BENHA MEDICAL JOURNAL bmj

Print ISSN 1110-208X.

Online ISSN 2357-0016

Original article

The Role of High-Resolution Ultrasound in Diagnosis of Rotator Cuff Pathology Correlated with Magnetic Resonance Imaging Findings

Ahmed E.Shalaan, Mohab H.Elsheikh, Mariam H.Mohammed

Department of Radiodiagnosis, Faculty of Medicine , Benha University, Egypt.

Corresponding to: Mohab H.Elsheikh, Department of Radiodiagnosis, Faculty of Medicine , Benha University, Egypt.

.

Email:

mohabelsheikh949@gmail.com

Received:
Accepted:

Abstract

Background: High-resolution imaging, particularly magnetic resonance imaging (MRI) and ultrasound play a role in the diagnosis and management of different shoulder pathologies. **This study aimed to** describe and correlate the ultrasonographic findings in shoulder rotator cuff different pathologies with the magnetic resonance findings. **Methods:** This cross-sectional study included fifty patients referred to the Radiology Department for MRI shoulder evaluation, who are symptomatic and with positive clinical tests in Benha University Hospital. All studied cases were subjected to long head biceps tendon and subscapularis tendon assessment. **Results**: Ultrasound (US) could correctly detect the presence of joint effusion in 18 patients; however, MRI proved the presence of joint effusion in 22 patients, with a sensitivity of 81.82% (95% confidence interval (CI)=59.72% to 94.81%). Moreover, US gave positive findings in none of the studied patients, which was correctly confirmed later by MRI scan, with a specificity of 100.00% (95%CI=87.66% to 100.00%). The calculated overall accuracy of the US was 92.00% (95%CI=80.77% to 97.78%). Kappa statistics were 0.834 (P<0.001) indicating great agreement between MRI and US in the discriminative ability of joint effusion. **Conclusion:** High-resolution US demonstrates excellent diagnostic performance for most rotator cuff pathologies, offering a practical, cost-effective alternative to MRI in the evaluation of shoulder disorders—particularly in settings where MRI availability is limited. Nevertheless, MRI remains essential for accurately characterizing fatty infiltration, evaluating complex tears, and planning surgical interventions.

Keywords: High-Resolution Ultrasound, Diagnosis, Rotator Cuff Pathology, Magnetic Resonance Imaging.

Introduction

The shoulder joint is one of the complex and mobile joints that play a key role in our daily activities, allowing us to perform a wide range of motions. However, this flexibility also has its drawbacks [(1)]. Shoulder pain is a quite common musculoskeletal condition encountered among patients of various ages, lifestyles, and occupations, which can significantly affect individuals' quality of life. High-resolution imaging, particularly magnetic resonance imaging (MRI) and ultrasound play a role in the diagnosis and management of different shoulder pathologies. Although MRI is the gold standard modality for evaluating the soft-tissue structures of the shoulder and its pathologies, ultrasonography (US) is also an important complementary tool in evaluating the superficial soft-tissue structures such as the rotator cuff tendons and muscles, subacromial-subdeltoid bursa, and biceps tendon [(2)]. The advantages of the US include accessibility, low cost, and one great advantage is that is the capability for real-time imaging which enables dynamic assessment of the shoulder rotator cuff structures and needle guidance [(3)]. Another advantage of the US, over MRI, includes the opportunity for patient-clinician interaction and real-time feedback, as well as the lack of contraindications for MRI such as pacemakers. However, the limitations of the US are patient cooperation, obese patients in assessing deep structures, and the most important limitation is the operator skill in performing the technique and accurately interpreting the findings [(4)].

The shoulder joint is a ball-and-socket joint that is composed of the scapula's humeral head and the glenoid cavity. It is surrounded by a complex network of tendons, ligaments, and muscles, collectively known as the rotator cuff, that provides stability and allows for a wide range of motion, static (glenoid labrum, capsule, glenohumeral and coracoacromial ligaments) and dynamic stabilizers (rotator cuff tendons) maintain the joint congruence during movement [(1)]. The rotator cuff is composed of four muscles with relative tendons attached to the humerus: the subscapularis, the supraspinatus, the infraspinatus, and the teres minor. The long head of the biceps tendon has a proximal insertion at the apex of the glenoid making the bicipital-labral complex, courses laterally and anteriorly through the rotator interval between the subscapularis and supraspinatus tendons and turns down vertically through the bicipital groove of the humerus. The long head of the biceps tendon is the only tendon around the shoulder with a synovial sheath, which communicates with the glenohumeral joint space [(5)].

