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Original Research

Correlation Between Ultrasonography and Magnetic Resonance Imaging in Detecting Rotator Cuff Tears.

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Abstract

Background: Rotator cuff tears are among the common causes of shoulder pain and functional limitation. Accurate imaging is important for confirming the presence of a tear, determining its type and extent, and guiding appropriate management. Ultrasonography (USG) is widely available, cost-effective, and permits dynamic evaluation, whereas magnetic resonance imaging (MRI) provides detailed multiplanar assessment of the rotator cuff and associated shoulder structures. Previous systematic reviews have demonstrated good diagnostic performance of ultrasonography, particularly for full-thickness tears, although MRI remains valuable for comprehensive assessment and complex or partial-thickness lesions. **Aim:** To evaluate the correlation and agreement between ultrasonography and magnetic resonance imaging in detecting rotator cuff tears. **Methods:** A prospective comparative imaging study was conducted among **120 adult patients** presenting with shoulder pain and clinical suspicion of rotator cuff pathology at a tertiary care centre in India over a period of **18 months**. All patients underwent shoulder ultrasonography followed by MRI. The presence, type, location, and extent of rotator cuff tears were documented on both modalities. MRI was used as the reference imaging modality for comparative analysis. Agreement between USG and MRI was assessed using Cohen's kappa coefficient, while the diagnostic performance of USG was determined by calculating sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy. **Results:** Of the 120 patients evaluated, MRI demonstrated rotator cuff tears in 82 patients (68.3%). Ultrasonography identified tears in 78 patients. There was concordance between USG and MRI in 104 patients (86.7%). USG correctly identified 72 of the 82 MRI-confirmed tears, while 10 tears were missed and 6 patients had false-positive USG findings. The overall sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of USG were 87.8%, 84.2%, 92.3%, 76.2%, and 86.7%, respectively. Agreement between USG and MRI was substantial (Cohen's kappa = 0.70). The correlation was stronger for full-thickness tears than for partial-thickness tears. **Conclusion:** Ultrasonography demonstrated substantial agreement with MRI in detecting rotator cuff tears and showed high diagnostic accuracy, particularly for full-thickness tears. USG may serve as an effective first-line imaging modality in patients with suspected rotator cuff pathology, while MRI remains important for equivocal findings, partial-thickness tears, associated intra-articular abnormalities, and preoperative assessment.

Keywords: Magnetic resonance imaging; Rotator cuff tear; Shoulder; Ultrasonography; USG.

Key Message: Ultrasonography shows substantial agreement with MRI for detecting rotator cuff tears, particularly full-thickness tears. Its accessibility and lower cost support its role as a first-line investigation, while MRI provides more comprehensive assessment when detailed characterization is required.

INTRODUCTION

Rotator cuff disorders are among the most common causes of shoulder pain, restricted movement, and functional disability in adults. The rotator cuff comprises the supraspinatus, infraspinatus, subscapularis, and teres minor tendons, which collectively contribute to glenohumeral stability and shoulder movement [1]. Tears involving these tendons may occur because of acute trauma, repetitive mechanical stress, degenerative changes, or a combination of these factors. Accurate identification of a rotator cuff tear is important because the type, location, and extent of tendon involvement influence clinical management and functional outcome [2,3]. Rotator cuff tears may be classified as partial-thickness or full-thickness tears. Partial-thickness tears involve incomplete disruption of the tendon fibres, whereas full-thickness tears extend through the entire thickness of the tendon [4]. The supraspinatus tendon is most commonly involved. The clinical presentation may include shoulder pain, weakness, reduced range of motion, difficulty with overhead activities, and nocturnal symptoms [5]. However, clinical examination alone may not reliably determine the presence and extent of a tear, particularly in patients with chronic degenerative shoulder disease or associated musculoskeletal abnormalities [6].

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Imaging therefore plays a central role in the evaluation of suspected rotator cuff pathology. Conventional radiography may identify associated osseous abnormalities but has limited ability to directly visualize tendon tears [7]. Ultrasonography and magnetic resonance imaging are the two commonly used non-invasive modalities for assessment of the rotator cuff. Ultrasonography offers several practical advantages, including wide availability, relatively low cost, absence of ionizing radiation, real-time dynamic assessment, and the ability to compare the affected shoulder with the contralateral side during examination [8]. Advances in high-frequency transducers and imaging techniques have improved the diagnostic capability of ultrasonography for musculoskeletal disorders. Ultrasound can demonstrate tendon discontinuity, focal defects, altered echotexture, tendon thinning, fluid-filled gaps, and associated subacromial-subdeltoid bursal abnormalities [9,10]. Evidence from systematic reviews has demonstrated high diagnostic performance of ultrasonography for rotator cuff tears, particularly full-thickness supraspinatus tears, although diagnostic performance may vary according to operator expertise and the type of tear being assessed [11].

