S ORIGINAL ARTICLE

Pre-operative departmental ultrasound of the rotator cuff: sensitivity and specificity in a regional specialist orthopaedic centre

Shahid Punwar and Neil Blewitt

Department of Trauma and Orthopaedics, Avon Orthopaedic Centre, Southmead Hospital, Bristol, UK

Received

Received: 25 August 2013;
accepted: 31 October 2013

Keywords

Rotator cuff tears, ultrasound, sensitivity, specificity, accuracy.

Conflicts of interest

None declared

Correspondence

Shahid Punwar, Top Flat, 30 Salisbury Road,
Redland, Bristol BS6 7AP, UK.
Tel.: +44 (0)7811 942192.
E-mail: shahpunwar@gmail.com

DOI: 10.1177/1758573213514498

ABSTRACT

Background The present study aimed to assess the accuracy of radiology department ultrasound scans in identifying rotator cuff tears at our institution, a regional specialist orthopaedic centre.

Methods Pre-operative ultrasound scan reports were obtained from 64 consecutive patients who subsequently underwent arthroscopic subacromial decompression and/or rotator cuff repair. The ultrasound reports were compared with the arthroscopic findings as a reference standard.

Results If both full- and partial-thickness tears are counted as true positives, ultrasound has a sensitivity of 70%, a specificity of 67% and a positive predictive value of 81%. If only partial tears are counted as true positives, sensitivity decreases to 8% and positive predictive value to 10%. The mean time lag from scan to surgery was 44 weeks.

Conclusions A positive pre-operative ultrasound scan at our institution predicts an actual rotator cuff tear in 70% of cases. However, it is not accurate with respect to identifying partial-thickness tears or distinguishing them from full-thickness defects. Ultrasound scanning is highly operator dependent and, in addition, its accuracy may be affected by the lengthy time period from scanning to surgery. Clinicians should be cautious in proceeding to surgery based on the ultrasound findings.

INTRODUCTION

Ultrasound scans have been in routine use for the evaluation of shoulder pathology since the 1980s. They are relatively cheap, non-invasive and allow dynamic examination of the cuff. They are more acceptable to patients than magnetic resonance imaging (MRI) scans because there is no need to go through an enclosed space.

Several studies have confirmed the high sensitivity and specificity of ultrasonography for the detection of full-thickness tears, comparable to MRI scanning [1–3]. However, ultrasonography has not proven so accurate for the detection of partial-thickness tears and is also known to be highly operator dependent [3–5].

In our unit, 'one stop' or 'office-based' scanning is not yet widely available [6–9]. Patients are usually filtered through to the shoulder clinic by a musculoskeletal assessment team (MATS) who take all referrals from the local general practitioners. Ultrasound scans are often booked by the MATS practitioners, and patients are then referred on to the specialist shoulder clinic as appropriate. In addition, a proportion of patients have scans booked following their shoulder clinic appointment.

The primary aim of the present study was to compare the accuracy of pre-operative ultrasound scans with arthroscopic findings because, anecdotally, we did not perceive there to be a high correlation rate. A secondary aim was to determine the average time lag between scan and surgery.

MATERIALS AND METHODS

Pre-operative ultrasound scan reports from 64 consecutive patients were obtained retrospectively over a 1-year period using our 2010 electronic theatre database. The ultrasound reports were compared with the typed arthroscopic findings as a gold standard. The presence or absence of partial or full-thickness rotator cuff tears was recorded. Surgery was performed by or under the direct supervision of consultant surgeons.

Ultrasound scans were performed using modern high-resolution scanners by experienced consultant musculoskeletal radiologists, according to a standardized departmental protocol.

The time lag from the date of scan to the date of surgery was calculated for each patient and the results were summated to provide a mean value in weeks.

RESULTS

In total, 43 tears were found at arthroscopy. Thirty of these were full thickness and 13 were partial thickness. Because of the low number of partial tears, a distinction was not made between articular or bursal sided lesions. The sensitivity of ultrasound for tear detection was 70%, specificity was 67%, positive predictive value was 81%, negative predictive value was 51% and overall accuracy was 69%. The results are summarized in Tables 1 to 3.

Table 1 All tears.

	Ultrasound +ve	Ultrasound -ve	Total
Operation +ve	30	13	43
Operation -ve	7	14	21
Total	37	27	64

Sensitivity = 70%; specificity = 67%; positive predictive value = 81%; negative predictive value = 51%; accuracy = 69%.

Fifty of 64 scans were ordered by the local MATS. The mean time period from scan to surgery for all scans was 44 weeks. For the MATS scans, it was 47 weeks and, for the scans ordered from the orthopaedic clinic, it was 33 weeks.

DISCUSSION

Accurate pre-operative diagnosis of shoulder pathology allows an informed discussion to be made between patient and surgeon, as well as being invaluable in the planning of operating lists and equipment.

In our department, a pre-operative ultrasound scan correctly predicts a cuff tear in 70% of cases. This is some way short of the best results available in the literature where sensitivities of up to 100% have been reported [1–3]. Scans were not accurate in identifying partial-thickness tears and this is supported in the majority of the literature [3,4,10].

