La radiologia medica (2026) 131:855–869
https://doi.org/10.1007/s11547-026-02171-7

MUSCULOSKELETAL RADIOLOGY

Whole-body magnetic resonance imaging in rheumatology: advancements, key applications and future perspectives

Gabriele Mirabella[1] · Giambattista Privitera[2] · Angelo Montana[2] · Luca Ultimo Esposto[2] · Enzo Fausto Santonocito[2] · Emanuele David[1] · Pietro Valerio Foti[1] · Stefano Palmucci[1] · Placido Romeo[2] · Antonio Basile[1]

Received: 23 January 2025 / Accepted: 3 January 2026 / Published online: 13 February 2026
© The Author(s) 2026

Abstract

Whole-body magnetic resonance imaging (WB-MRI) is widely used in rheumatology to assess peripheral and axial joints and entheses throughout the body. Despite some limitations, it has potential in determining the overall inflammatory burden, tracking disease progression, and evaluating treatment response. It is used in the evaluation of idiopathic inflammatory myositis (IIM) or in the pediatric population where it is becoming the gold standard for the diagnosis and monitoring of conditions, such as juvenile idiopathic arthritis (JIA) and chronic recurrent multifocal osteomyelitis (CRMO). In addition to advancements in technology and the development of WB-MRI scoring systems, the integration of artificial intelligence (AI) may improve diagnostic accuracy by automating assessments and enabling early detection of subclinical inflammation. The aim of this review is to examine the current scientific evidence for the use of WB-MRI in rheumatology.

Keywords Whole-body MRI · Rheumatology · Artificial intelligence · Review · OMERACT

Introduction

Applied mainly in oncologic settings for the detection of bone marrow involvement in malignancies such as multiple myeloma, lymphoma and metastases, whole-body magnetic resonance imaging (WB-MRI) has evolved as a highly valuable diagnostic technique [1, 2]. Today WB-MRI is becoming more common in non-oncological fields, particularly rheumatology, where it provides complete evaluation of multisystem inflammatory disorders [3, 4]. WB-MRI has potential for assessing the complex patterns of systemic inflammation and enthesitis characteristic of rheumatic conditions, including ankylosing spondylitis, psoriatic arthritis, and juvenile idiopathic arthritis [3, 5, 6]. WB-MRI has become popular in pediatric rheumatology for diseases like chronic recurrent multifocal osteomyelitis (CRMO) and juvenile idiopathic arthritis (JIA), where it decreases repeated radiation exposure in long-term follow-up. Moreover, the main advantage of WB-MRI is its ability to identify asymptomatic areas of inflammation that conventional, region-specific imaging techniques may miss [3]. Despite apparent advantages, critical barriers impede widespread clinical translation: absence of prospective randomized controlled trials demonstrating superior diagnostic accuracy or prognostic stratification compared to conventional imaging, absence of economic analyses comparing WB-MRI costs to conventional imaging strategies with documented outcome improvements, radical protocol heterogeneity across institutions preventing meaningful evidence synthesis and lack of standardized scoring systems specific to WB-MRI applications in most rheumatologic conditions [4].

Methods

This review synthesizes literature, international clinical practice guidelines and recent comprehensive reviews on WB-MRI in rheumatologic diseases spanning 1997 and 2025. Critical gaps in evidence—including absence of prospective randomized trials, health economic analyses, and

✉ Gabriele Mirabella
gabrielemirabella14@gmail.com

[1] Department of Medical Surgical Sciences and Advanced Technologies "GF Ingrassia", University Hospital Policlinico "G. Rodolico-San Marco", 95123 Catania, Italy

[2] Division of Radiology, San Marco Hospital, AOU Policlinico "G. Rodolico-San Marco", 95123 Catania, Italy

protocol standardization—were explicitly identified. This approach follows SANRA criteria for quality assessment of narrative reviews [7].

WB-MRI protocol

Although there is no standard protocol for WB-MRI in rheumatology, usually it consists of T1-weighted and Short Tau Inversion Recovery (STIR) sequences as recommended by the ESSR subcommittee [4]. Giraudo et al. conducted a survey to examine the various protocols employed in Europe: other participants not using such guidelines, applied for example protocols based on the most updated literature, disease-tailored, and the ESTHER trial protocol; 51% of the participants, especially radiologists working in private practice ($p = 0.025$), referred to the guidelines of the Arthritis subcommittee of the ESSR [5, 8].

T1-weighted sequences are essential for the evaluation of structural changes, including fatty infiltration, sclerosis, and erosions in bones. They provide anatomical detail that is critical for the diagnosis of disease progression and chronicity [4, 5, 9]. STIR sequences, on the other hand, are particularly sensitive to fluid and edema, making them ideal for detecting bone marrow edema (BME) and soft tissue inflammation—early indicators of active disease that are critical for timely diagnosis and intervention.

Both 1.5 or 3.0 T scanners can be used equally even though it is shown by Mohan et al. that 1.5 T scanners are preferable in children because 1.5 T has significantly better image quality, fixed structure visibility and fewer artifacts, as compared to WB-MRI at 3 T in children; large studies comparing actual detection of pathology at two field strengths are required [10]. These protocols have been further refined by advancements in WB-MRI technology, which enables scans to be completed in under 45 min without the need to reposition the patient. Modern scanners using numerous phased-array coils—which offer a field of view (FOV) of 15–40 cm along the longitudinal axis—allow complete body scanning in a single session: head, neck, thoracic, abdominal, spine, and lower extremities; the upper limbs are not usually included in the acquisition and need a separate investigation if it is recommended [1].

The whole spine acquisition is advised to be done in sagittal view, STIR/TIRM and/or T1-weighted [4]. For several oncological uses, WB-MRI has become the accepted standard of care imaging method; its non-oncological uses are also growing [1, 11].

Despite not advised as "standard" protocol, there are additional sequences that may be used during WB-MRI, especially Dixon technique and Diffusion-Weighted imaging (DWI). These sequences may improve the sensitivity and specificity of WB-MRI in identifying and characterizing inflammatory processes. The article by Bozgeyik et al. (2008) emphasizes the value of DWI in the early detection of active sacroiliitis, a common symptom of ankylosing spondylitis. This is achieved by measuring apparent diffusion coefficients (ADC) in the sacroiliac joints. Their research revealed that ADC values in affected areas were much greater than in areas with mechanical low back pain, suggesting that DWI is a sensitive and useful technique for spotting early inflammation in sacroiliitis [12]. Using many *b*-values (100, 600, and 1000 s/mm^2), DWI provides a consistent substitute for contrast-enhanced T1-weighted imaging, which has historically been employed for sacroiliac joint assessment. It also allows separation between acute and chronic inflammatory alterations. Protocol heterogeneity across institutions has prevented standardization of WB-MRI practice, consequently hindering the development of evidence-based clinical guidelines. Major international societies, including the American College of Radiology, have not formally endorsed WB-MRI as a standard imaging modality, with neither the 2017–2022 ACR Appropriateness Criteria for joint pain nor the 2021 update for axial spondyloarthritis providing definitive recommendations for routine clinical use [13].

Introduction to whole-body MRI in seronegative spondyloarthritis

WB-MRI has emerged as a significant imaging modality for assessing seronegative spondyloarthritis (SpA), a category of chronic inflammatory diseases characterized by a genetic predisposition associated with the HLA-B27 gene and the absence of rheumatoid factor. Classification of spondyloarthritis according to anatomical distribution distinguishes two major phenotypes: axial disease (axSpA), characterized by predominant involvement of the spine and sacroiliac joints, and peripheral disease (pSpA), with primary manifestations in peripheral articulations. In adult populations, ankylosing spondylitis represents the prototypical axial phenotype, whereas psoriatic arthritis, reactive arthritis, enteropathic spondyloarthritis and undifferentiated forms typically present with peripheral joint predominance, though variable axial involvement may develop during disease progression. [14, 15] (Table 1).

WB-MRI facilitates the identification of inflammation, bone marrow edema, and structural alterations in both axial and peripheral joints, offering a thorough perspective that is especially beneficial for early diagnosis and tracking disease progression. Unlike conventional MRI, it can assess the entire body in a single session, evaluating the multi-district involvement typical of SpA, however, distal small joints may require targeted small-FoV acquisitions to preserve diagnostic detail [13].

