

## Diagnostic Accuracy of Ultrasonography for The Diagnosis of Rheumatoid Arthritis. A Systematic Review

**Safura**

Lecturer, Kalam Bibi International Women's Institute, Bannu, Pakistan.

**Nazish Rehman Orakzai**

Lecturer, Rehman College of Allied Health Sciences, Peshawar, Pakistan.

**Hilal Ahmad Malik\***

Department of Management Sciences, Ibadat International University, Islamabad, Pakistan.

Email: [hilal.ahmed@dms.iiui.edu.pk](mailto:hilal.ahmed@dms.iiui.edu.pk)

### Author Details

#### Keywords:

Rheumatoid arthritis, ultrasonography, diagnostic accuracy, sensitivity, specificity, synovitis, power Doppler, early detection

Received on 23 April, 2026

Accepted on 02 June, 2026

Published on 20 June, 2026

Corresponding E-mails & Authors\*:

**Hilal Ahmad Malik**

[hilal.ahmed@dms.iiui.edu.pk](mailto:hilal.ahmed@dms.iiui.edu.pk)

### Abstract

**Background:** Rheumatoid arthritis (RA) is a chronic autoimmune disorder characterized by persistent synovial inflammation, leading to progressive joint destruction and disability. Early and accurate diagnosis is essential for preventing irreversible joint damage and improving patient outcomes. Conventional diagnostic methods, including clinical evaluation, serological markers, and radiography, have limitations in detecting early-stage RA. Ultrasonography has emerged as a promising imaging modality for evaluating synovitis, tenosynovitis, and bone erosions in RA patients. However, its diagnostic accuracy remains a topic of debate. This systematic review aims to assess the sensitivity, specificity, and overall effectiveness of ultrasonography in diagnosing RA compared to other diagnostic modalities.

**Methodology:** A systematic literature review was conducted by searching five major electronic databases, including Google Scholar, PubMed, and Cochrane Library. Relevant studies published

in English between 2011 and 2024 were identified using Medical Subject Headings (MeSH) terms and keywords related to "ultrasonography," "rheumatoid arthritis," "diagnostic accuracy," "sensitivity," and "specificity." Studies involving adult patients with a confirmed or suspected RA diagnosis, which utilized ultrasonography as a diagnostic tool, were included. The study selection followed PRISMA guidelines, and data extraction focused on study characteristics, ultrasound techniques, and diagnostic accuracy measures. The Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool was used to evaluate the risk of bias.

**Results:** A total of ten studies were included in this review, comprising cross-sectional, cohort, and case-control studies. The sensitivity of ultrasonography in detecting RA ranged from 9% to 93.6%, while specificity varied from 55% to 98.2%. Power Doppler ultrasonography demonstrated superior sensitivity and specificity in detecting active synovitis compared to gray-scale ultrasonography. Several studies reported that ultrasonography is more effective than conventional radiography in identifying early joint changes and correlates well with disease activity and functional impairment scores. However, variability in operator expertise, differences in equipment, and the lack of standardized diagnostic criteria contributed to inconsistencies in reported diagnostic performance.

**Conclusion:** This systematic review highlights the significant role of ultrasonography in the early detection and assessment of RA. While ultrasonography, particularly power Doppler, offers high specificity and moderate-to-high sensitivity, its diagnostic accuracy is influenced by operator dependency and variations in scanning protocols. Despite these limitations, ultrasonography remains a valuable, non-invasive, and cost-effective tool that can complement clinical assessment and serological markers in RA diagnosis. Future studies should focus on standardizing ultrasound protocols and training to enhance its reliability and reproducibility in clinical practice.

