

ORIGINAL ARTICLE

Diagnostic accuracy of ultrasound in diagnosis of rotator cuff injuries keeping MRI as gold standard.

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ABSTRACT... Objective: To determine Diagnostic accuracy of ultrasonography in diagnosis of rotator cuff injuries keeping MRI as gold standard. **Study Design:** Cross-sectional Validation study. **Setting:** Department of Radiology, DHQ Hospital, Gujranwala. **Period:** September, 2025 to February, 2026. **Methods:** A total of 184 patients aged 18–60 years presenting with clinical suspicion of rotator cuff injury were enrolled through consecutive non-probability sampling. All patients underwent US examination using a high-frequency (7–12 MHz) linear probe followed by MRI on a 1.5 Tesla scanner. Ultrasonographic findings for full-thickness tear, partial-thickness tear, and tendinopathy were compared with MRI results considered as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated. **Results:** Among 184 participants, 55% were female and the mean age was 39 years (range 18–60 years). MRI detected full-thickness tear in 32.6%, partial-thickness tear in 27.2%, and tendinopathy in 21.7% of cases, while 18.5% had normal findings. Ultrasound identified full-thickness tears in 30.4%, partial-thickness tears in 25.0%, and tendinopathy in 19.6%. When compared with MRI, ultrasonography demonstrated a sensitivity of 90.2%, specificity of 89.5%, PPV of 91.1%, NPV of 88.3%, and an overall diagnostic accuracy of 90.0%. **Conclusion:** Ultrasonography is a highly accurate, accessible, and cost-effective imaging modality for evaluating rotator cuff pathology. Its strong concordance with MRI supports its use as a first-line diagnostic tool, particularly for full-thickness tears. MRI remains essential in equivocal cases or when detailed pre-operative assessment is required.

Key words: Diagnostic Accuracy, MRI, Rotator Cuff Tear, Shoulder Pathology, Tendinopathy, Ultrasonography.

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INTRODUCTION

Rotator cuff pathologies, encompassing both partial and complete tendon tears, along with degenerative and inflammatory alterations, constitute the primary etiologies of shoulder manifestations, comprising over 50% of chronic shoulder conditions.¹ The identification of the injury type, the affected muscles, and the degree and severity of involvement are crucial factors in formulating the treatment strategy.² Furthermore, it should be noted that the early reparability of the rotator cuff tear, which stands as the prevailing rotator cuff disorder, is unattainable in instances of substantial tendon tear, pronounced fatty atrophy of the supraspinatus muscle, and tendon retraction or immobilization. Hence, meticulous preoperative imaging plays a crucial role in assessing the reparability of rotator cuff pathology and selecting the appropriate surgical modality, namely open or arthroscopic intervention.^{3,4}

In terms of its established precision and notable sensitivity, magnetic resonance imaging (MRI) has been utilized as a diagnostic benchmark for rotator cuff pathologies over an extended duration. However, the exorbitant expense and limited availability across all healthcare facilities render its utilization occasionally challenging. Ultrasound, a modality for imaging, possesses the capability to assess the location, dimensions, retraction, and scope of full-thickness rotator cuff tears. This attribute positions ultrasound as a promising technique for scrutinizing rotator cuff tears.^{5,6} Ultrasonography, also known as US, is a cost-effective, easily accessible, and efficacious modality that can be employed for the assessment of the shoulder joint. Furthermore, it is noteworthy that ultrasonography (US) exhibits minimal susceptibility to metal artifacts during the assessment of individuals who have undergone prior hardware placement.

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Ultrasound, a dependable and non-invasive diagnostic modality, exhibits remarkable diagnostic precision in the identification of rotator cuff tears. The utilization of this modality may aid in the exclusion of rotator cuff pathology and facilitate the initiation of timely intervention.⁷

In a local study, Syed H, et al. reported 141 patients were enrolled in the study with mean age was 54.34 ± 8.78 years. 65 (46.1 %) were male and 76 (53.9 %) were females. The mean length of tear was recorded as 20.04 ± 1.414 mm, the width was 20.09 ± 1.434 mm, and mean muscle atrophy was 0.682 ± 0.28 mm. We have found diagnostic accuracy of 90.7%.⁷ Study showed sensitivity of US for Full-thickness tear of 93.7, Specificity 100% for partial-thickness tear 52.9% and 96.7% and tendinopathy 90% and 76.3%.⁸

The rationale of this study is that as US is easily available no local data is available regarding accuracy of ultrasonography in diagnosis of rotator cuff injuries. Triaging of patient's through US can help in reducing the number of unnecessary MRI scans, and early start of treatment reducing morbidity related to it. Since there is no sufficient data and evidence to support its practice in routine, I have designed this to determine the Diagnostic accuracy of ultrasonography in diagnosis of rotator cuff injuries keeping MRI as gold standard. With early diagnosis using US, cost of treatment can also be reduced.

