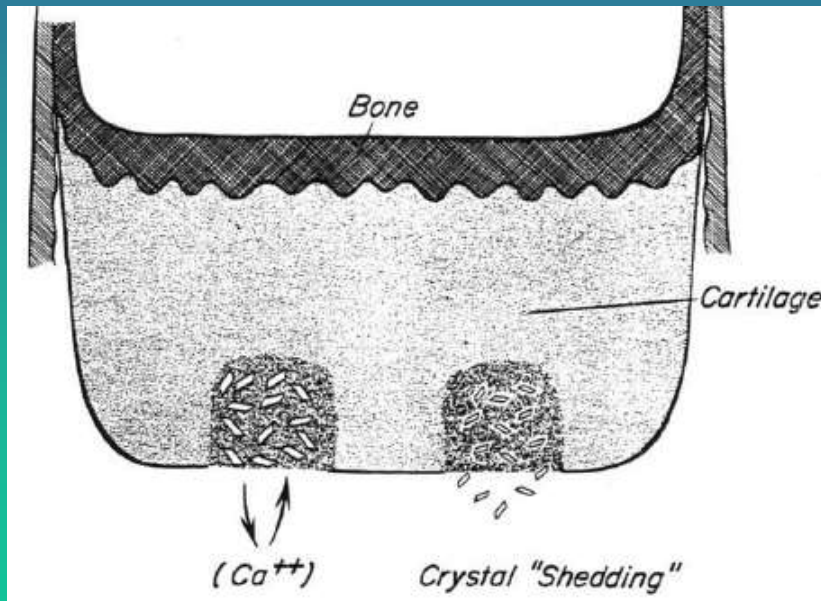
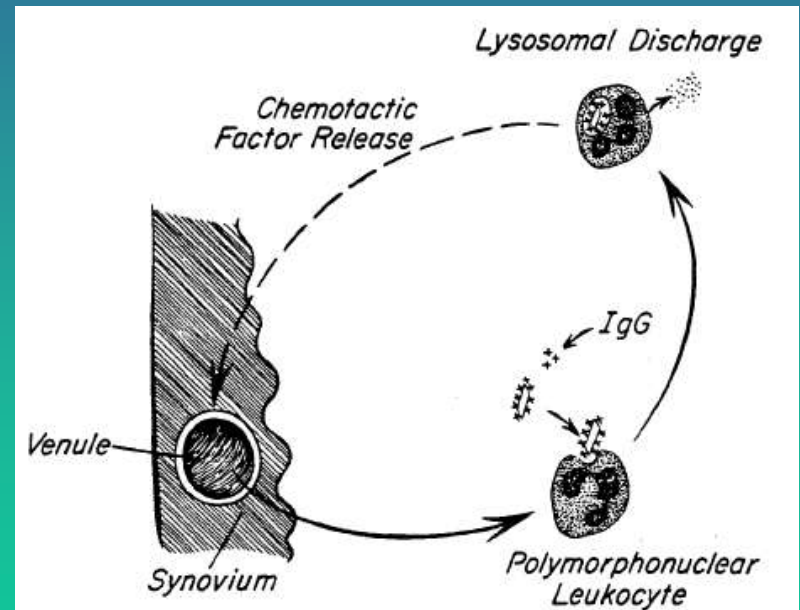
Present

