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Role of MRI in the evaluation of painful shoulder

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Abstract
Introduction: Shoulder pain is a common complaint in primary health care resulting in significant pain and disability, loss of productivity and health care costs. Magnetic resonance imaging (MRI) has played an increasingly important role as a noninvasive test for determining the patients of shoulder pain which may benefit from surgery.
Aim and Objectives: The study is done to demonstrate the role of MRI in detecting shoulder pathologies encountered in patients of shoulder pain.
Methods: The study included 50 patients referred for MRI Shoulder after a detailed clinical workup. Images were acquired using various non-contrast enhanced sequences and were analyzed for pathologies.
Results: Among rotator cuff tendon supraspinatus tendon was most commonly involved (64%).Tendinosis, partial thickness tear and full thickness tear of supraspinatus tendon was revealed among 36%, 26% and 2%. In case of Subscapularis and Infraspinatus tendon; partial thickness tear and tendinosis was reported among 4%, 8% and 2%, 4% of the subjects respectively. Acromio-clavicular arthropathy and labral tear was found among 32% and 18% of the subjects respectively. Most common bony pathology was Hill Sach lesion (10%) followed by Humeral Head Cyst (6%) and Joint Effusion (6%). Impingement was present in 8% of the subjects.
Discussion: MRI is the preferred test for evaluating impingement syndrome and rotator cuff pathology.
Conclusion: Magnetic resonance imaging is an excellent modality for imaging pathological processes of the shoulder joint. It has benefit of non-invasiveness, lack of contrast exposure, nonionizing radiation and high degree of soft tissue resolution with multiplanar mode of imaging.

Keywords: Shoulder, magnetic resonance imaging, rotator cuff, hill sach lesion

Introduction

The shoulder joint is an incongruous ball and socket joint which has a wide range of motion in multiple planes; hence stability is compromised for the cost of mobility. This range is unique to humans and primates. To compensate for the unstable bony anatomy, the shoulder joint is protected anteriorly, superiorly and posteriorly by the capsule and the tendons (supraspinatus, infraspinatus, teres minoir and subscapularis) that form the rotator cuff and by glenoid labrum.

Shoulder pain is a common complaint in primary health care resulting in significant pain and disability, loss of productivity and health care costs [1]. The lifetime prevalence of shoulder pain in the general population is reported between 10% to 67% [2]. Shoulder pain is the third most common musculoskeletal complaint in the general population, and accounts for 5% of all musculoskeletal consultations.

Patients younger than 30 yrs. old tend to have mild inflammatory or biomechanical causes of pain such as atraumatic instability, arthropathy or tendinosis. The major cause of shoulder pain in patients older than 40 years is rotator cuff impingement and tears. Sub acromial impingement syndrome is the leading cause of rotator cuff injury [3]. Overall the four most common underlying causes are rotator cuff disorders (85% of cases), glenohumeral disorders, acromioclavicular joint (ACJ) pathology, and referred neck pain [4].

It is clinically difficult to differentiate between these diagnoses and distinguish rotator cuff problems from other conditions like glenohumeral instability. With time various imaging modalities has come for establishing the diagnosis, which includes radiographs, arthrography, ultrasonography (USG), computed tomography(CT) and magnetic resonance imaging (MRI).

Since the availability of Magnetic resonance imaging (MRI)) for medical use in early 1980s it has substituted other imaging modalities in evaluation of shoulder joint lesions as the most accurate imaging modality, due to its excellent soft tissue contrast, multiplanar imaging, non-ionising radiation and non-invasive nature.
The present study is conducted to review the spectrum of disease detectable with MRI and to know the advantages and usefulness of MRI in evaluation of shoulder pain.

Aims and Objective

1 To evaluate the demographic profile of patients coming for MRI evaluation of painful shoulder.
2 Role of MRI in evaluation of painful shoulder.
3 To delineate and understand the common lesions of shoulder encountered on MRI.
4 To analyze the correlation of imaging and clinical findings if any.

