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Original Research Paper

Radiology

MRI SHOULDER: A TROUBLESHOOTER IN ROTATOR CUFF PATHOLOGIES

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ABSTRACT

Introduction: Shoulder pain is a commonly encountered complaint which is not only prevalent among athletes but it also affects patients performing repetitive activities in their daily routine. Most common cause of shoulder pain is found to be rotator cuff pathologies. Although many rotator cuff pathologies can be detected on ultrasonography but Magnetic Resonance Imaging (MRI) plays a pivotal role to determine and characterize them for better clinical management. **Aim and Objectives:** This study was done to demonstrate the utility of MRI in diagnosing and characterising rotator cuff pathologies in patients presented with shoulder pain. **Methods:** The study included 50 patients referred for MRI Shoulder after a detailed clinical workup. Aquisition of images was done using various non-contrast enhanced sequences followed by their analysis. **Results:** Among the 4 rotator cuff tendons, supraspinatus tendon was found to be the most common culprit for shoulder pain (64%). Full thickness tear, partial thickness tear and tendinosis was noted among 3%, 25% and 36% subjects respectively. In case of Subscapularis and Infraspinatus tendon; partial thickness tear and tendinosis was reported among 4%, 8% and 2%, 4% of the subjects. **Discussion:** MRI is a preferred non-invasive imaging tool in patients with rotator cuff pathologies.**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, tear.

INTRODUCTION

Shoulder joint is a ball and socket type of joint in which the humeral head articulates with the glenoid fossa of the scapula to stabilise the joint, it is covered on superior, anterior and posterior aspect by the joint capsule and various ligaments as well as rotator cuff muscles.

Shoulder pain with or without restriction of movements is a commonly encountered complaint which causes significant debilitation to the patient [1]. The lifetime prevalence of aching shoulder is reported between 10% to 67% [2].

Patients younger than 30 years of age often have inflammatory or biomechanical causes of pain such as atraumatic instability owing to multitude of causes like lesions of glenoid labrum, arthropathy or tendinosis. The prominent etiology leading to shoulder pain in older patients is rotator cuff impingement and rotator cuff tears. Sub-acromial impingement syndrome is one of the leading cause of rotator cuff injury commonly affecting the supraspinatus tendon [3]. Rotator cuff pathologies are detected in upto 85% patients coming with shoulder pain with glenohumeral disorders, acromioclavicular joint (ACJ) pathology, and referred neck pain being the other common causes [4].

Clinically it is often very difficult to differentiate between these causes and therefore imaging plays an indispensable role in correctly diagnosing the cause of shoulder pain. Radiographs are often used as a screening tool to look for any fracture or dislocation, os-acromiale, signs of arthropathy and decreased acromio-humeral interval pointing towards shoulder impingement etc. Ultrasonography can help in detecting tendinopathy and tears of rotator cuff as well as abnormalities like joint effusion and bursitis. However, to accurately diagnose the pathology and to characterize it further in terms of its extent , magnetic resonance imaging (MRI) plays a crucial role.

The present study is conducted to review the spectrum of rotator cuff pathologies detectable with MRI and to emphasize the advantages of MRI to convey necessary information required in making treatment related decisions in patients with shoulder pain.

AIMS AND OBJECTIVE

1. To assess the demographic profile of patients coming for MRI evaluation of painful shoulder.
2. Role of MRI in evaluation of patients with rotator cuff pathologies.
3. To delineate different types of rotator cuff tears on MRI.

MATERIALS AND METHODS

Department of Radio diagnosis Vardhaman Mahavir Medical College & Safdarjung Hospital.

Type of Study

Prospective observational study.

Sample Size

The study has been conducted on 50 patients.

Duration and source of study

Patients referred to Department of Radio diagnosis, imaging and interventional radiology from OPD/IPD of Safdarjung Hospital, under the ageis of Vardhaman Mahavir Medical College, Delhi for a period of 2 years, from October 2016 to August 2018.

Inclusion criteria

All skeletally mature patients who were referred to the radiology department for MRI evaluation with clinical complaints of shoulder pain were included irrespective of their gender.

Exclusion Criteria

- Patients having contra-indication for MRI like patients with pacemaker, metallic implants, claustrophobia.
- Patients with past history of surgery over the involved

shoulder.
- Patients who have undergone any interventional intra-articular procedures like arthroscopy.

