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## Accuracy of MRI in diagnosing rotator cuff and labral tears of shoulder

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### Abstract

**Introduction:** The most common cause of shoulder pain is rotator cuff pathology and most common finding in shoulder instability is labral tears, hence these two are the most common abnormalities detected in MRI shoulder and the common indication of arthroscopic intervention. MRI has decisive role in planning the treatment for patients. Hence analysing the accuracy and pitfalls of MRI in diagnosing rotator cuff and labral tears in comparison with arthroscopy, which is the gold standard tool is necessary.

**Aim:** To compare the MRI shoulder accuracy with arthroscopy, as the gold standard in detecting rotator cuff and labral pathologies of shoulder.

**Materials and Methods:** Prospective study of forty consecutive patients with chronic shoulder pain and instability presented to out patient clinic of orthopaedics department of our hospital with clinical signs of rotator cuff tear, impingement and instability, who had undergone MRI of the shoulder joint followed by arthroscopic intervention. The MRI results were compared with arthroscopy findings for evaluation of diagnostic accuracy.

**Results:** Out of 40 patients, supraspinatus tendon tear was the commonest pathology detected and next common was the Bankart's labral tear. MRI showed 100% sensitivity in the diagnosis of complete thickness supraspinatus and subscapularis tears and bankart's lesion but had poor sensitivity of 60% to detect SLAP tear. The accuracy of MRI in detecting rotator cuff tear and labral tears were comparable.

**Conclusion:** MRI is highly sensitive in diagnosing rotator cuff tears and Bankart's tear but was not sensitive in diagnosing SLAP tears. Radiologist needs to understand the pitfalls of MRI while evaluating the MRI shoulder for higher accuracy.

**Keywords:** MRI, labral tears, shoulder

### Introduction

The shoulder joint is a ball and socket joint with wide range of mobility making it an unstable joint. To overcome the innate instability, shoulder is stabilised with joint capsule, rotator cuff and labroligamentous complex. The tendons are the commonest to get injured due to wear and tear [1, 2, 3].

Shoulder pain is one of the most common complaints in patients attending the orthopaedic outpatient department. Shoulder pain hinders the daily physical activity whether routine household or at the work place, which can hamper the quality of life or financial earning of a person. Hence it is the responsibility of the orthopaedician and the radiologist to do accurate diagnosis and treatment. Multimodality imaging like conventional radiography, sonography and MRI (Magnetic Resonance Imaging) are currently used to evaluate cases of shoulder pain and instability.

Routine radiographs of shoulder are useful for the evaluation of the osseous structure of the shoulder girdle but cannot assess soft tissue pathology involving rotator cuff, joint capsule and the labroligamentous complex.

Ultrasonography is used to assess rotator cuff, the subacromial-subdeltoid bursa and dynamic assessment of subacromial impingement. However, the internal joint structures like labroligamentous complex and osteochondral injury cannot be assessed. The results are highly operator dependent based on the experience and training. Though the ultrasound diagnoses rotator cuff tears, it is difficult differentiate high grade partial tears and full thickness tears.

MRI plays a key role in diagnosis of shoulder pathologies. It allows visualisation of both soft tissue and osseous structures of shoulder with high spatial resolution.

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It can be performed in acute painful shoulder where clinical assessment is a challenge. MRI is a non-invasive, no radiation investigation with high soft tissue contrast, has proved on par with diagnostic arthroscopy in diagnosing intra articular shoulder disorders which is considered as the gold standard. MRI is helpful in assessing the areas which are not accessible in arthroscopy, i.e the blind spots of arthroscopy like inferior two thirds of infraspinatus and inferior glenohumeral ligament [4]. The rotator cuff intrasubstance partial thickness tear and fatty degeneration, extra articular pathologies like paralabral cysts in suprascapular notch and neurofibromas are better visualized on MRI than arthroscopy. Because of orientation of rotator cuff tendons and labrum along the imaging plane makes it less accurate in diagnosing certain cuff and labral tears due to partial volume averaging [5, 6, 7]. MRI is contraindicated in patients with cardiac pacemakers, metallic implants and claustrophobia.

Arthroscopy is considered the gold standard in assessing shoulder pathologies because of direct 20 X magnified visualization of labrum, labroligamentous complex, rotator cuff tendon and articular surfaces and orthopaedician can manipulate these structures with a probe and does a dynamic evaluation [8]. However, Arthroscopy has its own limitation in evaluation of extraarticular shoulder and blind spots which are not accessible to the arthroscope. With the establishment of different types of portals, there is availability of wide landscape to assess during this examination. Being invasive procedure, it has risks of complications like infection, damage to articular cartilage and musculocutaneous nerve [9].