Materials and Methods

Setting

Department of Radio diagnosis, Imaging &Interventional radiology N.S.C.B Subharti Medical College, CSS Hospital, Meerut.

Type of Study

Prospective observational study.

Sample Size

The study has been conducted on 50 patients.

Duration and source of study

The source of data for this study has been patients referred to Department of Radio diagnosis, imaging and interventional radiology from OPD/IPD of C.S.S. Hospital, under the ageis of N.S.C.B Subharti Medical College, Meerut for a period of 2 years, from october 2019 to August 2021.

Inclusion criteria

All patients with skeletally mature bones of either gender referred to the radiology department for MRI evaluation with clinical history of shoulder pain.

Exclusion Criteria

- Patients who have contraindication for MRI like pacemaker, metallic implants, claustrophobia.
- Patients who already have undergone interventional intra-articular procedures.
- Patients with operative history over involved shoulder.

Methodology

After obtaining clinical history and relevant clinical examination, MRI examinations will be done on GE – Signa HDe 1.5 T using small parts coil and based on MR imaging findings evaluation of shoulder lesions will be done.

Technique

Every patient laid supine with the head pointing towards magnet (head first supine), shoulder in positioned in small parts coil and immobilised with sand bags and laser beam localiser centred over shoulder or in midline of the coil.

Protocol

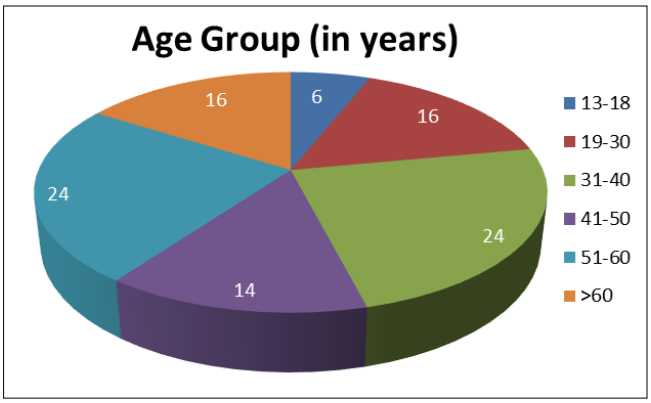
Patients included in the study shall be subjected to routine MRI of the shoulder joint by various pulse sequences consisting: AXA PD FSE fatSAT, COR PD FSE fatSAT, SAG PD FSE fatSAT, AX 3D FSPGR special fat sat and PROSP SAG T2 frFSE. Slice thickness: 2 to 4 mm.

Results and Observations

In our study more than 50% of the subjects were having age of >41 years. Only 6% of the subjects were having age between 13-18 years. 40% of the subjects belonged to age group of 31-50 years (Table 1, Graph 1). 64% and 36% of the subjects were male and female respectively (Table 2, Graph 2).

Table 1: Age distribution

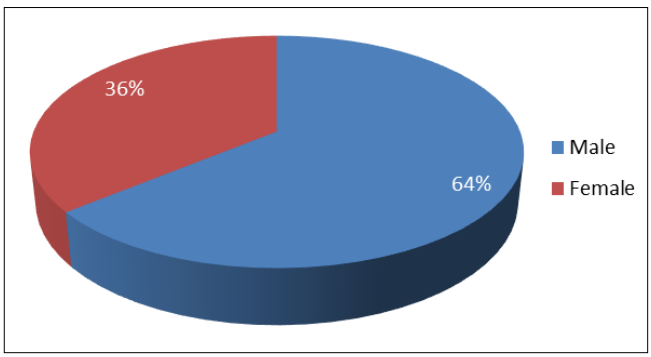
Age Group (in years)	N	%
13-18	3	6
19-30	8	16
31-40	12	24
41-50	7	14
51-60	12	24
>60	8	16
Total	50	100