4

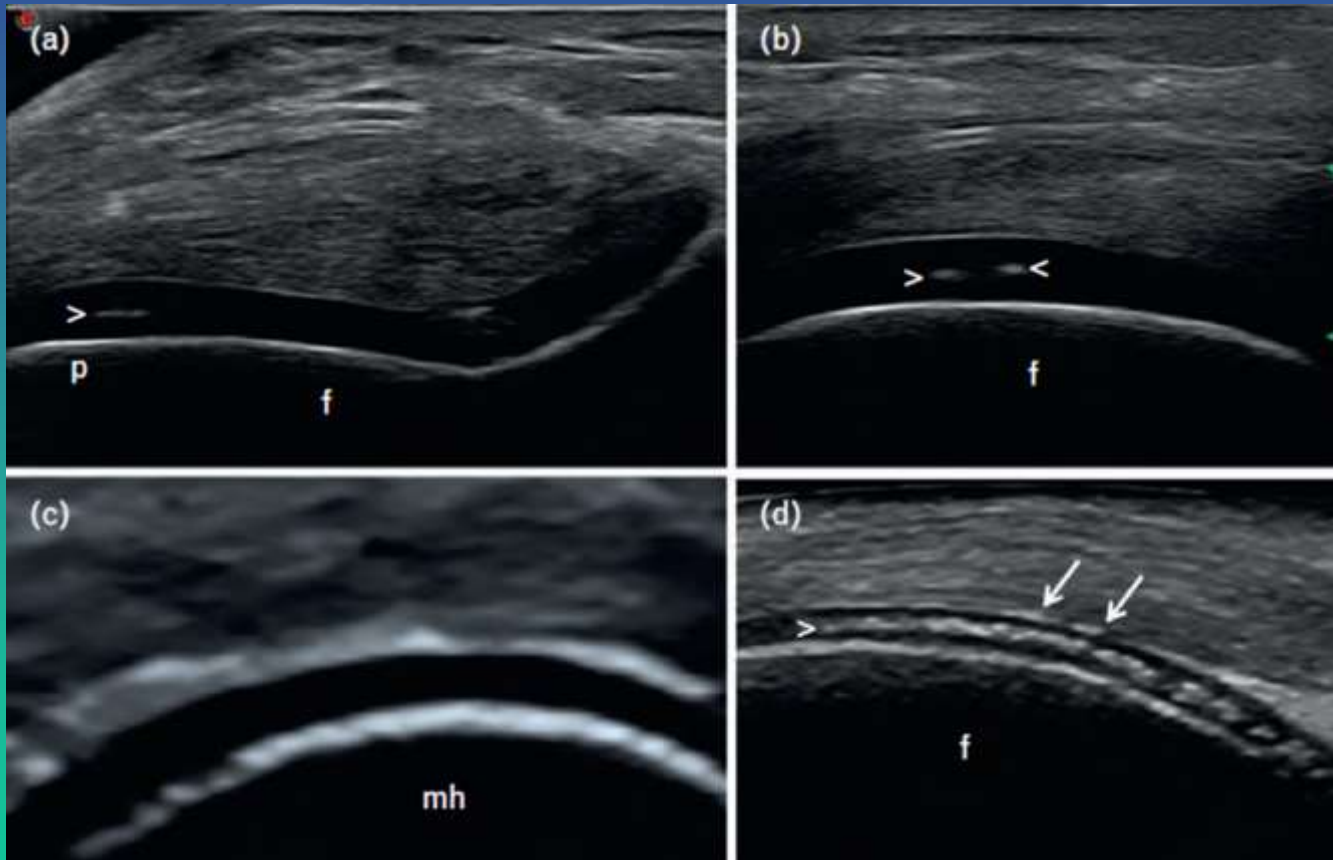


CALCIUM PYROPHOSPHATE DIHYDRATE CRYSTAL DEPOSITION DISEASE—1975

DANIEL J. McCARTY



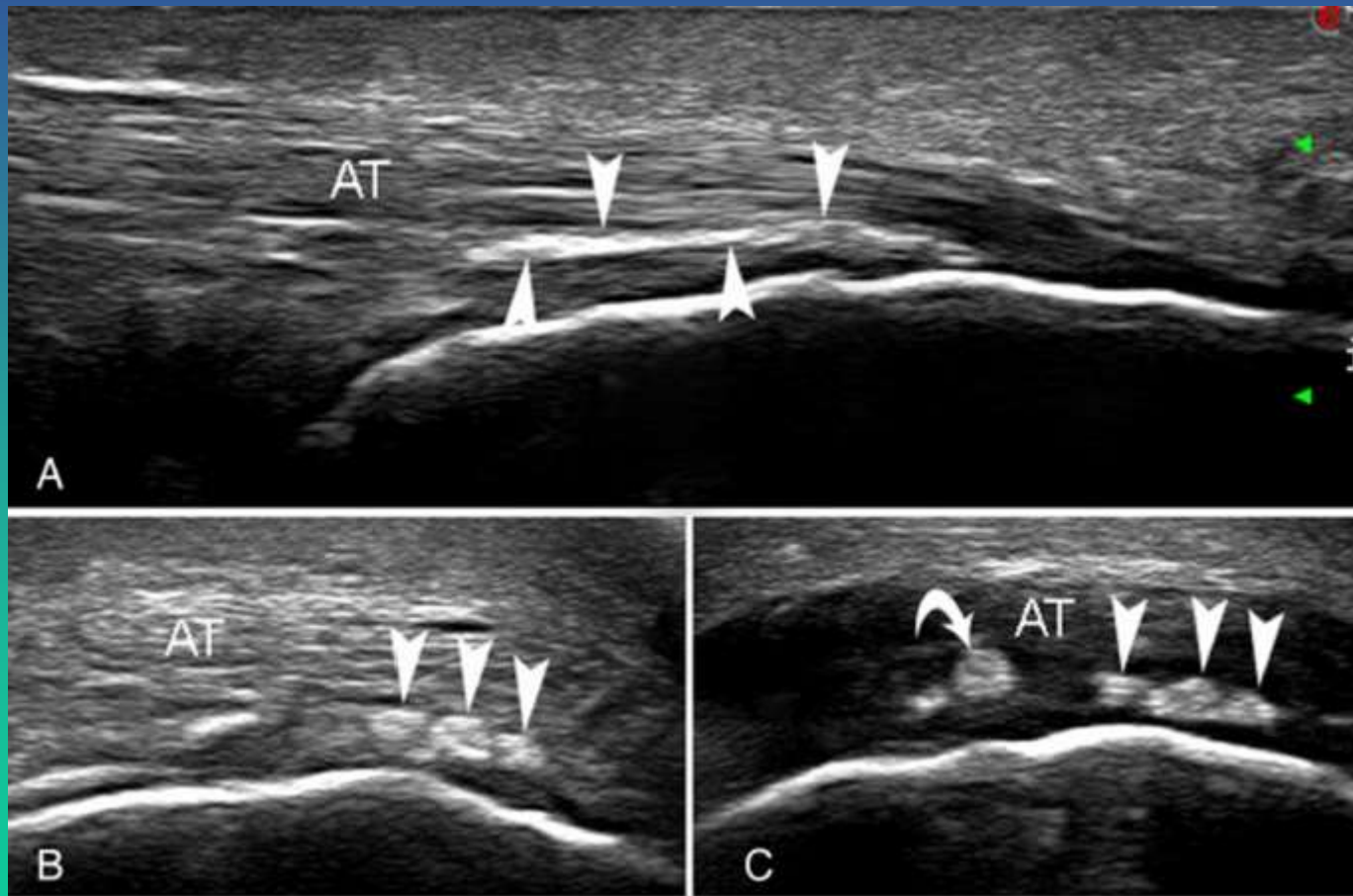
Grassi et al.: Use of ultrasound for diagnosis and monitoring of outcomes in crystal arthropathies



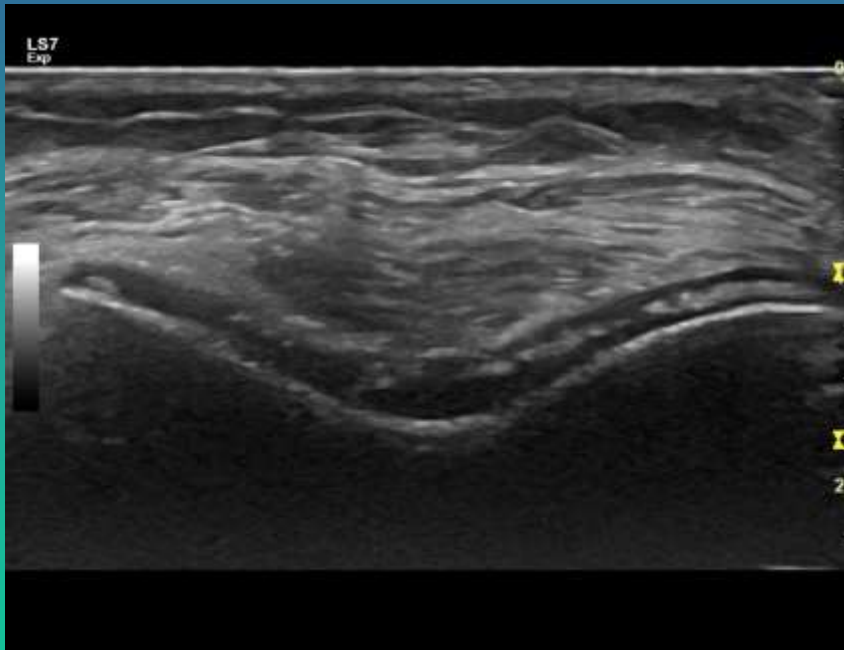
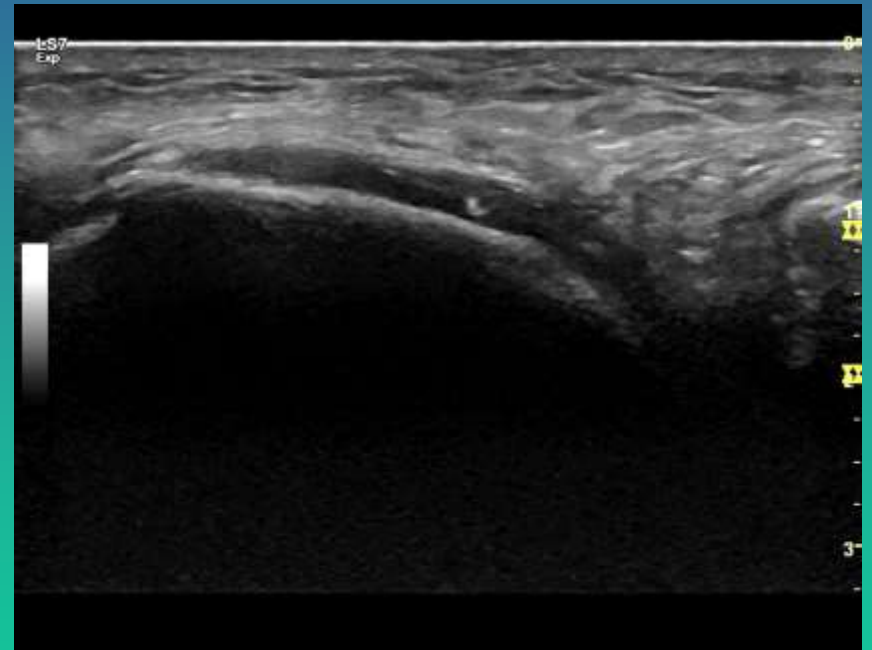
Curr Opin Rheumatol. 2015 Mar;27(2):147-55

