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The spectrum of MRI findings in painful shoulder: A prospective study of 81 cases

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Abstract

Background: Shoulder MRI is now considered the standard among the imaging methods to diagnose the etiology of shoulder pain as MRI allows the direct visualization of the rotator cuff tendons, their tears and abnormalities, their relationship to the undersurface of the acromion and the acromioclavicular (AC) joint and also identifies tears of labro-ligamentous complex.

Objective: The purpose of this study was to highlight the MRI spectrum of various non-infective, non-neoplastic pathologies of shoulder joint in patients presenting with pain and to analyse the results statistically.

Materials & Methods: This prospective cross-sectional study was conducted on 81 patients in the age group of 16 to 72 years with the complaints of shoulder pain with or without associated instability and restricted mobility using conventional 1.5 T MRI. Informed consent was taken from all the participants.

Results: In our study, Rotator cuff tear was the most common lesion noted in 85% cases, out of which the predominant lesion was full-thickness supraspinatus tear, in 29.6% cases. Rotator cuff tendinosis & impingement syndrome were the second & third most common lesions encountered on MRI in painful shoulder, observed in 77.7% & 39% of the patients respectively. 49% cases showed lesions of both rotator cuff & rotator interval, However only 3% had isolated involvement of rotator interval. 42% had MRI diagnosis of labro-ligamentous tears with bankart lesion & its variants accounted maximum (25%) and its co-occurrence with hill-sachs defect noted in 81% cases.

Conclusion: This study concludes that MRI is well accepted, non-invasive imaging modality and can evaluate the patients with shoulder pain efficiently due to its excellent soft tissue contrast and multiplanar acquisition. It also suggests that besides rotator cuff tears, the infrequent but important shoulder pathologies like tears of rotator interval and labro-ligamentous complex can also be detected on conventional MRI with thorough observation.

Keywords: Painful shoulder; magnetic resonance imaging; rotator cuff tears; labro-ligamentous tears; hypertrophied acromioclavicular joint; impingement.

Introduction

Shoulder pain is the third most common cause of musculoskeletal pain after low backache and cervical pain. The reported annual incidence of shoulder pain in primary care is 14.7 per 1000 patients per year with a lifetime prevalence of up to 70% [1, 2].

Rotator cuff disorders like tears & impingement are considered to be among the most common causes of shoulder pain and disability [3]. Two types of impingement attributes to shoulder pain- Extrinsic and Intrinsic. Extrinsic impingement is a common cause of orthopaedic evaluation for shoulder pain and occurs because of mechanical compression from the hooked acromion, hypertrophied acromioclavicular joint and thickened coracoacromial ligament. Intrinsic impingement is relatively uncommon and occurs as a result of extreme abduction and external rotation, which can lead to entrapment of the supraspinatus and/or the infraspinatus tendons between the glenoid [4]. Other causes of pain can be soft tissue injuries secondary to trauma or dislocation (like labral tears, ligament tears/sprain), bursitis, arthritis and adhesive capsulitis.

As shoulder joint is a ball and socket joint which is formed by articulation between the humeral head and shallow scapular glenoid fossa. This disparity gives the glenohumeral joint not only the greatest mobility but also makes this joint particularly vulnerable to dislocation which may cause tear/avulsion of RC tendons, glenoid labrum & ligaments attributing to shoulder pain.

Dynamic stabilizers of the joint, including the rotator cuff muscles, alone are insufficient to maintain normal glenohumeral location and function [5]. Joint stability also depends on the passive constraints provided by especially the glenoid rim, glenoid labrum, and glenohumeral ligaments [6]. Any abnormality or disruption of dynamic and passive stabilizers of the shoulder may lead to pain.

Though the rotator interval is a small triangular area in the anterosuperior aspect of the shoulder, but an important region of the shoulder with respect to normal function. It includes the extra-articular coracohumeral ligament (CHL), the superior and middle glenohumeral ligaments (SGHL and MGHL, respectively), the long head of the biceps tendon (LHBT), and a thin layer of capsule that fills the capsular openings in the RI region [7].