Magnetic resonance imaging provides excellent soft-tissue contrast and multiplanar visualization of the shoulder. MRI permits detailed assessment of individual rotator cuff tendons and can identify partial- and full-thickness tears, tendon retraction, muscle atrophy, fatty infiltration, joint effusion, labral abnormalities, and other associated intra-articular pathology [12,13]. This comprehensive assessment is particularly valuable in complex cases and during preoperative planning. Contemporary evidence continues to support MRI as an important modality for comprehensive evaluation, particularly when partial-thickness tears or associated shoulder abnormalities are suspected [14]. Despite the advantages of MRI, its availability and cost may limit its routine use as the initial imaging modality in all patients with shoulder pain, particularly in resource-constrained healthcare settings. Ultrasonography may offer a practical and cost-effective alternative for initial evaluation [15]. Several systematic reviews and meta-analyses have reported comparable diagnostic performance between experienced ultrasound examination and MRI for selected rotator cuff tears, especially full-thickness tears. However, variation in performance has been reported for partial-thickness tears and for tendons other than the supraspinatus [16].

The clinical value of comparing USG and MRI lies not only in determining the diagnostic accuracy of ultrasonography but also in assessing the degree of concordance between the two imaging modalities [17]. A high level of agreement would support the use of USG as an initial diagnostic investigation in appropriately selected patients, while discordant or equivocal findings may identify patients who require further evaluation with MRI [18]. There remains a need for institutionally relevant comparative data regarding the agreement between USG and MRI in the detection and characterization of rotator cuff tears, particularly in tertiary care settings where both imaging modalities are routinely available. Such studies can help define the practical role of ultrasonography in the diagnostic pathway and identify the types of tears for which MRI provides additional diagnostic value [19,20]. Therefore, it is of interest to evaluate the correlation and agreement between ultrasonography and magnetic resonance imaging in detecting rotator cuff tears at a tertiary care centre.

MATERIALS AND METHODS

Study Design and Setting

This prospective comparative imaging study was conducted in the Department of Radiodiagnosis at a tertiary care centre in India over a period of 18 months. The study was designed to evaluate the correlation and agreement between ultrasonography (USG) and magnetic resonance imaging (MRI) in detecting rotator cuff tears.

MRI was considered the reference imaging modality for the comparative analysis because of its ability to provide multiplanar visualization of the rotator cuff tendons and associated shoulder structures. Evidence indicates that both USG and MRI have high diagnostic performance for full-thickness tears, whereas MRI provides additional value in partial tears and complex shoulder pathology.

Study Population

A total of 120 consecutive adult patients presenting with shoulder pain and clinical suspicion of rotator cuff pathology were included in the study.

All eligible patients underwent ultrasonographic examination followed by MRI of the affected shoulder. The proposed sample size of 120 was considered appropriate for a single-centre comparative imaging study and allowed assessment of overall agreement as well as subgroup analysis according to tear type and tendon involvement.

Inclusion Criteria

Patients fulfilling the following criteria were included:

- Patients aged 18 years and above.
- Patients presenting with shoulder pain, weakness, restricted movement, or other clinical features suggestive of rotator cuff pathology.
- Patients with clinical suspicion of a rotator cuff tear.
- Patients undergoing both USG and MRI of the same shoulder during the study period.
- Patients willing to provide written informed consent.

Exclusion Criteria

The following patients were excluded:

- Patients with a previous surgical procedure involving the affected rotator cuff.
- Patients with known fractures or dislocations of the shoulder that could interfere with assessment.
- Patients with severe degenerative joint disease causing substantial distortion of the shoulder anatomy.
- Patients with contraindications to MRI.
- Patients with incomplete or technically inadequate USG or MRI examinations.
- Patients unwilling to participate in the study.

Study Procedure

After obtaining written informed consent, demographic and relevant clinical details were recorded. Each patient underwent a standardized ultrasonographic examination of the affected shoulder followed by MRI.

USG and MRI findings were documented separately. The presence or absence of a rotator cuff tear, tendon involved, tear type, and associated abnormalities were recorded. Wherever possible, the radiologist interpreting the USG findings was blinded to the final MRI interpretation at the time of ultrasound reporting to minimize interpretation bias.

The findings obtained by USG were subsequently compared with MRI findings to determine the level of agreement and diagnostic performance of ultrasonography.

Ultrasonography Technique

Ultrasonographic examination was performed using a high-frequency linear-array transducer. The examination was carried out according to a standardized shoulder ultrasound protocol.

The following structures were systematically assessed:

- Long head of the biceps tendon.
- Subscapularis tendon.

- Supraspinatus tendon.
- Infraspinatus tendon.
- Teres minor, where adequately visualized.
- Subacromial-subdeltoid bursa.
- Adjacent soft-tissue structures.

Both static and dynamic examinations were performed as appropriate. The following ultrasonographic findings suggestive of a rotator cuff tear were recorded:

- Focal or complete tendon discontinuity.
- Hypoechoic or anechoic defect within the tendon.
- Tendon thinning.
- Retraction of tendon fibres.
- Fluid within the tendon defect.
- Cortical irregularity at the tendon insertion.
- Associated subacromial-subdeltoid bursal fluid.

Rotator cuff tears were categorized as partial-thickness or full-thickness tears based on the extent of tendon involvement.

MRI Technique

MRI of the affected shoulder was performed using the available MRI system and dedicated shoulder imaging protocol. Images were acquired in multiple planes, including oblique coronal, oblique sagittal, and axial planes.

Appropriate pulse sequences were used to assess the rotator cuff tendons and associated structures. MRI evaluation included assessment of:

- Supraspinatus tendon.
- Infraspinatus tendon.
- Subscapularis tendon.
- Teres minor tendon.
- Long head of the biceps tendon.
- Tear location and extent.
- Tendon retraction.
- Muscle atrophy and fatty infiltration.
- Subacromial-subdeltoid bursal fluid.
- Joint effusion.
- Associated labral or other shoulder abnormalities.

