



Musculoskeletal imaging of the inflammatory and degenerative joints: current status and perspectives

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This special issue of “La Radiologia Medica” focuses on the broad spectrum of musculoskeletal imaging, ranging from essential concepts for inflammatory (rheumatoid arthritis, spondyloarthritis, gout, and other crystal-induced arthropathies), noninflammatory (osteoarthritis, algoneurodystrophy) to multisystem and general pathologic conditions (such as large-vessel vasculitis) [1]. Musculoskeletal radiology continues to evolve rapidly, benefiting from advances as continually improving magnets, sequences in magnetic resonance imaging (MRI) as well as the broader application of plain radiographs, ultrasonography (US), and computed tomography (CT), or dual-energy CT (DECT) to the musculoskeletal system [2]. The articles included in this focused issue have been compiled with a goal to provide a valuable resource for residents, fellows, and practicing radiologists and rheumatologists in the scope of a shared interpretation of musculoskeletal imaging examinations. Both specialties have a duty to use imaging cost-effectively, to provide the requisite clinical information on diagnosis, prognosis, and serial assessment with the least risk and inconvenience to the patient. This can be best achieved by close working relationships between the specialties.

The lead article, “*An Overview of Commonly Used Radiographic Scoring Methods in Rheumatoid Arthritis and Psoriatic Arthritis*,” is spearheaded by Fausto Salaffi,

MD, Ph.D., and colleagues at the Rheumatological Clinic, Università Politecnica delle Marche, Ancona (Italy); it provides a focused guide for the scoring of plain radiographs in patients with rheumatoid arthritis (RA) and psoriatic arthritis (PsA). Radiographic progression is one of the most important outcome measures in RA and PsA clinical trials, because it reflects historical disease activity, is associated with loss of function over time, and can be reliably assessed [3]. These differ in the joints and features assessed. This results in differences in the scoring range, but also in the method of performance [4]. The various scoring systems for the two diseases are detailed in this issue.

The potential applications of US in rheumatology have been further increased with the dawn of the “third generation” US machines, equipped with very high-frequency probes (> 10 MHz). These can reach a spatial resolution of less than a tenth of a millimeter and make it possible to study the finest details of the smaller joints and hand tendons which are involved early on in RA [5–8]. In their article, “*Ultrasound imaging in rheumatoid arthritis*,” Emilio Filippucci, MD, and colleagues at the Rheumatological Clinic, Università Politecnica delle Marche, Ancona (Italy), provide an overview of the main studies focusing on the value of US in the assessment of the patients with RA, and discussing the elementary lesions detectable by US (synovitis, bone erosion, cartilage damage, tenosynovitis, and tendon damage), the scoring systems currently available, and the scanning protocols in definite clinical settings (undifferentiated arthritis, early and long-standing RA).

Several sonographic abnormalities may be also observed in patients with osteoarthritis (OA) [9]. These include changes within cartilage, joint space widening resulting from fluid collection with or without synovial proliferation, and osteophytes. Loss of the thin, sharp contour of the superficial margin of the cartilaginous layer is one of the early features of OA. The US is exquisitely sensitive in detecting structural changes within different tissues and can reveal fibrillation and cleft formation in osteoarthritis. In

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their article, “*Clinical utility and potential of ultrasound in osteoarthritis*,” Tadashi Okano, MD, and colleagues at the Orthopedic Surgery, Osaka City University Graduate School of Medicine, Osaka (Japan), describe the specific findings and utility of US for OA assessment.

In the last decades, the use of imaging guidance (notably US, but also CT and MRI) has emerged as an essential tool to perform several different kinds of interventions around bone and soft tissues; in their article “*Interventional therapeutic procedures to treat degenerative and inflammatory musculoskeletal conditions: state of the art*”, Vito Chianca, MD, and colleagues at the IRCCS Istituto Ortopedico Galeazzi, Milano (Italy), review the current indications and results of the main therapeutic procedures in interventional musculoskeletal radiology for degenerative and inflammatory conditions.

Along with the development of novel drugs and therapies that are intended to alter the course of degenerative osteoarthritis, imaging plays a key role for the early detection and accurate assessment of joint status [10–12]. Federico Bruno, MD, and colleagues at the Department of Biotechnology and Applied Clinical Sciences, University of L’Aquila, L’Aquila (Italy), in the article “*New advances in MRI diagnosis of degenerative osteoarthropathy of the peripheral joints*,” provide an overview of the recent applications of advanced MRI techniques for the evaluation of degenerative joint changes (notably affecting the articular cartilage) that could have a great potential in the early diagnosis and treatment monitoring.

While conventional radiography and US remain a mainstay in rheumatology, MRI and CT have become increasingly common in patient care. Efficient methods for diagnosis, monitoring, and prognostication are essential in early RA [13, 14].

Mikkel Østergaard, MD, Ph.D., and colleagues at the Center for Rheumatology and Spine Diseases, Rigshospitalet, Glostrup, and the Department of Clinical Medicine, University of Copenhagen, Copenhagen (Denmark), focused on the potential uses of MRI and CT in the clinical management of patients with suspected or definite RA in the article “*Imaging in Rheumatoid Arthritis: The Role of Magnetic Resonance Imaging and Computed Tomography*.” After sections on technical aspects, it described the current knowledge on MRI and CT for early detection of RA manifestations, diagnosis of RA, monitoring of disease activity and joint damage progression, and its role in determining prognosis.

