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Do we really need to order magnetic resonance imaging? Shoulder surgeon ultrasound practice patterns and beliefs

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Background: Despite significant benefits, many orthopedic surgeons are hesitant to incorporate diagnostic ultrasound into their practice. This may be because of a lack of comfort, knowledge, and/or training. The purpose of this study was to analyze practice patterns regarding the use of shoulder ultrasound by orthopedic surgeons to diagnose rotator cuff tears.
Materials and methods: We conducted a survey of the members of the American Shoulder and Elbow Surgeons (ASES) regarding their use of ultrasound. A systematic review of the literature on the use of ultrasound in the shoulder by orthopedic surgeons was also performed.
Results: Of the members of ASES responding to the survey, 55% are using ultrasound for diagnostic purposes in the shoulder. The leading reason for not using ultrasound as the sole imaging modality prior to performing rotator cuff repair was lack of confidence in the ability to determine the reparability of the tear (83%). Our systematic review showed that for an orthopedic surgeon diagnosing a full-thickness rotator cuff tear, the mean sensitivity was 92% and mean specificity was 89%.
Conclusions: Many ASES surgeons are not using ultrasound in the shoulder despite its many potential benefits over magnetic resonance imaging. This is because of a lack of confidence in the ability to quantify fatty infiltration, muscle atrophy, and the level of retraction medial to the acromion. Our systematic review showed that orthopedic surgeons can be accurate in the diagnosis of full-thickness rotator cuff tears. Future research should focus on defining parameters of shoulder ultrasound associated with rotator cuff tendon reparability. Educating surgeons on ultrasound technique, cost, and evidence may be a promising strategy to enhance the value in musculoskeletal care delivery.

Although there are many advantages for shoulder surgeons to perform ultrasound in a clinical setting, many are hesitant to incorporate ultrasound into their practice. This may be because of a lack of comfort, knowledge, and/or training. The first reported use of ultrasound in the shoulder was in 1977 by Mayer. A subsequent report on the diagnosis of rotator cuff tears with ultrasound was published in 1985 by Middleton et al.[21] Recently, higher-frequency probes and smaller machines have been developed that have allowed for much better accuracy in diagnosis and in-office use by orthopedic surgeons.[12,37] Advancements in the equipment along with improvements in technique have allowed ultrasound to achieve accuracy equal to magnetic resonance imaging (MRI) in the diagnosis of both full-thickness and partial-thickness rotator cuff tears at a much lower cost.[5,19]

The purpose of this study was to analyze the practice patterns and beliefs regarding the use of ultrasound in the shoulder among members of the American Shoulder and Elbow Surgeons (ASES). By analyzing practice patterns of ultrasound among shoulder surgeons, we hoped to shed light on the reasons it is not used more. We also aimed to review the published evidence for ultrasound as a primary diagnostic imaging modality when specifically used by orthopedic surgeons in the clinical setting.

Materials and Methods

Survey

To better understand the current use of ultrasound in the shoulder among orthopedic surgeons, we conducted an anonymous survey of ASES members. Study data were collected and managed using REDCap (Research Electronic Data Capture)

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electronic data capture tools hosted at Greenville Health System.[10] REDCap is a secure, web-based application designed to support data capture for research studies, providing (1) an intuitive interface for validated data entry, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for importing data from external sources.

The survey consisted of 12 questions regarding the use of ultrasound in the shoulder, in addition to a section for general comments (Table I). The survey was constructed in a stemmed manner so that if the respondent answered yes or no to certain questions, a second question would be asked. A priori, it was determined that a 25% response rate would be the cutoff for the survey. Excel X (Microsoft, Redmond, WA, USA) was used to conduct the analysis. Frequencies were counted and respondent percentages were calculated based on the branching logic of the survey questionnaire. The denominator used to calculate the percentage of responses for each question is the number of respondents to whom the question was presented during the survey process. These analyses looked to determine the current use of ultrasound in the shoulder for various purposes by the orthopedic surgeon.