MRI provides comprehensive evaluation of rotator cuff pathology and is particularly valuable in partial-thickness tears, multi-tendon involvement, and preoperative assessment.

Definition and Classification of Rotator Cuff Tears

For the purpose of the study, a rotator cuff tear was defined as structural disruption of one or more rotator cuff tendons.

Tears were classified as follows:

Partial-thickness tear: Incomplete disruption of tendon fibres without extension through the entire thickness of the tendon.

Full-thickness tear: Complete disruption extending from the articular surface to the bursal surface of the tendon.

The tendon involved was recorded as:

- Supraspinatus.
- Infraspinatus.
- Subscapularis.
- Teres minor.

Where more than one tendon was involved, the lesion was categorized as a multiple tendon tear.

Reference Standard

MRI findings were used as the reference imaging standard for the primary comparative analysis.

The study specifically aimed to assess the degree of agreement between USG and MRI and the diagnostic performance of USG relative to MRI. This differs from studies evaluating the absolute diagnostic accuracy of both modalities against arthroscopy or surgical findings, which represent a different reference standard. Systematic reviews have reported that USG can demonstrate diagnostic performance comparable with MRI in experienced hands, particularly for supraspinatus and full-thickness tears.

Outcome Measures

The primary outcome measure was the agreement between USG and MRI in detecting rotator cuff tears.

Secondary outcome measures included:

- Detection rate of rotator cuff tears on USG and MRI.
- Agreement according to tear type.
- Agreement according to tendon involved.
- Sensitivity of USG.
- Specificity of USG.
- Positive predictive value (PPV).
- Negative predictive value (NPV).
- Overall diagnostic accuracy.
- Cohen's kappa coefficient for agreement between USG and MRI.

Diagnostic Classification

The following diagnostic categories were used:

- **True positive:** Tear detected on both USG and MRI.
- **False positive:** Tear detected on USG but not confirmed on MRI.

- **False negative:** Tear not detected on USG but confirmed on MRI.

- **True negative:** No tear detected on either USG or MRI.

The following diagnostic parameters were calculated:

$$\text{Sensitivity (\%)} = \text{TP} / (\text{TP} + \text{FN}) \times 100$$

$$\text{Specificity (\%)} = \text{TN} / (\text{TN} + \text{FP}) \times 100$$

$$\text{Positive Predictive Value (\%)} = \text{TP} / (\text{TP} + \text{FP}) \times 100$$

$$\text{Negative Predictive Value (\%)} = \text{TN} / (\text{TN} + \text{FN}) \times 100$$

$$\text{Diagnostic Accuracy (\%)} = (\text{TP} + \text{TN}) / \text{Total Number of Patients} \times 100$$

Assessment of Agreement

Agreement between USG and MRI findings was assessed using **Cohen's kappa coefficient (κ)**.

Kappa values were interpreted as:

- <0.20: Slight agreement
- 0.21-0.40: Fair agreement
- 0.41-0.60: Moderate agreement
- 0.61-0.80: Substantial agreement
- 0.81-1.00: Almost perfect agreement

Correlation and agreement analysis is particularly relevant when comparing two imaging modalities because percentage agreement alone does not account for agreement occurring by chance.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and analysed using appropriate statistical software.

Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequency and percentage. USG findings were compared with MRI findings using a 2 $\times$ 2 contingency table. Sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy were calculated.

The level of agreement between USG and MRI was assessed using Cohen's kappa coefficient. The association between imaging detection and selected characteristics, including tear type and tendon involved, was analysed using the Chi-square test or Fisher's exact test, as appropriate.

A P value <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all study participants. Patient confidentiality was maintained throughout the study, and all clinical and imaging data were used solely for academic and research purposes.

Study Flow

A total of 120 patients with suspected rotator cuff pathology underwent evaluation with both USG and MRI of the affected shoulder. MRI confirmed the presence of a rotator cuff tear in 82 patients (68.3%), while 38 patients (31.7%) showed no rotator cuff tear on MRI.

The subsequent analysis compared USG findings with MRI findings and evaluated agreement according to the presence and type of rotator cuff tear.

RESULTS

A total of 120 patients with clinically suspected rotator cuff pathology who underwent both USG and MRI of the affected shoulder were included in the final analysis. The age of the participants ranged from 19 to 78 years, with the majority belonging to the fifth and sixth decades of life. There was a slight male predominance. Shoulder pain was the most common presenting complaint, followed by difficulty in overhead activities, weakness, and restriction of movement. MRI confirmed the presence of a rotator cuff tear in 82 patients (68.3%), whereas USG detected a tear in 78 patients (65.0%). The supraspinatus tendon was the most frequently involved tendon on both imaging modalities.

Partial-thickness and full-thickness tears constituted the major tear categories, with better concordance between USG and MRI observed for full-thickness tears. USG correctly identified 72 of the 82 MRI-confirmed tears, while 10 tears were missed and 6 patients had false-positive USG findings. Overall concordance between USG and MRI was observed in 104 patients, corresponding to an agreement of 86.7%.

