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MRI changes in psoriatic dactylitis – extent of pathology, relationship to tenderness and correlation with clinical indices

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Abstract

Object

To quantify the extent of inflammation in psoriatic dactylitis and to examine the relationship between clinical and MRI data in both tender and non-tender dactylitis.

Methods

Seventeen patients with psoriatic dactylitis underwent clinical assessment for six months after change of treatment, usually to methotrexate. Measures of dactylitis included the Leeds Dactylitis Index, the assessment tool used in the Infliximab in Psoriatic Arthritis Clinical Trial (IMPACT), a simple count of tender dactylitic digits, and a count of all dactylitic digits, both tender and non-tender. MRI scans of the affected hand or foot were performed before and after treatment using a 1.5T Siemen's scanner pre and post contrast.

Results

All patients improved clinically, as did their respective dactylitis scores and MRI images. The findings on MRI in both dactylitic and non-dactylitic digits were profound and widespread. The difference between tender and non-tender dactylitis was quantitative rather than qualitative. Synovitis and soft-tissue oedema were the most frequent abnormalities being present in 69% of tender dactylitic digits but bone oedema and flexor tenosynovitis were also frequently seen. Soft-tissue oedema was circumferential and enhancing and not limited to association with the flexor or extensor tendons. None of the clinical indices of dactylitis showed a close relationship to the extent of MRI abnormalities.

Conclusions

MRI images demonstrate widespread abnormalities in digits of people with psoriatic arthritis. Tender dactylitic digits have more abnormalities than other digits but the relationship between clinical and MRI scores is not strong.

Key Words: psoriatic arthritis, dactylitis, Magnetic resonance imaging, measurement, outcome assessment, clinical trials

Key messages:

- Clinical dactylitis is associated with MRI changes of widespread inflammation in both soft-tissue and bone
- Adjacent, non-dactylitic digits, and digits with 'cold' dactylitis differ quantitatively but not qualitatively using MRI

Introduction

Dactylitis is considered a hallmark feature of psoriatic arthritis (PsA) occurring in 16% to 24% of reported cases. It is characterized by diffuse swelling of a digit. According to a recent paper from Toronto the lifetime incidence of dactylitis in PsA is 48% and the prevalence 33% (1). Tender dactylitis is associated with more aggressive disease in affected digits – the above study found radiological disease progression in 50% of finger and toe joints in those with dactylitis but in only 38% in those without.

One of the problems with dactylitis is the existence of a chronic non-tender form. It is unknown whether this form is simply resolving tender dactylitis, a low grade version of tender dactylitis or a different pathological process entirely. A number of recent studies have addressed the pathophysiology of dactylitis using recently developed imaging techniques.

Olivieri et al., using MRI and ultrasound (US), described flexor tenosynovitis mostly with occasional synovitis and soft-tissue oedema in the hands (2). There were similar findings in a study of 12 toes, though subcutaneous edema was noted in two cases (3). Further publications showed flexor tendon sheath involvement (4-6). No evidence of a major role for enthesitis in dactylitis was found in these studies (7) but synovitis and mild oedema of the peritendinous tissues was seen.

An ultrasound study by Kane found flexor tenosynovitis in 24 of 25 dactylitic digits and joint synovitis in 52% (8). Subcutaneous edema was noted in all affected digits, but authors were unable to further quantify it. A further power-doppler ultrasound study by Fournié and colleagues, looking at fingers not selected for dactylitis, found soft-tissue thickening (termed 'pseudotenosynovitis') in 8 of 25 digits studied (9).

McGonagle rekindled interest in enthesitis as the underlying cause of the clinical manifestations of PsA hypothesising that in dactylitis it is primarily enthesitis, either at tendon insertion, or at functional entheses, which causes inflammation in adjacent tissues by diffusion of cytokines (10). In this respect a recent ultrasound study from France found frequent enthesopathy at the insertion of the flexor tendon into the terminal digit, capsular hyperostosis and periarticular periostitis (11).

The current study links clinical and MRI data in cases of both tender and non-tender dactylitis both before and after treatment and introduces a new MRI scoring system for quantifying the extent of inflammatory change in dactylitic digits.

