

**ORIGINAL RESEARCH**

# MRI Characteristics Of Rotator Cuff Pathologies

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## ABSTRACT

**Background:** Rotator cuff tears may be partial or full thickness. Partial-thickness tears are depicted as focal defects that are either intratendinous or limited to one surface without disrupting the entire thickness of the tendon. The present study was conducted to describe the MRI Characteristics Of Rotator Cuff Pathologies.

**Material & Methods:** The present retrospective descriptive study was performed at the Dept of Radio diagnosis, Pacific Medical College and Hospital, Bhilo ka Bedla, Udaipur to describe magnetic resonance imaging features of rotator cuff pathologies. 50 Patients having rotator cuff pathologies in the MRI examination were studied. All the MRI scans in this study were performed using T MRI scanner (Siemens magnetom essenza 1.5T). The data was compiled and analysed.

**Results:** The most frequently affected tendon being supraspinatus and the least affected being teres minor. Partial tear and tendinopathy were the most commonly encountered abnormalities in the Supraspinatus tendons in this study population accounting for 40% and 30% respectively. There were 15 patients with partial tear of Supraspinatus, of these the common type was articular surface tear in 10(66.6%), followed by bursal surface tear 4(26.6%) and the least common was the intrasubstance tear in 1 (6.6%). Tendinosis or tendinopathy is the frequently encountered pathology in the subscapularis tendons. Associated abnormalities in bicipital tendons were noted in 19(44.1%) patients. The common abnormal finding seen in relation to the biceps tendon in a rotator cuff disease was tenosynovitis followed by fluid around the tendon. Of the 50 patients examined in this study, type I Acromion was seen in 11(22%) while type II Acromion was seen in 25(50%) and type III in 14(28%) patients. In our study joint effusion was found in 18(36%) and bursal fluid noted in 19(38%). Acromio- clavicular joint degeneration/ hypertrophy has been noted in 27 (54%) patients. In our study only 2(4%) showed normal supraspinatus tendon in patients with less than 10mm AHD. Twenty eight patients (56%) had coracohumeral distance more than 10mm.

**Conclusion:** The study concluded that the most frequently affected tendon being supraspinatus and the least affected being teres minor. Partial tear and tendinopathy were the most commonly encountered abnormalities. Tendinosis or tendinopathy is the frequently encountered pathology in the subscapularis tendons. The common abnormal finding seen in relation to the biceps tendon in a rotator cuff disease was tenosynovitis Acromio- clavicular joint degeneration/ hypertrophy has been noted in 54% patients. Only 4% showed normal supraspinatus tendon in patients with less than 10mmAHD and 56% had coracohumeral distance more than 10mm.

**Keywords:** Supraspinatus, tendinopathy, Acromio- clavicular joint, MRI

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## INTRODUCTION

Disorders of the rotator cuff are the most common causes of a painful shoulder. These disorders include impingement, partial and full-thickness rotator cuff tears, calcific tendinitis, and coracoid

impingement. The pathomorphological changes of the rotator cuff are probably multifactorial, including intrinsic and extrinsic factors. Important etiologic considerations include age-related degeneration, acute trauma, repetitive microtrauma,

anatomic impingement, and secondary impingement associated with either glenohumeral instability or capsular contracture. Other pathologic entities that may represent additional sources of pain in association with rotator cuff pathology include acromioclavicular arthropathy, biceps tendinitis, and frank rupture of the long head of the biceps tendon.<sup>1</sup> Julius Neviasser in 1954 proposed that ruptures of one or more components of the rotator cuff usually occur in one of three ways: There may be a rupture following a history of injury without a dislocation or a fracture, a rupture may occur following a dislocation of the shoulder and rupture of the cuff may follow a dislocation of the shoulder with a fracture of the greater tuberosity of the humerus.<sup>2</sup> 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.<sup>3</sup> The present study was conducted to describe the MRI Characteristics Of Rotator Cuff Pathologies.