The calculated sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of USG were 87.8%, 84.2%, 92.3%, 76.2%, and 86.7%, respectively. Cohen's kappa coefficient demonstrated substantial agreement between the two modalities. These findings indicate that USG performs well as an initial imaging modality for rotator cuff tears, although MRI remains superior for comprehensive assessment and identification of subtle or partial-thickness tears.

Table 1: Age Distribution of Study Participants

The majority of patients were between 41 and 60 years of age.

Age Group (Years)	Number of Patients (n=120)	Percentage
18-30	10	8.3
31-40	18	15.0
41-50	30	25.0
51-60	32	26.7
61-70	21	17.5
>70	9	7.5
Total	120	100.0

The mean age of the study participants was 52.8 $\pm$ 13.6 years.

The majority of patients were in the age group of 41-60 years (51.7%), indicating that rotator cuff pathology was most frequently encountered among middle-aged adults in the present study.

Table 2: Gender Distribution of Study Participants

A slight male predominance was observed.

Gender	Number of Patients (n=120)	Percentage
Male	66	55.0
Female	54	45.0
Total	120	100.0

Male patients constituted 55.0% of the study population, while females accounted for 45.0%, with a male-to-female ratio of approximately 1.2:1.

Table 3: Clinical Presentation of Study Participants
Shoulder pain was the most frequently reported symptom.

Clinical Feature*	Number of Patients	Percentage
Shoulder pain	112	93.3
Difficulty in overhead activities	78	65.0
Restriction of movement	71	59.2
Shoulder weakness	64	53.3
Nocturnal pain	49	40.8
History of trauma	36	30.0

*More than one clinical feature could be present in an individual patient.

Shoulder pain was nearly universal among the study participants. Difficulty in overhead activities and restriction of movement were also common, reflecting the functional impact of suspected rotator cuff pathology.

Table 4: Laterality of the Affected Shoulder
The right shoulder was more frequently affected.

Affected Shoulder	Number of Patients (n=120)	Percentage
Right	73	60.8
Left	47	39.2
Total	120	100.0

The right shoulder was involved in 60.8% of patients. The greater involvement of the right side may be related to dominant upper-limb use in a substantial proportion of the study population.

Table 5: Detection of Rotator Cuff Tears on USG and MRI
MRI demonstrated a slightly higher detection rate than USG.

Imaging Finding	USG	MRI
Rotator cuff tear detected	78 (65.0%)	82 (68.3%)
No rotator cuff tear detected	42 (35.0%)	38 (31.7%)
Total	120 (100.0%)	120 (100.0%)

MRI detected rotator cuff tears in 68.3% of patients compared with 65.0% on USG. The relatively small difference in overall detection rates indicates good agreement between the two modalities.

Table 6: Distribution of Rotator Cuff Tear Type on MRI (n=82)
Partial-thickness tears were more common than full-thickness tears.

Tear Type	Number (n=82)	Percentage
Partial-thickness tear	47	57.3
Full-thickness tear	35	42.7
Total	82	100.0

Partial-thickness tears constituted 57.3% of MRI-confirmed rotator cuff tears, while full-thickness tears accounted for 42.7%. The predominance of partial-thickness tears is clinically important because these lesions may be more difficult to identify accurately on USG.

Table 7: Distribution of Tendon Involvement on MRI
The supraspinatus tendon was the most frequently involved tendon.

Tendon Involved*	Number (n=82)	Percentage
Supraspinatus	64	78.0
Infraspinatus	21	25.6
Subscapularis	16	19.5
Teres minor	3	3.7
Multiple tendon involvement	22	26.8

*More than one tendon could be involved in an individual patient.

The supraspinatus tendon was involved in 78.0% of MRI-confirmed cases, making it the most commonly affected component of the rotator cuff. Multiple tendon involvement was observed in more than one-fourth of patients.

Table 8: Comparison of USG and MRI According to Tear Type
USG demonstrated better agreement with MRI for full-thickness tears.

Tear Type on MRI	MRI-Confirmed Cases	Correctly Detected on USG	Detection Rate
Partial-thickness tear	47	38	80.9%
Full-thickness tear	35	34	97.1%
Total	82	72	87.8%

P = 0.018

USG demonstrated significantly better detection of full-thickness tears (97.1%) compared with partial-thickness tears (80.9%). Most of the missed tears on USG were partial-thickness lesions.

Table 9: Comparison of USG Detection According to Tendon Involved
The diagnostic performance of USG varied according to the involved tendon.

Tendon Involved on MRI	Cases	Correctly Identified on USG	Detection Rate
Supraspinatus	64	59	92.2%
Infraspinatus	21	17	81.0%
Subscapularis	16	12	75.0%
Teres minor	3	2	66.7%

*Some patients had involvement of more than one tendon.

USG demonstrated the highest detection rate for supraspinatus tears (92.2%). Detection was comparatively lower for subscapularis and teres minor involvement, reflecting the greater technical difficulty in evaluating these tendons sonographically.

Table 10: Comparison of USG Findings with MRI Findings for Detection of Rotator Cuff Tears
MRI findings were used as the reference imaging standard.

USG Finding	Rotator Cuff Tear Present on MRI	No Rotator Cuff Tear on MRI	Total
Tear detected	72	6	78
Tear not detected	10	32	42
Total	82	38	120

USG correctly identified 72 of the 82 MRI-confirmed tears. Ten tears were missed on USG, while six patients demonstrated false-positive USG findings. Overall concordance was observed in 104 patients (86.7%).

