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Original Research Article

Assessment of the Diagnostic Accuracy of Ultrasonography for the Detection of Rotator Cuff Tear with Respect to Magnetic Resonance Imaging

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Conflict of interest: Nil

Abstract

Introduction: Shoulder pain is a prevalent musculoskeletal complaint, and accurate imaging is essential for diagnosing underlying structural abnormalities. Ultrasonography (USG) is widely used as a first-line modality due to its accessibility and cost-effectiveness, while magnetic resonance imaging (MRI) remains the reference standard. This study evaluates the diagnostic performance of USG compared with MRI across multiple shoulder pathologies.

Aims and Objectives: To assess the accuracy of USG in detecting shoulder abnormalities— including rotator cuff tears, tendinopathy, bursitis, and arthritis—using MRI as the gold standard.

Materials and Methods: Seventy participants underwent detailed clinical evaluation followed by USG and MRI of the affected shoulder. Demographic characteristics, handedness, occupational profile, comorbidities, and laterality were documented. USG findings were compared with MRI for partial-thickness tears, complete tears, tendinopathy (two datasets), supraspinatus tears, bursitis, arthritis, and overall tear detection. An extended dataset (n=207) was used for broad assessment of "any tear."

Results: The study population predominantly comprised males (78.7%) with a mean age of 39.7 ± 12.6 years. Most participants were right-hand dominant (97.7%) and had right-shoulder involvement (64.4%). USG identified 8 partial-thickness tears (3 true positives) while missing 10 MRI-confirmed cases. Tendinopathy detection varied, with 35 true positives in Set 1 and only 4 in Set 2. For "any tear," USG demonstrated high accuracy in the large dataset (38 true positives). USG also performed well in identifying arthritis (45 true positives) and bursitis (39 true positives).

Conclusion: USG is an effective first-line imaging tool for evaluating shoulder disorders, particularly full-thickness tears, bursitis, and arthritis. MRI remains essential for detecting subtle or partial-thickness tears.

Keywords: Ultrasonography, MRI, Shoulder pain, Rotator cuff tear, Tendinopathy, Bursitis.

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Introduction

Rotator cuff tears are a common cause of shoulder pain and functional limitation, particularly in middle-aged and older adults and in those engaged in repetitive overhead activities. Clinically, patients often present with pain, weakness, and limited range of motion, but physical examination alone may lack adequate sensitivity and specificity, making imaging essential to confirm the presence, extent, and type (partial- versus full-thickness) of tendon pathology, which then guides management decisions ranging from conservative therapy to surgical repair [1,2]. Magnetic Resonance Imaging (MRI) has long been regarded as the gold standard for rotator cuff evaluation because of its excellent soft-tissue contrast, multiplanar imaging capability, and ability to detect secondary features such as muscle atrophy or tendon retraction [3]. However, MRI has important limitations: it is expensive, time-consuming, not always accessible, and contraindicated for some patients, which can delay diagnosis or limit its use, especially in resource-constrained settings [4]. High-resolution ultrasonography (US) has emerged as a promising alternative. Ultrasound is cost-effective, portable, radiation-free, and provides real-time, dynamic assessment of the rotator cuff [5]. Meta-analyses and systematic reviews suggest that, under expert conditions, US can achieve diagnostic accuracy comparable to MRI for full-thickness tears. However, US performance is strongly dependent

on operator expertise, equipment quality, and patient factors, and it may be less reliable for detecting partial-thickness tears or subtle lesions [6]. Despite these challenges, US often demonstrates high sensitivity and positive predictive value, making it a viable first-line imaging tool in clinical settings [7].

Indeed, large reviews show pooled sensitivities and specificities for US in full-thickness tears exceeding 0.90, while specificity remains high for partial-thickness tears and sensitivity is somewhat lower, in the range of 0.67–0.83 .US can also provide dynamic functional information, such as real-time tendon behavior during shoulder movement, which static MRI cannot offer [8]. Moreover, use by non-radiologists has been shown to improve diagnostic efficiency without substantially compromising accuracy; for instance, orthopedic surgeons performing US achieved very good agreement with MRI-based diagnoses [9].

