

AMSER Case of the Month

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A 46-year old man presents with pain in the left first metatarsophalangeal (MTP) joint

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Patient Presentation

- A 46 year-old man presents with pain, swelling, and limited range of motion in the left first metatarsophalangeal (MTP) joint
 - History of polyarthritis including both hands, wrists, and both feet
 - Did not adhere to previous diet and medication recommendations
- Radiographs were obtained to identify the specific cause of pain and guide further management
- Clinical differential diagnosis:
 - gout flare, osteoarthritis, inflammatory arthritis such as rheumatoid arthritis or septic arthritis

Pertinent Labs

Uric Acid level: 11 mg/dL
reference range: (3.4-7.0 mg/dL)

What Imaging Should We Order?

Select the applicable ACR Appropriateness Criteria

Variant 1:

Chronic foot pain. Unknown etiology. **Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---------------------------------------|--------------------------|--------------------------|
| Radiography foot | Usually Appropriate | ⊕ |
| US foot | Usually Not Appropriate | ○ |
| MRI foot without and with IV contrast | Usually Not Appropriate | ○ |
| MRI foot without IV contrast | Usually Not Appropriate | ○ |
| CT foot with IV contrast | Usually Not Appropriate | ⊕ |
| CT foot without and with IV contrast | Usually Not Appropriate | ⊕ |
| CT foot without IV contrast | Usually Not Appropriate | ⊕ |
| Bone scan foot | Usually Not Appropriate | ⊕⊕⊕ |

This imaging modality was ordered by the ER physician



Findings: Unlabeled Left foot radiographs- 3 standard projections



AP



Oblique



Lateral

Findings: Labeled Left Foot Radiographs



- Cloud-like opacity and swelling at the medial aspect of the first metatarsophalangeal (MTP) joint: is suspicious for crystal deposition such as a gouty tophus (yellow arrow)
- Focal lucency of bone at the medial aspect of the first metatarsal head (blue arrow) is known as a marginal erosion, a typical finding in gout arthritis

What Imaging Should We Order Next?

Select the applicable ACR Appropriateness Criteria

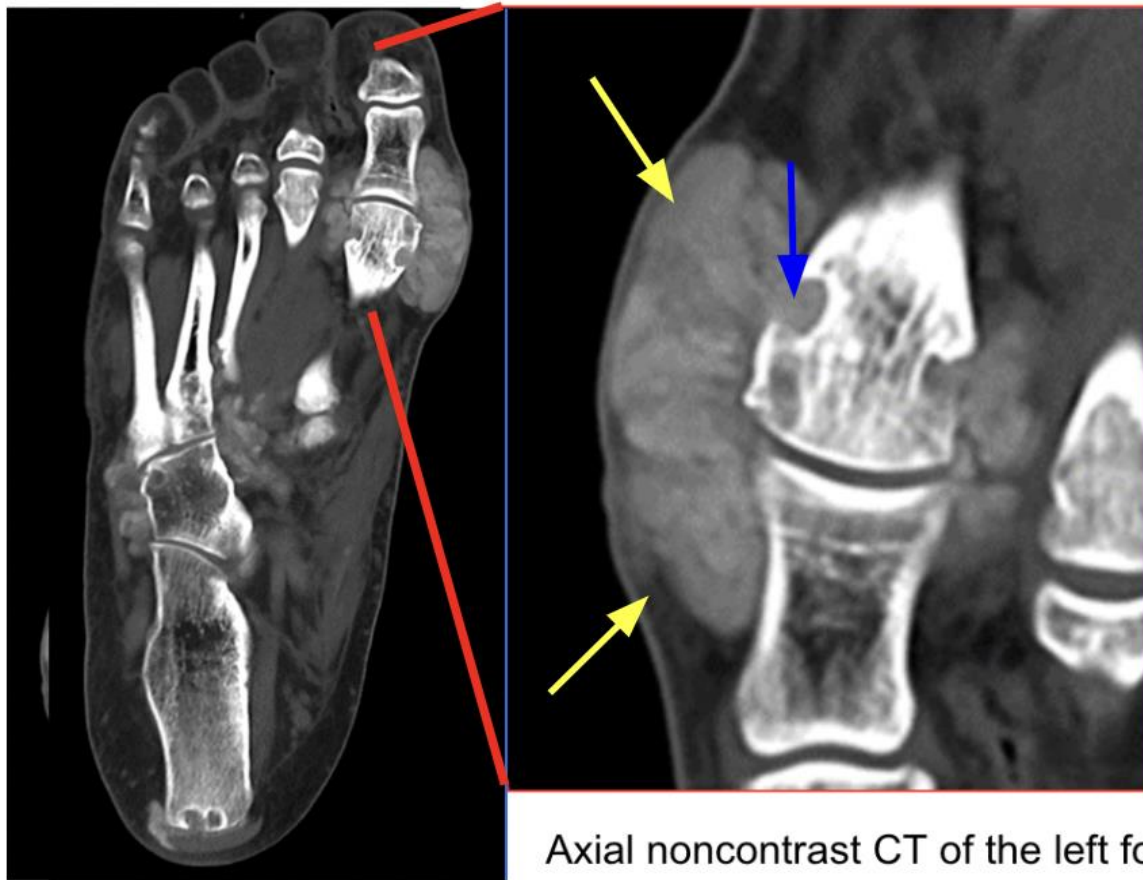
Variant 3: Chronic metatarsalgia including plantar great toe pain. Radiographs negative or equivocal. Clinical concern includes sesamoiditis, Morton's neuroma, intermetatarsal bursitis, chronic plantar plate injury, or Freiberg's infraction. Next imaging study.