Graph 1: Age distribution among the study subjects

Table 2: Gender distribution

Gender	N	%
Male	32	64
Female	18	36
Total	50	100

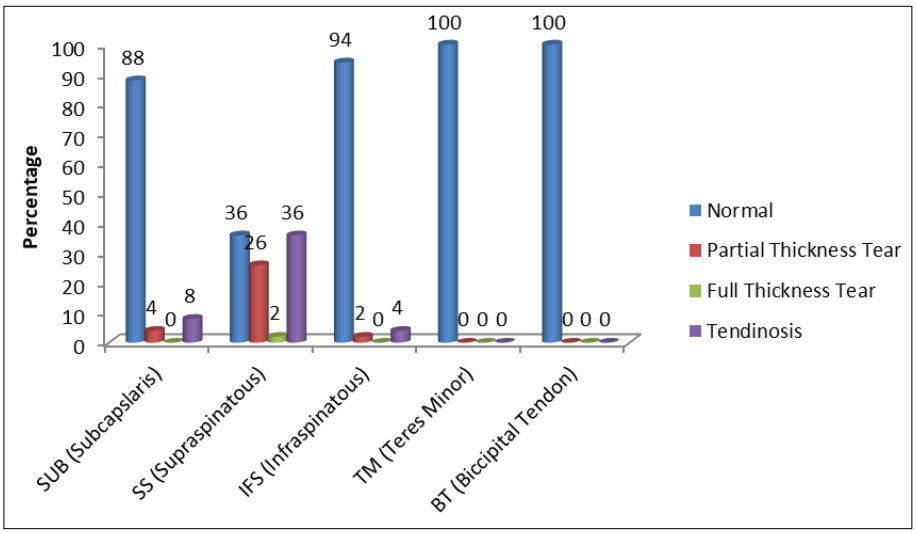


Graph 2: Gender distribution among the study subjects

Partial thickness tear, full thickness tear and tendinosis of supraspinatus tendon were revealed among 26%, 2% and 36% of the subjects. In case of subscapularis tendon and infraspinatus tendon; partial thickness tear and tendinosis was reported among 4%, 8% and 2%, 4% of the subjects respectively (Table 3, Graph 3).

Table 3: Showing distribution of different types in tears among different rotator cuff tendons.

Parameters	Normal		Partial Thickness Tear		Full Thickness Tear		Tendinosis	
	N	%	N	%	N	%	N	%
Subcapslaris tendon (SUB)	44	88	2	4	0	0	4	8
Supraspiantous Tendon (SS)	18	36	13	26	1	2	18	36
Infraspinatus tendon (IFS)	47	94	1	2	0	0	2	4
Teres Minor tendon (TM)	50	100	0	0	0	0	0	0
Biccipital Tendon (BT)	50	100	0	0	0	0	0	0

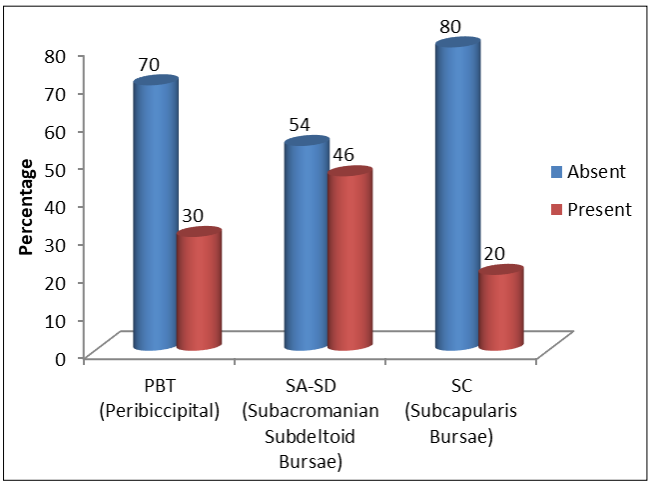


Graph 3: Distribution of different types in tears among different rotator cuff tendons.

