

Article

Evaluation of hand and wrist joints using ultrasonography and doppler in patients of Rheumatoid Arthritis

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Abstract: Rheumatoid arthritis (RA) is a chronic autoimmune disease characterized by joint inflammation and systemic involvement. The management of RA has evolved over the years, with early diagnosis and rapid achievement of remission being the primary goals. In this prospective observational study conducted at the Department of Radio-diagnosis, Baroda Medical College and Hospitals, Vadodara, Gujarat, we aimed to evaluate the pathological involvement of hand and wrist joints in patients with rheumatoid arthritis using ultrasonography (USG) and color Doppler. A total of 32 diagnosed RA patients were included, and their clinico-pathological scores were assessed. The most common ultrasonographic finding in the examined wrist joints was joint synovitis, with the radio-carpal joint being the most frequently involved. Among the small joints of the hand, synovitis and erosions were commonly observed, with the second metacarpophalangeal joint showing the highest involvement. Comparison with clinical disease activity using the Disease Activity Score 28 (DAS-28) revealed that patients with higher DAS-28 scores had a higher incidence of pathological changes in hand and wrist joints on USG. The use of power Doppler ultrasound allowed for the monitoring of disease activity, with increased doppler signals observed in joints of patients with high disease activity. These findings were consistent with previous studies showing correlations between DAS-28 scores and ultrasound findings. Ultrasonography and color Doppler proved to be reliable tools for visualizing pathological processes in RA patients, with synovitis grading and power Doppler grading demonstrating good correlations with disease activity. In conclusion, ultrasonography and color Doppler can be valuable in assessing and monitoring rheumatoid arthritis, enabling early detection and accurate evaluation of joint involvement.

Keywords: Rheumatoid arthritis; Ultrasonography; Color Doppler; Hand and wrist joints; Disease activity monitoring.

1. Introduction

Rheumatoid arthritis (RA) is a chronic, systemic autoimmune disease characterized by joint inflammation that affects both large and small joints, as well as periarticular structures. The introduction of new classification criteria in 2010, which no longer required radiographic evidence of joint erosion, has facilitated quicker and easier diagnosis of patients. Consequently, the approach to managing RA has undergone significant changes in recent years, with early diagnosis and achieving remission becoming primary goals through a "treat-to-target" strategy. The advent of advanced imaging modalities such as magnetic resonance imaging (MRI) and musculoskeletal ultrasound (MSUS) has revolutionized the accurate assessment of RA patients compared to traditional clinical assessment. In particular, MSUS has emerged as a reliable, noninvasive, practical, and accessible tool for evaluating peripheral joints and periarticular structures involved in RA patients during clinical practice. MSUS has found utility in both diagnostic purposes, including differential diagnosis, and monitoring disease activity [1].

Within the context of MSUS, various ultrasonographic findings have been identified in RA, including synovitis. According to the OMERACT definitions published in 2005, synovial effusion/synovial hypertrophy is characterized by abnormal hypoechoic or anechoic intra-articular material that is displaceable and compressible, relative to subdermal fat. Power Doppler ultrasound (PDUS) and color Doppler (CD) are

employed to visualize the vascularization of inflamed synovium. Previous studies comparing histopathology with bone marrow ultrasonography (BMUS), PDUS, and MRI have demonstrated the highest correlation between PDUS and histopathology [2].

To assess synovitis in a semiquantitative manner, a scoring system is used. For BM synovitis, the scores are defined as follows: Grade 0 indicates the absence of synovial thickening, Grade 1 indicates mild synovial thickening, Grade 2 indicates moderate synovial thickening with bulging over the tops of peri-articular bones, and Grade 3 indicates marked synovial thickening with extension beyond the joint. For Doppler synovitis, the scores are defined as follows: Grade 0 denotes no flow in the synovium, Grade 1 indicates up to three single spot signals or up to two confluent spots or one confluent spot plus up to two single spots, Grade 2 indicates vessel signals in less than half of the synovial area, and Grade 3 indicates vessel signals in more than half of the synovial area [3].

Tenosynovitis, another important feature in RA, is characterized by the detection of hypoechoic or anechoic thickened tissue within the tendon sheath, with or without the presence of fluid. It can be visualized in two perpendicular planes and may exhibit a Doppler signal, indicating increased vascularity [4].

