



Diagnostic Accuracy of High-Resolution Ultrasonography Compared with Magnetic Resonance Imaging for Supraspinatus Tendon Tears: A Cross-Sectional Study from a Tertiary-Care Hospital in Lahore, Pakistan.

¹Dr. Zunair Maqsood, ²Dr. Shehzad Karim Bhatti, ³Dr. Irum Shahzad, ⁴Dr. Maryam Inayat, ⁵Dr. Amir Rafiq, ^{6*}Sana Zaheer Qureshi, ⁷Noor Shahzad

¹MBBS, FCPS Radiology, Assistant Professor of Radiology, Department of Diagnostic Radiology & Medical Imaging, Mayo Hospital / King Edward Medical University, Lahore

²MBBS, FCPS radiology, Associate Professor of Radiology, Department of Diagnostic Radiology & Medical Imaging, Mayo Hospital / King Edward Medical University, Lahore

³FCPS Radiology, Senior Registrar Radiology, Department of Diagnostic Radiology & Medical Imaging, Mayo Hospital, Lahore

⁴MBBS, FCPS, Head of Department Anesthesia and Pain Management, Doctors Hospital, Lahore

⁵MBBS, MD Radiology, Department of Diagnostic Radiology & Medical Imaging, Mayo Hospital, Lahore

⁶B.Sc. Medical Imaging Technology, Lecturer MIT Radiology, Department of Diagnostic Radiology & Medical Imaging, Mayo Hospital / King Edward Medical University, Lahore

⁷Noor Shahzad, Bhatti, BS Honors Computer Sciences, PGD Public Health, Health Services Academy, Islamabad



Correspondence:

Sana Zaheer Qureshi.

B.Sc. Medical Imaging Technology, Lecturer MIT Radiology, Department of Diagnostic Radiology & Medical Imaging, Mayo Hospital / King Edward Medical University, Lahore.

Received: 02-09-2026

Revised: 15-09-2026

Accepted: 11-10-2026

Published: 27-10-2026

Abstract

Background: High-resolution ultrasonography (HRUS) is accessible, radiation-free and allows real-time assessment of the rotator cuff, but its accuracy against magnetic resonance imaging (MRI) for full- and partial-thickness supraspinatus tears needs local evaluation. Objective: To determine the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of HRUS for full-thickness and partial-thickness supraspinatus tendon tears, using MRI as the reference standard.

Methods: In this cross-sectional diagnostic-accuracy study at the Department of Diagnostic Radiology, Mayo Hospital, Lahore, Pakistan, 59 patients aged 18–85 years with suspected supraspinatus tears were recruited by convenience sampling and underwent both HRUS and MRI. Diagnostic performance was calculated separately for each tear type, and the association between HRUS and MRI findings was tested with the Pearson χ^2 test.

Results: Mean age was 54.7 ± 12.6 years; 40 patients (68%) were male. HRUS identified a partial-thickness tear in 21 patients (35.6%), a full-thickness tear in 32 (54.2%) and no tear in 6 (10.2%). For full-thickness tears, sensitivity was 92.5%, specificity 98.3%, PPV 93.6%, NPV 97.8% and accuracy 95.4%. For partial-thickness tears, the corresponding values were 88.7%, 94.2%, 90.3%, 92.5% and 91.5%. The χ^2 statistic was 5.72 (1 degree of freedom; $p = 0.017$). **Conclusions:** HRUS showed high diagnostic performance against MRI, particularly for full-thickness tears. It is a reasonable initial examination for suspected supraspinatus tears, with MRI reserved for equivocal or complex cases, but equivalence to MRI is not shown. Larger blinded studies with confidence intervals and arthroscopic verification are needed.

Keywords: supraspinatus; rotator cuff; ultrasonography; magnetic resonance imaging; diagnostic accuracy; sensitivity and specificity.