## MATERIAL & METHODS

The present descriptive study was performed at the Dept of Radio diagnosis, Pacific Medical College and Hospital, Bhilo ka Bedla, Udaipur for period of two years to describe magnetic resonance imaging features of rotator cuff pathologies. Patients who were found to have rotator cuff pathologies in the MRI examination were studied.

This consists of 50 patients with Rotator cuff lesions detected on magnetic resonance imaging of the shoulder joint. The MRI was done on the advice of the referring doctor and no patient was made to undergo MRI for the sole purpose of this study. This dissertation evaluates the magnetic resonance imaging characteristics of the Rotator cuff lesions that were detected in these patients. Patients who were suspected clinically with possible shoulder pathology, referred for MRI evaluation and shown to have rotator cuff tendon abnormalities were included in the study. Post operative patients, known case of rotator cuff lesions on treatment, all patients with clinical evidence of rotator cuff lesions in whom a MRI examination is contraindicated were excluded. e.g. Patients with any electrically, magnetically or mechanically activated implants (including cardiac pacemakers, biostimulators, neurostimulators, cochlear implants, and hearing aids) were excluded from the study. After clinical evaluation, once a patient satisfied the inclusion and exclusion criteria for this study, he or she would undergo the MRI evaluation after giving consent. All the MRI scans in this study were performed using 1.5 T MRI scanner (Siemens magnetom essenza 1.5T)

MRI Protocol MRI protocol consisted of the following Patient is positioned in supine position with external rotation of the arm. Adequate support for head and the limb is provided. Dedicated surface coil (Helmholtz pair) for shoulder is used.

Technique for MRI of shoulder: After obtaining localizer in all three orthogonal planes, following sequences are **obtained**:

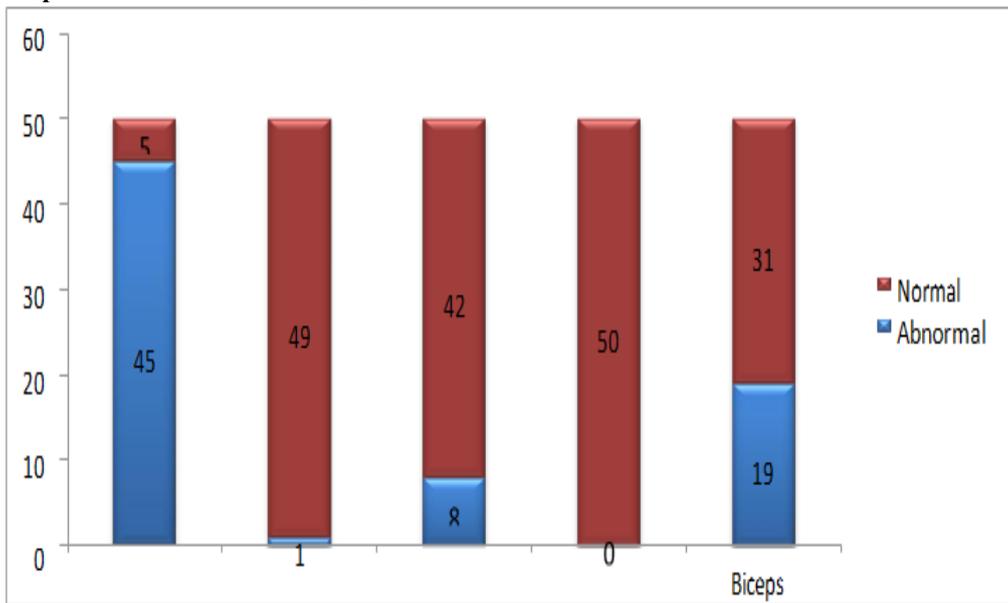
1. Axial STIR & PD FATSAT
2. Coronal T1, GRE and T2 FATSAT
3. Sagittal T2 FATSAT.