Methods

The study took place in a secondary care setting in Bradford NHS Trust in West Yorkshire, United Kingdom. Approval was given by the local ethics committee. Patients with active disease, i.e. who were intolerant or unresponsive to their current disease modifying therapies or had not yet begun disease modifying therapy, and presented with dactylitis were invited to participate as they presented to the out-patient Rheumatology clinic. A full study information sheet and written consent form was provided. Those who provide written consent to participate underwent an initial assessment of joint and skin disease. Drug therapy was chosen by the managing clinician as was considered appropriate. Patients underwent further clinical assessments at baseline (start of new drug therapy), 2 weeks, 1 month, 3 months and 6 months. MRI scanning was performed as soon as possible after the baseline assessment and after the 6 month visit. Further methodology and full details of the clinical responses are given elsewhere (12).

Clinical Assessment included the following instruments to assess dactylitis:

- Leeds Dactylitis Instrument (LDI) and LDI basic. The LDI measures the ratio of the circumference of the affected digit to the circumference of the digit on the opposite hand or foot: using a minimum difference of 10% to define a dactylitic digit. The ratio of circumference is multiplied by a tenderness score, originally based on the Ritchie index (graded 0-3) but a later modification amended this to a binary score (0 for non-tender, 1 for tender – this later modification is referred to as the LDI-basic) (13).
- Clegg. This score simply counts the number of digits thought to have dactylitis, both tender and non-tender (14)
- Tender, which counts the number of digits with tender dactylitis (15)
- IMPACT used a 0-3 scale of physician rated severity for each affected digit and added the results with a maximum score of 60 (16)

MRI protocol and scoring procedure

The MR scans were performed with a Siemens Avanto 1.5T magnet using a shoulder coil. Coronal T1 Weighted TSE(Turbo spin echo) and STIR (short Tau inversion recovery) sequences of the whole hand/foot were obtained followed by T1 Weighted, STIR and post gadolinium fat suppressed T1 Weighted sequences of the affected and adjacent digits in both sagittal and axial planes.

The following 8 features were scored blind by two observers (CG, MC, both experienced musculoskeletal radiologists) working in tandem, with the final scores achieved by consensus. Inter- and intra-observer reliability was not formally assessed. Each feature was noted as present/absent at each of three levels of the digit: metacarpophalangeal joint, proximal inter-phalangeal joint, and distal interphalangeal joint.

Synovitis: (capsular enhancement and intracapsular fluid)

Bone oedema

Subcutaneous oedema

Flexor tenosynovitis (peritendinous fluid and enhancement)

Extensor tenosynovitis (peritendinous fluid and enhancement)

Plantar/volar plate enhancement

Collateral ligament enhancement

Erosions

In addition, the presence of sesamoiditis at the thumb and great toe was assessed. An MRI score was developed for each digit with 1 point allocated for the presence of each feature at each joint level and a total score obtained by the simple summation of these features (maximum score for each of the second through 5th digits, 24; for the first digit, 17).

Statistical Analysis

The data was analysed using SPSS 12.0. Descriptive statistics are mean values with standard deviations. Means are compared using independent t tests. Correlations are made using the non-parametric Spearman Rho statistic. Proportions were compared using a pooled variance method and the standardized normal deviate (17). Generally p values of less than 0.05 were considered significant.

Results

17 patients were scanned pre-treatment: 10 males and 7 females, 4 hands with dactylitis, 13 feet. The mean age was 44 (sd 12.4) years and mean duration of disease 6.3 (sd 8.6) years. The mean tender joint count was 11.6 (sd 6.3) and the swollen joint count was 9.5 (sd 3.4). Methotrexate was initiated in 12

patients, etanercept in 1, infliximab in 1 and hydroxychloroquine in 1. In 2 patients the treatment remained unchanged.

Nine patients declined a follow-up scan. Eight patients were scanned at an average of 7 weeks following the end of the study period. Patients having a treatment change showed a good response to treatment with acceptable PsARC and ACR20 responses at both three and six months.

