Ultrasound, MRI and Arthroscopic Correlation of Rotator Cuff Tears

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ABSTRACT

Introduction: Rotator cuff tears are amongst the most frequently encountered problems in the shoulder joint. Clinical assessment has limited role and radiological imaging is necessary for confirmation of diagnosis and guiding management. Aim of the research was to study the sensitivity and specificity of ultrasound and MRI as compared to arthroscopy in evaluation of rotator cuff tears.

Material and methods: Ultrasound and MRI evaluation was done in clinically suspected patients of rotator cuff tear on Philips iU22 Ultrasound machine and on 1.5 Tesla GE MRI machine and was confirmed by arthroscopy.

Results: The sensitivity and specificity of diagnosing partial thickness tear was 91.4% / 100% and 88.2% / 100% for ultrasound and MRI respectively. The sensitivity and specificity of MRI for diagnosing full thickness tear was 100% each and that for ultrasound was 90% and 100% respectively. Supraspinatus tendon was the most commonly injured tendon, followed by combined injury of two or more tendons.

Conclusion: Our results show that ultrasound has comparable sensitivity to MRI in detection of rotator cuff tears. As ultrasound is easily available and cost effective, it can be a used as a primary screening modality in patients suspected of having rotator cuff tears. MRI provides additional information like associated labral tears. Arthroscopy remains the gold standard, however intrasubstance partial thickness tears can be missed on arthroscopy but can be diagnosed on MRI and sometimes ultrasound.

Keywords: rotator cuff tear, ultrasound, MRI, Arthroscopy

INTRODUCTION

Rotator cuff tear is the most common cause of shoulder pain and instability. The shoulder joint is a ball and socket variety of joint with wide range of movements in multiple planes where stability is compromised for mobility. The muscles and tendons are subjected to severe strain resulting in tears. In workup of patients with rotator cuff tears the role of imaging is to guide treatment decisions. Several radiological imaging techniques including ultrasound, MRI and arthrography are used to evaluate tears of rotator cuff. Ultrasound of rotator cuff is quick and relatively painless. Its accuracy for diagnosing both partial and full thickness tear is very high. The size of tear can be classified and the findings used as the basis for management decisions. The real time capability of ultrasound in conducting dynamic studies in the shoulder is a great asset. The simplicity, rapidity, low cost, and accuracy makes ultrasound the most effective imaging method for screening of rotator cuff injuries.[1] Now a days, availability of high resolution ultrasound with higher frequency, better beam penetration for musculoskeletal parts and increase in expertise and experience has had a significant impact on reliability and sensitivity of ultrasound for detection of rotator cuff tears.[2,3] MRI is considered superior for detecting both subtle and obvious internal derangement and assessing overall joint structure.[4] MRI gives very accurate soft tissue details. It can provide information about rotator cuff tears such as tear dimensions, tear depth or thickness, shape of tear, muscle retraction, muscle atrophy involvement of adjacent structures, impingement, and provides alternate diagnosis when rotator cuff tears are not seen. The disadvantages of MRI are, long examination time, high cost and limited availability. Arthroscopy is the gold standard method for diagnosing rotator cuff injuries, but that benefit must be set against the invasiveness, use of general anaesthesia and potential discomfort to the patient. The purpose of our study was to compare the diagnostic efficacy of ultrasound and MRI in detection of full thickness and partial thickness rotator cuff tears in symptomatic patients, with arthroscopy used as gold standard.

MATERIAL AND METHODS

This was a prospective study conducted in the department of radio-diagnosis and imaging, P.D.U. Medical College and Civil hospital, Rajkot over a period of 6 months from October 2015 to March 2016. 30 patients who were clinically suspected to have rotator cuff pathology by orthopaedician and referred for ultrasound and MRI evaluation in whom arthroscopy was done were included. The patients were evaluated by

1. Philips iU22 Ultrasound machine
2. 1.5 Tesla GE MRI machine

Imaging parameters performed during MR examination:					
Sequence	**FOV (cm)**	**Slice thickness**	**Interval**	**TR(ms)**	**TE(ms)**
Coronal PDFS	16	4 mm	0.5 mm	1850	32/Ef
Axial T2	16	4 mm	0.5 mm	5367	97/Ef
Coronal T2	16	3.5 mm	0.5 mm	2700	90/Ef
Axial PDFS	16	4 mm	0.5 mm	1967	26/Ef
Sagittal T1	16	4 mm	0.5 mm	110	12/Ef
Sagittal PDFS	16	4 mm	0.5 mm	2400	35/Ef

Inclusion criteria: Patients who were clinically examined and suspected to have a rotator cuff pathology, either acute or chronic, in whom ultrasound or MRI examination revealed a rotator cuff lesion, and for whom arthroscopy was performed.