However, the shoulder's intricate nature makes it susceptible to various injuries. One of the most common injuries is rotator cuff injuries, in the form of tears or strains in the tendons or muscles that can arise from different causative factors, including overuse, traumatic incidents, or age-related degenerative changes. Labral tears are also a frequent source of discomfort, the damage to the labrum rim surrounding the glenoid socket, is often associated with individuals engaging in repetitive overhead activities [6].

Rotator cuff injuries involve rotator cuff tears; full thickness and partial, which is the most common cause of shoulder pain, tendinopathies, and impingements. Subacromial impingement syndrome, bursitis, tendonitis, and partial or full-thickness rotator cuff tears collectively can be called rotator cuff syndrome. The rotator cuff tear risk factors include age, hand dominance, smoking, hypertension, and body weight. The incidence of rotator cuff tears increases with age, with approximately 25% of individuals over the age of 60 and 50% of individuals over 80 having experienced a rotator cuff full-thickness tear [7].

Age is the most common risk factor associated with rotator cuff injury, as it is a degenerative process that happens over time [8]. Rotator cuff injury starts from trauma. Macro-trauma leads to acute tears, which is seen usually in a younger patient resulting in a complete tear. Micro-trauma causes tendon degeneration and with insufficient healing, leads to degenerative tears. Typically, acute tears happen in younger patients, and degenerative tears occur in older patients. However, a smaller amount of force is needed to cause a complete tear if there is sufficient tendon degeneration [9]. Another risk factor is family history; poor posture has also been shown to be a predictor of rotator cuff disease. Other risk factors include trauma, hypercholesterolemia, and occupations or activities requiring significant overhead activity [10].

The purpose of this study was to describe and correlate the ultrasonographic findings in shoulder rotator cuff different pathologies with the magnetic resonance findings.

Patients and methods

This cross-sectional study included fifty patients referred to the Radiology Department for MRI shoulder evaluation, who are symptomatic and with positive clinical tests in Benha University Hospital, during the period from 1st June 2024 to 31st May 2025 (12 months).

An informed written consent was obtained from the patients. Every patient received an explanation of the purpose of the study and had a secret code number. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, Benha University.

Exclusion criteria were history of radiation therapy, neoplastic lesions, and congenital anomalies of the shoulder. Patients have contraindications to perform MRI such as metallic implants, pacemakers, cochlear implants, or any orthopedic metallic implants. As well as claustrophobic patients.

All studied cases were subjected to history-taking and clinical examination.

Ultrasound examination technique:

Ultrasound examinations were performed using an ultrasound Machine with a linear array transducer of 7.5-14 MHz. The patient was placed in the sitting position, and the ultrasound examination will be performed. All rotator cuff tendons were examined and evaluated including the long head of the biceps tendon (LHB), subscapularis tendon, supraspinatus tendon, infraspinatus tendon, acromioclavicular joint, glenoid labrum, subacromial subdeltoid bursa and dynamic examination for subacromial impingement. Each tendon was examined in various projections to recognize tendon anisotropy MSK ultrasound.

Long head biceps tendon assessment: The patient's arm was put in a neutral position, elbow flexed 90°, forearm supinated (palm up). The proximal long head of the biceps tendon was imaged both transversely and longitudinally in the inter-tubercular groove as it runs under the ligament, it was traced superiorly through the rotator cuff interval towards its insertion on the superior labrum and glenoid. Subscapularis tendon assessment: The patient's arm was kept in the same position as above and was externally rotated, pulling the insertion of the subscapularis tendon with it. The subscapularis tendon was traced both longitudinally and transversely: For longitudinal images, the probe was placed in mediolateral position over the humeral head, then the transducer was moved from top to bottom assessing the tendon superior, middle, and inferior fibers. Then dynamic study was done by asking the patient to internal and external rotate the arm while the probe is held still, to assess impingement. For the transverse images, the probe was turned 90 degrees in the cranio-caudal direction with the marker towards the patient's head, the short axis of the three portions of the tendon were assessed by a slow sweeping of the probe from its insertion on the lesser tubercle towards the midline.

Subscapularis tendon assessment: The patient's shoulder was internally rotated and extended ("scratching between shoulder blades" positions). The supraspinatus tendon was traced both longitudinally and transversely; usually, most tears occur in the extreme distal portion, therefore this region should be examined with care. Infraspinatus tendon: The patient reached across their chest and held the contralateral shoulder with their hand. The infraspinatus tendon is then traced both longitudinally and transversely. Acromioclavicular joint: The patient was positioned in either position. The transducer is placed over the humeral head and the clavicle. Glenoid labrum: The patient was positioned in the same position as the infraspinatus and inferior to this for the more inferior part of the posterior labrum. For the anterior part, transverse as for biceps tendon, and for the more posterior part, hand behind the head with shoulder abducted. The literature claimed high sensitivity and specificity, especially for the posterior labrum.

