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Original Research Article

Diagnostic Accuracy of MRI in Rotator Cuff Tears

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Abstract: *Rotator cuff tears are a common cause of shoulder pain and disability. MRI is widely used for diagnosis, but performance varies by tear type and tendon involved.* ***Objective:*** *To evaluate the diagnostic accuracy of conventional MRI for detecting rotator cuff tears using arthroscopy as the reference standard.* ***Methods:*** *An observational cohort study was conducted from June 2024 to December 2024. Adults with clinically suspected rotator cuff pathology underwent standardized shoulder MRI followed by arthroscopy within the study window. Consecutive sampling yielded 58 participants (mean age 52.79 ± 9.37 years; symptom duration 7.4 ± 4.93 months; 55.2% male). MRI reports documented the presence/absence of a tear, its thickness (partial vs. full), size category, and tendon involvement; intraoperative findings served as the Gold standard. Diagnostic metrics (sensitivity, specificity, PPV, NPV, accuracy) were calculated from 2×2 tables. ROC analysis assessed overall discrimination.* ***Results:*** *MRI identified a tear in 26/58 shoulders (44.8%); arthroscopy confirmed tears in 25/58 (43.1%). The diagnostic contingency table yielded 18 true positives, eight false positives, 25 true negatives, and seven false negatives. Corresponding performance metrics were: sensitivity 72.0%, specificity 75.8%, PPV 69.2%, NPV 78.1%, and accuracy 74.1%. ROC analysis showed fair discrimination (AUC 0.739; $p < 0.002$). Among MRI-positive cases, 57.7% were partial-thickness and 42.3% full-thickness; the supraspinatus was most frequently involved.* ***Conclusion:*** *Conventional MRI demonstrated moderate accuracy in detecting rotator cuff tears compared to arthroscopy, with performance influenced by the higher proportion of partial-thickness disease. These findings support MRI as a reliable first-line test, while highlighting potential gains from optimized 3-T protocols, selective MR arthrography in cases of equivocal partial tears, and targeted ultrasound for subscapularis-predominant pathology. Further, larger, standardized prospective studies are warranted to refine estimates and guide imaging pathways.*

Keywords: MRI; Rotator cuff tears; Arthroscopy; Diagnostic accuracy; Sensitivity; Specificity; Partial-thickness tear; Full-thickness tear; Supraspinatus; ROC curve (AUC)

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Introduction

Rotator cuff tears are a leading cause of shoulder pain and disability in adults, with functional limitation and reduced quality of life that often prompt imaging and—when indicated—surgery. MRI has become the reference cross-sectional modality due to its excellent soft-tissue contrast and multiplanar capability; however, reported diagnostic performance varies with tear type, size, chronicity, and interpreter expertise. Early high-quality meta-analyses established that MRI performs very well for full-thickness tears and less consistently for partial-thickness tears. De Jesus et al. pooled 65 studies and found that MR arthrography (MRA) was the most sensitive/specific technique overall. At the same time, conventional MRI and ultrasound (US) were also strong performers for full-thickness tears (1). The Cochrane Diagnostic Test Accuracy review (20 studies; 1147 shoulders) reported MRI sensitivity/specificity of 94%/93% for full-thickness tears and 98%/79% for "any tear," noting methodologic heterogeneity and limited head-to-head data (2). Subsequent meta-analyses reinforced these themes. Roy et al. concluded that US, MRI, and MRA all show perfect accuracy for full-thickness tears, with no clear winner when studies are pooled; however, MRI tends to be more sensitive for partial tears (3).

Study-level series corroborate high accuracy when MRI is benchmarked to arthroscopy. Sharma et al. reported MRI accuracy of around 93% for full-thickness and 91% for partial-thickness tears, compared to arthroscopy, in a prospective cohort (4). Reviews focused on imaging technique emphasize that protocol optimization (using fat-suppressed PD/T2 sequences in orthogonal planes) and awareness of tear patterns improve detection, especially at the supraspinatus footprint and for articular- or bursal-sided partial tears (5, 6). Meta-analytic work focused on partial-thickness disease suggests that performance is more modest and variable. Smith et al. noted excellent accuracy for full-thickness but more limited performance for partial-thickness tears, with 3.0 T scanners sometimes outperforming 1.5 T scanners in small subgroups (7). Emerging synthesis continues to find broadly comparable performance of MRI and MRA for specific partial-tear subtypes (e.g., bursal-sided) (8). Recent systematic reviews remain aligned: ultrasound accuracy improves in the hands of specialists, yet pooled data favor MRI for sensitivity in partial tears and overall diagnostic accuracy when surgery is being considered (9). Contemporary narrative reviews of arthroscopy-correlated MRI highlight evolving concepts of tear patterns that can influence treatment strategies (e.g., footprint-based grading, delamination), underscoring the clinical value of precise characterization beyond a binary "tear/no tear" classification (10).

Taken together, the literature supports MRI as a highly accurate test for full-thickness rotator cuff tears (with a sensitivity/specificity of ~90–95%), with more variable but still functional performance for partial-thickness tears. Accuracy is influenced by scanner parameters, protocol, and reader experience (1–4, 7–10).