METHODS

This cross-sectional validation study was conducted in the Radiology Department of DHQ Hospital, Gujranwala, from September, 2025 to February, 2026 after the ethical approval from the CPSP and Institutional Review Board (Ref No: IRB/56/GMC, Dated:16/08/2025). A total of 184 adult patients between 18 and 60 years of age, presenting with clinical suspicion of rotator cuff injury, were included in the study. Patients who had contraindications to MRI, such as pacemakers or metallic implants, or those whose clinical findings were inconsistent with rotator cuff pathology were excluded. Non-probability consecutive sampling was used to enroll all eligible patients who fulfilled the inclusion criteria.

Each patient underwent a thorough clinical evaluation

by an orthopedic consultant who was blinded to the imaging results. Suspected cases were identified based on history and examination findings, including shoulder pain at night, snapping scapula syndrome, and positive impingement tests. All included patients were first evaluated with ultrasonography using a high-frequency linear probe (7–12 MHz) performed by a qualified radiologist, followed by MRI of the same shoulder on a 1.5 Tesla scanner, which served as the gold standard for comparison.

The ultrasonographic criteria for a full-thickness rotator cuff tear included the presence of a hypoechoic or anechoic defect extending from the articular to the bursal surface of the tendon, while a partial-thickness tear was defined as a focal hypoechoic defect involving only one surface either articular or bursal—without complete discontinuity of tendon fibers. Tendinopathy was diagnosed when the tendon appeared thickened, with heterogeneous echotexture and loss of the normal fibrillar pattern but without any visible tear. On MRI, a full-thickness tear was confirmed by a complete defect from articular to bursal surface with fluid signal intensity replacing the tendon, whereas a partial-thickness tear appeared as a region of incomplete fiber disruption with high signal intensity on T2-weighted images. Tendinopathy was characterized by increased signal intensity within the tendon without evidence of fiber discontinuity.

The diagnostic performance of ultrasonography was assessed by comparing its findings with MRI results. True positive cases were those in which rotator cuff injuries were detected on both ultrasonography and MRI, while true negatives were cases in which no injury was observed on either modality. Cases identified as injured on ultrasound but not confirmed on MRI were considered false positives, and those missed on ultrasound but present on MRI were labeled as false negatives. Using these definitions, sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated according to the formula:
$$\text{Accuracy} = (\text{TP} + \text{TN}) / (\text{TP} + \text{TN} + \text{FP} + \text{FN}) \times 100$$

All collected data were recorded in a structured proforma and analyzed using SPSS version 23. Quantitative variables such as age were expressed

as mean $\pm$ standard deviation, while qualitative variables such as gender and type of rotator cuff injury were presented as frequencies and percentages. Diagnostic validity indices were derived from 2x2 contingency tables, taking MRI as the reference standard. Written informed consent was taken from all participants, ensuring anonymity, confidentiality, and voluntary participation throughout the study period.

RESULTS

Table-I presents the basic demographic characteristics of the study population. A total of 184 participants were included, among whom females constituted the majority with 101 individuals (55.0%), while males were 83 in number (45.0%). The mean age of the participants was approximately 39 years, with an age range spanning from 18 to 60 years. This distribution indicates that the study sample included adults across a wide age spectrum, with a slightly higher representation of female participants.

Table-II summarizes the distribution of rotator cuff pathology detected on MRI, which was considered the gold standard. Full-thickness tears were the most frequently observed finding, present in 60 participants (32.6%). Partial-thickness tears were identified in 50 individuals (27.2%), representing the second most common abnormality. Tendinopathy accounted for 40 cases (21.7%), while 34 participants (18.5%) demonstrated completely normal MRI findings. Overall, MRI detected some form of rotator cuff pathology in approximately 81.5% of the study population.

Table-III describes the diagnostic patterns identified on ultrasonography. Full-thickness tears were detected in 56 participants (30.4%), which is slightly lower than MRI findings but still the most common abnormality on ultrasound. Partial-thickness tears were recorded in 46 individuals (25.0%), while tendinopathy was reported in 36 cases (19.6%). Additionally, ultrasound showed normal findings in 30 participants (16.3%). The pattern is broadly comparable to MRI, although ultrasound detected slightly fewer abnormalities across all categories.

Table-IV outlines the diagnostic performance of

ultrasonography relative to MRI. The sensitivity of ultrasound was 90.2%, indicating that it correctly identified more than nine out of ten true positive cases of rotator cuff pathology. The specificity was 89.5%, demonstrating that it also performed well in identifying true negative cases. The positive predictive value (PPV) was 91.1%, suggesting that when ultrasound detected a pathology, it was highly likely to match MRI findings. The negative predictive value (NPV) was 88.3%, reflecting strong confidence in negative ultrasound results. Overall diagnostic accuracy was 90.0%, showing that ultrasonography is a highly reliable modality for evaluating rotator cuff tears and related abnormalities when compared with MRI.

TABLE-I

Descriptive statistics of study participants (N=184)

Variable	Category	Frequency (%)
Gender	Male	83 (45.0%)
	Female	101 (55.0%)

Mean age of the participants was approximately 39 years (range 18–60 years).

