Original Research Article

# Correlative study of MRI and high-resolution ultrasonography in internal derangements of shoulder

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## Abstract

**Background:** Pathologies of the shoulder are a common cause of shoulder pain and disability. The most common pathological derangements affecting the shoulder are Impingement, Rotator cuff injuries, and Instability. Adhesive capsulitis and Biceps tendinopathy are also not uncommon. **Objectives of the Study:** To study the role of MRI in shoulder joint pathology. To study the role of high resolution ultrasound in shoulder joint pathology. To correlate high resolution ultrasound findings with MRI findings. **Materials and Methods:** The patients referred to the department of Radio diagnosis Basaveshwar Teaching and General Hospital Kalaburagi with clinically suspected shoulder pathologies in the period of 2 years from Nov 2017 to April 2019 were offered to participate in the study.MR Imaging was done with 1.5 Tesla MRI scanner (Philips Achieva) using shoulder coil and the relevant sequences were selected as required USG was done with GE LOGIQ P9 and GE LOGIQ P5 Diagnosis was confirmed with MRA/ arthroscopy/ surgery/ CT or joint fluid aspiration, as per the case. **Results:** Both MRI and USG diagnosed full thickness tears of rotator cuff tendons with comparable sensitivity and specificity. MRI was significantly superior to USG in the detection to partial thickness tears of rotator cuff tendons. In instability, MRI showed high sensitivity (87.5 %) even without arthrography for anteroinferior labroligamentous injury. Bankart lesion (n = 10, 45.45 %) was the most common anteroinferior glenoid injury, with bony bankart lesion amenable to detection with ultrasound also, though it is deep and difficult to detect. Hill Sachs lesion was the most common detected lesion (59.09 %) in instability and was well demonstrated and quantified in both MRI and US. **Conclusion:** With benefit of being a cost effective tool USG is comparable to MRI in detection of full thickness tears of rotator cuff tendons. But MRI is better than USG for detection of partial thickness tears of rotator cuff tendons.

**Key Words:** Cuff, Rotator, Infraspinatus, Subscapularis, Supraspinatus.

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## INTRODUCTION

Pathologies of the shoulder are a common cause of shoulder pain and disability. The most common pathological derangements affecting the shoulder are Impingement, Rotator cuff injuries, and Instability. Adhesive capsulitis and Biceps tendinopathy are also not uncommon[8]. Pain around the shoulder joint with or without reduced range of motion are commonly referred to the radiologist for evaluation. Clinical examination and plain radiographic assessment help in providing proper choice of subsequent investigation modality[1]. Early diagnosis allows proper surgical treatment planning that can prevent functional impairment.

## MATERIALS AND METHODS

The present study is a prospective study conducted in Department of Radiodiagnosis, Basaveshwar Teaching

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and General Hospital, attached to M. R. Medical College, Kalaburagi

**Sample size:** Fifty five patients.

**Inclusion criteria:** The study includes

1. The patients with clinically suspected and radiologically confirmed shoulder joint pathologies
2. Trauma cases are also included

**Exclusion criteria:** The study will exclude

1. Known cases of rheumatoid arthritis and sero-negative arthritis
2. Known cases of metabolic bone disorders
3. Patient having history of claustrophobia.

**Duration of study:** 2 years (November 2017 to April 2019).

**Machines used**

**USG:**

**1.** GE LOGIQ P9

PROBES used - high frequency linear array transducer (7 to 11 MHz) and convex transducer (2 to 5MHz) whenever required.

**MRI:** 1.5 Tesla MRI scanner (Philips Achieva) using shoulder coil.

Imaging parameters[2]: Following sequences were used

1. Coronal oblique T1W/ proton density weighted (PDW) fast spin echo (FSE) sequence.
2. Coronal oblique fat suppressed (FS) PDW FSE / T2 – W FSE sequence.
3. Sagittal oblique T2 W FSE sequence (with / without fat suppression).
4. Axial T2 – W gradient echo (GE) sequence.
5. Axial PDW FSE (with / without fat suppression)

Patients were explained as to the procedure and techniques for both USG and MRI and informed consent was taken for the same.

**USG:**

High frequency linear transducer was used. Following steps were taken[3]:

1. Transverse images through the long head of biceps with patients arm and forearm on patient's thigh, palm supinated.
2. 90 degree rotation of transducer to view biceps in longitudinal view.
3. Transverse plane imaging of subscapular is tendon.
4. Transverse view of supraspinatus.
5. Longitudinal and transverse scanning of rotator cuff tendons and posterior labrum.
6. Further imaging based on patient symptomatology or indication is done.