## INTRODUCTION

Rheumatoid arthritis (RA) is a chronic, systemic autoimmune disorder characterized by persistent synovial inflammation, leading to progressive joint destruction, disability, and reduced quality of life(1). It is one of the most common inflammatory arthritis conditions, affecting approximately 0.5%–1% of the global population, with a higher prevalence among women(2). RA primarily targets the small joints of the hands and feet, but if left untreated, it can lead to severe joint deformities and extra-articular complications affecting the cardiovascular, respiratory, and nervous systems. Early diagnosis and intervention are crucial in preventing irreversible joint damage and improving patient outcomes(3). However, achieving an accurate and timely diagnosis remains challenging due to the heterogeneous nature of the disease, variability in clinical presentation, and limitations of conventional diagnostic methods(4).

The diagnosis of RA is typically based on a combination of clinical symptoms, serological markers, and imaging findings. The American College of Rheumatology (ACR) and European League Against Rheumatism (EULAR) classification criteria incorporate factors such as joint involvement, presence of rheumatoid factor (RF) and anti-citrullinated protein antibodies (ACPA), acute-phase reactants (C-reactive protein and erythrocyte sedimentation rate), and symptom duration. While these criteria improve diagnostic accuracy, they may not always detect early-stage RA(5). Serological markers, though useful, are not definitive, as a subset of patients with RA remains seronegative(6). Moreover, conventional radiography, which has been historically used to evaluate joint damage, lacks sensitivity in detecting early inflammatory changes, necessitating the use of more advanced imaging modalities(7).

Magnetic resonance imaging (MRI) and musculoskeletal ultrasonography (US) have emerged as valuable tools for the early detection of RA-related joint changes. MRI provides detailed visualization of synovial inflammation, bone marrow edema, and erosions, making it a highly sensitive modality for RA diagnosis(8). However, its high cost, limited availability, and lengthy examination times restrict its widespread use in routine clinical practice. In contrast,

ultrasonography is a non-invasive, cost-effective, and widely accessible imaging technique that allows real-time evaluation of synovial inflammation, tenosynovitis, and bone erosions(9). It has demonstrated superior sensitivity compared to radiography in detecting early joint abnormalities and can be used at the point of care to assess disease activity and response to treatment. Additionally, power Doppler ultrasonography enhances the detection of active synovitis by visualizing blood flow within the synovium, aiding in the differentiation between active and inactive disease states(10).

Despite these advantages, the diagnostic accuracy of ultrasonography in RA remains a topic of debate. Several factors, including operator dependency, variability in scanning protocols, differences in equipment quality, and the lack of standardized diagnostic criteria, contribute to discrepancies in study findings. While some studies report high sensitivity and specificity of ultrasonography in detecting RA-related joint changes, others suggest that its diagnostic performance may be limited when compared to MRI or serological markers. Since these reports give different results, a systematic review is needed to carefully examine the available evidence and find out how accurate ultrasonography is in diagnosing RA.

This systematic review aims to gather data from various studies to assess the sensitivity, specificity, and effectiveness of ultrasonography in diagnosing RA. By comparing ultrasonography with other diagnostic methods, including clinical evaluation, serological markers, and imaging modalities such as MRI, this review seeks to provide a comprehensive understanding of the role of ultrasonography in RA diagnosis.

## METHODOLOGY

A comprehensive systematic review was conducted to evaluate the diagnostic accuracy of ultrasonography in detecting rheumatoid arthritis. The literature search was performed using five major electronic databases, including Google Scholar, PubMed, and Cochrane Library. To ensure a thorough search, a combination of Medical Subject Headings (MeSH) terms and relevant keywords such as "ultrasonography," "rheumatoid arthritis," "diagnostic accuracy," "sensitivity,"

"specificity," "positive predictive value" and "negative predictive value" was used. Boolean operators (AND, OR) were applied to refine the search and maximize relevant study retrieval.

The eligibility criteria were carefully defined to ensure the inclusion of studies relevant to the research objective. Studies involving adult patients with a confirmed or suspected diagnosis of rheumatoid arthritis were selected. Only those studies that utilized ultrasonography as a diagnostic tool were considered. The review included systematic reviews, cohort studies, cross-sectional studies, and diagnostic accuracy studies to provide a comprehensive evaluation of the topic. Additionally, only studies published in English were considered to maintain consistency in data interpretation and analysis.

