

Original Research Article

Role of Magnetic Resonance Imaging in rotator cuff pathologies

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Abstract

Background: Stability to the shoulder joint which has great range of motility, is provided by the rotator cuff, the coraco-acromial arch and the glenoid labrum along with the capsule and glenohumeral ligaments. The common disorders involving the rotator cuff tendons include impingement, tendinopathies and tears. Magnetic Resonance Imaging (MRI) has good spatial resolution for identifying tendon edema and tears in the rotator cuff.

Aim and objectives: To describe the MRI characteristics of rotator cuff pathologies. To describe the rotator cuff pathologies in terms of age, gender, symptomatology and predisposing factors among the study population.

Materials and methods: The study was performed in the Department of Radiodiagnosis, NRI General Hospital, Chinakakani, Guntur from September 2015 to August 2017 and comprises of 100 patients with suspected rotator cuff pathologies who were referred for MRI shoulder.

Results: The age distribution of patients with rotator cuff abnormalities was in the range of 21 and 74 years. The most commonly affected was supraspinatus tendon followed by subscapularis and infraspinatus tendons. Among the rotator cuff abnormalities the frequently encountered finding was tendinosis followed by partial tears.

Conclusion: Magnetic Resonance Imaging is very useful in depicting rotator cuff disease in patients with painful, weak or stiff shoulder for prompt and accurate diagnosis.

Key words

MRI, Rotator cuff, Supraspinatus, Infraspinatus, Subscapularis, Teres minor, Tendinosis, Tear, Acromiohumeral distance (AHD).

Introduction

The shoulder joint is an anatomical structure formed by the humerus, clavicle and scapula. Anatomically, the articulation of the large humeral head with the small glenoid cavity confers relatively less joint stability thus making it tremendously versatile. Stability to this joint is provided by the musculotendinous cuff of the shoulder, the coraco-acromial arch and the glenoid labrum along with the capsule and glenohumeral ligaments [1, 2]. Of these, the rotator cuff forms the dynamic stabilizer and the rest are called static stabilizers. The rotator cuff muscles include the supraspinatus, infraspinatus, subscapularis and teres minor. The common disorders involving the rotator cuff tendons include impingement, tendinopathies and tears. MRI has good spatial resolution for assessment of soft tissue, identifying tendon edema and tears in the rotator cuff. It also has additional advantage of providing good multiplanar delineation even without contrast and lacks radiation hazards [3].

Materials and methods

The study was performed in the Department of Radiodiagnosis, NRI General Hospital, Chinakakani, Guntur from September 2015 to August 2017. This study comprised of 100 patients with suspected rotator cuff pathology who were referred for MRI shoulder. The MRI was done on the advice of referring doctor and no patient was made to undergo MRI for the sole purpose of this study.

Inclusion criteria: Patients who were suspected clinically with possible shoulder pathology, referred for MRI evaluation and shown to have rotator cuff tendon abnormalities.

Exclusion criteria: Post-operative patients, known case of rotator cuff lesions on treatment, patients with infective arthritis of shoulder joint, all patients with clinical evidence of rotator cuff lesions in whom a MRI examination was contraindicated were excluded.

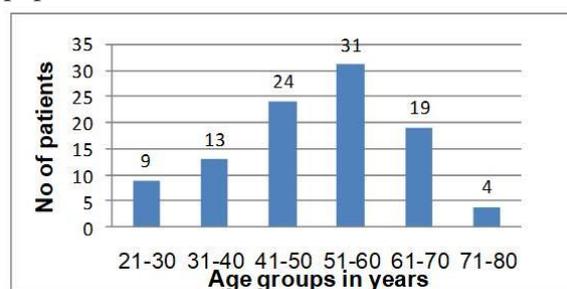
Data acquisition and MRI Protocol: After clinical evaluation, once a patient met the

inclusion and exclusion criteria for this study, he or she underwent the MRI evaluation after giving willful informed consent. All the MRI scans in this study were performed using 1.5 T Signa Excite System (General Electrical medical systems, Milwaukee, USA). Patient was positioned supine with arm in neutral position. Adequate support for head and the limb was provided. A dedicated eight channel High Resolution shoulder coil was used. After obtaining a localizer in all three orthogonal planes, T1 FSE- axial, oblique coronal, T2 FSE - axial, oblique coronal, STIR - oblique coronal, PD FAT SAT - axial, oblique sagittal, oblique coronal and GRE - Axial sequences were obtained.