Extent and distribution of CPP deposits in patients affected by CPPD: an ultrasonographic study

Filippou et al., Ann Rheum Dis 2013; 72: 1836-1839



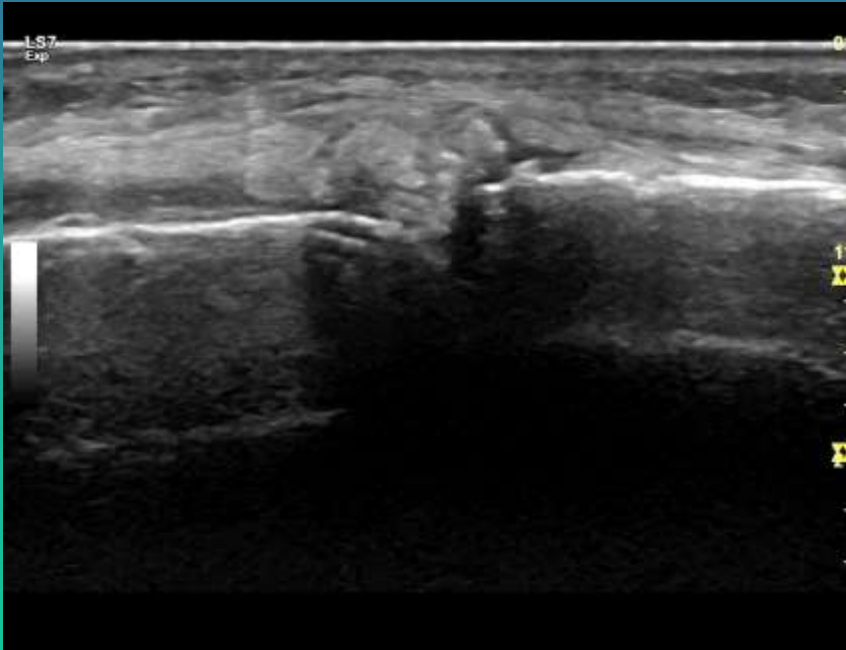
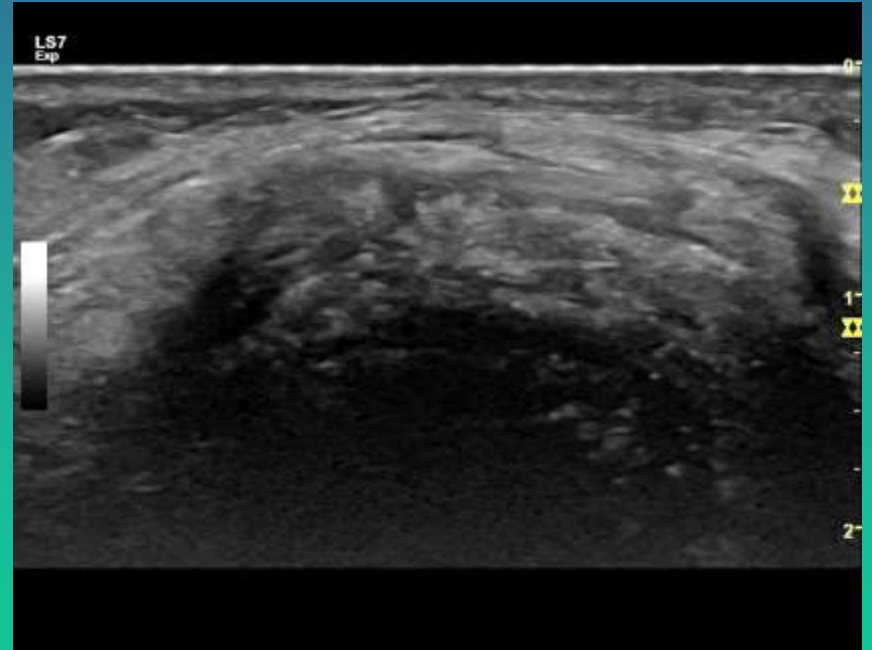
«the knee is the kingdom of CPPD»



meniscus

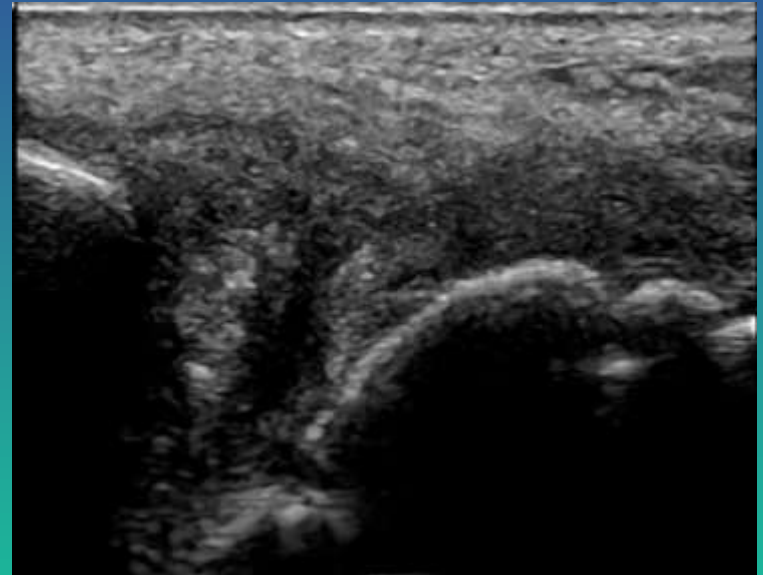
sagittal / longitudinal

transversal / horizontal !



