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REVIEW

Musculoskeletal Imaging for Dermatologists: Techniques in the Diagnosis and Management of Psoriatic Arthritis

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ABSTRACT

Psoriatic arthritis is an inflammatory condition affecting up to 30% of patients with psoriasis. Patients may experience irreversible joint damage if not treated early, and diagnostic delays of even 6 months are associated with radiographic progression and impaired function. Therefore, early detection and intervention are of critical importance in patients with psoriatic arthritis. Given that psoriasis often precedes symptoms of psoriatic arthritis, dermatologists are uniquely positioned to identify patients with psoriatic arthritis early in their disease course, before permanent damage has occurred. Several screening tools have been developed to help dermatologists identify patients who may have psoriatic arthritis, but these tools may not capture patients with subclinical disease or quantify the type and severity of the underlying tissue insult, which is often the presenting sign of psoriatic arthritis. In these cases, a combination of clinical assessment and musculoskeletal imaging (e.g., ultrasound) is required. This review summarizes three common musculoskeletal imaging techniques used in the diagnosis and management of patients with psoriatic arthritis: conventional radiography, ultrasound, and magnetic resonance imaging. Further understanding of musculoskeletal imaging will assist dermatologists in making treatment decisions and allow them to have a more active role in the detection of psoriatic arthritis.

Keywords: Psoriasis; Psoriatic arthritis; Radiography; Ultrasound; MRI

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Key Summary Points

The early detection and appropriate management of psoriatic arthritis (PsA) are critically important in improving patient outcomes.

In many patients who develop PsA, psoriasis precedes arthritis by 7–12 years, ideally positioning dermatologists to identify and treat patients who may have early signs of PsA.

However, PsA is often underdiagnosed in both primary care and dermatology practices; therefore, dermatologists should be encouraged to be proactive during patient visits and inquire about joint pain, consider the possibility of axial disease, and evaluate for tenderness at entheseal sites.

Understanding musculoskeletal imaging techniques that rheumatologists use will increase meaningful collaborations between dermatologists and rheumatologists and aid dermatologists in diagnosing PsA, including subclinical disease, and making timely treatment decisions.

DIGITAL FEATURES

This article is published with digital features, including a summary slide, to facilitate understanding of the article. To view digital features for this article go to https://doi.org/10.6084/m9.figshare.14681436.

INTRODUCTION

Psoriatic arthritis (PsA), a chronic inflammatory disease, is a common comorbidity of psoriasis, affecting up to 30% of patients [1, 2]. PsA is a heterogeneous disease with dermatologic and musculoskeletal manifestations—including peripheral and axial arthritis, enthesitis, dactylitis, psoriasis, and psoriatic nail disease—that is associated with a decreased quality of life and increased morbidity and mortality [3]. Patients may experience progressive, irreversible joint damage if not treated early; even a short delay of 6 months from symptom onset to diagnosis is associated with joint damage and poor long-term physical function [4]. Therefore, early detection and intervention are critical in reducing the extent of detrimental patient outcomes.

In 75–84% of patients who develop PsA, psoriasis precedes arthritis by 7–12 years [5], giving dermatologists a unique opportunity to identify and treat patients who may have early signs of PsA. However, PsA is often underdiagnosed in both primary care and dermatology practices [6–8]. Therefore, dermatologists are encouraged to be proactive during patient visits and inquire about joint pain, consider the possibility of axial disease, and evaluate for tenderness at entheseal sites [1]. Several validated screening tools [1, 9, 10] as well as the mnemonic acronym PSA (pain [in the joints], stiffness [> 30 min after a period of inactivity]/sausage digit [dactylitis/swelling], and axial spine involvement/back pain associated with stiffness and pain that improves with activity) have been developed to facilitate rapid screening [10].

Rapid assessment of patients using validated screening tools can identify PsA during routine office visits, whereas clinical assessment may be complemented by musculoskeletal imaging, which can provide key information in the diagnosis of PsA. For example, joint damage characteristic of PsA can be detected and monitored by radiographs, although radiograph findings are often negative in early disease [11, 12]. Newer imaging techniques, such as ultrasound and magnetic resonance imaging (MRI), can detect early and subclinical PsA signs such as enthesitis and aid in early differentiation of PsA from other conditions such as fibromyalgia [13–15]. The use of imaging may be especially relevant for patients with severe psoriasis, nail pitting, uveitis, inflammatory changes in the axial skeleton (i.e., sacroiliac joints, spine) indicative of axial PsA, or

nonspecific musculoskeletal symptoms (e.g., fatigue, joint pain, stiffness) [16–20]. Therefore, familiarity with common imaging techniques used in the assessment of PsA can help dermatologists better care for their patients with psoriasis. In this review, we provide an overview of the main musculoskeletal imaging techniques used in the diagnosis and management of PsA. This review is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Common Imaging Modalities Used in the Diagnosis and Management of PsA

This section provides a brief overview of conventional radiography, ultrasound, and MRI along with their advantages and disadvantages, the disease stage for which they are best suited, and the features that can be observed (Table 1).