Table 1 Overview on guidelines and MRI-based scoring system

Disease	Typical population/context	Primary WB-MRI sites	WB-MRI hallmarks	Helpful extra sites	Scoring/guidelines	Common pitfalls
Ankylosing spondylitis (axSpA)	Young–middle-aged; HLA-B27 often positive	Sacroiliac joints (subchondral BME); spine (vertebral corners)	ASAS-pattern SIJ BME; Romanus lesions; fat metaplasia → syndesmophytes/ankylosis	Anterior chest wall (MSJ/SCCJ); costovertebral joints	ASAS/OMERACT 2011, EULAR 2015, ACR 2021, ASAS-EULAR 2023; SPARCC SIJ/spine), Berlin/ASspiMRI-a/-c, CANDEN, ASAS-SPARTAN 2024	Isolated spinal BME; mechanical stress; infection mimics
Psoriatic arthritis (PsA)	Adults with psoriasis; heterogeneous phenotypes	Hands/feet small joints; SIJs; spine (corners/endplates)	Dactylitis; enthesitis beyond capsule; osteitis; new bone formation	Proximal costal joints; large-joint entheses	CASPAR; PsAMRIS/HEMRIS; MRI-WIPE	Overlap with RA/degeneration; distal-joint resolution on WB-MRI
Reactive arthritis (ReA)	Post-infectious; young adults	SIJs; knees/ankles; Achilles/plantar entheses	Peripheral oligoarthritis; insertional BME	Mid-foot/tarsus	n/a	Imaging overlap with other pSpA—clinical correlation key
Enteropathic SpA (IBD-related)	Crohn/UC; often young adults	SIJs; hips; variable spine	Bilateral/asymmetric sacroiliitis; enthesitis	Anterior chest wall; pubic symphysis	n/a	Mechanical SIJ change; therapy effects (biologics)
Rheumatoid arthritis (RA)	Adults (F > M);	Wrists, MCP/PIP/MTP; cervical spine (atlanto-axial)	Synovitis, tenosynovitis, BME, marginal erosions; pannus/retro-odontoid tissue	Elbows/shoulders (advanced)	2010 ACR/EULAR; RAMRIS (± SAFE/-5), ERAMRS	Non-specific synovitis/BME; GBCA improves tenosynovitis; differentiate from PsA
SAPHO	Adults; cutaneous lesions may precede/follow bone disease	Anterior chest wall (SCCJ/MSJ); spine; SIJs	Hyperostosis/osteitis; cortical + medullary change; enthesal sclerosis; juxtaphyseal lesions	Clavicles; sternum; ribs	n/a	Mimics infection/tumor; need small-FoV SCCJ/chest wall
CRMO/CNO (pediatric CAO spectrum)	Children/adolescents; sterile relapsing–remitting	Metaphyses (tibia), clavicle, pelvis, spine	Multifocal osteitis/BME; subclinical synchronous/metachronous foci; vertebral involvement	Tarsus; sternum	ESSR 2018 Recommendations for multifocal monitoring	Red marrow/open physes mimic edema; confirm with small-FoV
JIA—ERA/jSpA	Pediatric/teen; male-predominant; HLA-B27 frequent	SIJs; thoracolumbar spine; knees/ankles entheses	Early MRI-only axial inflammation; peripheral enthesitis	Patellar/calcaneal entheses; TMJ (targeted)	ILAR 2001, EULAR 2015, PRINTO 2019, ESSR 2020; pediatric MRI JAMRIS	Age-related marrow; motion; need targeted TMJ/hands/feet
Polymyalgia rheumatica (PMR)	≥ 50 years; morning stiffness; ↑ESR/CRP	Shoulders/hips/pelvic girdle	SASD bursitis; GH/hip effusions; peritendinitis; extracapsular pelvic edema	Symphysis pubis; acetabular peri-capsular fat	ACR 2015	Overlap with elderly-onset RA; avoid over-calling mild fluid

Table 1 (continued)

Disease	Typical population/context	Primary WB-MRI sites	WB-MRI hallmarks	Helpful extra sites	Scoring/guidelines	Common pitfalls
Systemic sclerosis (SSc)	Adult autoimmune; variable course	Fascia, subcutaneous tissues, muscles; large joints	Fascial/subcutaneous thickening-edema; perifascial enhancement; myositis-like edema	Proximal lower limbs; shoulder girdle	EULAR 2023	Chronic fibrosis vs active edema—correlate with CK/clinical
Idiopathic inflammatory myopathies (IIM)	Adults (DM/PM/IBM) or pediatric (JDM)	Proximal limb/girdle muscles; paraspinals	Muscle edema on fluid-sensitive sequences; fatty replacement; fascial edema	Biopsy planning targets; distribution mapping	EULAR/ACR 2017	Exercise-related edema; edema vs fat on mapping; motion

Columns list typical population/context, primary WB-MRI targets, hallmark findings, helpful extra sites, scoring/guidelines, and common pitfalls *across conditions*

Abbreviations: *WB-MRI*, whole-body magnetic resonance imaging; *axSpA*, axial spondyloarthritis; *AS*, ankylosing spondylitis; *SIJ*, sacroiliac joint; *BME*, bone marrow edema; *MSJ*, manubriosternal joint; *SCCJ*, sternocostoclavicular joint; *MCP/PIP/MTP*, metacarpophalangeal/proximal interphalangeal/metatarsophalangeal joints; *CASPAR*, Classification Criteria for Psoriatic Arthritis; *SPARCC*, Spondyloarthritis Research Consortium of Canada MRI score; *CANDEN*, Canada–Denmark comprehensive spine MRI score; *BerlinASspiMRI-a/-c*, Berlin ankylosing spondylitis spine MRI activity/chronicity scores; *RAMRIS*, Rheumatoid Arthritis MRI Score; *ERAMRS*, Extended Rheumatoid Arthritis MRI Score; *PsAMRIS*, Psoriatic Arthritis MRI Score (hands/forefeet); *HEMRIS*, Heel Enthesitis MRI Score; *MRI-WIPE*, Whole-Body MRI Inflammation in Peripheral joints and Entheses (global burden score); *JAMRIS*, Juvenile Arthritis MRI Scoring (WB-MRI module); *ERA*, enthesitis-related arthritis; *JIA*, juvenile idiopathic arthritis; *CRMO/CNO*, chronic recurrent multifocal osteomyelitis/chronic non-bacterial osteomyelitis; *IIM*, idiopathic inflammatory myopathies; *DM/PM/IBM/JDM*, dermatomyositis/polymyositis/inclusion body myositis/juvenile dermatomyositis; *GH*, glenohumeral; *TMJ*, temporomandibular joint; *ACW*, anterior chest wall; *FoV*, field of view

Ankylosing spondylitis

Ankylosing spondylitis (AS) is a chronic inflammatory disease that primarily affects the spine and sacroiliac joints (SIJs) and is the main form of axial spondyloarthritis (axSpA). Early sacroiliitis represents one of the initial observable characteristics of ankylosing spondylitis, and magnetic resonance imaging is essential for identifying these inflammatory changes especially in the non-radiographic form (nr-axSpA), which is not detected at X-ray, but meets clinical criteria for axSpA diagnosis. ASAS–EULAR guidance positions imaging as complementary to clinical/lab assessment: targeted SIJ MRI is preferred for classification/diagnosis. WB-MRI is not recommended routinely and may be considered only for selected whole burden mapping [16].

Bone sclerosis, erosions, and spine ankylosis are also among the primary AS structural findings. One of the imaging markers of AS is Romanus lesions, which manifest as bone marrow edema (BME) at the anterior and posterior vertebral corners. These lesions are frequently a precursor to syndesmophytes, which are bony growths that can eventually result in vertebral fusion and kyphosis as AS advances [17, 18]. Althoff et al. found that 92% of cases of ankylosing spondylitis showed active sacroiliitis as evaluated by whole-body MRI [18]. As previously stated, the addition of Dixon in WB-MRI protocols may facilitate the visualization of acute inflammatory and chronic structural changes, even though it is not a standard protocol [17, 19].

Axial and peripheral enthesitis are hallmark findings in AS. Fourniè et al. reported that inflammatory involvement of the manubriosternal joint occurs in 39–85% of patients with AS. Furthermore, enthesitis of the rotator cuff, characterized by intense acromial bone marrow edema at the deltoid origin, is described as a highly specific feature of AS [20–24]. For standardized reporting/monitoring in axSpA, commonly used MRI scoring systems include SPARCC (SIJ/spine), Berlin, ASspiMRI-a/-c, and CANDEN. [13] A recent International Acquisition Protocol (IAP) for SIJ MRI has been proposed to harmonize planes/sequences and improve reproducibility across: three semi-coronal stacks (T1-weighted, fluid sensitive fat-suppressed, high-resolution structural—3D GRE preferred for erosions) plus one semi-axial fluid sensitive stack, with semi-coronal planning parallel to the dorsal cortex of S2 [25].

Psoriatic arthritis (PsA)

Psoriatic Arthritis is a chronic inflammatory condition that predominantly impacts axial and peripheral joints, exhibiting an extensive range of musculoskeletal manifestations. This condition is strongly linked to psoriasis and is marked by asymmetric joint involvement; however, it may also present as symmetric polyarthritis,

dactylitis-predominant disease, arthritis mutilans, or axial-predominant forms, and in a subset, arthritis can precede cutaneous psoriasis ("psoriatic arthritis sine psoriasis"). The specific diagnosis of PsA is generally confirmed via the 2006 CASPAR criteria [25]. WB-MRI has become an important method in the evaluation of PsA, providing a thorough analysis of synovitis, enthesitis, bone erosions, and new bone formation in both axial and peripheral joints concurrently [1, 26–28].

Synovitis is commonly observed in the distal interphalangeal (DIP), metacarpophalangeal (MCP), sacroiliac (SI), and vertebral joints, as indicated by existing literature and our findings [27, 29]. Enthesitis is recognized as a key imaging feature in psoriatic arthritis (PsA) [29–33] (Fig. 1).

All imaging features can be identified using WB-MRI, which provides a comprehensive overview and may assist in determining appropriate treatment. S. Weckbach et al. reported that in their study, about 22 patients (73.3%) had their therapy regimen changed following WB-MRI findings. Specifically, in 18 patients (62.1%), TNF-alpha-inhibitor therapy was initiated based on WB-MRI results, while three patients (10%) moved to methotrexate therapy from prior NSAID medication [29]. WB-MRI may assist in differentiating PsA from other inflammatory arthritis, including rheumatoid arthritis. PsA typically exhibits a distinct pattern of dactylitis and enthesitis, with the enthesitis feature extending significantly beyond the joint capsule and associated with osteitis and synovitis in adjacent tissues. For quantification, MRI scoring systems such as PsAMRIS (hands/forefeet), HEMRIS (heel), and the whole-body MRI-WIPE score (83 peripheral joints and 33 entheses; total 0–738) can be considered [13].