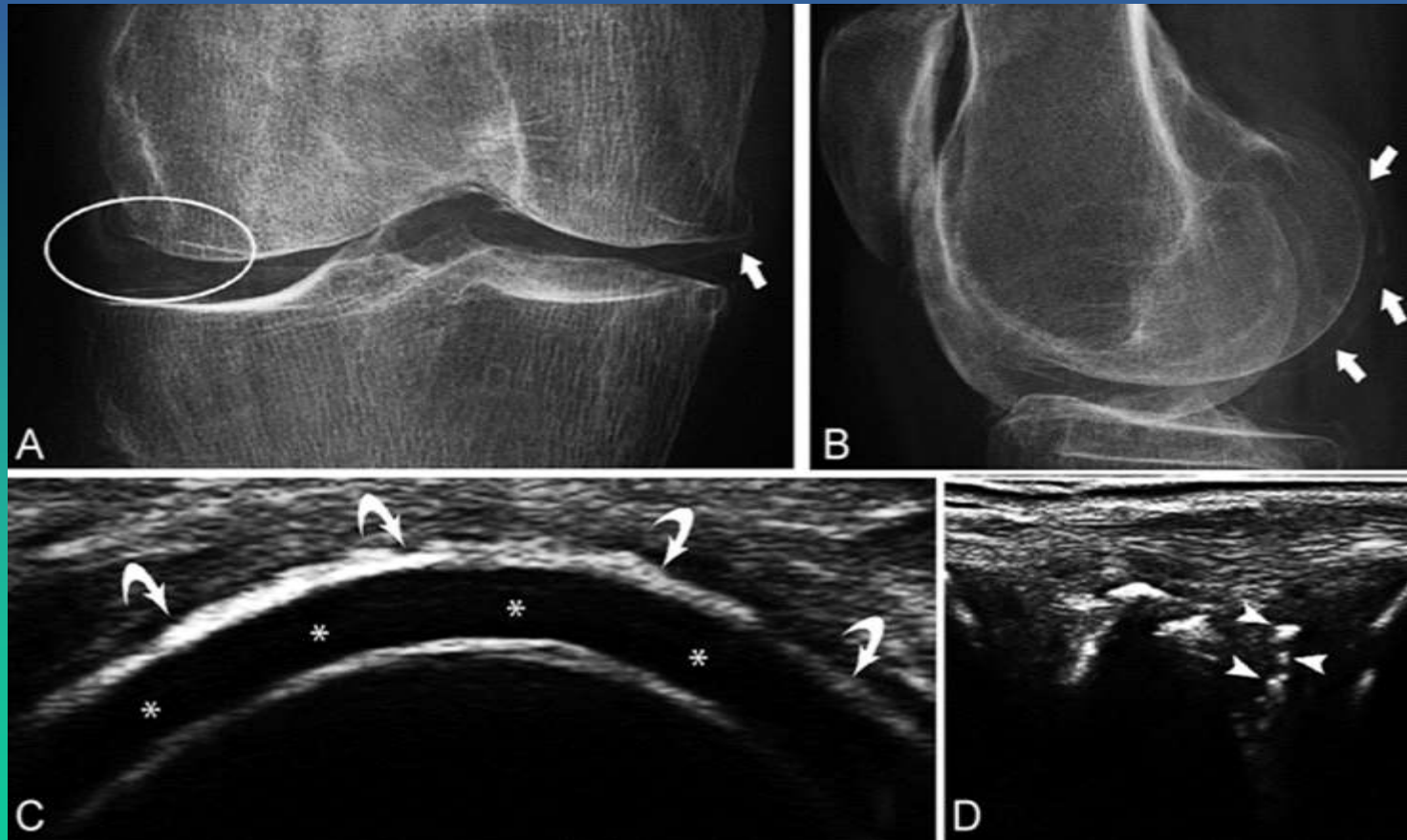
CPPD

- hyaline cartilage
knee, shoulder
- fibrous cartilage
menisci, discus
triangularis, ACJ
- osteoarthritis (MCP,
STT)
- synovitis
(nonspecific)



«inquiry is fatal to certainty»

Arthritis Rheum. 2013 Jul;65(7):1952



also more critical...

- **Potential pitfalls in the diagnosis of crystal-induced arthritis**
 - (Russell et al., J Clin Rheumatol 2013;19: 98-100)
- **Distinguishing gouty arthritis from cppd**
 - (Löffler et al., J Rheumatol 2015 Mar;42(3) :513-2)
- **A prospective evaluation of ultrasound as a diagnostic tool in acute microcrystalline arthritis** (Zufferey et al., Arthritis Research & Therapy (2015), 17: 188)

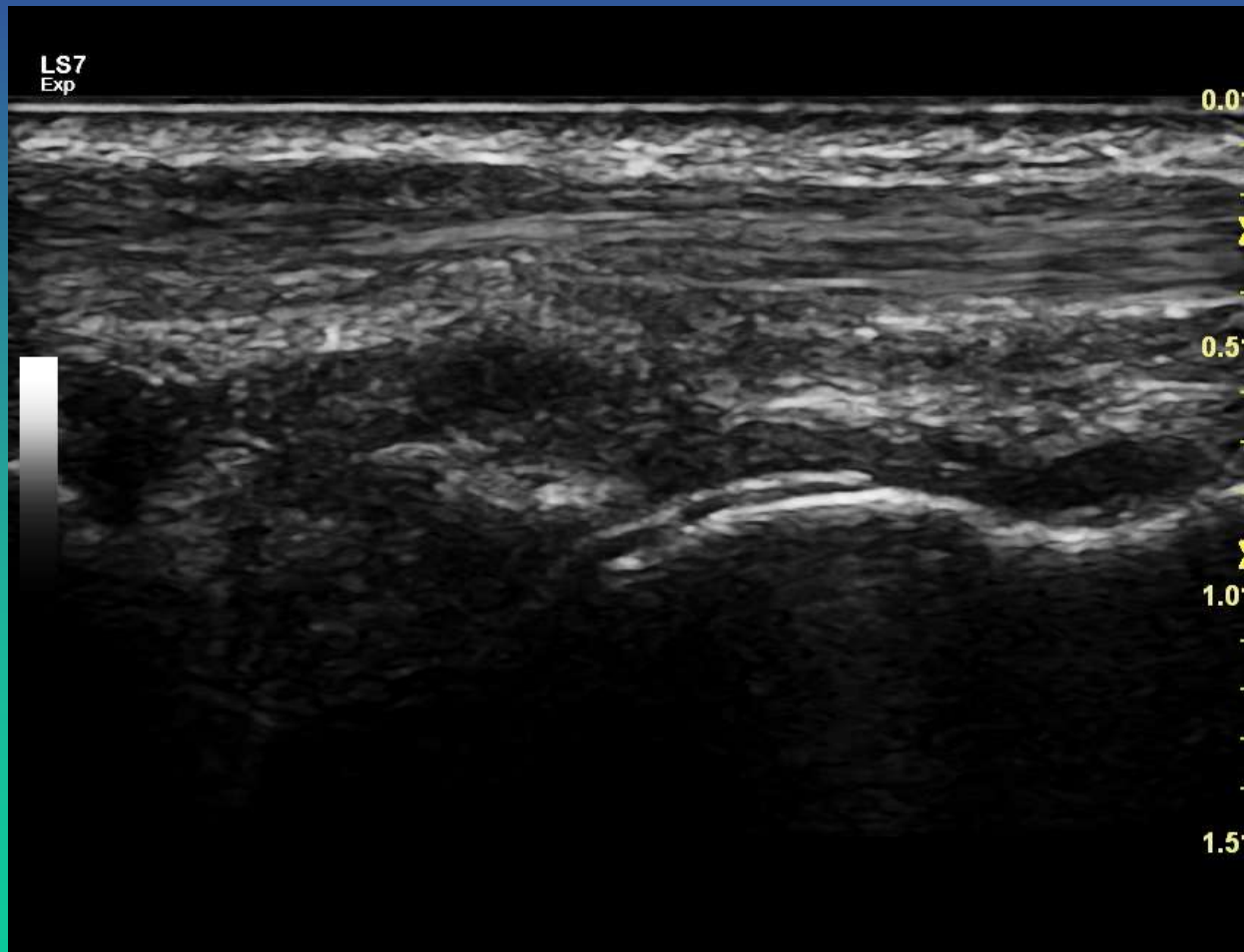
- Presence of joint fluid may facilitate inaccurate evaluation of cartilage
- DC alone can not distinguish reliably between gout and cppd...esp small joints
- DC in combination with hypervascularization more specific for gout
- gout 1 joint: sens 60% / spec 92%
- cppd 1 joint: sens 60% / spec 80%
- multiple joints: sensitivity $\uparrow > 80\%$