Results

Hundred cases of rotator cuff diseases as per the inclusion and exclusion criteria were included in the study. The observations in these 100 patients were compiled and analyzed. The age of the patients studied with rotator cuff pathologies ranged from 21 to 74 years (**Figure - 1**). Of these 76(76%) were males and 24 (24%) were females.

Figure - 1: Age wise distribution of the study population.



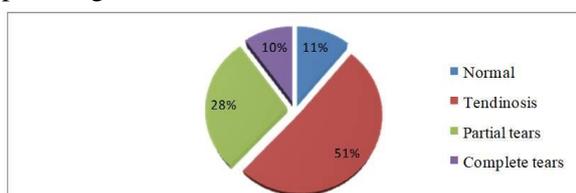
Among patients with age more than 50 years, 23 showed supraspinatus tears as compared to the patients with age less than 50 years among whom only 15 showed tears. Similarly among patients with more than 50 years of age, 29 showed supraspinatus tendinosis as compared to the patients of less than 50 years of age among whom 22 showed tendinosis. Thus in our study tears and tendinosis of supraspinatus tendon appear to be common in older age groups than in younger age groups, with tendinosis being more

commoner than tears in older age groups. Similar results were observed in the subscapularis and the infraspinatus tendons. Patients with rotator cuff diseases presented with pain, stiffness or reduced range of movement and weakness. The most frequent complaint was pain, and was observed in 48 subjects accounting for 48 %.

The pathologies of the rotator cuff tendons comprised of tendinosis and tendon tears. Associated and precipitating factors like acromion shape, acromioclavicular joint osteoarthritis, labral tears and joint effusion were also noted. The most frequently affected tendon was supraspinatus and the least affected was teres minor. In the decreasing order of frequency the other tendons involved were the subscapularis and the infraspinatus. Pathologies were observed in 89 supraspinatus, 54 subscapularis and 24 infraspinatus tendons. All the teres minor tendons were normal.

Of the supraspinatus tendon pathologies, tendinosis was seen in 51 patients, partial tear in 28 and complete tear in 10 patients. Thus tendinopathies and partial tears were the most commonly encountered among abnormalities in the supraspinatus tendons in our study population accounting for 57.30% and 31.46% respectively (Figure - 2).

Figure - 2: Incidence of suprapinatus tendon pathologies.



Partial tears can be further classified as intrasubstance, articular surface and bursal surface partial tears. There were 28 patients with partial tear of supraspinatus. Of these the common type was the articular surface tear in 13 (13 out of 28 = 46.4%), followed by bursal surface tear in 9 (9 out of 28 = 32.1%) and the

least common was the intrasubstance tear seen in 6 patients (6 out of 28= 21.4%).

Figure - 3: Incidence of the subscapularis tendon pathologies.

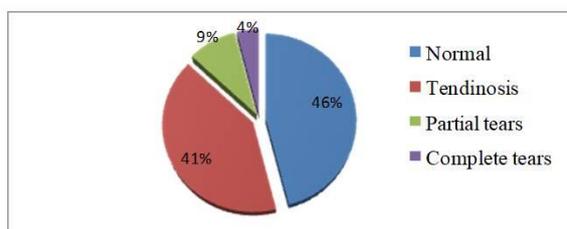


Figure - 4: Incidence of the infraspinatus tendon pathologies.

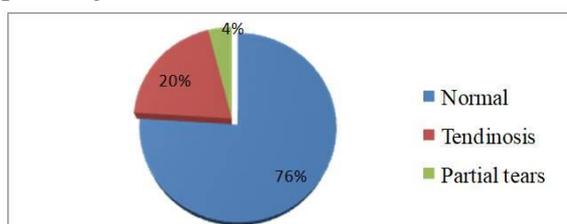


Table - 1: Incidence of the long head of the biceps tendon pathologies.