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INTRODUCTION

Rotator cuff disorders are a common cause of shoulder pain and functional limitation, and the supraspinatus is the tendon most often affected. Tears are classified as partial-thickness or full-thickness according to the extent of tendon disruption [1]. Ultrasound screening of a general population has shown that full-thickness tears are frequent, increase with age and are often asymptomatic [2], so imaging must be interpreted together with the clinical picture. Accurate characterisation of a tear informs decisions about conservative management, further imaging and surgical referral.

MRI provides detailed assessment of the rotator cuff, including tendon retraction and muscle quality. HRUS is widely available, does not use ionising radiation and is performed in real time, but its performance depends on operator experience, patient positioning and image quality, and it has recognised pitfalls and artefacts [3]. Partial-thickness tears are particularly challenging because small or surface-specific defects can be subtle [4].

Citation: Maqsood Z, Bhatti SK, Shahzad I, Inayat M, Rafiq A, Qureshi SZ, Shahzad N. Diagnostic accuracy of high-resolution ultrasonography compared with magnetic resonance imaging for supraspinatus tendon tears: a cross-sectional study from a tertiary-care hospital in Lahore, Pakistan. *Int. J. Med.*, 2026;**8**(10):417-422.

Systematic reviews and meta-analyses indicate that ultrasound performs well for full-thickness tears, whereas accuracy for partial-thickness tears is lower and more variable [5–10]. A Cochrane review found no statistically significant difference between ultrasound and MRI for full-thickness tears, although indirect comparisons suggested that ultrasound may be less sensitive for partial-thickness tears [8]. MRI is itself imperfect, with pooled sensitivity of 0.80 and specificity of 0.95 for partial-thickness tears and 0.91 and 0.97 for full-thickness tears [11]. Primary studies comparing ultrasound with MRI report similar full-thickness sensitivity (93.7–93.8%) but widely differing partial-thickness sensitivity (52.9–75.6%) [12,13], and a Pakistani study of 169 patients reported an overall sensitivity of 92.86% and specificity of 90.59% for rotator cuff pathology [14]. Ultrasound is regarded as reliable and accurate but operator dependent [15]. Data from tertiary-care departments in Pakistan remain limited.

The aim of this study was to determine the diagnostic accuracy of HRUS for full-thickness and partial-thickness supraspinatus tendon tears, with MRI as the reference standard, in patients referred to a tertiary-care radiology department in Lahore. This report follows the STARD 2015 recommendations [16,17].

MATERIALS AND METHODS

Study design and setting

This cross-sectional diagnostic-accuracy study was conducted in the Department of Diagnostic Radiology, Mayo Hospital, Lahore, Pakistan, between January 2024 to August 2024.

Participants and sample size

Patients were recruited by non-probability convenience sampling from outpatient and inpatient referrals. Eligible participants were men and women aged 18–85 years referred for shoulder MRI with a suspected supraspinatus tear and restricted shoulder movement. Patients were excluded if they had undergone previous shoulder surgery, had a shoulder implant, cardiac pacemaker, prosthetic heart valve, aneurysm clip or other ferromagnetic material, had claustrophobia, or were unable to cooperate with the study. The sample size of 59 was calculated for the sensitivity of HRUS for full-thickness tears, using a 95% confidence level, 10% absolute precision, an expected sensitivity of 93.7% [12], an expected specificity of 100% and an expected prevalence of 39%. Participant flow is shown in Figure 1.

Index test: high-resolution ultrasonography

HRUS was performed with a multifrequency 6–13 MHz linear-array transducer, with focus and frequency adjusted to the depth of the tendon. The patient sat, and the supraspinatus was examined in the Crass position (shoulder extended, adducted and internally rotated, elbow flexed, palm directed away from the body and fingers against the opposite scapula), which brings the tendon from beneath the acromion. When the bicipital groove was not seen, the modified Crass position (hand on the hip or in the back pocket with the elbow drawn back) was used. The long head of the biceps tendon was used to localise the anterior edge of the supraspinatus. The tendon was scanned in longitudinal and transverse planes, along its whole length, to avoid false-negative findings. Tears were classified as partial-thickness, full-thickness or absent.

Reference standard: magnetic resonance imaging

MRI was the reference standard for classifying supraspinatus tears as full-thickness, partial-thickness or absent.

