

# Role of high-resolution ultrasound in rotator cuff tears: A cross sectional study

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## Abstract

**Background:** Dynamic evaluation of high resolution ultrasound is non invasive and no radiation. The real time nature of sonography requires personal interaction with the patient, often resulting in a more directed examination specific for each individual. The aim of this study was to assess the role of high resolution ultrasound in rotator cuff tears.

**Materials and Methods:** This is a hospital based cross sectional study in which all patients referred to the department of Radio Diagnosis (Chettinad health city) with clinically suspected rotator cuff injuries in a period of January 2015 – May 2016 were assessed. 30 patients referred to the department of Radio Diagnosis (Chettinad health city) with clinically suspected rotator cuff injuries in a period of 2 years were included according to the inclusion criteria.

**Results:** In our study, most of the patients with rotator cuff injuries presented with shoulder pain (46.7%), followed by decreased range of shoulder movements (26.7%), shoulder pain and stiffness (13.3%), stiffness (10%) and shoulder pain and weakness (3.3%). In our study USG had a sensitivity of 63%, specificity of 82%, PPV of 100%, NPV of 33.5%, diagnostic accuracy of 68% and kappa degree of agreement of 0.34. These results suggest that USG is less reliable in detecting rotator cuff tears than previously reported and a positive sonographic reading is more reliable than a negative one.

**Conclusion:** No single test had both a high specificity and a high sensitivity, therefore diagnostic accuracy of shoulder examination is overestimated, and that these exams are only rarely useful to differentiate rotator cuff tears. USG is less reliable in detecting rotator cuff tears than previously reported and a positive sonographic reading is more reliable than a negative one.

**Keywords:** Ultrasound, high resolution, rotator cuff tears, shoulder joint

## Introduction

Evaluating rotator cuff by using ultrasonography was first described in 1979”and was used to detect shoulder joint effusions”. In early “1980s, availability of high resolution transducers made direct imaging of the rotator cuff possible<sup>[1,2]</sup>.

High resolution US is an important diagnostic tool for evaluation of musculoskeletal disorders. There has been demand for expanding clinical application of musculoskeletal sonography. Continual improvement in technology, wide availability and relatively lower

costs are the major factors contributing to the growth of sonography, therefore more frequently utilized in routine evaluation of the “shoulder joint”<sup>[3,4]</sup>.

Diseases of the “rotator cuff muscles are of vital importance. Visual criteria for diagnosing partial tear of rotator cuff muscles are in generally confusing and highly subjective because they are operator dependent. Diagnostic accuracy using only visual interpretation is currently estimated to be around 82%<sup>[5,6]</sup>.

High resolution musculoskeletal sonography is often the primary modality performed for many clinical indications of shoulder pathology<sup>[7,8]</sup>.”

Dynamic evaluation of high resolution ultrasound is non invasive and no radiation. The real time nature of sonography requires personal interaction with the patient, often resulting in a more directed examination specific for each individual. Disadvantage of ultrasonography is that it limits the ability to accurately assess labral and articular pathology<sup>[9]</sup>

**Aim of the study:** To assess the role of high resolution ultrasound in rotator cuff tears.

## Materials and Methods

This is a hospital based cross sectional study in which all patients referred to the department of Radio Diagnosis (Chettinad health city) with clinically suspected rotator cuff injuries in a period of January 2015 – May 2016 were assessed. 30 patients referred to the department of Radio Diagnosis (Chettinad health city) with clinically suspected rotator cuff injuries in a period of 2 years were included according to the inclusion criteria.

## Inclusion criteria

- To study the specificity and sensitivity of USG in diagnosing Rotator cuff tears.
- Cases of all age groups irrespective of sex.

## Exclusion criteria

- Patients with obvious clavicular fracture or dislocation or previous surgery were excluded.
- Patient who are unwilling for imaging.

## Patient selection

All patients were examined clinically by orthopedic surgeons. In addition, the patients were asked to answer questions in order to assess physical function that is, the ability to move upper limb. These questions focused on the ability of the patients to perform functions of the shoulder and therefore, overall scores were determined.

Before the study commences, from all patients after explaining fully about the procedure informed consent were obtained. Shoulder US was done on the same day. All shoulder examinations were performed in accordance with the” American College of Radiology Guidelines of the shoulder”.

