The efficacy of ultrasound in the diagnosis of long head of the biceps tendon pathology

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The use of shoulder ultrasound as an imaging modality has recently gained widespread attention; however, the ability of ultrasound to diagnose long head of the biceps tendon pathology accurately still remains unclear. The biceps tendons in 71 patients were prospectively evaluated by comparison of standard ultrasonographic and arthroscopic examinations. Arthroscopic examination was used as the gold standard comparison. Ultrasound showed a 100% specificity and 96% sensitivity for subluxation or dislocation. Ultrasound detected all complete ruptures of the biceps tendon but detected none of the 23 partial-thickness tears. Overall, ultrasound diagnosed 35 of 36 normal biceps tendons (specificity, 97%) and 17 of 35 abnormal biceps tendons (sensitivity, 49%). Ultrasound can reliably diagnose complete rupture, subluxation, or dislocation of the biceps tendon. It is not reliable for detecting intra-articular partial-thickness tears. (J Shoulder Elbow Surg 2006;15:7-11.)

Lesions involving the long head of the biceps tendon have become an increasingly recognized source of pain in the shoulder. Reliable preoperative assessment of the biceps is critical for making an accurate diagnosis that, in turn, enables appropriate patient counseling and surgical planning. Shoulder ultrasound has evolved as an excellent tool for diagnosing rotator cuff tears.6,7,11,13,21-24 However, its ability to detect lesions of the proximal biceps tendon in the shoulder accurately remains unclear. Several studies have suggested that shoulder ultrasound is useful in assessing the tendon, but to our knowledge, there has not been a well-controlled, prospective correlation of ultrasound results to surgical findings.

Early reports compared the results of shoulder arthrography and ultrasound for diagnosing biceps tendon pathology. Most studies demonstrated that ultrasound was superior to arthrography for localizing the intertubercular groove and the biceps tendon.2-4,6-18 The dynamic assessment capabilities of ultrasound may play a role in improving its ability to determine the biceps tendon location.1,10,28 There is no study to date that correlates ultrasonographic examination of the biceps tendon to the gold standard of arthroscopic examination.

The purpose of this study was to determine the diagnostic accuracy for detecting clinically relevant abnormality in the long head of the biceps tendon. It was hypothesized that ultrasound would be highly sensitive and specific for diagnosis of biceps tendon instability and tears.

METHODS

Patient inclusion

Between December 1998 and April 2001, 130 consecutive patients with shoulder pain were enrolled prospectively in the study. Patients with acute or chronic shoulder pain accompanied by a high suspicion for rotator cuff tear were included. Patients with previous surgery, fracture, or inflammatory arthritis were excluded. Seventy-one of the patients had an arthroscopic procedure, and they comprised the study group in this investigation. There were 41 men and 30 women, ranging in age from 34 to 80 years (mean, 59 years). Of the patients, 46 had a full-thickness tear of the rotator cuff, 19 had a partial-thickness rotator cuff tear, and 6 had an intact rotator cuff. Biceps tendons were evaluated intraoperatively for tears and subluxation or dislocation from the groove. The operative diagnosis with regard to the biceps tendon was normal in 39, partial tearing in 23, full tearing with tendon retraction in 7, and subluxation or dislocation from the groove in 6. The documented ultrasonographic and intraoperative arthroscopic findings with regard to the biceps were compared and assessed to determine the accuracy, sensitivity, and specificity of ultrasound in detecting biceps tendon pathology.

Ultrasonographic evaluation

All ultrasound examinations were performed in a standardized fashion by 1 of 2 experienced ultrasonographers.
as previously described. The use of ultrasound as a reliable modality for examining the rotator cuff has been previously validated at our institution. Sonograms were made in real time with the use of a Siemens Elegra scanner (Siemens Medical Systems, Issaquah, WA) and a variable high-frequency linear-array transducer (7.5-9 Hz). Tissue harmonic imaging was used in nearly all cases to improve image quality. The patient was seated on a rotating stool with the examiner standing behind him or her. The ultrasonographic examination started with assessment of the biceps tendon. The tendon was initially examined in the transverse plane where it emerges from beneath the acromion. The tendon was then examined in a longitudinal plane by rotation of the transducer by 90°. The radiologist reported whether the tendon was normal, subluxated, or dislocated from the groove or torn (either partial or complete). The tendon was considered to be subluxated if it partially extended above a line drawn from the lesser to the greater tuberosity. The tendon was considered to be dislocated if it was completely out of the groove and perched on or medial to the lesser tuberosity. No dynamic examination of the biceps tendon was performed via ultrasound. The rotator cuff was then assessed as previously described.

