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Comparison of MRI (1.5 T) and High-Resolution USG in Evaluating Patients with Rotator Cuff Pathologies

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Abstract: ***Background: Accurate diagnosis of rotator cuff pathologies is crucial for the effective management of shoulder pain. This study aimed to evaluate the diagnostic accuracy of high-resolution USG and MRI (1.5 T) for detecting rotator cuff injuries. Methods: A prospective study was conducted on 80 patients with shoulder pain who underwent both USG and MRI over two months at the Department of Radiology, Pandit Deendayal Upadhyay Government Medical College & Civil hospital, Rajkot, Gujarat, India. The diagnostic accuracy metrics of high resolution USG were compared to those of MRI (1.5 T). Results: The mean age of the 80 patients was 48.5 +/- 12.4 years. Among them, males represented the majority (n = 54, 67.5%), with a significant number having diabetes mellitus (n = 28, 35%) and hypertension (n = 18, 22.5%). The right shoulder was the most frequently affected (n = 66, 82.5%). USG identified supraspinatus tears in 66 patients (82.5%), subscapularis tears in 32 patients (40.0%), and infraspinatus tears in 4 patients (5.0%). MRI detected supraspinatus tears in 78 patients (97.5%), subscapularis tears in 36 patients (45.0%), and infraspinatus tears in 4 patients (5.0%). The diagnostic performance of USG demonstrated a sensitivity of 76.92% and specificity of 85.71%, while MRI exhibited a sensitivity of 92.86% and specificity of 80.77%. Conclusion: Both USG and MRI are valuable for diagnosing rotator cuff pathologies, USG remains a reliable and cost-effective initial diagnostic tool. However, MRI provides superior sensitivity and specificity.***

Keywords: Diagnostic accuracy, Magnetic resonance imaging, Ultrasonography, Rotator cuff, Shoulder pain.

1. Introduction

The shoulder is a complex ball-and-socket joint (glenohumeral joint) where the large head of the humerus meets a shallow socket called the glenoid, allowing for the greatest range of motion in the human body. To compensate for this inherent instability, the joint is supported by the rotator cuff, a group of four key muscles and tendons that provide essential strength and stabilization. Additionally, the labrum (a ring of cartilage) deepens the socket, while surrounding ligaments and bursa sacs ensure smooth, fluid movement across multiple planes. Given the high-demand nature of the shoulder joint, its musculotendinous structures are particularly vulnerable to repetitive stress and injury, a common occurrence in both high-impact sports and daily physical labor. Pain in this region is often multi-factorial, stemming from a range of issues such as sudden traumatic tears, long-term wear, or subacromial impingement, where soft tissues become trapped during movement. While bedside physical exams and specialized orthopedic maneuvers are useful for initial screening, they often lack the precision needed to pinpoint internal damage. Consequently, surgical visualization through arthroscopy frequently reveals complexities and lesions that standard clinical assessments simply cannot detect.

Issues involving the rotator cuff represent a wide array of persistent ailments that target the critical areas where muscle meets tendon and where tendon attaches to bone, particularly within the narrow confines of the subacromial space. Due to these complexities, sonography has surfaced as a go-to diagnostic tool for radiological evaluation. Modern breakthroughs in high-definition ultrasound probes and specialized scanning protocols have revolutionized how clearly we can see these injuries without surgery. This high-resolution approach provides a safe, radiation-free, and budget-friendly solution that is exceptionally sensitive at spotting both primary rotator cuff tears and other surrounding soft-tissue irregularities.

While standard X-rays are the starting point for checking bone fractures and joint wear, they fall short when it comes to the shoulder's complex soft tissues, often requiring more advanced backup. Historically, invasive arthrography was the go-to, but it has been largely pushed aside by the rise of MRI and Ultrasound (USG). MRI is now the "gold standard" because it provides incredibly detailed, 3D views and high-contrast images that can spot even the minimal internal damage that other scans might miss.

Parallelly, musculoskeletal ultrasound has seen a massive surge in popularity over the last twenty years, becoming a favorite in sports medicine and rheumatology. Its unique "superpower" is real-time, dynamic imaging; a doctor can

actually watch the shoulder move under the scanner while talking to the patient, pinpointing exactly which motion triggers the pain. Despite the global use of these tools, there is a lack of localized research focused on the Indian population. This study was launched to fill that gap, directly comparing how accurately high-resolution USG and MRI can identify rotator cuff injuries in Indian patients suffering from chronic shoulder discomfort.

2. Materials and Methods

2.1 Study Design and Duration

- This prospective study was conducted on patients with shoulder pain who were referred for high-resolution USG and MRI over 2 months (December 2025 to January 2026) in the Department of Radiodiagnosis, Pandit Deendayal Upadhyay Government Medical College & Civil hospital, Rajkot, Gujarat, India.
- The study included 80 patients presenting with clinical suspicion of rotator cuff tear.