| Procedure | Appropriateness Category | Relative Radiation Level |
|---------------------------------------|--------------------------|--------------------------|
| MRI foot without IV contrast | Usually Appropriate | 0 |
| US foot | May Be Appropriate | 0 |
| MRI foot without and with IV contrast | May Be Appropriate | 0 |
| CT foot without IV contrast | May Be Appropriate | ⊕ |
| Bone scan foot | May Be Appropriate | ⊕⊕⊕ |
| CT foot with IV contrast | Usually Not Appropriate | ⊕ |
| CT foot without and with IV contrast | Usually Not Appropriate | ⊕ |

A Dual energy CT was ordered due to specific concern for gout.



Findings: Labeled CT images from a Left Foot Dual Energy CT



Yellow arrow: tophus

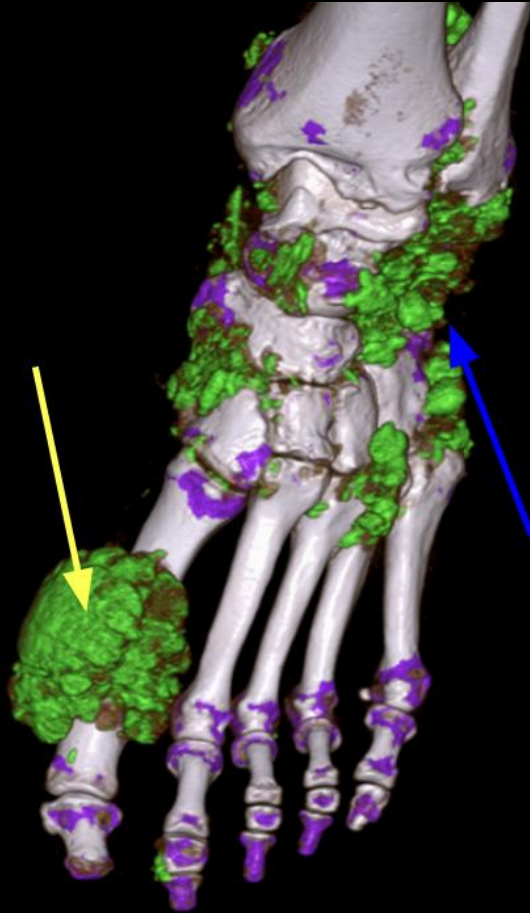
Blue arrow: marginal erosion in
the 1st metatarsal head

Findings: Unlabeled Left foot Dual Energy Computed Tomography (DECT)



- 3-dimensional reconstructed images of the left foot using DECT with post-processing to label monosodium urate crystals in green.
- The purple coloration occurs at sites of trabecular bone, a normal finding.

Findings: labeled Left foot Dual Energy Computed Tomography (DECT)



- Green-labeled monosodium urate crystal deposition around the 1st MTP joint indicates a tophus (yellow arrow)
- Additional sites of tophus including around the ankle joint (blue arrow)

Findings: Comparing the X-ray and DECT images...



- Tophus around the ankle is difficult to visualize on radiographs (red arrow)

Extent/Severity of the tophus is difficult to confidently assess by radiographs alone

Final Dx:

Gouty Arthritis

Case Discussion

- Gout is a common form of inflammatory arthritis where monosodium urate crystals are deposited into joints rising prevalence: currently affects 1-2% of men in developed countries
 - commonly associated with diabetes, hypertension, and metabolic syndrome
- Diagnosis: Physical exam, elevated serum uric acid level
 - invasive techniques like arthrocentesis and synovial biopsy provide definitive diagnosis
- First-line imaging study: radiographs of the involved joint(s)
 - Ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) can be useful in some cases
 - Dual energy CT (DECT) is non-invasive and provides definitive diagnosis

Our patient underwent a dual energy computed tomography (DECT) scan to confirm the diagnosis and assess the extent of tophus throughout the foot.

Case Discussion

- Radiographs are the first line imaging modality to diagnose arthritis of any type, including gout
 - Radiographs provide excellent resolution of bones and accurately depict mineralization such as deposits of calcium or other crystals
 - Thus radiographs can accurately detect tophus and erosions
- DECT is a non-invasive imaging technique to confidently identify, locate, and quantify monosodium urate deposition in patients with gout
 - DECT uses two X-ray beams of different photon energies
 - Differences in energy absorption are calculated and used to accurately determine the chemical composition of the intervening materials along the X-ray beams
 - Quantification of tophus can be a useful way to track treatment response in patients with gout

References:

Li S, Xu G, Liang J, Wan L, Cao H, Lin J. The Role of Advanced Imaging in Gout Management. *Front Immunol*. 2022 Jan 14;12:811323. doi: 10.3389/fimmu.2021.811323. PMID: 35095904; PMCID: PMC8795510.

Parakh A, Lennartz S, An C, Rajiah P, Yeh BM, Simeone FJ, Sahani DV, Kambadakone AR. Dual-Energy CT Images: Pearls and Pitfalls. *Radiographics*. 2021 Jan-Feb;41(1):98-119. doi: 10.1148/rg.2021200102. PMID: 33411614; PMCID: PMC7853765.

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