Assessing the Diagnostic Accuracy of Ultrasound and MRI for Rotator Cuff Tears in a Tertiary Care Hospital in Chennai

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KEYWORDS

Ultrasound ,magnetic resosnance imaging,rotator cuff tear,full thickness tear,partial thickness tear.

ABSTRACT:

Introduction: Rotator cuff disease (RCT) is a common cause of shoulder pain and dysfunction, with varying severity from minor partial-thickness tears to large retracted full-thickness injuries. Risk factors for RCTs include age, trauma, dominant arm, diabetes, smoking, hypercholesterolemia, and heredity. Ultrasound (US) and magnetic resonance imaging (MRI) are non-invasive imaging methods used to diagnose RCT and related shoulder pathologies.US is more widely available, less expensive, and allows for dynamic examination and evaluation of muscular contraction.US has been proven highly accurate in identifying or excluding full-thickness tears, with a combined sensitivity and specificity of 0.95 and 0.96. While US is less sensitive than MRI for identifying partial-thickness tears, it is as sensitive as MRI for diagnosing full-thickness tears.

Objectives: To compare the ultrasound for the detection of RCT with respect to MRI. To identify tendinopathic changes, PTT and FTT of RC and to assess sensitivity and Specificity of ultrasound to against MRI, as benchmark

Methods: A total of thirty cases with RCT were included.

All patients aged above 18 years with clinical suspicious of RCT

MRI Procedure: Based on inclusion criteria with informed consent MRI shoulder was taken with the required MR sequences

MRI Analysis**:** Look for rotator cuff muscle or tendon injury or any collection around shoulder joint and assess the degree and type of tear.

Ultrasound Scanning: Followed by ultrasound scanning of shoulder joint was done

Comparison of Findings: Compare USG findings with respect to MRI

Results: In this study, the mean age of the participants was 41.5 years, with a predominance of male individuals. Ultrasound (USG) findings indicated abnormalities in the subscapularis, supraspinatus, infraspinatus, and teres minor in 30%, 6.7%, 66.7%, and 3.3% of cases, respectively. Similarly, magnetic resonance imaging (MRI) revealed abnormalities in the subscapularis, supraspinatus, infraspinatus, and teres minor in 33.3%, 3.3%, 70%, and 3.3% of cases, respectively. Notably, USG demonstrated diagnostic accuracy (DA) of 96.7%, 93.3%, 97.5%, and 90% for no tear, tendinitis, partial thickness tear (PTT), and full thickness tear (FTT), respectively.

Conclusions: USG is better in identification of partial RCT followed by no tear , tendinitis and full RCT. Hence in resource limited setting USG can be used as a screening tool to identification of degree of RCT, however , MRI is the choice of preference in fully equipped set ups.

1. Introduction

Rotator cuff disease (RCT) is a leading cause of shoulder pain and dysfunction, with varying levels of severity, ranging from minor partial thickness tears to large, full-thickness ruptures. Accurately assessing the type and extent of rotator cuff damage is critical for determining the most appropriate treatment plan for each patient. While clinical examination plays an important role, it is not sufficient to fully determine the extent of rotator cuff pathology.[1]

The rotator cuff is made up of four muscles—the supraspinatus, infraspinatus, subscapularis, and teres minor—that are connected to the humeral head by tendons. These structures work together to stabilize the shoulder while maintaining a wide range of motion. A variety of shoulder conditions, such as RCT, tendinosis, bursitis, impingement, joint effusion, and degenerative changes in the acromioclavicular joint, can lead to shoulder pain and are typically diagnosed using imaging techniques like ultrasound (US) and magnetic resonance imaging (MRI).[1,2]

Age is a significant risk factor for RCT, with approximately 25% of individuals in their 60s and more than 50% in their 90's experiencing full-thickness tears. Additional risk factors include a history of trauma, dominant arm use, smoking, diabetes, hypercholesterolemia, and genetic predisposition. Both MRI and ultrasound, along with other non-invasive imaging methods, are valuable tools for visualizing rotator cuff pathology. However, MRI is more expensive and may not be suitable for patients with metallic implants, pacemakers, or claustrophobia.[3]

