

Original Research Article

Diagnostic accuracy of ultrasound in common shoulder pathologies: a retrospective cohort study and literature review

Osama Mohamed¹, Jerry Sam^{1*}, Satya Kanth Pydah², Kanwalnaini Cheema¹

¹Trauma and Orthopaedics, Grange University Hospital-Aneurin Bevan University Health Board, Newport, United Kingdom

²Trauma and Orthopaedics, Ysbyty Gwynedd Hospital-Betsi Cadwaladr University Health Board, Bangor, United Kingdom

Received: 20 November 2024

Revised: 19 December 2024

Accepted: 04 January 2025

*Correspondence:

Dr. Jerry Sam,

E-mail: Jerry.Sam@wales.nhs.uk

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: This study aims to evaluate the diagnostic accuracy of shoulder ultrasound in detecting common shoulder pathologies, including rotator cuff tears, AC joint diseases, glenohumeral joint diseases, subacromial impingement, and long head of biceps conditions. The research question focuses on comparing ultrasound findings with arthroscopy results.

Methods: We conducted a retrospective cohort study of 60 patients who underwent preoperative ultrasound followed by shoulder arthroscopy. Sensitivity, specificity, and diagnostic accuracy were calculated for each pathology, comparing ultrasound to arthroscopic findings.

Results: Ultrasound demonstrated high sensitivity (90%) for detecting rotator cuff tears but showed lower sensitivity and specificity for AC joint diseases, subacromial impingement, and glenohumeral joint diseases. Ultrasound was particularly limited in identifying early biceps tendon pathologies.

Conclusions: Ultrasound is highly sensitive for diagnosing rotator cuff tears and serves as a valuable initial diagnostic tool. However, it is less reliable for other shoulder pathologies, where additional imaging modalities may be needed to confirm diagnoses. Improved operator training could enhance diagnostic accuracy.

Keywords: Acromioclavicular joint, Diagnostic accuracy, Glenohumeral joint, Rotator cuff tear, Shoulder ultrasound, Subacromial impingement

INTRODUCTION

Shoulder disorders, including rotator cuff tears, AC joint diseases, and subacromial impingement, are prevalent orthopaedic conditions that significantly impact the quality of life and function.^{1,2} These conditions are commoner with increasing age, repetitive overhead activities, and trauma, making accurate and timely diagnosis crucial for effective management.³ Imaging plays a vital role in diagnosing shoulder issues, guiding treatment decisions and monitoring the outcomes of therapeutic interventions.⁴

Ultrasonography (US) has emerged as a popular diagnostic tool due to its easy accessibility, cost-effectiveness, lack of radiation hazard, and ability to provide a real-time, dynamic assessment of musculoskeletal structures.^{5,6} Despite these advantages, the accuracy of ultrasound is highly operator-dependent, with significant variability based on the prior experience and skill of the sonologist.⁷ Studies have shown that well-trained musculoskeletal sonographers are able to achieve diagnostic accuracy comparable to magnetic resonance imaging (MRI) for specific pathologies, mainly rotator cuff tears.⁸

This study aims to assess the diagnostic accuracy of shoulder ultrasound by comparing sonographic findings with arthroscopic results in 60 patients. We also integrate a comprehensive literature review to discuss ultrasound's strengths, limitations, and clinical implications in diagnosing various shoulder pathologies.

METHODS

Study design

This retrospective cohort study included 60 consecutive patients who underwent shoulder arthroscopy and preoperative shoulder ultrasound at Ysbyty Gwynedd hospital, Bangor, United Kingdom, over 12 months from Feb-2022 to Jan-2023.

Inclusion criteria comprised all patients who underwent shoulder arthroscopy within the study's timeframe and had a preoperative ultrasound of the shoulder.

Exclusion criteria were patients with incomplete imaging records, prior shoulder surgeries, or significant comorbidities that could challenge the diagnostic process.⁹

Data collection

Medical records provided data on patient demographics, US findings, and arthroscopic results. Musculoskeletal sonographers conducted US examinations with min of 5 years of experience in shoulder imaging. All arthroscopic surgeries performed by single experienced shoulder surgeon, ensuring consistency in evaluating intra-articular findings. Pathologies assessed included rotator cuff tears (partial and complete thickness), AC joint diseases, long head of biceps pathologies, subacromial impingement, and glenohumeral joint diseases.

Statistical analysis

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and 95% confidence intervals (CIs) were calculated for each pathology using standard diagnostic test evaluation formulas. The accuracy of ultrasound findings was compared with arthroscopic results, which is considered the gold standard. Statistical significance was set at $p < 0.05$.