Rheumatoid arthritis

Rheumatoid arthritis (RA) is a systemic autoimmune disorder that predominantly affects synovial joints and tends to have a symmetrical distribution. It frequently affects small joints in the hands and feet. The imaging characteristics of RA encompass synovitis, bone marrow edema (BME), joint effusions, and structural alterations, including erosions and fat infiltration. WB-MRI is beneficial in rheumatoid arthritis due to the common involvement of multiple peripheral joints and the cervical spine. Atlanto-axial level is the most frequent cervical spine location of RA with possible life-threatening complications [34] (Fig. 2). Classification/diagnosis is supported by the 2010 ACR/EULAR criteria (score $\geq$ 6/10 across joint involvement, serology, acute-phase reactants, and symptom duration), with MRI considered to confirm joint involvement [35] (Table 2).

The OMERACT (The Outcome Measures in Rheumatology) MRI Working Group developed and validated the OMERACT RA MRI Scoring system (RAMRIS) from 1998 to 2002. Since then, they updated their recommendations in 2017. They stated that the "core set" of basic MRI sequences in RA recommending T1-weighted images before and after IV gadolinium-contrast injection to better assess the synovitis and T2 fat-saturated or STIR images [36]. They also stated that he implementation of gadolinium (Gd) contrast in MRI for RA substantially improves the detection and evaluation of synovitis and of tenosynovitis by increasing the signal intensity of inflamed tissues; omitting Gd for assessing bone erosions and bone edema has minimal impact on diagnostic accuracy, offering an effective way to decrease costs, invasiveness, and examination duration. However, its accuracy decreases particularly in low-field MRIs, where sensitivity and inter-reader consistency are compromised [36, 37]. Subsequently, in

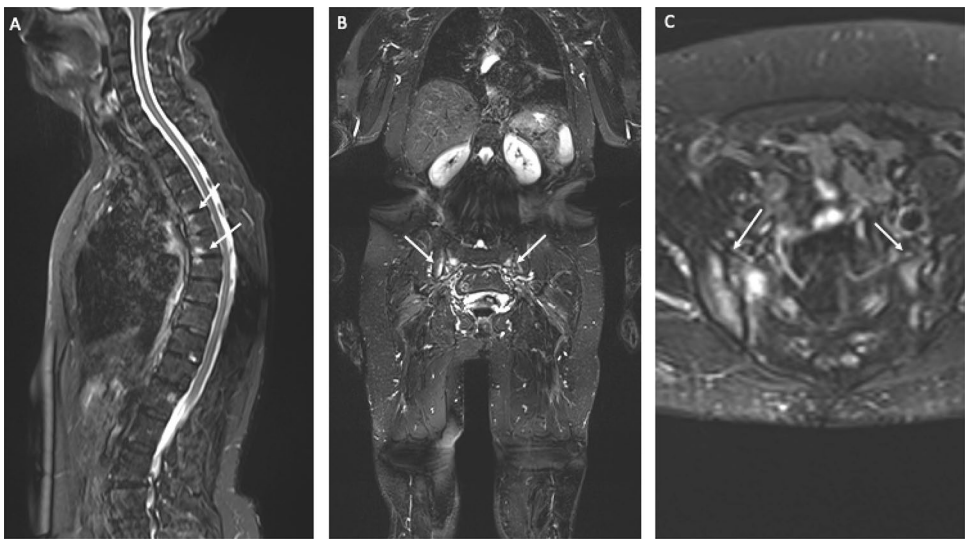


Fig.1 WB-MRI in a 59-year-old woman with PsA. Sagittal Whole-Spine (**a**) show anterior and posterior spondylitis in the thoracic spine. Coronal (**b**) and axial STIR (**c**) planes show bilateral intense sacroiliitis, mostly on the left side

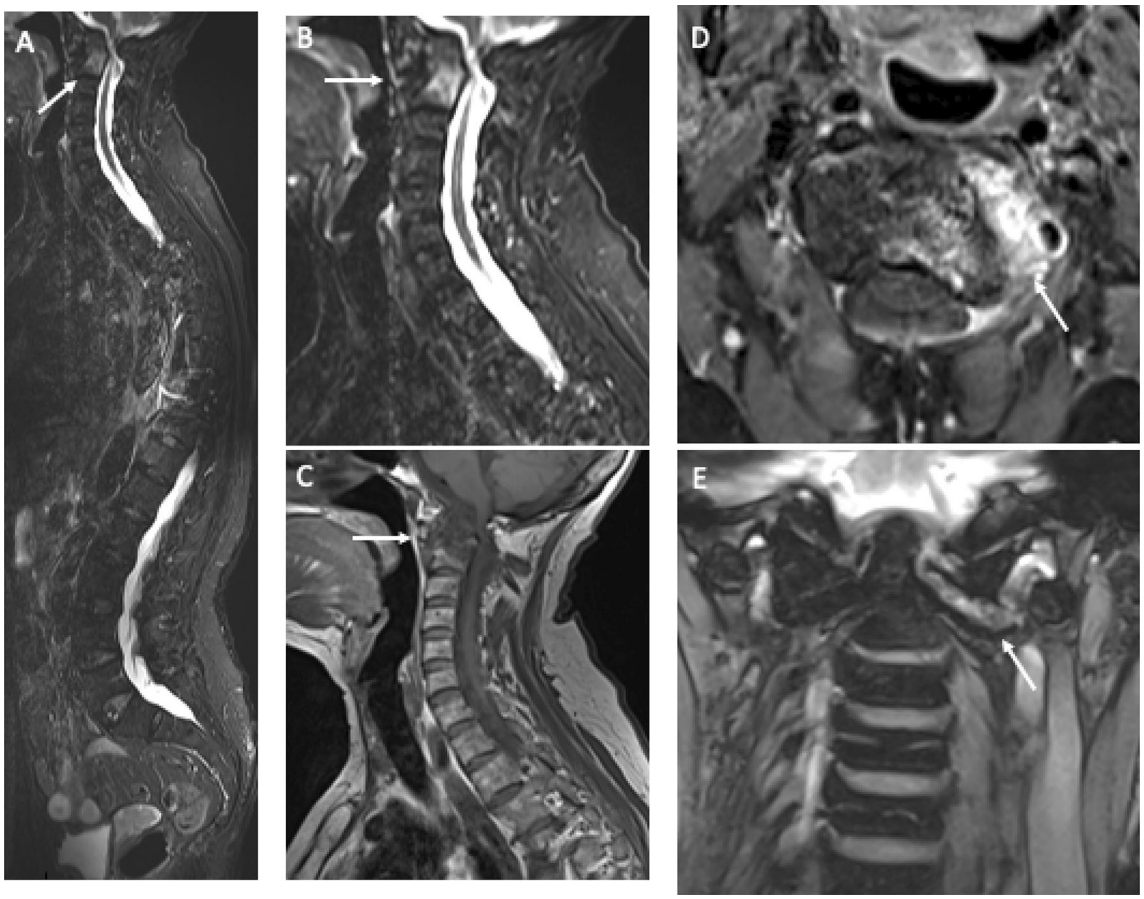


Fig. 2 WB-MRI in a 73-year-old woman with atlantoaxial rotatory subluxation due to rheumatoid arthritis (RA). STIR images in sagittal (**a** and **b**) and T1-weighted in sagittal (**c**) planes show that the posterior cortex of the anterior tubercle of C1 and the anterior cortex of the odontoid process are spaced and not parallel. Ax T1 + C (**d**) show intense synovitis. Cor T2 dedicated (**e**) also show spacing

accordance with the low accuracy of low-field MRI, Frenken et al. proposed the RAMRIS-SAFE (Sine-Gadolinium-For-Experts), a GBCA-free procedure for high-field MRI (3T), exhibiting nearly complete concordance with regular RAMRIS scores for synovitis ($\rho = 0.937$) and total joint assessments ($\rho = 0.976$) using STIR sequences [38]. However tenosynovitis detection was less accurate without contrast, according to the Tenosynovitis Scoring System developed by OMERACT group, where they highlighted the importance of post-contrast images to differentiate active tenosynovitis from normal fluid collections [39]. Research suggests that WB-MRI is highly effective in monitoring the response to therapies. Decreases in BME and synovitis scores following treatment are detectable prior to structural changes and are associated with clinical improvement, thereby supporting WB-MRI effectiveness in assessing therapeutic efficacy [40, 41]. However according to the 2023 EULAR management update, imaging (US/MRI) is adjunctive to clinical/lab assessment and routine treatment escalation should not be based solely on imaging, especially in clinical remission; ultrasound is generally first-line for small-joint synovitis, while MRI is reserved for uncertainty or difficult-to-assess areas [42].

Juvenile idiopathic arthritis (JIA)

Juvenile idiopathic arthritis frequently manifests inflammation in the joints and entheses. The clinical detection of this condition at an early stage can be challenging, particularly in cases of deep-rooted axial joints and pelvic entheses. Such modifications frequently progress without clinical manifestations and can result in irreversible osteochondral joint damage and functional impairments if not addressed [43–45]. The International League of Associations for Rheumatology (ILAR) stratify patients into seven mutually exclusive categories: systemic arthritis (systemic JIA [sJIA]), oligoarthritis, RF-negative polyarthritis, RF-positive polyarthritis, PsA, enthesitis-related arthritis (ERA), and undifferentiated arthritis [46]. The ILAR framework is being revisited, with PRINTO proposing updated categories that include enthesitis/spondylitis-related JIA, largely overlapping with juvenile spondyloarthritis (jSpA) [13] (Fig. 3).

