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Tendon-wise accuracy of ultrasonography in rotator cuff tears detection using MRI

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Abstract:
Rotator cuff tear is a common cause of shoulder pain and imaging is needed to confirm tendon involvement, tear type and severity. This cross-sectional analytical study included 40 patients with clinically suspected rotator cuff tear who underwent both ultrasonography (USG) and MRI of the affected shoulder, with MRI used as the reference comparator. USG detected 31 of 40 MRI-confirmed tears, with best performance for supraspinatus tear showing sensitivity of 80.6%, specificity of 100% and accuracy of 82.5%, while sensitivity was low for infraspinatus and subscapularis tears. Thus, USG showed good agreement with MRI for tear grading and detected all full-thickness tears, but missed 9 partial-thickness tears, suggesting that MRI remains important when USG is negative but clinical suspicion persists.

Keywords: Rotator cuff tear, ultrasonography (USG), magnetic resonance imaging (MRI), supraspinatus tear, shoulder pain, diagnostic accuracy

Background:
Rotator cuff tears are an important cause of shoulder pain and disability in adults, with varying prevalence across populations **[1].** USG and MRI are commonly used for evaluation of clinically suspected rotator cuff tears **[2].** MRI provides detailed assessment of tear thickness, tendon retraction, muscle atrophy and associated shoulder pathology **[3].** USG allows dynamic assessment but its diagnostic accuracy depends on operator experience and imaging technique **[4]**. A 2026 systematic review involving 792 patients reported better USG performance for full-thickness tears than partial-thickness tears **[5].** Chaudhari *et al.* reported sensitivity of 87.0% for USG and 96.5% for MRI in rotator cuff tear detection **[6].** Pandya *et al.* reported 83.85% sensitivity for supraspinatus tears and 94.74% specificity for subscapularis assessment **[7].** Koluman *et al.* reported higher sensitivity of dynamic USG than MRI for partial subscapularis tears using arthroscopy as reference **[8].** Shahid *et al.* reported better agreement of MRI than USG with MR arthrography in shoulder pathology assessment **[9].** Cai *et al.* reported an AUC of 0.92 for a multiparameter ultrasound scoring system in rotator cuff tear detection **[10].** Therefore, it is of interest to assess the diagnostic performance of USG using MRI as reference, with emphasis on tendon-wise accuracy, tear grading and false negative findings.

Materials and Methods:
This cross-sectional analytical study was conducted in the Department of Radiodiagnosis, ELMCH, in collaboration with the Department of Orthopaedics and Emergency Department. The final analysis included 40 adult patients with clinically suspected rotator cuff tear who underwent both shoulder ultrasonography and magnetic resonance imaging. Patients with previous shoulder surgery, contraindication to MRI, major unstable shoulder trauma or refusal for consent were excluded. Written informed consent was taken before imaging. Baseline data included age, sex, side involved, history of trauma, presenting symptoms and clinical impression. Ultrasonography was performed using a high-resolution linear array transducer of 7–15 MHz. Patients were examined in sitting position. Standard tendon-specific positions were used for supraspinatus, infraspinatus, subscapularis and biceps tendon assessment. Both long-axis and short-axis views were obtained. Dynamic assessment was done wherever patient cooperation allowed. USG findings were recorded as normal, tendinosis, partial-thickness tear or full-thickness tear. Tendon involved, approximate tear size and associated findings such as subacromial-subdeltoid bursal fluid, biceps tendon abnormality and acromioclavicular joint changes were also noted. All patients underwent MRI of the same shoulder using a dedicated shoulder coil. Standard sequences included axial, coronal oblique and sagittal oblique T1-weighted and proton density or T2 fat-suppressed images. MRI findings were recorded for tear type, tendon involvement, retraction, associated biceps abnormality, bursitis, acromioclavicular joint change, muscle atrophy and fatty infiltration where possible. MRI was used as the reference comparator for diagnostic accuracy analysis. Data were entered in Microsoft Excel and analysed using R software in RStudio. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of USG were calculated. Cohen's kappa or weighted kappa was used for agreement analysis. McNemar test, Fisher exact test and logistic regression were used where appropriate. A p value <0.05 was taken as statistically significant.

