

Role of Ultrasound in the Detection of Rotator-Cuff Syndrome: An Observational Study

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Abstract

The purpose of this study was to determine the accuracy of sonography in rotator cuff tears, clinical tests are used to determine rotator-cuff syndrome but are insufficient to predict the morphology and size of the rotator-cuff tear. A total of 50 patients with shoulder pain with rotator- cuff tear, as diagnosed by orthopods, were subjected to ultrasonography. Real-time ultrasonography was done for the acromioclavicular joint, biceps, infraspinatus, posterior labrum, subscapularis, supraspinatus, teres minor tendon, and the sub-acromial-subdeltoid bursa. The USG criteria indicative of rotator cuff tear were, 1) discontinuity in the normal homoechogenicity of rotator cuff 2) focal hypoechoic defect reaching up to either bursal or articular surface of tendon.3) Focal neovascularization of rotator cuff or a focal defect. Ultrasonography is a vital diagnostic procedure used by orthopaedic surgeons for diagnosis of the rotator-cuff tears in patients with shoulder pain

Keywords: Rotator cuff tears; positioning and techniques; supraspinatus tear; USG findings

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Introduction

Patients with rotator cuff tear, partial or complete, are more common than believed as most of them remain asymptomatic for long time. Ignorance about the rotator cuff pathology, over-diagnosis of frozen shoulder and overlap of cervical symptoms leads to mismanagement of the original problem of rotator cuff disease. As regards to pathology, there are many but the three most important entities affecting the shoulder are: A) Rotator cuff pathologies,

B) Impingement, and C) Instability. Few other important pathologies: Adhesive capsulitis, Biceps tendinopathy, Rotator interval injury, subacromial subdeltoid bursitis, etc [1]. A combination of intrinsic factor proposed by Codman and extrinsic factors theorized by Neer is more likely responsible for most rotator cuff tears, though the exact pathophysiology is still under controversy.

Intrinsic factors relate to the quality of the tendon substance itself, such as the chronic degeneration in conjunction with repetitive microtrauma whereas impingement ranks the foremost among external factors implicated in rotator cuff tears, better understanding of pathology, clinical symptoms and signs has led to improved clinical diagnosis of rotator cuff tear [2]. Though MRI remains gold standard for the diagnosis of rotator cuff tears, emergence of ultrasound has brought a new perspective to the diagnostics. Based on this, it appeared to be valuable to identify disease frequencies from the range of rotator-cuff disorder on a prospective basis in orthopaedic medicine patients having shoulder pain. A prospective observational study on patients with a 3-months history of shoulder pain showed that ultrasound diagnosis makes early treatment plausible. It is always better to have better, more valid imaging tests, because they are influenced by many variables such as operators' experiences, accuracy, sensitivity, and image analysis.

The objective of this observational study was to Access the role of ultrasound imaging in rotator-cuff syndrome in patients who had sudden pain in the shoulder.

Material and Methods

Fifty Patients with Possible Rotator Cuff syndrome Following Clinical Examination by Orthopaedic Surgeon in KIMS & SCB OPD, were Referred to Department of Radiology. Verbal Consent Was Taken from All Subjects.

Detailed Clinical History of Patients Was Recorded So That Data on Age, Sex, Duration of Symptoms, Involvement of Dominant or Nondominant Side, Clinical Presentation of Symptoms, Can Be Tabulated.

Techniques and positioning

Ultrasonography was done using GE Voluson S6 high frequency linear

transducer 6-12MHz. The examination was done in sitting position, with jelly applied over affected shoulder joint. The standard protocol as endorsed below has been followed for meticulous examination of all rotator cuff tendons

1. Patient was comfortably seated with palms in supination on the thigh. This slightly externally rotates the arm for better visualisation of subscapularis tendon. It was examined in transverse and longitudinal planes by ultrasound up to its insertion. To look for tendon subluxation or dislocation, the patient was asked to externally rotate. External rotation causes the subscapularis tendon to orient perpendicular to the ultrasound beam. The coracoid process is visualised in a medial position. Examination was done in both transverse and longitudinal planes.
2. For supraspinatus (SS) tendon two positions have been mentioned in literature. Crass and modified crass position. We mainly used the modified crass position⁴ in which the patients' hand is placed on ipsilateral hip with elbow pointing posteriorly (provides some external rotation to shoulder). This helps in visualisation of the supraspinatus tendon along with rotator interval. The acromion is usually located medially at this position. Examination was done in both transverse and longitudinal. The subacromial subdeltoid bursa was also examined in the same plane. The acromioclavicular joint is examined by placing the transducer directly over the joint. Any other bony cortical abnormalities related to humeral head were also evaluated in same position.
3. Lastly, patients' arm was placed in front of chest with elbows flexed, infraspinatus (IFS) and teres minor tendons were visualised from posterior approach. The posterior aspect of labrum was also visualised as a triangular hyperechoic structure superior to the glenoid rim. Dynamic sonography to rule out impingement was also performed.