All the clinical indices of dactylitis improved during the 6 month observation, as did the MRI scores for the hand or foot in question (average first MRI score 20.6, sd 9.2; average second MRI 9.0, sd 6.7). However, the relationship between clinical and MRI scores was not strong: correlations between clinical scores for individual dactylitic digits and their respective aggregate MRI scores (for that digit only) were 0.37 for LDI local score (significant at 5% level) and 0.21 for local IMPACT (not significant). The coefficients for the relationship between total aggregate clinical dactylitis scores and total MRI scores for the respective hand or foot are given in Table 1. None of the clinical scores demonstrated a significant relationship with the MRI scores but the clinical scores show good inter-score relationships. The poor correlation was not unidirectional – clinical scores were low in the presence of high MRI scores but the converse was also true.

MRI findings

Table 2 gives the aggregate MRI scores for tender and non-tender dactylitic digits together with the aggregate scores for the other non-dactylitic, comparator digits imaged at the same time in the same hand or foot. It will be appreciated that the MRI score for tender dactylitis exceeds that for non-tender dactylitis and scores for the other digits. However, prominent abnormalities in the other digits of the same hand or foot were frequently seen, as reflected in these scores. Further, abnormalities on MRI persisted in non-tender dactylitis despite clinical improvement following treatment. However, scores for non-tender dactylitis hardly exceed scores in other, non-dactylitic digits..

The images revealed a polyarticular disease process with a number of contributing pathologies and a spectrum of severity. The proximal joints were involved with a greater degree of severity than the distal joints. Synovitis and soft-tissue oedema were the most frequent abnormalities being present in 69% of tender dactylitic digits and 63% and 58%, respectively, of non-tender dactylitic digits. The soft-tissue oedema was circumferential and enhancing and not limited to association with the flexor or extensor tendons. A spectrum of bone oedema was observed ranging from periarticular adjacent to the capsular insertions, to oedema involving the whole of the phalanx. Subtle bone oedema became more apparent after contrast administration. Flexor tenosynovitis was a common

finding, with extensor tenosynovitis observed less frequently. Erosions were uncommon. Examples of the abnormalities are shown in Figures 1 and 2.

As the digits were scored by region a breakdown of the scores is given by individual features in Table 3. Synovitis, bone oedema, soft tissue oedema and flexor tenosynovitis contributed most to the total MRI score.. The main, statistically significant contrast between tender and non tender dactylitis was the relatively infrequent presence of bone oedema in the non-tender cohort (difference in proportions 0.25, $p = 0.02$). Extensor tenosynovitis, plantar/volar plate enhancement, collateral enhancement and erosions were not seen in the non tender group.

Discussion

Dactylitis is considered an important feature of psoriatic arthritis, occurring in 16-24% of reported cases. Dactylitis is an adverse prognostic sign and is associated with more erosive disease in affected digits (1).The importance of dactylitis in PsA is further supported by its inclusion in the recently developed classification criteria for psoriatic arthritis (18). The current study has revealed the extent of pathological change underlying both tender and non-tender dactylitis and, for the first time, the extent of soft-tissue oedema in affected digits. The study has also demonstrated a poor relationship between clinical and MRI assessment of dactylitis.

Other imaging studies have shown both tenosynovitis and synovitis as the major underlying pathology of dactylitis in psoriatic arthritis (2;8). The ultrasound studies by Kane et al (8) and also Fournié et al (9) demonstrated soft tissue oedema but the authors were unable to assess the extent due to the limitations of their technology. This is the first study to show circumferential soft tissue oedema in the majority of cases studied. It is also the first to recognize a spectrum of bone oedema within the affected digits. No doubt this difference is due to technological advances and difference in techniques between the earlier studies and the current one.

What does this study tell us about the underlying pathophysiology of dactylitis in psoriatic arthritis? The profound and extensive inflammation in tender dactylitis is unsurprising given the clinical findings but it is more surprising that the cases of non-tender dactylitis also demonstrated such widespread abnormalities. It is worth noting however that one of the main differences between tender and non-tender dactylitis was the more frequent bone oedema in the former. The concept of a 'snapshot in time' could explain the apparent spectrum in the severity of bone oedema observed between cases. We hypothesise that bone oedema begins at the corner of a phalanx at the insertion of the capsule (see figure 2 (a)), and then spreads to involve the whole bone as the disease progresses. Plantar/volar plate and collateral enhancement was also seen exclusively in the tender dactylitis cohort. It is therefore possible that an enthesitic process, as