Table 1: Baseline demographic and clinical profile of patients with suspected rotator cuff tear

Variables	Value
Total patients	40
Age	41.15 ± 16.23 years
Age range	18–86 years
Male	27 (67.5%)
Female	13 (32.5%)
Right shoulder involvement	28 (70.0%)
Left shoulder involvement	12 (30.0%)
History of trauma	25 (62.5%)
Pain with restricted range of motion	8 (20.0%)
Pain with restricted range of motion and trauma	3 (7.5%)
Pain only	3 (7.5%)
Other trauma history	1 (2.5%)

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Table 2: Overall detection of rotator cuff tear by ultrasonography using MRI as reference

USG findings	MRI positive	MRI negative	Total
Tear present	31	0	31
Tear absent	9	0	9
Total	40	0	40

Table 3: Tendon-wise diagnostic accuracy of ultrasonography for rotator cuff tear detection

Tendons	TP	FP	FN	TN	Sensitivity	Specificity	PPV	NPV	Accuracy
Supraspinatus	29	0	7	4	80.6%	100%	100%	36.4%	82.5%
Infraspinatus	1	1	7	31	12.5%	96.9%	50.0%	81.6%	80.0%
Subscapularis	3	0	13	24	18.8%	100%	100%	64.9%	67.5%

Table 4: Tear grading agreement between ultrasonography and MRI in rotator cuff tears

Parameters	Value
MRI partial-thickness tear	30
MRI full-thickness tear	10
Partial tears correctly detected by USG	21/30
Partial tears missed by USG	9/30
Full-thickness tears correctly detected by USG	10/10
Overall grading agreement	31/40
Agreement percentage	77.5%
Weighted kappa	0.684

Table 5: Tendon-wise agreement and factors associated with false negative ultrasonography findings

Variables	Main finding	Statistical value
Supraspinatus agreement	Moderate agreement	Kappa 0.453
Infraspinatus agreement	Poor agreement	Kappa 0.130
Subscapularis agreement	Poor agreement	Kappa 0.217
Supraspinatus under-detection	Significant	p = 0.023
Infraspinatus under-detection	Not significant	p = 0.077
Subscapularis under-detection	Significant	p = 0.001
False negative in males	6/27 (22.2%)	p = 1.000
False negative in females	3/13 (23.1%)	p = 1.000
False negative in left shoulder	6/12 (50.0%)	p = 0.012
False negative in right shoulder	3/28 (10.7%)	p = 0.012
Right versus left side	Lower odds of false negative	OR 0.117, 95% CI 0.022–0.615
Male versus female	Not significant	OR 0.936, 95% CI 0.161–5.447
Age	Not significant	OR 0.992, 95% CI 0.943–1.042

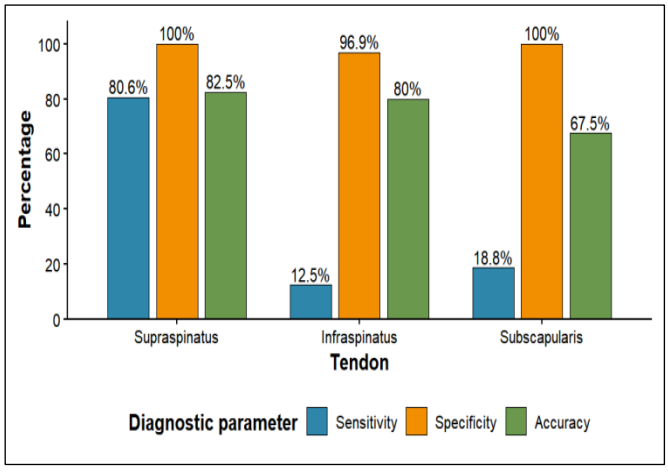


Figure 1: Tendon-wise diagnostic performance of ultrasonography for rotator cuff tears detection

Results:

