E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.585

Original Research Article

Role of High-Resolution Sonography in the Evaluation of Non-Traumatic Wrist Joint Pain and Correlation with MRI Findings

Dr. Sanjeevi R.[1], Dr. Suvendu Ghosh[2]
[1]Third Year Postgraduate Trainee, Department of Radiodiagnosis, Murshidabad Medical College, Berhampore, Murshidabad, West Bengal, India.
[2]Assistant Professor, Department of Radiodiagnosis, Murshidabad Medical College, Berhampore, Murshidabad, West Bengal, India.
Corresponding Author
Dr. Sanjeevi R., Third Year Postgraduate Trainee, Department of Radiodiagnosis, Murshidabad Medical College, Berhampore, Murshidabad, West Bengal, India.
Received: 18.04.2026 Revised: 04.05.2026 Accepted: 20.06.2026 Published: 26.06.2026

ABSTRACT
Background: Non-traumatic wrist pain is a common clinical problem caused by a variety of conditions including tendinopathy, ganglion cysts, arthritis, carpal tunnel syndrome (CTS), solid masses, and triangular fibrocartilage complex (TFCC) tears. Magnetic Resonance Imaging (MRI) is considered the gold standard for evaluating wrist pathologies; however, its cost and limited availability may restrict routine use. High-resolution ultrasonography (USG) offers a rapid, non-invasive, and cost-effective alternative. This study evaluated the effectiveness of USG in diagnosing non-traumatic wrist pain and correlated its findings with MRI.
Methods: A descriptive observational cross-sectional study was conducted in the Department of Radiodiagnosis, Murshidabad Medical College and Hospital, West Bengal. Eighty patients presenting with non-traumatic wrist pain were included using purposive sampling. All participants underwent both high-resolution ultrasonography and MRI examination. MRI findings were considered the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and Cohen's kappa statistic were calculated to assess the diagnostic performance and agreement of USG with MRI.
Results: The mean age of participants was 43.2±12.3 years, with females constituting 55% of the study population. MRI identified tendinopathy (26.3%) as the most common pathology, followed by ganglion cysts (20.0%), arthritis (16.3%), solid masses (15.0%), CTS (13.8%), and TFCC tears (8.8%). Ultrasound demonstrated high sensitivity and specificity for tendinopathy (95.2%, 100%), ganglion cysts (93.8%, 100%), and solid masses (100%, 100%). Moderate sensitivity was observed for arthritis (69.2%) and CTS (72.7%). Ultrasound showed poor sensitivity for TFCC tears (14.3%), although specificity remained 100%. Overall agreement between USG and MRI was substantial (Cohen's κ = 0.78), with concordant findings in 81.3% of cases.
Conclusion: High-resolution ultrasonography is an effective first-line imaging modality for evaluating non-traumatic wrist pain, particularly for tendinopathy, ganglion cysts, and solid masses. Despite its limitations in detecting TFCC tears and certain deep intra-articular lesions, its high diagnostic accuracy, accessibility, and cost-effectiveness support its routine use, with MRI reserved for complex or inconclusive cases.

Keywords: Non-Traumatic Wrist Pain, High-Resolution Ultrasonography, MRI, Tendinopathy, Ganglion Cyst, Carpal Tunnel Syndrome, TFCC Tear, Diagnostic Accuracy.

INTRODUCTION
Non-traumatic wrist joint pain is a common clinical problem with a wide range of causes, including inflammatory arthritis, tendon disorders, ganglion cysts, nerve entrapment syndromes, and other soft-tissue lesions. Accurate diagnosis is essential for appropriate management because the wrist is a complex anatomical structure comprising multiple tendons, ligaments, joints, and neurovascular components. High-resolution sonography (USG) has emerged as an important imaging modality for evaluating wrist pathologies due to its ability to provide real-time visualization

of superficial musculoskeletal structures, detect synovial thickening, joint effusions, tendon abnormalities, and cortical erosions, and facilitate dynamic assessment during movement.[1]

Inflammatory arthritis commonly affects the wrist and may result in synovitis and erosive changes. Both ultrasound and magnetic resonance imaging (MRI) are more sensitive than clinical examination in detecting synovitis, with ultrasound demonstrating pooled sensitivity and specificity of approximately 73% and 78%, respectively, when MRI is used as the reference standard.[2] Ultrasound can also identify MRI-confirmed synovitis with high specificity (80–98%) and detect active inflammation through power Doppler imaging, which has excellent specificity for active synovitis.[3]