Outcomes and statistical analysis

The primary outcomes were sensitivity, specificity, PPV, NPV and accuracy of HRUS for full-thickness and partial-thickness tears. Continuous variables are presented as mean $\pm$ standard deviation and categorical variables as number (percentage). The association between HRUS and MRI findings was assessed with the Pearson χ^2 test, with $p < 0.05$ considered statistically significant. Analyses were performed with SPSS 2026.

Ethical considerations

The study was approved by King Edward Medical University, Lahore Institutional Review Board. Written informed consent was obtained from all participants, and the study followed the Declaration of Helsinki.

RESULTS

Table 1. Characteristics of the study participants (n = 59)

Characteristic	Value
Participants, n	59
Age, years, mean $\pm$ SD	54.7 $\pm$ 12.6
Age, years, range	18–85
Sex, n (%)	
Male	40 (68)

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Female	19 (32)
Clinical presentation, %	
Shoulder pain	87
Restricted shoulder movement	75
Difficulty with abduction	55
HRUS classification, n (%)	
Partial-thickness tear	21 (35.6)
Full-thickness tear	32 (54.2)
No tear	6 (10.2)

HRUS, high-resolution ultrasonography; SD, standard deviation.

Participants

Fifty-nine patients underwent both HRUS and MRI (Figure 1).

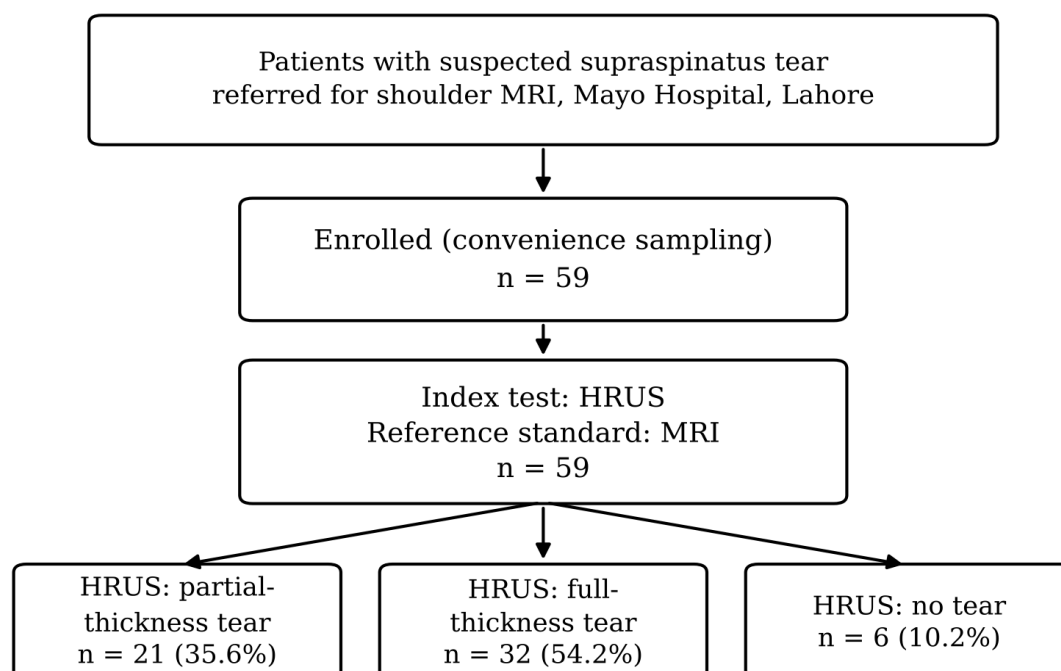


Figure 1. Flow of participants through the study. HRUS, high-resolution ultrasonography; MRI, magnetic resonance imaging.

The mean age was 54.7 ± 12.6 years (range, 18–85 years); 40 (68%) were male and 19 (32%) were female. Shoulder pain was reported by 87% of patients, restricted shoulder movement by 75% and difficulty with abduction by 55% (Table 1). HRUS classified 21 patients (35.6%) as having a partial-thickness tear, 32 (54.2%) as having a full-thickness tear and 6 (10.2%) as having no tear. These are HRUS classification counts and should not be read as MRI-defined disease prevalence.

