

Imaging Techniques in Psoriatic Arthritis: Update 2012-2014 on Current Status and Future Prospects

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ABSTRACT. By providing additional and more sensitive information over clinical examination, imaging techniques are useful in the assessment of patients with psoriatic arthritis (PsA) and have been increasingly used to obtain additional clues to its pathogenesis. This review describes the current status and future development of conventional radiography, computed tomography, magnetic resonance imaging, positron emission tomography, and other novel techniques in the evaluation of PsA, with a focus on their use in diagnosing, monitoring, and predicting disease course and followup treatment response. The role and applications of ultrasonography are outside the scope and are reviewed elsewhere in these proceedings. (J Rheumatol Suppl. 2015 Nov;93:53–6; doi:10.3899/jrheum.150637)

Key Indexing Terms:

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MAGNETIC RESONANCE IMAGING

FLUORESCENCE OPTICAL IMAGING

Psoriatic arthritis (PsA) is a chronic inflammatory joint disease with heterogeneous clinical presentation and a tendency to irreversible joint damage. PsA typically involves peripheral joints, with an asymmetric pattern, and the axial skeleton. Its initiating mechanism is enthesitis of articular capsules, fasciae, tendons, and ligaments. The disease has different clinical subgroups, but usually presents as oligoarthritis.

By providing additional and more sensitive information over clinical examination, imaging techniques are useful in assessment of patients with PsA and permit additional insights into its pathogenesis. If inflammatory changes are promptly recognized, patients have earlier access to treatment and may delay or even avoid destructive joint changes.

This review is an update covering the previous 2 years of studies performed in PsA with conventional radiography (CR), computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET).

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METHODS

A computerized literature search, from January 1, 2012, to April 30, 2014, was conducted by a single reviewer to identify articles on imaging in patients with PsA. Articles were retrieved through PubMed search using MeSH (US National Library of Medicine subject heading) terms “psoriatic arthritis” in combination with “magnetic resonance,” “MRI,” “computed tomography,” “CT,” “radiography,” “conventional radiology,” “positron emission tomography,” “PET,” and “PET/CT.” Only publications in English were considered. Reviews, editorials, case reports, letters, and commentaries were excluded. The search yielded a total of 148 articles, which were reviewed by title and abstract. Of them, 45 were found eligible and retrieved as full-text articles. Finally, 21 articles fulfilling all inclusion criteria were included in the study.

RESULTS

Conventional radiography. CR has been the preferred imaging technique^{1,2} for diagnosing and monitoring bone damage in patients with PsA. The radiographic hallmark of PsA is the combination of destructive changes such as erosions, tuft resorption, and osteolysis with bone proliferation, including periostitis, ankylosis, spur formation, and non-marginal syndesmophytes³. CR, mainly used in the clinical management of PsA, is also a reference method to assess the sensitivity and specificity of other imaging modalities, or the efficacy of therapies over time. In clinical research, CR has been surpassed by new, sensitive imaging techniques, such as US and MRI (Figure 1).

CR revealed inflammatory changes in peripheral joints about 6 months after onset of clinical symptoms⁴. To differentiate PsA from rheumatoid arthritis (RA), radiographs of hands and feet were obtained in 85 PsA and 135 RA patients. Only juxtaarticular bony proliferation was significantly more frequent in PsA than in RA⁵. Radiographs of the hands or feet were performed in 24 PsA patients with arthritis mutilans: of