	T1W	T2- FATSAT	GRE	STIR	PD FATSAT
<b>TR</b>	400	3400	350	4900	280
<b>TE</b>	10	63	13	20	40
<b>Matrix</b>	256 x 160	256 x 224	384 x 192	320 x 192	256 x 224
<b>No of excitations</b>	2	3	2	2	3
<b>Thicknessmm</b>	4	4	4	3	3
<b>Section spacing mm</b>	0.0	0.0	0.0	1.5	1.5
<b>FOV</b>	18	16	18	17	17
<b>Imagingtime min</b>	2min14 sec	2min40sec	mins12sec	4min20sec	3mins15sec

Table: Following parameters were used during acquisition of images The data was compiled and analyzed

**RESULTS**

**Figure 1: Spectrum of muscle involved**



The most frequently affected tendon being supraspinatus and the least affected being teres minor. In the decreasing order of frequency the other tendons involved are subscapularis, biceps and the infraspinatus. Of the pathologies of the supraspinatus tendon, tendinosis was seen in 20 patients (40%) partial tear in 15 (30%) and complete tear in 10 (20%). Thus partial tear and

tendinopathy are the most commonly encountered abnormalities in the Supraspinatus tendons in this study population accounting for 40% and 30% respectively. There were 15 patients with partial tear of Supraspinatus, of these the common type was articular surface tear in 10(66.6%), followed by bursal surface tear 4(26.6%) and the least common was the intrasubstance tear in 1 (6.6%

**Table 1: Various pathologies of supraspinatus involved**

Supraspinatus pathology	No. of patients	Percentage
Normal	5	10
Tendinosis	20	40
Partial tear	15	30
Full thickness tear	10	20
Total	50	100

**Table 2: Types of Partial tear of Supraspinatus**

Type of partial tear	No of patients	Percentage
Articular surface	10	66.67
Bursal	4	26.6
Intratendinous	1	6.67
Total	15	100

**Table 3: Subscapularis tendon pathology**

Subscapularis pathology	No of patients	Percentage %
Tendinosis	5	10
Partial tear	2	4
Full thickness tear	1	2
Normal	42	84
Total	50	100

**Table 4: Involvement of biceps tendon pathology**

Biceps tendon pathology	No of patients	Percentage
Normal	31	62
Tendinosis	11	22

<b>Fluid around the joint</b>	7	14
<b>Tear (partial/ full thickness)</b>	1	2
<b>Total</b>	50	100

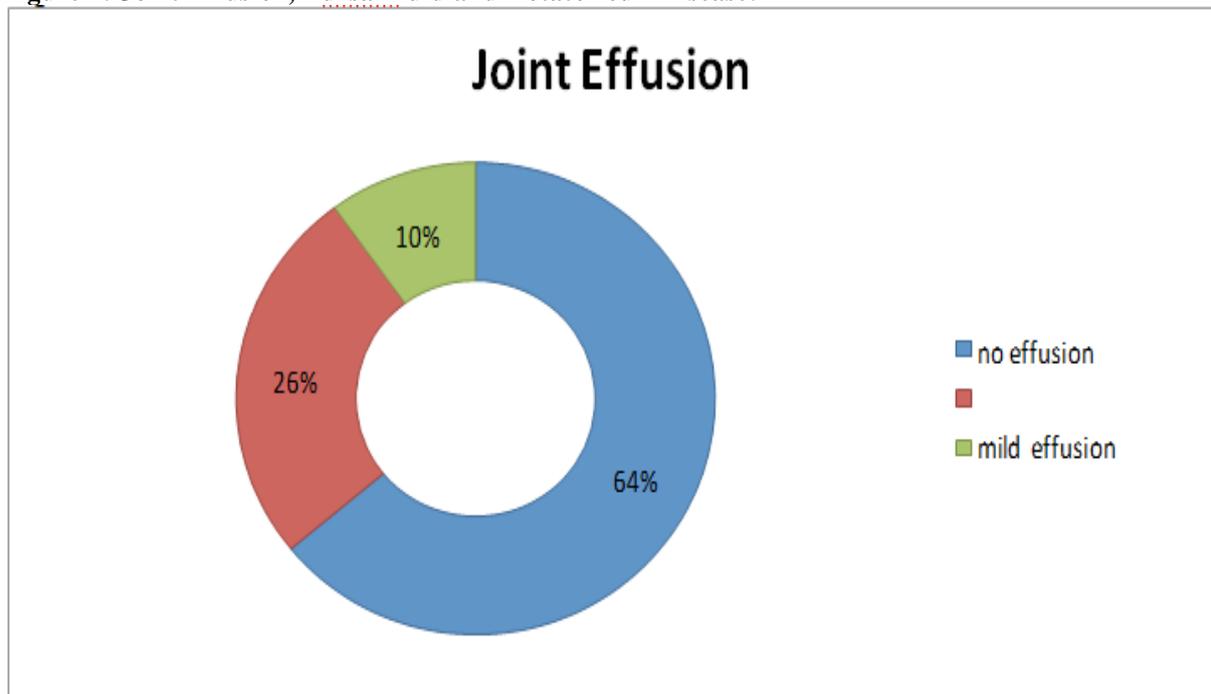
**Table 5: Types of acromion in study group**

