

# Psoriatic arthritis: imaging techniques

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## SUMMARY

Imaging techniques to assess psoriatic arthritis (PsA) include radiography, ultrasonography (US), magnetic resonance imaging (MRI), computed tomography (CT) and bone scintigraphy.

The radiographic hallmark of PsA is the combination of destructive changes (joint erosions, tuft resorption, osteolysis) with bone proliferation (including periarticular and shaft periostitis, ankylosis, spur formation and non-marginal syndesmophytes).

US has an increasing important role in the evaluation of PsA. In fact, power Doppler US is useful mainly for its ability to assess musculoskeletal (joints, tendons, entheses) and cutaneous (skin and nails) involvement, to monitor efficacy of therapy and to guide steroid injections at the level of inflamed joints, tendon sheaths and entheses. MRI allows direct visualization of inflammation in peripheral and axial joints, and peripheral and axial entheses, and has dramatically improved the possibilities for early diagnosis and objective monitoring of the disease process in PsA. MRI has allowed explaining the relationships among enthesitis, synovitis and osteitis in PsA, supporting a SpA pattern of inflammation where enthesitis is the primary target of inflammation. CT has little role in assessment of peripheral joints, but it may be useful in assessing elements of spine disease. CT accuracy is similar to MRI in assessment of erosions in sacroiliac joint involvement, but CT is not as effective in detecting synovial inflammation.

Bone scintigraphy lacks specificity and is now supplanted with US and MRI techniques.

**Key words:** *Imaging, psoriatic arthritis*

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## ■ RADIOGRAPHY

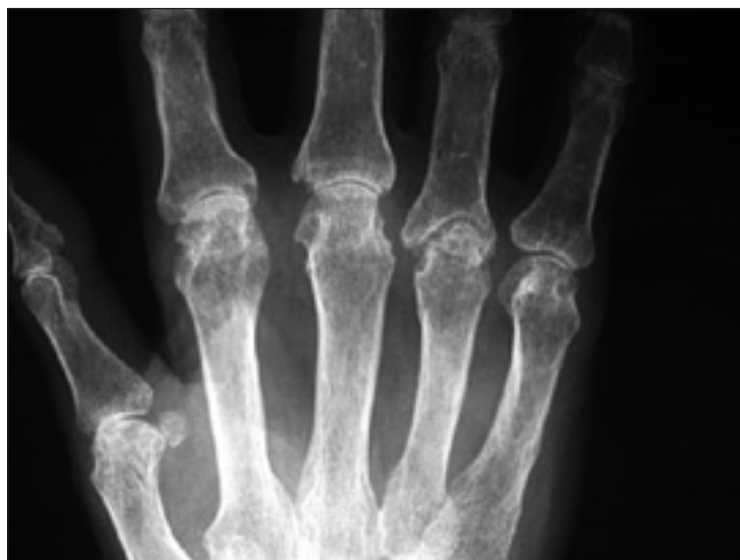
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### *Peripheral involvement*

Peripheral joint involvement in PsA is often asymmetrical and may be oligoarticular. Joint space narrowing or widening can be observed and osteoporosis is atypical. Although erosive changes in early PsA are marginal as in rheumatoid arthritis (RA), they become irregular and ill defined with disease progression because of periosteal bone formation adjacent to the erosions (2). Asymmetrical erosions may be detected in the carpus, in the metacarpophalangeal (MCP), proximal interphalan-

geal (PIP), and distal interphalangeal (DIP) joints of the hands as well as in the metatarsophalangeal and interphalangeal joints of the feet (2) (Fig. 1, 2). In the hand of a PsA patient, marginal erosions in proximal plate and marginal periostitis in the distal plate occurring at DIP joints ('mouse-ear' appearance) permit to differentiate PsA involvement from the typical aspects of erosive osteoarthritis (OA), including central erosion in the proximal plate and marginal proliferation in the distal plate of DIP and PIP joints ('gull wing' appearance) (3). In the small joints of hands and feet, the destruction of the head of one phalanx may produce a small blunt osseous surface, which projects into the enlarged base of the adjacent phalanx, resembling the aspect of "pencil in cup" (1) (Fig. 1). Tuft resorption with progressive osteolysis of distal phalanx of hands and feet is a characteristic of PsA. In severe cases, erosive changes may