Surgical procedure

Shoulder arthroscopy was performed in the beach-chair position by a single, subspecialty-trained shoulder surgeon. A standard posterior portal was used as the viewing portal and an anterior rotator interval portal as the working portal. With the arm in neutral rotation at the side, the biceps origin and the intraarticular portion of the tendon were visualized and assessed. A probe was used to evaluate biceps origin stability by pulling of the tendon inferiorly into the joint. The tendon was advanced from the groove into the joint to assess the proximal portion of the tendon in the intertubercular groove completely. The surgeon documented the appearance of any evidence of dislocation or subluxation of the tendon in the intertubercular groove. The tendon was noted to be subluxated if it was not centrally located in the groove but not out of the groove. The tendon was considered to be dislocated if it was completely out of the groove, perched on the lesser tuberosity, or medial to the tuberosity. The extent of partial tearing was documented as the percentage of the full thickness of the tendon that was involved, based on surgeon assessment. Arthroscopic images and videotapes were recorded in all cases.

The sensitivity and specificity of ultrasound for detecting subluxation or dislocation and partial or complete tears of the biceps tendon were determined by use of the arthroscopic examination as the gold standard comparison.

Statistical analysis

Specificity, sensitivity, positive predictive value, and negative predictive value were calculated for biceps tendon instability, tearing, and presence of pathology overall.

RESULTS

Thirty-nine patients had normal biceps tendons diagnosed during the time of arthroscopy. All 39 had normal biceps tendons on ultrasound examination. Seven patients had complete ruptures of the biceps tendon with retraction. Ultrasound correctly diagnosed these ruptures in all 7. Ultrasound incorrectly diagnosed full-thickness ruptures of the biceps tendon in 4 patients. However, these 4 had extensive partial tearing, involving greater than 70% of the normal thickness of the tendon. Two of the tears were judged by the surgeon as having tearing of approximately 70% and the other two as having tearing of greater than 90%, with only a few strands of tendon remaining intact.

Twenty-three patients had partial tears diagnosed at the time of arthroscopy. As stated previously, 4 of these were nearly complete ruptures and were diagnosed as complete ruptures by ultrasound examination. Ultrasound detected none of the other partial tears seen at arthroscopy (Figure 1). Four of the biceps tendons diagnosed with partial tears had concurrent instability detected by ultrasound. Two of these tendons were subluxated, and two were dislocated. The partial tears associated with these tendons were not visualized with ultrasound. Of the 23 partial tears, 19 were significant enough to require surgical treatment. A tenotomy was performed in 18 shoulders, and a tenodesis was performed in 1 shoulder. A tear determined to be greater than or equal to 25% of the thickness of the tendon was considered significant enough to perform a tenotomy or a tenodesis.

The 11 patients whose tendons were reported as ruptured by ultrasound were excluded from the assessment of biceps subluxation or dislocation. Of the remaining 60 patients, ultrasound detected all 4 patients with a subluxated biceps tendon (specificity, 96%) (Figure 2) but also reported subluxation in 2 tendons that were considered normal under arthroscopic examination (sensitivity, 100%). Findings on ultrasound and arthroscopy were in agreement that 54 patients did not have a subluxated or dislocated tendon (Table I). Therefore, for the diagnosis of a subluxated or dissected biceps tendon, ultrasonography had a positive predictive value of 66% and a negative predictive value of 100%. Of the 6 patients with subluxation on ultrasound, 2 were associated with subscapularis tears and 4 had full-thickness rotator cuff tears. The biceps was partially torn in 4 of the patients.

Overall, ultrasound diagnosed all 39 tendons without pathology correctly (specificity, 100%). Ultrasound diagnosed 16 of 32 biceps tendons with anatomic pathology (sensitivity, 50%) (Table II). Ultrasound had a positive predictive value of 100% and a negative predictive value of 71%. Ultrasound was very reliable in detecting subluxation or dislocation and was able to diagnose all tendons that were completely torn. Ultrasound diagnosed tendons with very high-grade partial-thickness tears as complete ruptures. Ultrasound was not accurate in diagnosing
Figure 1 A, Arthroscopic picture illustrating typical partial tear (arrow) of biceps tendon undetected by ultrasound. B, Corresponding ultrasound image of biceps tendon in the same patient. The tendon is seated in the groove (arrow) and surrounded by a small amount of fluid. C, Arthroscopic photo of a superior labrum anterior-posterior tear, which was also undetected by ultrasound.

Figure 2 The biceps tendon (arrow) in this clinical photograph is dislocated into the joint (left panel). Its relationship to the subscapularis (SS) and humeral head (HH) is illustrated. The corresponding ultrasound image in the same patient shows the biceps tendon (arrow) medial to the lesser tuberosity (LT) and the intertubercular groove (right panel).
minor partial-thickness tears or fraying of the intraarticular portion of the tendon.

Thirty patients had documented Speed’s and Yergasen’s tests to assess the biceps tendon. Of these, twelve had normal tendons at the time of surgery and also had negative biceps tests. Ten patients had positive Speed’s or Yergasen’s tests on physical examination and had a normal tendon at the time of surgery. Four patients with partial tears of the biceps also had a positive Speed’s or Yergasen’s test. Three patients with absent biceps tendons had negative Speed’s and Yergasen’s tests. One patient with a subluxated tendon had a negative physical examination.