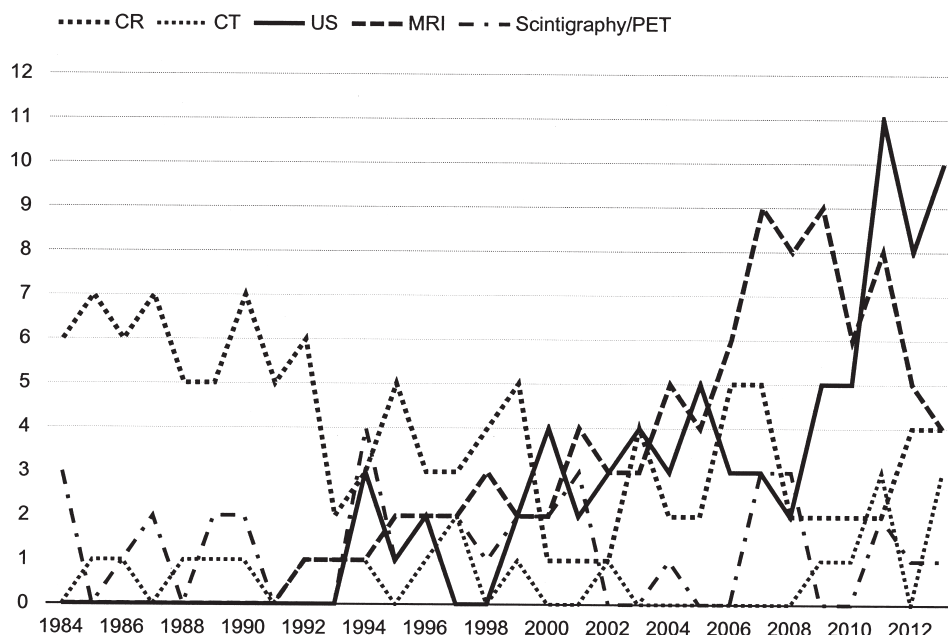


Figure 1. Trends in numbers of publications on various imaging techniques over the past 30 years with their respective logarithmic curves. CR: conventional radiography; CT: computed tomography; US: ultrasound; MRI: magnetic resonance imaging; PET: positron emission tomography.

these, 30% showed radiological changes indistinguishable from nodular osteoarthritis (OA)⁶.

Compared to other imaging techniques, CR is not sensitive in detecting erosions, although its specificity is high. Its major disadvantage is the 2-dimensional visualization of 3-D anatomy, resulting in suboptimal delineation of bone, due to projectional superimposition. Concurrent bone proliferations may also contribute to masking of erosions. Two recent studies by Poggenborg, *et al* confirm the high specificity (94–99%) and low sensitivity of CR in the detection of erosions, compared to CT^{7,8}.

Radiographs evaluated after 1 year of treatment with a tumor necrosis factor (anti-TNF) inhibitor revealed significantly less deterioration in hand/foot erosion scores than with placebo⁹. In a 1-year followup of the same cohort, anti-TNF therapy maintained its efficacy in inhibiting radiographic progression¹⁰. Fifty-three patients with PsA taking disease-modifying antirheumatic drugs (DMARD) and/or anti-TNF for 1 year were studied¹¹. Progressive radiological damage was more frequent among patients with increased swollen joint count than among those with stable or decreased count, and on DMARD therapy compared with TNF- α blocking agents.

The only article about axial involvement assessed sex-related differences in disease activity, joint damage, quality of life, and disability in 590 patients with PsA. Radiographic damage was more severe in men, in both axial and peripheral joints. Further, men were more likely to

develop sacroiliitis grade 3 or 4 and syndesmophytes in the cervical, thoracic, and lumbar spine¹².

An unusual recent article investigated the association of alcohol consumption with radiographic progression over 7 years in patients with different forms of arthritis compared with controls. Arthritis patients reported less alcohol consumption, while no significant association between alcohol consumption and rate of joint destruction was found¹³.

Tillett, *et al* assessed the feasibility, reliability, and sensitivity to change of the Sharp score (MSS), Sharp/van der Heijde modified method (SHS), modified Steinbrocker method, and PsA Ratingen method in 50 patients with PsA at baseline and after 2 years of anti-TNF therapy. The SHS method was the most reliable and sensitive to change but took longer to perform. The Steinbrocker method was the most feasible but lacked the sensitivity of the SHS, and the smallest detectable change of the Ratingen method, which was faster to perform, was close to that of the SHS and MSS¹⁴.

Computed tomography. CT is the imaging gold standard for evaluating bone, particularly in malignant disease and bone fractures, but is seldom used in arthritis. CT, like CR, has been used as a reference standard for other imaging modalities in the evaluation of bone erosions in RA. By contrast, only a few studies have examined bone damage in PsA with CT, primarily for assessment of the sacroiliac joints.

Bone erosions and proliferation of the hands in patients with

PsA were studied during adalimumab treatment for a period of 24 weeks⁷. Using CT as the standard, CR showed low sensitivity (17% and 26%) but high specificity (98% and 95%) for bone erosions and proliferations, respectively. Neither CT nor CR revealed changes in these lesions over time.

A novel CT instrument, high-resolution peripheral quantitative CT (HR-pQCT), can accurately and reproducibly image bone microstructures (< 100 µm) at high resolution and precisely measure 3-D morphometric details and volumetric density of bone. Radiation exposure (equivalent dose ~3–10 µSv/scan) is low, similar to that obtained with CT. Periarticular bone in RA and PsA metacarpophalangeal (MCP) joints and distal radius has recently been investigated using HR-pQCT¹⁵. Despite similar demographic variables, disease duration and activity, and antirheumatic therapy, patients with seropositive RA showed more severe deterioration of the trabecular bone structure than patients with seronegative RA and patients with PsA. Conversely, seronegative patients with RA were indistinguishable from patients with PsA for bone mineral density and trabecular and cortical bone structure. A followup study investigated whether methotrexate or anti-TNF inhibitors affect osteophyte formation at the MCP joints in 41 patients with PsA. Osteophyte size increased significantly from baseline to 1-year followup in both treatment groups¹⁶.