Table 2 Sequence type, coverage, plane, role(s), and comments

Sequence type	Coverage	Plane	Role(s)	Comments
3D T1-weighted VIBE Dixon	Whole body	Coronal	Anatomic detail/structural overview	Core **T1** required; **Dixon optional**; keep slices consistent (≤ 4 mm WB; thinner for small joints)
STIR (or T2-FS)	Whole body	Coronal	Inflammatory overview (BME)	Core **fat-suppressed fluid-sensitive** sequence (STIR/PD/T2-FS); STIR preferred for robustness
3D T1-weighted VIBE Dixon	Whole spine	Sagittal	Anatomic detail	T1 sagittal recommended; 3D optional; harmonize plane & thickness across follow-ups
STIR (or T2-FS)	Whole spine	Sagittal	Inflammatory overview (spinal BME)	Pair with T1 sagittal; do not classify axSpA on spine BME alone (SIJ primary)
± DWI / ADC	Whole body	Coronal	Inflammatory overview alternative	Optional, not a substitute for STIR
± STIR (high-res)	Targeted	Oblique	Detailing of unclear inflammatory foci	Use small-FoV add-ons for ACW/SIJ/hands-feet when WB screen is equivocal
± 3D T1-weighted VIBE Dixon (thin-slice)	Targeted	Oblique	Detailing of unclear structural changes	High-res for erosions/backfill; thinner sections for small joints
± PD-weighted TSE FS	Targeted	Oblique	Cartilage/tenosynovitis assessment (ACW, peripheral joints)	Peripheral minimum set: T1 + PD/T2-FS; add post-contrast T1-FS for synovitis/tenosynovitis
± 3D T1-weighted VIBE Dixon, GBCA +	Coronal/Sagittal	Coronal/Sagittal	Enhancement of hypervascular tissues / synovitis	GBCA not routine; reserve for specific differentials or peripheral synovitis/tenosynovitis assessment

Abbreviations: *ADC*, apparent diffusion coefficient; *BME*, bone marrow edema; *DWI*, diffusion-weighted imaging; *FoV*, field of view; *GBCA*, gadolinium-based contrast agent; *PD*, proton density; *SIJ*, sacroiliac joint(s); *STIR*, short-tau inversion recovery; *T2-FS*, T2-weighted fat-suppressed; *TSE*, turbo spin-echo;, Volumetric Interpolated Breath-hold Examination (3D T1-weighted gradient-echo); Dixon, fat–water separation technique (water-only/fat-only reconstructions), WB-MRI, whole-body magnetic resonance imaging

Furthermore, Juvenile Spondyloarthritis (JSpA) refers to a group of inflammatory rheumatological diseases distinct from adult spondyloarthritis where there is an association with the major histocompatibility complex (MHC) class I molecule HLA-B27 in 60–80% of children [47].

Juvenile spondyloarthritis types are mostly represented by the enthesitis-related arthritis (ERA), psoriatic arthritis and undifferentiated arthritis sub-types of JIA [48]. Following PRINTO's 2019 proposal to refine ILAR categories, "jSpA" designates JIA phenotypes within the spondyloarthritis spectrum—predominantly enthesitis/spondylitis-related JIA (ERA), and in some contexts PsA/undifferentiated forms with enthesitis or early axial disease—whereas "non-jSpA JIA" encompasses the remaining categories (oligoarthritis, RF − /RF + polyarthritis, systemic JIA).

A comprehensive standardized scoring system was developed by a multi-institutional expert panel of radiologists and rheumatologists within the OMERACT in juvenile idiopathic arthritis (JAMRI) working group leading to the creation of a scoring system for WB-MRI called JAMRIS-WB-MRI for inflammation in peripheral, axial joints and entheses [49].

The inter-reader reliability of this scoring system for the evaluation of inflammatory changes proved moderate-to-good results, which may support its use as a standardized evaluation tool in disease characterization and outcome measure studies of joint and enthesis site involvement in JIA.

Choida et al. subsequently published an easy joint assessment system for patients with JIA that was based on post-contrast WB-MRI Dixon images. This system proved that the assessment of multiple sites was feasible and time-efficient in terms of scanning and reporting times [50, 51]. They also demonstrated the value of WB-MRI in identifying JIA by forming two groups: one comprising JIA patients and the other consisting of controls presenting musculoskeletal symptoms but without JIA, to illustrate the efficacy of WB-MRI in detecting disease-specific inflammation. The study demonstrated WB-MRI capacity to distinguish true disease-related inflammation from accidental findings by identifying joint inflammation in 60% of JIA patients, in contrast with just 15% of controls. Moreover, WB-MRI



Fig. 3 WB-MRI in a 9-year-old girl with oligoarticular juvenile idiopathic arthritis (JIA). Whole-body (**a**) and STIR images in coronal (**b**, **c** and **d**) and axial (**e** and **f**) planes show right sided sacroiliitis (**b**), synovitis in bilateral knees (**a** and **f**), ankles (**c** and **e**) and elbows (**d**) with some spots of BME

identified subclinical inflammation in over half of the JIA patients [52, 53]. Despite increasing adoption, pediatric WB-MRI has practical (cost, access, scan time) and interpretive limits—distinguishing fluid from synovitis without GBCA, assessing oblique/small joints and immature cartilage, and age-dependent marrow/physis patterns—so reliability improves when whole-body scans are complemented by targeted small-FoV sequences, pediatric expertise, and MRI atlases; formal guidance remains limited for non-jSpA JIA and jSpA. [13]

Polymyalgia rheumatica (PMR)

Polymyalgia Rheumatica (PMR) is a chronic inflammatory condition predominantly seen in individuals over the age of 50. It is characterized by pain and stiffness in the shoulder and pelvic girdles, along with increased levels of inflammatory markers such as C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) [54–56]. Mackie et al. found that whole-body MRI can identify a specific subset of PMR patients exhibiting a unique "extracapsular pattern" of inflammation, which correlates with improved responsiveness to glucocorticoid therapy [57]. These Patients, exhibiting inflammation beyond joint capsules and elevated IL-6 levels, demonstrated improved responsiveness to glucocorticoid therapy, highlighting the role of WB-MRI in identifying this subgroup. This discovery may change PMR diagnosis and treatment by providing personalized management strategies. According to Mackie et al., Buttgereit and Matteson highlighted the potential of MRI for improving PMR outcomes by identifying more homogeneous sub-types, guiding glucocorticoid therapy, and informing targeted treatments [58].

However EULAR/ACR 2015 emphasize that PMR is a clinical diagnosis, with imaging used as an adjunct mainly in atypical/uncertain cases or to exclude mimics, where routine MRI/WB-MRI is not recommended by EULAR/ACR and ultrasound is the preferred imaging tool under study for assessment/monitoring [59].

Chronic recurrent multifocal osteomyelitis (CRMO)

Chronic Recurrent Multifocal Osteomyelitis, also known as Chronic Non-Bacterial Osteomyelitis (CNO), is a rare autoinflammatory bone disorder primarily observed in children and adolescents. It typically involves the metaphyses of long bones, clavicles, and the spine. The typical MRI finding is a hyperintense geographic metaphyseal lesion located near the growth plates of the long bones in the lower extremities, as well as potential lesions in the spine, pelvis, clavicle, and/or sternum [60–62]. WB-MRI serves as the primary diagnostic method for identifying both symptomatic and asymptomatic lesions, monitoring disease progression, and CRMO from infections or malignancies.

Andronikou et al. identified three patterns: (1) a tibioappendicular multifocal pattern characterized by multifocal appendicular lesions with predominant tibial involvement; (2) a claviculospinal pauci-focal pattern, primarily involving clavicular lesions with few others, mainly in the spine; and (3) a tibioclavicular crossover pattern, featuring simultaneous involvement of both clavicular and tibial regions [63]. Astolfi et al. supported, in according to other studies, that the inclusion of DWI in the protocol due to its potential for high sensitivity in detecting bone marrow edema foci and its possible utility in distinguishing malignancy from chronic recurrent multifocal osteomyelitis (CRMO) in the spine but it is not universally accepted [60, 64, 65].

Merlini et al. demonstrated in their study that DWI did not enhance lesion conspicuity in comparison with STIR [66]. WB-MRI allows early diagnosis, reduces the need for invasive biopsies, and is essential for evaluating treatment responses and complications such as vertebral deformities, where early vertebral involvement should be actively screened to prevent height loss/vertebra plana. Age-related red marrow and growth-plate signal can mimic edema—small-FoV spine/SIJ sequences improve specificity, while a pragmatic WB-MRI setup centers on coronal STIR with targeted sagittal spine/knees/ankles and axial pelvis as needed [67, 68] (Fig. 4).

SAPHO syndrome (synovitis, acne, pustulosis, hyperostosis, and osteitis)

SAPHO syndrome is an uncommon autoinflammatory disorder that is distinguished by a combination of skin and musculoskeletal manifestations, including synovitis, acne, pustulosis, hyperostosis, and osteitis. SAPHO and its pediatric counterpart (CRMO/CNO) can be framed within the chronic aseptic osteitis (CAO) spectrum, with "incomplete" variants such as sternocostoclavicular hyperostosis and pustulotic arthro-osteitis. [13] SAPHO in children and adolescents mainly affects long bone metaphyses, with clavicles being the next most involved sites. In adults, it predominantly affects the anterior chest wall, particularly the sterno-costo-clavicular junction, followed by the axial