Biceps tendon	Frequency	%
Normal	68	68
Tendinosis	9	9
Abnormal fluid around tendon	23	23

Table - 2: Incidence of acromion types.

Acromion type	Frequency	%
Type-1(Flat)	36	36
Type-II (curved)	41	41
Type-III (hooked)	21	21
Type-IV (convex)	2	2

Table - 3: Correlation of AHD and supraspinatus tendon pathologies.

AHD	Supraspinatus tendon		
	Normal	Tendinosis	Tears
<7mm	0	0	10
8-10mm	4	42	26
>10mm	7	9	2

Among the subscapularis tendons, tendinosis with no evidence of tear was noted in 41, tear in 13 patients - partial in 9 and complete in 4

patients. Normal subscapularis tendon was noted in 46 patients. Tendinosis was the frequently encountered pathology in the subscapularis tendons (**Figure - 3**).

Among infraspinatus tendons, tendinosis was found in 20 patients (20%) and partial tear in 4 patients(4%). Rest of the patients that is, 76 patients (76%) showed normal infraspinatus tendon. Complete tear was seen in none. Thus the frequent abnormality in the infraspinatus in our study group was tendinosis (**Figure - 4**).

Associated abnormalities in the long head of the biceps tendons were noted in 32 patients. The abnormalities seen in the tendon included: tendinosis in 9 patients, fluid around the tendon with no signal abnormality in the tendon in 23 patients. No biceps tendon dislocations were observed (**Table - 1**).

Acromioclavicular joint was assessed in terms of being normal or degenerative which showed either osteophytes, sclerosis or subchondral cysts. In our study, acromioclavicular joint was found to be normal in 39 patients (39%) and degenerative in 61 (61%) patients. Of these 61 patients with acromioclavicular arthropathy, 21 had tear, 33 had tendinosis and 7 had normal supraspinatus tendon. Thus abnormal supraspinatus tendon was common in patients with acromioclavicular joint arthropathy. Of the 100 patients, type I acromion was seen in 36%, type II in 41%, type III in 21% and type IV in 2%. In our study the most common type of acromion was the type II. Next common was type-I (**Table - 2**).

Of the 100 patients with rotator cuff pathologies, 14 patients had associated superior labral tear, one had posterior labral tear, one had anteroinferior labral tear and one had posterior labral tear with paralabral cyst. Rest of the patients showed no labral abnormality. Joint effusion was noted in 37 out of 100 patients (37%). No effusion was seen in 63 patients (63%). Joint effusion was mild or minimal in 29 (29%) and moderate in 8 (8%).

Figure – 5: PD FAT SAT oblique coronal image showing reduced AHD with complete full thickness tear of supraspinatus tendon at the insertion site with retraction of fibres. There is fluid in the joint cavity and subacromial subdeltoid bursa.

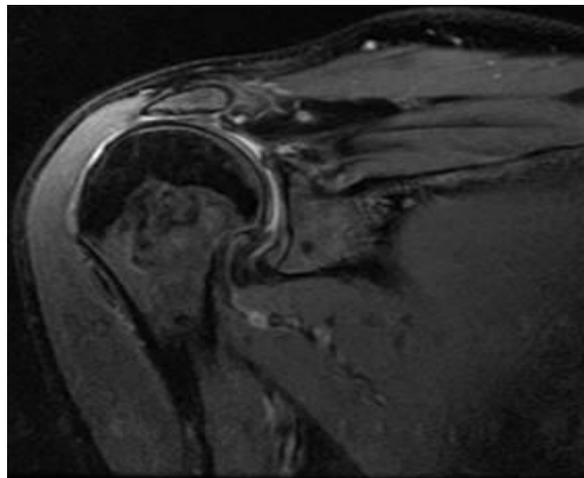
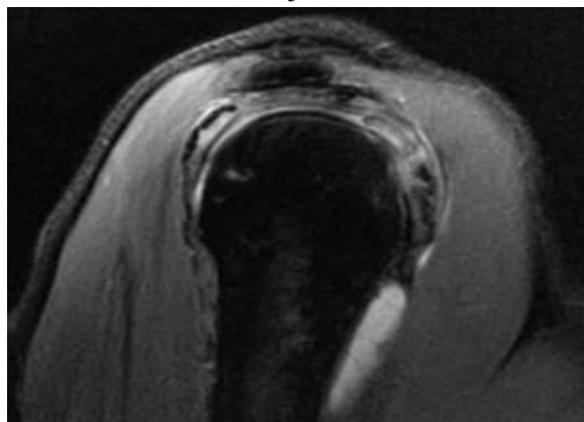