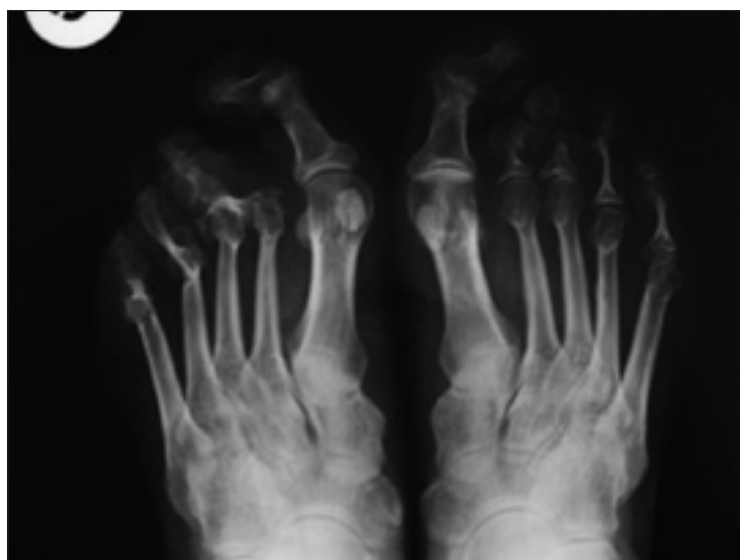
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**Figure 1** - X-ray: erosive changes of hand with pencil-in cup aspects of IV MCP joint.

progress to the arthritis mutilans with the aspect of opera-glass hand deformities (1). Proliferation of bone is a feature of PsA, involving particularly metaphysis and diaphysis of the hands and feet in the early phase of disease, before significant changes occur in the adjacent joint. Proliferation findings, accompanied by subchondral sclerosis, may take several aspects on x-Ray: spiculated, frayed or paintbrush appearance (1). Periosteal and endosteal bone formation may increase the radiodensity of an entire phalanx, and an "ivory" phalanx may result. Despite low sensitivity, this

**Figure 2** - X-Ray: severe destructive changes of feet.



finding is a specific and early radiographic manifestation of PsA (4).

At the level of entheses, such as plantar fascia or Achille's tendon, erosions can evoke sclerosis of the surrounding bone with irregular and ill-defined spurs (1). Ankylosis is another manifestation of bone proliferation occurring more frequently in DIP and PIP joints.

#### ***Axial involvement***

Axial involvement of PsA includes spondylitis and sacroiliitis.

Characteristics of spondylitic PsA are syndesmophytes, and less frequent than those in ankylosing spondylitis, atlantoaxial subluxation, apophyseal joint ankylosis (mainly in cervical spine), and ligamentous calcification (5-7). In PsA syndesmophytes may be paramarginal whereas the ossified bridge is separated from the outer fibers of the annulus fibrosus (1). They are bulky, large and asymmetrical occurring at the lower thoracic and upper lumbar spine. Osteitis and squaring are infrequent. Cervical spine abnormalities can be occasionally associated with sacroiliitis and minor changes in thoracolumbar spine. This pattern and bone distribution of outgrowths permit to radiologically distinguish PsA spondylitis from ankylosing spondylitis (1).

Sacroiliac joint (SIJ) involvement with erosion sclerosis and ankylosis is often unilateral and ranged approximately from 25% to 78% (3). PsA patients with radiological axial changes and peripheral arthritic involvement may have more frequent and more severe joint lesions (8).

The radiological evaluation of the anterior chest wall, i.e sternoclavicular and costosternal joints, represents a problem of difficult diagnostic assessment, both for the anatomic region complexity and for the variability of the radiographic findings. The integrated use of X-ray with other imaging techniques can be useful to detect such abnormalities (9, 10).

Specific methods for radiographic assessment of joints, particularly in the context of clinical trials, are reviewed by van der Heijde et al. (11). The Bath Ankylosing Spondylitis Radiology Index (BASRI), the

Stoke Ankylosing Spondylitis Spine Score (SASSS) and a new specific instrument, called the PsA Spondylitis Radiology Index (PASRI) have been validated for assessing the radiologic axial involvement in established PsA (12, 13).

