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ORIGINAL ARTICLE

Mini-enthesitis can differentiate rheumatoid arthritis from psoriatic arthritis: A comprehensive comparative ultrasound study of the joints and mini-entheses of the hands

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ABSTRACT

Objectives: This study aimed to explore whether hand ultrasonography (USG) could differentiate between rheumatoid arthritis (RA) and psoriatic arthritis (PsA) patients.

Patients and methods: A comprehensive USG of 35 PsA patients (13 males, 22 females; mean age: 60.9±8.4 years; range, 53 to 69 years), 30 RA patients (10 males, 20 females; mean age: 58.4±10.0 years; range, 50 to 61 years), and 20 healthy controls (5 males, 15 females; mean age: 55.6±5.8 years; range, 50 to 61 years) was performed with assessments of the wrist, tendons, mini-entheses, and joints of the second and third finger, both on gray scale and power Doppler USG.

Results: Two hundred forty-five joints of PsA patients, 210 joints of RA patients, and 120 joints of healthy controls were assessed by USG. Wrist joint synovitis and tenosynovitis of the extensor digitorum communis and extensor carpi ulnaris tendon were significantly more common in RA patients compared to PsA patients ($p<0.001$), detected in 93.30%, 63.30%, and 73.30% versus 57.10%, 14.30%, and 2.90%, respectively. The incidence of tenosynovitis of the flexor tendons at the wrist level was significantly higher in RA patients ($p=0.003$), detected in 36.70% versus 14.30%. Paratenonitis of the finger extensor tendon at the metacarpophalangeal joints was significantly more prevalent in PsA patients, detected in 85.70% versus 3.30% ($p<0.001$). Central slip enthesitis at the proximal interphalangeal joint and enthesitis of the distal slip of the extensor tendon at the second and third distal phalanx were exclusively found in PsA patients, occurring in 45.70%, 91.40%, and 71.30%, respectively ($p<0.001$). Flexor tenosynovitis and pseudotenosynovitis were significantly more prevalent in PsA patients (65.70% and 57.10%, respectively) compared to RA patients (16.70% and 0.00%, respectively; $p<0.001$). PsA patients had significantly higher thickness of the A1 pulley compared to RA patients ($p<0.001$).

Conclusion: Mini-enthesitis is a hallmark USG finding in PsA.

Keywords: Enthesitis, psoriatic arthritis, rheumatoid arthritis, ultrasound.

Rheumatoid arthritis (RA) and psoriatic arthritis (PsA) may present with similar clinical findings with pain and swelling in the small joints of the hands and prolonged morning stiffness, suggesting a possible diagnosis of an inflammatory joint disease. However, the absence of the specific antibodies and the typical rash of psoriasis or the family history, make the establishment of the correct diagnosis quite challenging.

Musculoskeletal ultrasound (MSUS) has been proven to be an extremely useful imaging modality in the everyday rheumatology practice in establishing a diagnosis, monitoring the disease activity, making treatment decisions in a treat-to-target approach and during drug tapering, predicting disease course, assessing remission, and guiding the correct needle placement during joint and peritendinous/bursal injections.[1-3] Data exists that performing an extensive ultrasonographic assessment of the joints, tendons, and entheses may be extremely useful in differentiating in the early stages of RA and PsA.[4]

Swollen joints are the clinical manifestation of different pathological changes, occurring at the joint/tendon/entheseal level. Swollen metacarpophalangeal (MCP) joints in PsA are reported to be clinical manifestation in joint synovitis in only 50% of the cases, as compared to RA, the remaining 50% are proven to be a result of inflammation of the peritenon of the finger extensor tendon.[5] Synovitis and tenosynovitis detected on ultrasonography (USG) are observed in both RA and PsA, while extrasynovial abnormalities, for example inflammation of the fibrous skeleton and mini-enthesitis, are predominantly observed in PsA.[6] Enthesitis detected on USG can be defined as hypoechoic or thickened insertion of the tendon close to the bone (within 2 mm from the bony cortex), exhibiting Doppler signal if active and potentially showing erosions and enthesophytes/calcifications as a sign of structural damage, according to the Outcome Measures in Rheumatoid Arthritis Clinical Trials (OMERACT) task force.[7]

Mini-enthesitis is a term, combining inflammation of the classical and functional small enthesis of the fingers. Examples of functional mini-enthesitis are paratenonitis of the finger extensor tendon at the MCP joint level, inflammation of the flexor pulleys, which become thickened and exhibit a positive power Doppler (PD) signal, and pseudotenosynovitis, observed as increased thickness of the soft tissue around the flexor tendon, with markedly increased PD signal.[4,8]

The flexor pulleys of the fingers are found to be thickened in patients with PsA compared to RA patients and healthy controls (HCs).[9,10] As functional mini-entheses, they bear high mechanical stress and are thought to exhibit the deep Koebner phenomenon, namely inflammation as a result of mechanical overload, which is a typical feature of patients with PsA, particularly in psoriatic dactylitis.[11]

The aim of the present study was to compare the hand USG findings at the joint/tendon/entheseal level between RA and PsA patients through an extensive assessment of different pathologies, including synovitis, tenosynovitis, mini-enthesitis, erosions, and new bone proliferation, to find specific USG patterns of inflammation in the two types of arthritides, thus outlining the values of MSUS in establishing the correct diagnosis in cases where patient, history, laboratory data, and radiographic imaging are not conclusive of RA or PsA.

PATIENTS AND METHODS

Thirty-five PsA patients (13 males, 22 females; mean age: 60.9±8.4 years; range, 53 to 69 years), 30 RA patients (10 males, 20 females; mean age: 58.4±10.0 years; range, 50 to 61 years), and 20 HCs (5 males, 15 females; mean age: 55.6±5.8 years; range, 50 to 61 years) were included in this cross-sectional study conducted at the University Hospital 'Pulmed' between November 10, 2023, and January 25, 2024. The inclusion criteria for the patients were as follows: *(i)* an age above 18 years; *(ii)* a confirmed diagnosis of RA or PsA based on the 2010 American College of Rheumatology (ACR)/European League Against Rheumatism (EULAR) criteria or the CASPAR (Classification for Psoriatic Arthritis) criteria, respectively;[12,13] *(iii)* moderate or high disease activity, calculated by Disease Activity Score for 28 joints (DAS28);[14] *(iv)* history of tender hand/finger joints at the time of the ultrasonographic assessment; *(v)* no intra-articular corticosteroid (CS) injections in the wrist/finger joints in the previous three months. The exclusion criteria for the HCs were as follows: *(i)* prior or current joint disease; *(ii)* history of joint pain during the last month with intensity more than 10/100 mm on a Visual Analog Scale (VAS); *(iii)* presence of swollen joints on physical examination; *(iv)* trauma to the joints of the hands during the previous year; *(v)* current use of CSs or nonsteroidal anti-inflammatory drugs; *(vi)* personal history of psoriasis. All participants signed a written informed consent. The study was protocol approved by the University Hospital 'Pulmed' Ethics Committee (date: 07.11.2023; no: 3). The study was conducted according to the principles of the Declaration of Helsinki.