Tendon and peri-tendon disorders such as tenosynovitis, tendinopathy, and tendon tears are frequent causes of wrist pain. High-resolution ultrasound provides excellent visualization of tendon morphology and allows dynamic evaluation. Studies have shown comparable diagnostic performance between USG and MRI for tendinopathy, with both modalities demonstrating sensitivity of 95%, specificity of 100%, and accuracy of 97.5%.[4] Ultrasound is also highly effective in identifying ganglion cysts, solid soft-tissue masses, and carpal tunnel syndrome, with median nerve measurements showing strong correlation with MRI findings.[5,6]

MRI remains the gold standard for evaluating these conditions because of its superior soft-tissue contrast and ability to visualize cartilage, ligaments, and bone marrow changes. Comparative studies indicate that while ultrasound may be less sensitive than MRI for subtle synovitis and deep wrist lesions, it demonstrates high specificity and reliable diagnostic accuracy for most superficial pathologies.[2,3]

Aims and Objectives

The present study was undertaken to evaluate the effectiveness of ultrasonography (USG) in detecting the various causes of nontraumatic wrist joint pain and to assess its diagnostic utility in routine clinical practice. Additionally, the study aimed to determine the correlation between ultrasonographic findings and magnetic resonance imaging (MRI) findings in the identification of different pathological conditions responsible for nontraumatic wrist joint pain, thereby assessing the accuracy and reliability of USG as a diagnostic modality in comparison with MRI.

MATERIALS AND METHODS

Study Design

This descriptive observational cross-sectional study was conducted in the ultrasonography and MRI units of the Department of Radio diagnosis, Murshidabad Medical College and Hospital, Berhampore, West Bengal, among patients referred for the evaluation of non-traumatic wrist pain. The total study period was 18 months, comprising 2 months of preparatory work, 12 months of data collection, 2 months for data entry using Microsoft Excel, and 2 months for data compilation, statistical analysis, and report writing, with mutual overlapping of these phases. The study population included all eligible patients presenting with non-traumatic wrist pain who underwent both ultrasonography and magnetic resonance imaging as part of their diagnostic evaluation.\

Inclusion and Exclusion Criteria

The study included all patients presenting with painful wrist symptoms who were referred to the Department of Radiodiagnosis for ultrasonographic evaluation of the wrist and who met the eligibility criteria. Patients were excluded if they had MRI-incompatible implants, cardiac implants, or metallic foreign bodies that could interfere with MRI examination. In addition, patients with a history of recent wrist trauma were excluded from the study to ensure that only cases of non-traumatic wrist pain were evaluated.

Sample Size Calculation

Sample size is calculated using the formula

Sample size (n)= 3.84 pq /d2

Where p= prevalence, q = 1-prevalence

d = allowable error

From a previous study by El-Deek et al we get sensitivity of USG to detect wrist joint tendinopathy as 95%.[4]

So, taking p as 95%, d as 5%, at 95% confidence interval, the sample size was

$=3.84 \times 95\times 5/5^2$

= 72.9 or 73

Considering 10% dropout, final sample size was 80.

Data Collection Procedure

The data collection process consisted of a preparatory phase and an actual data collection phase. During the two-month preparatory phase, the study schedule was developed in English, translated into Bengali, linguistically validated by experts, pretested, and revised as necessary. Approval was

obtained from the Scientific Research Committee and Institutional Ethics Committee before commencement of the study. During the data collection phase, eligible patients were selected according to the predefined inclusion and exclusion criteria after obtaining written informed consent. Sociodemographic and clinical information were collected through face-to-face interviews and review of OPD tickets, bed head tickets, and relevant medical records. Each patient underwent imaging evaluation by the Department of Radiology using both ultrasonography and MRI. Depending on the referring department's request, patients initially underwent either USG or MRI, followed by the other imaging modality within a few days based on availability. The findings from both imaging techniques were subsequently recorded and correlated to assess the effectiveness of ultrasonography in detecting the causes of non-traumatic wrist pain and its agreement with MRI findings.

Statistical Analysis

After data collection, all records were cleaned, verified for completeness, and entered into a Microsoft Excel master sheet for analysis. Descriptive statistics were used to summarize the data, with continuous variables expressed as mean and standard deviation (SD), and categorical variables presented as frequencies and percentages. To evaluate the diagnostic effectiveness of ultrasonography (USG) in comparison with magnetic resonance imaging (MRI), sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. Furthermore, the level of agreement and correlation between USG and MRI findings in detecting various causes of non-traumatic wrist pain was assessed using Cohen's kappa statistic.