When the rotator cuff could not be visualized because of a complete avulsion of the particular tendon and its retraction under the acromion or when there was a focal defect in the rotator cuff created by a variable degree of retraction of the torn tendon ends, it was diagnosed as a full thickness rotator cuff tear. It was a partial-thickness tear when a distinct focal hypo-echoic or mixed hyper-echoic and hypo-echoic defect was visualized in both the longitudinal and the transverse planes at the deep articular side of the rotator cuff (an articular side partial-thickness tear) or when there was a minimal flattening of the bursal side of the rotator cuff (a bursal side partial-thickness tear). A thinned cuff or one with a subtle concave contour was considered to be intact in the absence of a focal defect.

The extent of the rotator cuff tear was determined with transverse measurements. If the tear extended 1.5 cm posteriorly from the intra-articular portion of the biceps tendon, it was recorded as involving only the supraspinatus tendon, whereas if it extended >1.5 to 3.0 cm, it was recorded as involving both the supraspinatus and the infraspinatus tendon. The teres minor tendon was not evaluated. The sonograms were interpreted prospectively after clinical examination by the orthopaedic consultant of the hospital and then referred to radiologist.

Results

About 50 patients with various shoulder pathologies were screened with sector array probe with frequencies of 6 to 12 Mhz

Table 1: Age Distribution

AGE	NO OF PATIENTS		TOTAL
	MALE	FEMALE	
35-50	5	5	10
51-60	12	9	21
61-70	8	6	14
>70	3	2	5
TOTAL	28	22	50

Table 2: Sex Distribution

SEX	NO OF CASES	PERCENTAGE
MALE	30	60%
FEMALE	20	40%
TOTAL	50	100%

Table 3: Dominant Side

SIDE	NO OF CASES	PERCENTAGE
RIGHT	34	68%
LEFT	16	32%
TOTAL	50	100%

Table 4: Duration of Symptoms

DURATION	NO OF CASES	PERCENTAGE
<1MONTH	3	6%
1-6 MONTH	7	14%
7-12 MONTHS	35	70%
>1 YEAR	5	10%

Table 5: Clinical Symptoms

CLINICAL SYMPTOMS	NO PATIENTS	PERCENTAGE
RESTRICTED MOVEMENTS	50	100%
H/O TRAUMA	10	20%
TENDERNESS	40	80%

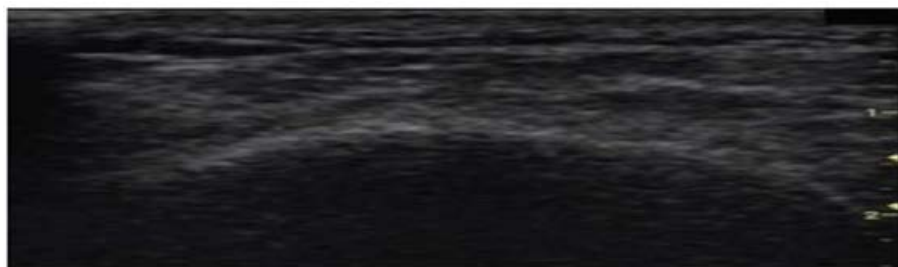


Figure 1: Full thickness tear of supraspinatus tendon with significant retraction of proximal end of tendon - deltoid resting on humeral head



Figure 2: 43-year-old man with pain and disability of left shoulder. Long-axis sonogram of supraspinatus tendon shows hypoechoic area in insertion (partial-thickness rotator cuff tear. GT = greater tuberosity.



Figure: 3 USG of partial tear of subscapularis tendon

Table 6: Incidence of No of Cases

CONDITION	NO PATIENT	PERCENTAGE
PARTIAL THICKNESS TEAR	22	44%
FULL THICKNESS REAR	9	18%
AC OSTEOARTHRITIS	16	32%
ADHESIVE CAPSULITIS	11	22%
OSTEOARTHRITIS GH JOINT	4	8%

Table 7: Usg Findings –Rotator Cuff Tears

MUSCLE	PARTIAL THICKNESS	FULL THICKNESS	TENDINOSIS	NORMAL
SUPRASPINATUS	20	9	5	14
INFRASPINATUS	2	0	0	48
SUBSCAPULARIS	2	-	3	45
TERES MINOR	-	-	-	50

Out of fifty cases no patient showed bilateral involvement of shoulder.