In the setting of shoulder pain, abnormal appearing radiograph, a nonspecific history and clinical findings can be a difficult diagnostic dilemma for orthopaedicians. MRI is a valuable tool in the evaluation of shoulder pathologies because it enables assessment of labro-ligamentous complex, rotator cuff tendons, extra-articular soft tissues, and the osseous structures that can be affected by shoulder disease. Thus in the patients with shoulder pain, MRI can be a deciding tool for the surgeons that which patients will get benefit from the surgery.

The present study was done to see the spectrum of non-infective, non-neoplastic shoulder pathologies in patients of shoulder pain who were referred for MRI in the Radiodiagnosis department of our institute.

Aims and Objectives

1. To determine the spectrum of various non-infective & non-neoplastic pathologies of the shoulder joint using MRI in patients presenting with shoulder pain.
2. To analyse the data of the patients statistically.

Materials and Methods

This was a prospective cross-sectional study that included eighty one patients of both genders who were referred to the Radiodiagnosis department of our tertiary institute for MRI because of shoulder pain with or without associated instability and restricted mobility. The study was conducted over a period of one year from July 2018 to July 2019.

Exclusion criteria

1. Patients with active joint infection.
2. Patients with known or suspected neoplastic pathology.
3. Patients with past history of shoulder surgery.
4. Patients having contraindications for MRI like metallic implants, pacemaker, claustrophobia etc.
5. Patients who were not willing to give consent to become part of the study.

MR technique and protocol

Relevant clinical history, physical examination, investigations and written consent of all the patients were taken prior to MRI examination. Patients who met the inclusion criteria were subjected to MRI Shoulder on Philips Achieva superconducting magnetic unit with field strength of 1.5 Tesla using dedicated surface coils.

The MR imaging protocol followed for the study consisted of axial T2W, axial T2 SPIR, T1W oblique coronal, STIR oblique coronal, T2W oblique sagittal and PD SPAIR oblique sagittal sequences. No medication/IV or

intraarticular contrast were used in the study.

The images were analysed by at least two senior radiologists with minimum 5 years of experience in interpreting MRI scans of the shoulder.

Findings of Rotator cuff tears on MRI were classified on the basis of

1. Full-thickness tear (with/without retraction).
2. Partial-thickness tear (articular, intrasubstance or bursal side).

Partial thickness supraspinatus tears were further sub-classified into:

1. PASTA lesion (Partial articular-side supraspinatus tendon avulsion)
2. Reverse PASTA lesion/ Bursal-side supraspinatus tendon avulsion
3. CID (Concealed interstitial delamination)

Results: In this cross-sectional study of 81 patients in the age group of 16 to 72 years who presented in our hospital with shoulder pain with or without restricted mobility and underwent MRI revealed that maximum numbers of cases (33.0%) were in the age group of 21-30 yrs and on the right side. There were 47 males and 34 females that gave the ratio of 1.4:1 depicting insignificant difference in sex group. Patients were distributed on the basis of involvement of rotator cuff & rotator interval as shown in pie diagram. Further categorisation of RC & RI pathologies is depicted in Table 1 & bar chart 1 respectively. Distribution of labro-ligamentous tears is represented by bar chart 2. Overall MRI spectrum of painful shoulder lesions is described in Table 2.

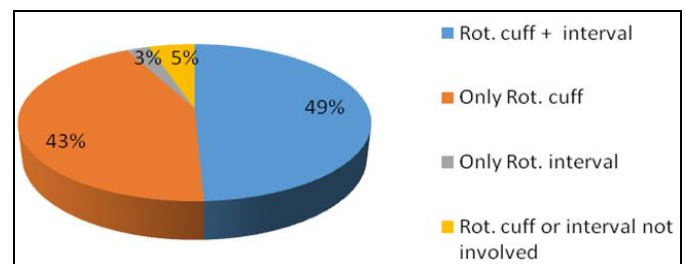
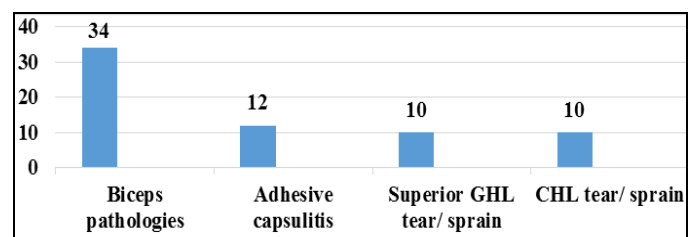