One physician examined the 28 joints (right and left proximal interphalangeal [PIP], MCP, wrist, elbow, shoulder, and knee joints)

for swelling or tenderness. The intensity of joint pain was evaluated on a VAS from 0 to 10 cm. Duration of morning stiffness was recorded for each patient. Disease activity of RA and PsA patients was assessed by DAS28. In addition, the DAPSA (Disease Activity in Psoriatic Arthritis) index was calculated for the PsA group.[15] Functional status was assessed in both patient groups by completing the Health Assessment Questionnaire Disability Index (HAQ-DI) questionnaire.[16]

The following laboratory parameters were measured: C-reactive protein (CRP; reference range, 0-6.0 mg/L), immunoglobulin M-rheumatoid factor (reference range, 0-20 U/L), and anti-cyclic citrullinated protein (CCP) antibodies (reference range, 0-20 U/L).

The joints, tendons, and entheses of the hand and fingers were assessed using longitudinal and transverse scans as recommended by the 2017 EULAR standardized procedures for USG in rheumatology.[17]

The dominant hand of each patient was scanned by an expert in MSUS with MyLab™X7 machine (Esaote, SpA, Florence, Italy), equipped with a multifrequency linear transducer (6-18 MHz). The USG assessor was blinded to the results from the clinical and laboratory assessments. The gray scale frequency was 12 MHz, and the gain varied according to the scanned joint and patient characteristics to obtain the image with the highest resolution, with an average value of 50%. The frequency for PD USG was 9.1 MHz, and the pulse repetition frequency was set at 500-750 Hz with a low wall filter (e.g., 3).

The joints and tendons of the wrist and the second and third finger of the dominant hand (the more symptomatic hand reported by the patient) were scanned both on a dorsal and on a palmar scan, using a longitudinal and a transverse scan. The wrist was scanned on a dorsal scan, assessing for presence of synovitis in the radiocarpal joint, tenosynovitis in the fourth extensor compartment, including the tendon of extensor digitorum communis, and for erosions. Ulnar scan was used to assess the sixth extensor compartment for presence of tenosynovitis of the tendon of extensor carpi ulnaris (ECU). The dorsal scan of the second and third MCP and MCP joints was performed to detect synovitis, paratenonitis of the finger extensor tendon, and erosions. The second and third PIP joints were scanned on the dorsal surface to assess for synovitis, central slip enthesitis, and new bone proliferation. Dorsal scans of the second and third distal interphalangeal (DIP) joints were used to assess for synovitis, enthesitis of the distal slip of the extensor tendon, and for new bone proliferation. The palmar scan of the wrist was used to assess the presence of flexor tenosynovitis at the wrist level, whereas the palmar scan of the second and third MCP and MCP joints was used to detect the presence of flexor tenosynovitis and pseudotenosynovitis (subcutaneous edema [STE] with a positive PD signal). The A1 pulley was measured at the level of the second MCP joint on a palmar scan.

The following pathologies were recorded: joint synovitis, tenosynovitis of the fourth (extensor digitorum communis) and sixth (ECU) extensor compartments of the wrist, tenosynovitis of the finger flexor tendons, paratenonitis of the extensor tendon of the fingers, central slip enthesitis at the PIP level, pseudotenosynovitis (a PD positive edema of the subcutaneous tissue above the flexor tendon), enthesitis of the insertion of the distal part of the extensor tendon at the distal phalanx, A1 pulley thickening and inflammation with a positive PD signal, presence of erosions, and new bone proliferation.

Every pathological USG finding was graded both on grey scale USG and on PD USG with 0 (absent) and 1 (present). The OMERACT definitions for synovitis, tenosynovitis, erosions, enthesitis, and new bone proliferation were used when reporting the pathologic findings.[7,18,19]

Pseudotenosynovitis (edema of the soft tissues around the finger flexor tendon) was defined as abnormal hypoechoic/anechoic areas, diffused or localized within the subcutaneous tissue between the epidermis and the tendon-related anatomic structures with local thickening, with or without a local abnormal Doppler signal, visualized in two perpendicular planes, and not evident on the contralateral side.[20] The findings were

compared with the nonaffected finger, as the ultrasonographic assessment of STE is highly variable and depends on the individual's characteristics such as dominant hand, age, sex, body mass index, and alcohol consumption.[21]

Paratenonitis of the finger extensor tendon at the MCP joint level was defined as increased thickness of the tendon and loss of fibrillar pattern, accompanied by a positive PD signal.[22,23]

The A1 pulley was measured at MCP joint level as reported by Tinazzi et al.[9] To determine the border between the A1 pulley and the finger flexor tendon, a dynamic scanning during passive finger flexion and extension was performed.[9]

Two total scores were calculated at the end: mini-enthesitis score and erosion score. Each of the following findings, as representatives of mini-enthesitis, were scored 1: presence of paratenonitis of the finger extensor tendon at the MCP joint level, central slip enthesitis at the PIP joint level, enthesitis of the distal slip of the extensor tendon at the distal phalanx, and pseudotensosynovitis (STE) of the finger flexor tendon at the PIP joint level. By summing the abovementioned findings, the total mini-enthesitis score was calculated. The erosion score was calculated by summing the number of joints with the presence of at least one bone erosion.

Statistical analysis

The data were analyzed using IBM SPSS version 27.0 software (IBM Corp., Armonk, NY, USA). Continuously measured variables were examined for normality using normality plots and the Shapiro-Wilk test results. Means and standard deviations were used to describe the outcomes when normality was observed. Groups were compared using the independent samples t-test and one-way analysis of variance with Bonferroni post hoc multiple comparisons. Nonnormally distributed variables were presented as medians and interquartile ranges, and the Mann-Whitney U test was employed to compare groups. The Hodges-Lehman test was used to calculate the 95% confidence interval [CI] of the Mann-Whitney U test's difference. The chi-square test was utilized to analyze categorical data presented as frequency and percentages (%). The 95% CI for the difference in proportions was calculated using Bonferroni adjustments. All statistical analyses were two-tailed, and type 1 error was set at 0.05.

RESULTS

There were no significant age differences between the groups (p=0.920). Females predominated in all three groups, with no significant differences between the groups (PsA, 69.20%; RA, 75%; HC, 80%, p=0.290).

Clinical data about the two patient groups is provided in Table 1. No significant differences were found regarding disease duration (p=0.135), tender joint count (p=1.000), swollen joint count (p=0.879), VAS pain (p=0.340), VAS patient global assessment (p=0.301), and morning stiffness duration (p=0.103).

Significantly higher CRP levels (p<0.001), rheumatoid factor and anti-CCP positivity (p<0.001), higher HAQ-DI scores (p=0.003), and higher DAS28 (p=0.014), were observed in patients with RA.

The dorsal scan of the wrist showed significantly higher proportions of synovitis, tenosynovitis of the fourth compartment, and erosions in patients with RA compared to PsA patients and HCs (p<0.001). ECU tenosynovitis was significantly associated with RA (p<0.001) and was found in only one PsA patient.