PBT (Peribiccipital), SA-SD (Subacromanian Subdeltoid Bursae) and SC (Subcapularis Bursae) fluid was found to be present in 30%, 46% and 20% of the study subjects (Table 4 Graph 4).

Table 4: Showing distribution of bursal fluid among study patients.

Parameters	Absent		Present	
	N	%	N	%
PBT (Peribiccipital Tendon Fluid)	35	70	15	30
SA-SD (Subacromanian Subdeltoid Bursae)	27	54	23	46
SC (Subcapularis Bursae)	40	80	10	20

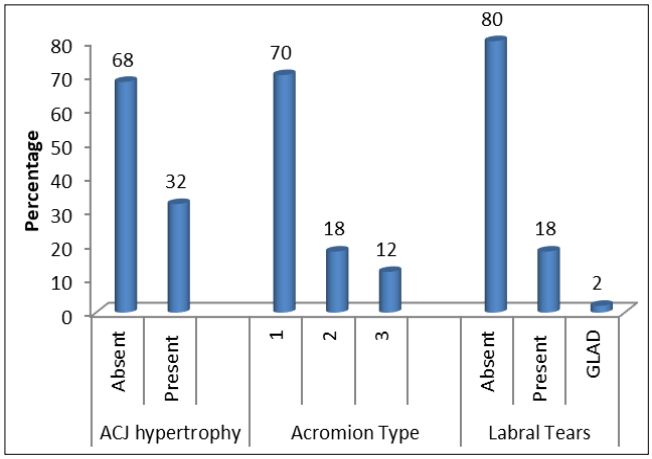


Graph 4: Showing distribution of bursal fluid among study patients.

Acromio-Clavicular Joint (ACJ) arthropathy and labral tear was found among 32% and 18% of the subjects respectively. Acromion type 1, 2 and 3 was reported in 70%, 18% and 12% of the subjects respectively (Table 5 Graph 5).

Table 5: Acromio-Clavicular Joint (ACJ) arhtropathy, acromion type and labral tears on MRI findings.

Parameters	N	%
Acromio-clavicular joint (ACJ) hypertrophy		
Absent	34	68
Present	16	32
Acromion Type		
1	35	70
2	9	18
3	6	12
Labral Tears		
Absent	40	80
Present	9	18
Gleno Labral Articular Disruption	1	2