Hyperuricemia Doesn't Always Indicate Gout in Rheumatic Disease

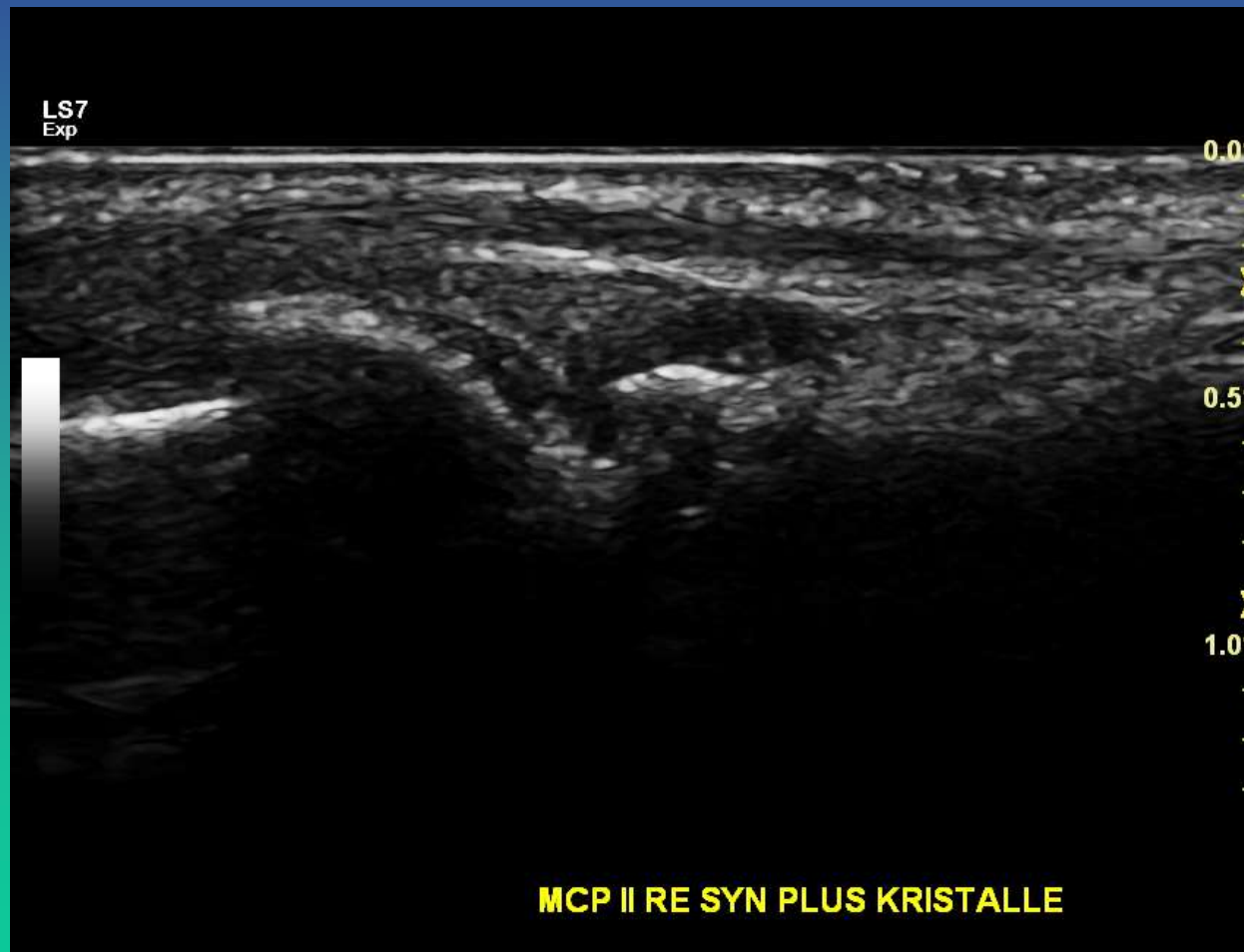
November 9, 2017 • By Veronika Sharp, MD, Alice Chuang, MD, Lily Kao, MD, RMSK, & Midori Jane Nishio, MD, RhMSUS



80y lady, wrist joint



MCP II palmar



FCR



*11.11.1911,

18.12.2017 16:24:49
48 kV 160 mA
2 mAs
4 cm
OFD: 0.0514 mGy
SID: 120 cm





Performance of Ultrasound in the Diagnosis of Gout in a Multicenter Study

Comparison With Monosodium Urate Monohydrate Crystal Analysis
as the Gold Standard

ARTHRITIS & RHEUMATOLOGY

Vol. 69, No. 2, February 2017, pp 429–438

- **DC specificity: 92%**
- **Tophi specificity: 95%**

Review

Ultrasound in the diagnosis of calcium pyrophosphate dihydrate deposition disease. A systematic literature review and a meta-analysis