2.2 Inclusion Criteria

- Patients complaining of shoulder pain.
- Cases with confirmed rotator cuff tear following MRI.
- Patients who underwent two imaging modalities (USG and MRI).

2.3 Exclusion Criteria

- Patients with other pathology/ lesions confirmed on USG/ MRI.
- Incomplete imaging or inadequate follow-up data.

2.4 Imaging Protocols

Ultrasonography

Performed as the initial modality using a high-resolution 3-16 MHz straight probe.

Parameters assessed included:

- Size, location, and number of tears
- Echotexture and calcification

Magnetic Resonance Imaging (MRI)

MRI was done on a 1.5T scanner using T1 weighted non fat suppressed, T2 weighted fat suppressed (T2FS), proton density fat suppressed (PDFS).

Special emphasis was given to:

- Signal intensity characteristics
- Size, locations and number of tears

2.5 Data Analysis

The ultrasound and MRI findings were correlated and tabulated for further analysis. Statistical analysis was performed using descriptive methods to assess sensitivity and specificity of each modality.

3. Results

In our research, we evaluated a cohort of 80 individuals, where the average age of the participants was recorded at 48.5 +/- 12.4 years. The demographic data showed a clear male majority, accounting for 54 participants (67.5%), while 26 participants (32.5%) were female. Regarding comorbidities, nearly one-third of the group was diagnosed with diabetes mellitus (n = 28, 35%), and hypertension was identified in 18 patients (22.5%).

The clinical presentation heavily favored the dominant side, with the right shoulder being symptomatic in 66 instances (82.5%), whereas the left shoulder was involved in only 14 cases (17.5%)

Characteristics (N = 80)		N	%
Gender distribution	Males	54	67.5
	Females	26	32.5
Comorbidities	Diabetes mellitus	28	35
	Hypertension	18	22.5
Side of involvement	Right	66	82.5
	Left	14	17.5
USG rotator cuff tears	Supraaspinatus	66	82.5
	Subscapularis	32	40
	Infrapinatus	4	5
Pathogenesis of rotator cuff on USG	Partial tear	44	55
	Complete tear	36	45
MRI rotator cuff tears	Supraaspinatus	78	97.5
	Subscapularis	36	45
	Infrapinatus	4	5
Pathologies of rotator cuff on MRI	Partial tear	52	65
	Complete tear	28	35

3.3 Imaging Findings

Ultrasound

USG identified supraspinatus tears in 82.5% (n = 66), subscapularis tears in 40.0% (n = 32), and infraspinatus tears in 5.0% (n = 4) of patients. Regarding the extent of rotator cuff pathology, USG detected partial tears in 55.0% (n = 44) of the patients and complete tears in 45.0% (n = 32). MRI revealed a higher prevalence of supraspinatus tears, with 97.5% (n = 78) of affected patients. Subscapularis tears were found in 45.0% (n = 36) of patients and infraspinatus tears in 5.0% (n = 4). In terms of rotator cuff pathologies, MRI identified partial tears in 65.0% (n = 52) of the patients and complete tears in 35.0% (n = 28)

Comparison between USG and MRI

The sensitivity, specificity, PPV, NPV, and accuracy of USG in detecting partial and complete rotator cuff tears were compared with those of MRI as the reference standard. A comparison of USG and MRI findings showed that USG and MRI identified partial tears in 40 patients. However, a complete tear was identified in 26 patients. For partial tears, 4 patients were detected by USG who were not found on MRI. In addition, 12 patients with partial tears were detected by MRI but were missing by USG. Overall, 24 patients did not have partial tears on USG and MRI.

		MRI Partial Tear	
		Yes	No
USG Partial Tear	Yes	40	4
	No	12	24

In the evaluation of complete rotator cuff tears, USG demonstrated a high degree of concordance with MRI, which is the reference standard. Specifically, USG accurately

identified 26 cases of complete tears confirmed by MRI (true positives). However, there were 10 instances where USG suggested the presence of a complete tear that MRI did not confirm (false positives). Conversely, MRI detected 2 complete tear that was missed by USG (false negative). Additionally, USG correctly identified 42 cases in which no complete tear was present, consistent with the MRI findings (true negatives)

		MRI Complete Tear	
		Yes	No
USG Complete Tear	Yes	26	10
	No	2	42

USG demonstrated sensitivity, specificity, PPV, NPV, and overall accuracy of 76.92%, 85.71%, 90.91%, 66.67%, and 80.00%, respectively. MRI showed a sensitivity of 92.86%, specificity of 80.77%, PPV of 72.22%, NPV of 95.45%, and an overall accuracy of 85.00%

Identification method	sensitivity	specificity	PPV	NPV	accuracy
USG	76.92%	85.71%	90.91%	66.67%	80.00%
MRI	92.86%	80.77%	72.22%	95.45%	85.00%

4. Discussion

In our expanded study of 80 patients, we examined the effectiveness of non-invasive imaging like Ultrasound (USG) and MRI in identifying rotator cuff injuries. Current medical literature suggests that USG is a highly reliable primary tool, as its ability to spot both partial and full-thickness tears often rivals the precision of an MRI.