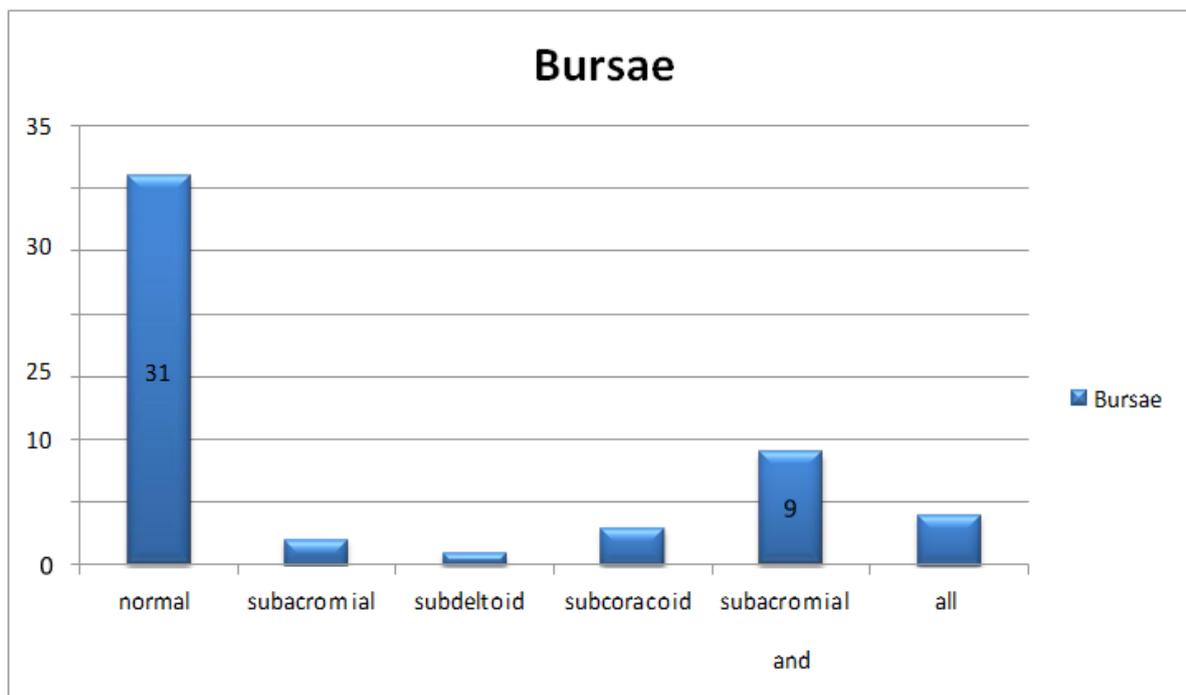
<b>Types of acromion</b>	<b>No of patients</b>	<b>Percentage</b>
<b>Type I</b>	11	22
<b>Type II</b>	25	50
<b>Type III</b>	14	28
<b>Type IV</b>	0	0
<b>Total</b>	50	100