MRI shoulder technique:

MRI examinations were performed using a 1.5-T MR imaging unit (Siemens healthineers Global- MAGNETOM Aera 1.5 Tesla) using the shoulder coil. All metallic objects were removed from the patient's body or clothes. Images were obtained with the Patient in a supine position with the arm mildly externally rotated and the thumb facing up. Imaging planes and pulse sequences: Preliminary scout localizers in axial, sagittal and coronal planes will be obtained. Axial T1-weighted and axial STIR-weighted sequences (including volume from above AC joint to below axillary pouch). Coronal oblique T1-weighted, coronal oblique T2-weighted, and coronal oblique STIR-weighted sequences (parallel to the scapular body or parallel to the supraspinatus tendon - including the entire humeral head). Sagittal oblique T2-weighted sequences (including volume lateral deltoid to scapular body).

Approval code: MS 37-6-2024

Statistical analysis

Data management and statistical analysis were done using SPSS version 27 (IBM, Armonk, New York, United States). Quantitative data were assessed for normality using the Kolmogorov–Smirnov test. According to normality, quantitative data were summarized as median and range. Categorical data were summarized as numbers and percentages. Roc analysis and kappa statistics was used to detect US performance in identifying various causes of ARF. Kappa statistics was interpreted as following: less than 0.2 represents poor agreement; 0.2–0.4 represents fair agreement; 0.41–0.6 represents moderate agreement; 0.61–0.8 represents substantial agreement; greater than 0.8 represents great agreement. The areas under the curve with 95% confidence intervals, best cutoff points, and diagnostic indices were calculated. All statistical tests were two-sided. P values less than or equal to 0.05 were considered significant.

Results

The median age of the studied patients was 37.0 years, which ranged between 18.0 to 85.0 years. The males represented the highest proportion among total studied sample (54.0%).66.0% of participants had traumatic disease, while 32.0% of them had degenerative disease. **Table 1**

Table 2 clarifies that US detected supraspinatus tendinopathy in 36.0% of participants, subscapular tendinopathy in 8.0%, supraspinatus partial thickness tear in 28.0%, subscapular partial thickness tear in 2.0%, Supraspinatus full thickness tear in 24.0%, subscapular full thickness tear in in none of participants, supraspinatus Tendon sub-acromial impingement in 14.0%, fatty infiltration (Atrophic changes) in 2.0%, long head biceps tendon tenosynovitis in 22.0% joint effusion in 36.0% and bursitis in 6.0% of participants.

US could correctly detect the presence of supraspinatus tendinopathy in 16 patients, however MRI proved the presence of supraspinatus tendinopathy in 22 patients, with a sensitivity of 72.73% (95% confidence interval (CI)=49.78% to 89.27%). Moreover, US gave positive findings in 2 patients, which was identified as false results later by MRI scan, with a specificity of 92.86% (95%CI=76.50% to 99.12%). The calculated overall accuracy of the US was 84.00% (95%CI=70.89% to 92.83%) Kappa statistics was 0.669 ($P<0.001$) indicating substantial agreement between MRI and US in the discriminative ability of supraspinatus tendinopathy. US could correctly detect the presence of subscapular tendinopathy in 4 patients, however MRI proved the presence of subscapular tendinopathy in 5 patients, with a sensitivity of 80.0% (95%CI=28.36% to 99.49%). Moreover, US gave no false positive findings with a specificity of 100.0% 92.13% to 100.00%). The calculated overall accuracy of the US was 98.0% (95%CI=89.35% to 99.95%). Kappa statistics was 0.879 ($P<0.001$) indicating great agreement between MRI and US in the discriminative ability of subscapular tendinopathy. US could correctly detect the presence of supraspinatus partial thickness tear in 10 patients, however MRI proved the presence of supraspinatus partial thickness tear in 12 patients, with a sensitivity of 83.33% (95%CI=51.59% to 97.91%). Moreover, US gave positive findings in 4 patients, which was identified as false results later by MRI scan, with a specificity of 89.47% (95%CI=75.20% to 97.06%). The calculated overall accuracy of the US was 88.00% (95%CI=75.69% to 95.47%) Kappa statistics was 0.389 ($P<0.001$) indicating substantial agreement between MRI and US in the discriminative ability of supraspinatus partial thickness tear. US could correctly detect the presence of subscapular partial thickness tear in 1 patient, which was correctly proved by MRI with absence of false negative findings, with a sensitivity of 100.00% (95%CI=2.50% to 100.00%). Moreover, US gave no false positive findings with a specificity of 100.00% (95%CI=92.75% to 100.00%The calculated overall accuracy of the US was 100.00% (95%CI=92.89% to 100.00%). Kappa statistics was 1.0 ($P<0.001$) indicating great agreement between MRI and US in the discriminative ability of subscapular partial thickness tear. **Table 3**