Systematic review

Scopus, the Cochrane Central Register, and PubMed (MEDLINE) were searched for all literature published up until April 16, 2018, on 6 different questions regarding the use of ultrasound in the shoulder by orthopedic surgeons: (1) Can orthopedic surgeons accurately diagnose rotator cuff tears with in-office ultrasound? The following keywords were used: shoulder AND (ultrasound OR sonography) AND rotator cuff AND (orthopedic OR surgeon) AND office. (2) What is the accuracy and/or efficacy of ultrasound-guided injections performed by orthopedic surgeons? The following keywords were used: shoulder AND (ultrasound OR sonography) AND injection. (3) Can orthopedic surgeons accurately diagnose long head of the biceps pathology using ultrasound? The following keywords were used: shoulder AND (ultrasound OR sonography) AND long head biceps. (4) Can orthopedic surgeons accurately diagnose postoperative rotator cuff tears with in-office ultrasound? The following keywords were used: shoulder AND (ultrasound or sonography) AND rotator cuff AND postoperative. (5) Can ultrasound be used by orthopedic surgeons to accurately evaluate the subscapularis in post-arthroplasty patients? The following

Table I
ASES survey results

	Frequency	%
Q1: Do you have an ultrasound machine in your office? (n = 112)		
Yes	65	58
No	47	42
Q2: Do you use ultrasound for diagnostic purposes in the shoulder? (n = 112)		
Yes	62	55
No	50	45
Q3: How long have you been using ultrasound for diagnostic purposes in the shoulder? (n = 62)		
<1 yr	3	5
1-3 yr	15	24
3-5 yr	14	23
>5 yr	30	48
Q4: Do you use ultrasound for guided injections? (n = 112)		
Yes	56	50
No	56	50
Q5: What is the reason for using ultrasound-guided injections? (n = 56)		
Improved accuracy	52	93
Patient satisfaction	27	47
Q6: If you use ultrasound for guided injections, which areas do you use it for? (n = 56)		
Subacromial	27	49
Long head of biceps	45	80
Glenohumeral joint	32	57
Acromioclavicular joint	26	47
Suprascapular nerve block	17	31
Q7: Would you feel comfortable recommending surgery to a patient for a full-thickness rotator cuff tear repair with only ultrasound as your soft-tissue imaging? (n = 112)		
Yes	61	54
No	51	46
Q8: Would you feel comfortable recommending surgery to a patient for a partial-thickness rotator cuff tear repair with only ultrasound as your soft-tissue imaging? (n = 112)		
Yes	38	34
No	74	66
Q9: Do you use ultrasound as the sole imaging modality prior to rotator cuff repair? (n = 112)		
Yes	11	10
No	71	63
Sometimes	30	27
Q10: What is the reason for not using ultrasound as the sole imaging modality prior to rotator cuff repair surgery? (n = 71)		
I do not have an ultrasound machine	24	34
Too busy to use ultrasound in the office for diagnostic purposes	26	37
Lack of confidence in diagnosing a tear	28	39
Lack of confidence in being able to determine the ability to repair a tear with ultrasound as the only form of soft-tissue imaging	59	83
Q11: Do you use ultrasound to evaluate postoperative rotator cuff repairs? (n = 112)		
Yes	56	50
No	56	50
Q12: Do you use ultrasound to evaluate subscapularis repairs postoperatively after shoulder arthroplasty? (n = 112)		
Yes	43	38
No	69	62

ASES, American Shoulder and Elbow Surgeons; *Q*, question.

keywords were used: shoulder AND (ultrasound OR sonography) AND arthroplasty. (6) Can ultrasound be used by orthopedic surgeons to accurately evaluate fatty atrophy of the rotator cuff muscle? The following keywords were used: shoulder AND (ultrasound OR sonography) AND rotator cuff AND (atrophy or fatty).

The articles were reviewed by 3 authors (K.K.K., M.F.D., and C.C.S.). The exclusion criteria were as follows: (1) articles that were not in English; (2) articles determined by the authors to not be of relevance to the particular question being asked; (3) articles in which the examination or injection was not performed by an orthopedic surgeon; (4) articles pertaining to the use of ultrasound-guided injections that were not level I; (5) articles pertaining to the diagnostic accuracy of ultrasound in which the findings of ultrasound did not have either MRI or intraoperative results with which to compare; and (6) any study that did not supply sensitivity or specificity in its results and for which the authors were unable to subsequently obtain this information by contacting the study's authors. In addition, any study that had been previously reviewed by the authors or was included in a meta-analysis on the aforementioned topics that fit the inclusion criteria was included.

For each of the studies included for analysis, study characteristics, demographic characteristics, preoperative data, operative data, and postoperative data were recorded. If more than 1 study was available for the question being asked, the data were pooled.

