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Original Research Article

A RETROSPECTIVE STUDY COMPARING DIAGNOSTIC EFFICACY OF HIGH RESOLUTION ULTRASONOGRAPHY (HRUSG) AND MAGNETIC RESONANCE IMAGING (MRI) WITH ARTHROSCOPY AS GOLD STANDARD IN ROTATOR CUFF TEARS

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ABSTRACT

Background: Rotator cuff tears (RCTs) represent a major global musculoskeletal problem. Earlier studies found no statistically significant differences between magnetic resonance imaging (MRI) and High-resolution ultrasonography (HRUSG) for diagnosing full- or partial-thickness tears, though modern high-resolution equipment and improved operator expertise may contribute to updated diagnostic trends. Therefore, the present study aims to evaluate and compare the diagnostic accuracy of HRUSG and MRI in correlation with arthroscopic findings in patients with rotator cuff tears. **Materials and Methods:** A retrospective study done in 100 cases meeting the inclusion criteria were identified from medical records. Variables Collected included demographic details, HRUSG, MRI and arthroscopic findings. For both HRUSG and MRI, the following were calculated sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall diagnostic accuracy. **Result:** For full-thickness tears, MRI demonstrated higher sensitivity (95.1% vs 90.3%) and specificity (92.1% vs 86.8%), resulting in greater overall accuracy (94% vs 89%). For partial-thickness tears, both modalities showed lower performance, but MRI still performed better, with slightly higher sensitivity (81.6% vs 78.9%), specificity (88.7% vs 85.4%), and diagnostic accuracy (86% vs 83%). **Conclusion:** MRI showed consistently better diagnostic performance than HRUSG for both full-thickness and partial-thickness rotator cuff tears.

INTRODUCTION

Rotator cuff tears (RCTs) represent a major global musculoskeletal problem. The rotator cuff, consisting of the supraspinatus, infraspinatus, teres minor and subscapularis tendons, is critical for providing dynamic stability and enabling smooth functional motion of the glenohumeral joint. Because of its anatomical configuration, limited vascularity and constant exposure to tensile and shear forces, the rotator cuff is highly vulnerable to degenerative and traumatic tears.[1] These injuries commonly result in pain, nocturnal discomfort, weakness during overhead activity and significant functional impairment, leading to considerable work-related disability and reduced quality of life.[2-4]

Rotator cuff tears are a common condition, with prevalence varying significantly by age. Contemporary population-based studies report an overall prevalence ranging from 6.8% to 22.4% among individuals aged above 40 years. The frequency of rotator cuff tears increases substantially with age, it affects nearly 25% of adults in their 60s.The prevalence rises to up to 50% in their 80s. It is also notable that a significant number of these tears may be asymptomatic.[4] In India a prevalence of 10.6% (95% CI 7.0%-14.1%), 10.9% (95% CI 7.3%-14.5%), and 21.1% (16.4%-25.9%) was noted for full-thickness RCTs, partial-thickness RCTs, and

RCTs overall.[4] These numbers highlight RCTs as a major contributor to shoulder-related morbidity in both Indian and global populations.

Clinically, RCTs may present with acute or chronic pain, restricted motion and weakness, but a substantial proportion of tears remain asymptomatic in early stages. Nevertheless, symptomatic cases contribute heavily to the disease burden, forming one of the most frequent causes of chronic shoulder pain.[6] Accurate diagnosis is essential because management—ranging from conservative therapy to arthroscopic repair—depends on precise characterization of tear morphology, tendon retraction and muscle quality.

Radiological evaluation plays a central role in this diagnostic pathway. High resolution ultrasonography (HRUSG) offers a cost-effective, dynamic and widely accessible modality, and when performed by trained operators, demonstrates high accuracy for detecting full-thickness tears. Magnetic Resonance Imaging (MRI) provides superior soft-tissue contrast, allowing detailed assessment of tear size, extent, delamination and associated muscle fatty infiltration.[7] However, arthroscopy remains the gold standard for direct visualization, grading and confirmation of RCTs. Therefore, the diagnostic performance of HRUSG and MRI must be validated against arthroscopic findings for meaningful clinical interpretation.