US could correctly detect the presence of supraspinatus full thickness tear in 12 patients, however MRI proved the presence of supraspinatus full thickness tear in 13 patients, with a sensitivity of 92.31% (95%CI=63.97% to 99.81%). Moreover, US gave positive findings in none of the patients, which with no false positive results, with a specificity of

100.00% (95%CI=90.51% to 100.00%). The calculated overall accuracy of the US was 98.20% (95%CI= 89.35% to 99.95%). Kappa statistics were 0.947 (P<0.001) indicating great agreement between MRI and US in the discriminative ability supraspinatus full thickness tear. US could correctly detect absence of subscapular full thickness tears in all patients, which was correctly proved by MRI. Moreover, US gave positive findings in none of the studied patients, with a specificity of 100.0% (95%CI=92.89% to 100.00%). US could correctly detect the presence of supra-spinatus tendon sub-acromial impingement in 7 patients, with no false negative cases, with a sensitivity of 100.00% (95%CI=59.04% to 100.00%). Moreover, US gave no false positive findings with a specificity of 100.00% (95%CI=91.78% to 100.00%). The calculated overall accuracy of the US was 100.00% (95%CI=92.89% to 100.00%). Kappa statistics were 1.0 (P<0.001) indicating great agreement between MRI and US in the discriminative ability of pra-spinatus tendon sub-acromial impingement. US could correctly detect the presence of fatty infiltration in 1 patient, however MRI proved the presence of fatty infiltration in 5 patients, with a sensitivity of 20.00% (95% CI= 0.51% to 71.64%). Moreover, US gave positive findings in none of the studied patients, which was confirmed later by MRI scan, with a specificity of 100.00% (95%CI=92.13% to 100.00%). The calculated overall accuracy of the US was 92.00% (95%CI=80.77% to 97.78%). Kappa statistics were 0.310 (P=0.002) indicating poor agreement between MRI and US in the discriminative ability of fatty infiltration. US could correctly detect the presence of long head biceps tendon in 11 patients, however MRI proved the presence of long head biceps tendon in 12 patients, with a sensitivity of 91.67% (95%CI=61.52% to 99.79%). Moreover, US gave positive findings in none of the studied patients, which was correctly confirmed later by MRI scan, with a specificity 100.00% (95%CI=90.75% to 100.00%). The calculated overall accuracy of the US was 98.00% (95%CI=89.35% to 99.95%). Kappa statistics were 0.941 (P<0.001) indicating great agreement between MRI and US in the discriminative ability of long head biceps tendon. **Table 4**

US could correctly detect the presence of joint effusion in 18 patients, however MRI proved the presence of joint effusion in 22 patients, with a sensitivity of 81.82% (95%CI=59.72% to 94.81%). Moreover, US gave positive findings in none of the studied patients, which was correctly confirmed later by MRI scan, with a specificity of 100.00% (95%CI=87.66% to 100.00%). The calculated overall accuracy of the US was 92.00% (95%CI=80.77% to 97.78%). Kappa statistics was 0.834 (P<0.001) indicating great agreement between MRI and US in the discriminative ability of joint effusion.US could correctly detect the presence of bursitis in 3 patients, which was confirmed by MRI with no false negative cases, with a sensitivity 100.00% 100.00% (95%CI=29.24% to 100.00%). Moreover, US gave positive findings in none of the studied patients, which was correctly confirmed later by MRI scan, with a specificity of 100.00% (95%CI=92.45% to 100.00%). The calculated overall accuracy of the US was 100.00% (95%CI=92.89% to 100.00%). Kappa statistics was 1.0 (P<0.001) indicating great agreement between MRI and US in the discriminative ability of bursitis. **Table 5**

Table 1: Demographics and disease related criteria of the studied patients

Parameters			Total participants (n=50)
Demographics	**Age (years)**	**Median**	37.0
		Range (Min-Max)	18.0-85.0
	Gender **Males**	**n (%)**	27 (54.0)
	Females	**n (%)**	23 (46.0)
Disease related criteria	**Traumatic disease**	**n (%)**	33 (66.0)
	Degenerative disease	**n (%)**	16 (32.0)

Data was presented as median or range (Min-Max) or frequency (%).