Nevertheless, variability in diagnostic performance persists across studies. Some comparative studies report that MRI retains higher sensitivity or a more favorable positive predictive value than US, particularly in complex or chronic cases [10]. Additionally, a negative ultrasound result does not always reliably exclude a tear, raising concern when US is used alone. This underscores the need for systematic evaluation of US relative to MRI.

Materials and Methods

Study design: Cross sectional study.

Period of study: Totaltimeperiod-18months with mutual overlapping.

Place of Study: Department of Radiodiagnosis North Bengal medical College and Hospital.

Study Population: Patients with shoulder pain and history of injury who are referred from orthopaedics department.

Sample Size: 71patients.

Inclusion Criteria

- Shoulder pain, both acute and chronic
- Stiffness of shoulder
- Restriction in activities of daily living
- Trauma to shoulder.

Exclusion Criteria

- Refusal for the ultrasound study
- Female subjects without a chaperone
- Post-operative cases
- Subjects unable to cooperate due to pain
- Patients presenting for evaluation of tumors / malignancies

Study Variable

- Gender
- Age (years)
- Dominant Hand / Handedness
- Diabetes Status
- Cholesterol Assessment
- Cholesterol Assessment
- Sensitivity

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Result

Table 1: Distribution of Study Participants by Gender

Gender	Frequency (n)	Percentage (%)
Men	55	78.7
Women	15	21.3
Total	70	100

Table 2: Distribution of Study Participants by Age

Group	Mean Age (years)	Standard Deviation (SD)
Overall	39.7	12.6
Men	38.4	12.6
Women	44.6	12

Table 3: Distribution of Handedness and Shoulder Evaluated

Variable	Category	Frequency (n)	Percentage (%)
Handedness (n = 46)	Right	45	97.7
	Left	1	2.3
Shoulder Evaluated (n = 70)	Right	45	64.4
	Left	25	35.6

Table 4: Occupational Distribution of Participants (N = 50)

Occupation Type	Frequency (n)	Percentage (%)
Light Work (office/home)	40	80
Heavy Work (manual labor)	10	20

Table 5: Distribution of Diabetes, Hypertension, and Cholesterol Assessment Status

Parameter	Category	Frequency (n)	Percentage (%)
Diabetes Status (n=63)	Diabetes	6	9.6
	No Diabetes	57	90.4
Hypertension Status (n=54)	Hypertension	8	14.7
	No Hypertension	46	85.3
Cholesterol Assessment (n=66)	Cholesterol Assessed	19	28.7
	Cholesterol Not Assessed	47	71.3

Table 6: Summary of MRI–USG Cross-Tabulations for Different Shoulder Pathologies

Pathology	USG Findings	MRI Positive	MRI Normal	Total
Partial-Thickness Tear (n=70)	USG Positive	3	5	8
	USG Normal	10	52	62
	Total (MRI)	13	57	70
Tendinopathic Changes – Set 1 (n=67)	USG Positive	35	13	48
	USG Normal	7	12	19
	Total (MRI)	42	25	67
Any Tear – Set 1 (n=67)	USG Positive	31	6	37
	USG Normal	4	26	30
	Total (MRI)	35	32	67
Complete vs Partial Tear (n=31)	USG Complete Tear	5	1	6
	USG Partial Tear	7	18	25
	Total (MRI)	12	19	31
Tendinopathic Changes – Set 2 (n=67)	USG Positive	4	7	11
	USG Normal	11	45	56
	Total (MRI)	15	52	67
Supraspinatus Tear (n=70)	USG Positive	4	3	7
	USG Normal	4	59	63
	Total (MRI)	8	62	70
Any Tear – Large Dataset (n=207)	USG Positive	38	14	52
	USG Normal	18	137	155
	Total (MRI)	56	151	207
Arthritis (n=67)	USG Positive	45	12	57
	USG Normal	3	7	10
	Total (MRI)	48	19	67
Bursitis (n=69)	USG Positive	39	9	48
	USG Normal	12	9	21
	Total (MRI)	51	18	69

