

## Role and Comparison of High Resolution Ultrasound and Magnetic Resonance Imaging in Evaluation of Patients with Shoulder Abnormalities.

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**Abstract:** Different diagnostic imaging modalities, such as ultrasonography (US), MRI, MR arthrography (MRA) are commonly used for the characterisation of rotator cuff (RC) disorders. Since the most recent systematic reviews on medical imaging, multiple diagnostic studies have been published, most using more advanced technological characteristics. This study assessed the role of USG and compared its findings with those of MRI. A cross-sectional study was conducted at Mahatma Gandhi Hospital, which included 52 patients with shoulder abnormalities. After taking informed written consent the patients underwent sonographic evaluation followed by MRI. The imaging findings were then compared. In our study maximum number of patients were in age bracket of 20-60 years. The most common clinical complaint was pain. The sonographic and MRI findings were then compared. The diagnostic accuracy of sonography and MRI was 99% and 100% respectively.

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### I. Introduction:

Of all things that make human beings unique, one that often gets overlooked is the shoulder joint. An undeniable fact is that shoulder altered the course of human evolution giving us survival skills we never could have imagined without it.<sup>1</sup> The whole joint angles out horizontally from the neck like a coat hanger and it points straight out allowing our arms to hang freely and flex arms at elbow and have our hands out front, highly useful for manipulation. The shoulder conferred to man the ability to throw and that unbelievably changed everything.<sup>1</sup> The secret of modern shoulder is its ability to move the arm in almost any direction, even behind the back, combined with other early human traits, enabled humans to throw with power and accuracy. Any joint can enjoy mobility only as much as it can compromise on stability. Shoulder is a ball and socket joint with decreased articular contact of the humeral ball with the glenoid enabling great range of motion but with increased susceptibility to instability. The complex anatomy in and around the joint makes it susceptible for various pathologies related to overuse, trauma and variety of other causes. MRI (Magnetic Resonance Imaging) has excellent soft tissue resolution and is the non-invasive imaging modality of choice for studying the morphology and pathology of shoulder joints.<sup>2</sup> Any kind of multidirectional orientation of the cross section slice can be enjoyed with MRI making the visualization of various normal and pathological structures in their en face and in profile directions. Various different sequences of MRI serve to delineate tissue type and bring out contrast between different adjacent structures. Further, usage of fat saturation, contrast in certain indications and arthrography with intra-articular contrast injection enable to diagnose any known shoulder problem, making MRI the versatile shoulder studying tool. High resolution ultrasound examination of the shoulder is a highly cost effective and efficient means of examining the shoulder joint with its main focus being the rotator cuff pathology and bicipital tendon abnormalities.<sup>3</sup> It has extended recently to diagnose various non-cuff pathologies also.<sup>4</sup> It also plays an important role in the evaluation of patients who have had surgical repair of a full thickness tear.<sup>3</sup> Usage of higher frequencies of more than 12 MHz has increased efficiency in diagnosing specific cuff disorders. Sonography is a non-invasive modality and is readily accepted by patients. Further dynamic imaging required to diagnose subtle tendon abnormalities is possible only with the real time capability of ultrasound and arthrographic techniques rely on ultrasound guidance more recently offering more advantages than fluoroscopic guidance.<sup>5</sup>

**II. Material And Method:**

The patients referred to the department of Radio diagnosis Mahatma Gandhi medical college ,jaipur with clinically suspected shoulder pathologies in the period of 18 months between January 2020 to June 2021 were offered to participate in the study. Initially a sample size of 50 was planned, however given the scope of an increasing number of cases within the study period, a total of 52 individuals participated in the study. MR Imaging was done with 1.5 Tesla MRI scanner (Signa exite; GE Medical system)) using shoulder coil and Coronal oblique T1W/ proton density weighted (PDW) fast spin echo (FSE) sequence. Coronal oblique fat suppressed (FS) PDW FSE / T2 – W FSE sequence. Sagittal oblique T2 W FSE sequence (with / without fat suppression), Axial T2 – W gradient echo (GE) sequence. Axial PDW FSE (with / without fat suppression) sequences were taken. Field of view 14-16 cm, slice thickness 2-3 mm and matrix 512 x 512. USG was done with SIEMENS ACUSON NX3 elite and TOSHIBA XARIO 100. Diagnosis was confirmed with MRI/ arthroscopy/ surgery/ CT or joint fluid aspiration, as per the case. The data was evaluated using various validity measures.