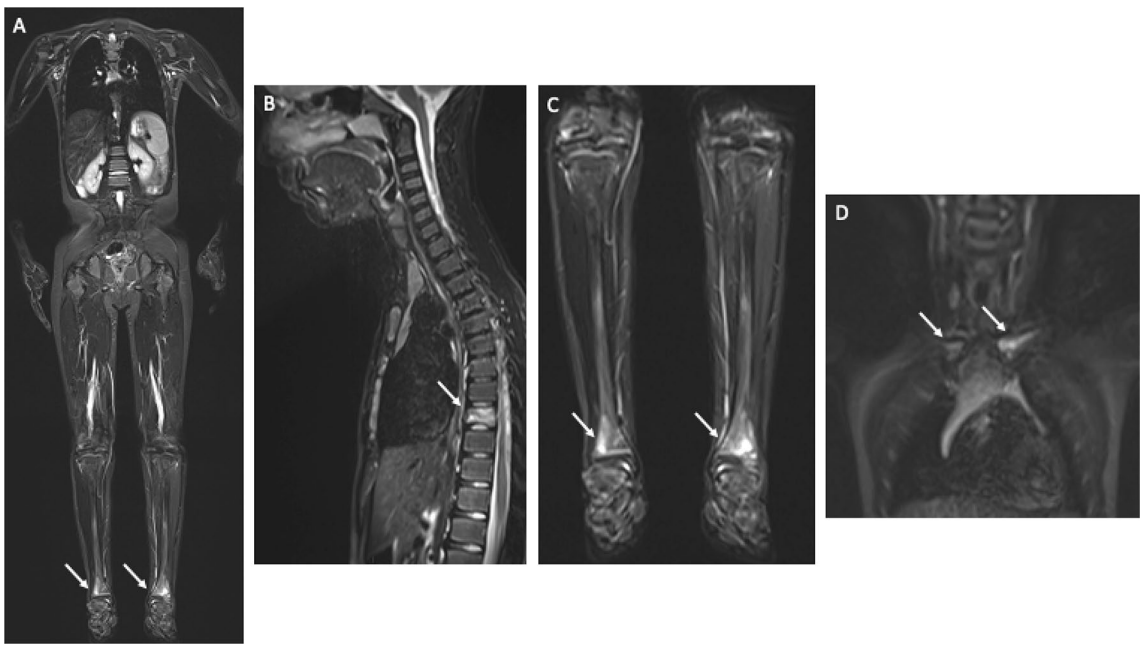


Fig. 4 WB-MRI in a 9-year-old boy with CRMO. WB STIR (**a**) and Cor STIR (**c**) plane images show bilateral BME of the meta-epiphyseal distal tibia. Sagittal STIR (**b**) plane image show a fracture of the D9 vertebral body. Cor STIR (**d**) plane show BME of the sternal end of bilateral clavicle, mostly on the left side

skeleton, including the spine and sacroiliac joints [69, 70]. The standard protocol for WB-MRI, whether with or without T1 post-gadolinium sequences, has been proved to be beneficial in identifying subclinical occult sites, which are identified as areas of bone marrow edema [69, 71]. Small-FoV targeted acquisitions (e.g., sternocostoclavicular region and other symptomatic sites) help preserve spatial detail and interpretability.

Fritz et al. showed that 67% of lesions identified on whole-body MRI were totally asymptomatic [72]. Chianca et al. demonstrated, according to Hidetomo et al., that whole-body MRI exhibits greater sensitivity than bone scintigraphy in identifying juxtaphyseal lesions [1, 73].

Myositis

Myositis defines a group of idiopathic inflammatory myopathies (IIM) marked by muscular inflammation, typically manifesting as symmetrical proximal muscle weakness, increased muscle enzymes, and distinctive histopathological characteristics [74–76]. The most common sub-types include dermatomyositis (DM), polymyositis (PM), immune-mediated necrotizing myopathy (IMNM), overlap myositis (OM) with the subgroup of anti-synthetase syndrome (ASS), sporadic inclusion body myositis (sIBM), inflammatory myopathy with mitochondrial pathology (IM-Mito) and statin-induced necrotizing autoimmune myopathy (SINAM), all of which are infrequent disorders that frequently pose diagnostic difficulties and present significant management challenges [77–79] (Fig. 5). WB-MRI has become an invaluable tool in the diagnosis and monitoring of these conditions, as it offers comprehensive insights into the distribution and severity of muscle involvement, frequently surpassing other diagnostic modalities [80, 81]. As an example, Huang et al. concluded that WB-MRI had a higher positive rate than the serum creatine kinase test and EMG in the role of diagnosis [77, 82] Essouma et al. claim in their scoping review the intention to create pediatric and adult whole-body/dedicated MRI scoring systems for the diagnosis, evaluation, and monitoring of idiopathic inflammatory myopathy-related skeletal muscle damage in both research and clinical settings [83]. MRI may also assist in the selection of the optimal biopsy

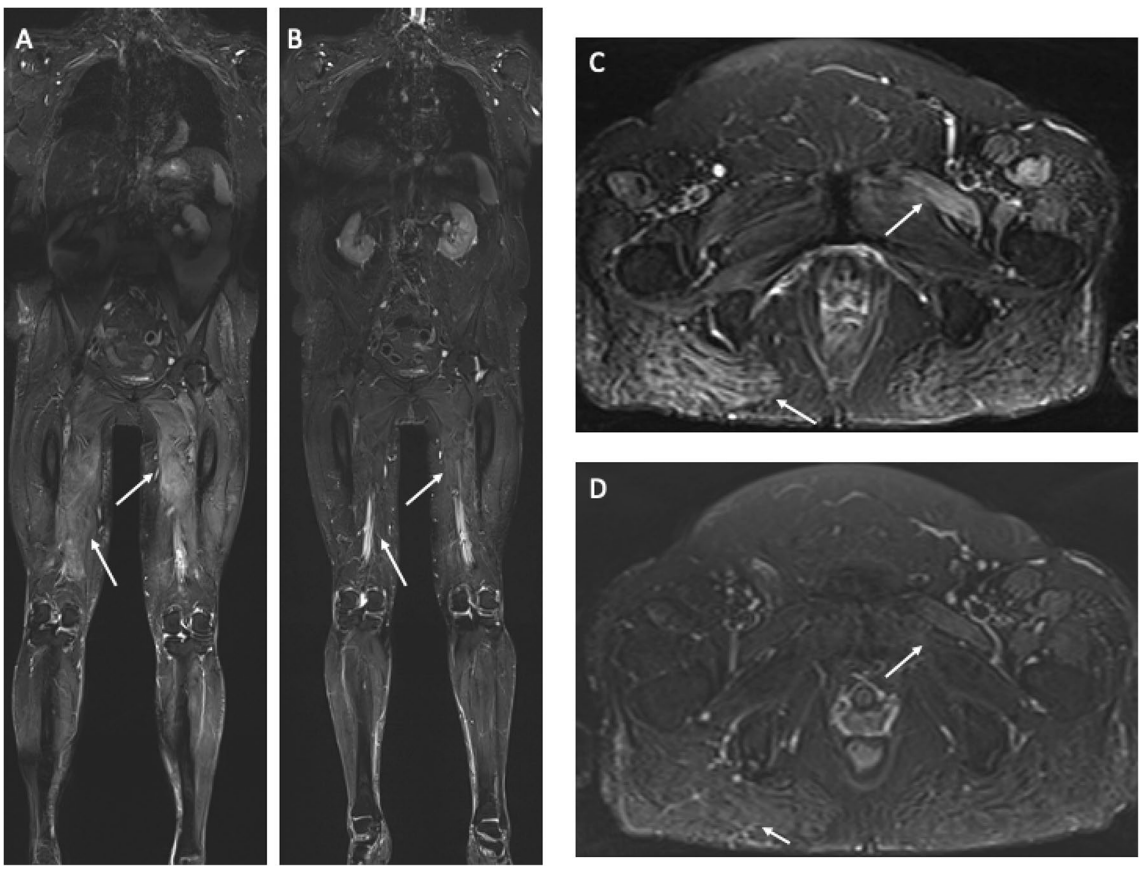


Fig. 5 WB-MRI of a 68-year-old woman with necrotizing myopathy. Image in **a** and **c** show diffuse muscle edema on the coronal and axial STIR planes. WB-MRI performed as follow-up 2 months later after starting treatment and stopping statin demonstrated a partial resolution of the muscle edema (coronal and axial STIR in **b** and **d**). Pathological anatomy requested a search for Anti-HMG-CoA reductase antibodies on suspicion of statin-induced necrotizing autoimmune myopathy (SINAM)

site by identifying the highest inflammatory activity with the STIR sequence, which decreases the false negative rate. This is necessary for the definitive diagnosis of an inflammatory myopathy, as microscopic examination of the muscle biopsy is essential. Additionally, MRI could confirm the diagnosis and rule out any other causes of myopathy [84].

Moreover, WB-MRI is an essential instrument for evaluating the overall inflammatory burden in Juvenile Dermatomyositis (JDM), a rare autoimmune disorder characterized by symmetrical proximal muscle weakness, chronic inflammation of the skin and skeletal muscles, and systemic involvement that may result in permanent disability. It identifies inflammation in both symptomatic and asymptomatic regions, covering subcutaneous tissue and myofascia [85]. Malattia et al. additionally highlight WB-MRI observations regarding disease activity and patterns of muscle inflammation (e.g., patchy vs diffuse) [86]. However in current EULAR/ACR classification, MRI is supportive but not mandatory; diagnosis remains clinico-serologic with biopsy when indicated [87].

Systemic sclerosis

Systemic sclerosis (SSc) is a chronic autoimmune disorder distinguished by progressive fibrosis caused by the excessive accumulation of extracellular matrix components in many tissues and organs. Vascular damage, inflammation, and the presence of specific autoantibodies are also suggestive of SSc [88, 89].

Schanz et al. focused on the characterization of musculoskeletal manifestations through whole-body MRI, which facilitated the recording of their distribution. The proximal regions of both extremities are believed to be the muscular sites that are preferentially affected by SSC.

Fasciitis, synovitis, tenosynovitis, and enthesitis are frequently observed, with a symmetrical distribution [90, 91]. EULAR 2023 recommendations frame imaging as adjunctive and do not recommend routine WB-MRI in SSc; MRI should be targeted to specific clinical questions (e.g., suspected myopathy or tendon involvement) rather than used systematically [92].