In contrast, ultrasound is more widely available, less costly, and better tolerated by most patients. It also provides the added benefit of evaluating shoulder function and dynamics. Ultrasound can be used not only to detect injuries but also to guide injection procedures for treatment. Ultrasound-guided injections have shown considerable benefits in managing shoulder pain.[1-4]

Ultrasound has been shown to be highly accurate in identifying full-thickness rotator cuff tears, with sensitivity (Sn) and specificity (Sp) rates of 0.95 and 0.96, respectively, when using high-frequency probes (≥10 MHz). [5] For full-thickness tears, ultrasound has been shown to

perform similarly to MRI, with some studies reporting 100% specificity and excellent sensitivity. [6] However, ultrasound is less sensitive than MRI for detecting partial thickness tears (PTT). Studies have found varying results for PTT detection, with sensitivity and diagnostic accuracy being higher for MRI compared to ultrasound.[7-8]

For instance, a study by Chen et al. found that ultrasound was highly sensitive for full-thickness tears (Sn 92.2%, DA 89%) but less sensitive for partial thickness tears (Sn 62.5%, DA 75%). MRI, by comparison, demonstrated higher sensitivity and diagnostic accuracy for partial thickness tears (Sn 87.5%, DA 88%). As the use of ultrasound in shoulder diagnostics has increased, so too has clinician experience, leading to improvements in its sensitivity and diagnostic accuracy. [9-10]

Ultimately, the choice between ultrasound and MRI should be based on factors such as diagnostic accuracy, patient tolerance, cost, and clinician expertise. Clinical context and patient preferences, including the fact that some studies show patients favor ultrasound over MRI, should also be considered.[8-10]

2. Objectives

- To compare the ultrasound for the detection of RCT with respect to MRI.
- To identify tendinopathic changes, PTT and FTT of RC and to assess Sensitivity and Specificity of ultrasound to against MRI, as benchmark

3. Methods

This cross-sectional study was conducted to compare ultrasound for the detect ion of RCT with respect to MRI. A total of thirty cases with RCT were included

Inclusion criteria:

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

Exclusion criteria:

- Refusal for the ultrasound
- Post -operative cases
- Subjects unable to cooperate due to pain.

Each participant received a thorough explanation of the study along with guarantees that their identity would be kept completely private and that they might decline to participate. Prior to the

interview, the study participants provided written informed consent. Following the acquisition of signed informed consent, the lead investigator used a pre-structured proforma to evaluate each

participant 's clinical presentation and demographics. Also, all the cases were subjected to USG and MRI scans. The lead investigator recorded the clinical presentation on the same proforma in which all the findings were submitted.

All patients aged above 18 years with clinical suspicious of RCT

Based on inclusion criteria with informed consent MRI shoulder was taken with the required MR sequences

Look for rotator cuff muscle or tendon injury or any collection around shoulder joint and assess the degree and type of tear.

Followed by ultrasound scanning of shoulder joint was done

Compare USG findings with respect to MRI

Data analysis

SPSS - 19 was used to evaluate the data after it was entered into an Excel sheet. For quantitative variables, descriptive statistics including mean, standard deviation, and proportions were computed. Chi Square testing and diagnostic test parameters were utilized to evaluate the hypothesis. A p-value of less than 0.05 was deemed exceptionally significant.

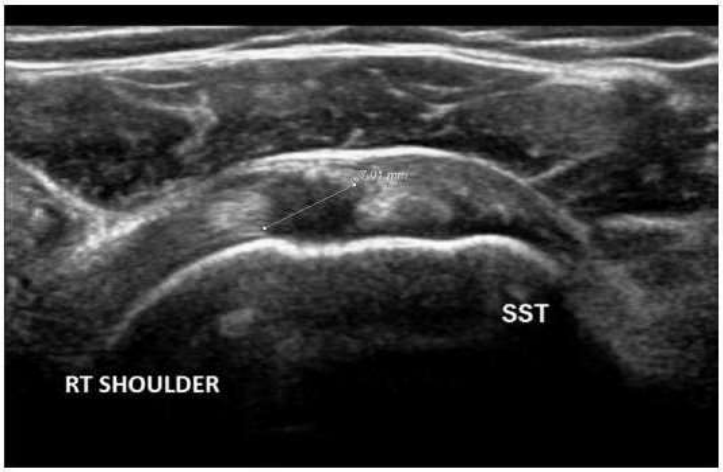

Fig.1 USG of right supraspinatus tendon of 42/ M, showing a hypoechoic area within involving its whole thickness denoting full thickness tear with a gap measuring ~7.0 mm.