**Statistical analysis**

For rotator cuff tears of various types, 2 x 2 contingency tables were made for each to numerate the true and false positive and negative results of both USG and MRI.

The validity measures for each test for each type of tears were calculated.

Sensitivity=a/(a+c)

Specificity = d / (b +d)

PPV=a/(a+b)

NPV = d / (c + d)

Diagnostic accuracy = (a+d) /N

These measures were compared between USG and MRI using **Z test of proportion** and p value was determined for each. The difference in validity of USG and MRI was considered significant if p value is less than 0.05,

**Cohen's Kappa Coefficient:**

When two binary variables are attempts of predicting the same finding in two different methods, the measure of agreement between the two methods can be analyzed by Kappa.

## RESULTS

Males (78.18 %) were more commonly affected as compared to females and right shoulder (72.73 %) was more commonly affected than the left shoulder. Both MRI and USG diagnosed full thickness tears of rotator cuff tendons with comparable sensitivity and specificity. MRI was significantly superior to USG in the detection to partial thickness tears of rotator cuff tendons. In instability, MRI showed high sensitivity (87.5 %) even without arthrography for anteroinferior labroligamentous injury. Bankart lesion (n = 10, 45.45 %) was the most common anteroinferior glenoid injury, with bony bankart lesion amenable to detection with ultrasound also, though it is deep and difficult to detect. Hill Sachs lesion was the most common detected lesion (59.09 %) in instability and was well demonstrated and quantified in both MRI and US. Rotator cuff disorders affected older population more (mean–57.23years, SD– 9.65 years) as compared to instability, which affected younger population (mean – 32.54 years, SD – 7.12years). Among miscellaneous pathologies, ultrasound and MRI both diagnosed a case of infective arthritis. Isolated GLAD lesion was not detected by ultrasonography. Pain was the most common complaint. Trauma was the most common aetiology. Full and partial thickness tears of rotator cuff tendons were more common in both type II and type III acromion (unfavourable morphology) with type III showing significant statistical difference from type I. It was also determined that type II and III acromion morphology were more common in elderly population than type I.

**Table 1:** Frequency of various etiology

| Category | Frequency | Percentage |
|---|---|---|
| Degenerative | 13 | 23.64 % |
| Impingement | 11 | 20 % |
| Traumatic | 27 | 49.1 % |
| Occupational / sports | 3 | 5.45 % |
| Infective | 1 | 1.82 % |

**Table 2:** Frequency of various categories

| Category | Frequency | Percentage |
|---|---|---|
| Primary rotator cuff pathologies | 30 | 54.54 % |
| Instability | 22 | 40 % |
| Others | 3 | 5.45 % |

**Table 3:** Frequency of rotator cuff pathologies and absolute detection rate

| Diagnosis in 30 cases | Frequency | USG | MRI |
|---|---|---|---|
| Supraspinatus Tendinosis | 6 | 6 | 6 |
| Full thickness supraspinatus tear | 9 | 7 | 9 |
| Partial Intrasubstance supraspinatus tear | 5 | 2 | 4 |
| Partial bursal surface supraspinatus tear | 5 | 3 | 4 |
| Partial articular surface supraspinatus tear | 10 | 7 | 9 |
| Full thickness Infraspinatus tear | 2 | 1 | 2 |
| Partial thickness infraspinatus tear | 1 | -- | 1 |
| SLAP | 2 | -- | 2 |
| Biceps tendinosis | 3 | 3 | 3 |

Partial articular surface supraspinatus tear was the most common diagnosis in this study seen in 10 (33.34 %) of this group, followed by full thickness supraspinatus tear (n = 9, 30 %) and degenerative tendinosis (n = 6, 20 %). Biceps tendinosis was seen in 3 patients (10 %). Infraspinatus involvement accounted only for 3 cases (10%).

**Table 4:** Frequency of findings in instability and absolute detection rate

| Diagnosis in 22 cases | Frequency | USG | MRI |
|---|---|---|---|
| Hill Sachs lesion | 13 | 10 | 13 |
| Bony Bankart lesion | 6 | 3 | 6 |
| Labroperiosteal Bankart lesion | 4 | -- | 3 |
| ALPSA | 4 | -- | 3 |
| Perthes lesion | 2 | -- | 2 |
| Supraspinatus tendinosis / tears | 2 | 1 | 2 |
| Marrow edema alone | 3 | -- | 3 |
| SLAP | 5 | -- | 5 |

Out of 22 shoulders presenting with instability, 10 (45.45 %) had presented with main complaint of recurrent dislocation. The rest had only one episode of dislocation following trauma.