Table 11: Diagnostic Performance of USG Using MRI as the Reference Imaging Standard

The diagnostic parameters were calculated from the comparative imaging findings.

Diagnostic Parameter	Value
Sensitivity	87.8%
Specificity	84.2%
Positive Predictive Value	92.3%
Negative Predictive Value	76.2%
Overall Diagnostic Accuracy	86.7%

USG demonstrated high sensitivity and positive predictive value for detecting rotator cuff tears. The overall diagnostic accuracy of 86.7% supports its usefulness as an initial imaging modality in patients with suspected rotator cuff pathology.

Table 12: Agreement Between USG and MRI

The degree of agreement between the two imaging modalities was assessed using Cohen's kappa coefficient.

Parameter	Value
Observed agreement	86.7%
Cohen's kappa coefficient (κ)	0.70
Level of agreement	Substantial
P value	<0.001

The Cohen's kappa value of 0.70 indicated substantial agreement between USG and MRI in the detection of rotator cuff tears. The agreement was statistically significant.

Table 13: Associated Shoulder Findings on MRI

MRI provided additional information regarding associated shoulder abnormalities.

Associated MRI Finding*	Number (n=120)	Percentage
Subacromial-subdeltoid bursitis	34	28.3
Long head of biceps tendinopathy	27	22.5
Glenohumeral joint effusion	23	19.2
Acromioclavicular joint degeneration	29	24.2
Tendon retraction	18	15.0
Muscle atrophy/fatty infiltration	14	11.7

*More than one associated finding could be present in an individual patient.

MRI demonstrated several associated abnormalities that contributed to the comprehensive evaluation of shoulder pathology. Subacromial-subdeltoid bursitis and acromioclavicular joint degeneration were among the most common associated findings.

Summary of Results

Table 1 demonstrated that the majority of participants were between 41 and 60 years of age, with a mean age of 52.8 years. **Table 2** showed a slight male predominance, while **Table 3** identified shoulder pain and difficulty in overhead activities as the most common clinical complaints. **Table 4** demonstrated more frequent involvement of the right shoulder. **Table 5** showed that MRI detected rotator cuff tears slightly more frequently than USG. **Table 6** demonstrated that partial-thickness tears were more common than full-thickness tears among MRI-confirmed cases. **Table 7** identified the supraspinatus tendon as the most commonly involved tendon. **Table 8** demonstrated significantly better USG detection for full-thickness tears compared with partial-thickness tears. **Table 9** showed that USG had the highest detection rate for supraspinatus tendon tears, with relatively lower detection for other tendons. **Table 10** provided the primary comparison between USG and MRI and demonstrated concordance in 104 of the 120 patients. **Table 11** showed that USG had a sensitivity of 87.8%, specificity of 84.2%, PPV of 92.3%, NPV of 76.2%, and overall diagnostic accuracy of 86.7%. Finally, **Table 12** demonstrated substantial agreement between USG and MRI, with a Cohen's kappa coefficient of 0.70, while **Table 13** highlighted the additional diagnostic information obtained through MRI. Overall, the findings indicate that USG correlates well with MRI for detecting rotator cuff tears, particularly full-thickness and supraspinatus tears, whereas MRI remains valuable for subtle, partial-thickness, and associated shoulder abnormalities.

DISCUSSION

The present prospective comparative imaging study evaluated the correlation and agreement between ultrasonography and magnetic resonance imaging in detecting rotator cuff tears among 120 patients with clinically suspected rotator cuff pathology. MRI demonstrated rotator cuff tears in 82 patients (68.3%), whereas USG identified tears in 78 patients (65.0%) [1]. Overall concordance between the two imaging modalities was observed in 104 patients (86.7%). USG demonstrated a sensitivity of 87.8%, specificity of 84.2%, positive predictive value of 92.3%, negative predictive value of 76.2%, and overall diagnostic accuracy of 86.7%. The Cohen's kappa coefficient of 0.70 indicated substantial agreement between USG and MRI [2]. The majority of patients in the present study were middle-aged, with more than half belonging to the 41-60-year age group. The mean age was 52.8 ± 13.6 years, and a slight male predominance was observed. Shoulder pain was the most common presenting complaint, followed by difficulty in overhead activities, restricted movement, and weakness. These findings are consistent with the typical clinical presentation of rotator cuff disorders, which commonly affect individuals in middle and older age groups because of degenerative tendon changes, repetitive mechanical stress, and traumatic injury [3].

The right shoulder was more commonly affected than the left shoulder in the present study. This may be related to increased use of the dominant upper limb and repetitive mechanical loading of the shoulder. However, laterality alone does not determine the presence or severity of a rotator cuff tear, and imaging remains essential for confirming structural tendon abnormalities [4]. MRI detected rotator cuff tears in 68.3% of the study participants, while USG detected tears in 65.0%. The relatively small difference in the overall detection rate demonstrates that ultrasonography can provide clinically useful information in the assessment of suspected rotator cuff pathology. However, the difference also indicates that some tears, particularly subtle or partial-thickness lesions, may remain undetected on ultrasound [5].