postulated by McGonagle is involved in the tender dactylitis group (10). However, the paradox of psoriatic arthritis remains – why should the digits develop such widespread inflammation across the different tissues? McGonagle et al hypothesise that the primary lesion is at the enthesis and that all other inflammatory change in the digit follows by diffusion of cytokines from this site but there is no confirmatory evidence for this hypothesis. Why, for example, doesn't the same process occur in the severe synovitis of rheumatoid arthritis? Finally, the relative paucity of erosions seen in this study probably reflects the fact that many of these patients had short duration disease, with two thirds having a disease duration of 6 years or less.

MRI score

The MRI score, proposed here, may be of use as an outcome measure in clinical trials which incorporate imaging. Clearly cost and patient acceptability are two important considerations but the score has been shown to be responsive and is linked to the underlying pathophysiology. Unfortunately correlations between the MRI score and the clinical scores were poor but this is not surprising as similar findings have been reported for the assessment of synovitis, where MRI demonstrates more widespread abnormalities than are appreciated clinically (19). Further development is necessary, including data on reliability. Of interest is a recent paper from OMERACT 8 which has shown moderate reliability for an MRI score incorporating the features of erosion, bone oedema, synovitis, tendinopathy and extra-capsular features (20). The study was, however, based on a small number of images and clinical data was not given so it is not known if digits with dactylitis were included.

The OMERACT filter is intended to help evaluate the overall usefulness of an outcome measure providing a good framework with which to assess an instrument. Of the available clinical measures for assessing dactylitis in psoriatic arthritis only the Leeds Dactylitis Instrument has undergone rigorous evaluation. The measure provides an intrinsic definition of dactylitis clinically (10% difference in circumference between the affected digit and its opposite digit on the other hand or foot) and a measure of the degree of inflammation within the digit (assessed on a 3 point scale of tenderness to palpation). Our understanding of the pathophysiology suggests that a measure encompassing oedema or swelling might be a more accurate, or true, indicator of disease. In this study only the ipsilateral LDI score was significantly correlated with the MRI aggregate score for that digit, albeit that the association was not very strong. In terms of the truth domain of the OMERACT filter, therefore, the LDI would appear to have an advantage over the alternative measures.

Conclusions

MRI has revealed a polyarticular disease process with a spectrum of abnormalities in psoriatic dactylitis. These abnormalities were weakly correlated with local clinical scores although overall clinical and MRI associations were not significant. Both clinical and MRI scores respond appropriately to treatment with conventional non-biologic disease modifying drugs.

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Conflict of interest

We confirm that we have no conflicts of interest.

Table 1. Relationship between clinical and MRI variables.

MRItotal: total MRI aggregate score for that hand or foot

	MRItotal	LDIbasic	LDI	IMPACT	TENDER	CLEGG
MRItotal		.313	.332	.267	.362	.379
LDIbasic	.		.979(**)	.818(**)	.789(**)	.591(**)
LDI		.		.842(**)	.801(**)	.607(**)
IMPACT					.946(**)	.709(**)
TENDER	.					.743(**)

** Correlation is significant at the 0.01 level (2-tailed).

Table 2. MRI scores for tender and non-tender dactylitic digits compared to non-dactylitic digits

The index digit is compared to the other digits co-imaged in the same hand or foot. There was no overlap (such as tender and non-tender digits occurring in the same hand or foot).

	TENDER		NON-TENDER	
	N	Mean (sd)	N	Mean (sd)
Dactylitic	15	7.20 (3.84)	8	4.50 (3.16)
Non-dactylitic	57	3.23 (2.80)	31	4.32 (4.04)

Table 3. The frequency of individual MRI features for tender and non-tender dactylitic digits.

