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Effect of surgeon-sonographer interaction on ultrasound diagnosis of rotator cuff tears: a five-year cohort study in 775 shoulders

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Background: Ultrasonography for the diagnosis of rotator cuff tears has been a topic of debate for years. The literature shows promising results for the diagnostic utility of ultrasonography for rotator cuff tears. This study assessed the effect of a surgeon-sonographer interaction on the ability of ultrasonography to predict the presence or absence of rotator cuff tears.

Methods: This study was a temporal cohort analysis of 775 patients to detect the diagnostic accuracy of ultrasonography at predicting a rotator cuff tear. The surgeon-sonographer interaction had three components: (1) presence of an ultrasound machine and ultrasonographer within a shoulder clinic, (2) the ultrasonographer attends shoulder operations, (3) and the ultrasonographer reviews patients preoperatively and postoperatively. Comparisons of 2 variables—presence and size of a tear—were made between the preoperative ultrasonographic findings with arthroscopic findings (gold standard).

Results: The diagnostic utility for the detection of rotator cuff tears by ultrasonography at the start of the study was 93% sensitive and 68% specific, and at the end of the study was 99% sensitive and 93% specific. There was an improvement in the correlation of the ability to estimate the size of rotator cuff tears from ultrasonography to surgery in both full- and partial-thickness tears.

Conclusions: The surgeon-sonographer interaction improved the diagnostic utility of an office-based ultrasonographer over time, particularly with respect to the overall accuracy of ultrasonography for the detection of rotator cuff tears and for the ability to predict the size of full- and partial-thickness rotator cuff tears.

Level of evidence: Level I; Diagnostic Study

Keywords: Partial-thickness rotator cuff tear; full-thickness rotator cuff tear; ultrasound diagnosis; arthroscopic rotator cuff repair; office-based ultrasound; surgeon-sonographer interaction

Rotator cuff tears are a common cause of shoulder pain and dysfunction. Full-thickness rotator cuff tears do not heal on their own, and surgical repair may be recommended. Partial-thickness tears occupying less than 50% of the thickness of the tendon and rotator cuff dysfunction without a tear are often

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managed without surgery. Determination of the presence or absence of a tear and its morphology is, therefore, an essential component of the assessment of many patients with shoulder pain and dysfunction.

The use of ultrasound as diagnostic imaging for rotator cuff pathology has been a topic of debate for several years. Some studies have shown that community-based ultrasonography is inaccurate for the detection of rotator cuff tears.[7] Other investigators have shown that office-based ultrasonography can be reliable for rotator cuff diagnosis.[4,5,8,14,17] Studies assessing the efficacy of ultrasonography for the diagnosis of rotator cuff tears have reported varying results, with sensitivities of 63% to 100% and specificities of 44% to 100% for the detection of full-thickness tears.[1,2,4,6,8,13-21]

The difference in the diagnostic utility for detecting full-thickness rotator cuff tears by ultrasonography may have several reasons. Firstly, there may be variability in the knowledge base of the personnel who perform the ultrasonographic studies; secondly, there may be variability in the experience of the ultrasonographer in performing the ultrasound interrogation of the shoulder; and thirdly, there may be variability in the quality of the equipment used.

We speculated that the diagnostic accuracy of ultrasonography could be improved by enhancing the interactions between the shoulder surgeon and the sonographer, and specifically by locating a high-quality ultrasound machine in a shoulder clinic and by having an experienced ultrasonographer become more involved in the management of patients with shoulder problems. This study assessed the effect of the surgeon-sonographer interaction on the ability of ultrasonography to accurately predict the presence or absence of a rotator cuff tear.

Materials and methods

Study design

This study was a temporal cohort analysis of the diagnostic accuracy of ultrasonography at predicting a rotator cuff tear. All patients who underwent arthroscopic shoulder surgery between January 2007 and June 2011 by the senior author (G.A.C.M.) and who had an associated preoperative office-based ultrasound examination by our office-based ultrasonographer were included. Excluded were patients who underwent revision surgery and who did not receive a preoperative ultrasound examination by our office-based ultrasonographer.

Ultrasonographer experience

The ultrasonographer in this study is a technician (L.H.) and had been performing musculoskeletal ultrasound imaging since 1993 through a primary care practice, and from 2005 to 2007 at a musculoskeletal specialist office. Before the start of this study, she had performed approximately 3000 shoulder ultrasound studies.

Surgeon-sonographer interaction

Efforts were made to enhance the surgeon-sonographer mentorship. The first component was to site a high-quality ultrasound machine and ultrasonographer within the shoulder clinic, the second was to have the ultrasonographer attend (over 100) shoulder operations. the final component was to have the ultrasonographer review the patients and the surgical reports of all patients at 1 week after the operation with the surgeon. We hypothesized that the diagnostic accuracy of ultrasonography would improve as the ultrasonographer's knowledge of the shoulder and surgery improved and as the surgeons' knowledge and understanding of ultrasonography improved.

Ultrasound technique

Two ultrasound machines were used in this study. A GE LOGIQ 9 (GE Healthcare, Sydney, NSW, Australia) was used from January 2007 to May 2009, and a GE LOGIQ E9 (GE Healthcare) was used from May 2009 to June 2011. A high-frequency linear probe (ML6-15 MHz) was used to evaluate the rotator cuff. The ultrasound technique for diagnosis of rotator cuff pathology is discussed in detail elsewhere.[3] Briefly, the patient sat opposite to the ultrasonographer in a chair at equal height. The affected arm was placed in the neutral position, the elbow was flexed at 90°, and the hand rested on the patient's lap. The protocol for shoulder ultrasonography was to demonstrate the rotator cuff in its entirety. The biceps brachii long head tendon was examined with the probe in the transverse position at the level of the bicipital groove. The examination continued distally to the musculotendinous junction of the biceps brachii long head. The probe position was then rotated 90°, and the biceps brachii long head tendon was examined in the longitudinal plane.

Next, the supraspinatus tendon was examined in the longitudinal and transverse planes. The bony landmarks used for the supraspinatus were the acromion medially and the greater tuberosity of the humerus laterally. The supraspinatus was examined in the transverse plane with the biceps tendon medially and acromion laterally. The tendon follows the contour of the humeral head; therefore, representing a thick echogenic band above the humerus (Fig. 1, *A*). The ultrasound probe was then positioned anteriorly to demonstrate the supraspinatus tendon at its insertion, with the bicipital groove used as the bony landmark.

The probe was then rotated 90° to lie in the longitudinal plane. The acromion was the medial bony landmark, and the greater tuberosity was the lateral landmark. In this plane, the supraspinatus tendon resembles a "bird's beak" in its configuration. Once the supraspinatus was identified in this plane, the supraspinatus was scanned anteriorly to its insertion, and its anterior fibers were followed into the greater tuberosity.

Dynamic scanning was used to observe the dynamics of the rotator cuff when the shoulder was in movement. Impingement was often associated with rotator cuff pathology, and bursal bunching was easily recognized with dynamic scanning. With the arm, the supraspinatus tendon and subacromial bursa move medially. Dynamic scanning was also used with loading of the tendon to demonstrate any supraspinatus tendon pathology. A normal tendon shows a broad band of tightly packed echogenic fibers that follow the orientation of the humeral head. In an abnormal tendon, the fibers are disorientated or absent and do not follow the contour of the humeral head. When the tendon is structurally compromised, the fibers of the tendon do