Several exclusion criteria were applied to eliminate studies that did not align with the research objectives. Studies that did not use ultrasound as a diagnostic method were excluded. Animal-based studies were also omitted, as they do not provide direct clinical relevance to human applications. Furthermore, studies that failed to report diagnostic accuracy measures such as sensitivity and specificity were excluded, as these parameters are essential for evaluating the effectiveness of ultrasonography in detecting rheumatoid arthritis.

The study selection process followed the PRISMA guidelines to ensure transparency and rigor. Initially, all retrieved articles were imported into reference management software (Zotero) to remove duplicate records. After duplicates were removed, titles and abstracts were screened based on the predefined inclusion and exclusion criteria. Articles that did not meet the eligibility requirements were excluded. In the next stage, full-text articles were reviewed to assess their relevance and methodological quality. Studies that lacked essential data, such as diagnostic accuracy measures, or used inappropriate reference standards were removed. After this rigorous selection process, the final set of studies was included for qualitative analysis.

Data extraction was conducted using a standardized form, capturing essential information such as study characteristics (authors, year, country, sample size), ultrasound techniques used, reference standards (such as MRI or clinical diagnosis), and diagnostic accuracy measures

(sensitivity, specificity, and predictive values). To ensure the reliability of the included studies, the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool was used to assess the risk of bias and methodological quality.