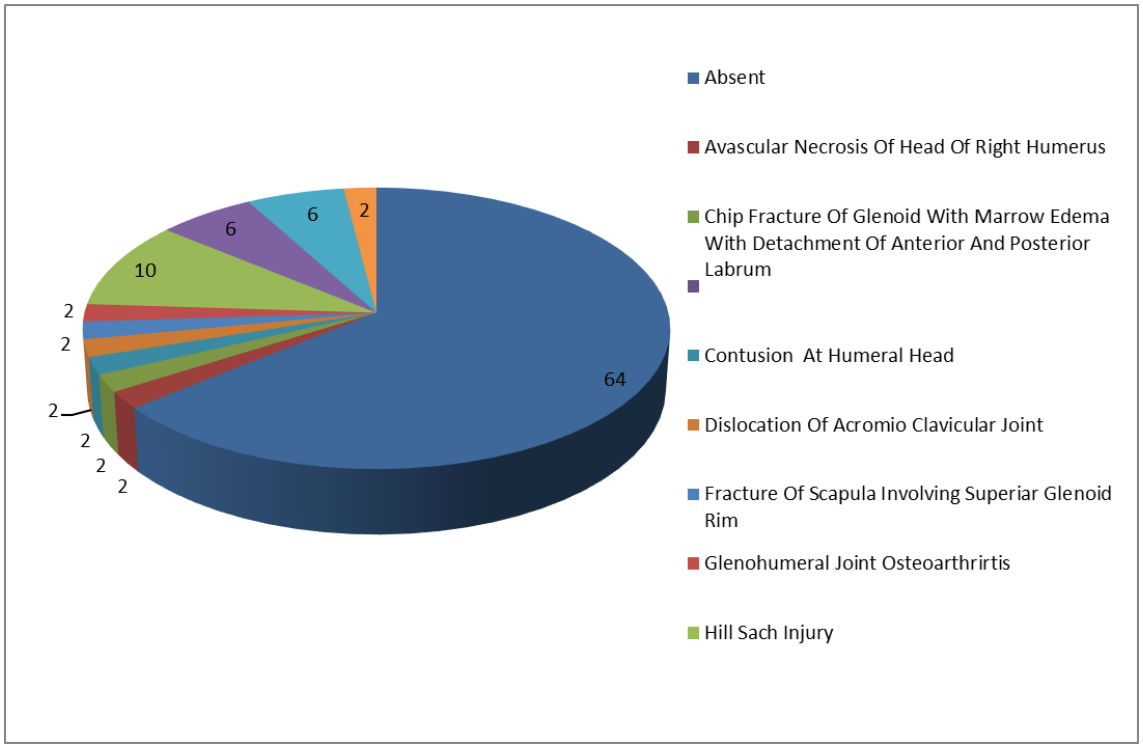


Graph 5: Acromio-Clavicular Joint (ACJ) arhtropathy, acromion type and labral tears on MRI findings.

Bony pathology was found among 36% of the subjects. Most common bony pathology was Hill Sach Injury (10%) followed by Humeral Head Cyst (6%) and Joint Effusion (6%). Avascular necrosis of head of right humerus and osteomyelitis at distal end of right clavicle was found in 1 subject each (Table 6 Graph 6).

Table 6: Bony pathology Spectrum on MRI.

Bony Pathology	N	%
Absent	32	64
Avascular Necrosis of Head of Right Humerus	1	2
Chip Fracture of Glenoid with Marrow Edema with Detachment of Anterior And Posterior Labrum	1	2
Contusion At Humeral Head	1	2
Dislocation of Acromio Clavicular Joint	1	2
Fracture Of Scapula Involving Superiar Glenoid Rim	1	2
Glenohumeral Joint Osteoarthrirtis	1	2
Hill Sach Injury	5	10
Humeral Head Cyst	3	6
Joint Effusion	3	6
Osteomyelitis at distal end of right Clavicle	1	2

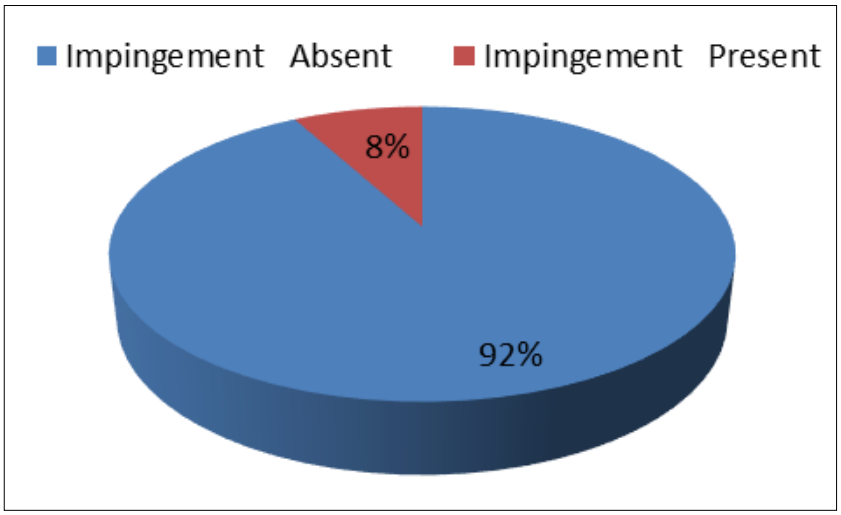


Graph 6: Bony pathology Spectrum on MRI.