Recent studies comparing imaging modalities both HRUSG and MRI demonstrated a 95.2% sensitivity for identifying full-thickness tears (FTT). For partial-thickness tears (PTT) measuring less than 5 mm, the sensitivities were 83.3% for HRUSG and 77.7% for MRI. When the PTT size exceeded 5 mm, HRUSG showed a sensitivity of 73.3%, while MRI achieved 86.4%. Considering all supraspinatus tears collectively, the overall sensitivities were 88.4% for HRUSG and 90.3% for MRI.[8] Earlier landmark meta-analyses such as de Jesus et al. (AJR 2009) found no statistically significant differences between MRI and HRUSG for diagnosing full- or partial-thickness tears, though modern high-resolution equipment and improved operator expertise may contribute to updated diagnostic trends.[9]

Despite extensive literature, gaps persist. Furthermore, contemporary Indian data correlating HRUSG and MRI with arthroscopy remain limited. This creates a need for updated, region-specific evidence using current technology to determine the true diagnostic accuracy of these imaging modalities. Therefore, the present study aims to evaluate and compare the diagnostic accuracy of HRUSG and magnetic resonance imaging in correlation with arthroscopic findings in patients with rotator cuff tears. This will strengthen evidence-based imaging protocols and help optimize cost-effective diagnostic pathways in the Indian clinical setting.

MATERIALS AND METHODS

A retrospective comparative observational study conducted to evaluate the diagnostic accuracy of HRUSG and MRI in detecting rotator cuff tears, using arthroscopy as the reference standard. The study was carried out in the Department of Radiodiagnosis at a tertiary care teaching hospital. Data were collected retrospectively from institutional electronic and paper medical records over a period of 18 months. All patients who underwent shoulder arthroscopy during the study period and had both preoperative HRUSG and MRI of the affected shoulder were considered eligible. Medical records, radiology reports, and operative notes were reviewed.

Inclusion Criteria

1. Patients who underwent diagnostic or therapeutic shoulder arthroscopy for rotator cuff pathology.
2. Availability of complete preoperative HRUSG and MRI studies performed within the same episode of care.
3. Adequately documented clinical findings and arthroscopy reports.

Exclusion Criteria

1. Previous shoulder surgery on the same side.
2. Acute fractures, glenohumeral dislocations, or inflammatory arthritis.
3. Incomplete or missing radiological reports, imaging files, or arthroscopy documentation.
4. MRI or HRUSG done at outside centers with inaccessible imaging or inadequate reporting.
5. Massive rotator cuff tears with pseudoparalysis where accurate delineation was not possible.

Sample Size: A total of 100 cases meeting the inclusion criteria were identified from medical records. No sampling was performed; all eligible cases available during the study period were included.

Data Collection Procedure: After obtaining institutional ethical committee clearance, data were extracted from electronic medical records, radiology information system (RIS), picture archiving and communication system (PACS), operative theatre arthroscopy logs, archived arthroscopy videos and reports. A structured data extraction sheet was used to ensure uniformity. Variables Collected included demographic details (like age, sex, side), clinical presentation (pain duration, weakness, range-of-motion limitations), HRUSG were performed using high-frequency linear probes (7–15 MHz) findings (type of tear (partial- vs full-thickness), tear size (<5 mm or >5 mm for PTT), supraspinatus, infraspinatus, subscapularis involvement. MRI studies were performed using a 1.5 Tesla scanner with a dedicated shoulder coil. MRI findings (tear morphology and size, tendon retraction, fatty infiltration grades and associated intra-articular pathology) were recorded. Arthroscopy findings (gold standard) in confirmation of partial- or full-thickness tear, exact tear size and location, tendon retraction and additional intra-articular abnormalities. All imaging findings were extracted from official radiology reports interpreted

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by musculoskeletal radiologists at the time of patient evaluation. Arthroscopy findings were taken from operative notes and video records documented by the operating surgeon and diagnostic accuracy statistics were calculated.[10]

Statistical Analysis: Data were compiled using Microsoft Excel and analysed using SPSS version 28 and Medcalc online calculator for diagnostic test statistics. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. For both HRUSG and MRI, the following were calculated sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and overall diagnostic accuracy. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 100 patients who fulfilled the inclusion criteria were analysed. The mean age of the study population was 52.8 ± 8.7 years (range: 32–74 years). Most patients belonged to the 51–60 year age group. Males (58%) were slightly more represented than females (42%). [Table 1]

Table 1: Age and Sex Distribution of Study Subjects (n = 100)

Variables	Sub group	Frequency (n=100)	Percentage
Age group	31–40	14	14%
	41–50	26	26%
	51–60	38	38%
	>60	22	22%
Sex	Male	58	58%
	Female	42	42%

Pain was the predominant presenting symptom, seen in all patients. The majority had symptoms for more than 3 months. Right-sided involvement was slightly more common. Range-of-motion restriction was noted in 78% of cases. [Table 2]

Table 2: Clinical Features of the Study Population (n = 100)

Clinical Parameter	Category	Frequency	Percentage
Pain duration	<1 month	12	12%
	1–3 months	28	28%
	> 3 months	60	60%
Side involved	Right	56	56%
	Left	44	44%
ROM limitation	Present	78	78%
	Absent	22	22%