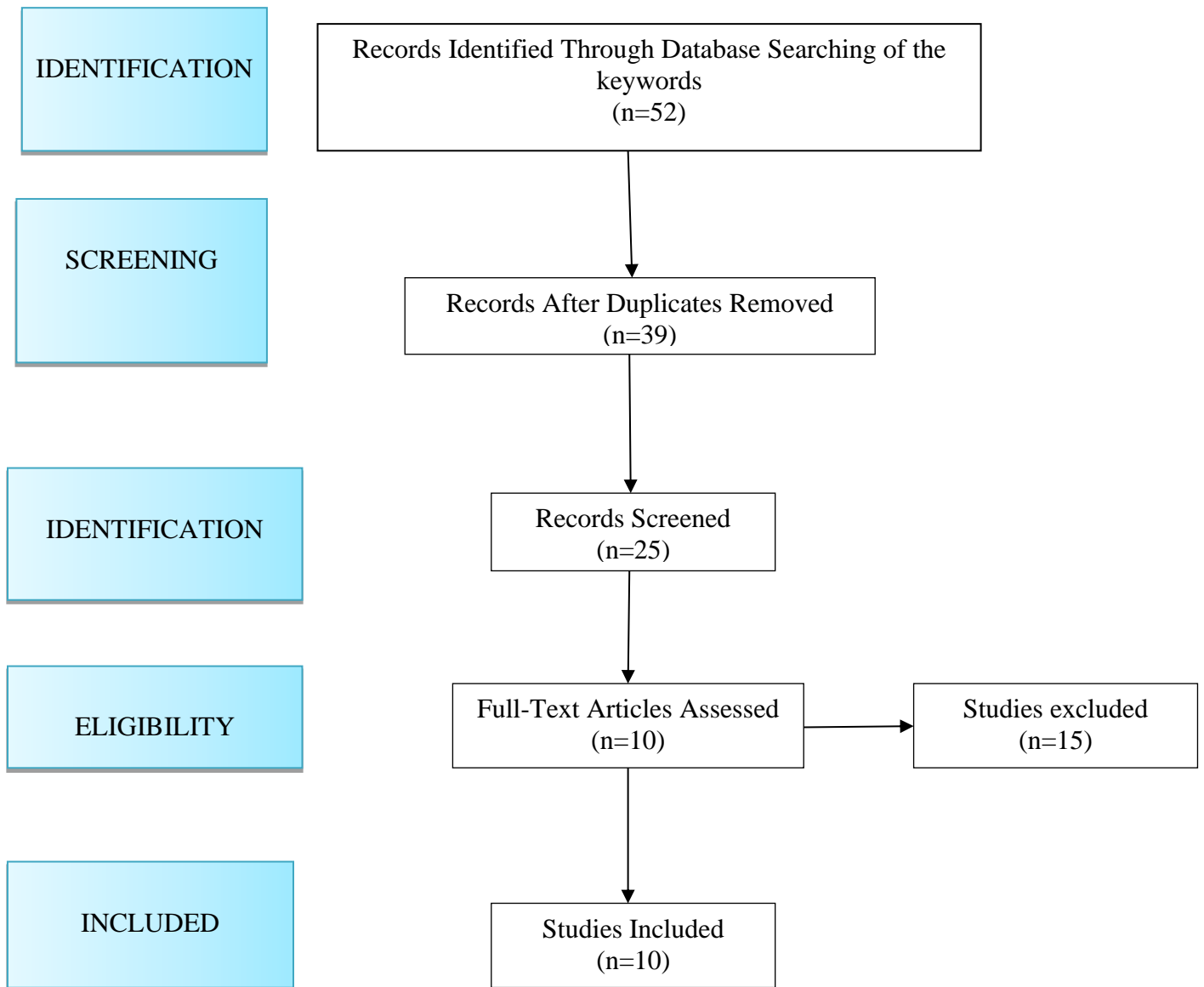


Figure 1- PRISMA Flow Diagram

## RESULTS

Table 1- Sensitivity and Specificity of Ultrasound for the diagnosis of Rheumatoid Arthritis

Author	Year	Journal name	Sample Size/ No. of article reviewed	Mean Age	Study design	Sensiti vity %	Specif icity %	PLR %	NLR %
Rahmani et al <sup>11</sup>	2021	Journal of ultrasound in medicine	They enrolled a total of 67 patients	The mean age of patien ts was 33.12	Cross- sectional	70.1	98.2	15.2	0.24
Hassan et al. <sup>9</sup>	2019	Journal of medical ultrasound	They reviewed a total of 29 articles including 934 patients in total	N/A	Review	58.3	93.8	N/A	N/A
Tang et al. <sup>12</sup>	2019	Clinical Rheumatol ogy	They reviewed a total of 26 articles including 1983 patients in total	N/A	Review	93.6	94.9	11.2	9

Kaoru et al. <sup>8</sup>	2018	Rheumatology	They reviewed a total of 601 articles with 376 patients in each study.	N/A	Review	73	78	3.32	0.35
Wang et al. <sup>13</sup>	2016	Experimental and Therapeutic Medicine	They enrolled a total of 39 patients	The mean age of patients was 51.8	Cohort	83	95	N/A	N/A
Ahmed S Zayat et al. <sup>14</sup>	2015	Annals of Rheumatic Disease	They enrolled a total of 310 patients	The mean age of patients was 52.6	Case Control	41.4	97.9	N/A	N/A
Peluso et al. <sup>15</sup>	2015	Clinical Rheumatology	They enrolled a total of 20 patients	The mean age of patients was 52	Cross Sectional	9	55	2	0.18

Døhn et al. <sup>16</sup>	2013	Annals of Rheumatic Disease	They enrolled a total of 49 patients	The mean age of patients was 61	Correlati onal	44	95	8.8	0.59
Døhn et al. <sup>17</sup>	2011	Annals of Rheumatic Disease	They enrolled a total of 52 patients	The mean age of patients was 61	Cohort	44	95	8.8	0.59
Filer et al. <sup>18</sup>	2011	Annals of Rheumatic Disease	They enrolled a total of 58 patients	The mean age of patients was 49.3	Cohort	38	93	5.43	0.67

**DISCUSSION**

In our systematic review, we evaluated studies conducted between 2011 and 2024 to assess the diagnostic accuracy of ultrasonography in detecting rheumatoid arthritis (RA). Our analysis focused on the effectiveness of ultrasonography in identifying early joint changes and assessing disease activity. The findings from the included studies indicate that ultrasonography, particularly gray-scale and power Doppler techniques, demonstrates high sensitivity and specificity in detecting synovitis and bone erosion. These results highlight ultrasonography as a valuable

imaging modality for diagnosing RA, providing clinicians with an effective tool for early detection and disease monitoring.