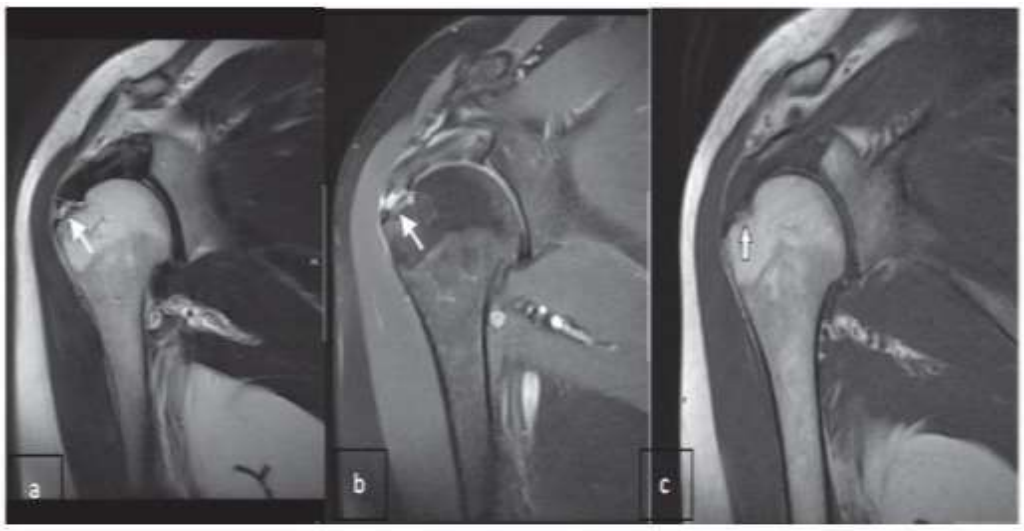

Fig. 2 MRI (a) coronal T2, (b) coronal PDFS, (c) coronal T1WI, shows full thickness tear of supraspinatus tendon near its humeral attachment with fluid signal intensity in gaping area measuring ~ 5.0 mm.

Fig. 3 US of right supraspinatus of 44 / M, shows an intrasubstance hypoechoic area within its tendon reaching its articular surface with no disruption of its fibers.

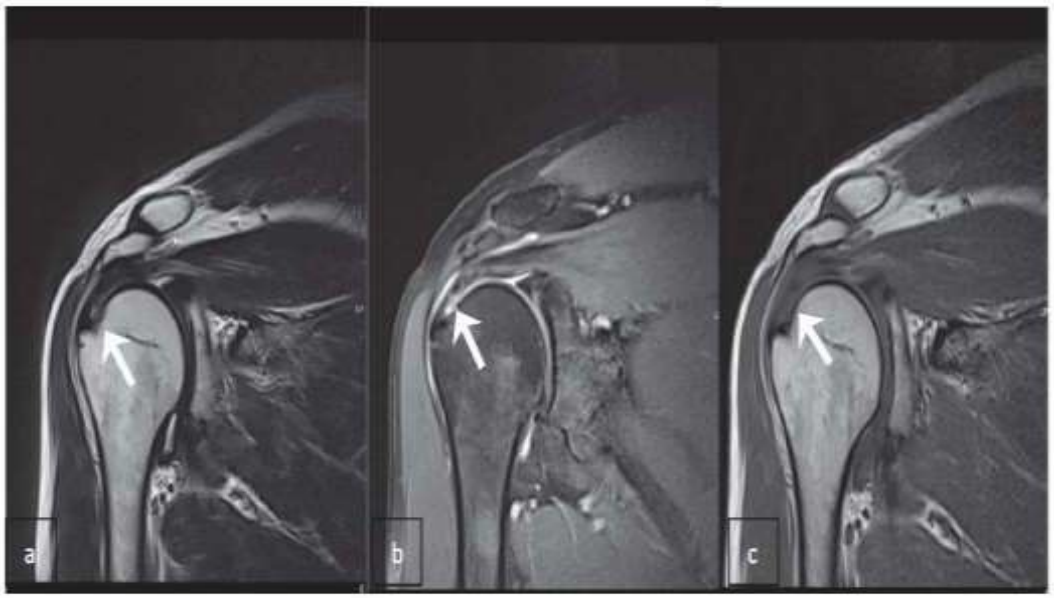

Fig. 4 MRI (a) T2 coronal, (b) PD with fat suppression, (c) T1WI shows abnormal bright signal in T2 and PDWI and hypointense signal T1WI involving articular surface of supraspinatus tendon denoting partial thickness tear.