The mean age of the study population was 41.15 ± 16.23 years, with 67.5% males. Right shoulder involvement was seen in 70% of patients and 62.5% had a history of trauma **(Table 1)**. Stephen *et al.* studied 60 patients and reported a higher mean age of 67.6 ± 10.6 years, with 58.3% males **[11].** USG detected 31 of 40 MRI-confirmed rotator cuff tears, giving an overall detection rate of 77.5% **(Table 2).** Nine tears were missed on USG. Fatima *et al.* studied 184 patients and reported USG sensitivity of 90.2%, specificity of 89.5% and diagnostic accuracy of 90.0% **[12].** The detection rate was lower in our study, although direct comparison is limited because all patients were MRI positive. Tendon-wise analysis showed best USG performance for supraspinatus tear, with sensitivity of 80.6%, specificity of 100% and accuracy of 82.5% **(Table 3, Figure 1).** Sensitivity was low for infraspinatus and subscapularis tears at 12.5% and 18.8% respectively. Stella *et al.* described a targeted ultrasound approach for anterior infraspinatus lesions in five patients, with MRI confirmation in three cases **[13].** Their findings suggest that

focused tendon examination may help identify lesions in difficult anatomical locations. USG correctly identified all 10 full-thickness tears but missed 9 of 30 partial-thickness tears **(Table 4).** This suggests better detection of full-thickness tears in the present study. Kondapavuluri also evaluated rotator cuff tears using ultrasound with arthroscopic validation **[14].** This highlights the importance of surgical correlation when assessing the diagnostic performance of imaging techniques. Agreement between USG and MRI for tear grading was 77.5%, with weighted kappa of 0.684 **(Table 4).** This indicates substantial agreement, although partial-thickness tears remained the main missed lesions. Kany *et al.* recommended assessment of partial-thickness tears according to tear location, depth and tendon involvement **[15].** Their 2026 consensus also highlighted the limitations of current imaging methods in characterising these lesions. Tendon-wise agreement was moderate for supraspinatus (κ = 0.453) and low for infraspinatus (κ = 0.130) and subscapularis (κ = 0.217) **(Table 5).** USG showed significant under-detection of supraspinatus (p = 0.023) and subscapularis tears (p = 0.001), while the difference for infraspinatus was not significant (p = 0.077). False negative findings were significantly higher in left shoulder examinations (50.0%) compared with right shoulder examinations (10.7%, p = 0.012). Right-sided examination showed lower odds of false negative findings (OR 0.117, 95% CI 0.022–0.615). Age and sex were not significant predictors. These findings should be interpreted carefully because of the small sample size and limited number of false negative cases. Accurate assessment of tear characteristics is important for clinical management and surgical planning. Hurley *et al.* reported an international consensus recommending classification of rotator cuff tears according to size, thickness, tendon involvement, fatty infiltration and retraction **[16].** These parameters may help in treatment selection and preoperative assessment. Recent imaging advances may improve the assessment of complex rotator cuff tears. Itoigawa *et al.* studied 102 patients with large or massive rotator cuff tears and found that shear wave elastography was useful for predicting tear irreparability **[17].** Recent studies also support careful interpretation of negative USG findings. Madhavi and Patil reported that positive USG findings were more reliable than negative findings, while MRI showed better sensitivity for rotator cuff injuries **[18].** Farooqi *et al.* reported median diagnostic accuracy of 93% for full-thickness and 81% for partial-thickness supraspinatus tears **[19].** Nadeem *et al.* reported sensitivity of 91%, specificity of 87% and accuracy of 90.2% for full-thickness rotator cuff tear detection **[20].** A 2026 preprint meta-analysis by Kassam *et al.* reported mean USG sensitivity of 88.5% for full-thickness tears and 71.5% for partial-thickness tears **[21].** These findings support careful assessment of partial-thickness lesions and the role of MRI when USG findings are inconclusive. This suggests that additional ultrasound techniques may provide useful information beyond routine structural imaging in selected patients. The present study adds local evidence on tendon-wise variation and false negative findings in rotator cuff ultrasonography. USG performed well for supraspinatus and full-thickness tears but showed low sensitivity for infraspinatus and subscapularis tears. Partial-thickness tears were the main missed lesions. The higher false negative rate in left shoulder examinations was another finding, although its cause could not be established. The small sample size, absence of MRI-negative patients and use of MRI rather than arthroscopy as the reference comparator were important limitations. These findings support the need for careful interpretation of negative USG findings and further MRI assessment when clinical suspicion remains high or detailed anatomical evaluation is required.

Conclusion:

Ultrasonography showed good diagnostic performance for supraspinatus tear and full-thickness rotator cuff tear. It was less sensitive for partial-thickness tears and for infraspinatus and subscapularis tendon involvement. MRI remains useful when USG findings are negative or equivocal in clinically suspected cases. USG can be used as an initial imaging modality in suitable patients, but MRI is needed for detailed anatomical assessment and surgical planning.

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