Table 2: Distribution of participants regarding US findings

Parameters	US	MRI
Supraspinatus tendinopathy	18 (36.0)	22 (44.0)
Subscapular tendinopathy	4 (8.0)	5 (10.0)
Supraspinatus partial thickness tear	14 (28.0)	12 (24.0)
Subscapular partial thickness tear	1 (2.0)	1 (2.0)
Supraspinatus full thickness tear	12 (24.0)	13 (26.0)
Subscapular full thickness tear	0 (0.0)	0 (0.0)
Supraspinatus Tendon sub-acromial Impingement	7 (14.0)	7 (14.0)
Fatty infiltration (Atrophic changes)	1 (2.0)	5 (10.0)
Long Head Biceps Tendon tenosynovitis	11 (22.0)	12 (24.0)
Joint effusion	18 (36.0)	22 (44.0)
Bursitis	3 (6.0)	3 (6.0)

Table 3: Diagnostic performances of ultrasound in diagnosis of supraspinatus tendinopathy, subscapular tendinopathy, and subscapular partial thickness tear

Parameters		**US**	**MRI**
Supraspinatus tendinopathy		18 (36.0)	22 (44.0)
Sensitivity= 72.73% (95%CI=49.78% to 89.27%)	**PVP=** 88.89% (95%CI=67.25% to 96.89%)	**Positive Likelihood Ratio=** 10.18 (95%CI=2.61 to 39.66)	**Prevalence of supraspinatus tendinopathy** = 40.74% (95%CI=27.57% to 54.97%)
Specificity= 92.86% (95%CI=76.50% to 99.12%)	**PVN =** 81.25% (68.49% to 89.63%)	**Negative Likelihood Ratio=** 0.29 (95%CI=0.15 to 0.59)	**Overall accuracy of US=** 84.00% (95%CI=70.89% to 92.83%)
Measure of agreement Kappa=0.669 (p<0.001)			
Subscapular tendinopathy		4 (8.0)	5 (10.0)
Sensitivity=80.0% (95%CI=28.36% to 99.49%)	**PVN =** 100.00% (39.76% to 100.00%)	---	**Prevalence of subscapular tendinopathy =** 10.0% (95%CI=3.33% to 21.81%)
Specificity= 100.0% (92.13% to 100.00%)	**PVN =** 97.83% (95% CI= 88.63% to 99.62%)	**Negative Likelihood Ratio=** 0.20 (95% CI=0.03 to 1.15)	**Overall accuracy of US=** 98.0% (95%CI=89.35% to 99.95%)
Measure of agreement Kappa=0.879 (p<0.001)			
Supraspinatus partial thickness tear		14 (28.0)	12 (24.0)
Sensitivity= 83.33% (95%CI=51.59% to 97.91%)	**PVP=** 71.43% (95%CI=48.88% to 86.73%)	**Positive Likelihood Ratio=** 7.92 (95% CI= 3.03 to 20.69)	**Prevalence of subscapular partial thickness tear =** 24.00% (95%CI=13.06% to 38.17%)
Specificity= 89.47% (95%CI=75.20% to 97.06%)	**PVN =** 94.44% (95%CI=82.68% to 98.37%)	**Negative Likelihood Ratio=**0.19 (95% CI=0.05 to 0.66)	**Overall accuracy of US=** 88.00% (95%CI=75.69% to 95.47%)
Measure of agreement Kappa= 0.689 (p<0.001)			
Subscapular partial thickness tear		1 (2.0)	1 (2.0)
Sensitivity= 100.00% (95%CI=2.50% to 100.00%)	**PVP=** 71.43% (95%CI=48.88% to 86.73%)	---	**Prevalence of subscapular partial thickness tear =** 20.00% (95%CI=0.05% to 10.65%)
Specificity= 100.00% (95%CI=92.75% to 100.00%	**PVN =** 94.44% (95%CI=82.68% to 98.37%)	---	**Overall accuracy of US=** 100.00% (95%CI=92.89% to 100.00%)
Measure of agreement Kappa= 1.0 (p<0.001)			

Data was presented as frequency (%). *: statistically significant as P value <0.05. MRI = Magnetic Resonance Imaging, US=Ultrasound, TP=True positive, FP=False positive, TN=True negative, FN=False negative, PVP=Predictive value positive, PVN=Predictive value negative, CI=Confidence interval.

Table 4: Diagnostic performances of ultrasound in diagnosis of supraspinatus full thickness tear, supra-spinatus tendon sub-acromial impingement, fatty infiltration, and long head biceps tendon

