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Magnetic Resonance Imaging of Axial and Peripheral Disease in Psoriatic Arthritis: A Report From the 2020 GRAPPA Annual Meeting

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ABSTRACT. Psoriatic arthritis (PsA) presents with diverse features of musculoskeletal inflammation that affect both axial and peripheral joints as well as entheses, tenosynovium, and bursae. Magnetic resonance imaging (MRI) is the imaging modality that is uniquely capable of identifying pathology in all these structures. The Group for Research and Assessment of Psoriasis and Psoriatic Arthritis (GRAPPA) Magnetic Resonance Imaging Working Group has increasingly explored diverse MRI methodologies for the purposes of quantifying inflammatory and structural abnormalities in clinical trials and research. The 2020 GRAPPA virtual workshop presented an opportunity to review progress in the field, summarize the status of MRI scoring systems developed for PsA, and review representative patient cases.

Key Indexing Terms: GRAPPA, MRI, psoriasis, psoriatic arthritis

Magnetic Resonance Imaging for Axial Inflammation and Structural Damage Evaluation

While there are internationally standard criteria for axial spondyloarthritis (SpA) and ankylosing spondylitis (AS),[1,2] there is a lack of consensus on how the axial phenotype of psoriatic arthritis (PsA) should be defined. Axial involvement in PsA has been diagnosed using one or more of a variety of criteria: back/buttock pain above a certain level, the Bath Ankylosing Spondylitis Disease Activity Index above a certain level, axial SpA (axSpA) or AS criteria, characteristic findings on radiography, and presence of inflammation or damage seen on magnetic resonance imaging (MRI) of sacroiliac joints (SIJs) or spine.[3] The lack of consensus on the definition also causes the prevalence of axial PsA to be reported very differently, from 2% to 5% in early disease and up to 75% in late advanced disease.[3,4] Nevertheless, there is international consensus that axial involvement is a very important manifestation of PsA that requires dedicated assessment and management.[5] The challenges of identifying the axial phenotype of PsA include the following: nonspecific clinical or laboratory methods/tools and clinical features (especially the presence of back pain), the low frequency of HLA-B27 in patients with PsA, and low sensitivity of C-reactive protein (CRP).[5] It is logical to turn to imaging, which allows direct visualization of axial disease.[6] It is well known that conventional radiography of the SIJs and spine can visualize the late signs of axial disease, and that in PsA, radiography is more likely to demonstrate asymmetrical sacroiliitis and syndesmophytes, as well as spinal changes without abnormalities in the SIJ, as compared to what is seen in AS.[7] MRI is considerably more sensitive for detecting sacroiliitis than radiography, and clinical assessment of sacroiliitis and the presence of HLA-B27 are poor predictors of MRI-diagnosed sacroiliitis, which are frequent even in patients without symptoms of back pain.[8] Thus, MRI is the most appropriate imaging modality for ascertaining the presence of axial disease in PsA, but since MRI studies of spine and SIJs in PsA populations are still relatively few, more research is needed to clarify how best to diagnose and monitor axial PsA by MRI.

These challenges to diagnosis were highlighted in the first case presentation of a 50-year-old female with a 20-year history of inflammatory-type back pain unresponsive to nonsteroidal antiinflammatory agents. She had become disabled and was walking with the aid of a stick. Physical examination revealed psoriasis (PsO) on the sole of the left foot and painful movement of the thoracolumbar spine. HLA-B27 was positive, CRP was 25 mg/L, pelvic radiograph was reported as normal, and spinal radiograph reported degenerative disc disease (DDD). MRI of the SIJ was unremarkable, whereas imaging of the spine demonstrated numerous large vertebral corner and endplate inflammatory lesions on the short-tau inversion recovery (STIR), a water-sensitive MRI sequence (Figure 1). The T1-weighted sequence demonstrated numerous vertebral corner and endplate