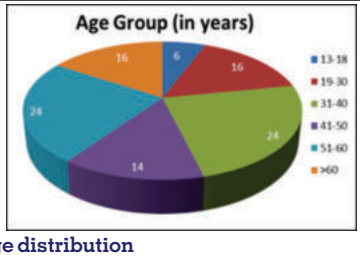
Methodology
Clinical assessment of patient with detailed history and examinations were done followed by their MRI examinations using Philips ACHIVA 1.5 Tesla MRI Scanner. Surface coil was used and analysis of acquired scans was done.

MRI acquisition protocol
Surface coil (dedicated shoulder coil) was used with patient lying in supine position with arm lying by the side in neutral or in slight externally rotated position. Scan was acquired in three orthogonal planes-coronal oblique (parallel to supraspinatus axis or perpendicular to glenoid articular surface), sagittal oblique (parallel to glenoid articular surface) and axial (from superior aspect of acromian to lowermost aspect of glenohumeral articulation). Small field of view (12-14 cm) was used with slice thickness of 2-4 mm. Sequences obtained were proton density fat saturated and T2-W and T1 W sequences.

Results and Observations
In our study more than 50% of the subjects were having age >41 years. 6% of the subjects belonged to age group between 13-18 years. 40% of the subjects fall in 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). Partial thickness supraspinatus tear, full thickness supraspinatus tear and tendinosis were found among 25%, 3% and 36% of the Patients. In case of subscapularis tendon and infraspinatus tendon; partial thickness tear and tendinosis was noted among 4%, 8% and 2%, 4% of the subjects respectively (Table 3, Graph 3). Impingement was present in 8% of the subjects (Table 4, Graph 4).

Table 1. Age distribution

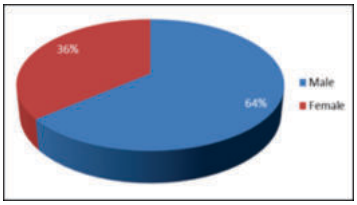
Age Group (in years)	N	%
13-18	3	6
19-30	8	16
31-40	12	24
41-50	7	14
51-60	12	24
>60	8	16
Total	50	100



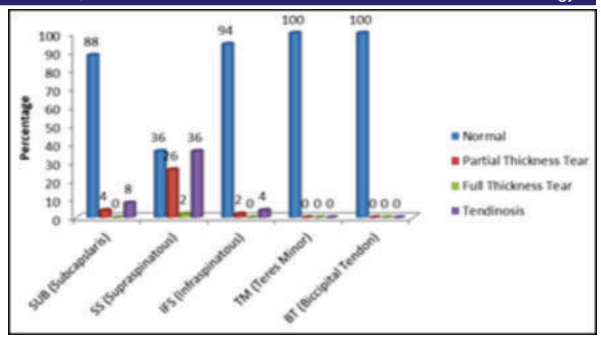
Graph – 1 Age distribution

Table 2- Gender distribution.

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



Graph 2- Gender distribution



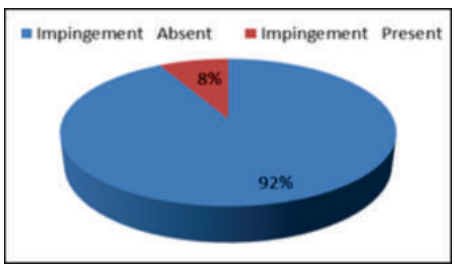
Graph 3 Distribution of different types in tears among different rotator cuff tendons

Table 3

Parameters	Normal		Partial Thickness Tear		Full Thickness Tear		Tendinosis	
	N	%	N	%	N	%	N	%
Subcapslaris tendon (SUB)	44	88	2	4	0	0	4	8
Supraspian tous 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

Table 4

Impingement	N	%
Absent	46	92
Present	4	8



Graph 4 Impingment among study subjects.

DISCUSSION
Shoulder pain is a debilitating condition which is often reported by the patients from different age groups. It is not only limited to sportsperson and athletes but due to chronic repetitive action anyone can develop this complaint. Shoulder pain is often associated with restriction of the movement of the joint. It is estimated to affect 17% of male and 25% of females in the geriatric age groups [5,6]. 21% of people over 70 years of age were reported to have shoulder pain suggesting the implication of age in the etiopathogenesis of this condition.

Magnetic resonance imaging is the preferred imaging tool for evaluating impingement syndrome and rotator cuff pathologies and has been recommended in American College of Radiology (ACR) appropriateness criteria for patients with shoulder pain . A normal MRI scan significantly reduces the possibility of a rotator cuff tear with a negative likelihood ratio of 0.08[7,8,9].