Parameters		**US**	**MRI**
Supraspinatus full thickness tear		12 (24.0)	13 (26.0)
Final US findings			
Sensitivity= 92.31% (95%CI=63.97% to 99.81%)	**PVP=** 100.0% (95%CI=73.54% to 100.00%)	---	**Prevalence of supraspinatus full thickness tear =** 20.00% (95%CI=14.63% to 40.34%)
Specificity= 100.00% (95%CI=90.51% to 100.00%)	**PVN =**97.37% (95% CI=84.91% to 99.59%)	**Negative Likelihood Ratio=** 0.08 (95%CI=0.01 to 0.51)	**Overall accuracy of US=** 98.20% (95%CI=89.35% to 99.95%)
Measure of agreement Kappa= 0.947 (p<0.001)			
Subscapular full thickness tear		0 (0.0)	0 (0.0)
Final US findings			
PVN = 100.0% (95% CI=92.89% to 100.00%)	**Prevalence of subscapular full thickness tear =** 0.00% (95%CI=0.00% to 7.11%)	**Specificity=** 100.0% (95%CI=92.89% to 100.00%)	---
Supra-spinatus tendon sub-acromial impingement		7 (14.0)	7 (14.0)
Final US findings			
Sensitivity= 100.00% (95%CI=59.04% to 100.00%)	**PVP=** 100.00 (95%CI=59.04% to 100.00%)	**Prevalence of supra-spinatus tendon sub-acromial impingement =**14.00% (95%CI=5.82% to 26.74%)	---
Specificity= 100.00% (95%CI=91.78% to 100.00%)	**PVN =** 100.00% (95% CI=91.78% to 100.00%)	**Overall accuracy of US=** 100.00% (95%CI=92.89% to 100.00%)	---
Measure of agreement Kappa=1.0 (p<0.001)			
Fatty infiltration		1 (2.0)	5 (10.0)
Final US findings			
Sensitivity=20.00% (95% CI= 0.51% to 71.64%)	**PVN=** 100.00% (95%CI=2.50% to 100.00%)	---	**Prevalence of fatty infiltration=** 10.00% (95%CI=3.33% to 21.81%)
Specificity= 100.00% (95%CI=92.13% to 100.00%)	**PVN =**91.84% (95%CI=87.89% to 94.58%)	**Negative Likelihood Ratio=** 0.80 (95% CI=0.52 to 1.24)	**Overall accuracy of US=**92.00% (95%CI=80.77% to 97.78%)
Measure of agreement Kappa= 0.310 (p=0.002)			
Long head biceps tendon		11 (22.0)	12 (24.0)
Final US findings			
Sensitivity= 91.67% (95%CI=61.52% to 99.79%)	**PVP=** 100.00% (95%CI=71.51% to 100.00%)	---	**Prevalence of long head biceps tendon =** 24.00% (95%CI=13.06% to 38.17%)
Specificity= 100.00% (95%CI=90.75% to 100.00%)	**PVN =** 97.44% (95% CI=85.33% to 99.60%)	**Negative Likelihood Ratio=** 0.08 (95%CI=0.01 to 0.54)	**Overall accuracy of US=** 98.00% (95%CI=89.35% to 99.95%)
Measure of agreement Kappa= 0.941 (p<0.001)			

Data was presented as frequency (%). *: statistically significant as P value <0.05. MRI= Magnetic Resonance Imaging, US=Ultrasound, TP=True positive, FP=False positive, TN=True negative, FN=False negative, PVP=Predictive value positive, PVN=Predictive value negative, CI=Confidence interval.

Table 5: Diagnostic performances of ultrasound in diagnosis of US joint effusion

Parameters		**US**	**MRI**
Joint effusion		18 (36.0)	22 (44.0)
Final US findings			
Sensitivity= 81.82% (95%CI=59.72% to 94.81%)	**PVP=** 100.00% (95%CI=81.47% to 100.00%)	---	**Prevalence of joint effusion=**44.00% (95%CI=29.99% to 58.75%)
Specificity= 100.00% (95%CI=87.66% to 100.00%)	**PVN =**87.50% (95% CI=74.26% to 94.44%)	**Negative Likelihood Ratio=** 0.18(95%CI=0.07 to 0.44)	**Overall accuracy of US=** 92.00% (95%CI=80.77% to 97.78%)
Measure of agreement Kappa=0.834 (p<0.001)			
Bursitis		3 (6.0)	3 (6.0)
Final US findings			
Sensitivity= 100.00% (95%CI=29.24% to 100.00%)	**PVP=** 100.00% (95%CI=29.24% to 100.00%)	**Prevalence of Bursitis=** 6.00% (95%CI=1.25% to 16.55%)	---
Specificity= 100.00% (95%CI=92.45% to 100.00%)	**PVN =** 100.00% (95% CI=92.45% to 100.00%)	**Overall accuracy of US=** 100.00% (95%CI=92.89% to 100.00%)	---
Measure of agreement Kappa=1.0 (p<0.001)			

Data was presented as frequency (%). *: statistically significant as P value <0.05. MRI= Magnetic Resonance Imaging, US=Ultrasound, TP=True positive, FP=False positive, TN=True negative, FN=False negative, PVP=Predictive value positive, PVN=Predictive value negative, CI=Confidence interval.

Discussion

The median age of our cohort was 37 years (range: 18–85 years), with a slightly higher proportion of males (54%) than females (46%). Most participants (66%) presented with traumatic shoulder pathology, while degenerative changes accounted for 32%.