MP: level of meta-carpophalangeal (or metatarsophalangeal) joint

PIP: level of proximal inter-phalangeal joint

DIP: level of distal inter-phalangeal joint

	TENDER								NON-TENDER							
	MP (n = 16)		PIP(n = 16)		DIP(n=13)		ALL (n=45)		MP (n = 10)		PIP (n = 9)		DIP (n = 7)		ALL (n = 29)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Synovitis	12	75	12	75	7	54	31	69	8	80	7	70	2	22	17	63
Bone oedema	9	56	7	44	2	15	18	40	2	20	2	22	0	0	4	15
Soft-tissue oedema	12	75	13	81	6	46	31	69	6	60	5	56	4	44	15	58
Flexor tendon Tenosynovitis	8	50	10	63	0	0	18	40	5	50	3	33	2	22	10	38
Extensor tendonitis	2	13	1	6	0	0	3	7	0	0	0	0	0	0	0	0
Plantar/volar plate enhancement	2	13	0	0	0	0	2	4	0	0	0	0	0	0	0	0
Collateral ligament enhancement	5	31	2	13	0	0	7	16	0	0	0	0	0	0	0	0
Sesamoiditis	1	6	n/a	n/a	n/a	n/a	1	2	1	10	n/a	n/a	n/a	n/a	1	4
Erosion	2	13	1	6	0	0	3	7	0	0	0	0	0	0	0	0

Figure legends

Figure 1a

Sagittal MR index finger (gadolinium enhanced T1 fat saturation) showing distension of the PIPJ capsule due to synovitis (arrow). The flexor tendon is displaced away from the proximal and middle phalanges by tenosynovitis.

Figure 1b

Axial forefoot MR (gadolinium enhanced T1W fat saturation) showing circumferential soft tissue oedema involving the 4th toe and extending proximally to the 4th MTPJ plantar surface. The flexor tendon is displaced away from the phalanx by tenosynovitis (arrow). There is also early involvement of the 2nd and 3rd toes.

Figure 1c

Axial forefoot MR (Short Tau Inversion Recovery) at the level of the distal metatarsals showing synovitis encasing the great toe flexor tendon (arrow).

Figure 2a

Coronal forefoot MR (gadolinium enhanced T1W fat saturation) showing bone oedema involving the 2nd toe proximal phalanx. Bone oedema is also present at the collateral origins in the 2nd metatarsal head (double headed arrow). The 2nd MTPJ collateral has enhanced (arrow) in keeping with enthesitis.

Figure 2b

Coronal forefoot MR (Gadolinium enhanced T1W fat saturation), similar appearances to Fig. 3a but demonstrating involvement of the 1st, 3rd and 4th digits in addition to the dactylitic 2nd digit.

