

Diagnostic Accuracy of Ultrasonography and Magnetic Resonance Imaging in the Evaluation of Rotator Cuff Pathologies: A Hospital-Based Observational Study.

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Abstract

Background:

Rotator cuff disorders are common causes of shoulder pain and disability. Ultrasonography (USG) is accessible and dynamic, whereas magnetic resonance imaging (MRI) provides broader soft-tissue, osseous, and intra-articular assessment.

Objectives:

To characterize rotator cuff pathology and acromion morphology and to compare USG findings with MRI in patients with suspected rotator cuff disease.

Methods:

This hospital-based cross-sectional comparative imaging study included 50 symptomatic patients evaluated at a government teaching hospital in Vijayawada from August 2023 to July 2024. All participants underwent USG followed by 1.5-T MRI. Frequencies, percentages, means, standard deviations, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were reported. Valid paired inferential p-values could not be calculated because participant-level discordant cells were unavailable in the retained dataset.

Results:

Participants were predominantly 51-60 years old (54.0%) and male (62.0%); 62.0% reported shoulder trauma and 76.0% had chronic symptoms. Type II curved acromion was most frequent (36.0%). MRI detected supraspinatus tendinopathy in 62.0%, partial-thickness tears in 22.0%, and full-thickness tears in 10.0%, compared with 50.0%, 18.0%, and 6.0% on USG. USG sensitivity ranged from 66.7% to 93.8% and NPV from 75.0% to 94.1%. No between-modality p-values are reported because valid paired contingency data were unavailable.

Conclusion:

USG detected clinically relevant rotator cuff abnormalities, while MRI identified more tendon lesions and additional associated pathology. The modalities are best interpreted as complementary within the limits of this dataset.

Recommendations:

USG can be used as an initial imaging examination when experienced operators are available; MRI is appropriate for equivocal findings, complex tears, or suspected associated intra-articular or osseous lesions.

Keywords: Rotator cuff; ultrasonography; magnetic resonance imaging; diagnostic imaging; shoulder; tendon tear.

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Introduction

Rotator cuff disorders constitute a major source of shoulder pain, weakness, and activity restriction in adults. The spectrum includes tendinopathy, partial-thickness tears, full-thickness tears, and secondary changes

involving the subacromial-subdeltoid bursae and long head of the biceps tendon. Population studies show a strong age-related increase in rotator cuff tears, including lesions in asymptomatic shoulders, indicating that structural degeneration can precede or exist independently

of clinical symptoms [1,2]. Trauma, dominant-arm use, and advancing age have been associated with tear prevalence, while metabolic conditions such as diabetes, hypertension, and hyperlipidemia are also linked with rotator cuff disease [1,3]. Because clinical manifestations overlap across tendinopathy, impingement-related disorders, tears, and other shoulder abnormalities, imaging has an important role in defining structural pathology and guiding management.

Ultrasonography (US) is widely used for rotator cuff assessment because it is non-ionizing, comparatively inexpensive, portable, and capable of dynamic examination. Modern high-frequency transducers permit direct evaluation of tendon echotexture, continuity, bursal fluid, biceps tendon position, and impingement during movement. Diagnostic performance, however, depends on operator expertise, examination technique, lesion size, and tear type. Meta-analyses have demonstrated high accuracy of US for full-thickness tears and clinically useful performance for partial-thickness tears, particularly when examinations are performed by experienced operators [4-6]. Arthroscopy-correlated investigations have also shown that US and MRI can achieve comparable accuracy for many rotator cuff tears [7,8].

MRI provides high soft-tissue contrast and multiplanar visualization of the rotator cuff, muscles, bursae, bone marrow, labrum, articular surfaces, and other intra-articular structures. Its broader field of assessment is particularly valuable when the clinical question extends beyond tendon integrity. Comparative studies indicate that MRI can add information after ultrasonography by identifying associated intra-articular lesions, although well-performed US remains an effective first-line examination in appropriate settings [9,10]. Previous comparative studies therefore support complementary roles for US and MRI in rotator cuff assessment [4-10]. Systematic evidence similarly indicates that diagnostic performance varies with tear type, study population, operator experience, and reference standard [4,5,11].

Anatomical factors can also influence rotator cuff pathology. Acromial morphology has long been examined in relation to impingement and cuff degeneration, although age and other structural variables can confound this relationship [12]. More recent work using quantitative scapular measurements has reinforced an association between individual scapular anatomy and degenerative rotator cuff tears [13]. Simultaneous characterization of tendon disease and acromial morphology can therefore provide useful descriptive information in patients investigated for shoulder symptoms.