In addition to evaluating synovitis and tenosynovitis, the Disease Activity Score 28 (DAS28) is a commonly used scoring system to assess disease activity in RA. The formula for calculating DAS28(4) includes the following parameters: 28 tender joint count (t28), 28 swollen joint count (sw28), erythrocyte sedimentation rate (ESR), and general health (GH). By incorporating these variables, DAS28 provides a comprehensive measure of disease activity in RA patients.

The aims and objectives of this study are to evaluate the pathological involvement of hand and wrist joints using ultrasonography and color Doppler in patients with rheumatoid arthritis. The specific goals include assessing the presence of synovitis, erosions, and other changes in the hand and wrist joints through ultrasonography. Furthermore, the study aims to monitor disease activity using ultrasonography and color Doppler techniques.

By employing these advanced imaging methods, a comprehensive evaluation of RA-related joint pathology can be achieved, facilitating accurate diagnosis, disease monitoring, and treatment decision-making.

Other documented findings in RA on USG

1. Bone erosions
2. Tendon damage
3. Bursitis
4. Enthesopathy
5. Rheumatoid nodules

2. Material and Methods

2.1. Study Design

This study utilized a prospective observational design conducted in a hospital setting.

2.2. Study Center

The research was carried out at the Department of Radio-diagnosis, Baroda Medical College and Hospitals, located in Vadodara, Gujarat.

2.3. Study Period

The study was conducted from November 1, 2021, to October 30, 2022, spanning a duration of one year.

2.4. Sample Size

A total of 32 cases were included in the study based on the predefined criteria.

2.5. Inclusion Criteria

The study included patients who had been diagnosed with rheumatoid arthritis according to the 2010 ACR/EULAR criteria.

2.6. Exclusion Criteria

Patients with other rheumatic diseases were excluded from the study. Additionally, individuals with a history of hand and wrist trauma, those who had undergone any previous surgical procedure on the hand and wrist, and those with swelling or edema in the hand and wrist due to causes unrelated to the disease under investigation were also excluded.

By establishing clear inclusion and exclusion criteria, the study aimed to ensure a focused and relevant sample of participants for accurate evaluation of the pathological involvement of hand and wrist joints in rheumatoid arthritis.

