

**The Role Of Ultrasound Diagnosis Of Full Thickness**  
**Rotator Cuff Tears**

Jerome A. Goldberg M.B.B.S., F.R.A.C.S., F.A. Orth.A. (1, 2)

Warwick J.M. Bruce M.B.B.S., F.R.A.C.S., F.A.Orth.A (1, 2)

William Walsh PhD (2)

David H. Sonnabend M.D., M.B.B.S., B.Sc (Med), F.R.A.C.S., F.A.  
Orth.A. (3)

1 -Orthosports Group

2 – Orthopaedic Research Laboratory, Prince of Wales Hospital

3 – Professor of Surgery, University of Sydney

Sydney, Australia

**ABSTRACT**

This study reviews the accuracy and potential usefulness of ultrasound, as currently practiced in Australia, in diagnosing full thickness rotator cuff tears in a general community setting. Ultrasound findings in 336 cases are compared to arthrography, and in 225 cases, findings at surgery. A very poor accuracy rate of 0.38 was found for ultrasound. The sensitivity was 0.24 and specificity was 0.61. The authors recommend extreme caution in the use of ultrasound, as currently practiced, in diagnosing full thickness rotator cuff tears.

## **INTRODUCTION**

In planning treatment of rotator cuff disease, accurate diagnosis is important. This is especially so if surgical intervention is considered. History and clinical examination alone may not suffice and several imaging modalities are available to aid diagnosis. These include ultrasonography, arthrography and magnetic resonance imaging. Ultrasonography has the theoretical advantages of being non invasive, relatively cheap and readily available in the general community.

Accuracy rates reported in the literature for ultrasound diagnosis of full thickness cuff tears vary from 73% to 100% (1 - 10). This includes the reported experience of one of the authors (6). This was not consistent with the impression gained by the senior authors (J.A.G. and D.H.S.) in clinical practice. Most of these studies were relatively small, only one reporting more than 125 cases (10). The cases studied generally came from units with particular interests in ultrasonography. Some studies compared ultrasonography to arthroscopy (2, 3, 4, 5, 6, 7, 10) while other studies compared ultrasonography to arthrography (1, 8, 9). This study reviews a large group of patients who had both ultrasound and arthrography, and compares the accuracy rate of the ultrasound to that of arthrography and clinical examination, using findings at surgery as the "gold standard"

## **MATERIALS AND METHODS**

Three hundred and thirty six patients were included in this prospective study. They presented to the one author (J.A.G.) between May 1996 and December 1997. The average age was 57 years (range 17 to 65 years). One hundred and ninety four patients were males.

A full history was taken, examination performed, and plain radiographs were obtained. A provisional diagnosis was made of either a full thickness tear or impingement without a full thickness tear. Patients who had any other provisional diagnoses or had had previous surgery were excluded from the study. The following subgroups were included: (1) all patients assessed clinically as potentially requiring surgery (this included patients with significant loss of function and/or pain unresponsive to three months or more of non operative treatment), irrespective of the ultrasound findings and (2) all patients with positive ultrasounds for full thickness cuff tears, who were under 50 years of age and would require surgery if the ultrasounds were proven correct (surgery is generally indicated in these patients because of the risk of tear extension). Older patients who clinically may have had rotator cuff tears but were assessed as not requiring surgery were also excluded, as these patients did not undergo arthrography which would not have altered the decision not to operate.

All patients in the study group presented with an ultrasound ordered by their referring physician. The majority of patients were referred for consideration of surgical intervention. The ultrasounds were performed by one hundred and nine different radiologists. Twenty one radiologists had performed five or more studies, including three radiologists who had performed ten or more. We recorded the radiologists report and did not rely on our own interpretation of the films. Ultrasonography of the shoulder is a dynamic investigation, and the surgeon is effectively reliant on the radiologist's assessment. The radiologist's conclusion and not the criteria used to reach them are the basis of this study.

All patients underwent single contrast arthrography. These were performed by three radiology practices. All arthrograms were interpreted by the consultant radiologist and by the same author (J.A.G.) who at the time of interpretation was blinded to the clinical and radiological findings. A diagnosis of a full thickness rotator cuff tear was made contrast entered the subacromial space. In all cases the author's interpretation agreed with the radiologist's interpretation. Sixty seven percent of the patients in this study underwent surgery and in every case the arthrogram assessment regarding full thickness tear or otherwise was found to be correct.

The ultrasound reports were compared with the arthrography findings and clinical examination.

## **RESULTS**

The results are summarized in Tables 1, 2 and 3.

There were 155 false negatives (where the arthrograms and in many cases surgery revealed full thickness tears while the ultrasounds were negative). Ninety seven percent of those patients were in fact diagnosed clinically as having full thickness tears.

There were also 51 false positive readings (using arthrography as the definitive diagnostic modality). In these cases unnecessary surgery might have been undertaken if the patient had not undergone arthrography. In these patients the clinical diagnoses were correct in 94% of cases (based on arthrography findings).

Full thickness tears were however diagnosed CLINICALLY incorrectly in 47 cases out of 242, or in 19% of cases.

These results indicate that ultrasound, as currently practiced in the community, is not a reliable tool for the diagnosis of full thickness tears of the rotator cuff.

## **DISCUSSION**

The literature to date (1 - 10) suggests that ultrasound is very accurate and sensitive in the diagnosis of full thickness rotator cuff tears.