The dorsal second MCP joint scan revealed high prevalence of synovitis in both patient groups in comparison to HCs (p<0.001). However, paratenonitis of the finger extensor tendon was significantly associated with the PsA patients (p<0.001). Erosions were most commonly associated with RA patients (p<0.001) but were also significantly more common in PsA patients compared to HCs (p=0.005).

In the PsA group, 85.75% (n=30) of patients had both synovitis and paratenonitis, four (11.40%) had synovitis without paratenonitis, and one (2.85%) had paratenonitis without synovitis.

The dorsal scan of the third MCP joint revealed similar trends, with a higher presence

Table 1. Clinical data about the patients

	PsA (n=35)						RA (n=30)							
	n	%	Mean±SD	Median	IQR	Min-Max	n	%	Mean±SD	Median	IQR	Min-Max	95% CI	*p*
Variables				28	144	0-480				64	177	0-480	–56.00 to 0.00	0.135*
Tender joint count				8	11	2-60				7	5	3-18	–2.00 to 3.00	1.000*
Swollen joint count				6	5	2-60				6	4	3-16	–1.00 to 2.00	0.879*
VAS pain (0 to 100)				70	15	50-85				70	20	50-100	–10.00 to 0.00	0.340*
VAS PtGA (0 to 100)				65	15	50-85				70	20	50-100	–10.00 to 0.00	0.301*
Morning stiffness (min)				30	40	10-120				45	33	10-120	–0.025 to 0.000	0.103*
CRP (mg/L)				4.95	7.85	0.40-59.70				21	25.15	3.40-98.45	–22.00 to –7.42	<0.001*
RF Positive Negative	 1 34	 2.9 97.1					 23 7	 76.70 23.30					52.67% to 85.57%	<0.001†
Anti-CCP Positive Negative	 1 34	 2.9 97.1					 29 1	 96.70 3.30					76.07% to 97.41%	<0.001†
HAQ score				0.97	0.62	0.25-1.88				1.33	0.51	0.50-2.38	–0.58 to –0.13	0.003t
DAS 28 (disease activity)			4.73±0.74			3.43-6.10			5.26±0.93			3.78-7.51	–0.94 to –0.11	0.014‡
DAPSA (PsA)			31.53±10.82			14.58-57.94			NA					NA

PsA: Psoriatic arthritis; RA: Rheumatoid arthritis; SD: Standard deviation; IQR: Interquartile range; CI: Confidence interval; VAS: Visual Analog Scale; PtGA: Patient Global Assessment; CRP: C-reactive protein; RF: Rheumatoid factor; CCP: Cyclic citrullinated protein; HAQ: Health Assessment Questionnaire; DAS28: Disease Activity Score for 28 joints; DAPSA: Disease Activity Score for PsA patients; * Mann-Whitney U test; 95% CI of the difference for the Mann-Whitney U test was calculated using the Hodges-Lehman test; †: Chi-square test; 95% CI of the difference for the Chi-square test was calculated for the difference in proportion of positive RF findings; ‡ Independent-samples t-test; NA: Not applicable.

Table 2. Ultrasonographic data

	PsA (n=35)		RA (n=30)		HC (n=20)			
Variables	n	%	n	%	n	%	95% CI of the different PsA *vs.* RA	*p*
Wrist dorsal scan								
Synovitis	20a	57.10	28b	93.30	2c	10.00	15.30% to 53.18%	<0.001
Tenosynovitis	5a	14.30	19b	63.30	0a	0.00	25.64% to 65.83%	<0.001
Erosions	5a	14.30	19b	63.30	0a	0.00	25.64% to 65.83%	<0.001
ECU tenosynovitis	1a	2.90	22b	73.30	0a	0.00	49.11% to 83.12%	<0.001
MCP 2 dorsal scan								
Synovitis	34a	97.10	30a	100	0b	0.00	-8.69% to 14.59%	<0.001
Paratenonitis	30a	85.70	1b	3.30	0b	0.00	62.26% to 90.87%	<0.001
Bone proliferation	32a	91.40	1b	3.30	0b	0.00	68.90% to 94.34%	<0.001
Erosions	11a	31.40	23b	76.70	0c	0.00	21.14% to 62.58%	<0.001
MCP 3 dorsal scan								
Synovitis	29a	82.90	29a	96.70	1b	5.00b	-2.29% to 29.57%	<0.001
Paratenonitis	24a	68.60	3b	3.30	0b	0.00b	44.05% to 78.45%	<0.001
Bone proliferation	29a	82.90	0b	0.00	0b	0.00b	63.66% to 91.92%	<0.001
Erosions	4a	11.40	16b	53.30	0a	0.00a	19.40% to 59.72%	<0.001
PIP2 dorsal scan								
Synovitis	29a	82.90	23a	76.70	0b	0.00	-13.14% to 25.97%	<0.001
CS Enthesitis	16a	45.70	0b	0.00	0b	0.00	26.69% to 61.79%	<0.001
Bone proliferation	24a	68.60	0b	0.00	0b	0.00	48.53% to 81.47%	<0.001
Erosions	4a	11.40	12b	40.00	0a	0.00	7.43% to 47.57%	0.001
PIP3 dorsal scan								
Synovitis	22a	73.30	27a	77.10	0b	0.00	-17.35% to 23.78%	<0.001
CS Enthesitis	8a	22.90	0b	0.00	0b	0.00	6.66% to 38.30%	0.002
Bone proliferation	25a	71.40	0b	0.00	0b	0.00	51.38% to 83.65%	<0.001
Erosions	3a	8.60	10b	33.30	0a	0.00	4.96% to 43.45%	0.002
DIP2 dorsal scan								
Synovitis	32a	91.40	0b	0.00	0b	0.00	73.51% to 97.03%	<0.001
Enthesitis	32a	91.40	0b	0.00	0b	0.00	73.51% to 97.03%	<0.001
Bone proliferation	32a	91.40	0b	0.00	0b	0.00	73.51% to 97.03%	<0.001
DIP3 dorsal scan								
Synovitis	28a	80.00	0b	0.00	0b	0.00	60.47% to 89.96%	<0.001
Enthesitis	26a	74.30	0b	0.00	0b	0.00	54.39% to 85.84%	<0.001
Bone proliferation	24a	68.60	0b	0.00	0b	0.00	48.53% to 81.47%	<0.001
Wrist flexor tenosynovitis palmar scan	5a	14.30	11b	36.70	0a	0.00	1.26% to 41.94%	0.003
MCP2 palmar scan								
Tenosynovitis	23a	65.70	5b	16.70	1b	5.00	25.33% to 65.38%	<0.001
Pseudotenosynovitis	20a	57.10	0b	0.00	0b	0.00	16.93% to 57.96%	<0.001
MCP3 palmar scan								
Tenosynovitis	8a	22.90	5a	16.70	0a	0.00	-13.86% to 24.86%	0.074
Pseudotenosynovitis	5a	14.30	0b	0.00	0b	0.00	0.39% to 29.39%	0.032

PsA: Psoriatic arthritis; RA: Rheumatoid arthritis; HC: Healthy controls; ECU: Extensor carpi ulnaris; MCP: Metacarpophalangeal; PIP: Proximal interphalangeal; DIP: Distal interphalangeal; MCP: Metacarpophalangeal. Cells marked with different letters indicate significant differences between proportions at type 1 error of 0.05 after Bonferroni adjustments were applied.

of synovitis in both patient groups compared to HCs (p<0.001) and no significant differences between PsA and RA patients (p=0.130). Paratenonitis was significantly associated with PsA patients (p<0.001) and was rare or entirely absent in the RA patients. Erosions were mostly characteristic of RA patients (p<0.001).