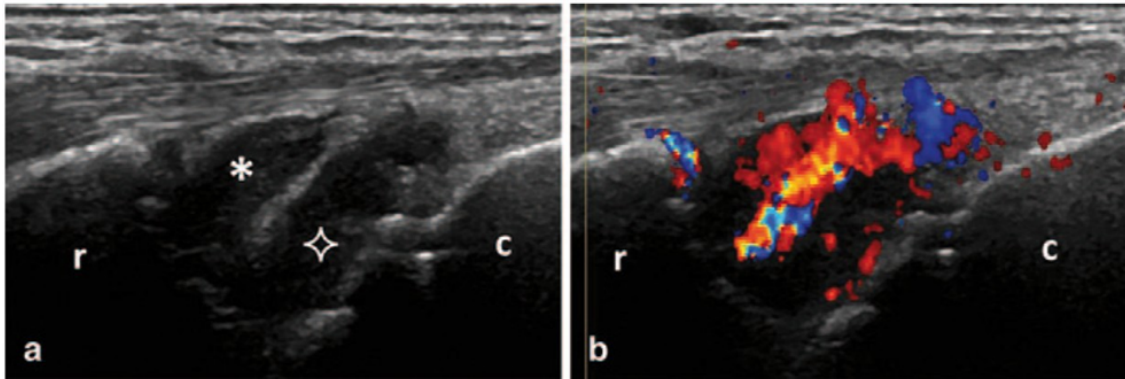


Figure 1

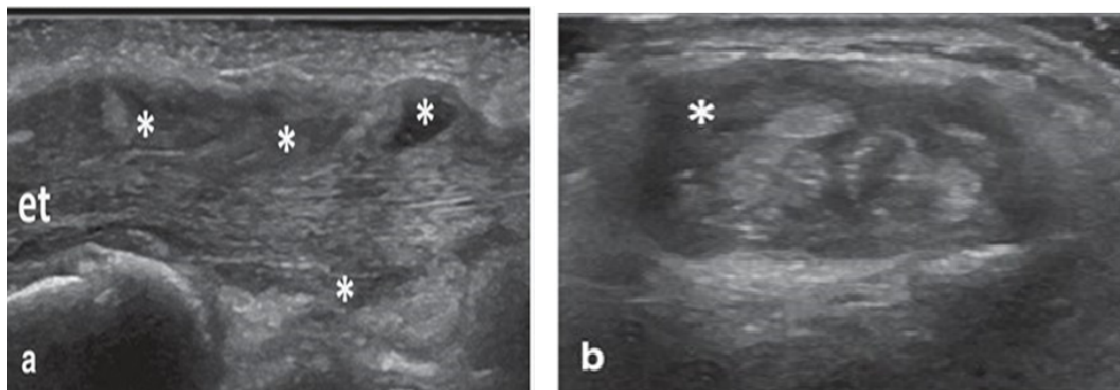


Figure 2

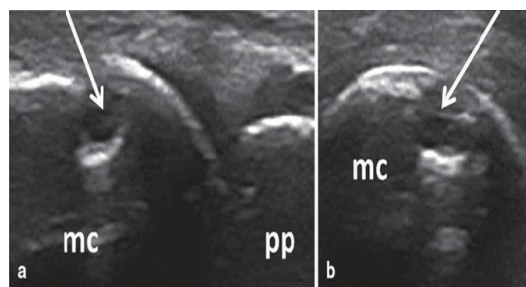


Figure 3

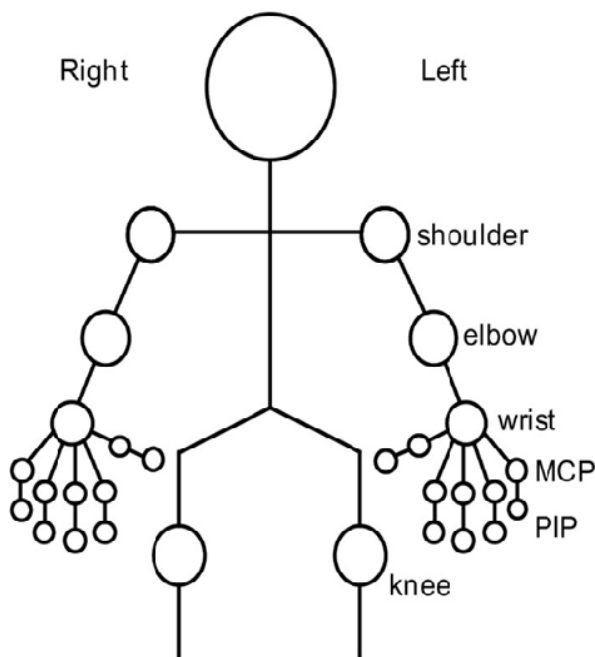


Figure 4

3. Results

Among patients with a DAS-28 score <5.1 , an abnormality on ultrasonography (USG) was detected in 1 out of 10 patients (10%). Conversely, in patients with a DAS-28 score >5.1 , abnormal findings on USG were observed in 16 out of 22 patients (72.72%). These results indicate that patients with a higher DAS-28 score exhibited a significantly greater prevalence of pathological changes in the hand and wrist joints.

The findings suggest a positive association between disease activity, as indicated by the DAS-28 score, and the presence of abnormal USG findings in the hand and wrist joints of patients with rheumatoid arthritis.

Table 1. Spectrum of findings at wrist joints

USG findings	Number of joints
Normal	2
Joint synovitis	16
Tenosynovitis	8
Bone erosions	5
Synovitis+erosions	1
Total	32

Table 2. Spectrum of findings in hand joints

USG findings	Number of joints
Normal	8
Synovitis	13
Erosions	8
Synovitis+erosions	3
Total	32

JSG FINDINGS IN HAND AND WRIST JOINTS	LOW DAS28 SCORE	MODERATE DAS28 SCORE	HIGH DAS28 SCORE	CHI SQUARE STATISTIC =10.86 pvalue<0.001
NO ABNORMALITY DETECTED ON ULTRASOUND	3	6	6	
ABNORMALITY DETECTED ON ULTRASOUND IN HAND AND WRIST JOINTS	0	1	16	

Figure 5. Comparison of disease activity with USG findings

Table 3. Correlation of grades of synovitis with clinicopathological disease activity

Synovitis grading	Patients with low to moderate das-	Patients with das-28 score (>5.1)
Grade 0		
Grade 1		
Grade 2	4	11
Grade 3	0	5