Conventional Radiography

Conventional radiography is the most commonly used imaging technique for assessing structural damage in PsA [12, 21]. Radiographs are especially useful in detecting bone erosion

Table 1 Imaging techniques currently used in the diagnosis and analysis of progression of PsA

Imaging technique	Strengths	Weaknesses	Preferred use
X-ray [23]	Inexpensive and readily available	Unable to detect early signs of subclinical PsA in soft tissues	Assessment of clinical PsA
	Can identify joint damage/new bone formation associated with more advanced disease (e.g., erosions and enthesophytes)	Ionizing radiation (doses to hands are lowest risk)	Detection of joint damage (erosion, fluffy periostitis, new bone formation, enthesophytes) and monitoring of radiographic progression
Ultrasound	Inexpensive, portable, and readily available [26, 44]	Unable to detect intraosseous abnormalities due to active enthesitis, such as bone marrow edema [25, 79]	Assessment of preclinical PsA
	Nonionizing and noninvasive [26, 44]	Weak signals and artifacts due to small number of blood vessels in entheses and proximity to bone [32]	Visualization of the peripheral joints and entheses for detection of enthesitis and assessment of synovial tissue, joint effusions, and erosions [23, 25]
	Capability of real-time dynamic imaging of multiple joints/enthuses [26, 44]	Lack of standardization among different machines [80]	Identification of subclinical synovitis and tenosynovitis [25]
		Operator must be familiar with imaging artifacts that can cause misinterpretation or be mistaken for pathology [50, 51]	Measurement of abnormal vascularization (indicator of active inflammation) [31]
			Differentiation of subclinical enthesitis [14]

Table 1 continued

Imaging technique	Strengths	Weaknesses	Preferred use
MRI	Nonionizing and noninvasive [63]	Substantially higher cost and lower availability; long length of time to perform scan [26]	Assessment of preclinical PsA [38]
	Muscles, ligaments, and tendons are seen much more clearly than on X-rays [63]	Potential for toxicity (use of gadolinium-containing contrast agents) [81]	Assessment of axial involvement and active inflammatory changes and soft tissue abnormalities (thickening of tendons and ligaments, joint effusions and inflammation, bone erosions, enthesophytes, and intraosseous bone marrow edema associated with enthesitis and sacroiliitis) [14]
	Can monitor therapeutic response [63]		Visualization of small, active inflammatory changes and lesions that are present early in the disease course [53, 54]

and/or new bone formation, which tend to be seen in later stages of the disease, and can help visualize soft tissue swelling suggestive of dactylitis (Fig. 1) [12, 22].

Patients with PsA most frequently have structural changes in the hands and feet, but other joints may also be affected [11]. Typical radiographic changes include fluffy periostitis, joint damage (e.g., joint space narrowing, erosions, osteolysis, subluxation, ankylosis, pencil-in-cup deformity), and new bone formation (e.g., enthesophytes) (Table 2) [23].

The main advantages of plain radiography are its low cost and availability. Additionally, plain radiography can determine involvement of the sacroiliac joint and joints of the spine, including entheseal new bone formation [24]. These changes, which are seen in more advanced disease, are not readily imaged using other techniques such as ultrasound, which cannot penetrate the bone surface [25]. However, plain radiography has limited utility in assessing the early soft-tissue changes seen in PsA [13, 26], especially axial changes [27]. Radiographs taken during this stage of the disease can appear normal, resulting in a significant delay in diagnosis if other imaging modalities are not used. Ultrasound and MRI are generally preferred to conventional radiography for identifying early signs of inflammatory arthritis and changes in musculoskeletal structures.

Ultrasound

Ultrasound displays the structures and compositions of different tissues based on their echogenicity (Table 2) [28–30]. Structures can be characterized as anechoic (transmit sound waves; black image), hyperechoic (greatly reflect signal; bright/white image), or hypoechoic (reflect and transmit sound waves; darker gray image) (Table 2). Soft tissue results in images in varying shades of gray; tissues leading to brighter images compared to their surroundings are considered hyperechoic, and those leading