Of the PsA patients, 65.70% (n=23) had both synovitis and paratenonitis on the dorsal scans of the third MCP joint. The remaining five (14.25) were negative for both, six (17.20%) had synovitis without paratenonitis, and one (2.85%) had paratenonitis without synovitis.

The dorsal scan of the second PIP joint showed a significant presence of synovitis in the PsA and RA groups compared to the HCs (p<0.001), and no significant difference between the patient groups (p=0.53). Central slip enthesitis was significantly associated with PsA (p<0.001) and was entirely absent in RA patients and HCs. Erosions were more common in RA patients (p=0.001).

Dorsal scan of the third PIP joint also showed a significant presence of synovitis in the patient groups, while it was absent in HCs (p<0.001). The PsA patients were significantly associated

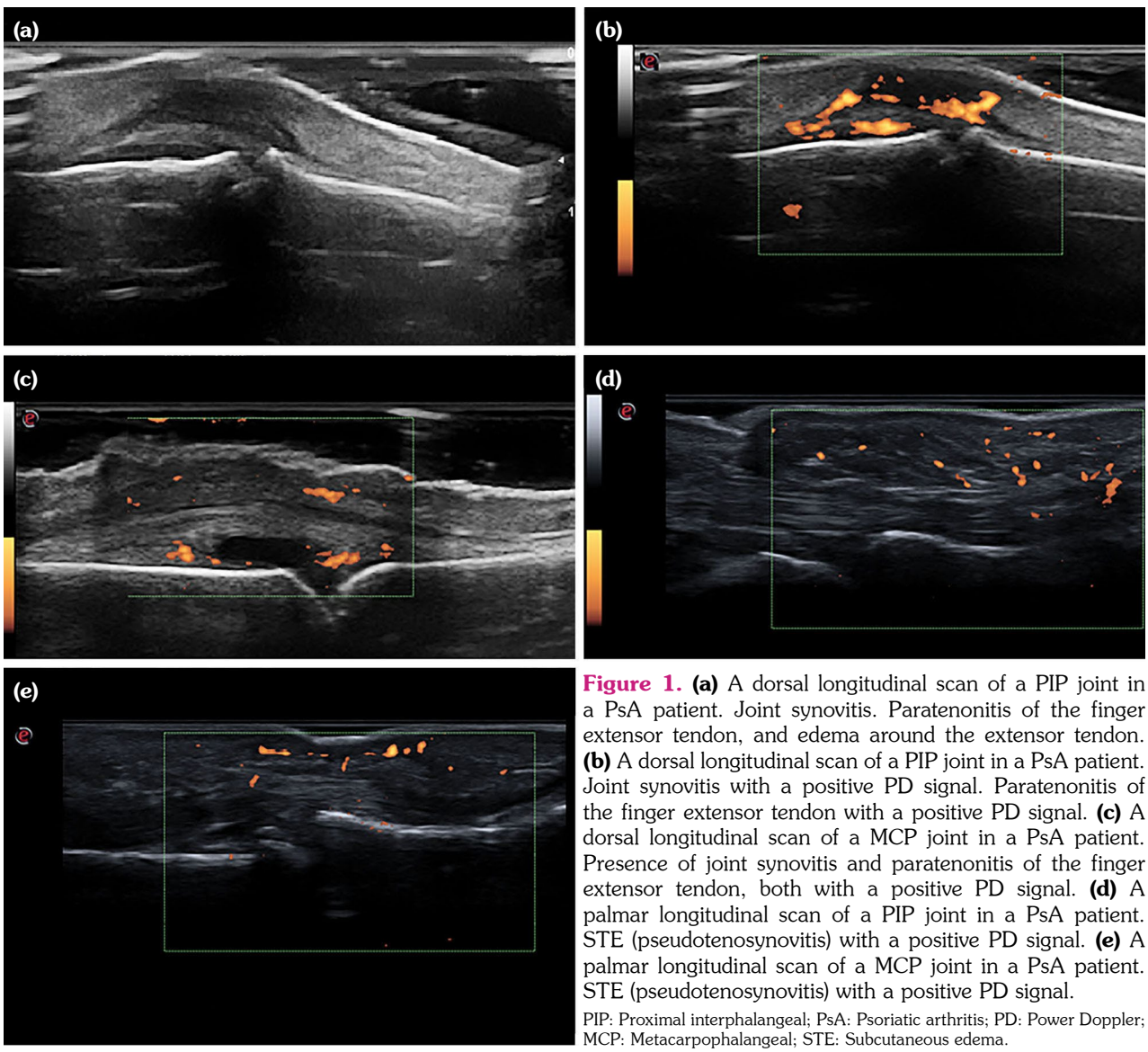

Figure 1. **(a)** A dorsal longitudinal scan of a PIP joint in a PsA patient. Joint synovitis. Paratenonitis of the finger extensor tendon, and edema around the extensor tendon. **(b)** A dorsal longitudinal scan of a PIP joint in a PsA patient. Joint synovitis with a positive PD signal. Paratenonitis of the finger extensor tendon with a positive PD signal. **(c)** A dorsal longitudinal scan of a MCP joint in a PsA patient. Presence of joint synovitis and paratenonitis of the finger extensor tendon, both with a positive PD signal. **(d)** A palmar longitudinal scan of a PIP joint in a PsA patient. STE (pseudotenosynovitis) with a positive PD signal. **(e)** A palmar longitudinal scan of a MCP joint in a PsA patient. STE (pseudotenosynovitis) with a positive PD signal.

PIP: Proximal interphalangeal; PsA: Psoriatic arthritis; PD: Power Doppler; MCP: Metacarpophalangeal; STE: Subcutaneous edema.

Table 3. Sum of USG findings

	PsA (n=35)			RA (n=30)				
Total scores	Median	IQR	Min-Max	Median	IQR	Min-Max	95% CI of the difference	*p*
Mini-enthesitis score	5	3	2-9	0	0	0-0	4 to 5	<0.001
Bone proliferation score	6	6	1-7	0	0	0-1	4 to 6	<0.001
Erosions score	0	1	0-5	2.50	4	0-5	–3 to –1	<0.001

USG: Ultrasonography; PsA: Psoriatic arthritis; RA: Rheumatoid arthritis; IQR: Interquartile range; The Mann-Whitney U test was used to compare the two patient groups. The 95% CI of the difference was calculated using the Hodges-Lehman test

with central slip enthesitis (p=0.002) versus its entire absence in RA patients and HCs. Erosions were more common in RA patients (p=0.002), rare in the PsA patients, and absent in HCs.