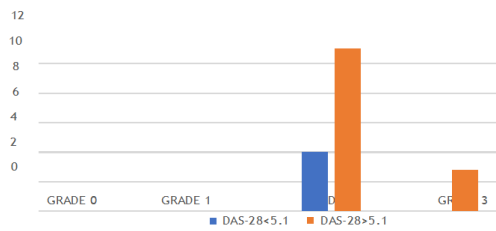


Figure 6. Chart Title

Table 4. Correlation of PDUS with clinico-pathological disease activity

Synovitis power doppler grading	Patients with low to moderate das- 28score(<5.1)	Patients with das-28 score (>5.1)
Grade 0	4	1
Grade 1	2	3
Grade 2	1	3
Grade 3	1	5

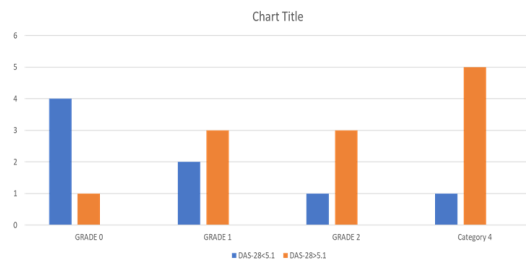


Figure 7

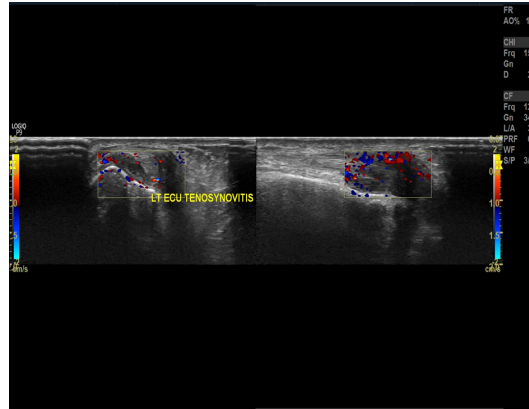


Figure 8

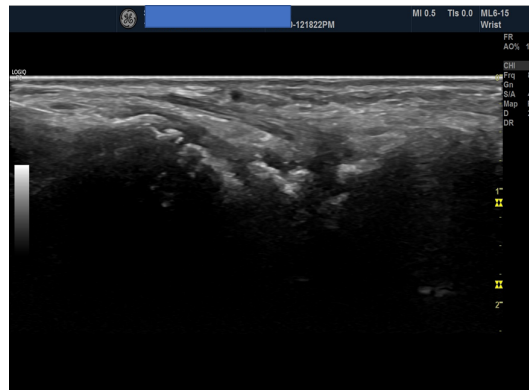


Figure 9

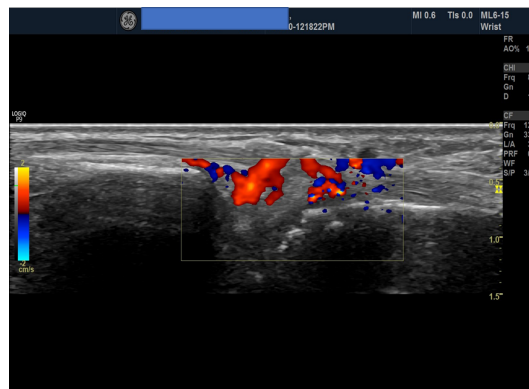


Figure 10

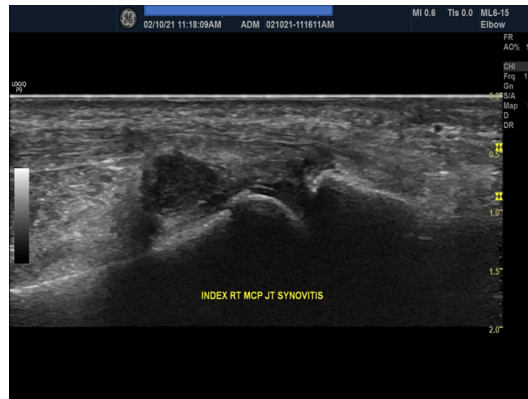


Figure 11

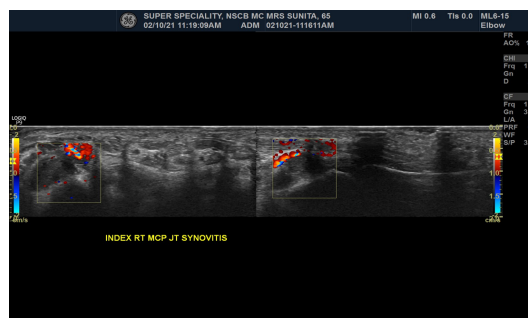


Figure 12

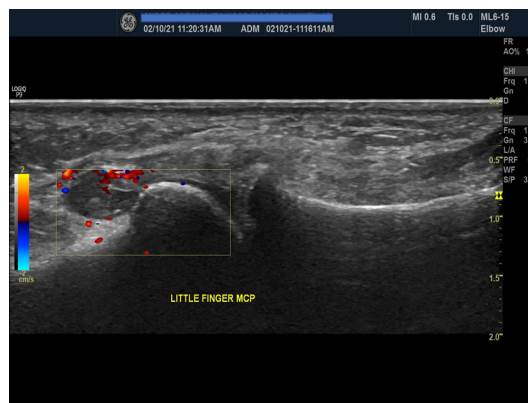


Figure 13

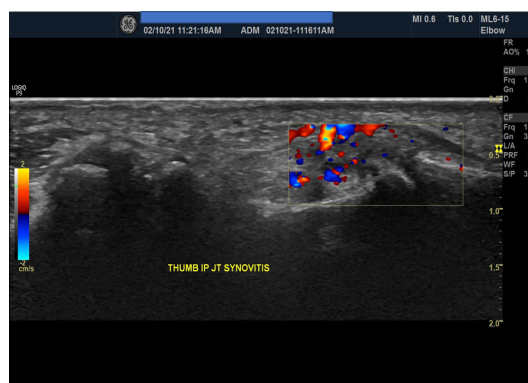


Figure 14

4. Discussion

In this study, patients diagnosed with rheumatoid arthritis were assessed using both clinical and pathological scoring systems, as well as ultrasonography and color Doppler imaging. Among the examined wrist joints, joint synovitis was the most common finding observed (50%). The radio-carpal joint was the most frequently involved joint, followed by the radio-ulnar joint. Regarding the small joints of the hand, synovitis (40%) and erosions (25%) were the most commonly observed abnormalities. The second metacarpophalangeal (MCP) joint showed the highest level of involvement.

When comparing the ultrasonography findings with clinical disease activity, it was observed that in patients with a DAS-28 score <5.1, abnormality on ultrasonography was detected in 1 out of 10 patients (10%). On the other hand, in patients with a DAS-28 score >5.1, abnormal findings on ultrasonography were detected in 16 out of 22 patients (72.72%). These results indicate that patients with higher DAS-28 scores have a significantly higher prevalence of pathological changes in the hand and wrist joints, as confirmed by ultrasound imaging ($p < 0.001$). These findings are consistent with previous studies demonstrated a good correlation between DAS-28 score and ultrasound findings. It had found a moderate to good correlation between the count of swollen joints and ultrasound-detected synovitis using power Doppler. Ultrasound-detected synovitis was shown to correlate better with erythrocyte sedimentation rate (ESR) compared to clinical assessment.