Arthroscopy confirmed full-thickness tears (FTT) in 62% of patients and partial-thickness tears (PTT) in 38%. Among PTT, 41% had <5 mm tears and 59% had >5 mm tears. Tendon retraction was present in 48% of cases. Additional intra-articular abnormality (biceps tendinopathy, SLAP lesions, bursitis) was found in 36%. [Table 3]

Table 3: Arthroscopic Findings (n = 100)

Arthroscopic Variable	Category	Frequency	Percentage
Type of tear	Full-thickness (FTT)	62	62%
	Partial-thickness (PTT)	38	38%
Size of tear (PTT only)	<5 mm	16	41% of PTT
	>5 mm	22	59% of PTT
Tendon retraction	Present	48	48%
	Absent	52	52%
Additional intra-articular abnormalities	Present	36	36%
	Absent	64	64%

Arthroscopy confirmed 62 full-thickness tears (FTT) and 38 PTT cases. When evaluating full-thickness tears, HRUSG correctly identified 56 true positives and 33 true negatives, with 6 false negatives and 5 false positives. MRI performed slightly better, showing 59 true positives and 35 true negatives, with only 3 false negatives and 3 false positives. [Table 4]

For partial-thickness tears (PTT), arthroscopy confirmed 38 cases, while 62 patients had no PTT. HRUSG detected 30 true positives and 53 true negatives, but also produced 8 false negatives and 9 false positives. MRI again showed marginally better performance, identifying 31 true positives and 55 true negatives, along with 7 false negatives and 7 false positives. [Table 5]

Table 4: Comparison of HRUSG FTT and MRI FTT with Arthroscopy FTT

Arthroscopic Variable	Category	Arthroscopy confirmed FTT Present (62)	Arthroscopy confirmed Absent (38)	Total
HRUSG Full-thickness (FTT)	Present	56 (TP)	5(FP)	61
	Absent	6 (FN)	33(TN)	39

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MRI Full-thickness (FTT)	Present	59 (TP)	3 (FP)	62
	Absent	3 (FN)	35 (TN)	38

Table 5: Comparison of HRUSG PTT and MRI PTT with Arthroscopy PTT

Arthroscopic Variable	Category	Arthroscopy confirmed PTT Present (38)	Arthroscopy confirmed PTT absent (62)	Total
HRUSG Partial-thickness (PTT)	Present	30 (TP)	9(FP)	39
	Absent	8 (FN)	53(TN)	61
MRI Partial-thickness (PTT)	Present	31 (TP)	7 (FP)	38
	Absent	7(FN)	55 (TN)	62

MRI demonstrated consistently superior diagnostic accuracy compared with HRUSG for both full-thickness and partial-thickness rotator cuff tears. For full-thickness tears, MRI showed higher sensitivity (95.1% vs 90.3%) and specificity (92.1% vs 86.8%), leading to a greater overall accuracy of 94%, compared with 89% for HRUSG. MRI also produced higher PPV and NPV values, indicating more reliable detection and exclusion of full-thickness tears.

In partial-thickness tears, both modalities showed reduced performance, but MRI again outperformed HRUSG. MRI achieved slightly higher sensitivity (81.6% vs 78.9%), specificity (88.7% vs 85.4%), and diagnostic accuracy (86% vs 83%). These results indicate that while both HRUSG and MRI are valuable tools, MRI provides greater overall diagnostic precision, particularly for full-thickness rotator cuff tears. [Table 6]

Table 6: Diagnostic Performance of HRUSG and MRI

Parameter	HRUSG (FTT)	MRI (FTT)	HRUSG (PTT)	MRI (PTT)
Sensitivity	90.3%	95.1%	78.9%	81.6%
Specificity	86.8%	92.1%	85.4%	88.7%
PPV	91.8%	94.8%	76.9%	81.5%
NPV	84.6%	92.1%	86.9%	88.7%
Diagnostic Accuracy	89%	94%	83%	86%

DISCUSSION

Accurately determining whether the rotator cuff is intact or torn—along with identifying the involved tendon and the extent of damage—is essential for planning appropriate treatment. Because management decisions rely heavily on precise diagnosis, imaging plays a crucial role. Over recent decades, HRUSG and MRI have become important tools for evaluating shoulder pain and rotator cuff pathology, helping surgeons make informed treatment plans.[11,12,13]