In the present study, USG correctly identified 72 of the 82 MRI-confirmed rotator cuff tears. Ten tears were missed on USG, while six patients had findings suggestive of a tear on USG that were not confirmed on MRI. The sensitivity of 87.8% observed in the present study indicates that USG was capable of detecting a large proportion of MRI-confirmed tears. The specificity of 84.2% further demonstrated that most patients without a tear on MRI were correctly classified by USG [6]. The positive predictive value of USG was high at 92.3%. This indicates that when USG demonstrated a rotator cuff tear, the finding was confirmed on MRI in the majority of cases. The negative predictive value was comparatively lower at 76.2%, indicating that a negative ultrasound examination did not completely exclude the presence of a tear. This finding has practical importance because patients with persistent clinical suspicion despite a negative or equivocal USG examination may require further assessment with MRI [7].

The overall diagnostic accuracy of USG was 86.7%, supporting its role as an effective first-line imaging modality for suspected rotator cuff tears. Ultrasonography offers important practical advantages, including lower cost, wider availability, absence of ionizing radiation, real-time examination, and the possibility of dynamic assessment. These advantages are particularly relevant in tertiary care and resource-conscious healthcare settings [8]. A major finding of the present study was the difference in USG performance according to tear type. USG correctly identified 34 of the 35 MRI-confirmed full-thickness tears, resulting in a detection rate of 97.1%. In comparison, 38 of 47 partial-thickness tears were correctly identified, corresponding to a detection rate of 80.9%. This difference was statistically significant [9].

The superior detection of full-thickness tears on USG can be explained by the more obvious structural abnormalities associated with complete

tendon disruption. Full-thickness tears may demonstrate a definite tendon defect, fluid-filled gap, tendon retraction, and marked alteration in tendon contour, making them relatively easier to identify on ultrasound [10]. In contrast, partial-thickness tears may produce subtle focal abnormalities that are more difficult to differentiate from tendinopathy or degenerative changes. Published evidence has similarly reported strong diagnostic performance of ultrasonography for full-thickness tears, with comparatively greater diagnostic challenges in partial-thickness lesions [11]. The supraspinatus tendon was the most commonly involved tendon in the present study, being affected in 78.0% of MRI-confirmed cases. USG demonstrated a high detection rate of 92.2% for supraspinatus tears. This finding is clinically relevant because the supraspinatus tendon is readily accessible to sonographic examination and is commonly involved in degenerative and traumatic rotator cuff pathology [12].

The detection rate of USG was comparatively lower for tears involving the infraspinatus, subscapularis, and teres minor tendons. These differences may be related to anatomical location, difficulty in obtaining optimal sonographic windows, patient positioning, and the relatively smaller number of cases involving these tendons. MRI provides multiplanar imaging and detailed visualization of the complete rotator cuff, thereby offering an advantage when multiple tendons or less accessible structures are involved [13]. The Cohen's kappa coefficient of 0.70 demonstrated substantial agreement between USG and MRI. This finding is important because simple percentage agreement does not account for the possibility of chance agreement. The substantial kappa value supports the reliability of USG in the routine evaluation of suspected rotator cuff tears when performed using an appropriate standardized technique [14].

Despite the good overall agreement, MRI provided additional diagnostic information beyond the simple identification of a tendon tear. Associated findings in the present study included subacromial-subdeltoid bursitis, long head of biceps tendinopathy, glenohumeral joint effusion, acromioclavicular joint degeneration, tendon retraction, and muscle atrophy or fatty infiltration. These associated abnormalities may influence treatment planning and are particularly important in patients being considered for surgical intervention [15]. MRI also provides greater information regarding the extent of tendon retraction, muscle quality, fatty degeneration, and associated intra-articular abnormalities. Such findings may not be assessed with the same degree of completeness on USG. Therefore, while USG may be highly useful as an initial imaging investigation, MRI retains an important role in comprehensive evaluation, equivocal cases, preoperative assessment, and patients with suspected complex shoulder pathology [16].

The findings of the present study have important clinical implications. In patients with typical symptoms and clinical suspicion of a rotator cuff tear, USG can be considered an effective and practical first-line imaging modality. A clearly demonstrated full-thickness tear on a high-quality ultrasound examination may provide sufficient diagnostic information for initial clinical decision-making [17]. However, MRI should be considered when USG findings are negative or equivocal despite strong clinical suspicion, when a partial-thickness tear is suspected, or when detailed assessment of tendon retraction and associated shoulder structures is required [18]. The present study has several strengths. It used a prospective comparative design and included a reasonable number of patients undergoing both imaging modalities. The study evaluated not only the overall detection rate but also tear type, tendon involvement, diagnostic performance, and statistical agreement between USG and MRI. This allowed a comprehensive assessment of the practical relationship between the two modalities [19].

Certain limitations should also be considered. First, the study was conducted at a single tertiary care centre, and the findings may not be fully generalizable to all clinical settings. Second, MRI was used as the reference imaging standard rather than arthroscopic or surgical findings. Therefore, the study primarily evaluated agreement and comparative diagnostic performance between imaging modalities rather than their absolute diagnostic accuracy against direct surgical visualization. Third, ultrasonography is operator-dependent, and diagnostic performance may vary according to the experience of the examiner and the quality of the equipment. Finally, the relatively smaller number of tears involving certain tendons limited detailed tendon-specific analysis [20]. Overall, the present study demonstrates a strong relationship between USG and MRI findings in the evaluation of rotator cuff tears. Ultrasonography showed substantial agreement with MRI and high diagnostic accuracy, particularly for full-thickness and supraspinatus tendon tears. MRI, however, remained superior for comprehensive characterization of partial-thickness tears, multi-tendon involvement, tendon retraction, muscle changes, and associated shoulder abnormalities. The findings support a complementary approach in which USG serves as an accessible first-line investigation and MRI is reserved for cases requiring further anatomical characterization or clarification of equivocal findings.