Exclusion criteria: Patients in whom MRI is contraindicated

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and claustrophobic patients.

Diagnostic criteria for rotator cuff tear on ultrasound: Full thickness tears extend from the bursal surface to the articular surface. Partial thickness tears are focal defects in tendon that involve only the bursal or articular surface or within the substance of the tendon.

Non visualization of tendon, hypoechoic discontinuity of tendon are direct signs of tear. Indirect signs include the double cortex sign[5], sagging peri bursal fat sign, compressibility and muscle atrophy. Cortical irregularity of greater tuberosity, shoulder joint effusion, fluid along biceps tendon and fluid in axillary pouch and posterior recess are the secondary associated signs.

Diagnostic criteria for rotator cuff tear on MRI: Presence of tendon defect filled with fluid is the most direct sign of rotator cuff tear. It appears as hyper intense signal area within the tendon on T2 weighted and proton density fat suppressed sequences. Tendon retraction may also be present.

Indirect signs on MRI are sub deltoid bursal effusion, medial dislocation of long head of biceps tendon, fluid along biceps tendon, and diffuse loss of peri bursal fat planes.

RESULTS

Out of 30 patients, 27 patients were found to have rotator cuff tears on arthoscopy. 26 patients were positive on either ultrasound or MRI. 1 patient with chronic partial thickness tendon tear diagnosed on arthroscopy was missed on both ultrasound and MRI. Out of 27 patients, 25 patients were diagnosed on ultrasound and 25 patients were diagnosed on MRI.

Out of 27 patients, 10 patients were having full thickness tear and 17 patients were having partial thickness tear on arthroscopy. Of the 10 patients with full thickness tears, 9 were positive on ultrasound and all 10 were positive on MRI. Of the 17 patients diagnosed with partial thickness tears, 16 patients were positive on ultrasound and 15 patients were positive on MRI (table-1).

Out of 27 patients, 14 patients were having isolated supraspinatus tendon tear, 2 patients were having isolated infraspinatus tear, 2 patients were having isolated subscapularis tendon tear and 1 patient was having isolated teres minor tear; rest of the 8 patients were having two or more tendon tears (table-2, figure–1,2,3).

DISCUSSION

Shoulder disorders are very common among the general

Rotator cuff pathologies	Number of patients		
	ultrasound	MRI	arthroscopy
Partial thickness tear	16	15	17
Full thickness tear	9	10	10
Other rotator cuff pathologies	1	3	3
Total rotator cuff tears	25	25	27

Table-1: Total number of rotator cuff tears diagnosed on ultrasound, MRI and arthroscopy.

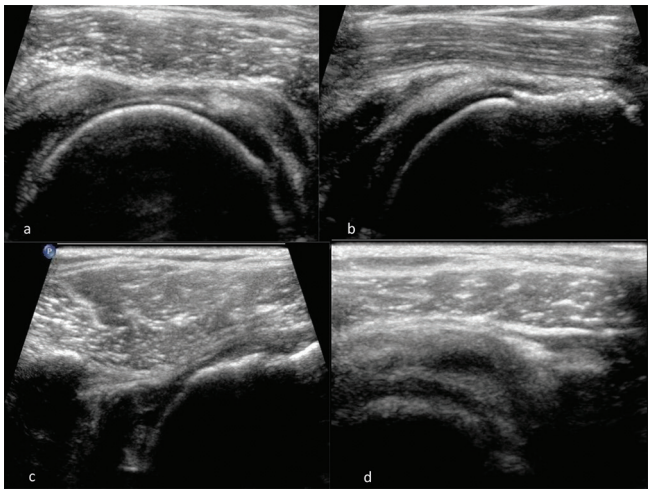

Figure-1: (a) incomplete full-thickness tear of mid part of supraspinatus tendon in short axis view (b) full-thickness tear of supraspinatus tendon with retraction of fibres in long axis view (c) full-thickness tear of subscapularis tendon in short axis view (d) intrasubstance partial thickness tear of supraspinatus in long axis view