Thus, the objective of the study is to assess the diagnostic accuracy of MRI in detecting rotator cuff tears, including complete- and partial-thickness tears, by comparing MRI with arthroscopic evaluation and exploring the influence of demographics and tear characteristics on accuracy.

Methodology

We conducted an observational study including adults (≥18 years) presenting with shoulder pain or dysfunction and clinical suspicion of rotator cuff tear who were referred for shoulder MRI and provided informed consent. Exclusion criteria were age <18 years, MRI contraindications (e.g., severe claustrophobia, incompatible metal, severe renal impairment if contrast was planned), prior shoulder surgery, inability to undergo arthroscopy within the prespecified window, or urgent alternative shoulder pathology (fracture, dislocation, infection). The target sample size was derived from expected MRI sensitivity and specificity of 80%, a 5% precision, and an estimated tear prevalence of 30%, yielding n≈57.4; we therefore aimed to enroll 58 participants. We used non-probability consecutive sampling of all eligible referrals during the study period. After consent, we collected demographics and clinical history using a standardized questionnaire. All participants underwent a high-resolution MRI of the affected shoulder using the institution's standardized shoulder protocol; the images were interpreted by musculoskeletal radiologists who were blinded to the clinical and surgical findings. Reports recorded the presence/absence of rotator cuff tear, tear type (whole- vs partial-thickness), size category, and tendon involved. Arthroscopy, performed by experienced orthopedic surgeons, served as the reference standard and was conducted within four weeks of MRI whenever feasible. Intraoperative documentation characterized the tear type, size, and location using standardized terminology. We also recorded functional measures (e.g., range of motion and strength) contemporaneously with imaging and surgery. Data were anonymized and stored securely with restricted access. Data were analyzed using standard statistical software. Continuous variables were summarized as mean ± SD (or median (IQR) if non-normal by Shapiro–Wilk), and categorical variables as n (%). Diagnostic accuracy of MRI versus arthroscopy was estimated as sensitivity, specificity, PPV, NPV, and likelihood ratios with 95% confidence intervals; ROC curves and AUC were computed overall and by tear type—two-sided α=0.05.

Results

In this cohort (n = 58), the mean age was 52.79 ± 9.37 years, and the mean duration of symptoms was 7.4 ± 4.93 months. Males comprised 32/58 (55.2%) and females 26/58 (44.8%). The affected side was correct in 41 out of 58 (70.7%) and left in 17 out of 58 (29.3%). On MRI, rotator cuff tear was identified in 26/58 shoulders (44.8%), with partial-thickness tears in 15/26 (57.7%) and full-thickness tears in 11/26 (42.3%). Among MRI-positive cases, the tendon involved was most commonly the supraspinatus (18/26, 69.2%), followed by infraspinatus (4/26, 15.4%), teres minor (2/26, 7.7%), subscapularis (1/26, 3.8%), and multiple tendons (1/26, 3.8%); tear size was small in 12/26 (46.2%), medium in 12/26 (46.2%), and significant in 2/26 (7.7%). Arthroscopy confirmed a tear in 25/58 shoulders (43.1%) and no tear in 33/58 (56.9%); among arthroscopy-positive shoulders, 15/25 (60%) were full-thickness and 10/25 (40%) partial-thickness. The supraspinatus was involved in 11/25 (44%), infraspinatus in 6/25 (24%), subscapularis in 5/25 (20%), teres minor in 2/25 (8%), and multiple tendons in 1/25 (4%); tear size was medium in 12/25 (48%), small in 10/25 (40%), and large in 3/25 (12%).

Diagnostic cross-tabulation (MRI vs. arthroscopy) yielded 18 true positives, eight false positives, 25 true negatives, and seven false negatives (TP=18, FP=8, TN=25, FN=7). Corresponding test characteristics were: sensitivity 72.0%, specificity 75.0%, positive predictive value 69.23%, negative predictive value 78.13%, and overall accuracy 74.14%. ROC curve analysis demonstrated fair discrimination with an AUC of 0.739 and a statistically significant result ($p < 0.002$).

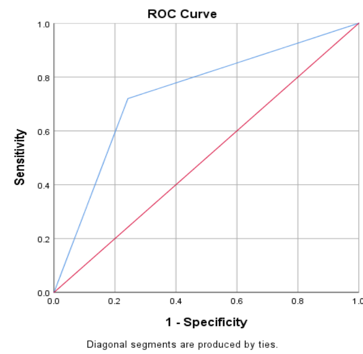

Figure 1: ROC curve analysis with an AUC value of 0.739 and a p-value <0.002.