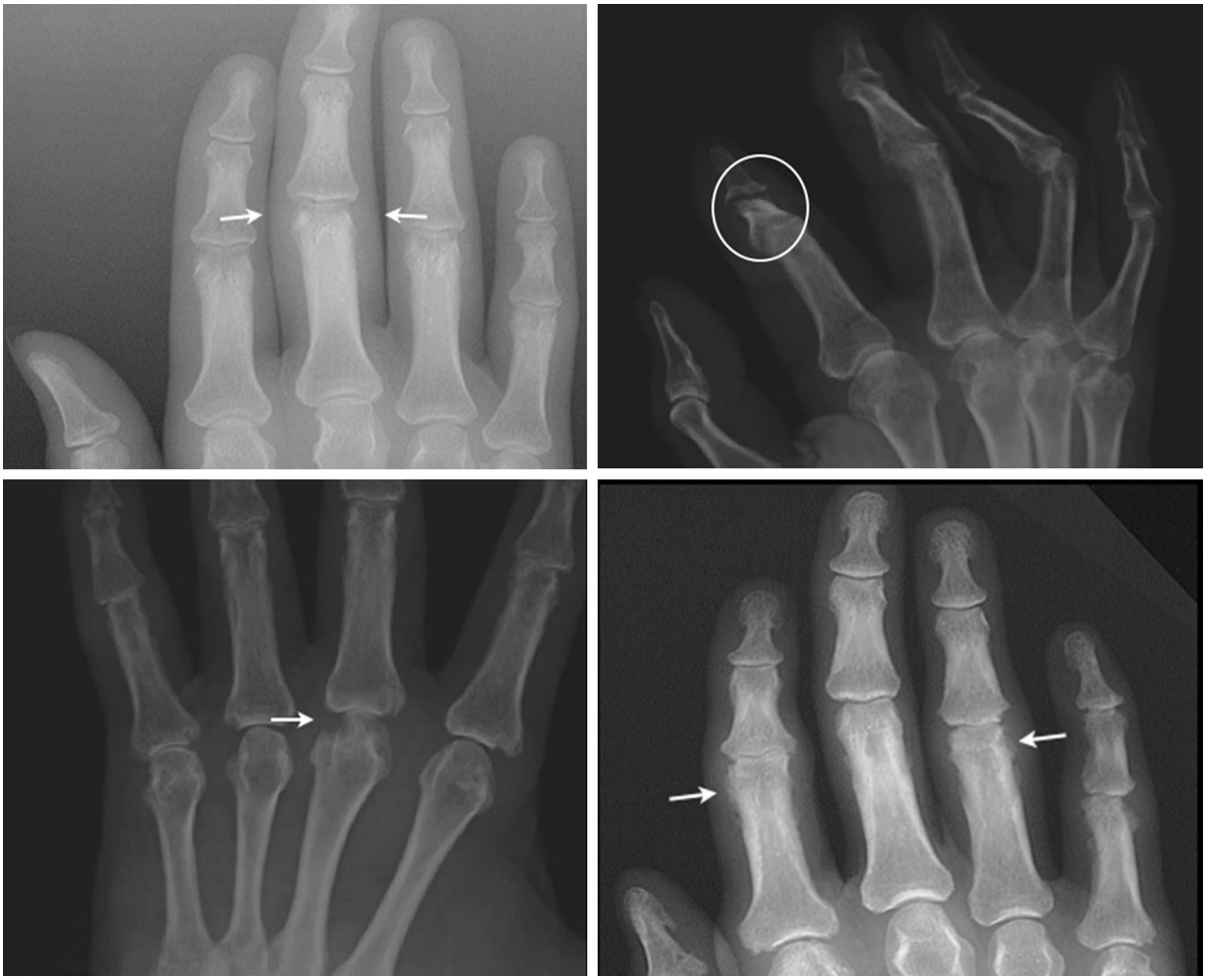

Fig. 1 X-ray imaging of structural changes in patients with PsA. *Clockwise from top left*: diffuse soft tissue swelling (sausage digit); destruction and widening of the joint space; bone production (periostitis); and marginal bone erosion. *PsA* psoriatic arthritis Batlle JA, et al. Presented at the European Congress of Radiology 2011, poster C-0065 (copyright ©: 2001–2018 European Congress of Radiology, 2005–2018 European Society of Radiology)

to darker images are considered hypoechoic (Fig. 2).

Structures at different depths can be assessed using different ultrasound frequencies [28, 29]. Superficial structures can be visualized using high frequencies (> 12 MHz), which have shorter wavelengths and less penetration but provide higher resolution; low frequencies (≤ 12 MHz) have longer wavelengths and can be used to visualize deeper body structures but with poorer resolution.

Ultrasound can be used to produce 2D grayscale images, and a series of 2D images can be combined to make a 3D image [29]. In addition, Doppler ultrasound can be used to visualize movement, such as blood in vessels, and to screen patients for abnormal vascularization, which is indicative of active inflammation [31–33]. Common Doppler techniques used in rheumatology include color Doppler, which is used to determine the direction and mean velocity of blood flow, and power Doppler, which has higher sensitivity to blood flow but does not provide the flow direction [34, 35]. Doppler ultrasound can be used to enhance conventional ultrasound, as the ability to identify even minimal abnormal vascularization is important for the detection of subclinical

Table 2 Glossary of technical terms used in clinical imaging study reports

Term	Definition
Absorption	Reduction in sound wave intensity as it passes through tissue, with energy lost in the form of heat
Anechoic	Without an echo; images appear black
Anisotropy	Artifact is dependent on the angle of the ultrasound beam, which may result in an incorrect diagnosis; dramatic changes in reflection result from small changes in the angle of incidence of the transducer; notably observed in muscles and tendons
Ankylosis	Abnormal joint stiffening and immobility resulting from fusion of bones
Attenuation	Sound waves become weaker and lose energy during deeper travel within the body; composed of three processes: reflection, absorption, and refraction
Contrast	Difference in signal intensity divided by the average signal intensity of two adjacent regions
Contrast agent	Substance given to a patient to alter the image intensity of a particular body region
Dactylitis	Diffuse soft tissue thickening/inflammation in the fingers and toes, i.e., "sausage digit" (associated with synovitis, tenosynovitis, and enthesitis)
Echogenicity	Ability to return the signal back to the transducer (an echo)
Enthesis	Connective tissue between bone and either a tendon or ligament
Enthesitis	Inflammation of the entheses
Enthesopathy	Presence of either the combination of at least abnormal thickening and hypoechogenicity of the tendon insertion with or without the presence of a Doppler signal (grade 0–3) or ≥ 2 Doppler signals alone with or without abnormal thickening and hypoechogenicity
Enthesophyte	Abnormal bony projection at the attachment of a tendon or ligament
Erosion	Gradual destruction and loss of bone in a particular area
Gadolinium (Gd)	Paramagnetic contrast agent that strongly shortens T1; very bright on T1W images and especially useful for observing vascular structures; given in chelated form, as it is toxic by itself
Hyperechoic	More echogenic (increased density of echoes) than surrounding tissues and appears lighter
Hypoechoic	Less echogenic (fewer echoes) than surrounding tissues and appears darker
Isoechoic	Same echogenicity as surrounding tissue and indistinguishable in color
Joint space narrowing (JSN)	Narrowing of the joint space between the bones, resulting in a change in the joint's range of motion
Juxta-articular osteopenia	Loss of bone mass near a joint
Luxation	Complete separation of the joints
Osteolysis	Progressive destruction of bony tissue through active resorption of bone matrix by osteoclasts (multinucleated bone cells)
Osteophyte	Abnormal bony projection along the edge of bone, often forming in joints
Osteoproliferation	Growth (proliferation) of bone tissue