- Table no 1. Shows that maximum numbers of patients were in the age group of 51-60 yrs (42% of patients). The next age group affected was 61-70 yrs (with 28% of patients).
- Table no. 2 shows that present study included a greater number of male patients, n = 30 (60%) as compared to females, n = 20 (40%) with male female ratio of 3:2
- Table no. 3 shows. Among all patients, 68% patients were having right sided shoulder pathology while remaining 32% patients had left sided shoulder pathology
- Table no 4 shows that most common group of patients in our study was having shoulder complains for 6 months to 1year.
- Table no. 5 shows that the most common presenting complaint was painful restricted movements of shoulder which was present in all 50 patients (100%) followed by shoulder pain and tenderness which was present in 40 patients (80%). Only 20% patients had history of old trauma.
- Table no. 6 shows that rotator cuff tear cases were commonest cause of restricted shoulder movements found in 62% patients. Among them, partial thickness tears were more common than full thickness tears. Osteoarthritis of acromioclavicular joint was the next most common cause of restricted movements of shoulder found in 32%

patients.

- Table no 7 shows that supraspinatus was the most commonly involved tendon with its full thickness tear seen in 9 patients and partial thickness tear seen in 20 patients. Two partial thickness supraspinatus tears extended into infraspinatus. Subscapularis tendinosis was found in 3 patients and supraspinatus tendinosis in 5 patients. Involvement of teres minor or biceps tendon was not suspected in any patient.

Discussion

The present study was undertaken to find out the role of ultrasound in detecting rotator cuff tears and other possible causes responsible for restricted painful range of movements. Patients included in our study were referred for restricted movements and shoulder pain by the hospital orthopaedical. Detailed clinical examination findings were documented. All 50 patients underwent USG of both shoulders although no patient showed bilateral involvement of shoulder.

Age distribution of patients

In our study, incidence of shoulder pathologies is seen to increase from third through fifth decade. The similar observation is made in the study done by Brandt Tetal⁵. Common pathologies observed in young age group are fractures, labral tears, history of recurrent dislocations, etc.

Gender distribution of cases

Males are more prone to shoulder related disorders especially if they are concerned

with heavy occupational activities. Thomas D. Brandt [5] conducted a retrospective and prospective evaluation of clinical usefulness of shoulder sonography in evaluation of shoulder pathologies and found male predominance in shoulder related pathologies as in our study. The present study indicated males more prone for rotator cuff tears, which correlates to the study carried by Yamamoto A et al [2]. Present study shows that most patients had dominant shoulder involvement which is commonly right. So, there was significant difference in the side involved. This finding is also consistent with William D. Middleton [2] study who found dominant right shoulder involvement.

Duration of symptoms

In elderly patients, degenerative diseases are more common which often are of gradual onset and gradually progressive. So, the present study found 70% patients having duration of symptoms 7 months to one year. Diseases commonly seen in elderly patients are rotator cuff tears, acromioclavicular joint osteoarthritis, frozen shoulder. These observations are consistent with observations of study by Jaffrey R. Crass4

Clinical presentation of patients

When we examined the patient before ultrasound, we found that most patients had more than one symptom as presenting complaints. In many of the cases pain was the cause of restricted movements. Painful Restricted range of movements was presented in all the cases. Thomas D. Brandt5 studied patients presented with shoulder complaints with shoulder USG. Shoulder pain is commonest presenting complaint in his study and second commonest complain was restricted shoulder movements.

Incidence of number of cases

In the present series rotator cuff pathologies constituted maximum number of patients. Jaffrey R. Crass [4] did a study

on 130 patients with shoulder pain and restricted movements. Commonest pathology seen was partial thickness tear in 50% patients followed by full thickness tears of rotator cuff tendons. In study of Zlatkin [3] et al they found supraspinatus involvement was present in around 80% cases. While few cases showed Acromioclavicular joint degenerative change.

USG findings

Technical considerations in diagnosis of rotator cuff tears: Ultrasonography was done using GE Voluson S6 high frequency linear transducer 6-12MHz.