Fig 1: Pie diagram showing distribution of the patients on the basis of involvement of rotator cuff & rotator interval

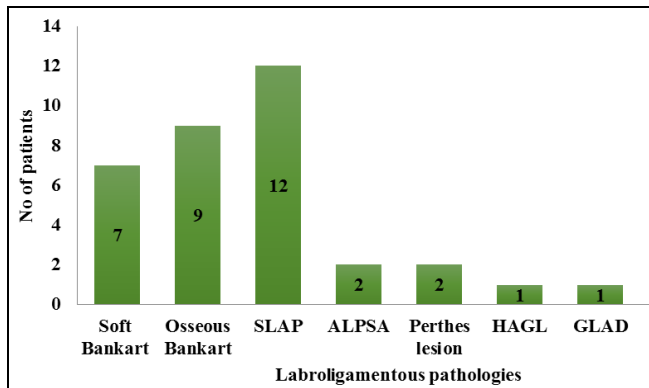
Table 1: Distribution of patients on the basis of various rotator cuff tendons pathologies

| | Full thickness tear | Partial thickness tear | Tendinosis |
|------------------|---------------------|------------------------|------------|
| Subscapularis | 4 | 14 | 23 |
| Supraspinatus | 24 | 19 | 32 |
| Infraspinatus-TM | 4 | 4 | 8 |



GHJL: Gleno Humeral Ligament CHL: Coraco Humeral Ligament

Chart 1: Bar chart showing pattern of distribution of various rotator interval pathologies



SLAP: Superior Labral Anterior Posterior Tear
 HAGL: Humeral Avulsion of Glenohumeral Ligament
 ALPSA: Anterior Labroligamentous Periosteal Sleeve Avulsion
 GLAD: Glenolabral Articular Disruption

Chart 2: Bar Diagram showing pattern of distribution of various labro-ligamentous pathologies

Table 2: Spectrum of painful shoulder lesions on MRI

| No of lesions | | % age distribution |
|--|----|--------------------|
| Partial-thickness supraspinatus tears | 19 | 23.5% |
| Full-thickness supraspinatus tears | 24 | 30% |
| Partial-thickness subscapularis tears | 14 | 17% |
| Full-thickness subscapularis tears | 4 | 5% |
| Other rotator cuff tears | 8 | 9.8% |
| Rotator cuff tendinosis/ tendinopathy | 63 | 77.7% |
| Biceps tear/ tendinopathy/ tenosinovitis | 34 | 42% |
| Adhesive capsulitis | 12 | 15% |
| Rotator interval ligament tears/ sprain | 20 | 25% |
| Bankart lesion & variants | 20 | 25% |
| Hill-sachs lesion | 20 | 25% |
| SLAP lesion | 12 | 15% |
| HAGL | 1 | 1.2% |
| GLAD | 1 | 1.2% |
| Impingement syndrome | 39 | 48% |
| Sub-acromial sub-deltoid bursitis | 27 | 33% |
| Sub-coracoid bursitis | 21 | 2.6% |
| Joint effusion | 37 | 45% |
| Degenerative changes | 26 | 32% |

Discussion: In India, work related musculoskeletal complaints have been reported as one of the major cause of shoulder pain [8-10]. The prevalence of shoulder pain in India has been reported to be 2% (urban) and 7.4% (rural) population [11, 12].

In our study, 70% patients reported pain on right side and 30% on left side which was similar to study by Onyambu CK *et al.* [13].

In our observation, Rotator cuff tears accounted maximum in causing shoulder pain i.e. in 85% (n=69) cases, out of which the most common lesion was full-thickness supraspinatus tear, noted in 29.6% (n=24) cases (Fig 1A & 1B) followed by partial-thickness supraspinatus tear in 23.5% (n=19) & partial-thickness subscapularis tear in 17.3% (n=14) cases. In partial thickness supraspinatus tears, we got 47.4% (n=9) CID, 31.6% (n=6) PASTA (Fig 2), 21% (n=4) reverse PASTA lesions. We did not observe any case

of partial tear of infraspinatus and subscapularis tendons without involvement of supraspinatus tendon tear.