The present study was undertaken to compare USG and MRI findings in patients with suspected rotator cuff pathology. The objectives were to identify tendinopathic changes, partial-thickness tears, and full-thickness rotator cuff tears; describe acromion morphology and evaluate its

relationship with rotator cuff pathology where supported by the available data; and summarize the comparative diagnostic performance of ultrasonography using MRI as the within-participant imaging comparator.

Methods

Study design

This hospital-based cross-sectional comparative imaging study was conducted from August 2023 to July 2024. Patients with clinical features suggestive of rotator cuff pathology underwent both ultrasonography and MRI during the study evaluation, enabling within-participant comparison of imaging findings.

Study setting

The study was conducted in the Department of Radio Diagnosis, New Government General Hospital, Vijayawada, Andhra Pradesh, India, a government teaching hospital affiliated with Government Siddhartha Medical College. The radiology department evaluates both inpatient and outpatient referrals, including patients with musculoskeletal complaints.

Participants and eligibility

Patients presenting with acute or chronic shoulder pain, shoulder stiffness, restriction of daily activities, or a history of shoulder trauma were eligible. Patients with claustrophobia or MRI contraindications documented in the source protocol, including cardiac pacemakers, cochlear implants, dental implants, and other contraindications to MRI, were excluded. Eligible patients were enrolled after written informed consent. The retained study records contained 50 enrolled participants but did not preserve a separate pre-enrolment screening log documenting the numbers initially approached, excluded before consent, or declining participation.

Clinical assessment and ultrasonography

Clinical history and physical examination assessed pain, range of motion, muscle strength, and tests for rotator cuff integrity. Ultrasonography was performed with 5-15 MHz linear probes using GE LOGIQ P9 and ESAOTE MY LAB X6 systems. Tendon integrity, echotexture, bursitis, and dynamic impingement were evaluated, while Doppler imaging assessed vascularity and inflammation. Findings were recorded for the biceps, subscapularis, supraspinatus, and infraspinatus tendons, the subacromial and subdeltoid regions, and the acromioclavicular joint.

Magnetic resonance imaging

MRI was performed on a Philips 1.5-T scanner using T1-weighted, T2-weighted, proton-density fat-suppressed, and short tau inversion recovery (STIR) sequences in axial, coronal, and sagittal planes. Evaluation included

tendon discontinuity, tendinopathic changes, muscle abnormalities, bursitis, joint pathology, and additional osseous or intra-articular abnormalities.

Outcome measures

Imaging findings were categorized as tendinopathic change, partial-thickness tear, full-thickness tear, bursitis, acromioclavicular arthritis, and other MRI-detected abnormalities. Acromion morphology was classified as type I flat, type II curved, type III hooked, or type IV convex. Sensitivity, specificity, PPV, and NPV for USG were reported using MRI findings as the within-participant comparator. Because the protocol did not include an independent arthroscopic or surgical reference standard, these indices represent comparative USG-MRI performance rather than accuracy against a definitive operative gold standard.

Bias

Potential selection bias was limited by applying the same clinical eligibility criteria to patients enrolled during the study period. Partial verification bias was reduced because every enrolled participant underwent both USG and MRI. Measurement variability was addressed by using predefined imaging protocols, specified equipment, and standardized categories for tendon and periarticular abnormalities. The study records did not document blinded image interpretation or interobserver reliability

assessment; these limitations were considered when interpreting comparative performance.

Statistical analysis

Data were entered in Microsoft Excel 2010 and analyzed using IBM SPSS Statistics for Windows, version 24.0. Categorical variables were summarized as frequencies and percentages, and quantitative variables as mean and standard deviation. USG and MRI findings were compared descriptively within the same participants. Reported sensitivity, specificity, PPV, and NPV were retained using MRI as the comparator. The analytical dataset available for this manuscript did not contain participant-level 2 x 2 discordant cells for each paired USG-MRI finding; consequently, a valid paired categorical test and corresponding inferential p-values could not be reconstructed. No unpaired chi-square or independent-sample testing was applied to the paired modality counts because that would violate the within-participant data structure.