Among the abnormalities of subscapularis, tendinosis with no evidence of tear was noted in 5 (10%), tear noted in 3 (6%), partial in 2 (4%) and complete in 1 (2%). Normal subscapularis tendon noted in 84 %. Tendinosis or tendinopathy is the frequently encountered pathology in the subscapularis tendons. No isolated involvement of Subscapularis was seen. Associated abnormalities in bicipital tendons were noted in 19(44.1%) patients. The abnormalities seen in the tendon included tendinosis in 11 (57.89%), fluid around the tendon with no signal abnormality in the tendon in 7 (36.8%) and tear of the tendon in 1 (5.2%). Thus the common abnormal finding seen in relation to the biceps tendon in a rotator cuff disease in our study group was tenosynovitis followed by fluid around the tendon. Of the 50 patients examined in this study, type I Acromion

was seen in 11(22%) while type II Acromion was seen in 25(50%) and type III in 14(28%) patients. Type IV was not seen in any of shoulder examined. In our study joint effusion was found in 18(36%) and bursal fluid noted in 19(38%). Of the 18 patients with effusion 11(61.1%) had tears and 7 (38.9%) had tendinosis. Of the 19 patients with bursal fluid, 11(57.9%) showed tear in the cuff tendon and 8 (42.1%) showed tendinosis in the cuff tendon. Acromio- clavicular joint degeneration/ hypertrophy has been noted in 27 (54%) patients. 25 (50%) patients had degenerative changes and subacromial spurs. while 2(4%) patients had fibrous outgrowth/hypertrophy of the capsule. Of these 27 patients in our study with acromioclavicular arthropathy, 10(37.3%) had tear, 15 (55.5%) had tendinosis and 2 (7.4%) had normal tendon.

**Figure 2: Joint Effusion, Bursal fluid and Rotator cuff Disease:**





**Table 6: Changes in acromioclavicular joint**

Acromio clavicular joint changes	No of patients	Percentage
Normal	23	46
Degenerative changes/spurs/osteophytes	25	50
Hypertrophic changes	2	4
Total	50	100

**Table 7: Relationship of acromiohumeral distance with supraspinatus tendon**

Acromio humeral distance/ supraspinatus pathology	Normal	Tendinosis	Partial thickness tear	Full thickness tear	Total
≤ 7 mm	0	7	6	7	20
8- 10 mm	2	8	8	3	21
>10 mm	3	5	1	0	9
Total	5	20	15	10	50

**Table 8: Relationship of coracohumeral distance and subscapularis tendon**

Coracohumeral distance/ subscapularis	Normal	Partial tear	Complete tear	Tendinosis	Total
< 6mm	0	1	1	3	5
6-8 mm	4	1	0	1	6
8-10mm	10	0	0	1	11
>10mm	28	0	0	0	28
Total	42	2	1	5	50

In our study only 2(4%) showed normal supraspinatus tendon in patients with less than 10mm AHD. In patients with AHD less than 7mm, abnormal Supraspinatus were seen 20/50 (40%) patients with tears in 13(65%) and tendinosis in 7 patients (35%). In patients with AHD between 8-10mm, 21 (42%) patients had abnormal tendon of which 11 (56.2%) had tear. Twenty eight patients (56%) had coracohumeral distance more than 10mm. Five (10%) had coracohumeral distance less than 6 mm, of

these all (100%) had abnormal Subscapularis tendon. Six (12%) had coracohumeral distance between 6 and 8 mm, of these 4(8%) had normal tendons and 2(4 %) has abnormal tendons. In the coracohumeral distance between 8 10 mm group there were 11 (22%) patients and out of them 1(2%) had abnormal tendon