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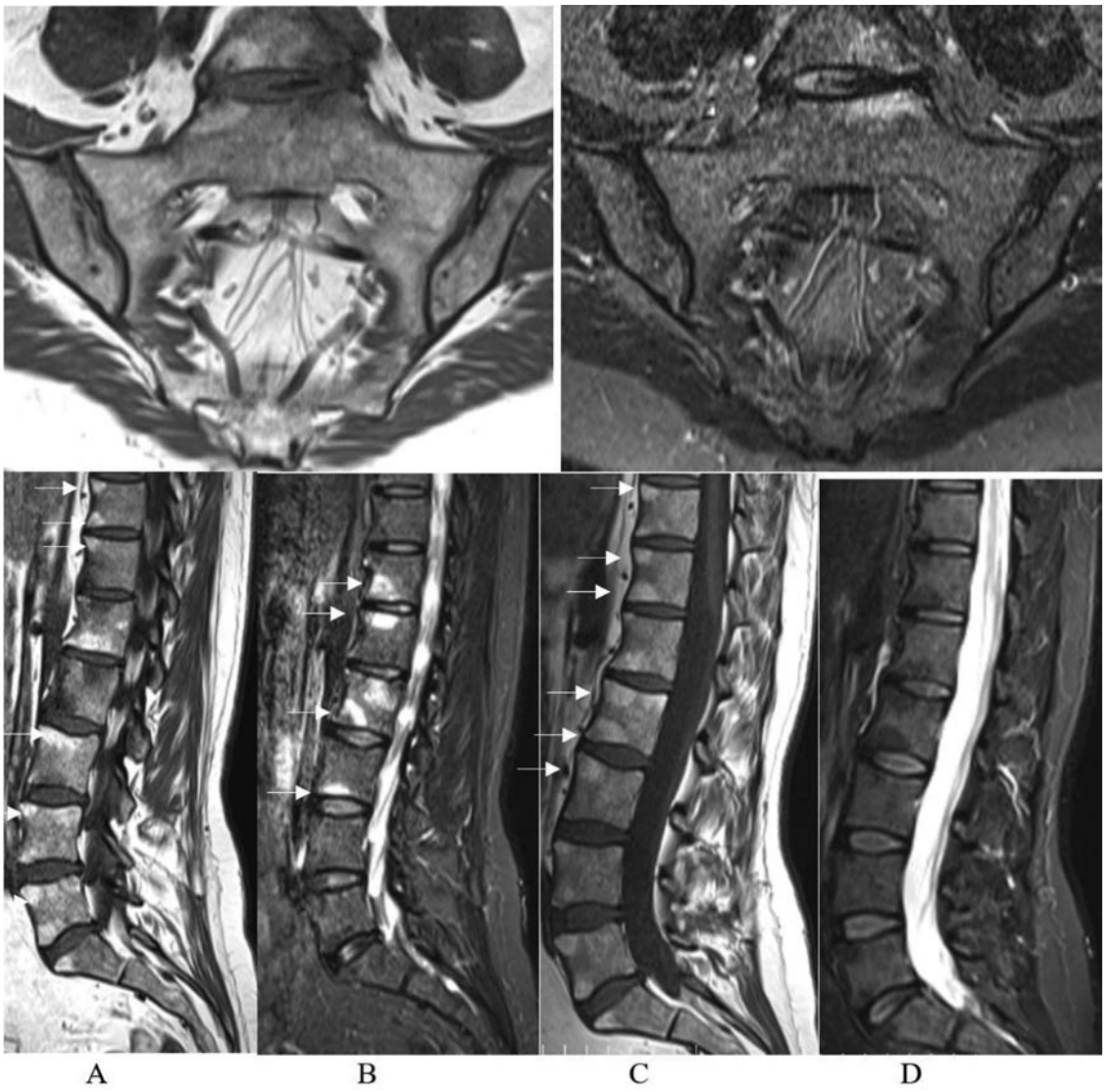