Table 2 continued

Term	Definition
Pencil-in-cup deformity	Periarticular (around the joint) erosions and bone resorption leading to a sharpened pencil shape
Periosteum	Tissue surrounding bone
Periostitis	Inflammation of the periosteum
Reflection	Sound wave passes between two tissues of different acoustic speeds, with a portion of the waves returning to the transducer
Refraction	Sound waves are deflected away from the straight path with an angle of deflection away from the transducer
Repetition time (TR)	Time between successive pulse sequences applied to the same slice
Sacroiliac joint	Joint that connects the hip bones to the sacrum (triangular bone between the lumbar spine and tailbone)
Sacroiliitis	Inflammation of the sacroiliac joints
Sclerosis	Unusual hardening or thickening of bone
Short-tau inversion recovery (STIR)	Used to suppress the signal from fat, or more specifically tissues with T1 values in the range of fat; cannot be used as a fat suppression technique following gadolinium administration
Subluxation	Connecting bone is partially out of the joint but can often return to normal position
T1	Spin–lattice relaxation time; measure of the time taken for spinning protons to realign with the external magnetic field
T1-weighted (T1W)	Image where most of the contrast between tissues is due to differences in tissue T1; fatty tissues appear bright while fluid appears black; produced by using a short echo time (TE) and TR
T2	Spin–spin relaxation time; measure of the time taken for spinning protons to lose phase coherence among nuclei spinning perpendicular to the main field
T2-weighted (T2W)	Image where most of the contrast between tissues is due to differences in tissue T2; both fatty and water-based tissues appear bright; fatty tissue is distinguishable from water-based tissue through comparison with T1W images; produced by using a longer TE and TR than T1W
Transmission	Sound waves continue traveling deeper into the body and are not reflected initially but can be reflected by deeper tissue structures

inflammation, though additional training may be needed for its use [34, 35].

Key features of PsA that are detected by ultrasonography include enthesitis and synovitis [36, 37]. Enthesitis, a hallmark of PsA that is believed to be the first sign of disease, has a prevalence of 20% in patients with psoriasis by clinical exam [15, 37]. However, the proportion of patients with enthesitis by ultrasound or MRI is much higher. Studies using advanced musculoskeletal imaging techniques have shown that up to half of patients with psoriasis may exhibit inflammatory and structural abnormalities in their joints and entheses, which can precede and even help predict the onset of PsA [38, 39]. Enthesitis is common in the tendons