RESULTS

Variable	Frequency	Percentage (%)
Age (Mean ± SD)	43.2 ± 12.3 years	-
Male	36	45.0
Female	44	55.0
Total	80	100

Table 1. Demographic Characteristics of Study Participants (n=80)

Table 1 illustrates the demographic profile of the study participants. The mean age of patients presenting with non-traumatic wrist pain was 43.2±12.3 years. Females constituted a slightly higher proportion (55%) compared to males (45%), indicating a mild female predominance in the study population.

Condition	MRI n (%)	USG n (%)
Tendinopathy	21 (26.3)	20 (25.0)
Ganglion cyst	16 (20.0)	15 (18.8)
Arthritis	13 (16.3)	11 (13.8)
Solid mass	12 (15.0)	12 (15.0)
CTS	11 (13.8)	8 (10.0)
TFCC tear	7 (8.8)	1 (1.3)
Normal	0 (0.0)	13 (16.3)

Table 2. Frequency Distribution of Wrist Pathologies Detected by MRI and USG (n=80)

Table 2 shows the distribution of wrist pathologies detected by MRI and ultrasound. Tendinopathy was the most common diagnosis on both MRI (26.3%) and USG (25.0%), followed by ganglion cysts. The greatest discrepancy was observed for TFCC tears, where MRI identified seven cases while USG detected only one case. Ultrasound also reported 13 cases as normal despite MRI-confirmed pathology.

Condition	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Arthritis	69.2	97.0	81.8	94.2
Tendinopathy	95.2	100	100	98.3
Ganglion cyst	93.8	100	100	98.5
Solid mass	100	100	100	100
CTS	72.7	100	100	95.8

TFCC tear	14.3	100	100	92.4

Table 3. Diagnostic Performance of USG Compared with MRI (n=80)

Table 3 demonstrates the diagnostic accuracy of ultrasound using MRI as the gold standard. Ultrasound exhibited excellent sensitivity and specificity for tendinopathy, ganglion cysts, and solid masses. However, sensitivity was markedly reduced for TFCC tears (14.3%), indicating poor performance in detecting deep intra-articular lesions.

Condition	MRI Positive Cases	USG Correctly Detected	Detection Rate (%)
Arthritis	13	9	69.2
Tendinopathy	21	20	95.2
Ganglion cyst	16	15	93.8
Solid mass	12	12	100
CTS	11	8	72.7
TFCC tear	7	1	14.3

Table 4. True Positive Detection Rate of USG for Different Wrist Pathologies

Table 4 highlights the proportion of MRI-confirmed lesions correctly identified by ultrasound. Solid masses showed perfect detection, while TFCC tears demonstrated the lowest detection rate. The findings emphasize the effectiveness of USG for superficial lesions and its limitations for deep joint abnormalities.

Condition	MRI Cases	Missed by USG	False Negative Rate (%)
Arthritis	13	4	30.8
Tendinopathy	21	1	4.8
Ganglion cyst	16	1	6.2
Solid mass	12	0	0
CTS	11	3	27.3
TFCC tear	7	6	85.7

Table 5. Missed Diagnoses by Ultrasound

Table 5 reveals the lesions missed by ultrasound. The highest false-negative rate was observed for TFCC tears (85.7%), followed by arthritis and CTS. No solid masses were missed, confirming the reliability of ultrasound in detecting soft-tissue masses.

Parameter	Value
Total cases	80
Exact agreement	65
Agreement percentage	81.3%
Disagreement	15
Cohen's Kappa	0.78
Interpretation	Substantial agreement

Table 6. Agreement Between USG and MRI Diagnoses (n=80)

Table 6 illustrates the overall agreement between ultrasound and MRI findings. Ultrasound correctly matched MRI diagnoses in 81.3% of cases, with a Cohen's kappa value of 0.78 indicating substantial diagnostic agreement.

MRI Diagnosis	Correctly Diagnosed by USG	Misdiagnosed/Missed
Arthritis (13)	9	4
Tendinopathy (21)	20	1
Ganglion cyst (16)	15	1
Solid mass (12)	12	0
CTS (11)	8	3
TFCC tear (7)	1	6

Table 7. MRI–USG Cross-tabulation

Table 7 summarizes the agreement pattern between MRI and ultrasound. The highest concordance was observed for solid masses and tendinopathy, whereas TFCC tears showed the greatest discordance, accounting for most of the diagnostic discrepancies.