## ■ ULTRASOUND

Ultrasound (US), in conjunction with power Doppler (PD) indicative of degree of inflammatory activity, has an increasing important role in the evaluation of PsA. In fact US, is useful mainly for its ability to assess musculoskeletal (joints, tendons, entheses) and cutaneous (skin and nails) involvement, to monitor efficacy of therapy and to guide steroid injections at the level of inflamed joints, tendon sheaths and entheses (14,15).

### *Joints*

The evaluations of joints, by grey scale US, could show effusion (homogeneous anechoic joint space widening), synovial proliferation (joint space widening with clusters of soft echoes and/or homogeneous synovial thickening) and erosions (an intra-articular discontinuity of the bone surface that is visible in two perpendicular planes) (16).

Dynamic assessment, with the compression of the soft tissues under examination with the probe, is the most reliable method to distinguish synovial fluid (more easily compressible and displaceable) from synovial tissue (17). Contrast-enhanced US seems to amplify small synovitis alterations detected by US providing useful information on the evolution of vascularization (18). Nevertheless, the US findings of joint involvement in PsA are non-specific, as they may occur in patients with OA and RA (14, 19). Moreover, psoriatic patients showed a significant prevalence of asymptomatic US synovitis and enthesopathy, which may indicate a subclinical musculoskeletal involvement (20-22).

SIJ involvement has been rarely investigated by US in PsA. Although US can only visualize the superficial part of the SIJ and

the surrounding soft tissue structures, this technique may be useful to diagnose active sacroiliitis or to guide corticosteroid injection (23). US showed joint effusion in 38.9% SIJ of 45 patients with spondyloarthritis (SpA), including 6 PsA patients. The presence of inflammatory back pain was significantly associated with SIJ effusion assessed by US alone or plus at least one SIJ test (24). Contrast enhanced Doppler US has shown high negative predictive value for the presence of sacroiliitis in patients with inflammatory low back pain (25). Nevertheless, it is well known that Doppler techniques may have low sensitivity in the detection of flow in deep areas such as SIJ, and that their sensitivity is strictly influenced by the quality of the US equipment.

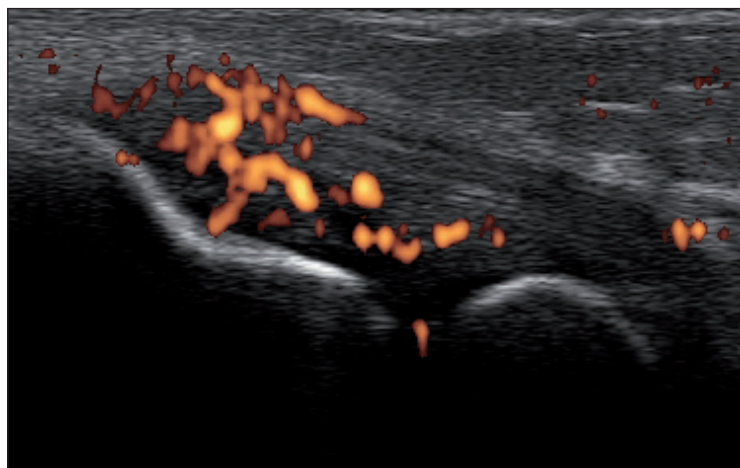
### *Tendons*

US findings indicative of tendon involvement include fusiform swelling and focal derangement of tendon echotexture with or without intratendinous PD signal. Achilles tendon, plantar fascia, patellar tendon and tenosynovial sheaths of hand and ankle are frequently affected in patients with PsA (17). Preliminary results demonstrated that peritendon extensor tendon inflammation pattern is a characteristic of PsA, which suggests a potential role of US in the differential diagnosis between RA and PsA at MCP joints level (26).

In dactylitis, a clinical hallmark of PsA, the different patterns of soft tissue involvement generated by the variable association of flexor tenosynovitis, synovitis of interphalangeal and MCP joints, and surrounding soft tissue edema may be identified by US (27).