G. Filippou †*, A. Adinolfi †, A. Iagnocco ‡, E. Filippucci §, M.A. Cimmino ||, I. Bertoldi †, V. Di Sabatino †, V. Picerno †, A. Delle Sedie ¶, L.M. Sconfienza #, B. Frediani †, C.A. Scire ††

Osteoarthritis and Cartilage

Volume 24, Issue 6, June 2016, Pages 973-981

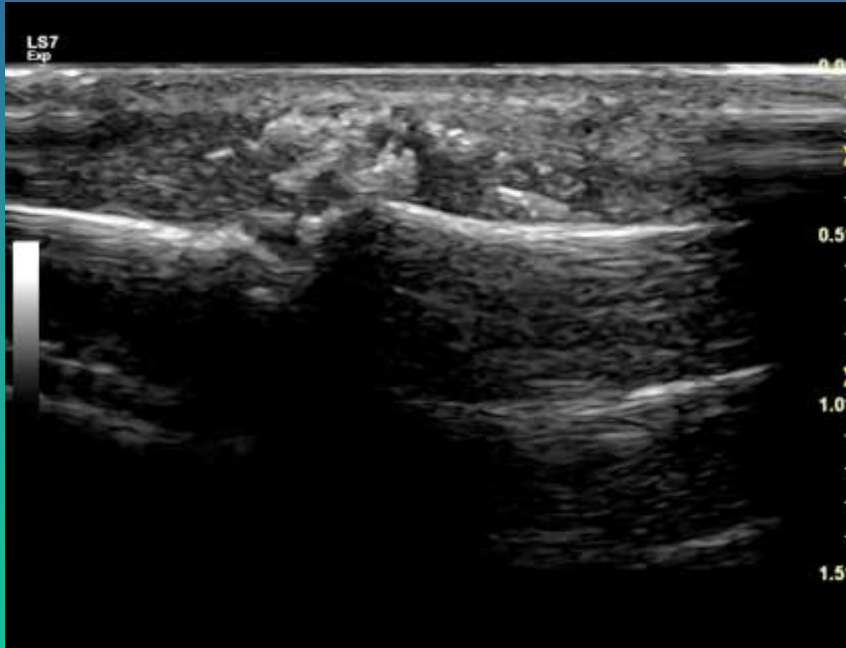
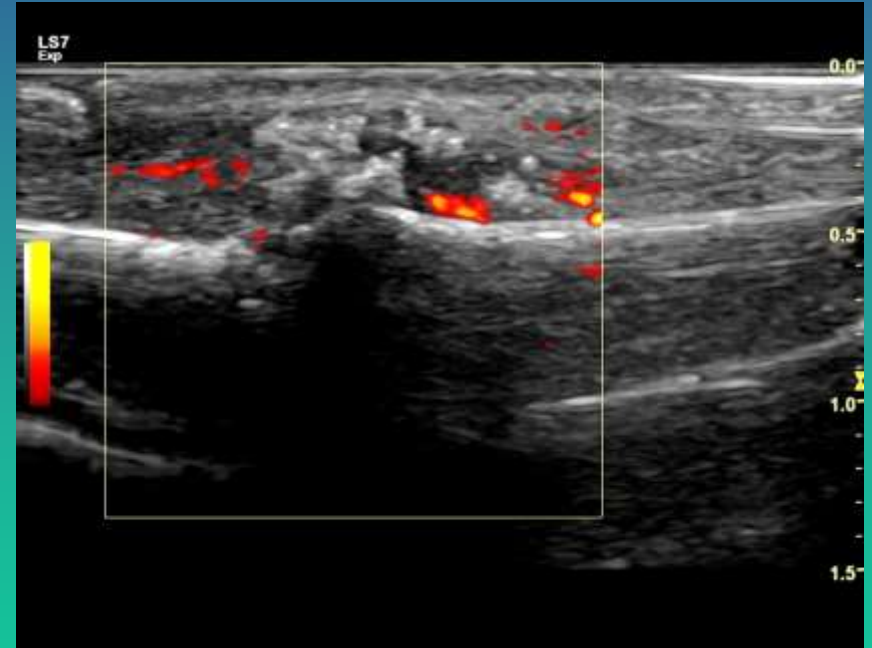
- Sensitivity: tendon 34%; hyaline cartilage 80%
- Specifity: 92%

Editorial

Is the Double Contour Sign Specific for Gout? Or Only for Crystal Arthritis?

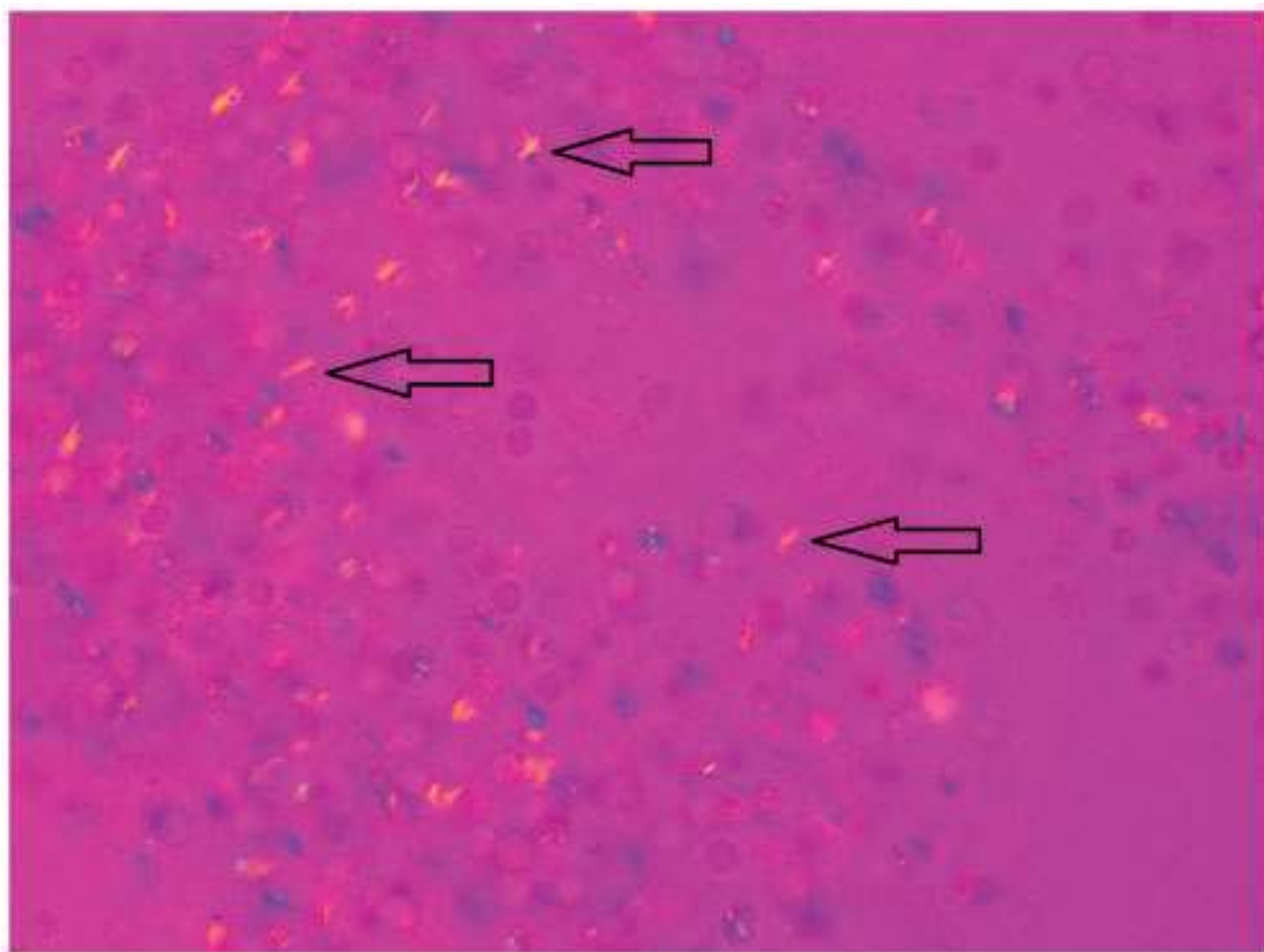
J Rheumatol 2015;42:353–4; doi:10.3899/jrheum.141322

