

Original Research Article

Diagnostic accuracy of high-resolution ultrasonography for detection of rotator cuff tear with respect to magnetic resonance imaging

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ABSTRACT

Background: Rotator cuff tears are a common cause of shoulder pain; although magnetic resonance imaging (MRI) is the diagnostic gold standard, this study evaluated high-resolution ultrasonography as a cost-effective, non-invasive alternative for detecting rotator cuff tears.

Methods: A prospective cross-sectional study was conducted at the Department of Radiodiagnosis, Al-Ameen Medical College, Bijapur, from 2023 to 2025. Sixty-five patients aged 18–49 years with suspected rotator cuff injury underwent high-resolution ultrasonography (HRUS) followed by MRI. Findings from both modalities were compared for tendon pathology, including complete and partial tears, tendinosis, and normal appearances.

Results: High-resolution ultrasonography detected partial-thickness rotator cuff tears in 20 patients (20/65, 30.8%) and complete tears in 17 patients (17/65, 26.2%), whereas MRI identified partial tears in 23 patients (23/65, 35.4%) and complete tears in 22 patients (22/65, 33.8%). The supraspinatus tendon was the most commonly involved tendon, affected in 28 patients (28/65, 43.1%). For complete supraspinatus tears, ultrasonography demonstrated high diagnostic performance, with a sensitivity of 83.1%, specificity of 97.4%, positive predictive value of 99.4%, negative predictive value of 96.7%, and a Kappa value of 0.90, indicating almost perfect agreement with MRI. However, ultrasonography showed reduced sensitivity and lower agreement for partial-thickness tears and for infraspinatus tendon involvement.

Conclusion: High-resolution USG is a reliable first-line modality for detecting complete rotator cuff tears, particularly of the supraspinatus and subscapularis tendons; however, MRI remains essential for evaluating partial and posterior tendon tears when USG findings are inconclusive.

Keywords: Rotator cuff tear, Ultrasonography, MRI, Supraspinatus, Shoulder injury, Diagnostic accuracy

INTRODUCTION

Although the shoulder is a ball-and-socket joint, its mobility comes at the cost of stability. The Glenoid's shallow socket has been compared to a basketball on a dinner plate. The rotator cuff, consisting of four muscles—subscapularis, supraspinatus, infraspinatus, and teres minor—provides joint stability. These muscles attach from the scapula to the humerus and function in rotation and abduction. Rotator cuff disease is primarily age-related and degenerative in nature.¹ Risk factors include smoking, which is associated with higher rates and larger tears.²

Family history, poor posture, trauma, hyperlipidemia, and repetitive overhead activity are also significant contributors.^{2,3} Tear progression depends on size, location, age, and symptom development. Larger or anterior tears are more likely to enlarge and cause symptoms, especially in older adults.⁴ Studies report that 30 % of individuals over 60 and 62 % over 80 have rotator cuff tears. In a German study of 411 asymptomatic shoulders, the overall prevalence was 23 %, increasing with age.⁵ Other European studies found full-thickness tears (FTTs) in 6–7.6 % of asymptomatic individuals.^{6,7} Diagnosis of rotator cuff tears (RCTs) requires clinical evaluation supported by

imaging. Magnetic resonance imaging (MRI), considered the gold standard, offers high-resolution visualization of tendon pathology, tear extent, retraction, and associated findings like bursitis and atrophy. Despite high sensitivity and specificity, MRI has limitations, including cost and limited accessibility, and is unsuitable for patients with claustrophobia or metal implants.^{8,9} High-resolution ultrasound (HRUS) is a valuable alternative, offering dynamic, real-time, and cost-effective imaging. It is non-invasive, portable, and allows bilateral comparison, although its accuracy depends on operator skill and may be reduced in patients with high BMI.¹⁰ While HRUS is effective for detecting full-thickness tears, MRI remains superior for comprehensive assessment. Despite a detailed overview of anatomy, risk factors, and imaging modalities, gaps remain in understanding treatment options, preventive strategies, pathophysiology, global epidemiology, prognosis, and the role of regenerative therapies. Thus, this study aimed to assess the diagnostic accuracy of high-resolution ultrasonography in detecting rotator cuff tears compared to MRI.