Dorsal scans of the second and third DIP joints identified a high presence of synovitis and enthesitis in the PsA patients compared to their absence in RA patients and HCs. The majority of the PsA patients (88.60%, n=31) had both enthesitis and bone proliferation in the second DIP joint. The remaining two (5.70%) patients were negative for both, one (2.85%) patient had enthesitis but no bone proliferation, and one (2.85%) had bone proliferation without enthesitis. Among the dorsal scans of the third DIP joint, 22 (62.90%) were positive for both dorsal enthesitis and bone proliferation, seven (20.00%) were negative for both, two (5.70%) had dorsal enthesitis without bone proliferation, and four (11.40%) had bone proliferation without enthesitis.

Flexor tenosynovitis at the wrist joint on palmar scan was not common in any of the groups, but its incidence was significantly higher in the RA patients (p=0.003).

The palmar scan of the second MCP joint revealed a significantly higher incidence of tenosynovitis and pseudotenosynovitis in PsA patients (p<0.001), whereas the third MCP joint showed that pseudotenosynovits was significantly more prevalent in the PsA group (Table 2; Figure 1).

The sum of the USG findings (Table 3) showed a significantly higher median of mini-enthesitis score in the PsA group (p<0.001), whereas erosions had a higher incidence in the RA group (p=0.006; p<0.001).

The PsA patients had significantly higher thickness of the A1 pulley on both longitudinal and transverse scans compared to the RA patients and HCs. There was no significant difference in A1 pulley thickness between the RA group and HCs (Table 4).

DISCUSSION

The lack of ionizing radiation, the cost-effectiveness, and the ability to assess many structures for a short period of time make the MSUS a preferred imaging modality in the everyday rheumatology practice. Over the past 50 years, a significant number of studies exploring the utility of USG in the establishment of diagnosis, treatment monitoring, assessment of remission, and correct needle placement in invasive procedures, have been published.[2,24-26] There is increasing evidence regarding the role of USG for the differentiation between RA and PsA presenting as symmetric polyarthritis, based on the different location of the inflammatory changes and the different bony alterations in the two disease entities.[4]

The present study is the first to include simultaneous assessment of joints, tendons, bones, and mini-entheses of the hands through a comprehensive ultrasonographic evaluation on grey scale and PD USG to reveal the difference in RA and PsA patients. The clinical impact of our study is that in patients with very early undifferentiated arthritis, presenting with swelling of the wrists and small joints of the fingers, in whom the immunologic tests (rheumatoid factor and anti-CCP antibodies) are negative, personal or family history of psoriasis is lacking and radiographic changes due to the

short duration of symptoms are absent, the comprehensive ultrasonographic assessment of joints, tendons, and anatomical and functional entheses of the fingers would be helpful to establish an early diagnosis of RA or PsA without current psoriasis.

The USG image of joint synovitis is the same in PsA and RA,[4,22] but the predilection to involvement of specific joints in the two arthritides is what may help in the differential diagnosis. We found that synovitis of the radiocarpal joint, wrist erosions, tenosynovitis of the fourth (the tendons of extensor digitorum communis) and sixth (the tendon of extensor carpi ECU) extensor compartments of the wrist, and flexor tenosynovitis at the wrist were more common in RA compared to PsA, similar to the previously reported data.[22,27-29] ECU tenosynovitis was detected in more than 70% of RA patients, which is a higher prevalence than the previously reported prevalence of approximately 50%.[30,31]

Paratenonitis of the finger extensor tendon at the second and third MCP joints was predominantly found in PsA patients; between 68% and 85% of PsA patients had evidence of PD-positive paratenonitis versus 3% of RA patients. In addition, in most PsA patients (65 to 85%) paratenonitis of the extensor tendon occurred simultaneously with MCP joint synovitis. Bone erosions at the second and third MCP joints were more common in RA than in PsA. In the pathogenesis of PsA, the mechanical stress has been proven to trigger inflammation of the peripheral entheses of the lower limbs as part of the deep Koebner phenomenon.[32] Similarly, the inflammation of the small entheses of the fingers is suggested to be a reaction towards repetitive movements.[32] The fact that mini-enthesitis, which can only be visualised through imaging, is almost exclusively found in PsA patients in our study, highlighting the role of high-frequency ultrasonographic assessment of the small entheses in patients with early undifferentiated arthritis.[4]

Gutierrez et al.[33] first reported a specific USG finding in PsA: peritenon extensor tendon inflammation. MCP joint swelling is proven to be a result of true joint synovitis in 50% of PsA patients and due to paratenonitis in

Table 4. One-way analysis of variance results for A1 pulley thickness between study groups

Thickness (mm)	PsA (n=35)		RA (n=30)		HC (n=20)		95% CI of the difference	p*
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max		
A1 pulley longitudinal scan	1.011±0.16a	0.74-1.30	0.546±0.10b	0.36-0.70	0.517±0.55b	0.42-0.60	PsA *vs.* RA (–0.583 to –0.406) PsA *vs.* HC (0.387 to 0.544) RA *vs.* HC (–0.616 to 0.120)	<0.001
A1 pulley transverse scan	1.00±0.16a	0.73-1.29	0.530±0.10b	0.35-0.71	0.500±0.05b	0.41-0.59	PsA *vs.* RA (0.30 to 0.533) PsA *vs.* HC (0.402 to 0.574) RA *vs.* HC (–0.572 to 0.119)	<0.001

PsA: Psoriatic arthritis; RA: Rheumatoid arthritis; HC: Healthy controls; SD: Standard deviation; CI: Confidence interval; * ANOVA test. Cells marked with different letters indicate significant differences in the mean thickness of A1pulley as shown by the Bonferroni paired comparisons

the other half.[34] The peritenon extensor tendon inflammation pattern has been proven to correlate with a higher Madrid Sonographic Enthesis Index in PsA, suggesting the mini-entheseal inflammation is related to classical entheses inflammation.[28] This result is similar to the results obtained by Zabotti et al.,[22] who found that paratenonitis is significantly more prevalent in PsA patients. Zabotti et al.[22] found that synovitis can be detected in almost all early RA patients and in half of the joints of early PsA patients, and every second PsA patient has an evidence of paratenonitis at the MCP joint level. The present study found an even higher prevalence of paratenonitis in PsA, with 68 to 85%.

We found that central slip enthesitis at the second and third PIP joints was prevalent only in PsA patients (45% and 22%, respectively) and in none of the RA patients. Similar findings were reported by other authors,[22] but they have found a lower prevalence (25%) of central slip enthesitis, which may be explained by the fact that their study enrolled only early RA and PsA patients, and the prevalence increases in patients with longer disease duration.

