Magnetic Resonance Imaging of Nail Unit in Psoriatic Arthritis

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ABSTRACT. The use of magnetic resonance imaging (MRI) has modified the imaging strategies of inflammatory arthritides. In psoriatic arthritis (PsA), MRI study of the nail unit identifies nail involvement that appears as the initial lesion for induction of distal phalanx damage and consequently of distal interphalangeal joint arthritis. All psoriatic patients, also in the absence of a clinically evident onychopathy, show characteristic MRI changes of the nail. This evidence could have practical diagnostic value because MRI study of the nail could document diagnosis in patients with undifferentiated spondyloarthropathies who have barely evident psoriasis. We discuss the advantages and problems related to the use of low- and high-field MRI in the study of the nail unit of patients with PsA. (J Rheumatol 2009;36 Suppl 83:42-45; doi:10.3899/jrheum.090222)

Key Indexing Terms:
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Correlation between the involvement of nails and distal interphalangeal (DIP) joints has been widely described in psoriatic arthritis (PsA)[1-3]. Bone changes of the distal phalanx have been generally considered in the context of DIP joint arthritis and frequently associated with more severe arthritic changes. In 2004, using standard radiographs of the hand, we carried out research in a cohort of psoriatic patients in order to study relationships between nail, synovial, and bone changes of the distal phalanx. Although DIP joint changes correlated with the duration of onychopathy, we found no statistical differences in the distribution of DIP joint arthritis in PsA patients with and without nail disease[4]. In the hypothesis of a pathogenetic link between bone changes of the distal phalanx and onychopathy of the adjacent nail, we then evaluated nails, distal phalanxes, and DIP joints of patients with PsA with and without onychopathy, using magnetic resonance imaging (MRI)[5]. Results of this research showed clinical aspects of particular interest. First, we recorded MRI nail involvement in almost all cases of psoriatic patients studied, even in those without a clinically evident onychopathy. Nail thickening with or without surface irregularity was the most common finding, and MRI nail changes were more marked in patients who had an increased Nail Psoriasis Severity Index (NAPSI), a score for clinical changes of the matrix and of the bed of the nail[6] (Figure 1a and 1b). In addition, we demonstrated the constant overlap between the involvement of the nail and the distal phalanx. Involvement of the DIP joint was present instead in a smaller percentage of patients and in no case without distal phalanx involvement. This point suggested a primary involvement of entheses linking nail to distal phalanx and supported the idea that the involvement of the DIP joint could be secondary to that of the distal phalanx.

USEFULNESS IN CLINICAL PRACTICE OF NAIL MRI IN PATIENTS WITH ARTHRITIS

Use of MRI has modified the imaging strategies of ungual and subungual diseases[7]. While traditional plain radiographs can reveal bone structure of the distal phalanx and joint space of the DIP joint, imaging of the soft tissues of the fingertip had remained poorly explored. MRI study of the nail unit in PsA[5] outlined nail involvement that appears as the main lesion for development of distal phalanx damage and consequently of DIP joint arthritis. In addition to this significant

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result, our studies provided evidence that all psoriatic patients, including those with no clinically evident onychopathy, show characteristic MRI changes of the nail. This result may have practical diagnostic value: MRI study of nail could be applied to patients belonging to the undifferentiated subset of spondyloarthropathies who have barely evident psoriasis; in these cases, demonstration of nail changes typical of psoriasis could permit a more precise classification of their cutaneous preclinical stage. Moreover, in the case of patients with other arthritic conditions, such as rheumatoid arthritis (RA), nail MRI could play a supportive role for differential diagnosis. Indeed, although patients with RA have revealed MRI involvement of the DIP joint, they show a completely normal ungual profile[8].

THE PRESENT

The association of nail alteration with PsA and the diagnostic potential of MRI has placed this type of image technique in an outstanding position for evaluation of patients with borderline psoriatic disease. In addition, the absence of ionizing radiation makes MRI a repeatable test.

MRI permits evaluation of the nail margin, with application of vaseline oil on its surface, thus visualizing differentiation of the nail's outer profile; as well, phalanx bone alterations and tendon involvement can be easily evaluated. That the sensitivity of MRI in revealing bone erosion, bone edema, and soft tissue inflammation is higher and earlier versus plain radiographic studies has been shown[9-12]. Intravenous contrast medium, for example, is widely used to demonstrate synovial inflammation in rheumatoid arthritis and increases the sensitivity in identifying bone alterations, in advance of morphological evidence.