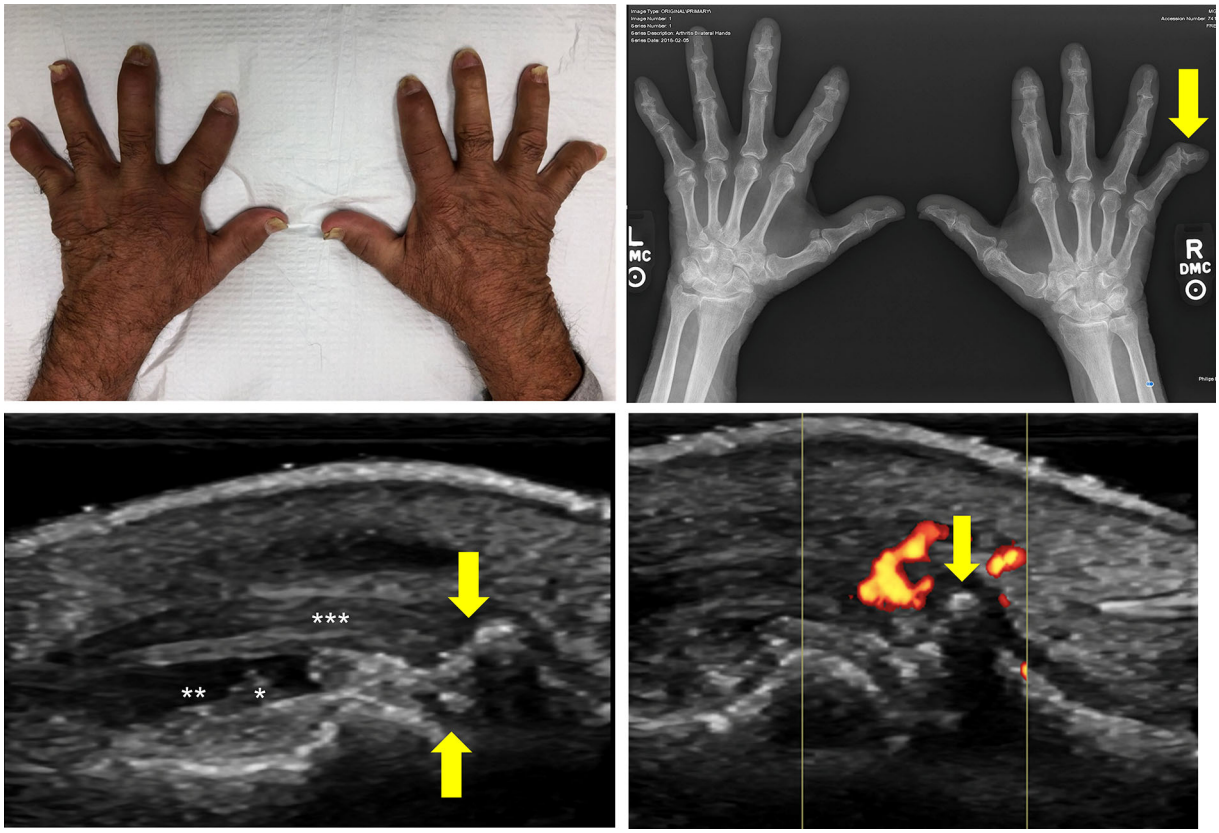

Fig. 2 Clinical, radiographic, and ultrasound assessments in a patient with PsA. *Top left*: nail changes, dactylitis, and DIP subluxation as seen during clinical examination. *Top right*: conventional radiographs of the same patient exhibiting "wispy periostitis" and DIP subluxation (indicated by the *arrow*). *Bottom left*: ultrasound providing a longitudinal view of the DIP extensor tendon (indicated by the *triple asterisk*) showing enthesitis in the hand (extensive cortical irregularity indicated by the *downward arrow*; DIP joint indicated by the *upward arrow*) as well as synovial effusion at the DIP joint (indicated by the *double asterisk*) and synovial hypertrophy (*single asterisk*). *Bottom right*: power Doppler ultrasound showing the same area of damage, with the Doppler signal indicating active inflammation around the cortical irregularity. *DIP* distal interphalangeal joint, *PsA* psoriatic arthritis. Reprinted with permission from *The Journal of Rheumatology*, Bakewell et al. [13]. All rights reserved

and fasciae of the extremities [40] and is characterized by tendon thickening and hypoechogenicity at the entheses (Fig. 3) [31, 41]. Multiple scoring systems, such as those from the Outcome Measures in Rheumatology (OMERACT) Ultrasound Working Group [41] and the Group for Research and Assessment of Psoriasis and Psoriatic Arthritis (GRAPPA) Ultrasound Working Group [31], have been devised to aid in identifying enthesitis by ultrasound [13]. Synovitis can also be detected by ultrasound in almost one-third of patients with psoriasis, despite these patients showing no musculoskeletal symptoms [37]. Ultrasound can also help identify patients with or without arthralgia who may be in a transitional phase of PsA—in these patients, tenosynovitis, synovitis, and enthesitis have been associated with arthralgia [16, 42].

Overall, ultrasound has many advantages. It is portable, less expensive than MRI, very low risk due to its nonionizing and noninvasive nature, and readily available, allowing for real-time dynamic imaging by healthcare providers, including dermatologists [26, 43]. Imaging of multiple joints/entheses, including upper and