These demographics align with prior studies indicating that rotator cuff injuries commonly affect middle-aged adults and that trauma remains a leading contributor in clinical practice [11].

Supraspinatus tendinopathy was detected by US in 36% of cases versus 44% by MRI . The sensitivity (72.7%; 95% CI: 49.8–89.3%) and specificity (92.9%; 95% CI: 76.5–99.1%) of US for supraspinatus tendinopathy demonstrated substantial agreement with MRI (κ = 0.669; p < 0.001) and an overall accuracy of 84.0% (95% CI: 70.9–92.8%).

Additionally, Farooqi et al.'s meta-analysis [12] reported similar diagnostic indices (sensitivity ≈ 75–85%, specificity ≈ 90–95%) for partial-thickness and full-thickness supraspinatus tears, consistent with our US sensitivity of 83.3% and specificity of 89.5% for partial tears (κ = 0.689) and sensitivity of 92.3% and specificity of 100% for full-thickness tears (κ = 0.947) . The high negative predictive value (NPV)= 94.4% for partial tears; 97.4% for full-thickness tears) further underscores US's utility in ruling out significant supraspinatus pathology when findings are negative.

Subscapularis tendinopathy was identified by US in 8% of patients versus 10% by MRI. US demonstrated 80.0% sensitivity (95% CI: 28.4–99.5%) and 100% specificity (95% CI: 92.1–100%) for subscapularis tendinopathy, with excellent agreement (κ = 0.879) and overall accuracy of 98.0%.

These results align with Lee et al. [3], who advocated a standardized US protocol for evaluating the subscapularis tendon, reporting sensitivities > 80% and specificities approaching 100% when performed by experienced operators.

Supraspinatus tendon sub-acromial impingement was present in 14% of participants on both modalities. US showed perfect performance (100% sensitivity, 100% specificity; κ = 1.0), reflecting the capacity of dynamic US to reproduce provocative maneuvers and visualize impingement in real time [5]. Gimarc & Lee et al., [13] similarly highlighted that US can detect sub-acromial impingement with high accuracy, especially when combined with patient positioning that mimics clinical impingement tests.

Fatty infiltration of the rotator cuff musculature was detected by US in only 2% of cases compared to 10% by MRI. US yielded a sensitivity of 20.0% (95% CI: 0.5–71.6%) and specificity of 100% (95% CI: 92.1–100%) for fatty infiltration, with poor agreement (κ = 0.310) and overall accuracy of 92.0%.

Therefore, when fatty infiltration is clinically suspected—especially in chronic or high-grade cases—MRI should be obtained for accurate assessment [14].

Ultrasound performed excellently for detecting related tendon cuff pathologies: long head of biceps tenosynovitis showed 91.7% sensitivity and 100% specificity (κ = 0.941; overall accuracy = 98.0%). Similarly, US detected joint effusion with 81.8% sensitivity and 100% specificity (κ = 0.834; overall accuracy = 92.0%), and bursitis with perfect sensitivity and specificity (κ = 1.0; overall accuracy = 100%).

These high diagnostic indices mirror those reported by Jacobson et al., [15] and Lee et al., [3] who emphasized US's superiority in evaluating superficial bursal fluid and biceps tendon sheath pathology owing to its high spatial resolution. Notably, the absence of false positives in these categories highlights US's role in confidently ruling in inflammatory changes when visualized.

In our cohort, 66% of patients sustained traumatic injuries, whereas 32% displayed degenerative pathologies.

This distribution is comparable to prior Egyptian tertiary-center reports, which noted that younger patients commonly present with acute traumatic tears, while older individuals more frequently exhibit degenerative changes [14]. The higher prevalence of traumatic cases may be attributed to referral patterns at our institution, where acute shoulder injuries are often triaged for imaging more urgently than chronic presentations.

Our results support the use of high-resolution US as the initial imaging modality for most rotator cuff pathologies, given its high accuracy for supraspinatus and subscapularis tendon tears, sub-acromial impingement, biceps tenosynovitis, joint effusion, and bursitis. In resource-limited settings—such as Benha University Hospital—US offers a rapid, cost-effective, and radiation-free alternative to MRI, with immediate patient feedback and dynamic assessment capability [5].

However, when fatty infiltration is suspected or when US findings are equivocal—particularly in complex or multi-tendon injuries—MRI remains indispensable, as demonstrated by our low US sensitivity for atrophy. Furthermore, the 7.3%–17.6% of supraspinatus cases that US failed to detect (false negatives) underscore that negative US cannot entirely exclude early or mild pathology, especially in the context of persistent clinical suspicion.