**III. Results:**

The sex ratio of patients in our study was 3:1(M:F), 39 males & 13 being females. Maximum number of patients were in age bracket of 20-60 years. Patients in age bracket of 20-40 years usually had a history of trauma. In patients in age bracket of 40-60, most did not have a history of trauma. Therefore, cause of rotator cuff injuries after age of 40 is usually non traumatic and is usually traumatic before the age of 40. Majority of supraspinatus tendon tears were partial thickness<sup>6</sup>. 4 patients had complete supraspinatus tendon tears. Out of partial thickness tears, most common is intrasubstance tears (n=09) followed by articular surface tears (n=06). Grade I (10) is most common followed by Grade II (n=05) tears, Grade III (n=01) being least common. There were 07 cases of subscapularis tendon tears, all of them being partial thickness tears. Most of the tears being Grade 1 (n=05), followed by Grade II (n=02). Free fluid around biceps tendon can be seen due to a primary biceps tendon tear or due to sweepage of fluid from shoulder joint effusion. Out of 22 patients with biceps tendon effusion, 15 were due to partial thickness tear of the biceps tendon. Infrapinatus tendon tear is very rare, we had two patients with complete thickness tear of infrapinatus tendon along with supraspinatus tendon tear, which was seen on MRI scan as well as on USG. We did not report a case of teres minor tendon tear. Subacromial subdeltoid bursitis can occur as an isolated finding or along with other tendinopathy. Isolated finding is was seen in young patients usually without history of trauma. 8 of 15 patients with SASD bursitis had isolated findings. 3 patients had concomitant supraspinatus tendinitis with partial thickness tears. All of 4 supraspinatus tendon full thickness tears were diagnosed both on USG as well as MRI, thereby USG is 100% sensitive and specific for full thickness tears. Out of 16 partial thickness supraspinatus tendon tears, 1 was missed on USG scans. Out of 7 partial thickness subscapularis tendon tears, 1 was missed on USG scans. Out of 22 patients with free fluid around biceps tendon, 2 were missed on USG scans. Diagnostic accuracy of sonography and MRI for tears was calculated which was ~99% and 100% respectively.

**Table 1:** Age distribution of the patients in present study

| Age (years) | Number |
|-------------|--------|
| 0-20        | 2      |
| 20-40       | 20     |
| 40-60       | 26     |
| >60         | 4      |

**Table 2 :** Diagnostic accuracy of USG ultrasound for partial thickness supraspinatus tendon tears against MRI (Reference modality)

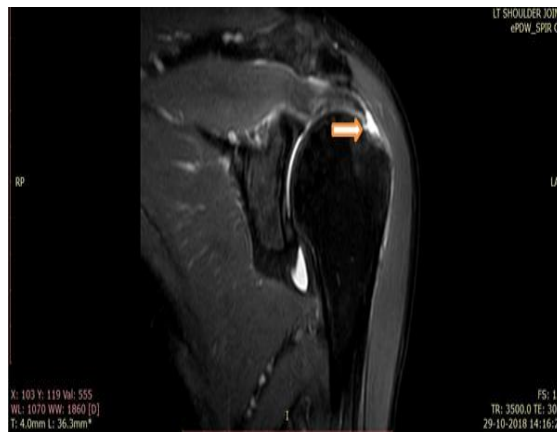
| USG           | MRI (Reference Modality) |               | Total |
|---------------|--------------------------|---------------|-------|
|               | Diagnosed                | Not Diagnosed |       |
| Diagnosed     | 15                       | 0             | 15    |
| Not Diagnosed | 1                        | 36            | 37    |
| Total         | 16                       | 36            | 52    |

Sensitivity of ultrasound for partial thickness supraspinatus tendon tears =  $15/16 = .9375 = 93.75\%$  specificity was 100%, PPV = 100%, NPV 97.29% and diagnostic efficacy was 98.07%.

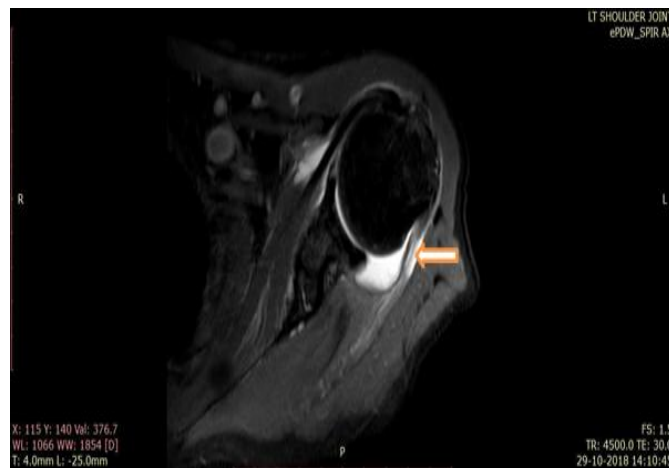
Table 3: Comparison of diagnostic accuracy of ultrasound against reference modality

|             | Supraspinatustendon tears | Subscapularistendon tears | Biceps tendon effusion | Total Tear entities | Subacromial-subdeltoid bursitis |
|-------------|---------------------------|---------------------------|------------------------|---------------------|---------------------------------|
|             | %                         | %                         | %                      | %                   | %                               |
| Sensitivity | 93.75                     | 85.71                     | 90.90                  | 95.12               | 93.33                           |
| Specificity | 100                       | 100                       | 100                    | 100                 | 100                             |
| PPV         | 100                       | 100                       | 100                    | 100                 | 100                             |
| NPV         | 97.29                     | 97.82                     | 93.75                  | 98.75               | 97.36                           |
| Efficacy    | 98.07                     | 98.07                     | 96.15                  | 99                  | 98.07                           |