Figure 1. A 50-year-old female with inflammatory back pain and skin psoriasis. The upper panel illustrates normal T1W (left) and STIR (right) MRI scans of the sacroiliac joints. The lower panel illustrates T1W (A and C) and STIR (B and D) scans before (A and B) and after (C and D) treatment with a bDMARD. White arrows indicate regions of fat metaplasia on the T1W scans and bone marrow edema on the STIR scans. bDMARD: biologic disease-modifying antirheumatic drug; MRI: magnetic resonance imaging; STIR: short-tau inversion recovery; T1W: T1-weighted.

fat lesions with little evidence of endplate irregularity and loss of disc height that would characterize DDD. This patient's symptoms and functional impairment resolved completely with institution of biologic disease-modifying antirheumatic drug therapy (bDMARD) and the MRI demonstrated resolution of inflammatory lesions (Figure 1).

In the second case presentation, a 59-year-old female presented with interscapular pain for 3 months of a persistent nature, which was more evident at night. She had PsO of elbows and knees, CRP was 11.2 mg/L, and HLA-B27 was negative, and she had normal pelvic and spinal radiographs. MRI of the pelvis was normal, whereas MRI of the thoracic spine revealed a focal area of intense osteitis in the thoracic spine (Figure 2). Computed tomography–guided biopsy was conducted for assessment of sepsis but was negative for bacteria. She received numerous courses of antibiotics with no benefit. Combined evaluation of the STIR and T1-weighted MRI scans indicates extensive vertebral bone marrow edema (BME) and vertebral corner erosive changes limited to 3 thoracic vertebrae. However, there is also evidence of intervertebral ankylosis. The patient responded well to bDMARD therapy.

These cases highlight the importance of new studies assessing the presenting features of the axial phenotype in cohorts of patients with PsO and undiagnosed back pain. Imaging assessment will require the evaluation of both SIJ and spine and the application of standardized definitions for MRI lesions, as recently reported by the Assessments in Spondyloarthritis international Society.[9] In addition, scoring methodologies documenting both inflammatory and structural lesions at specific anatomical locations will provide insights into the evolution of