A systematic review by Hassan et al. (2019) assessed the reliability of ultrasonography for detecting RA by analyzing studies from 2001 to 2021. The review reported that the sensitivity and specificity of gray-scale ultrasonography for synovitis detection ranged from 47.4% to 100% and 50% to 90.9%, respectively. For power Doppler ultrasonography, sensitivity ranged from 21% to 92%, and specificity from 60% to 98%. In assessing bone erosion, ultrasonography demonstrated sensitivity between 35.9% and 83%, and specificity between 69% and 98.7%(9). The authors concluded that ultrasonography is a vital diagnostic tool compared to X-ray, CT, MRI, and clinical examinations for evaluating bone erosion, synovitis, and synovial hypervascularity in RA patients. In a 2021 study by Rahmani et al., the efficacy of musculoskeletal ultrasonography (MSUS) was compared to conventional radiography in early RA detection. Findings revealed that MSUS detected more hand joint erosions than conventional radiography. Additionally, sonographic evidence of synovitis and active erosion significantly correlated with disease activity scores and functional disability assessments. The study concluded that joint sonography is superior to conventional radiography in early detection of structural joint damage and active disease in early RA patients, correlating with disease activity and functional ability scores. The overall sensitivity and specificity of MSUS in detecting RA were reported as 70.1% and 98.2%, respectively(11).

Several other studies have contributed to the understanding of ultrasonography's diagnostic accuracy in RA. Tang et al. (2019) reported a sensitivity of 93.6% and specificity of 94.9%, demonstrating the strong diagnostic capability of ultrasonography(12). Similarly, a 2018 review by Kaoru Takase-Minegishi found a sensitivity of 73% and specificity of 78%(8). Wang et al. (2016) conducted a cohort study and reported a sensitivity of 83% and specificity of 95%, reinforcing ultrasonography's role in early detection(13). Conversely, Ahmed S. Zayat (2015) found a lower sensitivity of 41.4% but a high specificity of 97.9%, indicating that while ultrasound is highly specific, it may miss early cases in some instances(14).

Further supporting evidence comes from Peluso et al. (2015), who reported a sensitivity of just 9% but a specificity of 55%, suggesting limitations in certain clinical settings(15). Meanwhile, Døhn et al. (2013) and Døhn et al. (2011) found a sensitivity of 44% and specificity of 95% in both studies, highlighting variability in ultrasound performance across different study designs and populations(16)(17). Filer et al. (2011) reported a sensitivity of 38% and specificity of 93%, further confirming the technique's high specificity but moderate sensitivity(18).

Collectively, these studies underscore the utility of ultrasonography in the early detection and management of RA. The high sensitivity of ultrasonography, particularly in studies such as Tang et al. (2019) and Wang et al. (2016), suggests its superiority in identifying synovitis and bone erosions compared to conventional radiography. Moreover, the consistently high specificity values across multiple studies confirm ultrasonography's ability to accurately differentiate RA from other joint disorders. Despite some variations in reported sensitivity, ultrasonography remains a critical tool in the timely diagnosis and monitoring of RA progression, aiding in early intervention and improved patient outcomes.

## CONCLUSION

Ultrasonography is a highly effective diagnostic tool for RA, offering superior sensitivity in detecting early inflammatory changes compared to clinical examination and radiography. While it is a valuable modality for disease monitoring and treatment evaluation, its diagnostic accuracy is influenced by operator expertise and protocol standardization. Further research is needed to refine ultrasound techniques and integrate them into standardized RA diagnostic pathways, ensuring wider accessibility and improved patient outcomes.