This study indicates that in the clinical setting in which the study was conducted, ultrasound was often inaccurate. The authors recognize that the study assumes arthrography was as the gold standard and this is recognized as a theoretical weakness in the study. In the 67% of this group of patients who underwent surgery, however, the arthrogram was found to be correct in all cases. This certainly supports the use of arthrography as the gold standard in the accurate diagnosis of rotator cuff tears. Other studies in the literature have relied also on this (1, 8).

The study confirmed an accuracy rate of 0.38, a sensitivity of 0.24, and a specificity of 0.61. For preoperative ultrasound the positive predictive value was 0.49 while the negative predictive value was 0.34.

A large number of radiologists were represented in this study. We are unaware of their experience with shoulder ultrasound. The literature stresses the importance of the equipment used and the experience of the operator (5, 6). The purpose of the study is not to determine the potential reliability of ultrasound in a specialized unit but to assess its role in the general Australian community.

Data from the Health Insurance Commission (11) indicates that there were 72,854 services for shoulder ultrasound in 10 months from July 2000 to April 2001 (benefits paid \$6,152,301) and 152,742 services from July 2001 to April 2002 (benefits paid \$12,904,124). This was a growth rate of 109.75% in one year. These figures do not include Workers Compensation or Third Party investigations.

These results suggest that a large amount of money is being spent on an investigation which, at least in the diagnosis of full thickness rotator cuff tears, is unacceptably unreliable.

Discussion of ultrasound's role in the diagnosis of other shoulder conditions including subacromial impingement is beyond the scope of this study.

In conclusion, the authors caution against the use of shoulder ultrasound to diagnose or exclude full thickness rotator cuff tears, at least in the general community.

## **REFERENCES**

1. Drakeford, M.K., Quinn M.J., Simpson, S.L., Pettine, K.A.,  
A comparative study of ultrasonography and arthrography in the  
evaluation of the rotator cuff, Clin Orthop 1990, 253, 118-22
2. Farin, P.U., Jaroma, H., Harju, A., Soimakallio, S.,  
Shoulder impingement syndrome: sonographic evaluation. Radiology,  
1990, 176, 845-849.
3. Hodler, J., Fretz, C.J., Terrier, F., Gerber, C., Rotator cuff  
tears: correlation of sonographic and surgical findings, Radiology 1988,  
169, 791-794.
4. Pattee, G.A., Snyder, S.J., Sonographic evaluation of the  
rotator cuff: correlation with arthroscopy, Arthroscopy, 1988, 4 (1) 15-  
20
5. Read, J.W., Perko, M., Shoulder ultrasound: Diagnostic  
accuracy for impingement syndrome Rotator cuff tear, and biceps  
tendon pathology, J. Shoulder Elbow Surg 1998;7:264-71
6. Sonnabend, D.H., Hughes, J.H., Giuffre, B.M., Farrell, R., The  
clinical role of shoulder.  
Ultrasound, Aust. N.Z. J. Surg. 1997, 67, 630-633.



7. Teefey, S.A., Hasan, S.A., Middleton, W.D., Patel, M., Wright, R.W., 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 82 (4) 498-504.
8. Triebel, H.J., Wening, V., Witte, G., and Rotator cuff ruptures of the shoulder joint. Sonography- arthrography. Rontgen-Blatter, 1986, 39(9) 266-272
9. Vick, C.W., Bell, S.A., Rotator cuff tears; diagnosis with sonography, 1990, A.J.R. 154, 121- 123
- 10 Wiener, S.N., Seitz, W.H., Sonography of the shoulder in patients with tears of the rotator cuff, 1993, A.J.R. 160, 103- 107
- 11 Personal Communication – Statistics Section of Health Insurance Commission, Tuggeranong, A.C.T., Australia, 2002.

**TABLE 1****SUMMARY OF RESULTS FOR FULL THICKNESS ROTATOR CUFF TEARS**

<b>ULTRASOUND</b>	<b>ARTHROGRAM</b>	<b>NUMBER</b>	<b>CLINICAL DIAGNOSIS</b>
<b>CORRECT RESULT</b>			
Positive	positive	44	r.c. tear
Positive	positive	5	impingement
Negative	negative	44	r.c. tear
Negative	negative	37	impingement
<b>INCORRECT RESULT</b>			
Positive	negative	3	r.c. tear
Positive	negative	48	impingement

Negative	positive	151	r.c. tear
Negative	positive	4	impingement
TOTAL		336	

**TABLE 2****SUMMARY OF RESULTS OF ULTRASOUND EXAMINATION**

TRUE POSITIVES	(T.P.)	49	
TRUE NEGATIVES	(T.N.)	81	
FALSE POSITIVES	(F.P.)	51	
FALSE NEGATIVES	(F.N.)	155	
ACCURACY	( TN+TP/ TOTAL)		0.38
SENSITIVITY	( TP/TP+FN)		0.24
SPECIFICITY	( TN/TN+FP)		0.61
POSITIVE PREDICTIVE VALUE	( TP/TP+FP)	0.49	
NEGATIVE PREDICTIVE VALUE	( TN/TN+FN)	0.34	

**TABLE 3**

	ARTHROGRAM POSITIVE	ARTHROGRAM NEGATIVE
ULTRASOUND POSITIVE	49	51 incorrect result
ULTRASOUND NEGATIVE	155 incorrect result	81