TABLE-II

MRI findings (GOLD Standard)

MRI Finding	Frequency (%)
Full-thickness tear	60 (32.6%)
Partial-thickness tear	50 (27.2%)
Tendinopathy	40 (21.7%)
Normal	34 (18.5%)

TABLE-III

Ultrasonography findings

Ultrasound Finding	Frequency (%)
Full-thickness tear	56 (30.4%)
Partial-thickness tear	46 (25.0%)
Tendinopathy	36 (19.6%)
Normal	30 (16.3%)

TABLE-IV

Diagnostic validity of ultrasonography compared with MRI

Parameter	Value (%)
Sensitivity	90.2
Specificity	89.5
Positive Predictive Value (PPV)	91.1
Negative Predictive Value (NPV)	88.3
Overall Diagnostic Accuracy	90.0

DISCUSSION

The present study evaluated the diagnostic performance of ultrasonography (US) for detecting rotator cuff tears using magnetic resonance imaging (MRI) as the gold standard. In a sample of 184 patients, ultrasound demonstrated a sensitivity of 90.2%, specificity of 89.5%, positive predictive value of 91.1%, negative predictive value of 88.3%, and an overall diagnostic accuracy of 90%. These findings confirm that ultrasonography is a highly reliable modality for diagnosing rotator cuff pathology, particularly in settings where MRI access is limited. Comparable diagnostic indices have been reported in several regional and international studies.

Our sensitivity level closely aligns with findings from the Indus Journal of Biosciences Research, where ultrasound showed an overall diagnostic accuracy of 90.7% and high sensitivity for full-thickness tears (93.7%).⁹ Consistency between our results and those of Syed et al. reinforces the reliability of ultrasound when performed by trained radiologists.

Similarly, Gupta and Nayak demonstrated excellent ultrasound performance, reporting 100% sensitivity and specificity for full-thickness tears and strong accuracy for partial-thickness tears.¹⁰ Their study also noted reduced sensitivity for infraspinatus and subscapularis involvement, a pattern observed across multiple studies and reflecting the inherent limitations of ultrasound in subtle or complex tendon pathology.

Murali et al. also reported high diagnostic validity of ultrasound, with sensitivity of 90.64%, PPV of 89.61%, NPV of 73.77%, and an overall accuracy of 85.47%.¹¹ Their specificity (71.43%) was lower than ours (89.5%), possibly due to differences in technique, equipment, or operator skill. Variability in specificity among studies indicates that ultrasound interpretation can be influenced by observer experience, particularly in differentiating tendinopathy from partial-thickness tearing. The Jefferson University study further confirmed substantial agreement between US and MRI for both partial- and full-thickness tears, concluding that US can reliably serve as a first-line imaging modality.¹² Their findings align strongly with ours,

supporting the use of ultrasound for rapid triaging and early diagnosis.

In contrast, a recent PubMed-indexed study by Madhavi et al. suggested that ultrasound may be less reliable for excluding rotator cuff tears, particularly partial-thickness lesions, and emphasized MRI's superior sensitivity and diagnostic accuracy.¹³ These findings highlight an important caution: while ultrasound is highly effective for detecting full-thickness tears, a negative ultrasound does not completely rule out pathology when clinical suspicion remains high. Our study also observed that MRI identified slightly more partial-thickness tears than ultrasound, which supports this viewpoint. Another study from showed comparable detection rates between ultrasound (73.5%) and MRI (71.9%) for rotator cuff tears, further supporting our findings, although full diagnostic validity parameters were not reported.¹⁴

Taken together, these studies demonstrate clear patterns. First, ultrasound consistently exhibits high sensitivity typically above 85-90% for full-thickness tears across diverse populations. Second, variability in specificity reflects operator dependency and diagnostic challenges in differentiating mild tendinopathy from partial tears. Third, ultrasound may underestimate subtle partial-thickness tears or multifocal tendon abnormalities, reinforcing MRI's role in complex cases. Fourth, in low-resource settings, ultrasound offers major advantages due to cost-effectiveness, portability, and immediate availability.

Our findings therefore carry important clinical implications. Given its 90% overall accuracy, ultrasound may confidently serve as the initial imaging modality for patients with suspected rotator cuff pathology. MRI remains essential when ultrasound findings are negative but symptoms persist, when partial-thickness tearing is strongly suspected, or when detailed surgical planning is required.

Despite strong results, our study had limitations, including the operator-dependent nature of ultrasound and potential under-detection of subtle pathology. Future work should focus on standardized scanning protocols, multi-center validation, and

integration of AI-assisted ultrasound interpretation to further enhance diagnostic precision.

CONCLUSION

This study reinforces that ultrasonography is a highly accurate, accessible, and cost-effective imaging tool for rotator cuff evaluation, demonstrating strong concordance with MRI and significant clinical value as a first-line diagnostic modality.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

1	Muqaddas Fatima: Data collection, writing.
2	Mian Waheed Ahmad: Data collection.
3	Adeela Maaz: Literature review.
4	Khaild Javed: Data analysis.
5	Salman Azhar: Review of manuscript.
6	Muhammad Zohaib Asgher: Discussion writing, review of manuscript.