Magnetic resonance. The majority of articles available for our review are concerned with MRI. MRI can assess all joints with similar efficacy, has been sufficiently standardized, and yields data on inflammation that can be quantified¹⁷.

Seven patients with PsA and 10 with RA performed a dynamic contrast-enhanced MRI (DCE-MRI) of the wrist and quantification of the enhancement within the synovial membrane. The volume of inflammation was significantly higher in RA than in PsA for all extensor compartments except the second, and in joint synovial membrane. The DCE-MRI indicators of degree of inflammation were higher for PsA in the joint synovial membrane¹⁸.

The ability of high-resolution MRI to differentiate among RA, SpA, PsA, and OA was tested in 69 patients with suspected inflammatory joint disease of the hands or feet¹⁹. MRI diagnosis of OA corresponded in most cases to the clinical one but was less successful in patients with SpA, PsA, and RA. Although osteitis and periostitis were best suited to differentiate RA from SpA, PsA, and OA, these variables seemed not to help to further distinguish SpA and PsA from OA.

In the only MRI followup study of anti-TNF-α therapy, signs of inflammation decreased after 48 weeks, but did not disappear. No overall changes in bone erosions or proliferations of the hand joints were demonstrated⁹.

Dalbeth, *et al* examined the association between MRI features of distal phalanx (DP) disease and the progression of nail pathology in PsA²⁰. Nails with onycholysis and hyperkeratosis at baseline were more likely to have corresponding

DP bone erosion and proliferation on MRI, and DP bone edema on baseline MRI was associated with development of onycholysis and hyperkeratosis in the corresponding nail.

Information about MRI of axial involvement in PsA originates primarily from studies of SpA in general. In a recent study, MRI from 76 patients with PsA, nonradiographic axial SpA, and ankylosing spondylitis (AS) were evaluated²¹. Total MRI scores (lumbar spine plus sacroiliac joints) were higher in AS patients than in PsA patients or in patients with non-radiographic axial SpA. A relationship was seen between the severity and extent of disease and HLA-B27 positivity in PsA patients, which was comparable to that in AS.

Only 1 article evaluated knee MRI in patients with psoriasis but not in those with arthritis²². Subclinical synovitis and enthesitis were frequently found, being possible early signs of PsA.

The OMERACT (Outcome Measures in Rheumatoid Arthritis Clinical Trials) MRI inflammatory arthritis group has developed the PsA MRI scoring system for the evaluation of inflammatory and destructive changes in PsA hands (PsAMRIS-H)²³. To date, the score has been evaluated only on a 0.6-T MRI system. Strube, *et al* evaluated the PsAMRIS-H on a low-field MRI system, showing good intrareader reproducibility, although inter- and intrareader agreement for individual features including tenosynovitis and periarticular inflammation were low²⁴.

Skeletal scintigraphy and positron emission tomography. Skeletal scintigraphy and PET are rarely used in PsA. The pattern of distal interphalangeal (DIP) joint bone metabolism was studied to test the hypothesis that the nail was functionally integrated with the bone²⁵. The DIP joints of 30 subjects (10 PsA, 10 OA, 10 healthy controls) were scanned with high-resolution 18F-fluorodeoxyglucose PET (FDG-PET). FDG-PET uptake in the DIP was strong relative to the intermediate phalanx in both PsA and OA. In PsA there was a trend for uptake to occur in a diffuse pattern involving the entire DIP. There was also greater uptake at the entheses, the periosteum, and at the tufts of the DIP compared with OA. Both PsA and OA joints with uptake at the subchondral or periosteal bone were likely to be more symptomatic.

Another study involved 28 newly diagnosed patients with arthritis, of whom 3 had PsA²⁶. Patients with PsA showed high FDG uptake, predominantly in the DIP joints. Six weeks after specific treatment, there was a decrease in maximum uptake values.

Fluorescence optical imaging. Fluorescence optical imaging (FOI) is an established technology for the imaging of inflammation. FOI was compared with other imaging modalities in 60 patients with psoriatic diseases and agreed well with clinical examination, MRI, and US, but was more sensitive for detecting synovitis and tenosynovitis²⁷. FOI findings correlated significantly with disease activity and were highly specific, being negative in nearly all healthy subjects.

Imaging techniques are excellent tools for the evaluation

of patients with PsA, because both peripheral and axial disease can be detected and monitored. This review has summarized both the strengths and weaknesses of each imaging modality as shown in recent publications.

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