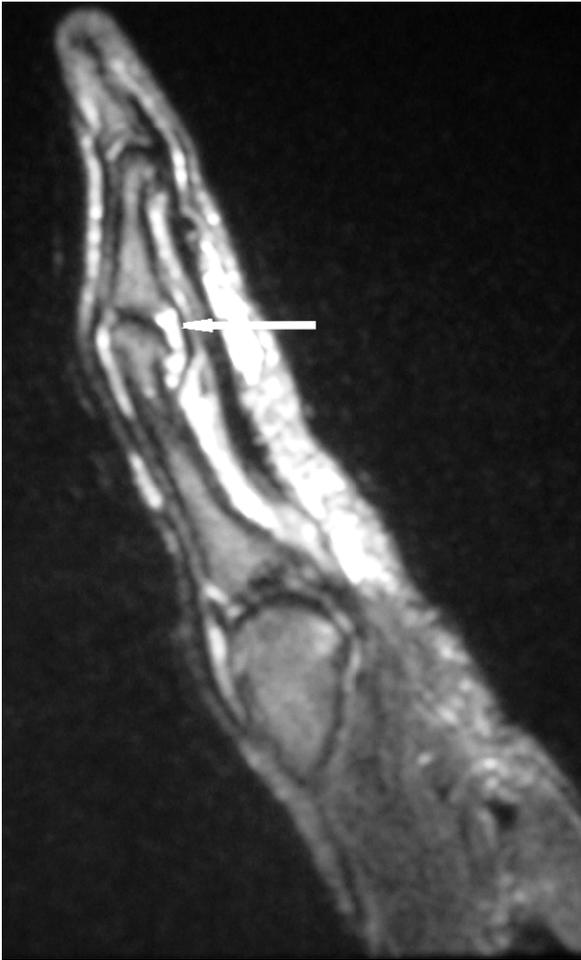


Figure1a

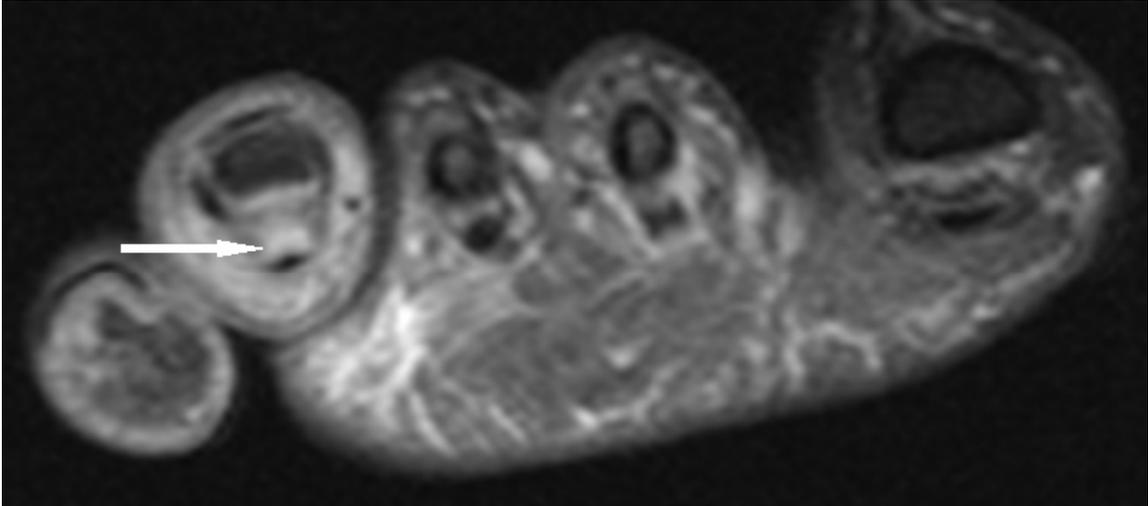


Figure1b

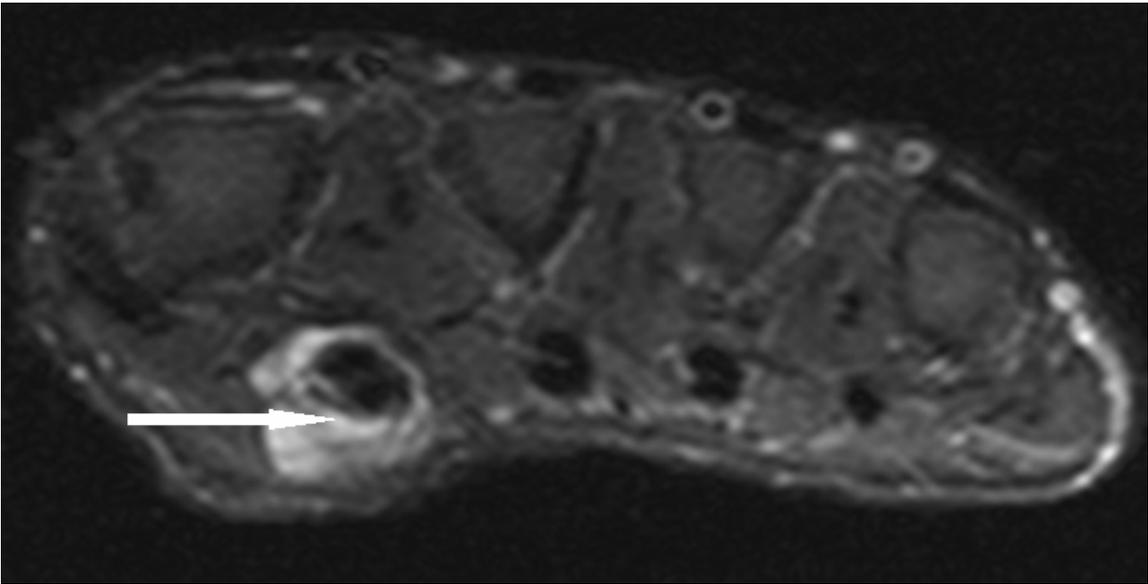


Figure 1c