### *Entheses*

US signs of enthesitis include hypoechoic swelling of the tendon insertion, erosions, enthesophytes, possible bursal enlargement (i.e. retrocalcaneal bursa) (17). The landmark of enthesitis in SpA patients was the presence of abnormal vascularisation at entheses insertion into the cortical bone detected by using PD (14) (Fig. 3). US has been shown to be a sensitive tool for re-



**Figure 3** - Ultrasound (US) examination in B mode combined with power Doppler: abnormal vascularization of extensor common tendon at the insertion of lateral epicondyle (entesophyte\*).

vealing subclinical enthesal involvement, both at the lower and upper limbs (28). US scores for SpA enthesal involvement have been developed (14).

#### **Skin**

US appearance of normal skin consists of a bilaminar layer: hyper-echoic line of the epidermis and thicker and less echogenic band of the underlying dermis. This US aspect is lost in psoriatic plaque that presents inhomogeneous thickening of the epidermis with or without acoustic shadow and hypoechoic swelling of the dermis with or without PD signal (29).

#### **Nails**

US appearance of normal nail plate consists of a trilaminar structure: two hyper-echoic sharp margins with an interposed thin anechoic line. Psoriatic onychopathy includes the loss of the sharpness of the hyper-echoic lines (focally curved and/or thickened), the loss of the intermediate anechoic layer (focal or complete) and a variable degree of thickening of the nail bed (with or without PD signal) (17).

### ■ MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) allows direct visualization of inflammation in peripheral and axial joints, and peripheral and axial entheses, and has dramati-

cally improved the possibilities for early diagnosis and objective monitoring of the disease process in PsA (30). MRI has allowed explaining the relationships between enthesitis, synovitis (or the synovio-enthesal complex) and osteitis or bone oedema in PsA (31), supporting a SpA pattern of inflammation where enthesitis comes first and is followed by synovitis, in contrast to RA pattern where synovial involvement is the primary target of inflammation.

#### **Peripheral involvement**

In PsA, most MRI papers studied the hand and wrist, and only few of them were concerned with the knee, foot, temporomandibular joint, and elbow (32).

The MRI findings of PsA hand include enthesitis, bone marrow edema, and periostitis accompanying articular or flexor tendon sheath synovitis in the early stage accompanied by destructive and proliferative bony changes, subluxation, and ankylosis in the late stage (33). MRI bone edema can be detected at the enthesal, subchondral level but diaphyseal involvement seems relatively specific to PsA (34). In hand PsA, MRI permits to study bone lesions, as a sign of structural damage, and synovial membrane enhancement post gadolinium, as an index of disease activity. In patients with PsA, differently from RA, bone edema does not seem to predict the appearance of erosions and a different pattern of inflammation (35). In fact, dynamic contrast-enhanced MRI (DCE MRI), a technique that evaluates the time-dependent diffusion of gadolinium in the inflamed synovium, showed in PsA patients less inflammation than in RA patients (36). Moreover, DCE MRI showed that synovial enhancement, fifteen minutes after contrast injection, was statistically significant different between PsA and RA (37).

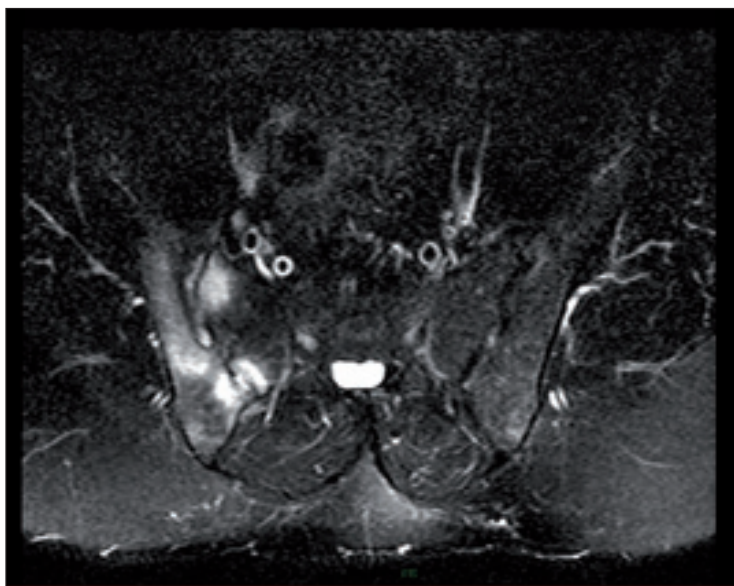
Another aspect of PsA peripheral involvement is the MRI evidence that nail changes appear as the initial lesion for induction of distal phalanx damage and consequently of DIP joint arthritis. All patients with PsA, also in the absence of a clinically evident onychopathy, showed characteristic MRI changes of the nail (38).