**DISCUSSION**

MRI can demonstrate the rotator cuff excellently including the subacromial portion, which is hidden

from view on ultrasonography. In this study, 50 patients with rotator cuff disorders were included. All the imaging was done using a Siemens magnetom essenza 1.5T Tesla machine in the department of Radio-diagnosis, Pacific Medical College and Hospital, Bhilo ka Bedla, Udaipur for period of two years to describe magnetic resonance. Spectrum of rotator cuff disorders like impingement, tendinosis and partial and full thickness tears, along with types of Acromion, acromial orientation, Acromio- Clavicular joint arthropathy were analysed in the study. Depalma<sup>4</sup> found even higher incidence of partial tears. In his study of 96 specimens aged 18 to 74, 37% were found to have partial tears. Cadaver studies have consistently shown that partial thickness tears are more common than full-thickness tears.<sup>5</sup> Full thickness tears are more commonly seen in supraspinatus. In this study supraspinatus tendon was the most commonly involved among rotator cuff in 45 out of 50 patients (90%). Among these tears were seen in 25 patients (15 partial tears and 10 full thickness tears.). Tendinosis/Tendinopathy was seen in 25 patients. This was well correlated with the previous studies and literature available. Walz DM et al 2006<sup>6</sup> stated that the most commonly affected tendon was Supraspinatus followed by Subscapularis and Infraspinatus. Partial thickness tears were seen in 19/50 patients in which supraspinatus were involved in 15 patients. (30%). Articular surface of tendon was most commonly involved in 10/15 patients (66.6%), next was bursal side partial thickness tears with 26% involvement. (4/15 patients). Least commonly injured were intratendinous type tears. (7%). Among the three subtypes of partial tear, articular tears are two to three times more common than Bursal tears. This is supported by various studies. Itoi E<sup>7</sup> studied incomplete tears in 36 patients in which deep /articular surface tears were most commonly involved (23), next were superficial/bursal (12) followed by, intratendinous (three). In our study tendinosis/tendinopathy was seen in 36 patients (72%) out of which supraspinatus most commonly affected tendon (40%) was followed by biceps and subscapularis. Various intrinsic and extrinsic causes have been attributed to tendinopathy and impingement syndrome. Li and co-workers<sup>8</sup> studied the MR appearance of tears of the subscapularis tendon and assessed the association of subscapularis tears with other rotator cuff tears and injuries of the biceps tendon. In their study 2% of rotator cuff tears involved the subscapularis, 27% were partial and 73% were complete tears. Tears were best seen in the sagittal oblique plane. Almost all subscapularis tears in this study were an extension of typical rotator cuff tears: supraspinatus 79%, extending into infraspinatus tears in 56% and into teres minor tears in 4% (two patients). Bicipital dislocations