The limitations of the study were that this was a single-center study with a relatively small sample size (n = 50), which may limit generalizability, all US examinations were performed by experienced musculoskeletal radiologists; therefore, diagnostic indices might be lower in settings with less-trained operators Lee et al., [3] inter- and intra-observer reliability for US interpretation were not formally assessed; prior literature indicates that US performance can vary significantly with operator experience and technique (Jacobson 2011), and MRI was used as the reference standard without surgical correlation, which may overestimate US specificity and sensitivity, especially for partial-thickness tears where MRI itself is not infallible [12, 13].

Conclusion

High-resolution ultrasonography demonstrates excellent diagnostic performance for most rotator cuff pathologies, offering a practical, cost-effective alternative to MRI in the evaluation of shoulder disorders—particularly in settings where MRI availability is limited. Nevertheless, MRI remains essential for accurately characterizing fatty infiltration, evaluating complex tears, and planning surgical interventions.

Therefore, future research should involve multi-center studies with larger and more diverse cohorts to validate these findings, incorporating inter-observer reliability assessments and standardized training protocols could help delineate operator-dependent variability, and advanced US techniques—such as elastography or contrast-enhanced US—may improve detection of subtle tendon pathology and fatty infiltration (Nunna et al. 2023). Additionally, integrating artificial intelligence algorithms for automated tendon segmentation and pathology detection may further enhance US accuracy and reproducibility in routine practice.

References

1. Nunna B, Jr., Parihar P, Wanjari M, Shetty N, Bora N. High-Resolution Imaging Insights into Shoulder Joint Pain: A Comprehensive Review of Ultrasound and Magnetic Resonance Imaging (MRI). Cureus. 2023;15:48-60.
2. Nunna B, Parihar PH, Wanjari M, Shetty N, Bora N. High-Resolution Imaging Insights into Shoulder Joint Pain: A Comprehensive Review of Ultrasound and Magnetic Resonance Imaging (MRI). Cureus. 2023;15:5-11.
3. Lee MH, Sheehan SE, Orwin JF, Lee KS. Comprehensive Shoulder US Examination: A Standardized Approach with Multimodality Correlation for Common Shoulder Disease. Radiographics. 2016;36:1606-27.

4. Arnold TC, Freeman CW, Litt B, Stein JM. Low-field MRI: clinical promise and challenges. J Magn Reson Imaging. 2023;57:25-44.
5. Serpi F, Albano D, Rapisarda S, Chianca V, Sconfienza LM, Messina C. Shoulder ultrasound: current concepts and future perspectives. J Ultrason. 2021;21:154-61.
6. Sripathi P, Agrawal DK. Rotator Cuff Injury: Pathogenesis, Biomechanics, and Repair. J Orthop Sports Med. 2024;6:231-48.
7. Okoroha KR, Fidai MS, Tramer JS, Davis KD, Kolowich PA. Diagnostic accuracy of ultrasound for rotator cuff tears. USG. 2019;38:215-20.
8. May T, Garmel G. Rotator cuff injury. StatPearls. Treasure Island: FL StatPearls Publishing; 2022.
9. Abdelwahab A, Ahuja N, Iyengar KP, Jain VK, Bakti N, Singh B. Traumatic rotator cuff tears - Current concepts in diagnosis and management. J Clin Orthop Trauma. 2021;18:51-5.
10. Giri A, O'Hanlon D, Jain NB. Risk factors for rotator cuff disease: A systematic review and meta-analysis of diabetes, hypertension, and hyperlipidemia. Ann Phys Rehabil Med. 2023;66:10-31.
11. May T, GM. G. Rotator Cuff Injury Treasure Island (FL)2023 [Available from:https://www.ncbi.nlm.nih.gov/books/NBK547664/.
12. Farooqi AS, Lee A, Novikov D, Kelly AM, Li X, Kelly JDt, et al. Diagnostic Accuracy of Ultrasonography for Rotator Cuff Tears: A Systematic Review and Meta-analysis. Orthop J Sports Med. 2021;9:99-112.
13. Gimarc DC, Lee KS. Shoulder MR Imaging Versus Ultrasound: How to Choose. Magn Reson Imaging Clin N Am. 2020;28:317-30.
14. Nunna B, Jr., Parihar P, Wanjari M, Shetty N, Bora N. High-Resolution Imaging Insights into Shoulder Joint Pain: A Comprehensive Review of Ultrasound and Magnetic Resonance Imaging (MRI). Cureus. 2023;15:48-74.
15. Jacobson JA. Shoulder US: anatomy, technique, and scanning pitfalls. Radiology. 2011;260:6-16.

To cite this article: Ahmed E.Shalaan, Mohab H.Elsheikh, Mariam H.Mohammed. The Role of High-Resolution Ultrasound in Diagnosis of Rotator Cuff Pathology Correlated with Magnetic Resonance Imaging Findings. BMFJ XXX, DOI: 10.21608/bmfj.2025.388205.2437