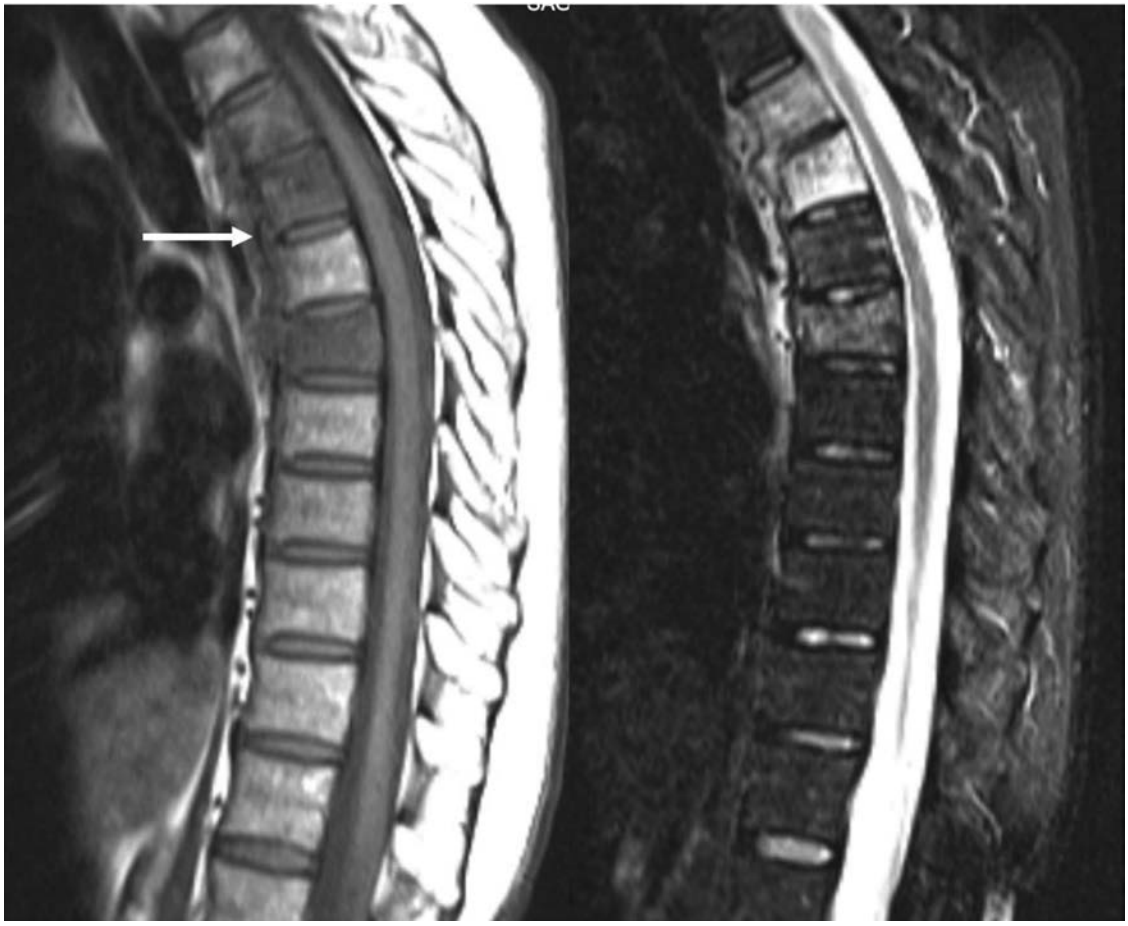

Figure 2. A 59-year-old female with interscapular pain for 3 months duration and skin psoriasis. The T1-weighted scan on the left illustrates a region of intervertebral ankylosis (white arrow). Short-tau inversion recovery scan on the right illustrates 2 vertebrae with bright signal indicative of bone marrow edema.

and associations between different types of lesions. For the SIJs, the Spondyloarthritis Research Consortium of Canada MRI inflammation and structural scores are validated methods that have been used in placebo-controlled trials for assessing the presence/absence of lesions in the SIJ according to SIJ quadrants and halves on consecutive semicoronal slices through the joint.[10,11] These scores have also been used to determine operational cutoffs that define what constitutes a positive MRI for active or structural lesions typical of axSpA according to the number of SIJ quadrants.[12,13,14] These cut-offs may be different for the axial phenotype of PsA. For the spine, the Canada-Denmark assessment system documents the presence/absence of inflammatory and structural lesions in all regions of the spine according to anatomical location.[15,16] In addition, it scores for inflammation in the total spine and various subscores, such as the vertebral body corners, the facet joints, and the posterolateral elements.[17,18] It has been shown to be responsive and to discriminate between active therapy and placebo in a randomized trial of axSpA.[18] Evaluation of the SIJ and spine using these scores can also be incorporated into whole-body MRI (WB-MRI) methods, thereby allowing assessment of both axial and peripheral lesions with 1 imaging method.[19,20] These methodologies should be used in randomized controlled trials (RCTs) of the axial phenotype of PsA to assess the efficacy of new therapeutic agents and to ensure appropriate case ascertainment, since assessment of plain radiographs of the SIJ is unreliable even in expert hands.