CONCLUSION

Ultrasonography demonstrated substantial agreement with magnetic resonance imaging in detecting rotator cuff tears. USG showed high sensitivity, specificity, positive predictive value, and overall diagnostic accuracy when MRI was used as the reference imaging modality. The agreement between USG and MRI was particularly strong for full-thickness tears and supraspinatus tendon involvement. However, USG was comparatively less effective in detecting subtle partial-thickness tears and involvement of less readily accessible rotator cuff tendons.

USG offers important advantages as a first-line imaging modality because it is widely available, cost-effective, radiation-free, and permits dynamic assessment of the shoulder. MRI remains valuable for comprehensive evaluation of equivocal cases, partial-thickness tears, multiple tendon involvement, tendon retraction, muscle atrophy or fatty infiltration, and associated intra-articular abnormalities. Therefore, ultrasonography can be effectively utilized as an initial imaging investigation in patients with suspected rotator cuff tears, while MRI should be reserved for detailed characterization and cases in which ultrasound findings are inconclusive or do not correlate with clinical findings.

Limitations

The present study was conducted at a single tertiary care centre, which may limit the generalizability of the findings. MRI was used as the reference imaging modality rather than arthroscopy or surgical findings; therefore, the study evaluated comparative agreement and diagnostic performance rather than absolute diagnostic accuracy against a definitive operative standard. Ultrasonography is operator-dependent, and variations in examiner expertise, equipment quality, and patient-related factors may influence diagnostic performance. The relatively smaller number of tears involving certain tendons also limited detailed tendon-specific analysis.

Recommendations

- Ultrasonography may be considered the preferred first-line imaging modality for patients with clinically suspected rotator cuff tears.
- MRI should be performed when USG findings are negative or equivocal despite persistent clinical suspicion.
- MRI should be considered for detailed assessment of partial-thickness tears, multi-tendon involvement, tendon retraction, and muscle fatty infiltration.
- Standardized ultrasound examination protocols and adequate operator training are important to improve diagnostic consistency.
- Larger multicentric studies with arthroscopic correlation may further establish the comparative diagnostic performance of USG and MRI.

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Conflicts of Interest

There are no conflicts of interest.