Figure – 6: PD FAT SAT oblique sagittal image showing partial tear of infraspinatus tendon evident by fluid signal. Also subscapularis tendinosis and minimal joint effusion are noted.



The acromiohumeral distance (AHD) was measured between the superior articular surface of the humeral head and under surface of the acromion. The patients were grouped into three categories: more than 10mm, 8-10mm and less than 7 mm. 10 patients had AHD less than 7mm and all 10 patients had abnormal supraspinatus tendon (8 had complete tears and 2 had partial tears). 72 patients had AHD between 8-10mm, of this 68 (94.4%) had abnormal tendons. There were 18 patients in the more than 10mm group,

of this 11 (61%) had abnormal tendons (**Table - 3**). Images of study were as per **Figure – 5 to 7**.

Figure - 7(a): GRE axial image showing partial intrasubstance tear of infraspinatus tendon evident by fluid signal within the tendon.

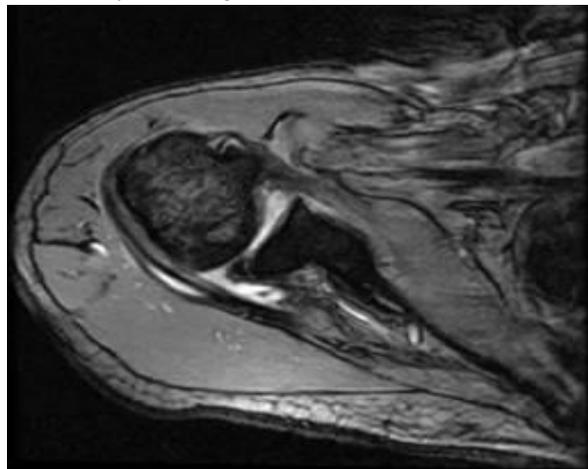
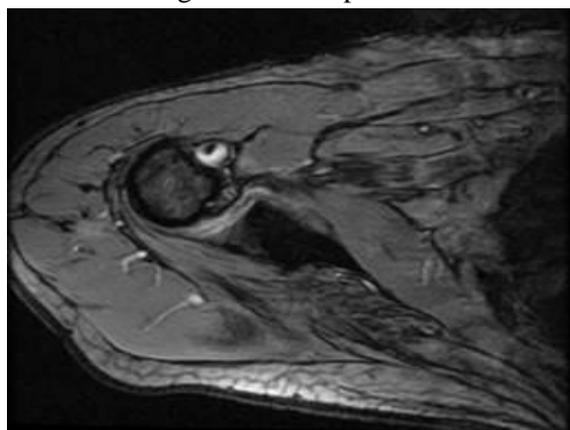


Figure - 7(b): GRE axial image showing fluid around the long head of biceps tendon.



Discussion

In our study the age of the patients with rotator cuff disorders ranged from 21 to 74 years with the peak incidence in fifth and sixth decades of life. In our study tears and tendinosis were common in older age groups than in younger age groups, with tendinosis being more common than tears in older age groups. Similar results were seen in subscapularis and infraspinatus tendons. Higher frequency of tendinosis in younger patients compared to older patients as seen in study conducted by Needell, et al. [4] was not found in our study. This may be due to difference in the lifestyle and demographic characteristics

of the study population.