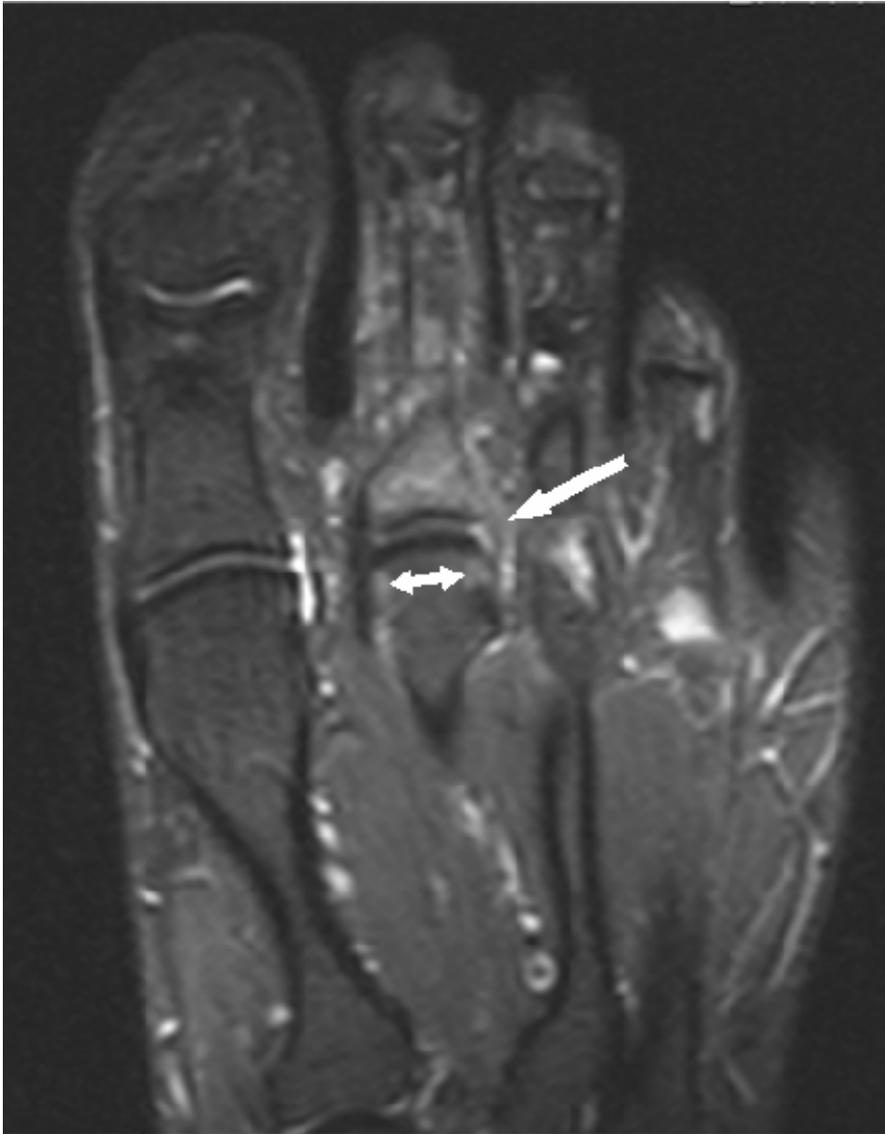


Figure 2a

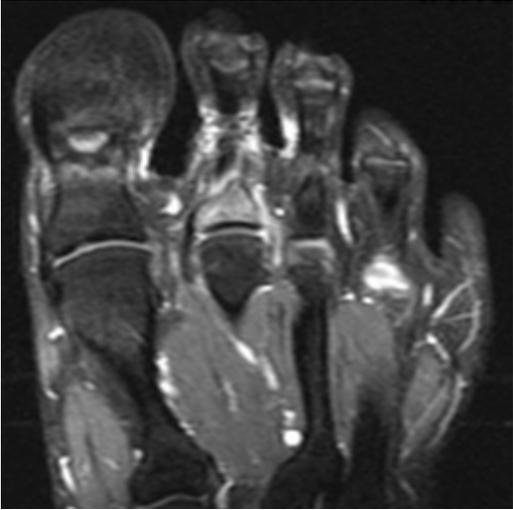


Figure 2b

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