Fig.5 USG of left supraspinatus muscle of 30/F shows increased tendon thickness with heterogenous echogenicity denoting tendinopathy.

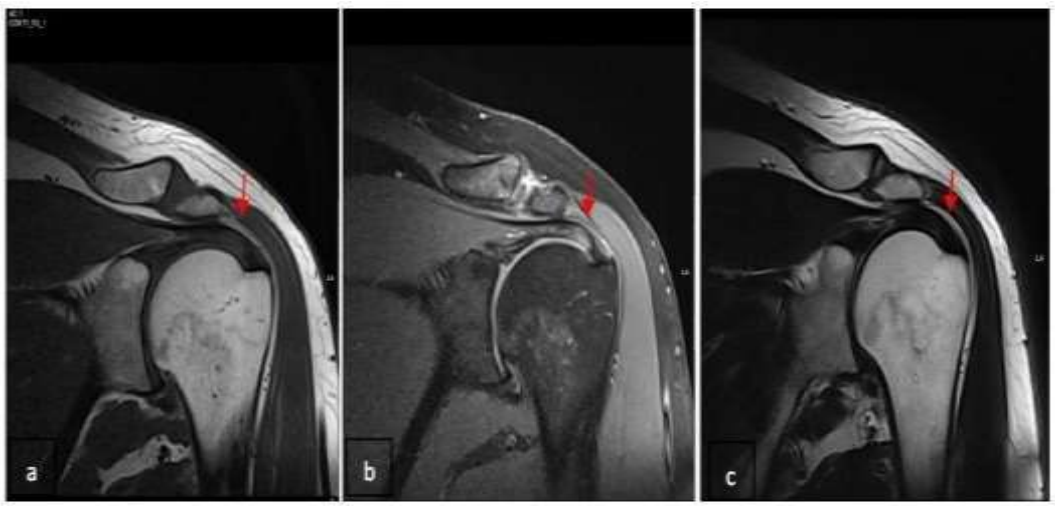

Fig.6 MRI (a) T1 coronal, (b) PD with fat suppression, (c) T2 WI shows abnormal intermediate signal of supraspinatus tendon in all sequences with no disruption of its fibers denoting tendinopathy, and shows osteoarthritis changes of acromioclavicular joint.

4. Results

In this study, mean age of the study participants was 41.5 years with male predominance. Based on USG, abnormalities in subscapularis, supraspinatus, infraspinatus and teres minor were noted in 30%, 6.7%, 66.7% and 3.3% of cases, respectively. Similarly, based on MRI, abnormalities in subscapularis, supraspinatus, infraspinatus and teres minor were noted in 33.3%, 3.3%, 70% and 3.3% of cases, respectively. Notably, USG showed DA of 96.7%, 93.3%, 97.5% and 90% for no tear, tendinitis, PTT and FTT, respectively.

Table 1: Mean age

Parameter	Mean	SD
Age (in years)	41.5	11.4

Table 2: USG – Pathologies

USG findings	Frequency	Percentage
No tear	9	30.0
Tendinitis	7	23.3
Partial tear	10	33.3
Full tear	4	13.3
Total	30	100.0

Table 3: MRI – Pathologies

MRI	Frequency	Percentage
No tear	8	26.7
Tendinitis	7	23.3
Partial tear	10	33.3
Full tear	5	16.7
Total	30	100.0