## Sonography study

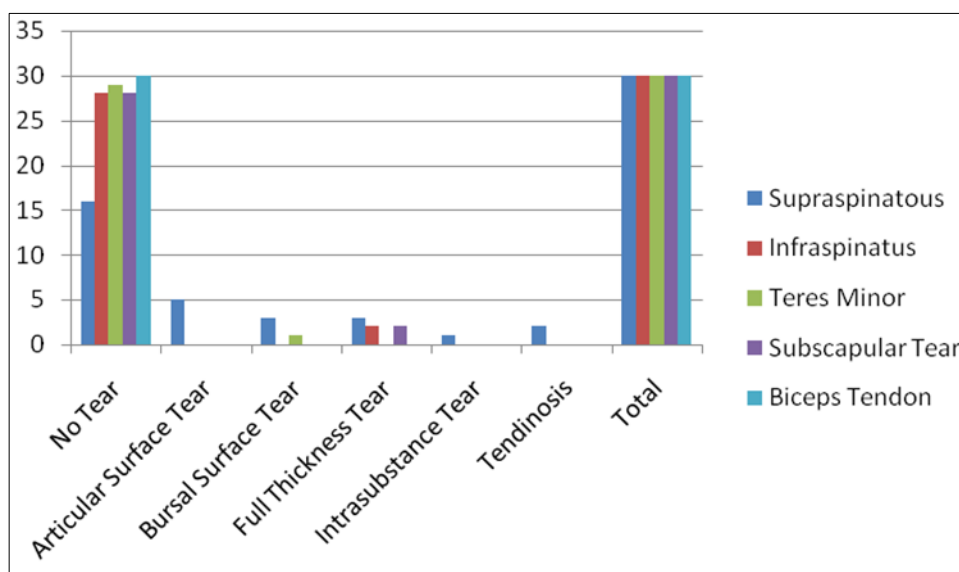
Ultrasonography was carried out on GE Voluson machine using a high frequency probe of 5-17 MHZ. The rotator cuff tendons, muscles, ACJ, Joint cavity and bursae were examined in different positions. Dynamic examination of shoulder were carried out for impingement. On same day opposite shoulder was also done, to compare the normal findings with abnormal findings.

## Results

**Table 1:** Demographic variables of the patients with rotator cuff injuries

Variables		Frequency (n=30)	Percentage (%)
Age	<50 years	17	56.7%
	>50 years	13	43.3%
Sex	Male	22	73.3%
	Female	8	36.7%
Dominant hand	Right hand	23	76.7%
	Left hand	7	33.3%
Clinical symptoms of patients	Shoulder Pain	14	46.7%
	Decreased range of shoulder movements	8	26.7%
	Stiffness	3	10.0%
	Shoulder pain & Stiffness	4	13.3%
	Shoulder Pain & weakness	1	3.3%

Rotator cuff injuries were observed after 50 years of age in 43.3% of subjects. Out of the 30 patients, 22 were males (73.3%) and females were 8 (36.7%). The frequency and percentage of affected hand 23 (76.7%) were Right handed and 7 (33.3%) were Left handed. Most of the patients with rotator cuff injuries presented with shoulder pain (46.7%), followed by decreased range of shoulder movements (26.7%), shoulder pain and stiffness (13.3%), stiffness (10%) and shoulder pain and weakness (3.3%) (table:1)

**Fig 1:** Bar diagram showing Tendons injuries diagnosed by USG

In our study, by using USG it was observed that 12 patients had supraspinatus tendon tear, 2 patients had infraspinatus tear and subscapular tear, 1 patient had teres minor tear and no tear was observed in biceps tendon. (Figure:1)

**Table 2:** Calcification diagnosed by USG

Tendons	Present (%)	Absent (%)	Total
Supraspinatus	1(3.3%)	29(96.7%)	30
Infraspinatus	0(0%)	30(100.0%)	30
Teres Minor	0(0%)	30(100.0%)	30
Subscapularis	0(0%)	30(100.0%)	30
Biceps Tendon	0(0%)	30(100.0%)	30

In our study by using USG, Supraspinatus calcification was found only in 1 (3.3%) patient.

(table: 2)

**Table 3:** Abnormalities in the rotator cuff tendons and the age range

Status of Rotator Cuff Tendon	Age Range in Years		Total
	<50	>50	
Normal	3(10.3%)	2(6.3%)	5
Tendinosis	2(6.3%)	3(10.3%)	5
Partial Thickness Tear	4(13.1%)	8(26.7%)	12
Full Thickness Tear	3(10.3%)	5(16.7%)	8
Total	12(40%)	18(60%)	30

In our study, patients with age more than 50 years, 18(60%) patients show tears as compared to less than 50 years, where 12(40%) patients show tear in the rotator cuff tendons. In patients less than 50 years of age, 2(6.3%) showed tendinosis and in more than 50years of age 3(10.3%) showed tendinosis. Thus in our study tears appear to be common in older age group than in younger patients, with tears being more common than tendinosis in older age groups. (table: 3)

**Table 4:** Validity of USG findings in tendon injuries

Tendons	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnostic Accuracy
Supraspinatous	58%	100.0%	100.0%	45.0%	70.0%
Infraspinatus	53.0%	100.0%	100.0%	94.5%	95.6%
Subscapular Tear	62.5%	100.0%	100.0%	90.2%	92.3%
Teres Minor	0	100.0%	0	100.0%	100.0%
Biceps Tendon	0	100.0%	0	100.0%	100.0%

In our study USG sensitivity of 63%, specificity of 82%, PPV of 100%, NPV of 33.5%, diagnostic accuracy of 68% (table: 4)

## Discussion

Different techniques are used for evaluating patients with suspected rotator cuff tears". These includes clinical examination, X-ray, USG, CT, MRI and Arthrography. Among the various techniques the gold standard is arthrography, but it has disadvantage of being invasive. MRI has good sensitivity and specificity in diagnosing rotator cuff injuries, but it's disadvantage is expensive and it cannot used as a first line investigation in all patients <sup>[10]</sup>. So, therefore USG being inexpensive and non – invasive technique can be used as a basic of investigation in all patients.