Hill Sachs lesion was the most common abnormality found in 13 (59.09 %) shoulders out of 22, followed by Bankart's lesion (n = 10, 45.45 %).

### Absolute detection quantification in miscellaneous pathologies

Out of three patients with miscellaneous disorders, infective arthritis was seen in 1 (33.34 %) cases. The other two patients presented with trauma, and were diagnosed to have glenolabral articular defect (n = 1) and full thickness pectoralis major partial tear (n = 1).

Acromial morphology was classified according to the shape and configuration of the inferior surface into three types [5] as type I – curved, concave inferiorly; type II – flat and type III – flat with anteroinferior hook.

Acromial morphology of all shoulders revealed that Type I morphology was the commonest, followed by type II and then type III. The average age of incidence of those three morphologies was studied which revealed increased incidence of type II and type III with increasing age.

## DISCUSSION

In the present study of 55 patients, it was observed that maximum patients were in the 51 to 60 year age range. Mean age of patients presenting with shoulder pathology was 46.98 years with standard deviation of 14.7 years. Most common side involved was right side seen in 72.73 % of our patients.

**Etiology:** Trauma was the most common etiology accounting for 54.54 % of our patients followed by degeneration (40%) and impingement (20%)..

**Rotator cuff pathologies:** 54.54 % of total shoulders studied in our series had primary rotator cuff pathology. In addition, 2 (additional 3.64 %) patients in instability group had rotator cuff pathologies associated or related.

**I. Full thickness tears:** No significant difference in sensitivity between USG and MRI in detection of full thickness rotator cuff tears. Both USG and MRI showed high specificity in detection of full thickness rotator cuff tears. Report of a positive full thickness tear in either USG or MRI is enough for the diagnosis since positive predictive value is 100%. The chance of having a full thickness tear after being missed in USG and MRI is 5.45 % and 0 % respectively. Very good agreement between USG and MRI findings (kappa value of 0.81).

**II. Partial thickness tears:** MRI has a statistically significant higher sensitivity compared to USG in detection of partial surface tears. The chances of having a partial thickness tear after being missed or ruled out in USG and MRI are 16.36 % and 5.46 % respectively – statistically MRI is superior to USG in ruling out partial thickness tear. Good agreement between USG and MRI findings (kappa value of 0.72).

**Instability:**

**I. Hill Sachs lesion:** The most common lesion found in patients presenting with one episode of dislocation or recurrent dislocations is Hill Sachs lesion seen in 13 (59.09

%) shoulders out of 22 studied. MRI had detected Hill Sachs lesion in all patients whereas USG detected 9 of them.

**II. Antero inferior gleno-labro-ligamentous and periosteal lesions:** USG suffers severe handicaps when it comes to study the anteroinferior labor ligamentous complex injuries in patients with instability. On the other hand, MRI can visualize the normal and torn labrum, glenohumeral ligaments and the ruptured or avulsed anterior glenoid periosteum. Among the anteroinferior injuries, Bankart lesion was most common seen in 10 shoulders, six of which had Bankart glenoid fracture.

## CONCLUSIONS

MRI is a versatile investigation tool for studying all internal derangements of shoulder affording great soft tissue contrast and multi-planar imaging. With the benefit of being cost effective tool USG is comparable to MRI in detection of full thickness tears of rotator cuff tendons. But MRI is better than USG for detection of partial thickness tears of rotator cuff tendons. MRI is an efficient tool in evaluation of shoulder instability with high sensitivity even without arthrography. The clinical applications of High Resolution Ultrasonography have been extended apart from rotator cuff evaluation to detection of Hill Sachs lesion, bony Bankart lesion, synovial thickening, effusions in joint and in subacromial bursa, biceps tendinosis, rotator cuff tendon calcifications, pectoralis major muscle tear and guiding needle for MR arthrographic contrast injection and joint fluid aspiration. However it suffers serious drawbacks in evaluation of labral and cartilaginous lesions. Type III acromion morphology is a significant risk factor for the development of rotator cuff tear.

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