Truthful, discriminative and feasible scoring systems are available for the assessment of inflammatory activity in the hands of patients with peripheral PsA (39).

A magnetic resonance image scoring system for evaluation of inflammatory and destructive changes in PsA hands (PsAMRIS), has been developed by OMERACT (40). This instrument has high interobserver and intraobserver reliability for hand PsA, with a moderate sensitivity to change for synovitis, tenosynovitis, and periarticular inflammation, suggesting that PsAMRIS could be a valuable tool during PsA clinical trials (41). Obviously, the hand involvement is one of the joint sites involved in PsA. In this context, the total-body MRI may provide a comprehensive overview of multiple locations not always readily accessible to clinical exam of patients with PsA (42).

MRI may be an useful tool to assess dactylitis and enthesitis, too. In fact, MRI may be useful to describe the possible causes of dactylitis or “sausage like” digit. In MRI, at least 4 lesions have been described: flexor tenosynovitis (43), soft tissue edema, joint synovitis, and enthesitis (44). These features most probably coexist, but one may prevail in a given patient determining the classic diffuse painful swelling of a finger or toe (35).

In MRI, enthesitis is characterized by extracapsular inflammation at the insertions of ligaments and tendons plus accompanying bone edema at bony attachments (34). Nevertheless, in standard MRI sequences, tendons and fibrocartilage appear dark as their echo time is too short to be identified. Therefore, on standard MRI images, the tendons and the fibrocartilage only becomes visible when are significantly inflamed and thickened. Ultra-short echo time (UTE) MRI allows imaging of these structures in greater detail and identifies inflammation at an earlier stage. As the image from a UTE-MRI sequence shows only the signal received at a very short echo time, the image contrast can be poor, unless it is further enhanced by techniques such as subtraction, T1 weighting, fat suppression, magnetization transfer, and intravenous contrast (45).



**Figure 4** - Short tau inversion recovery (STIR) sequence: Bone marrow edema of right sacroiliac joint appears as hyperintense signal.

Another common feature of PsA is the upper or lower distal extremity swelling with pitting edema, usually unilateral, due to tenosynovitis or altered lymphatic drainage. MRI can define the structures involved and predict the prognosis (46, 47).

#### *Axial involvement*

There are scarce MRI studies on the axial involvement of patients with PsA (48). MRI features of sacroiliitis were found in 38% of 68 PsA patients. The presence of sacroiliitis on MRI was associated with restricted spinal movements and the duration of PsA, but not with HLA-B27 (48). Thus, on MRI, SIJ abnormalities of PsA could be referred to MRI abnormalities described in axial SpA (49) (Fig. 4). Furthermore, MRI may be useful for the evaluation of cervical cord compressions due to atlantoaxial subluxation in PsA (50).

## ■ COMPUTED TOMOGRAPHY

Computed tomography (CT) has little role in assessment of peripheral joints, but may be useful in assessing elements of spine disease. CT accuracy is similar to MRI in assessment of erosions in SIJ, but CT is not as effective in detecting synovial inflammation (2). In particular sites (i.e. sterno-

clavicular joints) CT could be complementary to other techniques (9, 10).

## ■ SCINTIGRAPHY

Although bone scintigraphy could yield a more accurate evaluation of entheso-articular involvement and distribution in patients with early PsA (51), it lacks specificity (52) and is now supplanted with US and MRI techniques. In particular scintigraphy of the sacroiliac joints is not considered in decision tree on diagnosing axial SpA (53).

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