Statistical analysis

After data were obtained from the sources, they were standardized to arithmetic means and standard deviations. SPSS software (version 21; IBM, Armonk, NY, USA) was used to conduct the analysis. If the standard deviation was not reported in an article, it was calculated from the measure of variance reported by the authors. The sample size was used to weight all means. Weighted means and standard deviations were used to report data. Only for those variables reported by greater than 50% of the cohort was the statistical analysis reported. $P < .05$ was considered statistically significant in all cases. A *Z*-test calculator was used to compare data reported as proportions, which allowed statistical comparison between 2 groups with different sample sizes.

Results

Survey

We electronically sent the survey to the members of ASES and received 112 responses, yielding a response rate of 26.6% (Table I). Of the respondents, 58% have an ultrasound machine in their office and 55% use ultrasound for diagnostic purposes in the shoulder. Of these respondents, 5% have been using ultrasound for diagnostic purposes in the shoulder for less than 1 year; 23%, for 1 to 3 years; 23%, for 3 to 5 years; and 49%, for more than 5 years. Fifty percent of the respondents reported using ultrasound for guided injections for improved accuracy (93%) and patient satisfaction (47%). Among these respondents, ultrasound was used for guided injections in the following anatomic areas: subacromial space (49%), long head of the biceps tendon groove (80%), glenohumeral joint (56%), acromioclavicular joint (47%), and suprascapular region (31%).

Fifty-six percent of the respondents reported feeling comfortable recommending surgery to patients with full-thickness rotator cuff tears with ultrasound as the only form of soft-tissue imaging, whereas only 34% reported feeling comfortable recommending surgery for partial-thickness rotator cuff tears. When asked whether respondents use ultrasound as the sole imaging modality prior to rotator cuff repair, the responses were yes in 10%, no in 63%, and sometimes in 27%.

The reasons for not using ultrasound as the sole imaging modality prior to rotator cuff surgery were as follows: not having an ultrasound machine (34%), too busy to use ultrasound in the office for diagnostic purposes (36%), lack of confidence in diagnosing tears (39%), and lack of confidence in being able to determine the ability to repair the tear with ultrasound as the only form of soft-tissue imaging (83%). Finally, 50% of the respondents reported using ultrasound to evaluate postoperative rotator cuff repairs, and 38% reported using ultrasound to evaluate subscapularis repairs postoperatively after shoulder arthroplasty.

Systematic review

The resulting number of articles after the initial search for each question was as follows for each database: 11 articles for question 1, 350 articles for question 2, 98 articles for question 3, 173 articles for question 4, 313 articles for question 5, and 79 articles for question 6 for PubMed; 10, 87, 6, 29, 18, and 1 article, respectively, for Cochrane database; and 78, 667, 173, 255, 70, and 161 articles, respectively, for Scopus. After use the aforementioned exclusion criteria for each question, the following number of articles was included for each question: 12 articles for question 1, 3 articles for question 2, 2 articles for question 3, 3 articles for question 4, 0 articles for question 5, and 0 articles for question 6.

Question 1: Can orthopedic surgeons accurately diagnose rotator cuff tears with in-office ultrasound?

For question 1, 12 articles were found.[1,2,8,9,12,13,22-24,26,29,37] The mean sensitivity for the ability of an orthopedic surgeon to detect a full-thickness rotator cuff tear with ultrasound was 92.4% (range, 70%-100%). The mean sensitivity in detecting a partial-thickness rotator cuff tear was 67% (range, 7%-95%). The overall specificity in detecting a normal tendon (ie, no partial- or full-thickness tear) was 89% (range, 80%-100%). We excluded the study by Alavekios et al[2] (2013) from the assessment of partial-thickness rotator cuff tear sensitivity because of missing data, and we excluded the study by Ok et al[26] (2013) from the assessment of overall specificity for detecting a normal tendon because of data heterogeneity (Table II).

Question 2: What is the accuracy and/or efficacy of ultrasound-guided injections performed by orthopedic surgeons?

For question 2, 3 articles were found in which an orthopedic surgeon performed an ultrasound-guided injection in the shoulder. For glenohumeral joint and acromioclavicular joint injections, surgeons were found to have an accuracy of 93% and 90%, respectively, with ultrasound guidance vs. an accuracy of 73% and 70%, respectively, with landmark guidance.[4,27] Ultrasound-guided biceps injection was compared with landmark-guided injection performed by orthopedic surgeons and was shown to be more accurate (100% vs. 66%)[11] and have improved visual analog scale and Constant-Murley scores at 4 weeks.[36]

Question 3: Can orthopedic surgeons accurately diagnose long head of the biceps pathology using ultrasound?