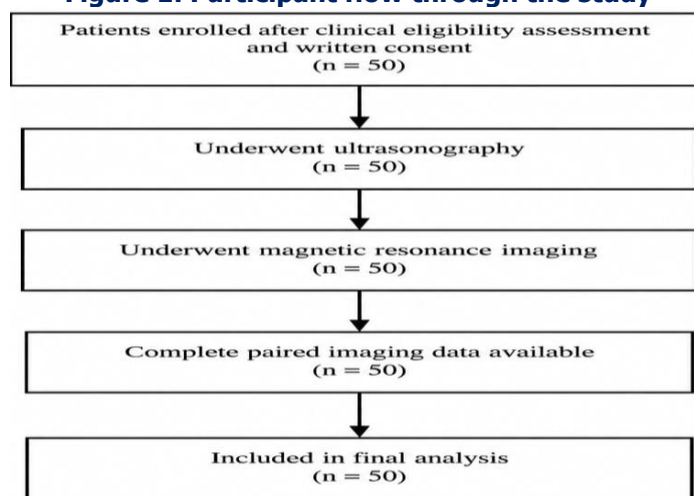
Ethical considerations

The study was conducted after approval from the Institutional Ethics Committee of Government Siddhartha Medical College, Vijayawada, Andhra Pradesh, India (Approval No. IECSMCGGH/2023/AP/107, dated 28 July 2023). Written informed consent was obtained from all participants. Confidentiality and privacy were maintained throughout the study, and procedures followed applicable institutional ethical standards.

Results

Participants

Figure 1. Participant flow through the study



The finalized study dataset contained 50 participants who had completed both USG and MRI, and all 50 were

included in the analysis. No post-enrolment loss occurred in the retained dataset. The numbers of patients screened

before enrolment, excluded before consent, or declining participation were not separately documented in the available study records; this is shown explicitly in Figure 1.

Baseline demographic and clinical characteristics

Table 1. Baseline demographic and clinical characteristics of participants (n = 50)

Characteristic	Value
Age, 20-30 years	2 (4.0%)
Age, 31-40 years	5 (10.0%)
Age, 41-50 years	16 (32.0%)
Age, 51-60 years	27 (54.0%)
Male sex	31 (62.0%)
Female sex	19 (38.0%)
Weight, kg	63.12 ± 6.45
Height, cm	169.11 ± 13.13
Body mass index, kg/m ²	25.17 ± 1.32
Diabetes mellitus	21 (42.0%)
Hypertension	12 (24.0%)
History of shoulder trauma	31 (62.0%)
Shoulder pain	41 (82.0%)
Shoulder stiffness	18 (36.0%)
Restriction of daily activities	50 (100.0%)
Acute symptoms	12 (24.0%)
Chronic symptoms	38 (76.0%)

Note. Data are n (%) unless otherwise stated. Comorbidities and presenting complaints are not mutually exclusive.

More than half of the participants were 51-60 years old (54.0%), and 62.0% were male. The mean body mass index was 25.17 ± 1.32 kg/m². Diabetes mellitus and hypertension were present in 42.0% and 24.0%, respectively. A history of shoulder trauma was recorded in 62.0%. Shoulder pain occurred in 82.0%, restriction of daily activities in all participants, and chronic symptoms in 76.0% (Table 1).

Acromion morphology

Table 2. Distribution of acromion morphology

Acromion type	n	%
Type I (flat)	16	32.0
Type II (curved)	18	36.0
Type III (hooked)	14	28.0
Type IV (convex)	2	4.0
Total	50	100.0

Acromion morphology was distributed across all four recorded types. Type II (curved) was most common in 18 patients (36.0%), followed by type I (flat) in 16 (32.0%), type III (hooked) in 14 (28.0%), and type IV (convex) in 2 (4.0%) (Table 2). The available dataset did not contain lesion-by-acromion cross-tabulations, so no inferential association or p-value between acromion type and individual rotator cuff lesions could be calculated.

Comparison of ultrasonography and MRI findings

Table 3. Comparison of ultrasonography and MRI findings

Structure/region	Pathological finding	USG, n (%)	MRI, n (%)
Biceps tendon	Tendinopathic changes	15 (30.0%)	16 (32.0%)
Biceps tendon	Fluid along tendon	12 (24.0%)	12 (24.0%)
Biceps tendon	Dislocation	2 (4.0%)	3 (6.0%)
Subscapularis	Tendinopathic changes	5 (10.0%)	5 (10.0%)
Subscapularis	Partial-thickness tear	2 (4.0%)	3 (6.0%)
Subscapularis	Full-thickness tear	1 (2.0%)	3 (6.0%)
Supraspinatus	Tendinopathic changes	25 (50.0%)	31 (62.0%)
Supraspinatus	Partial-thickness tear	9 (18.0%)	11 (22.0%)
Supraspinatus	Full-thickness tear	3 (6.0%)	5 (10.0%)
Infraspinatus	Tendinopathic changes	10 (20.0%)	11 (22.0%)
Infraspinatus	Partial-thickness tear	6 (12.0%)	6 (12.0%)
Infraspinatus	Full-thickness tear	1 (2.0%)	2 (4.0%)
Subacromial region	Bursitis	12 (24.0%)	15 (30.0%)
Subdeltoid region	Bursitis	11 (22.0%)	13 (26.0%)
Acromioclavicular joint	Arthritis	31 (62.0%)	35 (70.0%)