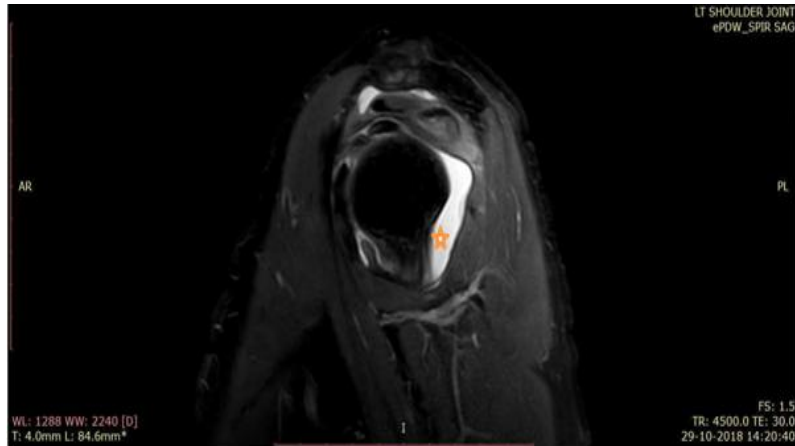
**Case1:** 66 year old patient presented with trauma to left shoulder



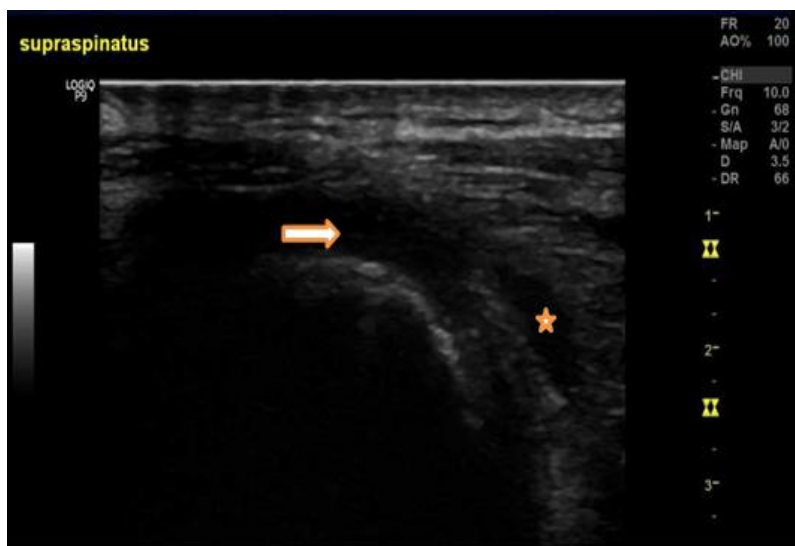
Full thickness tear of supraspinatus tendon



And also intraspinatus tendon



Sagittal image showing joint effusion (orange star) with supraspinatus and infraspinatus tendon tears.



Corresponding ultrasound images showing joint effusion (orange star) and supraspinatus tendon tear (orange arrow).

**Case 2:** 53 year old male patient with history of fall on outstretched hand



Full thickness tear at insertion of supraspinatus with marrow contusion



Corresponding ultrasound images showing fluid echogenicity at its attachment.

#### IV. Conclusion:

This study confirmed that that USG & MRI are well correlated for evaluation of rotator cuff tears. Both modalities are well correlated in terms of sensitivity, specificity and efficacy. High resolution ultrasonography is a highly sensitive and specific for Rotator cuff injuries and should be first line and final diagnostic modality for such isolated rotator cuff injuries. Once MRI has been done, then serial USG can be done as a follow up to monitor healing of the tendon, as it much more time and cost effective. However MRI should be indicated only if labral pathologies are suspected, or joint effusion is seen on sonography, either directly or as continuing effusion around biceps tendon. Because of dynamic nature of ultrasound, many pathologies like impingement, calcific tendinitis are much better diagnosed on ultrasound, then on MRI thereby further strengthening the importance of USG as a necessary modality for musculoskeletal pathologies especially rotator cuff. USG can be effectively done patients unfit for MRI. eg claustrophobic patients, patients with paramagnetic implants (which distort MRI signals).

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