METHODS

This prospective cross-sectional study was conducted in the Department of Radiology, Al-Ameen Medical College and Hospital, Bijapur, Karnataka, over a period of two years from 2023 to 2025. A total of 65 patients with suspected rotator cuff injury were enrolled based on predefined inclusion and exclusion criteria. Patients between 18 and 49 years of age, of either gender, with restricted shoulder movement and confirmed or suspected rotator cuff injury who provided informed consent were included. Patients with a history of shoulder surgery, implants, cardiac pacemakers, claustrophobia, uncooperative behaviour, or those who did not provide consent were excluded. After obtaining ethical approval [IEC/AMMC/2023/041 (Dated 11/04/2023)], informed consent was taken from all participants.

Clinical data including age, gender, socioeconomic status, duration, and mode of injury were recorded using a structured proforma. All patients first underwent a high-resolution ultrasound (USG) examination of the shoulder, followed by a plain MRI for further evaluation. The MRI was performed using a field of view of 16-18 cm and a slice thickness of 3 mm. Ultrasound findings suggestive of complete rotator cuff tears included complete non-visualisation of the tendon on at least two planes. Partial tears were identified as localized areas of hypo or hetero-echogenicity involving the articular surface, bursal surface, or within the tendon. Intra-substance tears were diagnosed by the presence of fluid-filled lines within the tendon that did not extend to either surface. Tendinosis on USG appeared as hypoechoic or thickened tendons with loss of the normal fibrillar pattern.

On MRI, complete tears were identified as hyperintense defects on T2-weighted images extending from the bursal to the articular surface. Partial tears showed focal

hyperintensity limited to one surface or within the tendon. Tendinosis appeared as intrasubstance hyperintense signals on proton density fat-saturated (PD-FS) images that did not show hyperintensity on T2-weighted images.

Statistical analysis

Data were analyzed using SPSS version 26 (IBM Corp., Chicago, IL, USA). Continuous variables were summarized using mean±standard deviation or range, as appropriate, while categorical variables were expressed as frequencies. The chi-square test was applied where applicable, and p-values < 0.05 were considered statistically significant.

RESULTS

Patients were categorized into three age groups: 18–29 years (25/65, 38.46%), 30–39 years (22/65, 33.85%), and 40–49 years (18/65, 27.69%) (Figure 1). The mean age of the study population was 31.67±8.82 years, indicating that the sample primarily consisted of young to middle-aged adults. Gender distribution showed a slight male predominance, with 37 males (56.9%) and 28 females (43.1%) (Figure 2), which may reflect higher physical activity or occupational exposure among males.

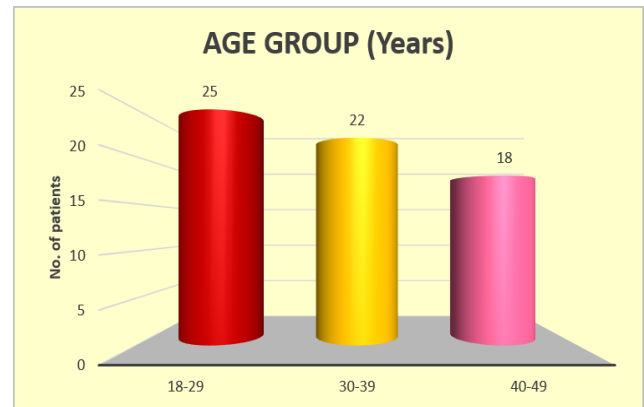


Figure 1: Distribution of patients according to age groups (in years).

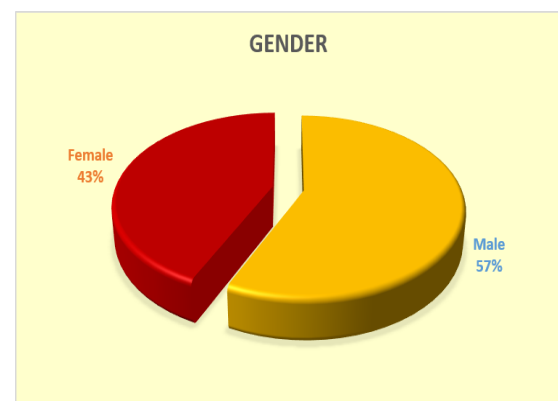


Figure 2: Gender-wise distribution of study participants.

The right shoulder was more commonly involved in 35 patients (53.8%) compared to the left shoulder in 30 patients (46.2%), possibly due to dominant hand usage (Figure 3). Socioeconomic distribution revealed that 28 patients (43.1%) belonged to the middle-income group, followed by the low-income group (21/65, 32.3%) and the high-income group (16/65, 24.6%), indicating representation across all social strata (Figure 4).