Fig 1A & 1B: T2 Coronal & PDFS sagittal image of the right shoulder showing the chronic full thickness tear of supraspinatus tendon [thick red arrow] with retraction gap ms 33.5 mm with extension to rotator interval. Also noted is partial tear of subscapularis tendon [thin red arrow].



Fig 2: (PASTA) lesion. PDFS coronal image of the right shoulder showing partial articular-side supraspinatus tendon avulsion near insertion with sparing of bursal surface fibres. [Red arrow]

A strong agreement was observed between the rotator cuff tears and increased age as higher no of RC tears were noted in elderly women. Many studies have been published on high correlation between the onset of RC tears and increasing age-in one, higher incidence of rotator cuff tears (RCT) were associated with advanced age, with rates as high as 80% in those older than 80 years of age [14]. In this study, we want to highlight the pathologies of Rotator interval specifically like biceps tendon tear, bicipital tenosinovitis, adhesive capsulitis (Fig 3), tear & sprain of

SGHL and CHL, which to the best of our knowledge have not been well elaborated in previously published similar studies. Biceps tendon involvement was maximum i.e. in 42% (n=34), amongst other RI pathologies. Only 3% patients presented with isolated rotator interval involvement without involving cuff. So our study suggests that isolated rotator interval injury is infrequent but an important cause of shoulder pain & should not be missed while reporting.



Fig 3: Adhesive capsulitis. STIR axial image of the right shoulder revealed distended axillary recess and thickening of inferior glenohumeral ligament & joint capsule [yellow arrow]. Bone edema is also evident in humeral head & greater tuberosity.

Rotator cuff tendinosis/ tendinopathy which is characterised by thickening without discontinuity of tendon fibers and presence of increased signal within the tendons, was the second most common lesion encountered in shoulder MRI, observed in 77.7% (n=63) cases with involvement of supraspinatus tendon in 39.5% (n=32) followed by subscapularis tendinosis in 28.4% (n=23) & infraspinatus tendinosis in 9.8% (n=8) cases.

Impingement (intrinsic and extrinsic) is also considered to be an important causative factor for rotator cuff tears and eventually pain, noted in 39% (n=48) of the patients in our study and was related to rotator cuff tears in 87% of the patients suggesting our results were according to the statement given by Neer *et al* that 95% of rotator cuff tears were attributed to impingement [15]. Subacromial impingement is the commonest amongst the well-known impingement syndromes which is defined as entrapment of the supraspinatus tendon and subacromial-subdeltoid bursa between the coraco-acromial arch and the greater tuberosity of the humerus. The main causes of such impingement include abnormal acromion configuration [16] arthrosis of the acromio-clavicular (AC) joint (Fig 4A & 4B) and narrowed subacromial space [17].

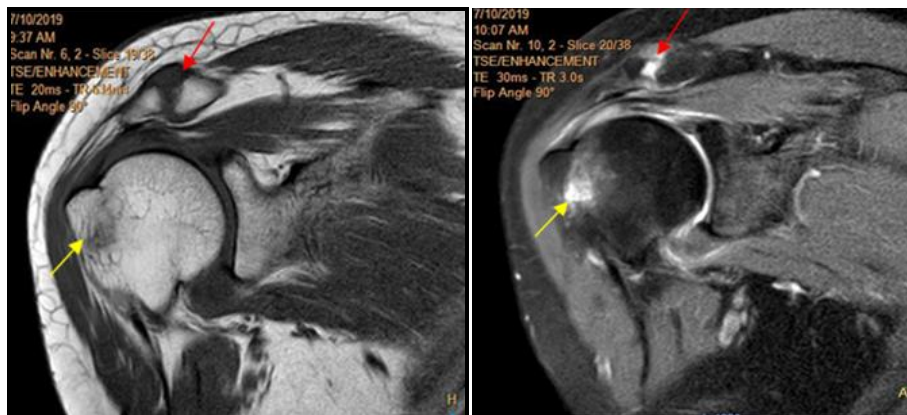


Fig 4A & 4B: Impingement syndrome. T1 & PDFS oblique-coronal image of the right shoulder showed supraspinatus impingement & resultant tendinosis by acromio-clavicular arthrosis [Red arrows]. Fracture & bony contusions of greater tuberosity of humerus are also evident in this image. [Yellow arrows]