Diagnostic performance of HRUS

Diagnostic performance against MRI is summarised in Table 2 and Figure 2.

Table 2. Diagnostic performance of HRUS for supraspinatus tendon tears, with MRI as the reference standard

Measure	Full-thickness tear	Partial-thickness tear
Sensitivity, %	92.5	88.7
Specificity, %	98.3	94.2
Positive predictive value, %	93.6	90.3
Negative predictive value, %	97.8	92.5
Accuracy, %	95.4	91.5

HRUS, high-resolution ultrasonography; MRI, magnetic resonance imaging. Pearson $\chi^2 = 5.72$, 1 degree of freedom, $p = 0.017$.

For full-thickness tears, sensitivity was 92.5%, specificity 98.3%, PPV 93.6%, NPV 97.8% and accuracy 95.4%. For partial-thickness tears, the corresponding values were 88.7%, 94.2%, 90.3%, 92.5% and 91.5%.

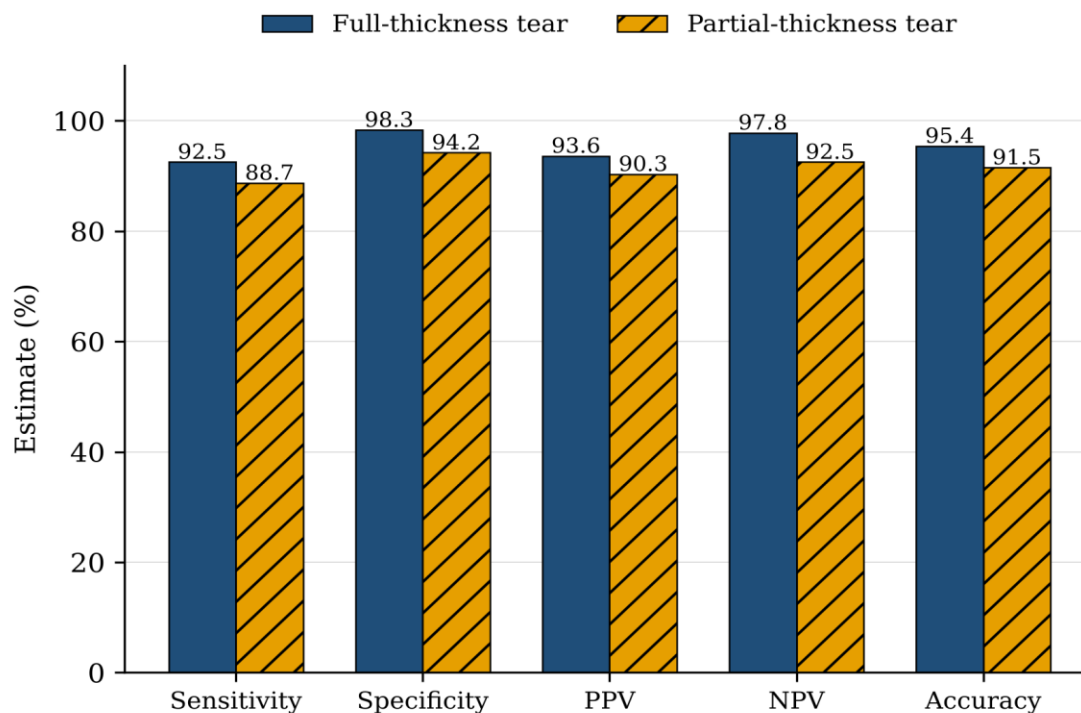


Figure 2. Diagnostic performance of HRUS for full-thickness and partial-thickness supraspinatus tears against MRI. PPV, positive predictive value; NPV, negative predictive value.

Every estimate was numerically higher for full-thickness than for partial-thickness tears.