DISCUSSION

Pathology involving the long head of the biceps is an increasingly recognized and important source of pain in the shoulder. Biceps abnormalities are commonly associated with rotator cuff disease. Therefore, reliability of preoperative imaging in diagnosing biceps tendon pathology is important. Magnetic resonance imaging has long been the primary mode of evaluating the painful shoulder, but ultrasound has rapidly assumed a similar role as an imaging modality in the past several years. Ultrasound has high levels of accuracy and sensitivity in diagnosing rotator cuff tears, especially full-thickness tears. Its ability to diagnose biceps tendon pathology is less well understood. This study evaluates the ability of ultrasound to accomplish this in a prospective study by use of arthroscopic surgical assessment as the gold standard comparison.

The ability of ultrasound to detect intracapsular pathology was unreliable. None of the 23 partial-thickness tears diagnosed by arthroscopic examination were reported with ultrasonographic examination. Ultrasound was able to detect reliably 7 of 7 tendons that were completely ruptured but could not diagnose partial tendon tears. In the 4 tendons with tearing of greater than 70%, ultrasound reported these as absent. Conversely, there were no tears of this magnitude that were recorded as partial-thickness tears. The few intact strands in these tendons could not be detected. It has been suggested that as the biceps tendon becomes intraarticular, it closely abuts the rotator cuff tendon, making it difficult to isolate its anatomy on ultrasound. Arthroscopic examination is necessary for the diagnosis of intracapsular lesions.

Ultrasound has been shown to be accurate in diagnosing subluxation or dislocation of the biceps tendon when compared with arthrography. Our results are in agreement, showing high specificity (100%) and sensitivity (96%). In our study biceps instability was identified in all 4 patients by ultrasound. Of the 4 patients with biceps tendon dislocation, 3 had a subscapularis tear. The other patient had a rotator interval tear. This finding may be important for diagnosing a subscapularis or interval tear. Earlier reports indicated that biceps subluxation may be difficult to detect because the intertubercular groove was usually filled with scar tissue that mimicked the appearance of the tendon sitting in the groove. Our data do not substantiate these findings. Improved techniques and equipment, along with recognition of this problem, have resulted in better diagnostic accuracy for biceps instability.

Previous studies have evaluated the biceps tendon by use of ultrasonography in patients with a painful shoulder but without surgical correlation. Iagnocco et al reported biceps tendon pathology in 48.1% of biceps tendons in 528 shoulders, including sheath effusion, texture changes, tears, and thickening, and correlated their findings to physical examination. However, no surgical correlation was available in these patients. Similarly, another study looked at the value of ultrasound in evaluating patients with pain after arthroplasty. Lesions of the long head of the biceps were reported in this patient population, but the findings were discussed only in the context of clinical outcome.

A study by Read and Perko compared ultrasound evaluation with surgical findings. Their findings were similar to ours. They showed an accuracy and sensitivity of 100% for the detection of biceps subluxation. They had less favorable results in terms of complete tendon rupture (sensitivity, 75%; accuracy, 98%). They reported detecting one partial tear involving 25% of the tendon fibers, which differed from our
study, but they did not specify whether this was an intraarticular or intertubercular lesion.

The strengths of our study are as follows: (1) this was a controlled, prospective analysis of patients with shoulder pain who were thought to have a rotator cuff tear clinically by the treating surgeon; (2) there were strict inclusion and exclusion criteria, making this a homogeneous group of patients representative of the typical population of patients with rotator cuff pathology; (3) the radiologists were highly experienced, and the use of ultrasound had been previously validated at our institution; and (4) arthroscopic surgical examination was used as the gold standard for comparison. A limitation of this study was the large number of normal tendons in the patient group and the relatively small number of tendons with biceps tendon pathology. The surgeon was not blinded to the ultrasound results.

In conclusion, ultrasound was very sensitive and specific for detecting pathology in the intertubercular groove, such as complete ruptures or tears that were nearly full thickness and subluxation or dislocation from the groove. Ultrasonography is less reliable for detection of intracapsular lesions, such as partial-thickness tears. Overall, ultrasound has a very high specificity (100%) but low sensitivity (50%). Although ultrasound has a positive predictive value of 100% for abnormal findings, sonographic findings of a normal bicep do not rule out a partial tear. Ultrasound is very helpful in detecting subluxation or dislocation of the long head of the biceps tendon. This may help to diagnose subtle subscapularis and rotator interval lesions. Ultrasound is not helpful in detecting partial-thickness tears. The large tears were recorded as ruptures, and the small, intracapsular tears were undetected. With a negative finding on ultrasound, one should still examine the tendon carefully for intraarticular and extraarticular partial tears at the time of surgery.

REFERENCES