In our study most commonly affected tendon was supraspinatus followed by subscapularis and infraspinatus. Among 100 patients, pathologies were observed in 89 supraspinatus, 54 subscapularis and 24 infraspinatus tendons. All the teres minor tendons were normal. In a study conducted by Gaurav Kumar, et al. [5] (2017) in 100 patients with suspected rotator cuff pathologies most common abnormal tendon encountered was supraspinatus seen in 81%.

Partial-thickness tears are tears that do not involve the entire thickness of the tendon. On MRI they appear as focal areas of hyperintensity on both short and long TE sequences. This hyperintense signal does not extend through the entire thickness of the tendon. Full thickness tears are ones in which the signal abnormalities appear to traverse through the whole thickness, extending from articular surface to bursal surface on at least one image. This bright signal intensity is related to the presence of fluid secondary to tear. In our study, 38 patients had supraspinatus tears of which 28 patients (73.6%) had partial tears and 10 (26.3%) had full thickness tears. Similarly among subscapularis and infraspinatus tendon tears, partial tears were common. Magdalena Freygant, et al. [6] (2014) in 137 patients with suspected rotator cuff injury found partial tendon tear is more common than complete tear. Partial tears can be further classified as intrasubstance tear when it does not involve the surfaces, articular surface partial tear when the humeral side of the tendon is involved and bursal surface partial tear when the acromial side is involved. In our study there were 28 patients with partial tear of supraspinatus. Of these the common type was articular surface tear seen in 13 patients (46.4%), followed by bursal surface tear seen in 9 patients (32.1%). Jacobson, et al. [7] in a study of 50 cases with rotator cuff tears with surgical correlation reported 10 cases of articular surface tears out of the total 15 partial tears.

Bigliani and colleagues [8] classified acromion

as type I to IV, namely flat, curved inferior surface, hooked and convex near the distal end, respectively and in a study found 80% correlation between type II and type III acromion with rotator cuff disease. In the present study most common acromion was type II. Abnormal tendons were seen with all types, most commonly with type II and III. More than 95% of Type-II and all (100%) of type-III were associated with abnormal tendons. Acromioclavicular osteophytes from the inferior surface of the joint have also been associated with supraspinatus tendon tears. In our study acromioclavicular joint was found to be normal in 39 patients (39%) and degenerative in 61 patients (61%). Of these 61 patients with acromioclavicular arthropathy, 21 had tears, 33 had tendinosis and 7 had normal tendon. Freygang, et al. [6] in a study of 137 patients with rotator cuff tendon pathology found 58 (55%) patients with acromioclavicular osteoarthritis.

Tears of the rotator cuff, specifically, the subscapularis tendon, have been associated with medial subluxations or dislocations of the biceps tendon as well as with biceps tendinopathy. Chen, et al. [9] in a study of 176 patients with rotator cuff pathologies found that among the single tendon rotator cuff tears, the incidence of biceps tendon pathology was seen in the 71% cases. In our study of 100 patients with rotator cuff disease, 32 patients (32%) had abnormal biceps tendon. In a study conducted by Glenn, et al. [10] on 41 patients with arthroscopy proven labral tear, 15 had full-thickness rotator cuff tears, 13 had partial-thickness tears, and 13 had normal appearing rotator cuff tendons. In the present study, out of 100 patients 17 patients showed abnormal glenoid labrum. This smaller number may be because of less sensitivity of Magnetic Resonance Imaging without arthrogram in detecting labral tears.

Decrease in the acromiohumeral space can cause impingement on the cuff tendons especially supraspinatus leading to degeneration/ tendinosis and tears. In our study, 10 patients had AHD less than 7 mm and all had abnormal supraspinatus

tendon. Saupe, et al. [11] conducted a study in 63 patients where the incidence of supraspinatus tears was less in group III (AHD > 10 mm), and group I (AHD < 7 mm) had highest incidence of tears.

Conclusion

Magnetic Resonance Imaging is very useful in depicting rotator cuff disease in patients with painful, weak or stiff shoulder for prompt and accurate diagnosis along with the predisposing factors like acromion type, reduced acromiohumeral distance and other associated features like biceps tendon abnormality and effusion.

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