RESULTS

Patient demographics

The study included 60 patients with a mean age of 59 years (range 25-85); 55% were female, and 45% were male as represented in Table 1. The mean interval between ultrasound and arthroscopy was 16 months (range 2-67 months), with a standard deviation of 14.96.

Table 1: Demographic characteristics of patients.

Characteristics	Value
Number of patients	60
Age (in years)	
Mean	59
Range	25-85
Sex distribution	
Female	55% (33 patients)
Male	45% (27 patients)

Diagnostic accuracy of ultrasound

Table 2 summarizes ultrasound's sensitivity, specificity, and diagnostic accuracy for each shoulder pathology. The sensitivity for rotator cuff tears was significantly higher compared to other pathologies, whereas the specificity varied, with glenohumeral joint disease showing the highest specificity among the assessed conditions.

Table 2: Diagnostic accuracy of ultrasound for common shoulder pathologies.

Pathology	Sensitivity (%)	Specificity (%)	P value	95% CI
Rotator cuff tear	90	42	0.01	77-97
Acromioclavicular joint	62.5	58	0.01	41-81
Long head of biceps	57	84	0.01	39-74
Subacromial impingement	30.5	72	0.04	19-44
Glenohumeral joint disease	24	92	0.003	8-47

Pathology-specific findings

Rotator cuff pathology: Ultrasound demonstrated high sensitivity (90%) but moderate specificity (42%) in detecting rotator cuff tears.

This variability reflects the diagnostic challenges of differentiating between tendinopathy and partial or full-thickness tears.

Acromioclavicular joint disease: Sensitivity and specificity were moderate, highlighting the need for clinical correlation in cases of AC joint-related pain.

Long head of biceps: Ultrasound was more specific (84%) than sensitive (57%), indicating its possible limitations in early or mild biceps tendon pathologies.

Subacromial impingement and glenohumeral joint disease: The sensitivity for these conditions was notably

low, suggesting that ultrasound may not be the optimal diagnostic tool for these pathologies without adjunctive imaging.

DISCUSSION

The results of this study are consistent with recent literature, showing that ultrasound is highly sensitive in detecting rotator cuff tears but less effective in diagnosing other shoulder pathologies. A systematic review by Roy et al reported pooled sensitivity and specificity of 87% and 88%, respectively, for full-thickness rotator cuff tears, in line with our findings of 90% sensitivity.¹⁰ These results underline the importance of ultrasound as a first-line imaging modality in patients with suspected rotator cuff injury.^{6,9}

However, the ultrasound's specificity for rotator cuff tears in this study was significantly lower (42%), potentially leading to false positives, especially in distinguishing between partial tears and tendinopathy.^{11,12} This aligns with the findings of Teefey et al who observed that ultrasound is more accurate in diagnosing full-thickness tears than in detecting partial-thickness tears.¹¹

The study found that ultrasound has a moderate sensitivity (62.5%) when used to assess AC joint diseases, indicating its limitations in identifying degenerative changes and joint instability. As a result, additional imaging such as MRI or CT may be necessary.⁵ Similarly, the low sensitivity of ultrasound for subacromial impingement (30.5%) suggests that it may not be the best tool for evaluating this condition, and clinical correlation and additional imaging techniques may be needed.¹³

Clinical implications

Ultrasound is highly sensitive for detecting rotator cuff tears, making it a valuable tool for initial diagnosis, especially when MRI is not available or not recommended for certain patients, such as those with pacemakers or severe claustrophobia.⁶ However, the study suggests that careful clinical examination and additional imaging techniques may be necessary when ultrasound findings are inconclusive due to its relatively low specificity.⁹

For AC joint diseases and subacromial impingement, ultrasound has moderate diagnostic performance, so it should be used in combination with clinical assessment and other imaging methods as needed to improve accuracy.¹⁴ This multi-modal approach is crucial in complex cases where shoulder pain may be caused by multiple overlapping conditions.¹⁵

Operator dependence and training

A significant limitation of shoulder ultrasound is its reliance on the operator's experience and skill. Research has demonstrated that the accuracy of diagnosis is significantly higher when conducted by experienced

radiologists or musculoskeletal sonographers compared to less skilled operators.^{7,8} The variability observed in our study emphasizes the need for standardized training programs and ongoing education to improve ultrasound's diagnostic capabilities for shoulder pathologies.⁴

Limitations

This study has limitations due to its retrospective design, single-center nature, and dependence on a single surgeon's arthroscopic findings as the gold standard, which may introduce bias. Additionally, the wide range of time between ultrasound and arthroscopy (up to 67 months) could have affected the correlation between imaging and surgical findings due to the progression of shoulder pathologies over time. Future studies should strive to include larger sample sizes, multiple centers, and standardized imaging protocols to further validate these findings.