It has already been reported that USG-detected synovitis in DIP joints is typical for PsA.[35] In our study, 70 to 90% of PsA patients had evidence of enthesitis of the distal insertion of the extensor tendon at the level of the second and third distal phalanx, and in almost all of them, bone proliferation at the second and third DIP joints was detected. It is a well-known fact that new bone proliferation at DIP joints is a typical feature of PsA, thus USG evidence of irregular cortical surface with new bone proliferation, in addition to the signs of enthesitis, is suggestive of PsA.[36,37] Krajewska-Włodarczyk et al.[38] found that enthesitis of the extensor tendon insertion at the DIP joint occurred in 52% of all PsA patients, a lower prevalence than that found in our study. In clinical practice, DIP joints are frequently affected both in osteoarthritis (OA) and PsA. Considering the age of the patients in our study, DIP involvement may be present both in PsA and in RA patients with accompanying OA of the DIP joints.[39] The clinical utility of the findings from our study is the fact that the role of USG to detect inflammation of the enthesis of the distal slip of the finger extensor tendon at the level of the distal phalanx is highlighted. Furthermore, the study found that enthesitis at the level of the DIP joint is what can help to differentiate both arthritides, as it is exclusively found in PsA, while new bone proliferation can be evident both in PsA and in RA with concomitant OA of the DIP joints.

In our study, erosions at the wrist, MCP, and PIP joints were found to be more prevalent in RA compared to PsA, which is consistent with the reported result from similar studies.[36,40,41] Zayat et al.[40] suggested that the number and size of bone erosions detected by means of MSUS might distinguish the two arthritides, reporting a higher number and a larger size of the erosions in the wrists, MCP, and PIP joints in RA patients.

In our study, PsA patients were found to have a significantly higher incidence of flexor tenosynovitis and pseudotenosynovitis of the finger flexor tendon at the level of the second and third MCP joints. It is important from clinical point of view that patient-reported pain in PsA was found to correlate with extra-articular inflammation, predominantly flexor tenosynovitis, and soft tissue edema (pseudotenosynovitis),[42,43] whereas joint synovitis does not appear to cause pain in PsA, compared to RA, where joint pain is caused by joint synovitis, particularly if PD is positive. Only two studies of RA patients evaluating the correlation between USG-detected synovitis and joint symptoms found that joint tenderness on palpation does not correlate with the detection of joint synovitis by grey scale and PD USG.[27,44] To summarize, a patient reporting pain in the small joints of the hands should be screened for extrasynovial abnormalities and presence of mini-enthesitis, even in the absence of joint synovitis.

Data exists that finger flexor tenosynovitis is more prevalent in PsA.[35,45] Our study found a higher prevalence of flexor tenosynovitis in PsA than the one reported by Tinazzi et al.[45] (65% *vs.* 38%). A specific finding of PsA is the pseudotenosynovitis of the flexor tendon, described by some authors as STE around the finger flexor tendon, exhibiting a positive PD

signal.[20] More than half of the PsA patients in our study demonstrated pseudotenosynovitis of the flexor tendon, a higher prevalence than that reported by Tinazzi et al.[45] (30%) and Zabotti et al.[22] (42.3%). An interesting fact is that STE is an even more common USG finding in the fingers with dactylitis, with a reported prevalence of 75 to 91% in hand dactylitis cases.[46] Felbo et al.[47] also found that STE is more common than flexor tenosynovitis and joint synovitis in dactylitis.

Data exists that the USG findings are different in acute ("hot") and chronic ("cold") dactylitis with greater prevalence of grey scale and PD flexor tenosynovitis, PD-positive soft tissue edema in the former, and grey scale/PD PIP joint synovitis in the latter,[47] suggesting the idea of extra-articular origin of the initial inflammation in PsA, spreading into the joint in the latter stages. This suggests that in early PsA, the lack of joint synovitis may explain the normal values of the acute-phase reactants (e.g., CRP) despite active disease observed as extra-articular inflammation on USG.

Pulley thickness measured by USG has been validated in one study where intraoperative and ultrasonographic measurement of the pulley thickness were found to correlate to a great extent.[48] A cutoff value of 0.62 mm for the A1 pulley was proposed.[48] A magnetic resonance imaging study found that inflammation of the pulley of the finger flexor is detected in half of patients with dactylitis.[49] Thickening of the A1 pulley with a positive PD signal was reported in more than a quarter (26.7%) of PsA patients even without a history of dactylitis.[50] In our study, PsA patients were found to have a significantly higher thickness of the A1 pulley both on longitudinal and transverse scans compared to the RA patients and HCs. In addition, this finding confirms the high prevalence of flexor pulley inflammation in PsA, as part of the spectrum of mini-enthesitis. One of the practical implications of this finding is that a comprehensive ultrasonographic evaluation of a patient presenting with arthritis of the small joints of the hands should include not only scanning of the joints and tendons but also of the flexor pulleys due to their frequent inflammation as part of the deep Koebner phenomenon in PsA patients.

The present study found that the mini-enthesitis score, calculated by summing the joints with presence of paratenonitis of the finger extensor tendon at the MCP joint level, central slip enthesitis at the PIP joint level, enthesitis of the distal slip of the extensor tendon at the distal phalanx, pseudotenosynovitis (STE) of the finger flexor tendon at the PIP joint level, and bone proliferation score had a significantly higher value in the PsA group, whereas erosion score had a significantly higher value in the RA group, proving that ultrasonographic assessment of the mini-entheses is crucial when the clinical/laboratory data is insufficient to distinguish between RA and PsA. Considering the fact that both arthritides may present with synovitis with an undistinguishable appearance on USG, what may help the rheumatologist to establish the correct diagnosis besides patient history, physical examination, laboratory tests, and radiography is USG, as it can detect the presence of inflammation outside the joint, particularly of the small finger entheses, which as our study found, is very common in early PsA compared to early RA.

One of the limitations of the current study was the small number of the included patients. Another limitation was that the ultrasonographic assessment of only the dominant hand was performed. In addition, the reliability of scoring large entheses in the setting of spondyloarthritis has been reported, while there is still no validation of the scoring for mini-entheses, which warrants further research.[47,51]