For question 3, we found 2 articles that investigated the accuracy of an orthopedic surgeon in diagnosing biceps tendon pathology with ultrasound in 395 total patients, resulting in a sensitivity of 82.7% and specificity of 97.7% when evaluating for instability, interstitial tears, or tendinitis[9,23] (Table III).

Question 4: Can orthopedic surgeons accurately diagnose postoperative rotator cuff tears with in-office ultrasound?

For question 4, 3 studies reported the accuracy of ultrasound in diagnosing rotator cuff tears in the post-repair setting (within 1 year of surgery) performed by orthopedic surgeons, resulting in a

Table II
Findings regarding question 1 (Can orthopedic surgeons reliably diagnose rotator cuff tears with ultrasound?)

Authors	Year	No. of shoulders	FTRTCT sensitivity, %	PTRTCT sensitivity, %	Overall specificity for detecting normal tendon, %
Roberts et al[29]	1998	24	80	71	100
Ziegler[37]	2004	282	96	94	86
Iannotti et al[12]	2005	99	88	70	80
Moosmayer and Smith[23]	2005	79	77	14	98
Moosmayer et al[22]	2007	58	100	7	95
Jeyam et al[13]	2008	64	92	86	94
Al-Shawi et al[1]	2008	143	96	95	91
Ok et al[26]	2013	51	80	46	86*
Murphy et al[24]	2013	159	91	37	84
Alavekios et al[2]	2013	400	95	Not recorded†	90
Fischer et al[9]	2015	42	100	60	100
Day et al[8]	2016	19	70	71	100

FTRTCT, full-thickness rotator cuff tear; *PTRTCT*, partial-thickness rotator cuff tear.
We searched for all studies in the literature in which ultrasound was performed or read by an orthopedic surgeon, resident, or fellow and in which findings were confirmed by magnetic resonance imaging, by magnetic resonance arthrogram, or intraoperatively. Twelve studies in the literature met these criteria.
* The study by Ok et al was excluded from the assessment of overall specificity for detecting a normal tendon because of data heterogeneity.
† The study by Alavekios et al was excluded from the assessment of PTRTCT sensitivity because of missing data.

Table III
Findings regarding question 3 (Can ultrasound accurately diagnose biceps tendon pathology?)

Authors	Year	No. of shoulders	Sensitivity, %	Specificity, %
Moosmayer and Smith[23]	2005	350	80	100
Fischer et al[9]	2015	45	95	80

We included all studies in the literature that had an ultrasound examination of the long head of the biceps that was compared with magnetic resonance imaging or intraoperative findings.

sensitivity of 90.5% and specificity of 88.4% in combined shoulders analyzed[7,25,28] (Table IV).

Question 5: Can ultrasound be used by orthopedic surgeons to accurately evaluate the subscapularis in post-arthroplasty patients?

No articles met the inclusion and exclusion criteria for question 5.

Question 6: Can ultrasound be used by orthopedic surgeons to accurately evaluate fatty atrophy of the rotator cuff muscle?

No articles met the inclusion and exclusion criteria for question 6.

Discussion

Ultrasound has been used for the diagnosis of rotator cuff tears for almost 40 years, and a recent Cochrane review showed that ultrasound was of equal accuracy compared with MRI or MRI arthrogram for the diagnosis of rotator cuff tears.[18] However, many orthopedic surgeons are still hesitant to use ultrasound as a primary imaging modality. Although our systematic review showed that ultrasound can be very accurate in diagnosing rotator cuff pathology, only 10% of our ASES respondents stated that they are comfortable using ultrasound as their sole imaging modality preoperatively, which represents only 2.6% of all ASES members. These principal findings of our study highlight the discrepancy between the evidence-based support for routine ultrasound use to diagnose shoulder pathology and the hesitation to adopt this practice among experienced and expert shoulder surgeons in ASES.

There are numerous benefits of ultrasound over MRI. One of the most significant benefits is the decreased cost. In a recent review of the preoperative costs of rotator cuff repair, Yeranosian et al[35] found that the average cost before surgery was $1748 per patient. The highest percentage of this cost was for preoperative imaging (65%; ie, $1136), and the majority of this was spent on MRI. The current Medicare reimbursement for a complete ultrasound examination of the shoulder is $136 (roughly 10% of the cost of MRI).[35] Ultrasound also offers the advantage of immediate real-time imaging by the surgeon, as well as the ability to image patients with pacemakers or claustrophobia, the ability to perform dynamic and functional imaging, and overall improved patient satisfaction.[21,30] Even with all of these advantages, its use is still not widespread among orthopedic surgeons in the United States, and we sought to investigate why this was the case.