High-field MRI (1,5 T or more) is routinely used to study several anatomical structures, often in more severe and life-threatening pathologies, such as in brain or abdomen evaluation in patients with neoplasms, but also for vascular examinations, functional studies, spectroscopy, and so on. For this reason the study of the nail was considered expensive and difficult to perform using standard machines, while reducing the time available for more urgent or complex studies. Moreover, in order to obtain high imaging quality in closed magnets, patients must remain in an uncomfortable position with the hand above the head. This body posture can be difficult for patients with arthritis or claustrophobia.

Therefore a new low-field technology, dedicated to peripheral joint study, was developed to solve several of the high-field MRI limitations. These new machines cost less to install, take up less space, and are easier to use. The absence of a superconductive magnet avoids helium usage, reducing the costs of maintenance.

The major drawback is a lower signal to noise ratio, with more imaging noise. High-field MRI allows higher spatial resolution (thinner slices, smaller field of view) and higher temporal resolution (faster examination). In order to compensate for this difference, low-field scanners need longer acquisition time. Another drawback is the lack of complex fat-suppressed sequences like spoiled gradient echo (SPGRE) or spectral saturation by inversion recovery (SPAIR). From this point of view, even if new sequences have been developed (fast spin-echo, steady-state, Dixon subtraction, etc.) to reduce acquisition time and to improve image contrast, edema sensitivity at present is very low in small part examination on low-field MRI.

On the other hand, open structures allow easy access to the patients, avoiding claustrophobia and reducing anxiety. Patients do not need to assume an uncomfortable position, simply lying with the arms along the body. The anatomical region of interest, in our case the finger, in this way is already in the center of the coil inside the magnetic field. Having a comfortable position, the patient is relaxed and movement artifacts are drastically reduced. Another point to be considered in low-field MRI is the reduction of safety risks, mainly linked to the magnetic field strength (e.g., interactions with ferromagnetic foreign objects of the patients).

With regard to the question of image resolution, the open devices allow diagnostic images comparable (for the articular studies) to those of the high-field MRI, as confirmed in our recent study[13], where results obtained on high-field MRI are comparable to those obtained on low-field dedicated machines (Figure 1c).

FUTURE TRENDS

Future perspectives are related to development of new sequences aimed at reducing acquisition time and increasing tissue contrast. Dedicated coils can obtain a higher signal to noise ratio with a smaller field of view. We recently tested the prototype of a dedicated finger coil, obtaining better images in less time with higher resolution, compared with a standard wrist coil[14] (Figure 2a and 2b). In this prototype the finger can be inserted into the small hole of the coil. The region of interest can be easily centered in the magnetic field, allowing a smaller field of view. In the images, signal is significantly increased and pixel size reduced, without image degradation, resulting in higher resolution, with shorter time of execution.

In conclusion, MRI with either high- or low-field apparatus opens new perspectives in rheumatic patients[15]. In particular, it could be very helpful in patients with early or uncertain diagnosis of PsA. In future, new coils and new sequences may further improve image quality and diagnostic sensitivity.

