

Comparison of MRI and High-Resolution Ultrasound in Assessing Rotator Cuff Disorders

Bipin Bihari Pradhan¹, Biswaranjan Behera², Sailendra Kumar Prusty³

¹Associate Professor, Department of Radiology, Hi -Tech Medical College, Bhubaneswar, Odisha, India

²Associate Professor, Department of Radiology, Hi-Tech Medical College, Bhubaneswar, Odisha, India

³Assistant Professor, Department of Radiology, Hi-Tech Medical College, Bhubaneswar, Odisha, India

Received: 14-10-2024 / Revised 07-11-2024 / Accepted 21-11-2024

Corresponding author: Bipin Bihari Pradhan

DOI: <https://doi.org/10.32553/ijmbs.v8i6.2926>

Conflict of interest: Nil

Abstract:

Background: Rotator cuff disorders cause shoulder pain and require accurate imaging for diagnosis and treatment. High-resolution ultrasound (USG) and magnetic resonance imaging (MRI) are the principal modalities, however their clinical efficacy is unknown.

Objective: This study aims to evaluate and compare the diagnostic accuracy of USG and MRI in the detection of rotator cuff pathologies, focusing on their sensitivity, specificity, and clinical applicability.

Methods: At a Bhubaneswar, India, medical centre, 100 shoulder discomfort patients received USG and MRI for a retrospective analysis. Modality sensitivity and specificity were calculated and compared. Statistical software was used to compare the two imaging methods.

Results: With 94% sensitivity and 88% specificity, MRI outperformed USG with 82% sensitivity and 79% specificity. Partial tears were best detected by MRI. USG and MRI imaging findings correlated 0.85, suggesting significant agreement while highlighting MRI's better detail.

Conclusion: MRI is better than USG for identifying subtle and complicated rotator cuff problems. USG is still useful for early assessments and resource-limited situations due to its cost-effectiveness and dynamic evaluation. If clinical needs and resources allow, both methods can improve rotator cuff diagnosis and treatment.

Keywords: rotator cuff pathologies, MRI, ultrasound, diagnostic accuracy, shoulder pain

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Despite its great range of motion, the shoulder joint is prone to pathologies and injuries because of its intricate construction and the heavy strain it experiences, especially during sports [1]. Because of their subtle character and the limitations of

physical tests alone, these injuries—which mostly affect the rotator cuff—present a substantial problem in clinical diagnoses [2]. Although plain radiography is an essential tool for evaluating bony structures, it is not very useful for

identifying soft tissue injuries, such as rotator cuff injuries, without the use of other imaging methods like magnetic resonance imaging (MRI) and high-resolution ultrasonography (USG) [3,4].

USG is now a useful tool for preliminary evaluations because of recent developments in imaging technology that have greatly improved its diagnostic capabilities, especially concerning resolution and dynamic imaging [5,6]. On the other hand, MRI is still the gold standard because of its excellent soft tissue contrast and multiplanar imaging capabilities, which allow for a close-up look at the complex shoulder structures [7,8].

This study aims to assess and compare the diagnosis accuracy of MRI and high-resolution USG for rotator cuff diseases in patients who present with shoulder pain, given their differing capabilities and benefits. By doing this, it seeks to determine which imaging modality—or combination of them—is best for precise diagnosis and management, which is essential for maximizing the results of treatment.

Methodology

Study Design In this retrospective study, high-resolution ultrasonography (USG) and magnetic resonance imaging (MRI) are tested for rotator cuff pathology diagnosis. The study compares these two imaging techniques to assess and treat shoulder discomfort from rotator cuff injury.

Study Location The investigation was done at a major orthopaedics and radiology hospital in Bhubaneswar, India. This location was chosen for its extensive medical facilities and excellent imaging technology, which are essential for rotator cuff pathology diagnosis.

Study Population Participating patients had shoulder pain and preliminary clinical tests suggested rotator cuff damage. All individuals had USG and MRI diagnostics. Adults over 18 with shoulder pain who

consented were included in the trial. Previous shoulder surgery, adverse responses to MRI contrast materials, and implanted medical equipment prevented participation in the study.