Our cohort consisted of 80 individuals with an average age of 48.5 +/-12.4 years. Reflecting patterns seen in studies by Singh et al. and Mehta et al., we observed a clear male majority at 67.5% (54 men) compared to 32.5% (26 women). Health markers showed that 35% (28 patients) managed diabetes, while 22.5% (18 patients) had hypertension.

The data indicates a clear preference for right-sided pathology, which affected 82.5% of the cohort compared to only 17.5% for the left side. Regarding specific anatomical damage, the supraspinatus tendon was the most frequent site of injury across all modalities. USG identified supraspinatus tears in 82.5% of patients, while MRI demonstrated an even higher sensitivity, detecting them in 97.5% of cases. Other tendons were less frequently involved, with USG showing subscapularis and infraspinatus tears at 40% and 5%, respectively.

In terms of injury severity, USG categorized 55% of cases as partial tears and 45% as complete, whereas MRI identified a higher proportion of partial tears at 65% and complete tears at 35%. Despite these slight variations in diagnostic categorization, the study reinforces the clinical consensus that the supraspinatus is the most vulnerable component of the rotator cuff.

A comparative analysis between USG and MRI highlights several key findings. USG showed a sensitivity of 76.92%, specificity of 85.71%, PPV of 90.91%, NPV of 66.67%, and overall accuracy of 80.00%. MRI showed a sensitivity of 92.86%, specificity of 80.77%, PPV of 72.22%, NPV of 95.45%, and an overall accuracy of 85.00%. MRI was used as the reference standard, and the comparison revealed that USG identified 40 out of 52 partial tears detected by MRI, with 12 partial tears missed by USG. Additionally, 24 patients showed no partial tear in either modality. USG accurately identified 26 complete tears confirmed by MRI and missed only 2 complete tear (false negative), while incorrectly diagnosing 10 cases as complete tears where MRI did not find any (false positives). This is because ultrasound is based on operator-dependent and obese patients, and restricted movement due to pain may interfere with detecting the exact findings. Notably, USG correctly identified 42 cases in which no complete tear was present (true negative).

These observations emphasize that ultrasonography (USG) serves as a highly capable diagnostic method for identifying rotator cuff injuries, showing significant consistency with MRI findings. While USG demonstrates exceptional precision in detecting full-thickness ruptures and maintains a solid performance in identifying partial-thickness damage, its slightly lower sensitivity compared to MRI suggests it may occasionally overlook more subtle partial tears. Nevertheless, the advantages of USG—specifically its capacity for dynamic, real-time imaging and its relative affordability—render it an indispensable clinical resource that works in tandem with MRI to provide a thorough evaluation of the shoulder. Consequently, this research advocates for USG as a practical and efficient primary screening tool for suspected rotator cuff pathology, even as MRI continues to be the gold standard for intricate structural analysis and definitive confirmation of complex partial injuries.

5. Limitations

This research is constrained by several key factors, most notably a restricted sample population and a demographic skew toward male participants, which may limit how broadly these results can be applied. Because the data was gathered from a single medical center and focused exclusively on rotator cuff pathology rather than a wider range of shoulder conditions, the findings lack the breadth of a multicenter trial. Furthermore, the inherent operator dependency of ultrasonography means that the accuracy is tied to the technician's skill level, and the absence of comparisons with alternative imaging modalities beyond those studied leaves room for further validation. Recognizing these limitations is essential, as they provide a clear roadmap for future investigations to enhance the depth and generalizability of shoulder injury research.

6. Conclusion

Our research highlights ultrasonography (USG) as a highly proficient diagnostic resource for detecting rotator cuff pathology. Given its high degrees of sensitivity and specificity, USG serves as a practical alternative for identifying various tendon tears. While its advantages include cost-efficiency and the ability to perform dynamic, real-time assessments, MRI continues to be the definitive gold standard for nuanced structural analysis, especially regarding partial-thickness injuries. Nevertheless, the strong correlation

between USG and MRI results justifies the use of ultrasound as a primary diagnostic tool in routine clinical settings. It is worth noting that certain variables—such as the technician's expertise, the patient's physical build, and limited range of motion caused by acute pain—can occasionally hinder the clarity of ultrasound findings. Because MRI offers superior precision and detail for complex cases, utilizing both imaging modalities in tandem can significantly improve diagnostic accuracy and help clinicians develop more effective treatment plans for rotator cuff injuries.

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