Table 4 : USG vs MRI – No tear – DA

Parameter	Value
Sensitivity	100%
Specificity	95.5%
PPV	88.9%
NPV	100%
DA	96.7%

Table 5: USG vs MRI – Tendinitis – DA

Parameter	Value
Sensitivity	85.7%
Specificity	95.7%
PPV	85.7%
NPV	95.7%
DA	93.3%

Table 6: USG vs MRI – Partial tear – DA

Parameter	Value
Sensitivity	80%
Specificity	90.9%
PPV	80%
NPV	90.9%
DA	97.5%

Table 7: USG vs MRI – Full tear – DA

Parameter	Value
Sensitivity	60%
Specificity	96%
PPV	75%
NPV	92.3%
DA	90%

5. Discussion

In the present study, 13.3%, 23.3%, 43.3% and 20% of cases belongs to age groups of 18-30 years, 31-40 years, 41-50 years and 51-60 years, respectively. Mean age of the study participants was 41.5 years with SD of 11.4 years. There were 73.3% males and 26.7% females in this study. Based on USG, abnormalities in subscapularis were noted in 30% of cases and the rest 70% of cases were normal . Based on USG, abnormalities in supraspinatus were noted in 6.7% of cases and the rest 93.3% of cases were normal . Based on USG, abnormalities Infraspinatus were noted in 66.7% of cases and the rest 33.3% of cases were normal . Based on USG, abnormalities in teres minor were noted in 3.3% of cases and the rest 96.7% of cases were normal .Based on MRI, abnormalities in subscapularis were noted in 33.3% of cases and the rest 66.7% of cases were normal . Based on MRI, abnormalities in supraspinatus were noted in 3.3% of cases and the rest 96.7% of cases were normal . Based on MRI, abnormalities in Infraspinatus were noted in 70% of cases and the rest 30% of cases were normal . Based on MRI, abnormalities in teres minor were noted in 3.3% of cases and the rest 96.7% of cases were normal.

Notably, USG showed No tear in 30% of cases, tendinitis in 23.3% cases, PTT in 33.3% cases and FTT in 13.3% of cases. Notably, MRI showed No tear in 26.7% of cases, tendinitis in 23.3% cases, PTT in 33.3% cases and FTT in 16.7% of cases. On assessing the association between the USG findings and the MRI findings, among the no tear cases, there was a remarkable association noted. Among the no tear cases, the USG had Sn, Sp, PPV, NPV and DA of 100%, 95.5%, 88.9%, 100% and 96.7%, respectively. On assessing the association between the USG findings and the MRI findings, among the tendinitis cases, there was a remarkable association noted. Among the tendinitis cases, the USG had Sn, Sp, PPV, NPV and DA of 85.7%, 95.5%, 85.7%, 95.7% and 93.3%, respectively. On assessing the association

between the USG findings and the MRI findings, among the PTT cases, there was a remarkable association noted. Among the PTT cases, the USG had Sn, Sp, PPV, NPV and DA of 80%, 90.9%, 80%, 90.9% and 97.5%, respectively. On assessing the association between the USG findings and the MRI findings, among the FTT tear cases, there was a remarkable association noted. Among the FTT tear cases, the USG had Sn, Sp,PPV, NPV and DA of 60%, 96%, 75%, 92.3% and 90%, respectively

6. Conclusion

In this study, the mean age of the participants was 41.5 years, with a higher prevalence of male patients. Ultrasound (USG) revealed abnormalities in the subscapularis, supraspinatus, infraspinatus, and teres minor muscles in 30%, 6.7%, 66.7%, and 3.3% of the cases, respectively. Similarly, magnetic resonance imaging (MRI) identified abnormalities in the same muscles in 33.3%, 3.3%, 70%, and 3.3% of cases, respectively.

A more detailed analysis of diagnostic accuracy (DA) for various conditions demonstrated that USG performed exceptionally well in detecting partial rotator cuff tears (RCTs), with DA rates of 96.7% for no tear, 93.3% for tendinitis, 97.5% for partial tendon tears (PTT), and 90% for full tendon tears (FTT).

Based on these findings, we conclude that USG is particularly effective in identifying partial RCTs, followed by the ability to detect no tear, tendinitis, and full-thickness tears. Therefore, in resource-limited settings, ultrasound can serve as an efficient and cost-effective screening tool for assessing the degree of rotator cuff damage. However, in fully equipped healthcare facilities with access to advanced imaging modalities, MRI remains the preferred diagnostic tool due to its superior resolution and ability to provide a more comprehensive assessment of rotator cuff pathology.

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