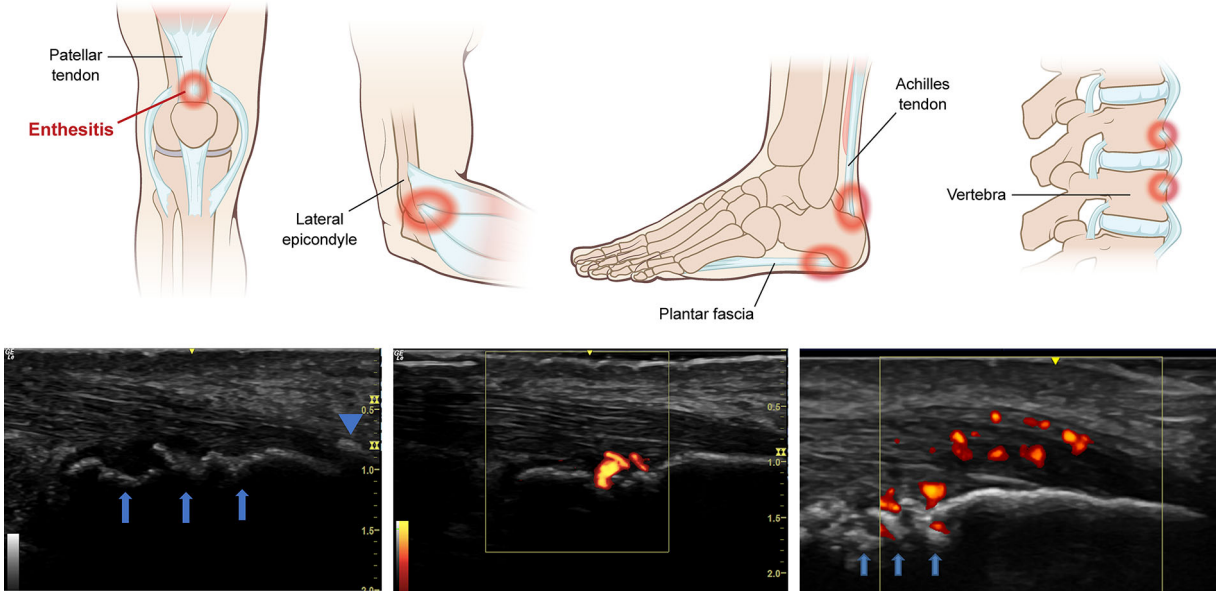

Fig. 3 Imaging of entheses by ultrasound. *Top*: entheseal structures. *Bottom left and center*: ultrasound (*left*) and ultrasound with Doppler images (*center*) of the right Achilles tendon of a patient with PsA experiencing no tenderness on clinical examination. Visualized changes include erosion/cortical irregularities (*arrows*) and distal enthesophyte (*arrowhead*). *Bottom right*: Achilles heel with Doppler signal within calcaneal erosion, indicating current activity and Achilles intrasubstance hypoechogenicity/thickening. *Arrows* indicate proximal erosions in the calcaneus. *PsA* psoriatic arthritis

lower extremity entheses, can be performed, allowing for contralateral comparison [44]. Doppler ultrasound can measure blood flow, which has been shown to correspond with the level of inflammation [31] and subsequent structural damage [45, 46]. Ultrasound can therefore identify patients with early PsA, allowing for earlier treatment.

However, because ultrasound waves cannot penetrate the bone surface, this technique is limited in the three-dimensional assessment of osseous structures or when evaluation of bone marrow edema (BME) is critical, such as when assessing inflammation or structural changes of the axial skeleton [47]. Thus, MRI is likely to remain the gold standard for imaging axial disease. Although the small number of blood vessels in entheses and artifacts due to the proximity to bone may also hinder ultrasound assessments in some cases, ultrasound is largely superior to MRI for generating higher-resolution images of entheses [32, 48, 49]. Another consideration is that the ultrasound examiner must be knowledgeable about imaging artifacts that can frequently occur. These artifacts can cause visualization of nonexistent structures or nonvisualization of existent structures and can also alter size, location, and brightness; this can lead to misinterpretation of results or mimic pathology in normal structures [50]. For example, fibrillary linear structures such as tendons or ligaments can appear hypoechoic if the ultrasound beam is not perpendicular during visualization; this could be misinterpreted as tendonitis or tears [51]. Proper training and awareness of artifacts can avoid such misinterpretations.

MRI

MRI is noninvasive and nonionizing and can be used to visualize inflammation in soft tissues and bone (Fig. 4) [14]. Different pulse sequences (e.g., T1-weighted [T1W] vs T2-weighted [T2W]) can change the image contrasts to visualize various structures (fat vs water sensitive, respectively); short-tau inversion recovery (STIR) sequences, which suppress signals from