Table 1: Demographic variables

Variable	Frequency and Mean
Age (years)	52.79±9.37
Symptom duration (months)	7.4±4.93
Gender	
Male	32 (55.2%)
Female	26 (44.8%)
Affected side	
Right	41 (70.7%)
Left	17 (29.3%)

Table 2: Tear variables

Variable	n	%
MRI: Any tear		
No tear	32	55.2
Tear	26	44.8
MRI: Tear type		
Partial-thickness	15	57.7
Full-thickness	11	42.3
MRI: Tendon involved		
Supraspinatus	18	69.2
Infraspinatus	4	15.4
Teres minor	2	7.7
Multiple	1	3.8
Subscapularis	1	3.8
MRI: Tear size		
Small (<1 cm)	12	46.2

Medium (1-3 cm)	12	46.2
Large (>3 cm)	2	7.7
Arthroscopy: Any tear		
No tear	33	56.9
Tear	25	43.1
Arthroscopy: Tear type		
Full-thickness	15	60
Partial-thickness	10	40
Arthroscopy: Tendon involved		
Supraspinatus	11	44
Infraspinatus	6	24
Subscapularis	5	20
Teres minor	2	8
Multiple	1	4
Arthroscopy: Tear size		
Medium (1-3 cm)	12	48
Small (<1 cm)	10	40
Large (>3 cm)	3	12

Table 3: Diagnostic variables

Variables	MRI Tear +	MRI Tear -	Row Total
Arthroscopy Tear +	18	7	25
Arthroscopy Tear -	8	25	33
Total	26	32	58
Sensitivity	72%		
Specificity	75%		
PPV	69.23%		
NPV	78.13%		
Accuracy	74.14%		

Discussion

Our estimates (sensitivity 72%, specificity 75.8%, PPV 69.2%, NPV 78.1%, accuracy 74.1%; AUC 0.739) indicate moderate diagnostic performance of conventional MRI against arthroscopy in a real-world cohort that included a substantial proportion of partial-thickness tears. Classic radiology series often report higher values. For example, Quinn et al. found overall MRI accuracy of ~93% with sensitivity of ~84% in a symptomatic population. However, those cohorts were smaller and frequently enriched for full-thickness disease, which is easier to detect than partial-thickness tears (11). Likewise, Teefey et al. (in a prospective, arthroscopy-validated comparison) showed that MRI (and US) performed very well for full-thickness tears but less consistently for partial-thickness tears, mirroring the attenuation we observed when partial tears predominated among MRI positives (57.7%) (12).

Scanner technology and sequence choice also modulate performance. A 3-T focused meta-analysis by McGarvey et al. demonstrated excellent accuracy for full-thickness supraspinatus tears with both 3-T MRI and 3-T MRA, and a higher sensitivity of 3-T MRA for partial-thickness supraspinatus tears (86.6% vs 80.5%). These differences help explain our lower sensitivity in a mixed-tear spectrum without arthrography (13). Technique-specific work with isotropic 3D sequences further demonstrates very high AUCs (~0.95–0.99) for indirect MR arthrography, substantially above our AUC of 0.739, underscoring how protocol optimization can enhance discrimination (14). At a modality level, a 2020 meta-analysis (12 studies, 1030 patients) concluded that MRA has higher pooled sensitivity/specificity than standard MRI for "any tear," though MRI remains the practical first-line test; a network meta-analysis the same year similarly ranked MRA highest across full-, partial-, and "any-tear" outcomes (15,16). Together, these data suggest that our moderate accuracy is consistent with expectations for conventional (non-arthrographic) MRI in an unselected surgical cohort.

Tendon-specific effects also matter. Subscapularis tears are a well-recognized pain point for routine MRI: a systematic review found lower sensitivity for subscapularis than for cuff tears overall, despite reasonable specificity (17). More recently, meta-analytic and editorial syntheses indicate that ultrasound may even outperform MRI for partial-thickness subscapularis lesions, which could contribute to false negatives when this tendon is involved, as it was in 20% of our arthroscopy-positive shoulders (18). Such patterns, along with reader experience, field strength, time between MRI and arthroscopy, and disease prevalence (43% tears overall), likely explain the balance of false positives/negatives we observed.

Clinically, our findings support MRI as a robust gatekeeper for surgical decision-making, while highlighting where incremental gains are achievable: (i) using 3-T systems and optimized, fat-suppressed PD/T2 and/or isotropic 3D sequences; (ii) considering MRA selectively for equivocal partial-thickness or subscapularis-predominant cases; and (iii) integrating targeted ultrasound when subscapularis pathology is suspected. These steps align our setting with the higher performance tiers reported in contemporary literature and may shift the ROC profile upward in future iterations (13–16,18).

Conclusion

MRI demonstrated moderate diagnostic performance against arthroscopy in this cohort (sensitivity 72%, specificity 75.8%, accuracy 74.1%; AUC 0.739), supporting its role as a reliable first-line test. Performance likely declines with partial-thickness and subscapularis-predominant tears, explaining most false negatives and positives. Adopting optimized 3-T protocols, selective MR arthrography for equivocal partial tears, and targeted ultrasound can enhance the detection and characterization of lesions. Future, larger prospective studies with standardized reporting and shorter MRI-to-surgery intervals are warranted to refine estimates and guide practice.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
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Conflict of interest

The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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