The first report on the use of ultrasound in the office by orthopedic surgeons for the purpose of diagnosing rotator cuff tears was published by Roberts et al[29] in 1998. A larger cohort of patients was reported on by Ziegler[37] in 2004. Multiple reports have followed.[2,12,13,22-24,26] The initial response by many surgeons regarding these reports was that for an orthopedic surgeon to be accurate with ultrasound, he or she would need to be a high-volume surgeon and have many years of experience using ultrasound. A study by Murphy et al[24] showed that an orthopedic surgeon with relatively little experience with ultrasound can achieve an accuracy equal to that of MRI in the diagnosis of rotator cuff tears after performing 50 to 100 scans.

When the data in our systematic review were pooled for all the studies examining the accuracy of orthopedic surgeons using ultrasound for diagnosing rotator cuff tears, the mean sensitivity for full-thickness tears was 92%, which is equivalent to that of MRI. Given that most of the reports on the use of ultrasound by orthopedic surgeons have been presented by higher-volume shoulder surgeons, we believed that by surveying ASES members, we would be able to gauge the use of ultrasound by the orthopedic surgeons who are using it most. A practice that comprises at least 50% shoulder or elbow cases is a requirement of the society. The survey showed that, currently, only 55% of the members of ASES responding to the study are using ultrasound for diagnostic purposes in the shoulder and, of this 55%, only 37% feel comfortable using it as the sole imaging modality prior to a patient undergoing surgery for rotator cuff repair. This finding is surprising given the multiple advantages ultrasound has over MRI, as well as the

Table IV
Findings regarding question 4 (Can orthopedic surgeons accurately diagnose postoperative rotator cuff tears with in-office ultrasound?)

Authors	Year	No. of shoulders	Sensitivity, %	Specificity, %
Prickett et al[28]	2003	44	91	86
Collin et al[7]	2015	61	80	98
Oh et al[25]	2017	77	98.63	82.14

Three studies met the inclusion criteria and were included.

growing body of literature showing that orthopedic surgeons can achieve accuracy equivalent to MRI in a short amount of time.

Multiple reasons were given in the survey regarding why orthopedic surgeons are not using ultrasound for the diagnosis of rotator cuff tears in their office (lack of machine, 34%; too busy, 36%; lack of confidence in diagnosing a tear, 39%), but the leading reason was a lack of confidence in ultrasound being able to determine whether the tear was reparable (80%). In addition, many respondents addressed the concern of being able to quantify fatty atrophy and retraction in the comments section of the survey. This leads us to believe that many of the surgeons in ASES feel confident in their ability to diagnose a full-thickness rotator cuff tear with ultrasound but do not feel comfortable with their ability to determine whether the tear is reparable.

Several reports performed by musculoskeletal radiologists have shown that fatty atrophy can accurately be assessed using ultrasound.[14,31,32] Wall et al[34] showed that ultrasound had 92.5% agreement for the detection of fatty degeneration of the supraspinatus and infraspinatus and 87.5% agreement for the teres minor compared with MRI. Khoury et al[15] showed that in 13 of 15 shoulders with moderate to severe fatty infiltration on MRI, the pennate pattern was absent and marked hyperechogenicity was present on sonography. They concluded that ultrasound had a good correlation with MRI regarding quantifying fatty atrophy. These studies show that fatty atrophy can be quantified accurately with ultrasound; however, these examinations were performed by musculoskeletal radiologists. Our systematic review failed to find any reports on the accuracy of an orthopedic surgeon quantifying fatty atrophy with in-office ultrasound. Although visualization of fatty infiltration is possible with ultrasound, it is not known whether this would correlate to tendon reparability. Ultrasound has also been shown to be very accurate in determining the anterior-posterior dimensions of a rotator cuff tear.[33] If a patient is found on ultrasound to have a small to medium (1- to 3-inch) full-thickness tear in which the edge of the tendon is visible lateral to the acromion, it is highly unlikely that he or she has an irreparable tear. This is an area in which future research could be directed.

