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Dual-Energy Computed Tomography: Increasing Clinical Applications of an Emerging Diagnostic Tool in Musculoskeletal Radiology

Antonio Barile, MD[1]

In their recently published article, "The Role of a Virtual Noncalcium Dual-Energy CT Application in the Detection of Bone Marrow Edema in Peripheral Osteomyelitis," Yan et al explore the diagnostic performance of dual-energy CT (DECT) with virtual noncalcium analysis in the diagnosis of osteomyelitis in several joint districts. According to their results, the additional evaluation of virtual noncalcium images with bone and soft tissue reconstructions provided increased sensitivity and specificity for the diagnosis of osteomyelitis.[1]

The present study is one of the pilot studies on the application of DECT in the diagnosis of osteomyelitis, representing an original and important contribution to understanding the actual potential of this novel CT technique in the field of musculoskeletal radiology.[2]

Indeed, in the last years, DECT has been gaining increased popularity, especially in neuro and body applications, though there is burgeoning research on the diagnostic validity of the different DECT techniques in several musculoskeletal (MSK) settings.

The characterization of sodium monourate in joints of patients affected by gout, using uric acid pair images, is for sure the most consolidated clinical application, with several studies confirming not only the reproducibility and diagnostic validity of DECT but also its fundamental contribution to the differential diagnosis and prognostic assessment of the disease.[3]

The application of virtual noncalcium images, as proposed by Yan et al in their study, turned out to be effective also for the qualitative and quantitative evaluation of bone marrow edema in inflammatory arthropathies (sacroiliitis and axial spondylarthritis). Following contrast medium administration, DECT with iodine maps showed good sensitivity and specificity also in the detection and characterization of bone erosions and periarticular soft tissues (synovitis and periostitis).

Material decomposition analysis of DECT images proved to be capable to characterize iron-containing tissues; this information can be valuable in MSK imaging to diagnose specific pathological entities such as pigmented villonodular synovitis, but also to detect metal debris in metallosis and pseudotumors, given also the potential advantage in metal artifact reduction around prostheses using virtual monoenergetic postprocessing techniques.[2]

A very promising application of DECT relies on the capability of virtual noncalcium imaging to assess bone marrow, subtracting bone mineral from trabecular bone. Several studies demonstrated high specificity and sensitivity rates, approaching the diagnostic accuracy of MR imaging, for the detection of occult/insufficiency fractures and vertebral compression fractures. Similarly, applications of DECT for detecting and characterizing osteolytic and osteoblastic bone lesions and neoplasms have been explored, with promising results in terms of diagnostic performance.[4]

Last, but not least, in vivo studies are exploring the validity and potential advantages of DECT for the visualization of tendon and ligament pathology using collagen-mapping postprocessing. In this field, equaling the Magnetic Resonance imaging (MRI) contrast resolution is challenging, but there are some potential advantages in exploiting CT imaging, mostly related to the examination timing, availability, and possible contraindications of MRI.[2]

In the coming years, the diffusion and optimization of DECT protocols and scanners will certainly open the scenario of a new musculoskeletal CT diagnostics, as many of the above-mentioned applications will surely be incorporated into routine clinical practice, modifying the indications to imaging and imaging analysis, improving the management of several MSK diseases.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

[1]Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila, L'Aquila, Italy

Corresponding Author:
Antonio Barile, Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila, via Vetoio 1, L'Aquila, 67100 Italy.
Email: antonio.barile@univaq.it

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