Partial thickness tears of Supraspinatus: Figure 2 shows, there is a small hypoechoic area along the inferior portion of supraspinatus tendon with loss of integrity of fibrils – this suggests Articular surface partial thickness tear. Supraspinatus was most commonly involved rotator cuff tendon to undergo degenerative tears. Partial thickness tears are more common than full thickness tears. Two partial thickness supraspinatus tears were also seen extending into infraspinatus. No independent in fraspinatus or any other rotator cuff tendon tear was noted in present study. Criteria used to diagnose partial thickness supraspinatus tear was focal hypoechoic defect reaching up to either bursal or articular surface of tendon. Focal hypoechoic areas that do not reach articular surface or bursal surface of tendon are not categorized as tears.

SobleM [6] described the major sonographic diagnostic criteria for diagnosing rotator cuff tear as a well-defined discontinuity usually visible as a hypoechoic focus in the cuff, non-visualization of the cuff and an echogenic focus within the cuff. In their study, 75 patients underwent both sonography and arthrography and they found ultrasound examinations enabled detection of 92% rotator cuff tears (24 of 26), with a

specificity of 84% and a negative predictive value of 95%. VlychouM7et al showed in his study that USG imaging can be considered almost equally effective in detecting partial tears of the rotator cuff compared to the MRI, particularly located in the area of the supraspinatus tendon. [7]

Full thickness tears of Supraspinatus: in figure 1 There is full thickness tear of supraspinatus tendon. It is seen extending up to both superior and inferior surfaces. There is also significant retraction of proximal end of tendon so that the deltoid muscle is now resting on humeral head.

Full thickness tear of supraspinatus was seen in 9 patients in our study. Full thickness tear is well identified in USG as loss of normal convexity of supraspinatus tendon. Discontinuity of tendon fibers is also noted from the articular surface to the bursal surface. If the discontinuity is not seen reaching both articular and bursal surfaces of supraspinatus, then it is partial thickness tear. Complete tear of supraspinatus means complete antero-posterior tendon bulk involvement. Kumugai, H. Ito and Kubo A considered full thickness anechoic areas to be specific findings of complete tears. Thomas D. Brandt [5] (1989) conducted a retrospective and prospective evaluation of clinical usefulness of shoulder sonography. Complete ruptures are further classified by them as (a) pure transverse tears, (b) pure vertical or longitudinal tears, (c) tears with retraction of tendon edges, (d) massive avulsion of the cuff (global tear). By using a comparison of sonography with surgery, using this study's criteria, Brandt demonstrated a sensitivity of 57% and a specificity 76% in detection of full thickness tears. Van Mopples F [8] found that sensitivity of sonography in detecting partial and total rotator cuff tears 86%, the specificity 91%. We also noted that supraspinatus was the most involved tendon. Rotator cuff tendons supraspinatus and infraspinatus insert on greater tuberosity posteriorly. Their tendons are

continuous near insertion to form rotator cuff to cover humeral head. We could not find any case of tear of only infraspinatus or any other rotator cuff tendon. Subscapularis tendon tear was not found in our study.

In our study Three patients were noted to have tendinosis of subscapularis. We used bicipital groove as an anatomical landmark to differentiate subscapularis tendon from supraspinatus tendon. Subscapularis lies medial to this bicipital groove. Supraspinatus tendinosis was diagnosed by USG in 5 patients. Sonographically, tendinosis appears as focal or diffuse areas of decreased echogenicity and tendon enlargement. Walz DM [9], in his study of 548 patients noted that this normal age-related degeneration is probably accelerated with increased stress or decreased resistance of the tendon by heavy occupational activity and sports related injuries. We could see that in our study most of the patients of tendinosis were elderly with age more than 55 years and were engaged in heavy occupational activity. Nathalie J. Bureau [10] sonographically examined both shoulders in small sample of patients with a clinical diagnosis of subacromial impingement. He described tendinosis as focal thickening of tendon and further added that subacromial impingement is associated with encroachment of tissues between the acromion and greater tuberosity and may result from intrinsic soft tissue abnormalities such as tendinosis with thickening of tendon. [11] We could not find significant association between tendinosis and impingement.

Conclusion

Our from study, ultrasound is a cost effective, easily available procedure which under proper technique and experienced hands can help to diagnose various types of rotator cuff pathologies in patients with painful, restricted movements of shoulder. Ultrasound has certain limitations of being operator dependent, however ultrasound

could safely be considered as first line imaging modality in patients presenting with shoulder pain especially with suspected traumatic rotator cuff pathology for its complete pre-treatment evaluation.

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