34 (42%) patients out of 81 had MRI diagnosis of labro-ligamentous tears with bankart & its variants being the most common lesion (25%) (Fig 5). Presence of acute or recurrent dislocation was observed in majority of such patients i.e. in 65% cases (n=22 out of 34) and associated hill-sachs defect in 59% (n=20) of the patients (Fig 6). Co-

occurrence of bankart lesion and hill-sachs defect was found in 81% patients with isolated occurrence of bankart lesion without hill-sachs defect in only 19% patients indicating a strong correlation between the two. In our observation, SLAP tears were seen in 15% (n=12) cases.

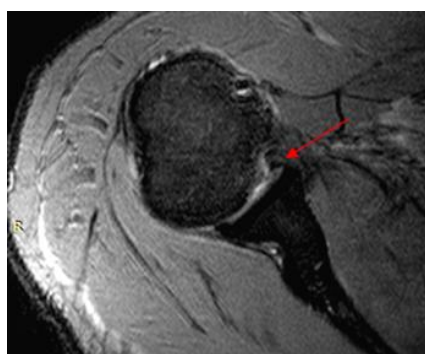


Fig 5: Bankart lesion. PDFS axial image of the right shoulder showed detachment of antero-inferior labrum from glenoid rim in patient with h/o recurrent dislocation [Red arrow].

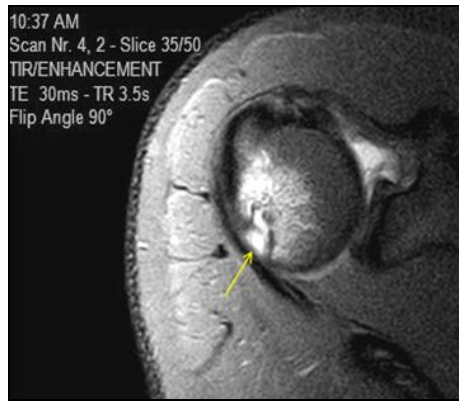


Fig 6: Hill-sachs defect. STIR axial image of the right shoulder revealed post-dislocation Hill-sachs defect [yellow arrow] with associated bony contusions in postero-superior aspect of humeral head.

Subacromian-subdeltoid bursitis is characterized by > than 3 mm thick bursa which is distended with fluid that extends 2 cm medial to the AC joint [18]. It accounted 33% (n=27) & 45% (n=37) patients had joint effusion in our study.

Conventional MRI has potential to evaluate the size and shape of RC tear, the amount of tendon retraction, the prominence of muscle atrophy, to characterise the labro-ligamentous tear, identify labral variations and diagnose impingement syndromes, bony pathologies & even minimal joint effusions with accuracy. In addition, it can accurately evaluate other potential causes of shoulder pain that may mimic RC tears [19].

In summary, MRI with a dedicated shoulder coil & accurate sequences is of utmost importance for evaluating a painful shoulder. A thorough & keen observation is required by radiologist to rule out RC tear mimics (tendinosis & tendinitis), to diagnose partial-thickness tears by inspecting articular, bursal surface & interstitial fibres of tendon carefully. Further, conspicuity of these lesions can be increased by the use of both intra-articular and IV gadolinium.

Conclusion

Though MR arthrography is considered diagnostic modality of choice for shoulder imaging, but our study concludes that even conventional MRI is well accepted, non-invasive imaging modality and has potential to evaluate patients presenting with shoulder pain. We diagnosed wide spectrum of MRI findings in patients with shoulder pain which included Rotator cuff tears & tendinopathy, rotator interval tear/sprain, adhesive capsulitis, impingement syndrome, labro-ligamentous tears/sprains, hill-sachs defect, bursitis, acromioclavicular arthrosis and joint effusion. In our study, we were also able to diagnose most of the tears of labro-ligamentous complex & rotator interval with precision which were later confirmed on arthroscopy.

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