The use of ultrasound for guided injection in the shoulder has grown substantially in recent years. Our survey showed that 50% of the surgeons in ASES responding to the study are using ultrasound for guided injections in the shoulder. Our systematic review found 3 studies examining the accuracy or efficacy of ultrasound-guided injection in the shoulder in which the injection was performed by an orthopedic surgeon. In the 2 studies examining accuracy, ultrasound was shown to improve accuracy in the acromioclavicular and glenohumeral joints. Ultrasound was also found to improve patient outcome scores for bicipital groove injections. In a recent meta-analysis of all level I randomized studies on ultrasound, Aly et al[3] found that ultrasound improved the accuracy in the acromioclavicular joint, long head of the biceps, and glenohumeral joint. Regarding the subacromial space, the accuracy was not shown to be greater with ultrasound, but patient outcomes were improved nonetheless compared with landmark-guided injections. This could be because ultrasound allows the practitioner to place the cortisone in a precise area of the subacromial space (ie, the leading edge of the supraspinatus) where impingement is most likely to occur. One of the arguments against the use of ultrasound for guided injections is the associated increase in cost. However, if injection failure can be avoided with more accurate shoulder injections with the use of ultrasound, the cost may be well substantiated. There is a greater emphasis on value in the current health care climate across the United States, which is defined as outcome divided by cost. Ultrasound is therefore an excellent strategy to improve a surgeon's ability to deliver better value to his or her patients by significantly decreasing imaging costs while maintaining the same quality of care and outcome.

Ultrasound is a valuable tool in the evaluation and management of the postoperative shoulder. The use of ultrasound in the evaluation of the integrity of a rotator cuff repair postoperatively was first reported in the 1980's.[20] Regarding the evaluation of postoperative rotator cuff repairs, several subsequent reports have shown that ultrasound is accurate in the assessment of the postoperative rotator cuff.[6,16,28] Our survey showed that 50% of the members of ASES responding to the survey use ultrasound to evaluate their postoperative rotator cuff repairs. We were able to find only 1 study in the literature in which an orthopedic surgeon performed an ultrasound examination on rotator cuff repair patients 6 months postoperatively and compared the results with MRI: Lee et al[17] showed that the addition of contrast may greatly improve the accuracy of their ultrasound examination in the postoperative rotator cuff repair setting 6 months from surgery.

In our survey, 62% of the respondents stated that they use ultrasound to evaluate the subscapularis in post-arthroplasty patients. This is not surprising given that special-sequence MRI must be obtained to properly image the rotator cuff in post-arthroplasty patients. There are multiple studies in which ultrasound has been used to evaluate the subscapularis in post-arthroplasty patients, but there have been no studies in which the results of ultrasound have been correlated to MRI or intraoperative findings.

As we look forward, it seems that the pressure to contain cost will be a very strong motivator for surgeons to incorporate ultrasound into their practice. Bundled-care payment plans will require providers to contain costs in as many ways as possible, and adding ultrasound to one's diagnostic armamentarium may add significant value to patient care. Diagnostic ultrasound use for rotator cuff tears has significant potential to enhance the value of care provided by orthopedic surgeons. It is possible that over the next 10 to 20 years, ultrasound will show a similar trajectory to shoulder arthroscopy. Shoulder arthroscopy began as a novelty of sorts in the 1980s, with few indications. The number of shoulder procedures performed arthroscopically has grown exponentially in the past 20 years. One of the ways to accelerate growth of the use of ultrasound is to offer training in ultrasound as a standard part of residency curricula. If residents have this skill set going into practice, it will be much easier to implement compared with surgeons already in practice with no prior training.

The strengths of this study include that it is the first study to review the literature on the use of ultrasound in the shoulder solely performed by orthopedic surgeons. The survey of the members of ASES provides insight into the current rates of use of ultrasound and areas in which its use has perceived limitations. One limitation of the study is response bias, as we had only a 26% response rate from the members of ASES. Ultrasound use in the diagnosis of rotator cuff pathology also has several significant limitations in general. In the case of a lawsuit, it is more difficult to prove an adequate indication for surgery because using MRI to diagnose rotator cuff pathology is much more common. It can be difficult to analyze images that have been obtained by someone else (even if the report of the findings is documented), which is why we have focused on

ultrasound use in the hands of an orthopedic surgeon. Traditionally, musculoskeletal ultrasound has been performed by radiologists, who usually have better ultrasound equipment.

Conclusion

Many ASES surgeons are not using ultrasound in the shoulder despite its many potential benefits over MRI. The main reason for this is a lack of confidence in the ability to quantify fatty infiltration and muscle atrophy with ultrasound alone. Our systematic review showed that orthopedic surgeons can be accurate in the diagnosis of full-thickness rotator cuff tears. Future research should focus on defining parameters of shoulder ultrasound associated with rotator cuff tendon reparability. Educating surgeons on ultrasound technique, cost, and evidence may be a promising strategy to enhance the value in musculoskeletal care delivery.

Disclaimer

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