MRI for Peripheral Inflammation and Structural Damage Evaluation

The Outcome Measures in Rheumatology (OMERACT) MRI in Arthritis Group has developed and validated the Psoriatic Arthritis Magnetic Resonance Image Scoring System (PsAMRIS) method for the hand and foot, which scores synovitis, edema, tenosynovitis, periarticular inflammation, erosion, and bone proliferation.[21] In a sample of patients with PsA from an RCT, the PsAMRIS method showed good reliability and, for the inflammatory components, good responsiveness.[22] More recently, this group has developed consensus-based standardized definitions for the scoring of arthritis and enthesitis using WB-MRI.[23,24] WB-MRI has been shown to detect subclinical inflammation in PsA at both joints and entheses.[25,26] In the OMERACT WB-MRI score for inflammation in peripheral joints and entheses (WIPE), 83 joints are scored 0–3 separately for synovitis and osteitis, and 33 entheses scored 0–3 separately

for soft tissue inflammation and osteitis.[24] Good levels of reliability can be achieved between trained readers for status scores and for change over time.[24] This encourages further testing and refinement in clinical trials.

Following a systematic literature search,[27] the OMERACT MRI in Arthritis Group also recently developed a Heel Enthesitis MRI Scoring System (HEMRIS), in which entheseal lesions at the Achilles and plantar fascia insertions are assessed by separate scoring of BME, retrocalcaneal bursitis (Achilles insertion only), intratendinous inflammation, and peritendinous inflammation, all scored 0–3.[28] High levels of reliability were achieved in a recent OMERACT scoring exercise. At the 2020 GRAPPA annual meeting, heel enthesitis cases were displayed and reviewed by the attendees. An atlas for the HEMRIS has now been published.[29]

Thus, in addition to the WIPE WB-MRI system, which allows overall assessment of enthesitis and arthritis in the extremities, more detailed MRI systems are available for assessing heels (HEMRIS), hands, and feet (PsAMRIS). In contrast, no detailed systems for assessment of inflammation in the hip and knee in PsA have yet been published. This would be highly relevant, as involvement of weight-bearing joints in PsA contributes greatly to functional impairment. Radiographic evaluation is only capable of detecting structural lesions once damage is extensive. MRI evaluation of BME and synovitis effusion may enhance the discriminatory capacity of WB-MRI tools developed for the scoring of total inflammatory burden in PsA. Moreover, BME in peripheral joints has been reported as predictor of erosive progression in PsA.[30] The Hip Inflammation MRI Scoring System (HIMRISS) and the Knee Inflammation MRI Scoring System (KIMRISS) scoring methods have been successfully applied in osteoarthritis (OA),[31–38] and these systems are promising methods for use also in PsA. Using HIMRISS, bone marrow lesions (BML) in the hip are scored using a single electronic overlay on a Web-based interface positioned over the femoral head and extending into the acetabulum on consecutive coronal slices through the hip joint (scoring range 0–100). It has been shown to have very good to excellent reliability for status scores and change in BML for patients with OA receiving glucocorticoid injections.[24,32] In KIMRISS, BML is scored using specific overlays for the femur, tibia, and patella on consecutive sagittal slices through the knee joint (scoring range 0–500). It has also been shown to have very good reliability for status scores and change in patients with knee OA followed for 1 year in the Osteoarthritis Initiative study and in a pilot evaluation of adalimumab for inflammatory knee OA.[36] Synovitis effusion is scored on consecutive slices of fluid-sensitive noncontrast-enhanced sequences, according to a grading scheme (0–2 for HIMRISS, 0–4 for KIMRISS). Both methods have been tested by the OMERACT MRI in Arthritis Group for scoring inflammation in hip and knee joints on WB-MRI scans of patients with PsA and data are to be published in proceedings of OMERACT 2020.

Conclusion

A methodological framework based on WB-MRI is now in place for the comprehensive evaluation of both inflammatory and structural lesions throughout the skeleton in PsA. This should be used in inception cohort studies of patients with PsO and/or PsA presenting with undiagnosed back pain and in RCTs of new therapeutics. This will permit greater precision and discrimination of new therapeutics targeting inflammation in PsA with decreased sample size requirements. Assessment of disease modification will also require these MRI-based methods, as radiography is increasingly nonfeasible because the degree of radiographic changes in the short time frame of current clinical trials is small.

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