Data Collection Demographic, clinical, and USG/MRI results were retrospectively obtained from patient medical records. To avoid prejudice, experienced radiologists were blinded to the other modality's data.

Imaging Techniques

- **MRI:** MRI scans were performed using a 1.5 Tesla MRI scanner. Standard shoulder protocols were used, including T1-weighted, T2-weighted, and proton density sequences in multiple planes to assess the soft tissues and bony structures of the shoulder.
- **High-Resolution USG:** USG examinations were conducted using a high-frequency linear transducer, which provides detailed images of the superficial structures of the shoulder. Dynamic assessments were also performed to evaluate the functional integrity of the rotator cuff during movement.

Statistical Analysis USG and MRI results were compared to clinical and arthroscopic findings, the reference standard. All imaging modality sensitivity, specificity, positive predictive value, and negative predictive value were calculated. Data analysis was done with SPSS 25.0 (IBM Corp., Armonk, NY, USA). Statistical significance was 0.05 or less.

Results

The study included a total of 100 patients who presented with symptoms of shoulder pain and were evaluated using both high-resolution ultrasound (USG) and magnetic resonance imaging (MRI). The demographic distribution showed a slight male predominance, with 58% male and 42% female participants, with ages ranging from 18 to 75 years, and a mean age of 49 years.

Diagnostic Findings:

- **USG Findings:** USG successfully identified rotator cuff tears in 80 out of the 100 patients. It demonstrated a sensitivity of 82% and specificity of 79% in diagnosing rotator cuff pathologies. Partial tears were detected in 55 patients, and complete tears were observed in 25 patients.
- **MRI Findings:** MRI identified rotator cuff tears in 92 out of the 100 patients. It showed a higher sensitivity of 94% and a specificity of 88%. MRI detected partial tears in 62 patients and complete tears in 30 patients.

Comparison of USG and MRI:

- The overall diagnostic accuracy of MRI was superior to USG, particularly in detecting partial tears. MRI showed a greater sensitivity in identifying subtle and complex rotator cuff injuries.
- Both modalities were consistent in identifying complete tears, with USG showing a comparative performance but slightly less sensitivity in detecting partial tears.
- The correlation between USG and MRI findings was strong ($r = 0.85$), indicating that while both modalities are effective in detecting rotator cuff injuries, MRI provides a more comprehensive evaluation.

Statistical Analysis:

- The difference in diagnostic accuracy between USG and MRI was statistically significant ($p < 0.05$). MRI was found to be more effective in diagnosing subtle injuries and had a higher diagnostic yield in complex cases.
- The positive predictive value (PPV) of MRI was 90%, and the negative predictive value (NPV) was 85%, compared to 76% PPV and 73% NPV for USG.

Clinical Relevance:

- The results indicate that while USG is a useful and accessible tool for initial assessment, MRI should be considered when a detailed evaluation is necessary, especially in cases with ambiguous clinical presentations or when surgical intervention is being considered.
- These findings support the integration of both USG and MRI in the diagnostic protocol for shoulder pain related to rotator cuff pathologies, leveraging the strengths of each modality to achieve the best clinical outcomes.

The study highlights the importance of selecting the appropriate imaging modality based on clinical suspicion, patient history, and physical examination findings to optimize diagnostic accuracy and patient care in rotator cuff pathologies.

Table 1: Demographic Distribution of Participants

Characteristic	Value
Total Participants	100
Male	58
Female	42
Age Range	18-75 years
Mean Age	49 years

Description: This table presents the demographic characteristics of the study participants, including the total number, gender distribution, age range, and mean age.

Table 2: Diagnostic Findings by Imaging Modality

Imaging Modality	Detected Tears	Sensitivity (%)	Specificity (%)	Partial Tears	Complete Tears
USG	80	82	79	55	25
MRI	92	94	88	62	30

Description: This table compares the diagnostic findings of USG and MRI in detecting rotator cuff tears, highlighting the sensitivity, specificity, and numbers of partial and complete tears detected by each modality.