In our study of 100 patients (62 arthroscopy-confirmed full-thickness tears and 38 partial-thickness tears), MRI outperformed HRUSG for full-thickness tears (sensitivity 95.1% vs 90.3%, specificity 92.1% vs 86.8%, accuracy 94% vs 89%). This pattern — MRI giving slightly higher sensitivity and specificity for full-thickness tears — is concordant with recent comparative analyses and single-centre series showing MRI's modest advantage for precise characterization of tendon discontinuity, retraction and muscle changes. In study by Madhavi et al, MRI clearly outperforms HRUSG in the assessment of rotator cuff tears across most diagnostic measures. It demonstrates far superior sensitivity (92% vs. 64%), a higher negative predictive value (67% vs. 36%), better overall diagnostic accuracy (90% vs. 70%), and stronger agreement with the final diagnosis ($\kappa = 0.66$ vs. 0.37).[14,15]

Although ultrasound remains an inexpensive, non-invasive, and easily accessible modality, its diagnostic performance for rotator cuff tears continues to generate debate. Liam et al stated that in their analysis, the pooled sensitivity, specificity, LR−, and diagnostic odds ratio (DOR) across included studies demonstrated considerable heterogeneity ($I^2 > 50\%$). Despite this variability, ultrasound still showed promising sensitivity and a reliable level of specificity for detecting rotator cuff tears. Their study observed a relatively high LR+, favourable DOR, reasonable overall accuracy, and a comparatively low LR−. Because likelihood ratios incorporate both sensitivity and specificity, they offer a more comprehensive measure of a test's diagnostic power and provide a clearer understanding of its clinical usefulness.[16] Arthroscopic examination confirmed full-thickness rotator cuff tears (RCTs) in 28 patients with rheumatoid arthritis (77.8%) and partial-thickness tears in eight patients (22.2%).[16]

Also study by Jayanth M et al, the predictive validity of HRUS rotator cuff tendon tears in predicting MRI tendon tears had a diagnostic accuracy of 68.89%, 98.89%, 88.89%, and 97.78% for supraspinatus, infraspinatus, subscapularis, and teres minor, respectively.[17]

In study by Chen et al, using arthroscopy as the reference standard, ultrasound identified full-thickness tears with a sensitivity of 92.9% and an accuracy of 89%. In comparison, MRI showed a slightly higher sensitivity of 96.4% and an accuracy of 90% for the same category. For partial-thickness RCTs, ultrasound demonstrated a sensitivity of 62.5% and an accuracy of 75.0%, whereas MRI performed better, with a sensitivity of 87.5% and an accuracy of 88%. When comparing the two imaging methods directly, the overall agreement between ultrasound and MRI reached 89.3% for full-thickness tears and 75.0% for partial-thickness tears.

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Additionally, ultrasound showed comparable sensitivity to MRI in detecting posterior recess synovitis, tenosynovitis, and subacromial-subdeltoid bursitis. [18]

Several contemporary single-centre and multicentre papers reinforce our finding that MRI better defines tear extent, tendon retraction and muscle fatty infiltration — features that influence decisions about reparability and technique — whereas HRUSG remains highly useful for initial diagnosis and dynamic assessment. Okoroha et al. found that ultrasound measurements of tear size and retraction were typically smaller than MRI measurements, which can lead to underestimation of tear chronicity if relying on HRUSG alone; this supports our conclusion that MRI is preferable when surgical planning requires precise anatomic detail.[7]

When contextualizing our results with the literature, two practical messages emerge. First, for detection of full-thickness tears, both HRUSG and MRI perform strongly, and HRUSG — given its accessibility and cost advantage — remains an excellent first-line test in many settings. Second, for partial-thickness tears, especially those suspected to be articular-sided, intratendinous, or when precise sizing/retraction assessment is required before repair, MRI should be considered because of its better overall precision in many studies. These recommendations are consistent with contemporary practice guidelines and recent comparative studies that advocate a tiered imaging strategy (HRUSG first-line; MRI reserved for equivocal/complex cases or preoperative planning).[18,19]

CONCLUSION

Our findings suggest that the diagnostic performance of ultrasonography (HRUSG) in identifying rotator cuff tears may be more limited than previously assumed. While HRUSG performs well when it demonstrates a positive result—indicating that its ability to correctly confirm the presence of a tear is high—the reliability of a negative ultrasound finding is considerably weaker. This discrepancy highlights the tendency of HRUSG to miss a notable proportion of true tears, reducing its value as a standalone tool for confidently ruling out pathology.

In contrast, MRI consistently demonstrates superior diagnostic capability. Its higher sensitivity, stronger negative predictive value, and better overall accuracy make it a more dependable modality for both detecting the presence of rotator cuff tears and assessing their extent. Compared with HRUSG and routine clinical evaluation, MRI provides a more comprehensive and precise assessment, thereby supporting more informed clinical decision-making and treatment planning.

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