Considering other imaging modalities, a meta-analysis by de Jesus et al. [11] found magnetic resonance arthrography to be statistically more sensitive and specific than either MRI or ultrasound in diagnosing full or partial cuff tears. However, a recent Cochrane review by Lenza et al. [10] including only prospective studies concluded that any of the three tests could be used to diagnose full-thickness tears with comparable accuracy, although MRI may be more sensitive in identifying partial-thickness tears.

Our study can be criticized in that it only included patients who went on to have surgery following scans and did not include all patients who had scans. However, this is unavoidable if surgery is to be used as a gold standard and is a weakness of all such studies [4,5].

The achievable accuracy of ultrasound is not in question; however, in the UK, the reality appears to be that less than satisfactory results are commonplace in both the specialist centre and district general hospital setting [5].

The reasons for this may be operator related; however, the time period from scan to surgery also warrants attention. A long time period from scan to scope may allow tears to progress or heal.

The introduction of the MATS referral system in our region has led to an average 14-week increase in this time period.

Recently, there have been reports of ultrasound scans being performed immediately in the shoulder clinic, obviating the need for a separate scan appointment [6–9]. These 'one stop' scans have been performed by both sonographers and

Table 2 Full-thickness tears.

	Ultrasound +ve	Ultrasound -ve	Total
Operation +ve	18	12	30
Operation -ve	9	25	34
Total	27	37	64

Sensitivity = 60%; specificity = 74%; positive predictive value = 67%; negative predictive value = 68%; accuracy = 67%.

Table 3 Partial-thickness tears.

	Ultrasound +ve	Ultrasound -ve	Total
Operation +ve	1	12	13
Operation -ve	9	42	51
Total	10	54	64

Sensitivity = 8%; specificity = 82%, positive predictive value = 10%; negative predictive value = 78%; accuracy = 67%.

appropriately trained surgeons. The results obtained have been shown to be comparable in accuracy to standard radiology department scans when compared with arthroscopic findings. In addition, one stop scanning has been shown to significantly shorten the time between initial outpatient presentation to the end of the treatment episode [7] with resulting financial savings.

In summary, we would advise all departments to audit the accuracy of their pre-arthroscopy ultrasound scans and recommend caution in the interpretation of ultrasound findings before proceeding to surgery.

ACKNOWLEDGEMENTS

The authors would like to thank Steve Morris for his assistance with the statistical calculations. No funding was received for this study. Previous communication: 'Accuracy of pre-operative ultrasound scans in identifying rotator cuff tears'. British Elbow and Shoulder Society, Newcastle, 22nd to 24th June 2011. Podium presentation.

References

1. **Teefey S, Hasan S, Middleton W, et al.** Ultrasonography of the rotator cuff: a comparison of ultrasonographic and arthroscopic findings in one hundred consecutive cases. *J Bone Joint Surg Am* 2000;82:498–504.

Corresponding author:

Please check; static content missing from "corresp"Please remove "tel" and "fax"Shahid Punwar, Top Flat, 30 Salisbury Road, Redland, Bristol BS6 7AP, UK.
Tel.: +44 (0)7811 942192.
E-mail: shahpunwar@gmail.com

Corresponding author:

Please check; static content missing from "corresp"Rotator cuff tearsultrasound-sensitivity
specificityaccuracy.

2. **Teefey S, Rubin D, Middleton W, et al.** 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;86:708–16.
3. **Smith T, Back T, Toms A, Hing C.** Diagnostic accuracy of ultrasound for rotator cuff tears in adults: a systematic review and meta-analysis. *Clin Radiol* 2011;66:1036–48.
4. **Modi C, Smith C, Ho K, et al.** Accuracy of high-resolution ultrasonography in the diagnosis of articular-sided partial thickness rotator cuff tears. *Shoulder and Elbow* 2010;2:267–70.
5. **McBride T, Mathur K.** Diagnostic ultrasound of the rotator cuff: sensitivity and specificity in a district general hospital. *Shoulder and Elbow* 2012;4:22–4.
6. **Al-Shawi A, Badge R, Bunker T.** The detection of full thickness rotator cuff tears using ultrasound. *J Bone Joint Surg Br* 2008;90:889–92.
7. **Seagger R, Bunker T, Hamer P.** Surgeon-operated ultrasonography in a one-stop shoulder clinic. *Ann R Coll Surg Engl* 2011;93:528–31.
8. **Cowling P, Gamble A, Rangan A.** The use of shoulder ultrasound in a one-stop clinic: diagnostic accuracy for rotator cuff tear and biceps tendon pathology. *Shoulder and Elbow* 2011;3:13–6.
9. **Iannotti J, Ciccone J, Buss D, et al.** Accuracy of office-based ultrasonography of the shoulder for the diagnosis of rotator cuff tears. *J Bone Joint Surg Am* 2005;87A:1305–11.
10. **Lenza M, Buchbinder R, Takwoingi Y, et al.** 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 of Systematic Reviews* 2013;9:CD009020. DOI: 10.1002/14651858.CD009020.pub2.
11. **de Jesus J, Parker L, Frangos A, Nazarian L.** Accuracy of MRI, MR arthrography, and ultrasound in the diagnosis of rotator cuff tears: a meta-analysis. *AJR* 2009;192:1701–7.