Impingement was present in 8% of the subjects (Table 7, Graph 7).

Table 7: Impingment among study subjects.

Impingement	N	%
Absent	46	92
Present	4	8



Graph 7: Impingment among study subjects.

Discussion

Shoulder pain is a common complaint in medical practice and leads to significant disability. A compromised shoulder due to pain, stiffness or weakness causes substantial disability and affects the person's ability to carry out daily activities. This not only reflects on the person's occupation but also on his social life. It is estimated to affect 17% of men and 25% of women in the elderly population [5]. Incidence increases with age. 21% of people over 70 years have shoulder pain. Self-reported prevalence of shoulder pain is estimated to be 16-26% in Britain. Women have more shoulder problems than men but the frequency in both sexes increases with age [6]. The burden of taking care of the musculoskeletal problem is enormous to the society in terms of lost man-hours, direct hospital bills and workers compensation. This has a tremendous strain on a nation's economy.

Magnetic resonance imaging is the preferred test for evaluating impingement syndrome and rotator cuff pathology. A normal MRI greatly reduces the chances of a rotator cuff tear, with a negative likelihood ratio of 0.08 [7, 8, 9].

Magnetic resonance imaging is also useful in the evaluation of avascular necrosis, biceps tendon disorders, inflammatory process and tumors [8]. The diagnosis of labral lesions can be challenging given the relatively low sensitivity and negative predictive value noted in several trials [10, 11].

For many orthopaedic surgeons, the main role of shoulder MRI is to detect a full-thickness rotator cuff tear (RCT). The most common appearance of a full-thickness tear is high signal intensity on a T2- weighted image (fluid signal intensity) that extends from the articular surface of the rotator cuff to the sub acromial-subdeltoid bursa (Figure 1).

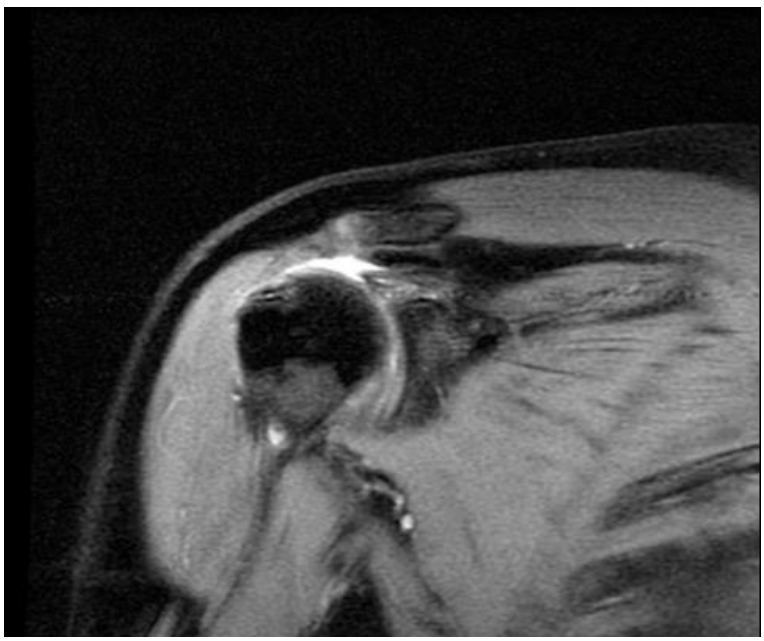


Fig 1: 50 year old female with history of trauma and shoulder pain and decreased range of motion of shoulder since 2 days. Coronal PD FAT SAT image shows area of increased signal intensity at supraspinatus tendon insertion with evidence of retraction of supraspinatus tendon suggestive of complete tear. Glenohumeral joint effusion also noted.