The use of power Doppler imaging for monitoring disease activity was evaluated in our study. Patients with synovitis in various hand and wrist joints were assigned a power Doppler ultrasound (PDUS) grade. It was observed that patients with high DAS-28 scores (>5.1) exhibited higher PDUS grades compared to patients with low DAS-28 scores (<5.1). This suggests that patients with high disease activity demonstrate increased Doppler signals at the examined joints. These results are consistent with other studies showed a fair to moderate correlation between Doppler ultrasound quantitative assessment of synovitis and the disease activity index (DAS) for 28 joints (DAS28). It was concluded that PD ultrasound can detect residual inflammation in rheumatoid arthritis patients in clinical remission, and the PDUS score was significantly associated with the Clinical Disease Activity Index (CDAI).

In conclusion, ultrasonography and color Doppler imaging of hand and wrist joints can be reliably used for visualizing the pathological processes in patients with rheumatoid arthritis. The pathological involvement observed on ultrasound imaging demonstrated a good correlation with the clinico-pathological profile of the disease. The grading of synovitis in conjunction with power Doppler grading showed a strong association with disease activity, with higher grades being assigned to patients with high disease activity and vice versa. Therefore, these imaging modalities can be valuable tools for monitoring disease activity in patients with rheumatoid arthritis.

Author Contributions: All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

Conflicts of Interest: The authors declare that they do not have any conflict of interests.

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