Rank	Pathology	Frequency	Percentage (%)
1	Tendinopathy	21	26.3
2	Ganglion cyst	16	20.0
3	Arthritis	13	16.3
4	Solid mass	12	15.0
5	CTS	11	13.8
6	TFCC tear	7	8.8

Table 8. Ranking of Wrist Pathologies Based on MRI Findings

Table 8 depicts the relative prevalence of various causes of non-traumatic wrist pain based on MRI findings. Tendinopathy emerged as the most common pathology, followed by ganglion cysts and arthritis. TFCC tears represented the least frequent diagnosis but posed the greatest challenge for ultrasound detection.

DISCUSSION

The mean age of participants in this study was 43.2 years (SD ±12.3), with a slight female predominance (55%), consistent with prior series. Chail et al. (2020) reported most patients between 21–60 years, and El-Kholy et al. (2015) noted 64% male patients in their cohort,[7] while Hampole et al. (2021) and Chail et al. both observed a female majority.[8,9] As in the literature, wrist pain was the universal presenting complaint, often with swelling or paresthesia. Clinical examination alone was insufficient for a definitive diagnosis in most cases, underscoring the need for imaging.[10]

The disease spectrum in our study - tendinopathy (26.3%), ganglion cysts (20.0%), arthritis (16.3%), solid masses (15.0%), CTS (14.0%), and TFCC tears (9.0%) - broadly mirrors published data. El-Deek et al. (2019) similarly reported tendinopathy as the most prevalent diagnosis at 40%,[4] while El-Jehory et al. (2019) found ganglion cysts in 28% and TFCC tears in 12% of 50 patients.[11] Arthritis prevalence in mixed imaging cohorts ranges from 10–20%,[7] and our 16.3% falls within this range, compared to up to 70% in rheumatology-focused studies.[9] Our higher proportion of solid masses (~15% vs. <5% in most series is likely attributable to referral bias at a tertiary centre. The slightly lower TFCC tear incidence (9% vs. 12–16% [4] reflects our strict exclusion of traumatic presentations.

For tendinopathy, ultrasound achieved 95.2% sensitivity and 100% specificity, closely replicating El-Deek et al.'s reported sensitivity and specificity of 95% and 100% for both modalities,[4] and Hampole et al.'s finding of 100% ultrasound sensitivity with MRI as reference.[8] For ganglion cysts, our ultrasound sensitivity of 93.8% is consistent with values approaching 95–100% in the literature.[8] Both modalities achieved 100% sensitivity and specificity for solid masses in this study, supported by comparable reports of equivalent ultrasound and MRI performance for superficial wrist tumours.[4] For CTS, our ultrasound sensitivity of 72.7% falls within the 70–80% range of comparative studies,[12] though high-resolution techniques using swelling ratio metrics have been shown to push sensitivity to 89% or higher [4] . Ultrasound sensitivity for arthritis was 69.2% in this series, below the 80–98% range achievable with power Doppler;[13] the shortfall likely reflects reliance on grey-scale imaging alone, as MRI identified bone marrow oedema and small erosions missed on ultrasound. The most significant limitation was in TFCC tear detection, where ultrasound sensitivity was only 14.3%. This is consistent with Singh et al. (2017), who documented poor ultrasound sensitivity for TFCC pathology,[14] and El-Deek et al., who reported 0% ultrasound sensitivity for TFCC tears against MRI.[4] MRI - particularly MR arthrography - remains the standard for this indication.[15]

Overall diagnostic agreement between ultrasound and MRI was substantial: 81.3% concordance and a Cohen's kappa of 0.78. This exceeds the $\kappa \approx 0.61$ reported by Backhaus et al. (2002) for synovitis detection in rheumatoid arthritis [16] and is consistent with the 67–90% concordance range across comparable series.[15] Singh et al. (2021), comparing HRUS and MRI in 40 patients,

found agreement in 67.5% of cases;[14] Parvathi et al. (2024) reported concordance in ~66%.[10] PPV for ultrasound was high (~95–100%) across all detectable lesion types,[8] while NPV was lower for TFCC and bony pathology. Thirteen cases read as normal on ultrasound harboured abnormalities on MRI, predominantly TFCC tears, early arthritis with marrow oedema, and one case of Kienböck's disease - findings inaccessible to ultrasound due to acoustic shadowing.