## LIMITATIONS OF THE STUDY

Despite the valuable insights gained from this systematic review, several limitations must be acknowledged. One of the primary limitations is the variability in ultrasonography protocols and operator dependency across different studies. The accuracy of ultrasonography in diagnosing rheumatoid arthritis (RA) is highly influenced by the expertise of the sonographer, the quality of

the ultrasound equipment, and the specific scanning techniques used. This variation may have led to inconsistencies in sensitivity and specificity across the included studies.

Another limitation is the heterogeneity of the included studies in terms of study design, patient populations, and reference standards. Some studies focused solely on early RA, while others included a broader range of disease durations. Additionally, different imaging modalities were used as reference standards, including MRI and clinical examination, which may have influenced the reported diagnostic accuracy.

The inclusion of only English-language articles in this review may have introduced language bias, potentially excluding relevant studies published in other languages. Moreover, studies that did not report diagnostic accuracy measures, such as sensitivity and specificity, were excluded, which may have limited the overall scope of the findings.

Another challenge encountered was the limited availability of high-quality randomized controlled trials (RCTs) on this topic. Most of the included studies were observational in nature, such as cross-sectional and cohort studies, which may be prone to selection bias and confounding factors. The lack of standardized outcome measures and uniform scoring systems for ultrasonographic assessment further complicated the direct comparison of results across different studies.

Additionally, publication bias may have affected the findings of this systematic review. Studies with significant positive results are more likely to be published, while those with negative or inconclusive findings may be underreported, potentially skewing the overall conclusions.

Finally, while ultrasonography has demonstrated significant diagnostic potential for RA, its role in routine clinical practice remains limited due to factors such as accessibility, cost, and the need for specialized training. These practical challenges must be addressed in future research to enhance the clinical utility of ultrasonography for RA diagnosis and disease monitoring.

## FUTURE RECOMMENDATIONS

To enhance the diagnostic accuracy and clinical utility of ultrasonography in rheumatoid arthritis (RA), several future directions should be considered. First, there is a need for standardized ultrasound protocols and scoring systems for assessing synovitis, bone erosions, and disease activity. The development of universal guidelines will improve the consistency and comparability of findings across different studies and clinical settings.

Second, training programs and certification courses for sonologists and sonographers should be expanded to ensure that ultrasound is performed and interpreted with high accuracy. Since operator dependency remains a major limitation, structured education and hands-on workshops can help minimize interobserver variability and improve diagnostic reliability.

Third, future research should focus on conducting large-scale, multicenter randomized controlled trials (RCTs) to validate the role of ultrasonography in early RA detection and treatment monitoring. Longitudinal studies assessing its predictive value in disease progression and treatment response will further establish its place in routine clinical practice.

Another promising direction is the integration of artificial intelligence (AI) and machine learning in ultrasound imaging. AI-assisted analysis can help reduce subjectivity, enhance detection accuracy, and provide automated scoring of synovitis and joint inflammation. Future studies should explore the feasibility and effectiveness of AI-based ultrasound interpretation in RA diagnosis.

Furthermore, cost-effectiveness studies should be conducted to evaluate the financial feasibility of incorporating ultrasonography as a routine diagnostic tool in rheumatology clinics. Addressing economic barriers and improving accessibility in resource-limited settings will be crucial for its widespread adoption.

Finally, future systematic reviews and meta-analyses should aim to include a broader range of studies, including non-English publications and unpublished data, to minimize publication bias.

Expanding the search criteria and using robust statistical methods will help refine the evidence on ultrasonography's diagnostic performance in RA.

By addressing these key areas, ultrasonography can be better integrated into RA management, leading to earlier detection, improved patient outcomes, and more personalized treatment strategies.