Avascular multifocal osteonecrosis (AMO)

Avascular multifocal osteonecrosis is an uncommon but debilitating syndrome that is distinguished by the death of bone tissue at multiple sites because of disrupted blood flow. AMO frequently impacts individuals with autoimmune or hematologic disorders undergoing high-dose corticosteroid therapy, potentially resulting in substantial joint and bone abnormalities if not appropriately detected and controlled. Yokota. et al. examined WB-MRI and whole-body bone scintigraphy (WB-BS) for the identification of multifocal osteonecrosis (ON); they found that ON is asymptomatic prior to collapse and is distinguished by a band-like pattern in T1 images. It becomes symptomatic and painful following the collapse due to bone marrow edema and joint effusion. WB-BS shows a lower degree of agreement with WB-MRI findings and has difficulty detecting asymptomatic ON, particularly in joints outside the hip [93, 94]. In accordance with other studies, they demonstrated that WB-MRI has a great sensitivity and accuracy, allowing the identification of early stage osteonecrosis and multifocal lesions in many joints, including the hip, knee, ankle, and shoulder [95, 96].

Artificial intelligence in whole-body MRI for rheumatology

Artificial intelligence (AI) has the potential to significantly influence the future of WB-MRI applications in rheumatology. Studies show that AI plays a significant role in the early detection of synovitis, BME, and bone erosions in these two rheumatic diseases, as evidenced by multiple studies [97–102]. Chandrika et al. performed a pilot study on CNO treated with pamidronate, using AI to evaluate pre- and post-treatment whole-body MRI scans for therapeutic response. A machine learning algorithm was developed to classify lesions as improved, worsened, or stable, with outcomes compared to those of expert radiologists. The AI model achieved a high level of sensitivity with 100% accuracy; however, it exhibited low specificity, misclassifying stable lesions, and resulting in an overall accuracy of 33.3%. This limitation was attributed to the challenge of distinguishing genuine pathological changes from normal variations or anomalies, as well as the small dataset size and the focus on restricted regions such as the knee. The integration of AI with WB-MRI has the potential to improve clinical practice by employing larger datasets, refining algorithms, and increasing coverage, which will allow more accurate and reliable assessments of treatment responses for CNO and other multifocal diseases [103].

However, other important critical limitations must be acknowledged: deep learning models are particularly prone to overfitting on small datasets, with 81% of published external validation studies showing diminished algorithm performance when applied to different institutions, and demographic biases in training data can compromise accuracy across diverse patient populations [104, 105].

Conclusions

WB-MRI is a powerful one-stop technique to phenotype inflammatory arthritis and quantify global disease activity, with growing support from initiatives that aim to harmonize acquisition, scoring, and reporting.

Its clearest clinical role today is in pediatrics—particularly CNO/CRMO, where WB-MRI helps establish diagnosis, map burden (including vertebral disease), and monitor response while avoiding radiation. In adults, WB-MRI can add value in selected scenarios (complex or multisite phenotypes; discordant clinical–imaging findings; suspected anterior chest wall or extra-axial disease; trial baselines), but routine use is not yet evidence-based given limited prospective comparative data, protocol heterogeneity, and uncertain health-economic impact. Until these gaps are addressed, a pragmatic approach is to reserve WB-MRI for well-defined indications (e.g., pediatric disease, radiation-sparing strategies, multisystem burden mapping, research/treat-to-target cohorts), interpret findings in clinical context, and standardize reporting with validated MRI scores to maximize reproducibility and clinical utility.

Author's contribution All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Gabriele Mirabella, Giambattista Privitera, Angelo Montana, Luca Ultimo Esposto, Enzo Fausto Santonocito, Emanuele David, Pietro Valerio Foti, Stefano Palmucci, Placido Romeo, and Antonio Basile. The first draft of the manuscript was written by Gabriele Mirabella and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open access funding provided by Università degli Studi di Catania within the CRUI-CARE Agreement. The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

Ethics approval No ethical approval is required.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

References

1. Chianca V et al (2024) Whole-body magnetic resonance imaging in rheumatology. W.B. Saunders, Philadelphia. https://doi.org/10.1016/j.rcl.2024.02.008.
2. Ahlawat S, Debs P, Amini B, Lecouvet FE, Omoumi P, Wessell DE (2023) Clinical applications and controversies of whole-body mri: ajr expert panel narrative review. AJR Am J Roentgenol 220(4):463–475. https://doi.org/10.2214/AJR.22.28229
3. Deplano L et al (2021) Whole-body MRI in rheumatology: major advances and future perspectives. Diagnostics. https://doi.org/10.3390/diagnostics11101770
4. Sudol-Szopińska I et al (2015) Recommendations of the ESSR arthritis subcommittee for the use of magnetic resonance imaging in musculoskeletal rheumatic diseases. Semin Musculoskelet Radiol 19(4):396–411. https://doi.org/10.1055/s-0035-1564696
5. Giraudo C et al (2021) Whole-body magnetic resonance imaging in inflammatory diseases: where are we now? Results of an international survey by the European Society of Musculoskeletal Radiology. Eur J Radiol. https://doi.org/10.1016/j.ejrad.2021.109533
6. Freeston J, Marzetti M, Larkman N, Rowbotham E, Emery P, Grainger A (2024) Whole-body MRI for the investigation of joint involvement in inflammatory arthritis. Skeletal Radiol 53(5):935–945. https://doi.org/10.1007/s00256-023-04515-0
7. Baethge C, Goldbeck-Wood S, Mertens S (2019) SANRA—a scale for the quality assessment of narrative review articles. Res Integr Peer Rev. https://doi.org/10.1186/s41073-019-0064-8
8. Song IH et al (2011) Effects of etanercept versus sulfasalazine in early axial spondyloarthritis on active inflammatory lesions as detected by whole-body MRI (ESTHER): a 48-week randomised controlled trial. Ann Rheum Dis 70(4):590–596. https://doi.org/10.1136/ard.2010.139667
9. Lee K et al (2019) Advances in whole body MRI for musculoskeletal imaging: diffusion-weighted imaging. Elsevier B.V., Amsterdam, https://doi.org/10.1016/j.jcot.2019.05.018.
10. Mohan S, Moineddin R, Chavhan GB (2015) Pediatric whole-body magnetic resonance imaging: intra-individual comparison of technical quality, artifacts, and fixed structure visibility at 1.5 and 3 T. Indian J Radiol Imaging 25(4):353–358. https://doi.org/10.4103/0971-3026.169448
11. Ahlawat S (2023) Current state-of-the-art imaging techniques in the domain of whole-body MRI and its advantages over other whole-body PET in different musculoskeletal diseases. Springer Science and Business Media Deutschland GmbH, Cham. https://doi.org/10.1007/s00330-023-09883-8.
12. Bozgeyik Z, Ozgocmen S, Kocakoc E (2008) Role of diffusion-weighted MRI in the detection of early active sacroiliitis. AJR Am J Roentgenol 191(4):980–986. https://doi.org/10.2214/AJR.07.3865
13. Zecca F, Dejua D, Rennie WJ, Saba L (2025) Whole-body MRI in arthritis. Springer Science and Business Media Deutschland GmbH, Cham. https://doi.org/10.1007/s00256-025-04998-z.
14. Mager AK, Althoff CE, Sieper J, Hamm B, Hermann KGA (2009) Role of whole-body magnetic resonance imaging in diagnosing early spondyloarthritis. Eur J Radiol. https://doi.org/10.1016/j.ejrad.2009.04.051
15. Althoff CE et al (2007) Whole-body MRI as a new screening tool for detecting axial and peripheral manifestations of spondyloarthritis. Ann Rheum Dis. https://doi.org/10.1136/ard.2007.069948
16. Lecouvet F et al (2015) The increasing spectrum of indications of whole-body MRI beyond oncology: imaging answers to clinical needs. Semin Musculoskelet Radiol 19(04):348–362. https://doi.org/10.1055/s-0035-1564695
17. Baraliakos X et al (2022) MRI lesions of the spine in patients with axial spondyloarthritis: an update of lesion definitions and validation by the ASAS MRI working group. Ann Rheum Dis 81(9):1243–1251. https://doi.org/10.1136/annrheumdis-2021-222081