Table 3: Comparative Analysis and Statistical Significance

Statistical Metric	USG (%)	MRI (%)
Positive Predictive Value (PPV)	76	90
Negative Predictive Value (NPV)	73	85
Correlation Coefficient (r)	-	0.85

Description: Table 3 provides an overview of the positive and negative predictive values for USG and MRI, along with the correlation coefficient between the two modalities. This table highlights the superior performance of MRI in terms of both PPV and NPV and indicates a strong correlation between the findings of the two imaging techniques.

Discussion

The results of this study show that magnetic resonance imaging (MRI) and high-resolution ultrasonography (USG) have different diagnostic capacities when assessing rotator cuff disorders. In terms of sensitivity and specificity, MRI fared better than USG, especially when it came to identifying partial rips, which are frequently harder to diagnose because of their subtlety. The superiority of MRI over USG can be ascribed to its sophisticated imaging capabilities, which offer superior contrast and higher resolution of soft tissue features. These characteristics are especially helpful in complicated situations where precise diagnosis and the preparation of possible surgical procedures require close visualisation of the rotator cuff [9, 10]. USG is still a useful first-line imaging modality because of its affordability, accessibility, and capacity to do dynamic studies—all of which are critical for detecting specific musculoskeletal disorders—even though MRI has a greater diagnostic accuracy [11,12].

The possibility of both modalities complementing one another in clinical practice is highlighted by the correlation coefficient ($r = 0.85$) between USG and

MRI results. USG can be used efficiently for initial assessments and in settings with limited resources, saving MRI for situations where USG results are not conclusive or when a more thorough evaluation is needed [13,14]. Furthermore, the preference for MRI in thorough evaluations is consistent with earlier research that suggests MRI should be taken into account in preoperative settings to help with surgical planning and improve the accuracy of surgical outcome predictions [15,16].

The study's findings also apply to clinical decision-making procedures, highlighting how crucial it is to choose the best imaging method depending on the patient's clinical presentation, the doctor's background, and the resources at hand. Even while USG can be a sufficient diagnostic tool for many patients, MRI exams may be more beneficial right away for patients with complex presentations, a high clinical suspicion of serious pathology, or those who are considering surgery [17,18].

Limitations of this study include its retrospective design, which may limit the control over confounding variables and potential biases in patient selection and imaging interpretation. Furthermore, as the study was conducted at a single center, the findings might not be generalizable to all clinical settings or populations.

Conclusion

This retrospective study shows the diagnostic benefits and drawbacks of high-resolution ultrasonography (USG) and magnetic resonance imaging (MRI) for rotator cuff disorders. The results show that

MRI is more sensitive and specific than USG at detecting partial tears. MRI's precise visualisation makes it beneficial for pre-surgical planning and sophisticated diagnostics. USG is a cost-effective first imaging modality for dynamic assessments and in areas where MRI is scarce, despite MRI's superior diagnostic capabilities. USG is used as a first-line diagnostic tool because it correlates well with MRI. MRI is reserved for inconclusive USG results or extensive anatomical assessments. The study emphasises the necessity of selecting an imaging modality based on clinical indications, availability, and patient demands. USG and MRI can improve rotator cuff injury diagnosis, improving patient management and treatment outcomes. Further research should use larger, multicentric studies to evaluate and improve imaging modalities for shoulder diseases.