Association between HRUS and MRI findings

The Pearson χ^2 test showed a statistically significant association between HRUS and MRI findings ($\chi^2 = 5.72$, 1 degree of freedom, $p = 0.017$).

DISCUSSION

In this single-centre study of 59 patients, HRUS showed high diagnostic performance against MRI for both full-thickness and partial-thickness supraspinatus tears, with higher estimates for full-thickness tears. This pattern is clinically plausible: full-thickness defects are usually more conspicuous on ultrasound, whereas small articular-sided, bursal-sided or intrasubstance defects can be subtle and depend more on technique and operator skill [3,4,15].

Our full-thickness estimates (sensitivity 92.5%, specificity 98.3%) are close to those of Aminzadeh et al. (93.7% and 100%; 48 patients) [12] and Agarwal et al. (93.8% and 100%; 50 patients) [13], and to meta-analytic estimates for ultrasound of 0.96 and 0.93 [6] and 92% and 93% [8]. A systematic review reported median full-thickness values of 0.88 and 0.93 [10], and individual studies against surgical findings report similar results [18,19]. For partial-thickness tears, our sensitivity (88.7%) and specificity (94.2%) are higher than the pooled 0.84 and 0.89 [6], the range of 0.67–0.83 for partial tears and tendinopathy [5] and the median of 0.65 and 0.86 [10], and far above the 52.9% and 75.6% reported by Aminzadeh et al. [12] and Agarwal et al. [13]. They do fall within the 72–94% range of sensitivities reported across 13 studies [9]. Meta-analytic work has found no significant difference between ultrasound and MRI for either tear type [7], and a smaller Pakistani study of 40 patients detected tears with ultrasound in 17 patients compared with 19 by MRI [20]. Our partial-thickness estimates should nevertheless be interpreted cautiously: only 21 patients were classified as having such tears, no confidence intervals are available, and differences in case mix, reader experience and MRI criteria could explain the higher values.

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These results support the use of HRUS as an accessible first-line examination for suspected supraspinatus tears when performed by trained operators, particularly where MRI is costly or has long waiting times. MRI remains important when ultrasound findings are equivocal, when symptoms and ultrasound findings disagree, when a partial-thickness tear is suspected despite a negative ultrasound, and when information on tendon retraction, muscle atrophy or associated intra-articular pathology is needed for surgical planning.

This study has limitations. First, the sample was small and recruited by convenience sampling at a single tertiary-care centre, which limits precision and generalisability and carries a risk of spectrum and selection bias. Second, confidence intervals for the diagnostic estimates are not presented; with 59 participants they are expected to be wide. Third, ultrasound is operator dependent, and inter-reader reliability was not assessed. Fourth, MRI is not a perfect reference standard [11]; arthroscopic or surgical verification was not available, so the estimates describe agreement with MRI rather than with the true anatomical state. Fifth, the χ^2 test indicates association only. It does not quantify agreement or demonstrate equivalence between the tests; agreement is better described with a chance-corrected statistic such as kappa [21], and paired differences in sensitivity and specificity with paired confidence-interval methods [22]. Finally, only the supraspinatus was evaluated, so the findings do not extend to the other rotator cuff tendons.

Future studies should recruit consecutive patients, prespecify ultrasound and MRI criteria, use blinded independent readers and standardised protocols, verify findings arthroscopically where possible, report complete 2×2 tables with 95% confidence intervals, and plan sample size around the desired precision of sensitivity and specificity. Risk of bias and applicability can be appraised with QUADAS-2 [23], and reporting should follow STARD 2015 [16,17]. Larger multicentre studies and the evaluation of contrast-enhanced or artificial-intelligence-assisted ultrasound could further clarify performance for subtle partial-thickness tears.

CONCLUSION

In this single-centre sample, HRUS showed high diagnostic performance against MRI for supraspinatus tendon tears, with better results for full-thickness than for partial-thickness tears. HRUS is a reasonable initial examination in suitable settings, particularly where MRI access is limited, but the present evidence is insufficient to conclude that it is equivalent to MRI or can replace it. Confirmation in larger, blinded studies with arthroscopic verification and confidence intervals is warranted.

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