Note. A participant could have more than one imaging abnormality. USG = ultrasonography; MRI = magnetic resonance imaging. Because patient-level discordant paired cells were unavailable, valid paired p-values could not be calculated from these marginal counts.

MRI identified equal or greater frequencies of most tendon and periarticular abnormalities than USG. The largest absolute difference was observed for supraspinatus tendinopathy, detected in 31 patients (62.0%) on MRI versus 25 (50.0%) on USG. MRI also detected more supraspinatus partial-thickness tears (22.0% vs 18.0%),

full-thickness tears (10.0% vs 6.0%), subacromial bursitis (30.0% vs 24.0%), and acromioclavicular arthritis (70.0% vs 62.0%) (Table 3). Inferential between-modality p-values are not presented because the retained dataset did not include the participant-level discordant cells required for a valid paired comparison.

Additional MRI-detected abnormalities

Table 4. Additional pathological changes detected on MRI

MRI finding	n	%
Mild effusion	15	30.0
Minimal joint effusion	5	10.0
Intramuscular myxoma	1	2.0
Hill-Sachs lesion	7	14.0
Supraspinatus cyst	1	2.0
Labral tear	4	8.0
Osteomyelitis of humerus	5	10.0
Bankart tear	3	6.0
Glenoid labrum tear	3	6.0

Note. Multiple MRI findings could occur in the same participant.

MRI demonstrated additional abnormalities beyond the tendon-focused comparison. Mild effusion was most frequent, affecting 15 participants (30.0%), followed by Hill-Sachs lesions in 7 (14.0%). Minimal joint effusion

and osteomyelitis of the humerus were each recorded in 5 patients (10.0%), while labral tear was present in 4 (8.0%). Other lesions were less frequent (Table 4).

Diagnostic performance of ultrasonography

Table 5. Reported diagnostic performance of ultrasonography in comparison with MRI findings

Structure/region	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Biceps	93.8	50.0	48.4	94.1
Subscapularis tendon	66.7	50.0	40.0	75.0
Supraspinatus tendon	80.6	50.0	44.6	83.8
Infraspinatus tendon	90.9	50.0	47.6	91.7
Subacromial region	80.0	50.0	44.4	83.3
Subdeltoid region	84.6	50.0	45.8	86.7
Acromioclavicular joint	88.6	50.0	47.0	89.7

Note. The protocol used MRI as the imaging comparator and did not report an independent arthroscopic or surgical reference standard. PPV = positive predictive value; NPV = negative predictive value.

Reported USG sensitivity ranged from 66.7% for subscapularis pathology to 93.8% for biceps pathology, while NPV ranged from 75.0% to 94.1%. Specificity was reported as 50.0% for all evaluated structures, and PPV ranged from 40.0% to 48.4% (Table 5). These values are retained as reported in the source dataset and should be interpreted as comparative USG-MRI indices rather than accuracy against an operative reference standard.

Discussion

The study objectives were to characterize rotator cuff pathology, describe acromion morphology, and compare USG with MRI in the same symptomatic patients. Participant flow was complete after enrolment, with all 50 patients undergoing both modalities and entering the final analysis (Figure 1). The cohort was predominantly middle-aged, male, and chronically symptomatic, with a frequent history of trauma (Table 1). These characteristics are compatible with the established age-related increase in rotator cuff disease and evidence linking trauma and metabolic disorders with cuff pathology [1-3]. Because the sample consisted of symptomatic hospital attendees, these findings characterize the study population rather than population-level risk.

In relation to the first objective, the supraspinatus was the most frequently involved rotator cuff tendon. MRI identified supraspinatus tendinopathy, partial-thickness tears, and full-thickness tears more frequently than USG, and MRI also detected more bursitis and acromioclavicular arthritis (Table 3). MRI additionally demonstrated effusions, Hill-Sachs lesions, labral abnormalities, Bankart lesions, and humeral osteomyelitis (Table 4). This broader detection is consistent with MRI visualization of intra-articular, osseous, and soft-tissue structures beyond the rotator cuff [4,9,11]. Conversely, arthroscopy-correlated studies and meta-analyses indicate that high-quality US can approach MRI for many rotator cuff tears when performed by experienced operators [5-10,14].