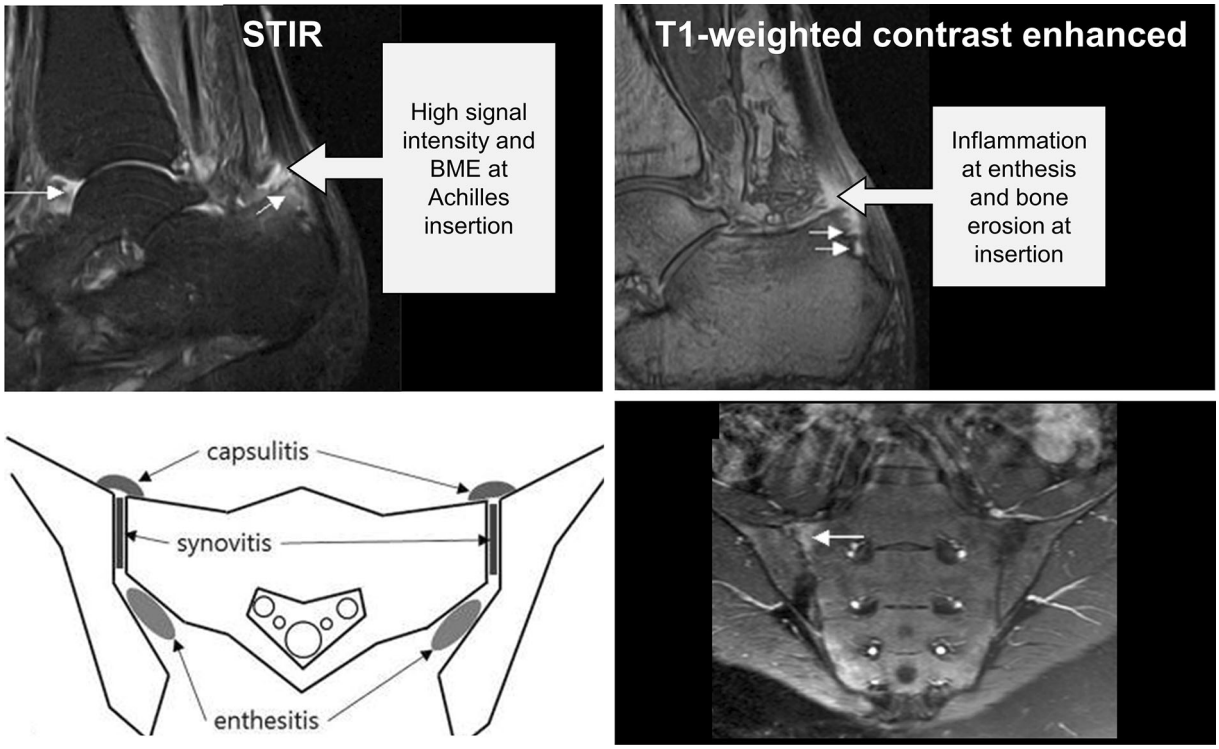

Fig. 4 Imaging of entheses by MRI. *Top*: soft tissues of the entheses visualized by MRI. *Bottom left*: enthesitis, synovitis, and capsulitis in sacroiliac joint. *Bottom right*: T1-weighted semicoronal MRIs through the sacroiliac joints after intravenous contrast injection. Enhancement is seen at the right sacroiliac joint (*arrow*), indicating active sacroiliitis. *BME* bone marrow edema, *MRI* magnetic resonance imaging, *STIR* short-tau inversion recovery Reprinted by permission from McQueen F, et al. Arthritis Res Ther. 2006;8(2):207 (copyright © 2006, Springer Nature) and from Sung S, et al. Br J Radiol. 2017; 90(1078):20170090 (© 2017 British Institute of Radiology)

fat, can be used to visualize BME, synovitis, and tenosynovitis. Imaging performed before and after the administration of a contrast agent, most commonly gadolinium, can aid in confirming and pinpointing inflammation and detecting structural pathologies.

The sensitivity of MRI allows the visualization of small, active inflammatory changes and lesions that are present early in the disease course [13, 52]. MRI can be used to detect axial or peripheral enthesitis and, like ultrasound, can detect early signs of enthesitis and inflammatory lesions that are not detectable by radiography [53, 54]. Lesions evident by MRI include thickening of tendons and ligaments, joint effusions and inflammation, bone erosions, enthesophytes, and intraosseous BME [27, 52].

MRI is particularly helpful in the early diagnosis of axial PsA, given its ability to detect inflammatory and structural lesions [27], and can aid in distinguishing axial PsA from ankylosing spondylitis or nonradiographic axial spondyloarthritis; patients with the latter do not show radiographic evidence of sacroiliitis but often show BME by MRI [55]. Although using inflammatory changes visible by MRI alone to diagnose axial spondyloarthritis could result in false positives [56], structural lesions in sacroiliac joints (e.g., erosions) are more specific for the presence of spinal inflammatory disease, even in the absence of sacroiliac joint BME on

MRI [57]. Imaging of active inflammation (i.e., synovitis, enthesitis) in the sacroiliac joints is best done with a postintravenous T1 gadolinium sequence or fat-suppressed T2W or STIR sequence [58, 59]. Changes associated with chronic inflammation, including fat deposition and erosions, can be detected by using a T1W sequence. For a more extensive assessment of axial disease, lumbar and/or cervical MRI can be performed [59].

Like ultrasound, MRI can help identify patients with subclinical or early PsA. In a study in patients with psoriasis without PsA, MRI revealed that approximately half of the patients had ≥ 1 inflammatory lesion, with synovitis being the most prevalent [38]. Subclinical inflammatory lesions in patients with arthralgia were associated with a higher risk of developing PsA. Similar findings were seen in the IVEPSA study in patients with psoriasis with inflammatory arthralgia; 83% had ≥ 1 inflammatory lesion, with synovitis and tenosynovitis being the most prevalent [60]. MRI scoring systems have been developed to aid in the diagnosis of PsA. The Psoriatic Arthritis Magnetic Resonance Imaging Score (PsAMRIS) has been developed specifically for PsA in the hands and feet and includes measures of synovitis, tenosynovitis, periarticular inflammation, BME, bone erosion, and bone proliferation [61–63]. The Heel Enthesitis MRI Scoring System measures both structural and inflammatory changes, including heel enthesitis [64].

Unlike radiography and ultrasound, MRI is costly, not readily available, and contraindicated in patients with pacemakers or ferromagnetic metal implants [13, 27]. Another disadvantage of MRI is that only a single body area can be imaged in one scan; however, whole-body multijoint MRI is being developed [13, 65]. This technique allows the assessment of entheses and all peripheral and axial joints as well as the distribution of inflammation and structural damage in the entire body in one examination. The MRI Whole-Body Score for Inflammation in Peripheral Joints and Entheses has been developed and continues to be validated in clinical trials and longitudinal studies; however, limitations include a lack of assessment of structural damage in hands and feet and the fact that few sites worldwide are able to perform these scans in a reasonable amount of time [66].