CONCLUSION

Ultrasound is an important tool for assessing shoulder problems, especially for rotator cuff tears, because it is highly sensitive and accessible. However, its accuracy in diagnosing different shoulder conditions varies, highlighting the importance of having skilled operators, conducting thorough clinical examinations, and using additional imaging techniques when needed. Future research should focus on standardizing ultrasound methods, improving training programs, and exploring the use of advanced imaging technologies, such as 3D ultrasound, to enhance diagnostic consistency.

Funding: No funding sources

Conflict of interest: None declared

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

REFERENCES

1. Oh LS, Wolf BR, Hall MP, Levy BA, Marx RG. Indications for rotator cuff repair: a systematic review. *Clin Orthop Relat Res.* 2007;455:52-63.
2. Yamaguchi K, Ditsios K, Middleton WD, Hildebolt CF, Galatz LM, Teefey SA. The demographic and morphological features of rotator cuff disease. A comparison of asymptomatic and symptomatic shoulders. *J Bone Joint Surg Am.* 2006;88(8):1699-704.
3. Yamamoto A, Takagishi K, Osawa T, Yanagawa T, Nakajima D, Shitara H, Kobayashi T: Prevalence and risk factors of a rotator cuff tear in the general population. *J Shoulder Elbow Surg.* 2010;19(1):116-20.
4. Teefey SA, Middleton WD, Payne WT, Yamaguchi K. Detection and measurement of rotator cuff tears with sonography: analysis of diagnostic errors. *AJR Am J Roentgenol.* 2005;184(6):1768-73.

5. Blanchard TK, Bearcroft PW, Constant CR, Griffin DR, Dixon AK. Diagnostic and therapeutic impact of MRI and arthrography in the investigation of full-thickness rotator cuff tears. *Eur Radiol*. 1999;9(4):638-42.
6. De Jesus JO, Parker L, Frangos AJ, Nazarian LN. Accuracy of MRI, MR arthrography, and ultrasound in the diagnosis of rotator cuff tears: a meta-analysis. *AJR Am J Roentgenol*. 2009;192(6):1701-7.
7. Rutten MJ, Jager GJ, Kiemeny LA. Ultrasound detection of rotator cuff tears: observer agreement related to increasing experience. *AJR Am J Roentgenol*. 2010;195(6):440-6.
8. Nazarian LN. The top 10 reasons musculoskeletal sonography is an important complementary or alternative technique to MRI. *AJR Am J Roentgenol*. 2008;190(6):1621-6.
9. Smith TO, Back T, Toms AP, Hing CB. Diagnostic accuracy of ultrasound for rotator cuff tears in adults: a systematic review and meta-analysis. *Clin Radiol*. 2011;66(11):1036-48.
10. 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.
11. Teefey SA, Rubin DA, Middleton WD, Hildebolt CF, Leibold RA, Yamaguchi K. Detection and quantification of rotator cuff tears. Comparison of ultrasonographic, magnetic resonance imaging, and arthroscopic findings in seventy-one consecutive cases. *J Bone Joint Surg Am*. 2004;86(4):708-16.
12. Michener LA, McClure PW, Karduna AR. Anatomical and biomechanical mechanisms of subacromial impingement syndrome. *Clin Biomech*. 2003;18(5):369-79.
13. Lenza M, Buchbinder R, Takwoingi Y, Johnston RV, Hanchard NC, Faloppa F. Magnetic resonance imaging, magnetic resonance arthrography and ultrasonography for assessing rotator cuff tears in people with shoulder pain for whom surgery is being considered. *Cochrane Database Syst Rev*. 2013;24(9):009020.
14. Alqunae M, Galvin R, Fahey T. Diagnostic accuracy of clinical tests for subacromial impingement syndrome: a systematic review and meta-analysis. *Arch Phys Med Rehabil*. 2012;93(2):229-36.
15. Dinnes J, Loveman E, McIntyre L, Waugh N. The effectiveness of diagnostic tests for the assessment of shoulder pain due to soft tissue disorders: a systematic review. *Health Technol Assess*. 2003;7(29):1-166.

Cite this article as: Mohamed O, Sam J, Pydah SK, Cheema K. Diagnostic accuracy of ultrasound in common shoulder pathologies: a retrospective cohort study and literature review. *Int J Res Orthop* 2025;11:255-8.