For the second objective, type II curved acromion was the most common morphology, followed by type I flat and type III hooked patterns (Table 2). Earlier studies have examined acromial shape and age in relation to cuff disease, while quantitative scapular measures have also been associated with degenerative tears [12,13]. The present dataset, however, did not include cross-tabulated lesion-by-acromion data; therefore, the observed distribution should not be interpreted as evidence that one acromion type independently predicts a specific tendon lesion.

For the third objective, USG showed reported sensitivity of 66.7%-93.8% and NPV of 75.0%-94.1%, whereas specificity was 50.0% across the evaluated structures and PPV was 40.0%-48.4% (Table 5). Within this dataset, that pattern suggests stronger negative than positive classification performance. Published meta-analyses generally report higher specificity for expert ultrasonography [4-6,8]. The lower reported values in this study should be interpreted in the context of the small sample, operator dependence, lesion prevalence, the use of MRI rather than arthroscopy as the comparator, and the absence of raw paired discordant-cell data for inferential testing. Accordingly, the observed frequency differences between modalities remain descriptive and should not be presented as statistically significant differences without the underlying paired data.

Generalizability

The findings are most applicable to adults with symptomatic shoulder complaints evaluated in a hospital radiology service using high-frequency ultrasonography and 1.5-T MRI. Similar performance is most plausible in settings with comparable equipment and experienced musculoskeletal sonographers. Generalization to asymptomatic populations, primary-care screening, younger athletic cohorts, or centers using different imaging protocols requires caution. Larger multicenter studies with prospectively retained paired data, blinded

interpretation, and arthroscopic confirmation would provide more precise and externally valid estimates.

Conclusion

In this symptomatic hospital cohort, type II curved acromion was the most frequent morphology and the supraspinatus was the most commonly involved tendon. USG detected clinically important tendon, bursal, and acromioclavicular abnormalities and showed relatively high reported sensitivity and NPV for several structures. MRI identified more tendon abnormalities and additional intra-articular, osseous, and soft-tissue lesions. The findings support a complementary role for the two modalities, while the lack of an operative reference standard and paired inferential data requires cautious interpretation of comparative performance.

Limitations

This single-center study included only 50 symptomatic patients, limiting precision and external validity. Pre-enrolment screening and refusal counts were not retained, so selection before enrolment could not be quantified. The study used MRI as the comparator without an independent arthroscopic or surgical reference standard. Blinded interpretation and interobserver agreement were not documented. Participant-level discordant paired cells and confidence intervals for diagnostic indices were unavailable, preventing valid inferential p-values for between-modality comparisons.

Recommendations

High-frequency ultrasonography should be considered an initial imaging option for suspected rotator cuff disease when experienced operators and standardized examination protocols are available. MRI should be prioritized when USG is negative or equivocal despite persistent clinical suspicion, and when complex tears, labral injury, instability-related lesions, osseous disease, or other intra-articular abnormalities are suspected. Future studies should use larger multicenter samples, blinded independent image interpretation, prespecified diagnostic criteria, arthroscopy or operative findings as an external reference standard, and prospectively retained paired 2 x 2 data to permit valid p-values and confidence intervals for modality comparisons.

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List of Abbreviations

US - Ultrasound
USG - Ultrasonography
MRI - Magnetic Resonance Imaging
BMI - Body Mass Index
PPV - Positive Predictive Value
NPV - Negative Predictive Value
STIR - Short Tau Inversion Recovery
SPSS - Statistical Package for the Social Sciences

Source of Funding

None reported in the source study records.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability

Data are available from the corresponding author on reasonable request, subject to applicable institutional and ethical requirements.

Author Contributions

Dr. M. Bhargavi: Conceptualization, literature review, study design, data collection, radiological evaluation, data interpretation, preparation of the initial manuscript draft, and incorporation of revisions.

Dr. G. V. Parvatheswara Rao: Conceptualization, study methodology, supervision, interpretation of radiological findings, critical review of the manuscript, scientific editing, and final approval of the manuscript.

Dr. T. Savithri: Study supervision, methodological guidance, validation of imaging findings, interpretation of results, critical intellectual revision of the manuscript, and final approval of the manuscript.

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