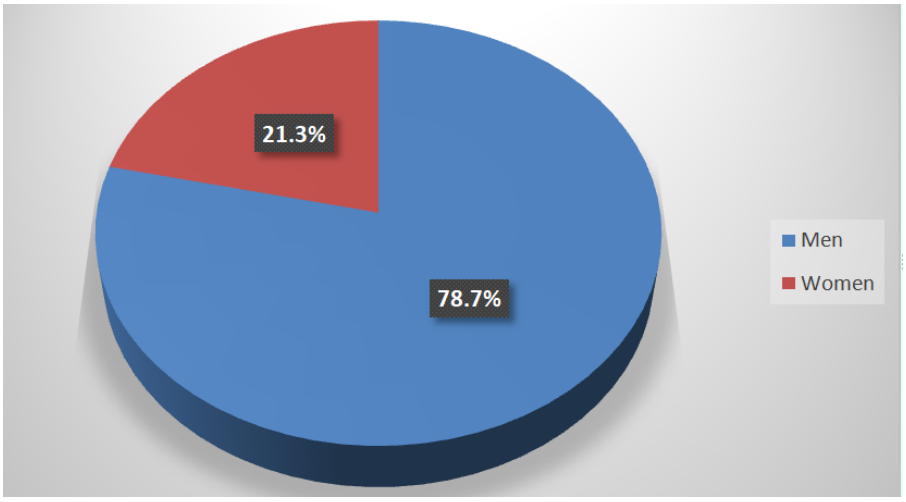

Figure 1: Distribution of Study Participants by Gender

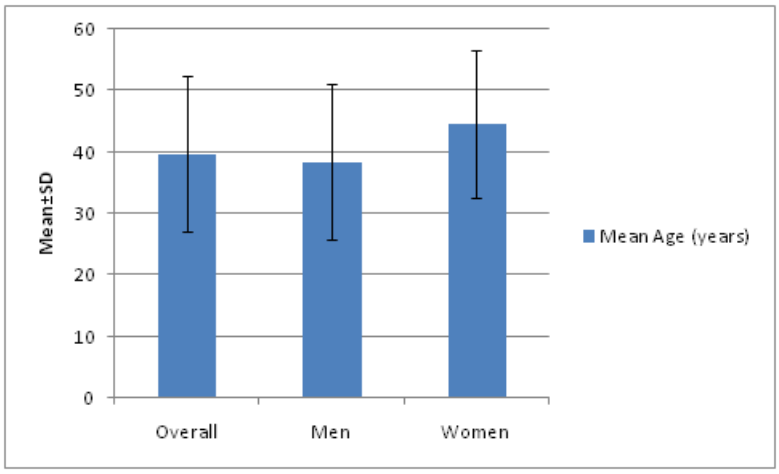

Figure 2: Distribution of Handedness and Shoulder Evaluated

In the present study, a total of 70 participants were evaluated. Among them, 55 (78.7%) were men, while 15 (21.3%) were women, indicating a clear male predominance in the study population.

The mean age of the overall study population was 39.7 years with a standard deviation of 12.6 years, indicating a moderately wide age variation among participants. Male participants had a mean age of 38.4 ± 12.6 years, while female participants were slightly older on average, with a mean age of 44.6 ± 12.0 years. This shows that women in the study tended to be older compared to men.

Among the 46 participants for whom handedness was recorded, the majority were right-hand dominant (45; 97.7%), while only 1 participant (2.3%) was left-hand dominant. Regarding the shoulder evaluated (n = 70), 45 participants (64.4%) had the right shoulder assessed, whereas 25 participants (35.6%) underwent evaluation of the left shoulder.

In our study, the majority of participants were engaged in light work (office/home duties), accounting for 40 patients (80%), while 10 patients (20%) were involved in heavy work (manual labor).