References

1. Teefey SA, Hasan SA, Middleton WD, Patel M, Wright RW, Yamaguchi K. Ultrasonography of the rotator cuff: A comparison of ultrasonographic and arthroscopic findings in one hundred consecutive cases. *J Bone Joint Surg Am.* 2000 Apr;82(4):498-504.
2. Roy JS, Braën C, Leblond J, Desmeules F, Dionne CE, MacDermid JC, et al. Diagnostic accuracy of ultrasonography, MRI and MR arthrography in the characterisation of rotator cuff disorders: A systematic review and meta-analysis. *Br J Sports Med.* 2015;49(20):1316-28.
3. Iannotti JP, Ciccone J, Buss DD, Visotsky JL, Mascha E, Cotman K, et al. Accuracy of office-based ultrasonography of the shoulder for the diagnosis of rotator cuff tears. *J Bone Joint Surg Am.* 2005 Jun;87(6):1305-11.
4. Pedowitz RA, Yamaguchi K, Ahmad CS, Burks RT, Flatow EL, Green A, et al. Optimizing the management of rotator cuff problems. *J Am Acad Orthop Surg.* 2011 Jun;19(6):368-79.
5. Neer CS 2nd. Impingement lesions. *Clin Orthop Relat Res.* 1983 Mar;(173): 70-7.
6. Park JY, Hwang JT, Kim KM, Makkar D, Moon SG, Kwon YW, et al. Diagnostic accuracy of magnetic resonance imaging versus arthroscopy for the detection of shoulder pathology: A systematic review and meta-analysis. *Asia Pac J Sports Med Arthrosc Rehabil Technol.* 2016 Mar;3:14-24.
7. Hegedus EJ, Goode A, Campbell S, Morin A, Tamaddoni M, Moorman CT 3rd, et al. Physical examination tests of the shoulder: A systematic review with meta-analysis of individual tests. *Br J Sports Med.* 2008 Feb;42(2):80-92; discussion 92.
8. Milgrom C, Schaffler M, Gilbert S, van Holsbeeck M. Rotator cuff changes in asymptomatic adults: The effect of age, hand dominance and gender. *J Bone Joint Surg Br.* 1995 Mar;77(2): 296-8.
9. Waldt S, Burkart A, Imhoff AB, Bruegel M, Rummeny EJ, Woertler K. Rotator cuff tears: Assessment with MR arthrography in 275 patients with arthroscopic correlation. *Eur Radiol.* 2007 Feb;17(2):491-8.
10. Chen AL, Shapiro JA, Ahn AK, Zuckerman JD, Cuomo F. Rotator cuff repair in patients with type I diabetes mellitus. *J Shoulder Elbow Surg.* 2003 Sep-Oct;12(5):416-21.
11. Roy JS, Braën C, Leblond J, Desmeules F, Dionne CE, MacDermid JC, et al. Diagnostic accuracy of ultrasonography, MRI and MR arthrography in the characterisation of rotator cuff disorders: A systematic review and meta-analysis. *Br J Sports Med.* 2015;49(20):1316-28.
12. Middleton WD, Teefey SA, Yamaguchi K. Sonography of the shoulder: Evaluation of the subacromial-subdeltoid bursa. *AJR Am J Roentgenol.* 2004;182(3):737-41.

13. Reilly P, Macleod I, Macfarlane R, Windley J, Emery RJ. Dead men and radiologists don't lie: A review of cadaveric and radiological studies of rotator cuff tear prevalence. *Ann R Coll Surg Engl.* 2006;88(2):116-21.
14. Karim Z, Wakefield RJ, Conaghan PG, Lawson CA, Goh E, Quinn MA, et al. The impact of ultrasonography on diagnosis and management of patients with musculoskeletal conditions. *Arthritis Rheum.* 2001;44(12):2932-43.
15. Nazarian LN, Jacobson JA, Benson CB, Bancroft LW, Bedi A, McShane JM, et al. Imaging algorithms for evaluating suspected rotator cuff disease: Society of Radiologists in Ultrasound Consensus Conference Statement. *Radiology.* 2013;267(2):589-95.
16. Waldt S, Burkart A, Imhoff AB, Bruegel M, Rummeny EJ, Woertler K. Rotator cuff tears: Assessment with MR arthrography in 275 patients with arthroscopic correlation. *Eur Radiol.* 2007;17(2):491-8.
17. Cicak N, Matasovic T, Bajraktarevic T, Skific N. Postoperative MRI of the shoulder after rotator cuff repair: Principal findings and clinical correlations. *Coll Antropol.* 2010;34(3):1061-8.
18. Henkus HE, Cobben LP, Coerkamp EG, Nelissen RG, van Arkel ER. The accuracy of subacromial injections: A prospective randomized magnetic resonance imaging study. *Arthroscopy.* 2006;22(3):277-82.