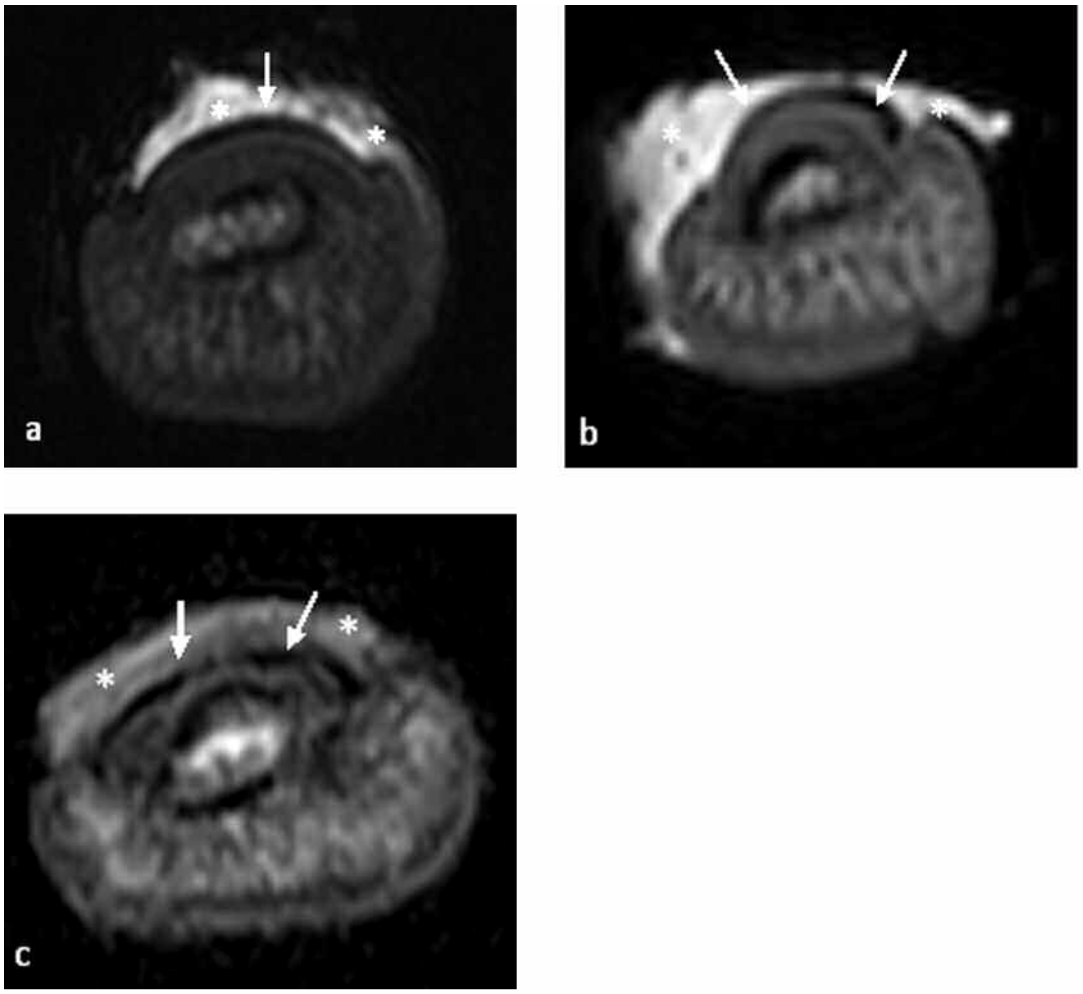

Figure 1. a. High-field MRI of the distal phalanx in a control subject. 3D T1-weighted FFE axial image, after applying vaseline (white asterisks) to the nail to identify its outer margin. The axial plane allows exhaustive study of the nail, which appears as a physiologic low signal with regular shape and thickness (white arrow). *b.* High-field MRI of the distal phalanx in a PsA patient with no clinically evident onychopathy; 3D T1-weighted FFE axial image, after applying vaseline (white asterisks) to the nail to identify its outer margin. The nail is asymmetrically thickened (white arrows; grade 1). *c.* Low-field MRI of the distal phalanx in a PsA patient with a clinically evident onychopathy; T1-weighted TSE axial image, after applying vaseline (white asterisks) to the nail to identify its outer margin. The nail is thickened with an irregular outer margin (white arrows; grade 2).

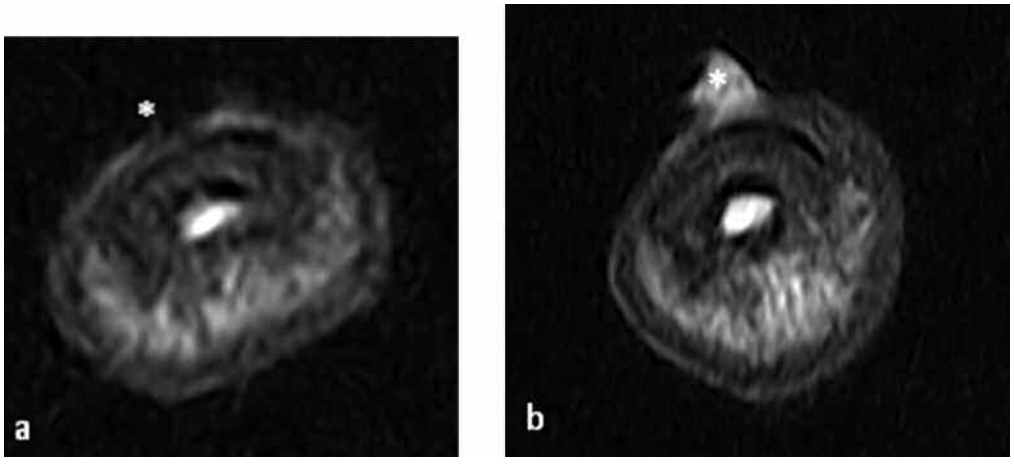

Figure 2. Low-field MRI of the distal phalanx in the same patient with PsA, T1 weighted TSE axial view, after applying vaseline (white asterisks) to the nail to identify its outer margin, with standard wrist coil (a) and with new dedicated prototype coil (b). Both images show nail thickened with an irregular outer margin; but in (b) the signal is higher, noise is reduced, and acquisition time is shorter.

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