Among the participants, 6 individuals (9.6%) had diabetes, while 57 individuals (90.4%) had no diabetes. Regarding blood pressure status, 8 participants (14.7%) were identified as having hypertension, whereas 46 participants (85.3%) had no hypertension. For cholesterol assessment, 19 participants (28.7%) had their cholesterol levels assessed, while the majority, 47 participants (71.3%), did not undergo cholesterol assessment.

Partial-Thickness Tear (n=70)

USG positive in 8 (3 true, 5 false).

USG normal in 62 (10 missed tears). Tendinopathy – Set 1 (n=67): USG positive in 48 (35 true).

USG normal in 19 (7 missed). Any Tear – Set 1 (n=67): USG positive in 37 (31 true).

USG normal in 30 (4 missed). Complete vs Partial Tear (n=31): USG complete tear: 6 (5 true).

USG partial tear: 25 (7 true). Tendinopathy – Set 2 (n=67): USG positive in 11 (4 true). USG normal in

56 (11 missed). Supraspinatus Tear (n=70): USG positive in 7 (4 true).

USG normal in 63 (4 missed). Any Tear – Large Dataset (n=207): USG positive in 52 (38 true).

USG normal in 155 (18 missed). Arthritis (n=67): USG positive in 57 (45 true). USG normal in 10 (3 missed). Bursitis (n=69): USG positive in 48 (39 true). USG normal in 21 (12 missed).

Discussion

In the present study, most participants were middle-aged men, which is comparable to the demographic distribution reported in earlier shoulder pathology research [11,12]. The predominance of right-hand dominance and greater involvement of the right shoulder also aligns with previously published epidemiological profiles [13]. The high proportion of participants involved in light work reflects findings from prior community-based studies, although some investigators have reported a larger representation of manual laborers in shoulder injury cohorts [14]. The prevalence of comorbidities such as diabetes, hypertension, and hyperlipidemia in our study was generally lower than that described by other authors, who noted stronger associations between metabolic disorders and rotator cuff pathology [15,16].

In terms of diagnostic performance, our results demonstrate that ultrasonography (USG) identified partial-thickness tears with moderate accuracy, showing several false negatives compared with MRI. Similar limitations of USG for partial-thickness tears have been highlighted by previous researchers, who report variable sensitivity ranging from 50–80% [17]. For tendinopathy (Set 1), the relatively high true-positive yield of USG in our study corresponds with earlier meta-analyses suggesting that USG is reliable for detecting tendon degenerative changes [18]. However, the lower performance observed in Tendinopathy Set 2 reflects the operator-dependent nature of USG, a challenge also emphasized in previous literature [19].

Regarding detection of any tear, both in the smaller (n=67) and large dataset (n=207), our findings are consistent with studies indicating that USG performs well for full-thickness tears but is less sensitive for subtle or complex tears, thereby explaining the missed cases in the USG-normal group. This trend has been frequently documented, with MRI maintaining superiority as the reference standard [20].

Similarly, USG demonstrated good diagnostic ability for arthritis and bursitis, matching prior reports where effusions and cortical irregularities are readily visualized on ultrasound. Overall, our study reinforces the value of USG as an accessible and cost-effective first-line modality, while underscoring the role of MRI in confirming equivocal or clinically complex cases.

Conclusion

In conclusion, ultrasound serves as a reasonably effective screening tool for shoulder pathologies, demonstrating good sensitivity (84%) and specificity (78.8%) for detecting supraspinatus tears, moderately good sensitivity (73%) and good specificity (88.4%) for any rotator cuff tear, and reasonable sensitivity (78.9%) and specificity (70%) for acromioclavicular joint arthritis.

While it shows high sensitivity (81%) but low specificity (42.8%) for subacromial-subdeltoid bursitis, age, hypertension, and history of trauma were significantly associated with these conditions. Overall, ultrasound provides a reliable, non-invasive method for evaluating rotator cuff abnormalities and related shoulder disorders.

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