Partial-thickness tears are incomplete tears that only involve the articular or bursal side of the cuff. The appearance of partial-thickness tears on MRI is focal discontinuity of the tendon with high signal intensity on T2-weighted images (Figure 2).

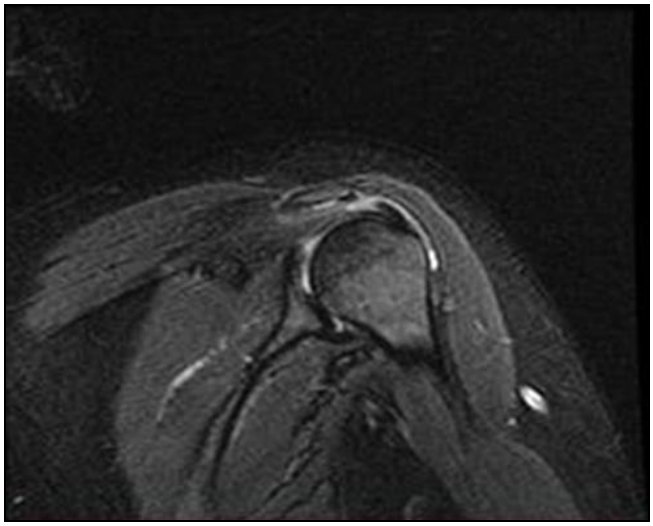


Fig 2: 53 year old female with history of trauma and shoulder pain since 7 days Coronal STIR Image showing area of STIR hyperintensity in supraspinatus tendon suggestive of partial tear with mild joint effusion and fluid in subacromial subdeltoid bursae.

Tendinopathy, occasionally incorrectly termed tendinitis, is a related intratendinous process that is histologically similar to rotator cuff degeneration. On MR it appears as high T2 signal intensity area with signal intensity less than fluid (Figure 3). It must be differentiated from anisotropy artifact by comparing with different sections.

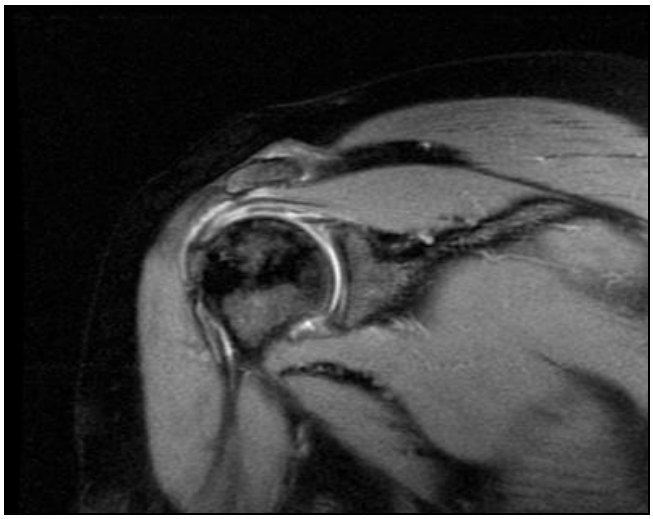


Fig 3: 40 year old female with history of shoulder pain on moving the shoulder since 10 days. Coronal PD FAT SAT images show mild lateral tilt of acromion with PD FAT SAT hyperintensity in supraspinatus tendon insertion suggestive of supraspinatus tendinopathy with impingement of supraspinatus muscle near tendon.

A Hill-Sachs defect is a posterolateral humeral head depression fracture, resulting from the impaction with the anterior glenoid rim, and indicative of an anterior glenohumeral dislocation. It is often associated with a Bankart lesion of the glenoid (Figure 4A and 4B).

Fig 4A: 30-year-old male with history of recurrent dislocation of shoulder. Axial PD FAT SAT image shows concave depression at postero-lateral aspect of humerus head suggestive of hill sach lesion.