Sacroiliac (SI) joints involvement is a crucial feature of inflammatory spondyloarthropathies, and MRI is the gold standard imaging modality to detect SI pathology [15–18]. Maria Antonietta Mazzei, MD, and colleagues at the Department of Medical, Surgical and Neuro Sciences, Diagnostic Imaging, University of Siena (Italy), in

their article “*Magnetic resonance imaging of the sacroiliac joints in SpA: with or without intravenous contrast media?*”, discuss the different MR imaging modalities and strategies available for the assessment of inflammatory involvement of the SI joints, with a particular focus on the advantages and limits in the use of intravenous contrast media.

Despite the recognized fundamental role of MRI in inflammatory joint pathologies, as previously discussed, MR imaging findings in clinical diagnostic criteria often lack specificity, giving potential diagnostic issues especially in the differential diagnosis with degenerative alterations [18–20]. To further explore this topic, in the contribution “*MRI of the axial skeleton: differentiating non-inflammatory disease and axial spondyloarthritis – a review of current concept and applications*,” Ernesto La Paglia, MD, and colleagues at the Department of Radiology, Ospedale Ss. Antonio e Biagio e Cesare Arrigo, Alessandria (Italy), discuss the main MRI signs and the possible differential diagnoses, to improve the diagnostic performance in inflammatory spondyloarthropathies.

Although the role of imaging in the diagnosis, staging, and disease monitoring has been well established [21], several anatomical variants and imaging artifacts can show unusual appearance, leading to possible diagnostic pitfalls [22, 23]. Marcello Zappia, MD, and colleagues at the Dipartimento di Medicina e di Scienze della Salute “Vincenzo Tiberio,” Università del Molise, Campobasso (Italy), with their contribution “*Diagnostic imaging pitfalls in rheumatology*,” illustrate the possible imaging pitfalls encountered in the imaging of inflammatory joint pathologies, and the available tips and tricks to recognize them.

With the assistance of innovations in scanner engineering and software design, dual-energy CT (DECT) is a recently developed advanced imaging method in the last decade. The principal advantages of DECT over conventional CT in the musculoskeletal setting relate to the additional information provided regarding tissue composition, artifact reduction, and image optimization [24–26]. Marina Carotti, MD, and colleagues at the Radiology Department, Università Politecnica delle Marche, Ancona (Italy), focus on applications of DECT to musculoskeletal imaging including gout and other crystal-induced arthropathies, virtual non-calcium images, and the study of bone marrow lesions in “*The application of dual-energy computed tomography in the diagnosis of musculoskeletal disorders—A review of current concepts and applications*.”

The next portion of this monograph is dedicated to multimodality musculoskeletal imaging. This section of the monograph issue comprises a topic relevant to the practicing radiologist and rheumatologist. Two articles are devoted to the large-vessel vasculitis (LVV) and the utility of a US B-lines assessment as an adjunct method

to assess interstitial lung disease (ILD) in patients with connective tissue disorders (CTD).

IPF is a frequent manifestation in patients with CTD [27–30]. Recently, the US criterion validity for its assessment has been proposed [27, 28]. In their article, “*Ultrasound as a potential tool for the assessment of interstitial lung disease in rheumatic patients. Where are we now?*”, Marwin Gutierrez, MD, and colleagues at the Instituto Nacional de Rehabilitación, Mexico City, and Rheumatology Section, Center of Excellence of Rheumatology, Mexico City (Mexico), provide an overview of the role of US in the assessment of ILD in rheumatic disorders and discuss the current evidence supporting its clinical application in daily clinical practice.

LVV is the most common form of primary vasculitis comprising giant cell arteritis (GCA), Takayasu arteritis (TAK), and idiopathic aortitis (IA) [31, 32]. Early diagnosis and treatment of LVV are paramount to reduce the risk of ischemic complications such as visual loss and strokes, vascular stenosis and occlusion, and aortic aneurysm formation. Use of imaging modalities (US, MRI, CT, and [18F]-fluorodeoxyglucose positron emission tomography (PET)) has steadily increased to enable assessment of cranial and extracranial arteries, as well as the aorta. Key concepts underlying LVV are covered in the article “*EULAR Recommendations for the use of Imaging in Large Vessel Vasculitis in Clinical Practice*” by Mohammad Bardi, MD, and colleagues at the Department of Rheumatology, University of British Columbia (Canada), that summarizes the current evidence of imaging in patients with or suspected of having LVV and highlights the clinical implications of the EULAR recommendations.

As guest editors, we hope that this monograph issue provides residents, fellows, and practicing radiologists and rheumatologists with a strong foundation for interpreting multimodality musculoskeletal imaging studies. The numerous authors composing these articles have contributed their expertise with the intention of providing the most accurate and current information available at the time of publication; we are grateful for their incredible efforts.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standards This article does not contain any studies with human participants or animals performed by any of the authors.

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