MRI now being the investigation of choice in assessing shoulder pathology before planning the management of these patients, It is necessary to establish the accuracy of MRI findings in diagnosing shoulder pathology. Therefore, we studied the sensitivity, specificity, and positive and negative predictive values of MRI in diagnosis of rotator and labral tears and compared the results with arthroscopy, which is the gold standard for assessing shoulder pathology.

### Materials and methods

This is a prospective, comparative study done for 1 year from October 2018 to October 2019 in our tertiary care 700 bedded hospital. Forty consecutive patients presenting with chronic shoulder pain or instability presented to out patient department of department of orthopaedics with clinical suspicion of impingement, labral and rotator cuff tear were included in the study. The sample size was determined by the prevalence of the disease. Patients with fractures, infection and osteoarthritis involving shoulder were excluded from the

study.

MRI of the shoulder joint was performed in a 1.5 tesla PHILIPS ACHIEVA. Imaging sequences used are axial, sagittal, coronal PDW fat sat, axial T2W, axial and sagittal T1WI and sagittal FFE. Images were analysed by single radiologist with musculoskeletal subspeciality. Arthroscopy was done to the patients after taking informed and written consent from patient. MRI findings of rotator cuff and labrum were compared with the arthroscopy findings and divided them as True positive (TP), where tear was found in both MRI and arthroscopy, True negative (TN) with no tear in either of the procedures, False positive (FP), when only MRI showed a tear and False negative (FN), when MRI missed detecting a tear, but arthroscopy showed a tear. Collected data was then assessed to calculate accuracy, sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV). All the calculations were done using statistics software.

### Results

Out of 40 patients that were included in the study, 25 were males and 15 were females with age range from 24 to 68 years. Majority of the study population (62%) was in active age of 24 to 45 years and were doing manual physical work. Younger population had labral tears and elderly group were diagnosed more of rotator cuff tears. Of the 20 patients who were diagnosed to have supraspinatus tear on MRI with 15 full thickness tear and 5 partial thickness tears, Arthroscopy had 14 full thickness tear and 1 partial tear. 5 patients had infraspinatus tear on MRI with four full thickness tear and 1 partial tear, on arthroscopy only 3 patients had full thickness infraspinatus tear and no partial tear was seen in these patients. Four patients were diagnosed to have subscapularis tear on MRI with 3 partial thickness tear and 1 full thickness tear, Arthroscopy had two partial thickness tear and no full thickness tear in these patients. 19 patients had labral tear on MRI, 15 of them had Bankart's lesion and 4 had SLAP tear. Out of 15 Bankart's lesion patients, Arthroscopy was positive for Bankart's in 12 patients, three patients had large labral tear extending from 12 to 6'O clock position and one had SLAP tear. Out of four SLAP tears detected on MRI, arthroscopy showed SLAP tear in three patients. One patient with no labral tear on MRI, but arthroscopy showed SLAP tear.

MRI diagnostic accuracy in diagnosing rotator cuff and labral tear as compare to arthroscopy is > 92%. The sensitivity of MRI in detecting supraspinatus and subscapularis tears and Bankart's labral lesion is 100% hence MRI is useful for confirming the clinical diagnosis of these lesions.

**Table 1:** MRI is least sensitive in detecting infraspinatus tear and SLAP tear as compared to arthroscopy with values of 50% and 60% respectively.

	True positive	True negative	False positive	False negative	sensitivity	specificity	Positive predictive value	Negative predictive value	Diagnostic accuracy
Supraspinatus Full thickness tear	15	24	1	0	100%	96%	93.7%	100%	97.5%
Supraspinatus partial tear	2	34	4	0	100%	89%	33.3%	100%	90%
Infraspinatus tear	3	35	1	1	50%	97.2%	50%	97.2%	94.7%
Subscapularis tear	2	36	2	0	100%	94.7%	50%	100%	95%
Bankart's lesion	12	25	3	0	100%	89%	80%	100%	92.5%
SLAP tear	3	34	1	2	60%	97%	75%	94%	92.5%

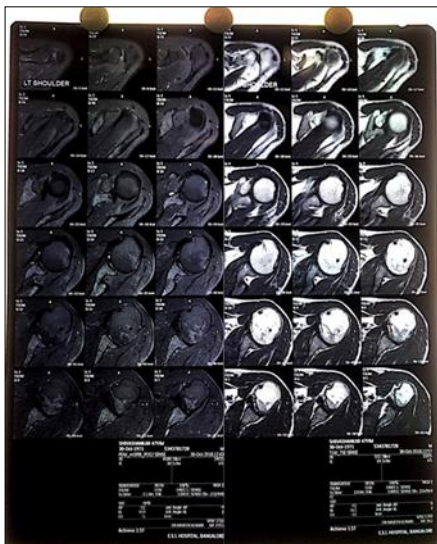


Fig 1: MRI Shoulder axial cut showing Bankart's tear.