18. Althoff CE et al (2013) Active inflammation and structural change in early active axial spondyloarthritis as detected by whole-body MRI. Ann Rheum Dis 72(6):967–973. https://doi.org/10.1136/annrheumdis-2012-201545
19. Khmelinskii N, Regel A, Baraliakos X (2018) The role of imaging in diagnosing axial spondyloarthritis. Front Med (Lausanne). https://doi.org/10.3389/fmed.2018.00106
20. Fournié B et al (1997) Prospective study of anterior chest wall involvement in ankylosing spondylitis and psoriatic arthritis. Rev Rhum Engl Ed 64(1):22–25
21. Lambert RGW et al (2004) High prevalence of symptomatic enthesopathy of the shoulder in ankylosing spondylitis: deltoid origin involvement constitutes a hallmark of disease. Arthritis Care Res. https://doi.org/10.1002/art.20681
22. Guo Z et al (2022) Peripheral enthesitis assessed by whole-body MRI in axial spondyloarthritis: distribution and diagnostic value. Front Immunol. https://doi.org/10.3389/fimmu.2022.976800
23. Mathew AJ, Østergaard M (2020) Magnetic resonance imaging of enthesitis in spondyloarthritis, including psoriatic arthritis—status and recent advances. Front Med. https://doi.org/10.3389/fmed.2020.00296
24. Weber U, Pfirrmann CW, Kissling RO, Hodler J, Zanetti M (2007) Whole body MR imaging in ankylosing spondylitis: a descriptive pilot study in patients with suspected early and active confirmed ankylosing spondylitis. BMC Musculoskelet Disord 8(1):20. https://doi.org/10.1186/1471-2474-8-20
25. Taylor W, Gladman D, Helliwell P, Marchesoni A, Mease P, Mielants H (2006) Classification criteria for psoriatic arthritis: development of new criteria from a large international study. Arthritis Rheum 54(8):2665–2673. https://doi.org/10.1002/ART.21972
26. Poulsen AEF et al (2021) Whole-body magnetic resonance imaging in psoriatic arthritis, rheumatoid arthritis, and healthy controls: Interscan, intrareader, and interreader agreement and distribution of lesions. J Rheumatol 48(2):198–216. https://doi.org/10.3899/jrheum.200084
27. Glinatsi D et al (2015) Validation of the OMERACT psoriatic arthritis magnetic resonance imaging score (PsAMRIS) for the hand and foot in a randomized placebo-controlled trial. J Rheumatol 42(12):2473–2479. https://doi.org/10.3899/jrheum.141010
28. Pascu LS et al (2023) MRI findings in axial psoriatic spondylarthritis. Diagnostics. https://doi.org/10.3390/diagnostics13071342
29. Weckbach S, Schewe S, Michaely HJ, Steffinger D, Reiser MF, Glaser C (2011) Whole-body MR imaging in psoriatic arthritis: additional value for therapeutic decision making. Eur J Radiol 77(1):149–155. https://doi.org/10.1016/j.ejrad.2009.06.020
30. McGonagle D (2005) Imaging the joint and enthesis: insights into pathogenesis of psoriatic arthritis. Ann Rheum Dis. https://doi.org/10.1136/ard.2004.034264
31. Godfrin B, Zabraniecki L, Lamboley V, Bertrand-Latour F, Sans N, Fournié B (2004) Spondyloarthropathy with entheseal pain. A prospective study in 33 patients. Joint Bone Spine 71(6):557–562. https://doi.org/10.1016/j.jbspin.2003.10.010
32. Aydin SZ, Mathew AJ, Koppikar S, Eder L, Østergaard M (2020) Imaging in the diagnosis and management of peripheral psoriatic arthritis. Best Pract Res Clin Rheumatol 34(6):101594. https://doi.org/10.1016/j.berh.2020.101594
33. Krabbe S et al (2019) Development and validation of an OMERACT MRI whole-body score for inflammation in peripheral joints and entheses in inflammatory arthritis (MRI-WIPE). J Rheumatol 46(9):1215–1221. https://doi.org/10.3899/jrheum.181084
34. Kotecki M, Gasik R, Głuszko P, Sudoł-Szopińska I (2021) Radiological evaluation of cervical spine involvement in rheumatoid arthritis: a cross-sectional retrospective study. J Clin Med. https://doi.org/10.3390/jcm10194587
35. Aletaha D et al (2010) 2010 rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. Ann Rheum Dis 69:1580–1588. https://doi.org/10.1136/ard.2010.138461
36. Østergaard M et al (2017) The OMERACT rheumatoid arthritis magnetic resonance imaging (MRI) scoring system: updated recommendations by the OMERACT MRI in arthritis working group. J Rheumatol 44(11):1706–1712. https://doi.org/10.3899/jrheum.161433
37. Østergaard M et al (2009) Reducing invasiveness, duration, and cost of magnetic resonance imaging in rheumatoid arthritis by omitting intravenous contrast injection—does it change the assessment of inflammatory and destructive joint changes by the OMERACT RAMRIS? J Rheumatol. https://doi.org/10.3899/jrheum.090350
38. Frenken M et al (2022) To contrast or not to contrast? On the role of contrast enhancement in hand MRI studies of patients with rheumatoid arthritis. Diagnostics. https://doi.org/10.3390/diagnostics12020465
39. Glinatsi D et al (2017) Development and validation of the OMERACT rheumatoid arthritis magnetic resonance tenosynovitis scoring system in a multireader exercise. J Rheumatol 44(11):1688–1693. https://doi.org/10.3899/jrheum.161097
40. Axelsen MB, Eshed I, Duer-jensen A, Møller JM, Pedersen SJ, østergaard M (2014) Whole-body MRI assessment of disease activity and structural damage in rheumatoid arthritis: first step towards an MRI joint count. Rheumatology 53(5):845–853. https://doi.org/10.1093/rheumatology/ket425
41. Ng SN et al (2020) Whole-body magnetic resonance imaging assessment of joint inflammation in rheumatoid arthritis—agreement with ultrasonography and clinical evaluation. Front Med. https://doi.org/10.3389/fmed.2020.00285
42. Smolen JS et al (2023) EULAR recommendations for the management of rheumatoid arthritis with synthetic and biological disease-modifying antirheumatic drugs: 2022 update. Ann Rheum Dis 82:3–18. https://doi.org/10.1136/ard-2022-223356
43. Panwar J et al (2021) Toward developing a semiquantitative whole body-MRI scoring for juvenile idiopathic arthritis: critical appraisal of the state of the art, challenges, and opportunities. Acad Radiol. https://doi.org/10.1016/j.acra.2020.01.022
44. Ciurtin C, Bray T, Choida V, Hall-Craggs MA (2023) Whole-body MRI for juvenile idiopathic arthritis. Lancet Rheumatol 5(1):e6–e8. https://doi.org/10.1016/S2665-9913(22)00342-3
45. Panwar J et al (2024) Reliability assessment of the OMERACT whole-body magnetic resonance imaging scoring system for juvenile idiopathic arthritis. Semin Arthritis Rheum. https://doi.org/10.1016/j.semarthrit.2024.152437
46. Yeung RSM (2023) What's in a name? That which we call JIA, by any other name, would it still be the same childhood arthritis? J Rheumatol 50(7 Suppl 1):2–6. https://doi.org/10.3899/jrheum.2023-0458
47. Tse SML, Laxer RM (2012) New advances in juvenile spondyloarthritis. Nat Rev Rheumatol 8(5):269–279. https://doi.org/10.1038/nrrheum.2012.37
48. Aquino MR, Tse SML, Gupta S, Rachlis AC, Stimec J (2015) Whole-body MRI of juvenile spondyloarthritis: protocols and pictorial review of characteristic patterns. Pediatr Radiol 45(5):754–762. https://doi.org/10.1007/s00247-015-3319-7
49. Panwar J et al (2021) Consensus-driven conceptual development of a standardized whole body-MRI scoring system for assessment of disease activity in juvenile idiopathic arthritis: MRI in JIA OMERACT working group. Semin Arthritis Rheum 51(6):1350–1359. https://doi.org/10.1016/j.semarthrit.2021.07.017
50. Choida V et al (2024) A simple, clinically usable whole-body MRI system of joint assessment in adolescents and young people with juvenile idiopathic arthritis. Rheumatology