PIP ♀ 1982?

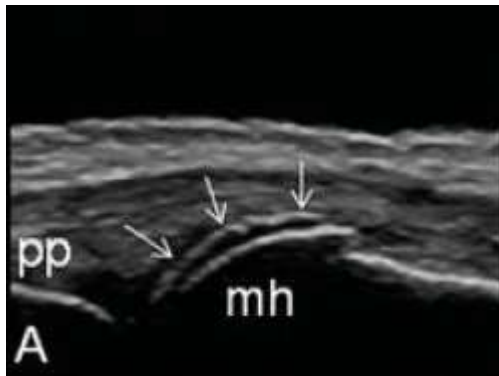
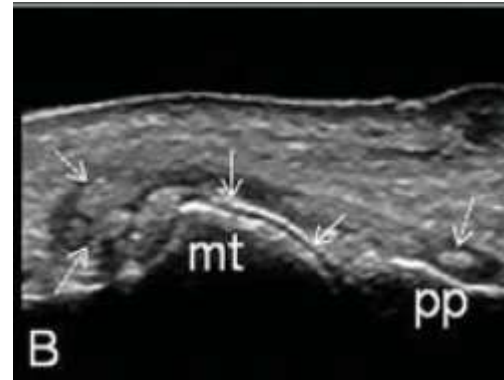
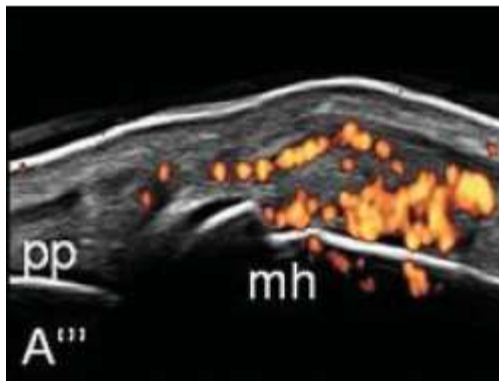
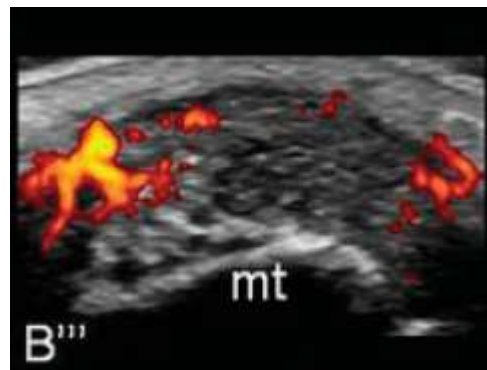


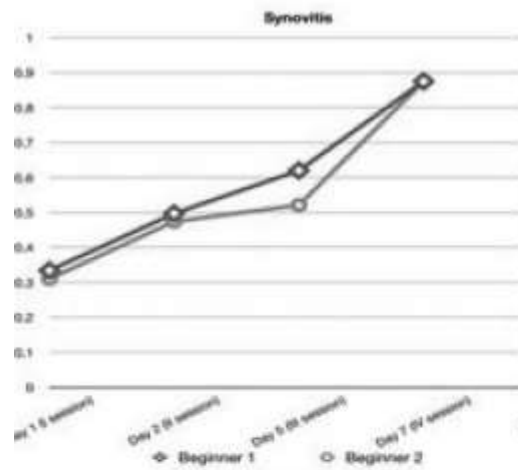
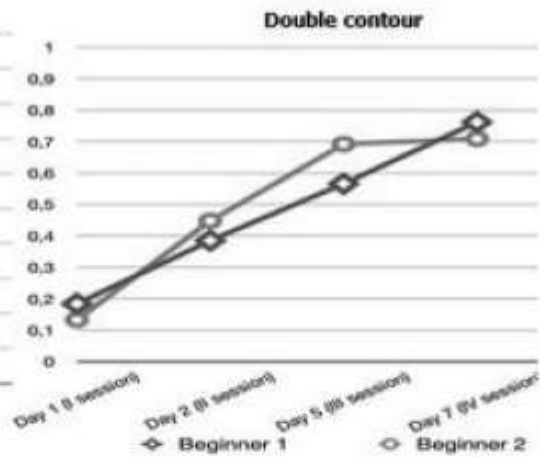
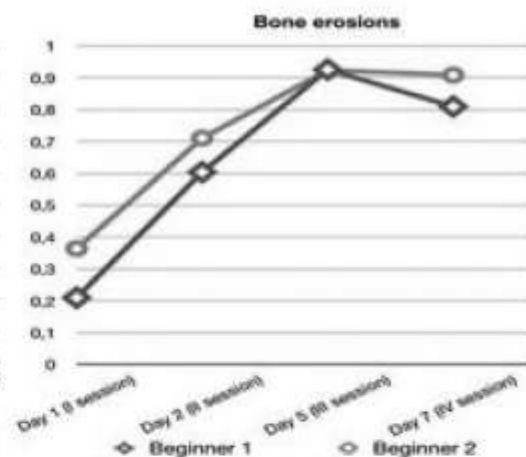
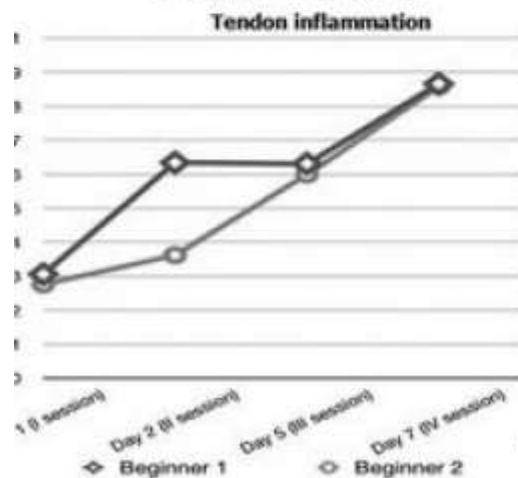
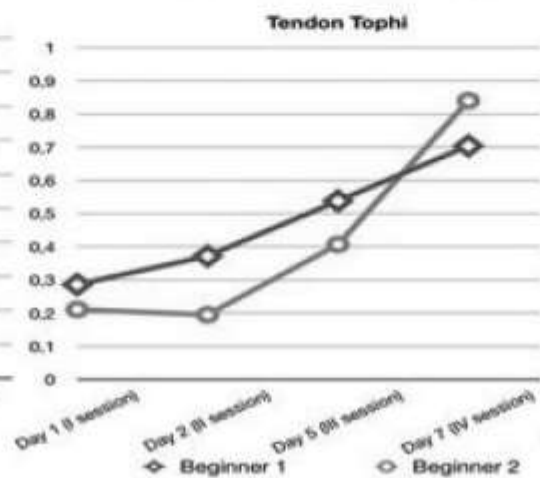
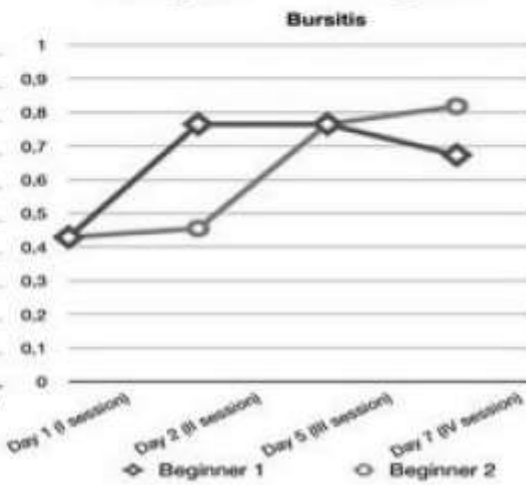