Fig 2: MRI Report describing the pathology.

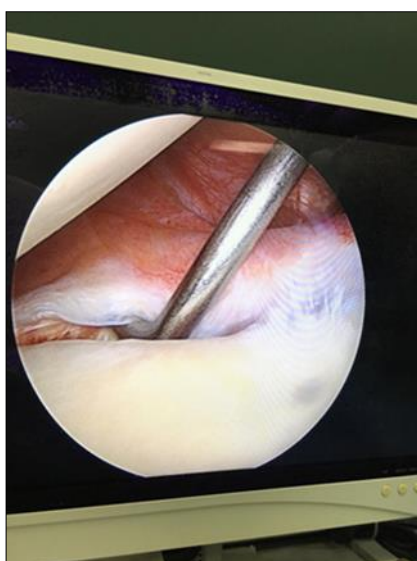


Fig 3: Arthroscopy finding showing Bankart's tear.

**Discussion**

MRI is rampantly done for the patients with clinically suspected rotator cuff and labral tears for confirmation of diagnoses and as a preoperative tool for excluding other

pathologies. Since ages it is realised that there is least agreement between orthopaedicians and radiologists on MRI findings of these patients [11]. For this to reduce, radiologist need to know the short comings of arthroscopy in shoulder evaluation and Orthopaedicians has to understand the pitfalls of MRI shoulder.

In our study, there was four false positive partial supraspinatus tears diagnosed on MRI, as compared to arthroscopy. Though normal tendons have uniformly low signal intensity on MRI, there is focal area of increased signal intensity in the distal supraspinatus tendon corresponding to the critical zone that can be seen in few normal individuals which can be wrongly read as intrasubstance partial tear and tendinosis. This has been proved in Kellen *et al.* [11] cadaver study, which was attributed to mucoid degeneration.

Increased signal intensity changes of supraspinatus could be secondary to artifacts and partial volume effects, and magic angle effect [12, 13]. Secondary signs of partial tear like minimal free fluid in the subacromion subdeltoid bursa without rotator cuff tear is seen in many individuals. The radiologist need to know this pitfall before calling the hyperintense supraspinatus tendon as partial tear.

T2 WI helps in differentiating tendinosis from true partial tear, the former appears normal, whereas the latter will be hyperintense in both PDW STIR and T2WI.

There was one false positive and one false negative infraspinatus tear diagnosed on MRI in our study. It is difficult differentiate supraspinatus and infraspinatus tendons at the foot print because of overlap of fibres due to patient positioning in a narrow MRI gantry. Hence radiologists tend to overcall large supraspinatus tear as both supraspinatus and infraspinatus tear.

Two false positive partial tear of subscapularis tear was given on MRI. This is because of subcoracoid bursa fluid collection, when interspersed with tendon fibres, will be easily mistaken for partial tear, when the reporting radiologist is in the early learning curve.

In our study MRI was less sensitive and had low positive predictive value in detecting SLAP labral tears. Many studies have shown good accuracy of MRI in detecting SLAP, but few have reported that MRI is less sensitive in detecting SLAP as compared to MR arthrogram. In our study MRI showed one false positive and 2 false negatives, with overall sensitivity of 60%. The possible reasons for this misdiagnosis could be due to innate curved labral surface which is typically not oriented along the MRI sections that were taken. Small SLAP tears will be missed because of partial volume averaging of similar intensity articular cartilage and glenoid cortex. Studies have shown that MR arthrogram and MRI done in abduction and external rotation can detect SLAP tear accurately. However, arthroscopy is more accurate in diagnosing superior labral tears [14-19].

Three false positive cases of Bankart's lesion on MRI was there in our study. Many studies have shown that MRI arthroscopy is more accurate in diagnosing labral tears, Reason being various anatomical variations and close proximity of labrum to the underlying glenoid cortex which makes it difficult to differentiate as described by Joshua M polster [20].

**Conclusion**

The objective of this article was to correlate the shoulder pathology image on MRI reviewed by arthroscopy during the procedure to see how they compare. So that we can better understand the strength and weakness of MRI. Which is

required to improve imaging interpretations and produce management guiding reports. The present study substantiates that MRI is effective in diagnosing rotator cuff tears, Bankart's tear but not helpful for SLAP lesions. Arthroscopy still remains the gold standard in diagnosing shoulder lesions. MRI and arthroscopy have complimentary roles in diagnosing shoulder pathology.

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