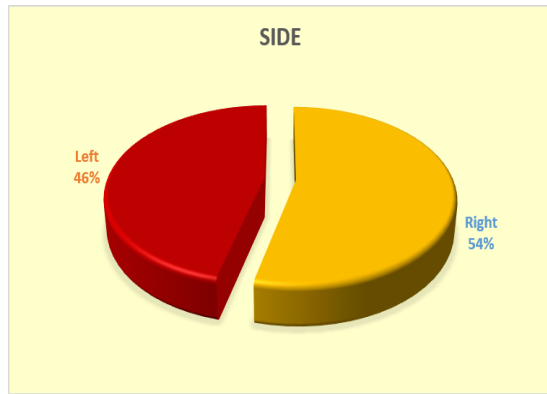


Figure 3: Laterality of shoulder involvement among patients.

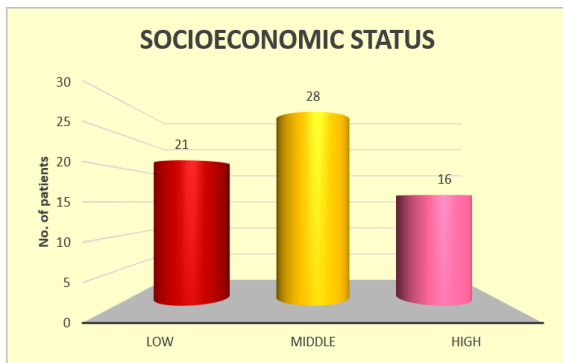


Figure 4: Socioeconomic status of the study population.

Partial-thickness rotator cuff tears were the most common diagnosis, observed in 23 patients (35.4%), followed by complete tears in 22 patients (33.8%) and tendinosis in 20

patients (30.8%). The supraspinatus tendon was the most frequently affected, involved in 28 patients (43.1%), followed by the infraspinatus in 20 patients (30.8%) and the subscapularis in 17 patients (26.1%) (Table 1). Ultrasonography detected partial tears in 20 patients (30.8%) and complete tears in 17 patients (26.2%), while no pathology was detected in 17 patients (26.2%) (Table 2). The “no pathology” group may include subtle lesions or cases where technical limitations affected detection, reinforcing the importance of MRI correlation. MRI identified partial tears in 23 patients (35.4%), complete tears in 22 patients (33.8%), and tendinosis in 20 patients (30.8%) (Table 3).

Table 1: Type of rotator cuff pathology and frequency of tendon involvements.

Findings		Number of Patients	Percentage (%)
Type of Injury	Complete Tear	22	33.8
	Partial Tear	23	35.4
	Tendinosis	20	30.8
Tendon	Supraspinatus	28	43.1
	Infraspinatus	20	30.8
	Subscapularis	17	26.1

Table 2: Ultrasonography (USG) findings.

USG Findings	Number of patients	Percentage (%)
Complete Tear	17	26.2
Partial Tear	20	30.8
Tendinosis	11	16.9
No Pathology Detected	17	26.2

Table 3: Magnetic resonance imaging (MRI) findings.

MRI Findings	Number of patients	Percentage (%)
Complete Tear	22	33.8
Partial Tear	23	35.4
Tendinosis	20	30.8

Table 4: USG vs MRI diagnostic comparison.

Findings		Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Kappa
Complete Tear	Supraspinatus	83.1	97.4	99.4	96.7	0.9
	Infraspinatus	61.3	100	98.8	93.9	0.76
	Subscapularis	63.7	99	97.8	97.2	0.81
Partial Tear	Supraspinatus	79.5	89.6	66.2	93.8	0.58
	Infraspinatus	50.2	99	35.9	98.9	0.36
	Subscapularis	68	100	100	97.7	0.79
Tendinosis	Supraspinatus	73.9	96.2	97.9	82	0.71
	Infraspinatus	34.3	98.9	100	96.7	0.48
	Subscapularis	63.5	99.5	98.8	89.7	0.76

The diagnostic performance of ultrasonography varied across tendons and injury types. For supraspinatus complete tears, ultrasonography demonstrated high sensitivity (83.1%), specificity (97.4%), positive predictive value (99.4%), negative predictive value (96.7%), and a Kappa value of 0.90, indicating almost perfect agreement with MRI. Moderate agreement was observed for supraspinatus partial tears (Kappa=0.58), whereas agreement was poor for infraspinatus partial tears (Kappa=0.36). For tendinosis, agreement was good for the supraspinatus (Kappa=0.71) and subscapularis (Kappa=0.76), but fair for the infraspinatus (Kappa=0.48). These findings support ultrasonography as a useful diagnostic tool, particularly for complete rotator cuff tears, while MRI remains superior for detecting subtle, partial, or complex pathologies (Table 4).

