# Dual Energy CT: An evolving technique for musculoskeletal imaging

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## Objectives :

This pictorial essay aims to illustrate the utilization of dual energy computed tomography (DECT) scan in musculoskeletal radiology using cases performed in the Department of Radiology and Imaging, Queen Elizabeth Hospital.

## Methods:

In our institute, DECT is performed with 80 kVp and 140 kVp spectra using Siemens CT machine. Specific post-processing software is used to generate standard combined images for analysis. The applications of DECT in musculoskeletal radiology include:

- **Gout imaging**, for which DECT has high specificity in the detection of urate deposition. Calcium and urate crystals are separated and color coded due to their different molecular weights.
- **Arthritis imaging**, for which DECT has high spatial resolution and is useful in patients with contraindications for MRI.
- **Bone marrow pathology**, for which DECT has the potential to detect bone marrow edema in occult fractures, osteitis, and replaced bone marrow in occult bone lesions.
- **Metallic artifact reduction**, which is achieved through the implementation of energy-specific post-processing, creating a virtual monochromatic energy spectrum. Higher energy beam undergoes less attenuation and therefore less beam hardening, while lower energy beam provides better soft tissue contrast. The highest quality images with the least metallic artifact are obtained at 130keV.

## Gout Imaging

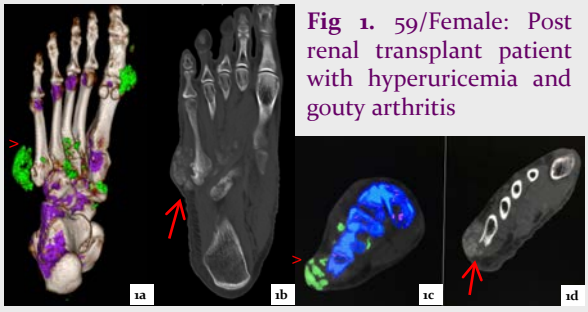


**Fig 1.** 59/Female: Post renal transplant patient with hyperuricemia and gouty arthritis

1b/d) Plain CT images show multiple calcified soft tissue masses with bony erosions, largest at the right 5th metatarsal base (⟶). Main differential diagnoses are calcinosis in chronic renal failure and gouty tophi. 3D reconstruction (1a) and coronal (1c) DECT images show urate deposition in green (>), confirming gouty tophi.

## Arthritis Imaging

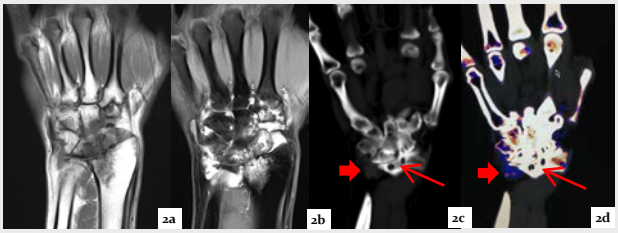


**Fig 2.** 44/Female: Erosive seropostive rheumatoid arthritis

2a/b) T1W and T1W with contrast MRI of the right wrist showing pannus formation at the distal radiocarpal, midcarpal, radiocarpal, ulnocarpal, and carpometacarpal joints with marrow edema and bony erosions involving the distal radius, distal ulna, scaphoid and lunate.
2c/d) Plain and DECT of the right wrist showing the pannus at the distal radioulnar and ulnocarpal joint (➡) and extensive bony erosions at the distal radius (⟶) , and scaphoid, lunate, corresponding well to the MRI images.

## Bone Marrow Pathology

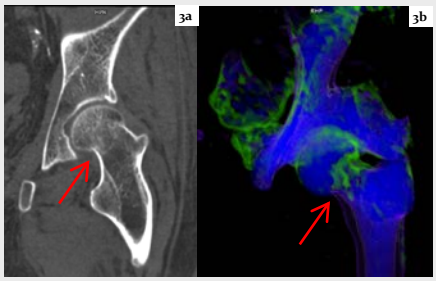


**Fig 3.** 68/Female: Left hip pain Subcapital femoral neck fracture

3a/b) Occult left femoral subcapital fracture, which only shows subtle cortical break in plain CT images, is confirmed by the extensive bone marrow edema and hemorrhage in the DECT images (green).

## Metallic Artifact Reduction

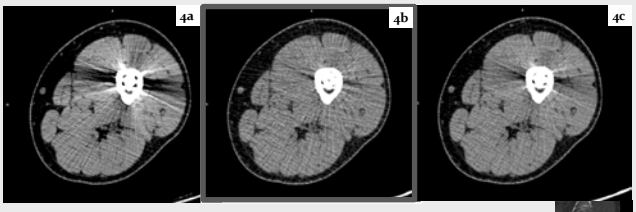


**Fig 4.** 38/Male: Fracture left distal femur with intramedullary nailing, complicated by non-union

Extrapolation from data acquired at 80 and 140 keV allows the creation of virtual images at various keV: (a) 100 keV (b) 130 keV (c) 140 keV. Least metallic artifact is achieved at 130keV in this case.

## Conclusion:

DECT is a useful tool for the detection and monitoring of various musculoskeletal diseases as well as metallic artifact reduction.