These results support positioning high-resolution ultrasound as the first-line imaging modality in non-traumatic wrist pain, as advocated by Singh et al. (2021), who recommended HRUS for initial evaluation with MRI reserved for equivocal or surgical cases.[14] Ultrasound's real-time dynamic capability (e.g., detection of ECU tendon instability in one case missed on MRI), sono-palpation, and capacity to guide therapeutic procedures further strengthen its clinical utility, particularly in resource-limited settings. MRI remains indispensable for deep intra-articular structures, TFCC and ligamentous injuries, osseous pathology, and complex or inconclusive cases.

CONCLUSION

High-resolution ultrasound is an effective, accessible, and cost-efficient first-line imaging modality for evaluating non-traumatic wrist pain, demonstrating high diagnostic accuracy for tendinopathy, ganglion cysts, and other superficial soft-tissue lesions, with substantial agreement with MRI findings. However, its limited sensitivity in detecting deeper intra-articular pathologies, particularly TFCC tears, highlights the continued importance of MRI as the gold standard for comprehensive wrist assessment. A stepwise imaging approach using ultrasound initially and reserving MRI for inconclusive or complex cases can optimize diagnostic accuracy, resource utilization, and patient care.

REFERENCES

1. Mülkoğlu C, Ayhan FF. A case with Behçet's disease involving erosive Metacarpophalangeal joint arthritis: the value of ultrasonography in the diagnosis of an Erosion. BMC Med Imaging 2020;20(1):60.
2. Takase-Minegishi K, Horita N, Kobayashi K, et al. Diagnostic test accuracy of ultrasound for synovitis in rheumatoid arthritis: systematic review and meta-analysis. Rheumatology (Oxford) 2018;57(1):49-58.
3. Ohrndorf S, Boer AC, Boeters DM, et al. Do musculoskeletal ultrasound and magnetic resonance imaging identify synovitis and tenosynovitis at the same joints and tendons? A comparative study in early inflammatory arthritis and clinically suspect arthralgia. Arthritis Res Ther 2019;21(1):59.
4. El-Deek AMF, Dawood EMAEHH, Mohammed AAM. Role of ultrasound versus magnetic resonance imaging in evaluation of non-osseous disorders causing wrist pain. Egypt J Radiol Nucl Med 2019;50:8.
5. Nepal P, Songmen S, Alam SI, et al. Common soft tissue tumors involving the hand with histopathological correlation. J Clin Imaging Sci 2019;9:15.
6. Hersh B, D'Auria J, Scott M, et al. A comparison of ultrasound and mri measurements of the cross-sectional area of the median nerve at the wrist. Hand (N Y) 2019;14(6):746-50.
7. El-Kholy M, Maaly M, Hemeeda Y. Role of MRI in evaluation of painful wrist joint. Menoufia Medical Journal 2015;28(2):503.
8. Hampole AB, Jeevika MU, Nirnay KK, et al. Ultrasonography and MRI evaluation in wrist joint pain. Asian J Med Radiol Res 2021;9(1):17.
9. Chail V, Abhijit N, Balasubramanyam R, et al. MR Evaluation in non Traumatic Chronic Wrist Pain. International Journal Contemporary Medicine, Surgery and Radiology 2020;5(1):A79-84.
10. Parvathi S, John PK, Sahana S. Role of ultrasonography in diagnosing wrist pathologies and correlating with MRI: a cross sectional study. Int J Dent Med Sci Res 2024;6(5):464-72.
11. El Shibiny AM, Abdul Rahim SA, AL Jbory NN. Assessment of wrist joint pain by Magnetic Resonance Imaging. Sohag Medical Journal 2019;23(2):28-37.
12. McNally EG. Ultrasound of the small joints of the hands and feet: current status. Skeletal Radiol 2008;37(2):99-113.
13. Yadav P, Lamba M, Bhagchandani D, et al. Comparison of ultrasound-doppler and magnetic resonance imaging

findings in rheumatoid arthritis of hand and wrist. International Journal of Health Sciences 2022;6(S5):11002-13.

14. Singh K, Thukral CL, Gupta K. Tendo-ligamentous pathologies of the wrist joint: can ultrasonography replace magnetic resonance imaging? The Egyptian Journal of Radiology and Nuclear Medicine 2017;48(3):653-60.
15. Oneson SR, Timins ME, Scales LM, et al. MR imaging diagnosis of triangular fibrocartilage pathology with arthroscopic correlation. AJR Am J Roentgenol 1997;168(6):1513-8.
16. Hoving JL, Buchbinder R, Hall S, et al. A comparison of magnetic resonance imaging, sonography, and radiography of the hand in patients with early rheumatoid arthritis. J Rheumatol 2004;31(4):663-75.