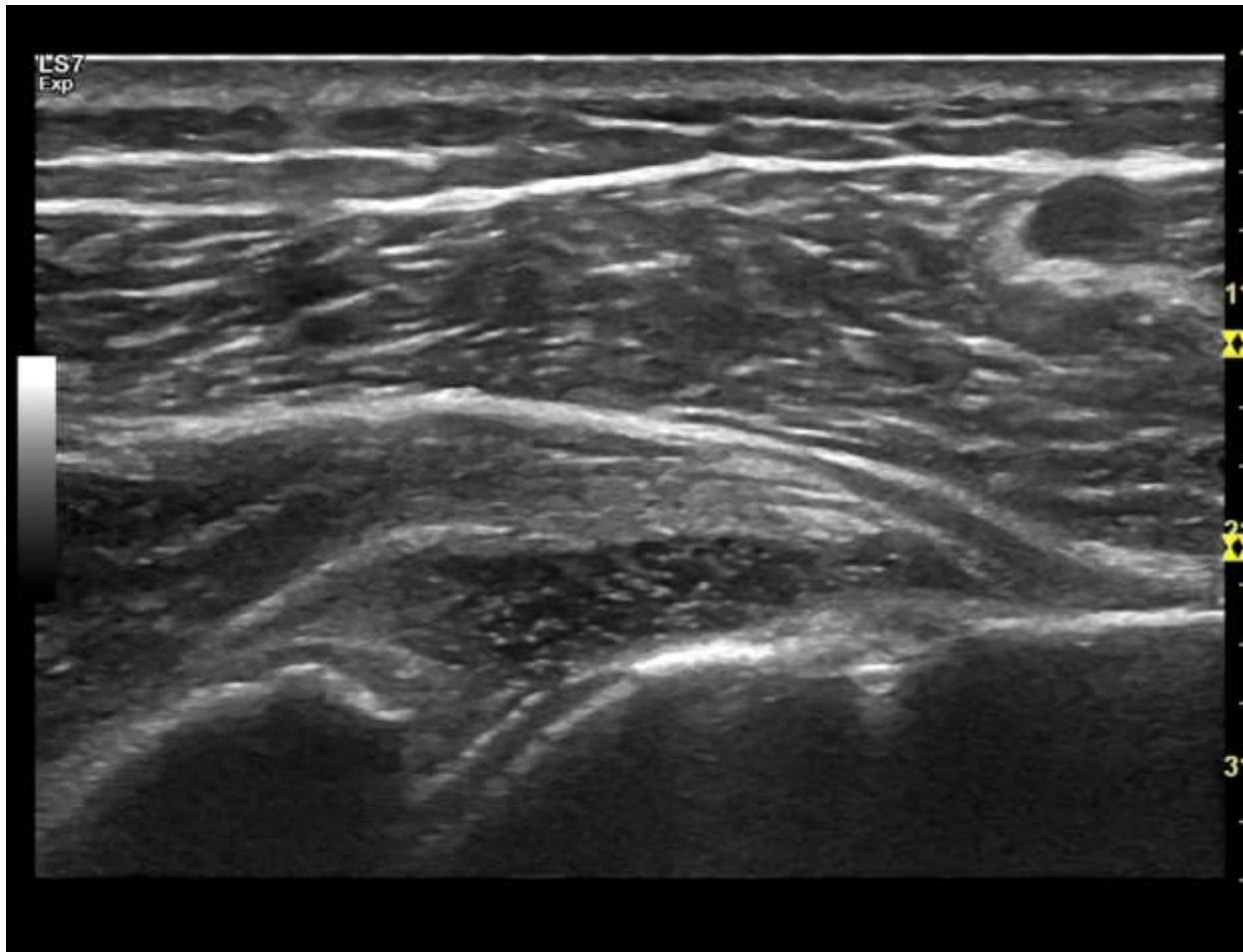
Gutierrez M, Di Geso L, Rovisco J, et al. Ultrasound learning curve in gout: a disease-oriented training program. *Arthritis Care Res* 2013; 65:1265–1274.





Arthritis Care & Research
Vol. 65, No. 8, August 2013, pp 1265–1274

?



Defining Elementary Ultrasound Lesions in Gout. Preliminary Results of Delphi Consensus and Web- Exercise Reliability

THU0345 Gutierrez et al

- **34 Teilnehmer, kumulatives Agreement**
 - **Doppelkontur 91%**
 - **Aggregate 90%**
 - **Erosionen 87%**
 - **Tophus 81%**
-
- **Ann Rheum Dis 2014;73:302 doi:10.1136/annrheumdis-2014-eular.5580**