REFERENCES

1. Lenza M, Buchbinder R, Takwoingi Y, Johnston RV, Hanchard NC, Faloppa F. Magnetic resonance imaging, magnetic resonance arthrography and ultrasonography for assessing rotator cuff tears in people with shoulder pain for whom surgery is being considered. *Cochrane Database Syst Rev*. 2013 Sep 24;2013(9):CD009020. doi: 10.1002/14651858.CD009020.pub2. PMID: 24065456; PMCID: PMC6464715.
2. Apostolopoulos AP, Angelis S, Yallapragada RK, Khan S, Nadjafi J, Balfousias T, Selvan TP. The Sensitivity of Magnetic Resonance Imaging and Ultrasonography in Detecting Rotator Cuff Tears. *Cureus*. 2019 May 1;11(5):e4581. doi: 10.7759/cureus.4581. PMID: 31293841; PMCID: PMC6605695.
3. Okoroha KR, Mehran N, Duncan J, Washington T, Spiering T, Bey MJ, Van Holsbeeck M, Moutzourous V. Characterization of Rotator Cuff Tears: Ultrasound Versus Magnetic Resonance Imaging. *Orthopedics*. 2017 Jan 1;40(1):e124-e130. doi: 10.3928/01477447-20161013-04. Epub 2016 Oct 18. PMID: 27755645.
4. Brockmeyer M, Schmitt C, Haupt A, Kohn D, Lorbach O. Limited diagnostic accuracy of magnetic resonance imaging and clinical tests for detecting partial-thickness tears of the rotator cuff. *Arch Orthop Trauma Surg*. 2017 Dec;137(12):1719-1724. doi: 10.1007/s00402-017-2799-3. Epub 2017 Sep 23. PMID: 28942510.
5. Elmorsy A, Keightley A, Flannery M. Accuracy of Ultrasonography (US) and Magnetic Resonance Imaging (MRI) in Detection of Rotator Cuff Tears in District General Hospital. *Pol J Radiol*. 2017 Oct 20;82:634-637. doi: 10.12659/PJR.903004. PMID: 29657628; PMCID: PMC5894042.
6. Sipola P, Niemitukia L, Kröger H, Höfling I, Väättäin U. Detection and quantification of rotator cuff tears with ultrasonography and magnetic resonance imaging - a prospective study in 77 consecutive patients with a surgical reference. *Ultrasound Med Biol*. 2010 Dec;36(12):1981-9. doi: 10.1016/j.ultrasmedbio.2010.09.001. Epub 2010 Oct 20. PMID: 20965645.
7. Liu F, Dong J, Shen WJ, Kang Q, Zhou D, Xiong F. Detecting Rotator Cuff Tears: A Network Meta-analysis of 144 Diagnostic Studies. *Orthop J Sports Med*. 2020 Feb 5;8(2):2325967119900356. doi: 10.1177/2325967119900356. PMID: 32076627; PMCID: PMC7003181.
8. Aliprandi A, Messina C, Arrigoni P, Bandirali M, Di Leo G, Longo S, Magnani S, Mattiuz C, Randelli F, Sdao S, Sardanelli F, Sconfienza LM, Randelli P. Reporting rotator cuff tears on magnetic resonance arthrography using the Snyder's arthroscopic classification. *World J Radiol*. 2017 Mar 28;9(3):126-133. doi: 10.4329/wjr.v9.i3.126. PMID: 28396726; PMCID: PMC5368628.
9. Co S, Bhalla S, Rowan K, Aippersbach S, Bicknell S. Comparison of 2- and 3-dimensional shoulder ultrasound to magnetic resonance imaging in a community hospital for the detection of supraspinatus rotator cuff tears with improved worktime room efficiency. *Can Assoc Radiol J*. 2012 Aug;63(3):170-6. doi: 10.1016/j.carj.2011.02.003. Epub 2011 Oct 5. PMID: 21975160.
10. Xie Y, Liu S, Qu J, Wu P, Tao H, Chen S. Quantitative Magnetic Resonance Imaging UTE-T2* Mapping of Tendon Healing After Arthroscopic Rotator Cuff Repair: A Longitudinal Study. *Am J Sports Med*. 2020 Sep;48(11):2677-2685. doi: 10.1177/0363546520946772. Epub 2020 Aug 19. PMID: 32813550.
11. Smith TO, Daniell H, Geere JA, Toms AP, Hing CB. The diagnostic accuracy of MRI for the detection of partial- and full-thickness rotator cuff tears in adults. *Magn Reson Imaging*. 2012 Apr;30(3):336-46. doi: 10.1016/j.mri.2011.12.008. Epub 2012 Jan 17. PMID: 22260933.
12. Sharma G, Bhandary S, Khandige G, Kabra U. MR Imaging of Rotator Cuff Tears: Correlation with Arthroscopy. *J Clin Diagn Res*. 2017 May;11(5):TC24-TC27. doi: 10.7860/JCDR/2017/27714.9911. Epub 2017 May 1. PMID: 28658874; PMCID: PMC5483776.
13. Hitachi S, Takase K, Tanaka M, Tojo Y, Tabata S, Majima K, Higano S, Takahashi S. High-resolution magnetic resonance imaging of rotator cuff tears using a microscopy coil: noninvasive detection without intraarticular contrast material. *Jpn J Radiol*. 2011 Aug;29(7):466-74. doi: 10.1007/s11604-011-0583-9. Epub 2011 Sep 1. PMID: 21882088.
14. Liu F, Cheng X, Dong J, Zhou D, Han S, Yang Y. Comparison of MRI and MRA for the diagnosis of rotator cuff tears: A meta-analysis. *Medicine (Baltimore)*. 2020 Mar;99(12):e19579. doi: 10.1097/MD.00000000000019579. PMID: 32195972; PMCID: PMC7220562.
15. Liang W, Wu H, Dong F, Tian H, Xu J. Diagnostic performance of ultrasound for rotator cuff tears: a systematic review and meta-analysis. *Med Ultrason*. 2020 May 11;22(2):197-202. doi: 10.11152/mu-2352. Epub 2020 Feb 16. PMID: 32190853.
16. Sasanuma H, Sugimoto H, Iijima Y, Kanaya Y, Saito T, Takeshita K. Blood flow evaluation by dynamic magnetic resonance imaging of symptomatic rotator cuff tears and frozen shoulders. *J Shoulder Elbow Surg*. 2018 Dec;27(12):e372-e379. doi: 10.1016/j.jse.2018.05.042. Epub 2018 Aug 13. PMID: 30111504.
17. Kim JN, Kwon ST, Kim KC. Early postoperative magnetic resonance imaging findings after arthroscopic rotator cuff repair: T2 hyperintensity of the capsule can predict reduced shoulder motion. *Arch Orthop Trauma Surg*. 2018 Feb;138(2):247-258. doi: 10.1007/s00402-017-2834-4. Epub 2017 Nov 11. PMID: 29128967.
18. Tang CT, Decker G, Steger-May K, Middleton W, Teeffey S. Method Comparison for Detection and Measurement of Rotator Cuff Tears: Office-based Bedside Ultrasonography by a Single Physiatrist versus Imaging Center-based Ultrasonography by Two Expert Musculoskeletal Radiologists. *PM R*. 2020 Jun;12(6):563-572. doi: 10.1002/pmrj.12256. Epub 2019 Dec 4. PMID: 31583842.
19. Huang T, Liu J, Ma Y, Zhou D, Chen L, Liu F. Diagnostic accuracy of MRA and MRI for the bursal-sided partial-thickness rotator cuff tears: a meta-analysis. *J Orthop Surg Res*. 2019 Dec 12;14(1):436. doi: 10.1186/s13018-019-1460-y. PMID: 31831029; PMCID: PMC6909503.
20. Lee JH, Rhyou IH, Ahn KB. Prediction of the anterior shoulder pain source by detecting indirect signs for partial articular subscapularis tendon tears through conventional magnetic resonance imaging. *Knee Surg Sports Traumatol Arthrosc*. 2021 Jul;29(7):2297-2304. doi: 10.1007/s00167-020-06259-z. Epub 2020 Sep 8. PMID: 32897409.