## REFERENCES

- Smith MH, Berman JR. What is rheumatoid arthritis? *Jama*. 2022;327(12):1194–1194.
- Finckh A, Gilbert B, Hodkinson B, Bae SC, Thomas R, Deane KD, et al. Global epidemiology of rheumatoid arthritis. *Nat Rev Rheumatol*. 2022;18(10):591–602.
- Alivernini S, Firestein GS, McInnes IB. The pathogenesis of rheumatoid arthritis. *Immunity*. 2022;55(12):2255–70.
- Deane KD, Holers VM. The natural history of rheumatoid arthritis. *Clin Ther*. 2019;41(7):1256–69.
- Ruta S, Prado ES, Chichande JT, Ruta A, Salvatori F, Magri S, et al. EULAR definition of “arthralgia suspicious for progression to rheumatoid arthritis” in a large cohort of patients included in a program for rapid diagnosis: role of auto-antibodies and ultrasound. *Clin Rheumatol*. 2020 May 1;39(5):1493–9.
- Diagnostic Value of Musculoskeletal Ultrasound in Rheumatoid Finger Arthritis. *J Coll Physicians Surg Pak*. 2020 Jun 1;30(06):617–21.
- Filippucci E, Cipolletta E, Mashadi Mirza R, Carotti M, Giovagnoni A, Salaffi F, et al. Ultrasound imaging in rheumatoid arthritis. *Radiol Med (Torino)*. 2019 Nov;124(11):1087–100.
- Takase-Minegishi K, Horita N, Kobayashi K, Yoshimi R, Kirino Y, Ohno S, et al. Diagnostic test accuracy of ultrasound for synovitis in rheumatoid arthritis: systematic review and meta-analysis. *Rheumatology*. 2018;57(1):49–58.
- Hassan R, Hussain S, Bacha R, Gillani SA, Malik SS. Reliability of ultrasound for the detection of rheumatoid arthritis. *J Med Ultrasound*. 2019;27(1):3–12.

**DOI:** <http://doi.org/10.5281/zenodo.20772187>

Boylan M. Should ultrasound be used routinely in the diagnosis of rheumatoid arthritis? *Ir J Med Sci* 1971 -. 2020 May;189(2):735–48.

Rahmani M, Chegini H, Najafizadeh SR, Azimi M, Habibollahi P, Shakiba M. Detection of bone erosion in early rheumatoid arthritis: ultrasonography and conventional radiography versus non-contrast magnetic resonance imaging. *Clin Rheumatol*. 2021 Aug;29(8):883–91.

Tang H, Qu X, Yue B. Diagnostic test accuracy of magnetic resonance imaging and ultrasound for detecting bone erosion in patients with rheumatoid arthritis. *Clin Rheumatol*. 2020 Apr;39(4):1283–93.

Wang MY, Wang XB, Sun XH, Liu FL, Huang SC. Diagnostic value of high-frequency ultrasound and magnetic resonance imaging in early rheumatoid arthritis. *Exp Ther Med*. 2016 Nov;12(5):3035–40.

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(5):897–903.

Peluso G, Bosello SL, Gremese E, Mirone L, Di Gregorio F, Di Molfetta V, et al. Detection of bone erosions in early rheumatoid arthritis: 3D ultrasonography versus computed tomography. *Clin Rheumatol*. 2015 Jul;34(7):1181–6.

Døhn UM, Terslev L, Szkudlarek M, Hansen MS, Hetland ML, Hansen A, et al. Detection, scoring and volume assessment of bone erosions by ultrasonography in rheumatoid arthritis: comparison with CT. *Ann Rheum Dis*. 2013 Apr;72(4):530–4.

Døhn UM, Ejbjerg B, Boonen A, Hetland ML, Hansen MS, Knudsen LS, et al. No overall progression and occasional repair of erosions despite persistent inflammation in adalimumab-treated rheumatoid arthritis patients: results from a longitudinal comparative MRI, ultrasonography, CT and radiography study. *Ann Rheum Dis*. 2011;70(2):252–8.

Safura et al - 2026

3007-2387

3007-2379

**DOI:** <http://doi.org/10.5281/zenodo.20772187>

---

Filer A, De Pablo P, Allen G, Nightingale P, Jordan A, Jobanputra P, et al. Utility of ultrasound joint counts in the prediction of rheumatoid arthritis in patients with very early synovitis. *Ann Rheum Dis.* 2011;70(3):500–7.