DISCUSSION

Rotator cuff injuries are a common cause of shoulder pain and frequently require imaging for accurate diagnosis. Although magnetic resonance imaging (MRI) is considered the gold standard, it is relatively costly and less accessible in many settings. High-resolution ultrasonography (USG) offers a dynamic, cost-effective, and widely available alternative. This study evaluated the diagnostic accuracy of USG compared with MRI in detecting rotator cuff tears.

In the present study, the mean age of the patients was 31.67 ± 8.82 years, with the majority belonging to the 18–39-year age group (72.3%), indicating an increasing incidence of rotator cuff injuries among younger, physically active individuals. Similar age distributions have been reported in previous studies, which attributed earlier onset of rotator cuff pathology to sports participation and manual labor.¹¹ A male predominance was observed, with males constituting 56.9% of the study population, which may be related to greater occupational and physical strain. Comparable gender distributions have been reported in earlier studies.^{12,13}

Right shoulder involvement was more common (53.8%) than left shoulder involvement, likely reflecting dominant-hand overuse. Similar laterality patterns have been documented in prior studies.^{12,13} The supraspinatus tendon was the most frequently involved tendon (43.1%), followed by the infraspinatus (30.8%) and subscapularis (26.1%). This distribution is consistent with earlier literature and may be attributed to the anatomical position of the supraspinatus beneath the acromion, making it more susceptible to impingement and degenerative changes.¹⁴

MRI findings in the present study demonstrated partial-thickness tears in 35.4% of patients, followed by complete tears in 33.8% and tendinosis in 30.8%, suggesting a progressive spectrum of rotator cuff pathology. Similar patterns have been reported in previous studies, which observed a higher prevalence of partial supraspinatus tears.^{15–17} In contrast, USG detected fewer cases of

tendinosis and failed to identify pathology in 26.2% of patients, highlighting its limitations in detecting subtle or deep-seated lesions, particularly in the infraspinatus and subscapularis tendons. These limitations have also been emphasized in earlier reports.^{15,18}

High-resolution USG demonstrated excellent diagnostic performance for complete supraspinatus tears, with high sensitivity, specificity, and near-perfect agreement with MRI (Kappa = 0.90). These findings are consistent with previous studies that reported high diagnostic accuracy of USG for full-thickness tears when performed by experienced operators.^{12,13,18} For complete infraspinatus and subscapularis tears, USG showed good specificity but relatively lower sensitivity, which may be explained by the deeper anatomical location and technical challenges associated with sonographic evaluation of these tendons.^{7,12}

For partial-thickness tears, USG demonstrated moderate agreement with MRI for supraspinatus involvement and poor agreement for infraspinatus tears, reflecting known limitations of ultrasonography in detecting partial and posterior tendon lesions. Similar observations have been reported in prior studies.^{18,19} Agreement for tendinosis was good for the supraspinatus and subscapularis tendons but only fair for the infraspinatus, consistent with previously published literature.^{17,19}

Overall, the findings of this study support the role of high-resolution USG as a reliable first-line imaging modality for the detection of complete rotator cuff tears, particularly involving the supraspinatus and subscapularis tendons. However, MRI remains superior for the evaluation of partial-thickness tears, posterior tendon involvement, and complex pathology, and should be used when USG findings are negative or inconclusive despite strong clinical suspicion. These results are in agreement with previously published meta-analyses and comparative studies.^{16,18,20}

CONCLUSION

Overall, this study demonstrates that high-resolution ultrasonography (USG) is a highly effective modality for diagnosing complete rotator cuff tears, particularly in the supraspinatus and subscapularis tendons, with high specificity and near-perfect concordance with MRI. However, its reduced sensitivity in detecting partial tears and posterior tendon pathologies underscores the need for caution in such cases. MRI should be considered a complementary tool, especially when USG findings are negative or inconclusive despite strong clinical suspicion. These findings reinforce the role of USG as a valuable first-line imaging technique, particularly in resource-constrained settings, while reaffirming MRI as the gold standard for comprehensive rotator cuff evaluation. Nevertheless, the study's limitations—such as a small sample size, lack of arthroscopic correlation, and operator dependency of USG—may affect the broader applicability

of results. Therefore, it is recommended that high-resolution USG be used primarily for screening clearly defined tears, with MRI reserved for ambiguous cases. Emphasis should also be placed on radiologist training and protocol standardization, and future multicentric studies with surgical validation are needed to further establish diagnostic reliability.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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