63(SI2):SI219–SI227. https://doi.org/10.1093/rheumatology/keae117
51. Sudoł-Szopińska I et al (2022) Advances in musculoskeletal imaging in juvenile idiopathic arthritis. BioMedicine 10(10):2417. https://doi.org/10.3390/biomedicines10102417
52. Choida V et al (2024) Detection of inflammation by whole-body MRI in young people with juvenile idiopathic arthritis. Rheumatology 63(SI2):SI207–SI214. https://doi.org/10.1093/rheumatology/keae039
53. Choida V, Madenidou AV, Sen D, Hall-Craggs MA, Ciurtin C, W.B. Saunders (2022) The role of whole-body MRI in musculoskeletal inflammation detection and treatment response evaluation in inflammatory arthritis across age: a systematic review. Semin Arthritis Rheum. https://doi.org/10.1016/j.semarthrit.2022.151953
54. Florescu M et al (2023) Polymyalgia rheumatica: an update (Review). Exp Ther Med. https://doi.org/10.3892/etm.2023.12242
55. Kermani TA, Warrington KJ (2013) Polymyalgia rheumatica. Lancet 381(9860):63–72. https://doi.org/10.1016/S0140-6736(12)60680-1
56. Leão RV et al (2022) Magnetic resonance imaging findings in patients with polymyalgia rheumatica. Radiol Bras. https://doi.org/10.1590/0100-3984.2021.0151
57. Mackie SL et al (2015) Whole-body MRI of patients with polymyalgia rheumatica identifies a distinct subset with complete patient-reported response to glucocorticoids. Ann Rheum Dis 74(12):2188–2192. https://doi.org/10.1136/annrheumdis-2015-207395
58. Buttgereit F, Matteson EL (2016) Whole-body MRI undresses polymyalgia rheumatica. Nat Rev Rheumatol 12(3):140–141. https://doi.org/10.1038/nrrheum.2015.163
59. Dejaco C et al (2015) 2015 recommendations for the management of polymyalgia rheumatica a European League Against Rheumatism/American College of Rheumatology collaborative initiative. Arthritis Rheumatol 67(10):2569–2580. https://doi.org/10.1002/art.39333
60. Nico MAC et al (2022) Chronic nonbacterial osteomyelitis: the role of whole-body MRI. Springer Science and Business Media Deutschland GmbH, Cham. https://doi.org/10.1186/s13244-022-01288-3
61. Falip C et al (2013) Chronic recurrent multifocal osteomyelitis (CRMO): a longitudinal case series review. Pediatr Radiol 43(3):355–375. https://doi.org/10.1007/s00247-012-2544-6
62. Arnoldi AP et al (2017) Whole-body MRI in patients with non-bacterial osteitis: radiological findings and correlation with clinical data. Eur Radiol 27(6):2391–2399. https://doi.org/10.1007/s00330-016-4586-x
63. Andronikou S, da Mendes Costa T, Hussien M, Ramanan AV (2019) Radiological diagnosis of chronic recurrent multifocal osteomyelitis using whole-body MRI-based lesion distribution patterns. Clin Radiol 74(9):737.e3-737.e15. https://doi.org/10.1016/j.crad.2019.02.021
64. Andronikou S et al (2020) Whole-body MRI in the diagnosis of paediatric CNO/CRMO. Rheumatology 59(10):2671–2680. https://doi.org/10.1093/rheumatology/keaa303
65. Leclair N, Thörmer G, Sorge I, Ritter L, Schuster V, Hirsch FW (2016) Whole-body diffusion-weighted imaging in chronic recurrent multifocal osteomyelitis in children. PLoS ONE 11(1):e0147523. https://doi.org/10.1371/journal.pone.0147523
66. Merlini L, Carpentier M, Ferrey S, Anooshiravani M, Poletti PA, Hanquinet S (2017) Whole-body MRI in children: would a 3D STIR sequence alone be sufficient for investigating common paediatric conditions? A comparative study. Eur J Radiol 88:155–162. https://doi.org/10.1016/j.ejrad.2017.01.014
67. Roderick M, Shah R, Finn A, Ramanan AV (2014) Efficacy of pamidronate therapy in children with chronic non-bacterial osteitis: disease activity assessment by whole body magnetic resonance imaging. Rheumatology 53(11):1973–1976. https://doi.org/10.1093/rheumatology/keu226
68. Guérin-Pfyffer S, Guillaume-Czitrom S, Tammam S, Koné-Paut I (2012) Evaluation of chronic recurrent multifocal osteitis in children by whole-body magnetic resonance imaging. Joint Bone Spine 79(6):616–620. https://doi.org/10.1016/j.jbspin.2011.12.001
69. Depasquale R et al (2012) SAPHO: what radiologists should know. Clin Radiol. https://doi.org/10.1016/j.crad.2011.08.014
70. Furer V, Kishimoto M, Tsuji S, Taniguchi Y, Ishihara Y, Tomita I, Helliwell P, Elkayam O (2020) The diagnosis and treatment of adult patients with SAPHO syndrome: controversies revealed in a multidisciplinary international survey of physicians. Rheumatol Ther 7(4):883–891. https://doi.org/10.6084/m9.figshare.12933134.
71. Li SWS, Roberts E, Hedrich C (2023) Treatment and monitoring of SAPHO syndrome: a systematic review. RMD Open. https://doi.org/10.1136/rmdopen-2023-003688.
72. Fritz J, Tzaribatchev N, Claussen CD, Carrino JA, Horger MS (2009) Chronic recurrent multifocal osteomyelitis: comparison of whole-body MR imaging with radiography and correlation with clinical and laboratory data. Radiology 252(3):842–851. https://doi.org/10.1148/radiol.2523081335
73. Himuro H et al (2020) Imaging features in patients with SAPHO/CRMO: a pictorial review. Jpn J Radiol 38(7):622–629. https://doi.org/10.1007/s11604-020-00953-1
74. Farrow M et al (2021) Quantitative MRI in myositis patients: comparison with healthy volunteers and radiological visual assessment. Clin Radiol 76(1):81.e1-81.e10. https://doi.org/10.1016/j.crad.2020.08.022
75. Elessawy SS, Abdelsalam EM, Abdel Razek E, Tharwat S (2016) Whole-body MRI for full assessment and characterization of diffuse inflammatory myopathy. Acta Radiol Open 5(9):205846011666821. https://doi.org/10.1177/2058460116668216
76. Dimachkie MM, Barohn RJ, Amato AA (2014) Idiopathic inflammatory myopathies. Neurol Clin 32(3):595–628. https://doi.org/10.1016/j.ncl.2014.04.007
77. Guimarães JB et al (2019) Diagnostic imaging of inflammatory myopathies: new concepts and a radiological approach. Curr Med Group LLC 1. https://doi.org/10.1007/s11926-019-0807-z.
78. Cavalcante WCP et al (2024) Whole-body muscle magnetic resonance imaging in inflammatory myopathy with mitochondrial pathology. Front Neurol. https://doi.org/10.3389/fneur.2024.1386293
79. Gawey B, Tannu M, Rim J, Sperling L, Henry TL (2020) Statin-induced necrotizing autoimmune myopathy. JACC: Case Reports 2(3):440–443. https://doi.org/10.1016/j.jaccas.2019.12.019
80. Cantwell C et al (2005) A comparison of inflammatory myopathies at whole-body turbo STIR MRI. Clin Radiol 60(2):261–267. https://doi.org/10.1016/j.crad.2004.06.027
81. O'Connell MJ, Powell T, Brennan D, Lynch T, McCarthy CJ, Eustace SJ (2002) Whole-body MR imaging in the diagnosis of polymyositis. AJR Am J Roentgenol 179(4):967–971. https://doi.org/10.2214/ajr.179.4.1790967
82. guo Huang Z et al (2017) An efficacy analysis of whole-body magnetic resonance imaging in the diagnosis and follow-up of polymyositis and dermatomyositis. PLoS ONE. https://doi.org/10.1371/journal.pone.0181069
83. Essouma M et al (2024) A protocol for scoping reviews on the role of whole-body and dedicated body-part magnetic resonance

imaging for assessment of adult and juvenile idiopathic inflammatory myopathies. Rheumatol Int. https://doi.org/10.1007/s00296-024-05649-7
84. Dalakas MC. Muscle biopsy findings in inflammatory myopathies.
85. Tzaribachev N, Well C, Schedel J, Horger M (2009) Whole-body MRI: a helpful diagnostic tool for juvenile dermatomyositis case report and review of the literature. Rheumatol Int 29(12):1511–1514. https://doi.org/10.1007/s00296-009-0890-y
86. Malattia C et al (2014) Whole-body MRI in the assessment of disease activity in juvenile dermatomyositis. Ann Rheum Dis 73(6):1083–1090. https://doi.org/10.1136/annrheumdis-2012-202915
87. Lundberg IE et al (2017) EULAR/ACR classification criteria for adult and juvenile idiopathic inflammatory myopathies and their major subgroups HHS public access. Ann Rheum Dis 76(12):1955–1964. https://doi.org/10.1136/annrheumdis-2017-211468
88. Sobolewski P et al (2019) Systemic sclerosis—multidisciplinary disease: clinical features and treatment. Rheumatology. https://doi.org/10.5114/reum.2019.87619
89. Volkmann ER, Andréasson K, Smith V (2023) Systemic sclerosis. Lancet 401(10373):304–318. https://doi.org/10.1016/S0140-6736(22)01692-0
90. Schanz S et al (2013) Magnetic resonance imaging findings in patients with systemic scleroderma and musculoskeletal symptoms. Eur Radiol 23(1):212–221. https://doi.org/10.1007/s00330-012-2584-1
91. Randone SB, Guiducci S, Cerinic MM (2008) Musculoskeletal involvement in systemic sclerosis. Best Pract Res Clin Rheumatol. https://doi.org/10.1016/j.berh.2008.01.008
92. Del Galdo D, et al. (2024) EULAR recommendations for the treatment of systemic sclerosis: 2023 update. Ann Rheum Dis. https://doi.org/10.1136/ard-2024-226430
93. Kaste SC et al (2015) Utility of early screening magnetic resonance imaging for extensive hip osteonecrosis in pediatric patients treated with glucocorticoids. J Clin Oncol 33(6):610–615. https://doi.org/10.1200/JCO.2014.57.5480
94. Yokota S et al (2021) Evaluation of whole-body modalities for diagnosis of multifocal osteonecrosis—a pilot study. Arthritis Res Ther. https://doi.org/10.1186/s13075-021-02473-3
95. Albano D, Patti C, Sconfienza LM, Galia M (2017) Whole-body MRI in the early detection of multifocal osteonecrosis. Br J Radiol 90(1077):20170240. https://doi.org/10.1259/bjr.20170280
96. Ley S, Ley-Zaporozhan J, Schenk J-P (2009) Whole-body MRI in the pediatric patient. Eur J Radiol 70(3):442–451. https://doi.org/10.1016/j.ejrad.2009.02.012
97. Nicoara AI, Sas LM, Bita CE, Dinescu SC, Vreju FA (2023) Implementation of artificial intelligence models in magnetic resonance imaging with focus on diagnosis of rheumatoid arthritis and axial spondyloarthritis: narrative review. Front Med (Lausanne). https://doi.org/10.3389/fmed.2023.1280266
98. Stoel B (2020) Use of artificial intelligence in imaging in rheumatology-current status and future perspectives. RMD Open. https://doi.org/10.1136/rmdopen-2019-001063
99. Aizenberg E et al (2018) Automatic quantification of bone marrow edema on MRI of the wrist in patients with early arthritis: a feasibility study. Magn Reson Med 79(2):1127–1134. https://doi.org/10.1002/mrm.26712
100. Lin KYY, Peng C, Lee KH, Chan SCW, Chung HY (2022) Deep learning algorithms for magnetic resonance imaging of inflammatory sacroiliitis in axial spondyloarthritis. Rheumatology 61(10):4198–4206. https://doi.org/10.1093/rheumatology/keac059
101. Adams LC, Bressem KK, Ziegeler K, Vahldiek JL, Poddubnyy D (2024) Artificial intelligence to analyze magnetic resonance imaging in rheumatology. Joint Bone Spine. https://doi.org/10.1016/j.jbspin.2023.105651
102. De Jongh J, et al (2023) POS0898 early detection of anti-TNF induced changes in new bone formation in psoriatic arthritis patients by ^{18} F-FLUORIDE PET-CT. In: Scientific Abstracts, BMJ Publishing Group Ltd and European League Against Rheumatism, pp. 757–758. https://doi.org/10.1136/annrheumdis-2023-eular.869.
103. Bhat CS et al (2020) Artificial intelligence for interpretation of segments of whole body MRI in CNO: pilot study comparing radiologists versus machine learning algorithm. Pediatr Rheumatol Online J. https://doi.org/10.1186/s12969-020-00442-9
104. Koçak B, et al. (2025) Bias in artificial intelligence for medical imaging: fundamentals, detection, avoidance, mitigation, challenges, ethics, and prospects. Diagn Interv Radiol. https://doi.org/10.4274/dir.2024.242854.
105. Yu AC, Mohajer B, Eng J (2022) External validation of deep learning algorithms for radiologic diagnosis: a systematic review. Radiol Artif Intell. https://doi.org/10.1148/RYAI.210064

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.