In our study, the age of the patients with rotator cuff disorders ranged from 28 to 77 years. Majority of Rotator cuff injuries were observed in patients above 50 years of age (43.3%). Various literatures have pointed out that the incidence of rotator cuff tendon degeneration and injury increases with the age. Rotator cuff diseases is multi factorial both extrinsic and intrinsic factors have been implicated. Intrinsic factors like poor vascularity, alteration in the material composition & properties with aging have been studied <sup>[11]</sup>. Ozaki *et al.* And Uhthoff believes that "the pathogenesis of rotator cuff disorders is an intrinsic process" and the risk of rotator cuff disorder increases with aging. Microvascular studies have shown diminished vascularity in the cuff tissue with increased age which appears consistent with the pattern of degeneration observed in age related degenerative tendinopathies.

David W.S *et al.*, showed female predominance in case of tendinosis and male predominance among patients with tears <sup>83</sup>. In our study rotator cuff disease was seen in 22 male patients (73.3%) and 8 female patients (36.7%), thus showing male preponderance among the study population correlating with study of David W.S *et al.* <sup>[12]</sup>.

Yamamoto *et al* in their study done on 1366 shoulders concluded that "risk factors for rotator cuff tears include increasing age, history of trauma and dominant hand". Urwin M, Symmons D, Allison T, Brammah T, Busby H, Roxby M *et al.* (1998) "concluded that rotator cuff tears tend to prevail in the dominant arm" <sup>[34]</sup>. In our study majority were right handed subjects i.e 76.7% and 33.3% were left handed subjects. All the individuals have statistically significant affected dominant hand, which correlates with study of Yamamoto *et al* <sup>[15]</sup> and Urwin M *et al.* <sup>[13]</sup>.

Shoulder pain is the most common complaint associated with rotator cuff pathology. It is usually located over the anterior, superior and lateral aspects of the shoulder". Shoulder pain usually minimal at rest in a neutral and supported position of the arm. The pain is typically exacerbated with overhead raising / abduction of arm as in combing hair, especially when lifting against resistance. Weakness may be a manifestation of either pain inhibition / muscular fatigue. True weakness often presents as an inability to raise the arm above the shoulder level. Stiffness may be secondary to pain / weakness of the rotator cuff. Our study showed pain as the most commonest presenting complaint (46.7%) of rotator cuff disorders, which is consistent with the literature. Many studies have shown that "disorders of the rotator cuff are the most common cause for a painful shoulder" <sup>[14]</sup>.

In our study most commonly involved tendon was supraspinatus 12 (40%), followed by infraspinatus 2 (6.67%) and subscapularis 2 (6.67%) with least affected tendons are biceps and teres minor (0%). This is consistent with the study conducted by Jerosch *et al.* <sup>[15]</sup>.

It was a study conducted on the dissected specimen of shoulder joints of 122 patients; it was found that isolated supraspinatus involvement occurred in 78% cases. It was also noted no tear occurred without the involvement of supraspinatus tendon. DePalma *et al* examined 96 cadaver shoulders and showed similar findings of supraspinatus as the commonly affected tendon and the incidence and degree of tear increased with age <sup>[16]</sup>.

In the present study USG sensitivity of 63%, specificity of 82%, PPV of 100%, NPV of 33.5%, diagnostic accuracy of 68% and kappa degree of agreement of 0.34, is consistent with study done by Cynthia L. Miller *et al* in which bilateral rotator cuff sonography was performed on 56 patients referred for shoulder arthrography to detect rotator cuff tears and showed that USG had a sensitivity of 58%, specificity of 93% and overall predictive value of 72%. These results suggest that a positive sonographic reading is more reliable than a negative one. Another study done by T D Brandt *et al* on evaluation of clinical usefulness of "rotator cuff sonography demonstrated that USG had a sensitivity of 57% and specificity of 76% depicting that shoulder sonography is less reliable than previously reported.

## Conclusion

Majority of the rotator cuff tears were seen in patients above 50 years of age (43.3%) with males affected more than females (M: F ratio – 4:1), dominant arm (76.7%) affected more than the non dominant arm with 16.7% of the cases with history of trauma showing rotator cuff tears depicting the fact that increasing age, male gender, dominant arm and history of trauma are predisposing factors for rotator cuff tears.

In our study, most of the patients with rotator cuff injuries presented with shoulder pain (46.7%), followed by decreased range of shoulder movements (26.7%), shoulder pain and stiffness (13.3%), stiffness (10%) and shoulder pain and weakness (3.3%).

In our study USG had a sensitivity of 63%, specificity of 82%, PPV of 100%, NPV of 33.5%, diagnostic accuracy of 68%. These results suggest that USG is less reliable in detecting rotator cuff tears than previously reported and a positive sonographic reading is more reliable than a negative one.

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