Other Imaging Modalities

Other imaging techniques that are used to assess patients with PsA include computed tomography (CT) and bone scintigraphy. The accuracy of CT is comparable to that of MRI for assessing erosions in the sacroiliac joint [23, 67]. Although standard-resolution CT has limited ability to detect synovial inflammation in peripheral joints, dual-energy CT iodine mapping has shown promise in detecting inflammatory lesions in distal interphalangeal joints [68, 69], while positron emission tomography/CT using ^{18}F-fluorodeoxyglucose has shown high sensitivity for evaluating enthesitis in patients with spondyloarthritis [70].

Bone scintigraphy uses radiolabeled phosphate analogues to identify active bone remodeling and increased vascularization indicative of inflammation [71]. It is highly sensitive and can detect both axial and peripheral arthritis and enthesitis, including subclinical involvement in patients with psoriasis without clinical arthropathy [72–75]. However, bone scintigraphy is less specific than ultrasound and MRI [23], but it may be useful as a complementary tool for characterizing patients with arthritis or for evaluating the extent of peripheral involvement in patients with limited clinical evidence of peripheral arthritis [71, 73–75].

Imaging in Patient Management

In addition to identifying signs of PsA, these imaging modalities can be used by dermatologists to monitor a patient's response to treatment. Radiographs can be used to assess response to therapy in clinical trials, and various scoring systems have been developed to assess radiographic progression; the most commonly used is the Sharp–van der Heijde scoring method for PsA [12, 21]. Radiographic damage in clinical trials is assessed by two or three readers to ensure reliability, and a mean change

of ≤ 0.5 in total score (vs 0) is usually used to determine the absence of radiographic progression [76]. Several studies have used radiography to show that biologics have the ability to inhibit radiographic progression—an important treatment goal—in patients with PsA [12]. On the basis of these findings, rheumatologists can use radiographs to measure the extent and progression of damage as well as bone erosions and joint space narrowing at baseline in patients with PsA, and to determine the best treatment options for them.

Similarly, ultrasound and MRI have been used to monitor the effect of treatment in patients with subclinical signs of PsA. A 6-month prospective study followed the evolution of enthesitis under systemic treatment with methotrexate and/or biologics (adalimumab, infliximab, ustekinumab). Among 13 patients with psoriasis who had ultrasound assessments at baseline and 6 months, the proportion of morphological abnormalities in entheses significantly decreased from 30.0% to 17.7% [77]. More recently, a pilot study in 23 patients with moderate to severe psoriasis without symptoms of PsA who fulfilled the OMERACT definition of enthesopathy by ultrasound and were treated with ustekinumab showed that mean entheseal inflammation scores decreased by 42.2% and 47.5% from baseline to weeks 24 and 52, respectively [15]. In the IVEPSA study, patients with psoriasis, no clinical PsA, and inflammatory or erosive changes by MRI or CT were treated with the interleukin 17A inhibitor secukinumab over 24 weeks [60]. Total PsAMRIS and synovitis subscores significantly improved and erosions and enthesophytes did not progress, suggesting that progression of subclinical PsA can be prevented by secukinumab treatment and its status monitored using MRI [60]. However, MRI is not commonly used in clinical practice to monitor disease progression.

These studies highlight the substantial role that imaging plays in the management of PsA. Although the use of imaging is more common in the rheumatology setting, understanding common imaging techniques can better equip dermatologists to identify patients with signs of PsA, including those with preclinical PsA. Given that approximately half of patients with psoriasis may have subclinical signs of PsA, incorporating imaging into future screening and treatment algorithms in dermatology settings may help with earlier referral to rheumatologists and diagnosis of PsA, resulting in optimal treatment of patients. More research is needed on the role of imaging in PsA. Recommendations by an international task force on the assessment of disease activity included clinical signs and symptoms and acute phase reactants, but not imaging, due to a lack of data on its use [78]. However, this task force also added a new recommendation that, in addition to clinical and laboratory measures, imaging may be considered in clinical management, noting that imaging could be used to assess if a therapeutic target had been reached, although it is not recommended as a target itself [78].

SUMMARY

Dermatologists play a critical role in the diagnosis of PsA in patients with psoriasis and are therefore strongly encouraged to routinely screen their patients for signs of PsA. The specific role will vary depending on the level of involvement and motivation of the dermatologist, but all are important. For example, there may be dermatologists who are deeply motivated and interested in using musculoskeletal ultrasound for screening in-office. At a more intermediate level, there may be a wider group of dermatologists who know when to order and interpret musculoskeletal imaging to support their clinical diagnosis and clinical decision making. Finally, dermatologists with a high-level understanding of the tools that are being used by rheumatologists and others to support their diagnosis of PsA can use this information in their decision making to potentially interpret reports about the use of imaging from radiology and those rheumatology providers. Early diagnosis and appropriate treatment of patients with PsA can prevent or delay joint damage and its associated negative outcomes. Along with clinical assessments, musculoskeletal imaging serves as a tool that can help physicians identify signs of clinical and subclinical PsA, which may be particularly relevant for patients with severe

psoriasis, nail pitting, uveitis, axial involvement, or other nonspecific musculoskeletal symptoms. Having even a basic understanding of the main imaging modalities used in the management of patients with PsA will enhance collaboration between dermatologists and rheumatologists in the shared management of patients with PsA and greatly benefit both patients and physicians.

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