were seen in 49%, and three complete tears of the biceps(7%) were noted as well. In our study only 1 case of partial tear was seen which was related with massive supraspinatus and subscapularis tendon tear. No involvement of teres minor was seen. Associated abnormalities in bicipital tendons were noted in 19(38%) patients. The abnormalities seen in the tendon included tendinosis in 11 (22%), fluid around the tendon with no signal abnormality in the tendon in 7 (14%) and tear of the tendon in 1 (2%). Thus the common abnormal finding seen in relation to the biceps tendon in a rotator cuff disease in our study group was tenosynovitis followed by fluid around the tendon. (Erickson SJ et al 1992).<sup>9</sup> Of the 50 patients examined in our study, type I Acromion was seen in 11(22%) while type II Acromion was seen in 25(50%) and type III in 14(28%) patients. Type IV was not seen in any of shoulder examined. In this study the common type of acromion is the type II or curved Acromion. In this study it was found 78% of patients (39 out of 50) had either type II or III acromion or spurs/osteophytes in the acromion. Of these patients 24(61.5%) had tears (partial and complete), 12(30.7%) had tendinosis and 3 (7.6%) had normal supraspinatus tendon. Thus in this study abnormal tendons were common with type II /III acromion. 10 out of 14 (71.4%) type 3 acromion were associated with tears. This was consistent with the literature available. Bigliani LU et al et al found the incidence of Acromion types as Type 1 acromion occur in 25%; type 2 in 61%; and type 3 in 14% of patients. Type 4 acromions occur in 7% of the general population.<sup>10,11</sup> Acromio- clavicular joint degeneration/ hypertrophy has been noted in 27 (54%) patients. 25 (50%) patients had degenerative changes and subacromial spurs. while 2 (4%) patients had fibrous outgrowth/hypertrophy of the capsule. Of these 27 patients in our study with acromioclavicular arthropathy, 10(37.3%) had tear, 15 (55.5%) had tendinosis and 2(7.4%) had normal tendon. Thus abnormal tendon was common in patient with AC joint arthropathy and tear being more frequent. Hijioka et al found degenerative changes in subacromial surface in 96 specimens out of 160 shoulders examined.(60%) and found significant level of correlation between severity of rotator cuff and subacromial surface.<sup>12</sup> In our study joint effusion was found in 18(36%) and bursal fluid noted in 19(38%). Of the 18 patients with effusion 11(61.1%) had tears and 7 (38.9%) had tendinosis. Of the 19 patients with bursal fluid, 11(57.9%) showed tear in the cuff tendon and 8 (42.1%) showed tendinosis in the cuff tendon. Thus presence of joint effusion or bursal effusion is a marker of abnormal cuff tendon especially tears. Various studies have concluded that bursal and joint fluids have low sensitivity and high specificity in detecting rotator cuff tears.<sup>13,14</sup> In our study only

2(4%) showed normal supraspinatus tendon in patients with less than 10mm AHD. In patients with AHD less than 7mm, abnormal Supraspinatus were seen 20/50 (40%) patients with tears in 13(65%) and tendinosis in 7 patients (35%). No normal Supraspinatus was seen. In patients with AHD between 8-10mm, 21 (42%) patients had abnormal tendon of which 11 (52.4%) had tear. The findings were similar to that of previous studies. Saupé et al 2006 in a study<sup>15</sup> showed that reduced acromiohumeral distance was associated with rotator cuff tears and rotator cuff muscle degeneration. In that study 63 patients were divided in to three groups according to the acromiohumeral distance with age and gender matched controls – group I less than 7 mm, group II 8-10mm and group III more than 10mm. They found that reduced acromiohumeral distance is a reliable sign of rotator cuff tear. More than 90% of patients with an acromiohumeral distance  $\leq 7$  mm had a full-thickness tear of the supraspinatus tendon, and 67% had a full-thickness tear of the Infraspinatus tendon. 58% of patient had tear with acromio humeral distance between 8- 10mm. In our study patients were classified into groups according to coracohumeral distance as less than 6mm, 6- 8mm, 8-10mm and more than 10 mm. Twenty eight patients (56%) had coracohumeral distance more than 10mm. Five (10%) had coracohumeral distance less than 6 mm, of these all (100%) had abnormal Subscapularis tendon. Six (12%) had coracohumeral distance between 6 and 8 mm, of these 4(8%) had normal tendons and 2(4 %) has abnormal tendons. In the coracohumeral distance between 8 -10 mm group there were 11 (22%) patients and out of them 1(2%) had abnormal tendon. In study by Nove-Josserand et al 1999, in 206 patients found a strong correlation between a narrowed coracohumeral distance and subcoracoid space and large rotator cuff tears.<sup>16</sup>

## CONCLUSION

The study concluded that the most frequently affected tendon being supraspinatus and the least affected being teres minor. Partial tear and tendinopathy were the most commonly encountered abnormalities. Tendinosis or tendinopathy is the frequently encountered pathology in the subscapularis tendons. The common abnormal finding seen in relation to the biceps tendon in a rotator cuff disease was tenosynovitis Acromioclavicular joint degeneration/ hypertrophy has been noted in 54% patients. Only 4% showed normal supraspinatus tendon in patients with less than 10mm AHD and 56% had coracohumeral distance more than 10mm.

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