In conclusion, ultrasonographic assessment of the fingers' mini-entheses in patients with inflammatory type of joint pain in the small joints of the hands may aid the rheumatologists in establishing the correct diagnosis in patients not fulfilling the official criteria for RA and PsA.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Silvagni E, Zandonella Callegher S, Mauric E, Chiricolo S, Schreiber N, Tullio A, et al. Musculoskeletal ultrasound for treating rheumatoid arthritis to target-a systematic literature review. Rheumatology (Oxford) 2022;61:4590-602. doi: 10.1093/rheumatology/keac261.
2. Sapundzhieva TL, Karalilova R, Batalov A. Musculoskeletal ultrasound in rheumatology - new horizons. Folia Med (Plovdiv) 2020;62:7-16. doi: 10.3897/folmed.62.e47772.
3. Sapundzhieva T, Karalilova R, Batalov A. Musculoskeletal ultrasound for predicting remission in patients with rheumatoid arthritis: Results from a 1-year prospective study. Rheumatol Int 2018;38:1891-9. doi: 10.1007/s00296-018-4131-0.
4. Sapundzhieva T, Karalilova R, Batalov A. Hand ultrasound patterns in rheumatoid and psoriatic arthritis: The role of ultrasound in the differential diagnosis. Rheumatol Int 2020;40:837-48. doi: 10.1007/s00296-020-04559-8.
5. Macía C, Falcao S, Gutierrez M, Medina J, Hammer HB, De Miguel E. SAT0626 Metacarpophalangeal joint swelling in psoriatic arthritis: what does it mean? Ann Rheum Dis 2017;76:1011.
6. Fournié B, Margarit-Coll N, Champetier de Ribes TL, Zabraniecki L, Jouan A, Vincent V, et al. Extrasynovial ultrasound abnormalities in the psoriatic finger. Prospective comparative power-doppler study versus rheumatoid arthritis. Joint Bone Spine 2006;73:527-31. doi: 10.1016/j.jbspin.2006.01.019.
7. Balint PV, Terslev L, Aegerter P, Bruyn GAW, Chary-Valckenaere I, Gandjbakhch F, et al. Reliability of a consensus-based ultrasound definition and scoring for enthesitis in spondyloarthritis and psoriatic arthritis: An OMERACT US initiative. Ann Rheum Dis 2018;77:1730-5. doi: 10.1136/annrheumdis-2018-213609.
8. Zabotti A, Idolazzi L, Batticciotto A, De Lucia O, Scirè CA, Tinazzi I, et al. Enthesitis of the hands in psoriatic arthritis: An ultrasonographic perspective. Med Ultrason 2017;19:438-43. doi: 10.11152/mu-1172.
9. Tinazzi I, McGonagle D, Aydin SZ, Chessa D, Marchetta A, Macchioni P. 'Deep Koebner' phenomenon of the flexor tendon-associated accessory pulleys as a novel factor in tenosynovitis and dactylitis in psoriatic arthritis. Ann Rheum Dis 2018;77:922-5. doi: 10.1136/annrheumdis-2017-212681.
10. Furlan A, Stramare R. The thickening of flexor tendons pulleys: A useful ultrasonographical sign in the diagnosis of psoriatic arthritis. J Ultrasound 2018;21:309-14. doi: 10.1007/s40477-018-0325-2.
11. Tinazzi I, McGonagle D, Macchioni P, Aydin SZ. Power Doppler enhancement of accessory pulleys confirming disease localization in psoriatic dactylitis. Rheumatology (Oxford) 2020;59:2030-4. doi: 10.1093/rheumatology/kez549.
12. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO 3rd, et al. 2010 Rheumatoid arthritis classification criteria: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis Rheum 2010;62:2569-81. doi: 10.1002/art.27584.
13. Taylor W, Gladman D, Helliwell P, Marchesoni A, Mease P, Mielants H, et al. Classification criteria for psoriatic arthritis: Development of new criteria from a large international study. Arthritis Rheum 2006;54:2665-73. doi: 10.1002/art.21972.
14. Prevoo ML, van 't Hof MA, Kuper HH, van Leeuwen MA, van de Putte LB, van Riel PL. Modified disease activity scores that include twenty-eight-joint counts. Development and validation in a prospective longitudinal study of patients with rheumatoid arthritis. Arthritis Rheum 1995;38:44-8. doi: 10.1002/art.1780380107.
15. Nell-Duxneuner VP, Stamm TA, Machold KP, Pflugbeil S, Aletaha D, Smolen JS. Evaluation of the appropriateness of composite disease activity measures for assessment of psoriatic arthritis. Ann Rheum Dis 2010;69:546-9. doi: 10.1136/ard.2009.117945.
16. Linde L, Sørensen J, Ostergaard M, Hørslev-Petersen K, Hetland ML. Health-related quality of life: Validity, reliability, and responsiveness of SF-36, 15D, EQ-5D [corrected] RAQoL, and HAQ in patients with rheumatoid arthritis. J Rheumatol 2008;35:1528-37.
17. Möller I, Janta I, Backhaus M, Ohrndorf S, Bong DA, Martinoli C, et al. The 2017 EULAR standardised procedures for ultrasound imaging in rheumatology. Ann Rheum Dis 2017;76:1974-9. doi: 10.1136/annrheumdis-2017-211585.
18. Bruyn GA, Iagnocco A, Naredo E, Balint PV, Gutierrez M, Hammer HB, et al. OMERACT definitions for ultrasonographic pathologies and elementary lesions of rheumatic disorders 15 years on. J Rheumatol 2019;46:1388-93. doi: 10.3899/jrheum.181095.
19. Naredo E, D'Agostino MA, Wakefield RJ, Möller I, Balint PV, Filippucci E, et al. Reliability of a consensus-based ultrasound score for tenosynovitis in rheumatoid arthritis. Ann Rheum Dis 2013;72:1328-34. doi: 10.1136/annrheumdis-2012-202092.
20. Tinazzi I, Idolazzi L, Zabotti A, Arancio L, Batticiotto A, Caimmi C, et al. Ultrasonographic detection, definition and quantification of soft tissue oedema in psoriatic dactylitis. Med Ultrason 2019;21:414-21. doi: 10.11152/mu-2258.