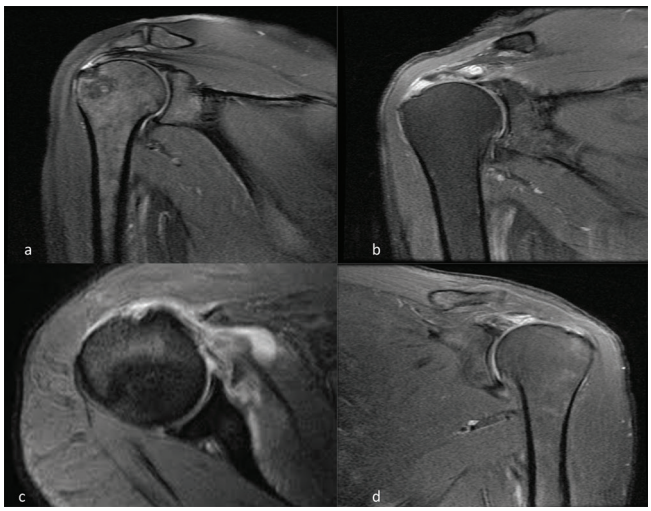

Figure-2: (a) full thickness tear of supraspinatus tendon in coronal PDFS view (b)partial thickness tear of supraspinatus tendon in coronal PDFS view (c) full-thickness tear of subscapularis tendon in axial PDFS view (d) full-thickness tear of supraspinatus tendon with retraction of fibres in corenal PDFS view

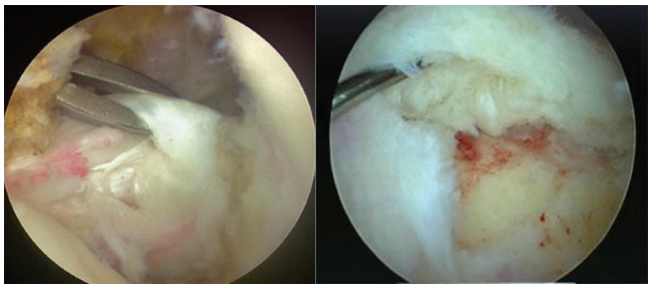

Figure-3: arthroscopic images showing (a) subscapularis tendon tear (b) a large crescent shaped suprapinatus tendon tear

Rotator cuff pathologies	ultrasound		MRI	
	sensitivity	specificity	sensitivity	specificity
Partial thickness tear	94.1%	100%	88.2%	100%
Full thickness tear	90%	100%	100%	100%

Table-2: Sensitivity and specificity of ultrasound and MRI for diagnosis of partial thickness and full thickness rotator cuff tears.

population. The location of shoulder pain is very poor indicator of its pathology[6,7] and the value of clinical assessment of the shoulder is very limited[8] Plain radiography, often used to supplement the clinical examination, is hardly diagnostic for rotator cuff tears. Traditionally arthrography has been used through years to detect rotator cuff tears.[9] Both sonography and Magnetic Resonance Imaging[10,11] have developed as new imaging techniques for shoulder pathologies in the past few decades. The purpose of this study was to evaluate the ability of ultrasound and MRI to detect rotator cuff tears in clinically suspected patients, compared to arthroscopy.

The study shows 94.1% sensitivity and 100% specificity of ultrasound in diagnosing partial thickness tear. The sensitivity and specificity of MRI in diagnosing partial thickness tear was 88.2% and 100% respectively. The sensitivity and specificity of MRI for diagnosing full thickness tear was 100% each and that for ultrasound was 90% and 100% respectively (table 2). The high sensitivity and specificity of ultrasound and MRI in evaluating rotator cuff tears in our study compared to certain other studies[12] may be attributed to sampling bias due to inclusion of only arthroscopicaly proven rotator cuff pathologies in the study. Amongst all tendons, supraspinatus tendon is most commonly injured, followed by combined injury of two or more tendons.

Full thickness tears are very accurately diagnosed on both ultrasound and MRI. Partial thickness tears with only mild thickening of tendon may be missed on MRI and misdiagnosed as tendinosis, while ultrasound can frequently diagnose these tears due to its ability to perform real time dynamic examination. Chronic partial thickness tear can be missed on both ultrasound and MRI.

Ultrasound and MRI have comparable sensitivity and specificity for both full thickness and partial thickness tears. These results, combined with the lower cost and easy availability of ultrasound, suggest that ultrasound may be the most cost effective imaging method for screening of rotator cuff tears. For practitioners without ultrasound expertise, MRI can be used.

Conclusion –

MRI also provides very detailed soft tissue information required for surgical management specifically tendon retraction and status of muscle atrophy/ fatty infiltration. MRI also provides information about associated labral tears which are poorly evaluated by ultrasound and may need surgical management Arthroscopy is the gold standard for diagnosing rotator cuff tears.

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