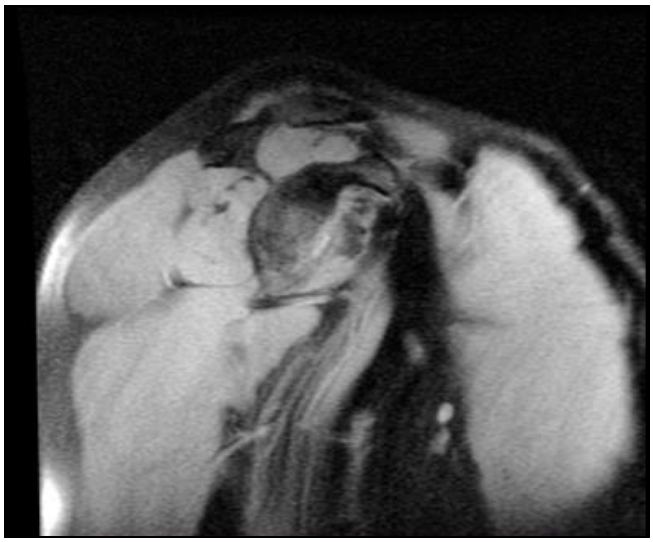


Fig 4B: Saggital PD FAT SAT image shows poor visualization of antero-inferior glenoid labrum with avulsion chip fracture of rim of inferior glenoid suggestive of soft tissue and bony bankart lesion.

In our study supraspinatus tendinopthy was most common pathology and most commonly involved among rotator cuff tendon, followed by subscapularis and infraspinatus tendon. In a similar study by Hema Chaudhary *et al.* [13], supraspinatus tendinopathy was found in 67.65% cases (55 patients), subscapularis tendinopathy were in 9.9% (8 patients) cases, infraspinatus tendinopathy were in 2.47% cases (2 patients) and in study by Shilpa Chudasama *et al.* [14] which reported that supra spinatus was the most commonly involved tendon followed by subscapularis, infraspinatus.

Peribiccipital fluid¸ fluid in Subacromanian Subdeltoid Bursae and Subcapularis Bursae was found to be present in 30%, 46% and 20% of the study subjects respectively which compares well with the study by Hema Chaudhary *et al.* [13] which reported subacromian subdeltoid bursitis in 37.04% (30 patients) which account for most commonly involved bursae.

In a study by Harris KD *et al*. [15], Acromioclavicular joint (ACJ) disease is reported to be present in 31% of all patients with shoulder pain which corresponds with our study. In study by Pankaj Chaudhari *et al.* [3] labral tears were reported among 12.5% of the subjects and in study by Shilpa Chudasama *et al*. [12] it was reported that Type I and type II acromion morphology was most commonly observed which corresponds with our study.

Bony pathology was found among 36% of the subjects. Most common bony pathology was Hill Sach Injury (10%) followed by Humeral Head Cyst (6%) and Joint Effusion (6%). These lesions were seen more commonly in those with history of dislocation of the shoulder joint. In a similar study by Shilpa Chudasama *et al*. [14], bony pathologies were reported among 30% of the subjects and in a study by C.K. Onyambu *et al*. [16], there were 4(3.3%) Bankart and seven (5.8%), Hill-Sach's lesions which were comparatively less as in our study.

Conclusion

As in medicine, elaborate diagnosis obviously makes sense if there are means for adequate therapy and there is a good chance for better outcomes. In the field of musculoskeletal disease, MRI nowadays fulfils these criteria and in many cases it replaces other investigations. MRI is a non-invasive, lack of contrast exposure, nonionizing radiation, and high degree of resolution mode of imaging. MRI shoulder is also helping in deciding which patients will benefit from medical and surgical treatment. The chronic shoulder pain is most common in dominant hand. Trauma and degenerative changes are the most common aetiologies. The commonest cause of shoulder pain is rotator cuff pathology such as tendinosis, partial tear and full thickness tear.

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