21. Rebollo-Giménez A, Martínez-Estupiñán L, Olivas-Vergara O, Fuensalida-Novo G, Garrido J, Mejía A, et al. How variable is the volar subcutaneous tissue of the digits on B-mode and color doppler ultrasound in non-psoriatic individuals and could it be included in a dactylitis score? Ultraschall Med 2021;42:643-51. doi: 10.1055/a-1168-6636.
22. Zabotti A, Salvin S, Quartuccio L, De Vita S. Differentiation between early rheumatoid and early psoriatic arthritis by the ultrasonographic study of the synovio-entheseal complex of the small joints of the hands. Clin Exp Rheumatol 2016;34:459-65.
23. Ramrattan LA, Kaeley GS. Sonographic characteristics of extensor tendon abnormalities and relationship with joint disease activity in rheumatoid arthritis: A pilot study. J Ultrasound Med 2017;36:985-92. doi: 10.7863/ultra.16.05024.
24. Dasgupta B, Cimmino MA, Maradit-Kremers H, Schmidt WA, Schirmer M, Salvarani C, et al. 2012 provisional classification criteria for polymyalgia rheumatica: A European League Against Rheumatism/American College of Rheumatology collaborative initiative. Ann Rheum Dis 2012;71:484-92. doi: 10.1136/annrheumdis-2011-200329.
25. Dejaco C, Ramiro S, Bond M, Bosch P, Ponte C, Mackie SL, et al. EULAR recommendations for the use of imaging in large vessel vasculitis in clinical practice: 2023 Update. Ann Rheum Dis 2024;83:741-51. doi: 10.1136/ard-2023-224543.
26. Sapundzhieva T, Sapundzhiev L, Batalov A. Practical use of ultrasound in modern rheumatology-from a to z. Life (Basel) 2024;14:1208. doi: 10.3390/life14091208.
27. Hirata A, Ogura T, Hayashi N, Takenaka S, Ito H, Mizushina K, et al. Concordance of patient-reported joint symptoms, physician-examined arthritic signs, and ultrasound-detected synovitis in rheumatoid arthritis. Arthritis Care Res (Hoboken) 2017;69:801-6. doi: 10.1002/acr.23006.
28. Macía-Villa C, Falcao S, Gutierrez M, Medina J, Hammer HB, De Miguel E. Peritenon extensor tendon inflammation in psoriatic arthritis is an enthesitis-related lesion. J Rheumatol 2019;46:1295-8. doi: 10.3899/jrheum.180856.
29. Forney MC, Winalski CS, Schils JP. Magnetic resonance imaging of inflammatory arthropathies of peripheral joints. Top Magn Reson Imaging 2011;22:45-59. doi: 10.1097/RMR.0b013e31825c008d.
30. Ohrndorf S, Halbauer B, Martus P, Reiche B, Backhaus TM, Burmester GR, et al. Detailed joint region analysis of the 7-joint ultrasound score: Evaluation of an arthritis patient cohort over one year. Int J Rheumatol 2013;2013:493848. doi: 10.1155/2013/493848.
31. Hammer HB, Kvien TK, Terslev L. Tenosynovitis in rheumatoid arthritis patients on biologic treatment: involvement and sensitivity to change compared to joint inflammation. Clin Exp Rheumatol 2017;35:959-65.
32. Schett G, Rahman P, Ritchlin C, McInnes IB, Elewaut D, Scher JU. Psoriatic arthritis from a mechanistic perspective. Nat Rev Rheumatol 2022;18:311-25. doi: 10.1038/s41584-022-00776-6.
33. Gutierrez M, Filippucci E, Salaffi F, Di Geso L, Grassi W. Differential diagnosis between rheumatoid arthritis and psoriatic arthritis: The value of ultrasound findings at metacarpophalangeal joints level. Ann Rheum Dis 2011;70:1111-4. doi: 10.1136/ard.2010.147272.
34. Macía-Villa C, Falcao S, Gutierrez M, Medina J, Hammer HB, De Miguel E. What is metacarpophalangeal joint swelling in psoriatic arthritis? Ultrasound findings and reliability assessment. Clin Exp Rheumatol 2018;36:896-9.
35. Ahmed AR, Tharwat S, Abd el-Khalek AM, Eltoraby EE. AB1134 Ultrasound findings in hand joint involvement: a comparative study between psoriatic and rheumatoid arthritis. Ann Rheum Dis 2020;79:1857.
36. Wiell C, Szkudlarek M, Hasselquist M, Møller JM, Vestergaard A, Nørregaard J, et al. Ultrasonography, magnetic resonance imaging, radiography, and clinical assessment of inflammatory and destructive changes in fingers and toes of patients with psoriatic arthritis. Arthritis Res Ther 2007;9:R119. doi: 10.1186/ar2327.
37. Epis O, Paoletti F, d'Errico T, Favalli E, Garau P, Mancarella L, et al. Ultrasonography in the diagnosis and management of patients with inflammatory arthritides. Eur J Intern Med 2014;25:103-11. doi: 10.1016/j.ejim.2013.08.700.
38. Krajewska-Włodarczyk M, Owczarczyk-Saczonek A, Placek W, Wojtkiewicz M, Wiktorowicz A, et al. Distal interphalangeal joint extensor tendon enthesopathy in patients with nail psoriasis. Sci Rep 2019;9:3628. doi: 10.1038/s41598-019-39985-7.
39. McGonagle D, Kavanaugh A, McInnes IB, Kristensen LE, Merola JF, Strober B, et al. Association of the clinical components in the distal interphalangeal joint synovio-entheseal complex and subsequent response to ixekizumab or adalimumab in psoriatic arthritis. Rheumatology (Oxford) 2024;63:3115-23. doi: 10.1093/rheumatology/keae060.
40. Zayat AS, Ellegaard K, Conaghan PG, Terslev L, Hensor EM, Freeston JE, et al. The specificity of ultrasound-detected bone erosions for rheumatoid arthritis. Ann Rheum Dis 2015;74:897-903. doi: 10.1136/annrheumdis-2013-204864.
41. Coates LC, Freeston JE, Nam J, Conaghan PG, Helliwell PS. Ultrasound identifIes additional erosive disease in patients with early psoriatic arthritis-results from the Ticopa Study. Ann Rheum Dis 2015;74:353.
42. Girolimetto N, Costa L, Mancarella L, Addimanda O, Bottiglieri P, Santelli F, et al. Symptomatic psoriatic dactylitis is associated with ultrasound determined extra-synovial inflammatory features and shorter disease duration. Clin Rheumatol 2019;38:903-11. doi: 10.1007/s10067-018-4400-z.

43. Girolimetto N, Macchioni P, Tinazzi I, Costa L, Peluso R, Tasso M, et al. Predominant ultrasonographic extracapsular changes in symptomatic psoriatic dactylitis: Results from a multicenter cross-sectional study comparing symptomatic and asymptomatic hand dactylitis. Clin Rheumatol 2020;39:1157-65. doi: 10.1007/s10067-019-04683-2.
44. Pereira DF, Gutierrez M, de Buosi AL, Ferreira FB, Draghessi A, Grassi W, et al. Is articular pain in rheumatoid arthritis correlated with ultrasound power Doppler findings? Clin Rheumatol 2015;34:1975-9. doi: 10.1007/s10067-015-2964-4.
45. Tinazzi I, McGonagle D, Zabotti A, Chessa D, Marchetta A, Macchioni P. Comprehensive evaluation of finger flexor tendon entheseal soft tissue and bone changes by ultrasound can differentiate psoriatic arthritis and rheumatoid arthritis. Clin Exp Rheumatol 2018;36:785-90.
46. Girolimetto N, Macchioni P, Tinazzi I, Costa L, McGonagle D, Peluso R, et al. Ultrasonographic evidence of predominance of acute extracapsular and chronic intrasynovial patterns in 100 cases of psoriatic hand dactylitis. J Rheumatol 2020;47:227-33. doi: 10.3899/jrheum.190046.
47. Felbo SK, Østergaard M, Sørensen IJ, Terslev L. Which ultrasound lesions contribute to dactylitis in psoriatic arthritis and their reliability in a clinical setting. Clin Rheumatol 2021;40:1061-7. doi: 10.1007/s10067-020-05483-9.
48. Spirig A, Juon B, Banz Y, Rieben R, Vögelin E. Correlation between sonographic and in vivo measurement of A1 pulleys in trigger fingers. Ultrasound Med Biol 2016;42:1482-90. doi: 10.1016/j.ultrasmedbio.2016.02.017.
49. Tan AL, Fukuba E, Halliday NA, Tanner SF, Emery P, McGonagle D. High-resolution MRI assessment of dactylitis in psoriatic arthritis shows flexor tendon pulley and sheath-related enthesitis. Ann Rheum Dis 2015;74:185-9. doi: 10.1136/annrheumdis-2014-205839.
50. Smerilli G, Cipolletta E, Di Carlo M, Di Matteo A, Grassi W, Filippucci E. Power doppler ultrasound assessment of A1 pulley. A new target of inflammation in psoriatic arthritis? Front Med (Lausanne) 2020;7:204. doi: 10.3389/fmed.2020.00204.
51. Balint PV, Terslev L, Aegerter P, Bruyn GAW, Chary-Valckenaere I, Gandjbakhch F, et al. Reliability of a consensus-based ultrasound definition and scoring for enthesitis in spondyloarthritis and psoriatic arthritis: An OMERACT US initiative. Ann Rheum Dis 2018;77:1730-5. doi: 10.1136/annrheumdis-2018-213609.