Apart from the rotator cuff abnormalities, MRI can be utilized to visualize rotator interval abnormalities like adhesive capsulitis, inflammatory or infective pathologies, causes of recurrent shoulder dislocations like labral lesions [8]. Now a days, MR arthrogram can be used to further improve the accuracy of rotator cuff tears involving the articular surface and to demonstrate the glenoid labral lesions[10, 11].

Among the four muscles of rotator cuff- supraspinatus, infraspinatus, teres minor and subscapularis, most commonly tear of supraspinatus tendon is noted. Further, most common location of supraspinatus tear was earlier presumed to be a relatively hypovascular areas called as the critical zone (1 cm medial to the site of attachment to greater tubercle of humeral head). But, the recent studies reveals that the footprint of supraspinatus is most often torn in the MRI scans of patients coming with shoulder pain.

A tear must be differentiated from tendinosis by analyzing the signal intensity on fat suppressed images. If the hyperintense signal is comparable to signal intensity of fluid, then only it is considered as tear (Figure 1, 2). Otherwise if there is subtle hyperintensity which is not comparable to the bright signal of fluid then it is referred as tendinosis (Figure 3) Once a tear is seen, it should be categorized as partial or full thickness tear. A full thickness tear is a focal tear involving the articular as well as the bursal surface of the tendon. It can be associated with retraction of the torn tendon, joint effusion and bursitis (Figure 1). Since it is focal, the fibers anterior and posterior to this tear are intact as visualized in axial or sagittal planes. But if no normal fiber seen with complete discontinuity at the musculotendinous junction or in critical zone or at footprint, then it is referred as complete tear.

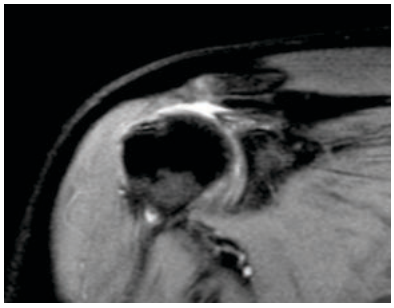


Fig 1: Coronal oblique proton density fat saturated image showing fluid signal intensity involving both articular and bursal surface of supraspinatus tendon (i.e full thickness tear) at the insertion site with retraction .

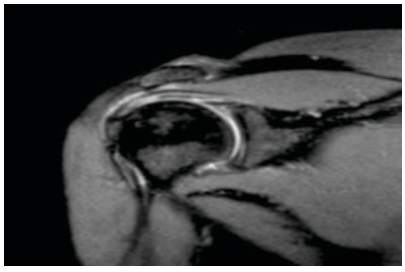


Fig 2: Coronal oblique STIR image showing fluid signal intensity at the articular surface of supraspinatus foot print with its extension into the supraspinatus tendon in horizontal plane associated with retraction of articular fibers more than bursal fibers (i.e type IV delamination tear). Mild joint effusion with fluid in subacromian-subdeltoid bursa seen.

A partial thickness tear is a focal tear involving either the articular surface or the bursal surface only (and not both unlike full thickness tear). Thickness of a partial thickness tear can be measured easily on MRI. Similarly, the location of tear can be accurately determined using this imaging modality. If a tear is located in the supraspinatus footprint region only, it is called as a rim-rent tear. Medio-lateral dimension (measured on oblique coronal plane) of a rim-rent tear is lesser than its anteroposterior dimension (measured in sagittal plane) [12,13].

Extension of tear from footprint into the tendon must be mentioned along with the direction in which extension is occurring. If the tear is extending in horizontal plane, separating the fibers with intact articular and bursal surface, then it is called as "delamination tear" (Figure 2).

However, if the extension is in vertical plane, then it is referred as "longitudinal tear".

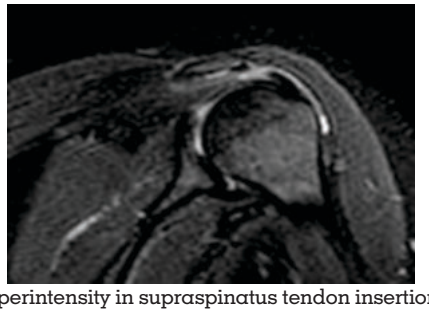


Fig 3: Hyperintensity in supraspinatus tendon insertion site is noted on proton density coronal oblique image (which is not as bright as the fluid), suggestive of tendinopathy. The acromio-humeral interval is reduced due to mild inferolateral tilt of acromion causing impingement of the supraspinatus tendon.

In our study supraspinatus tendinopathy was most common pathology 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 revealed that supraspinatus was the most commonly involved tendon followed by subscapularis and infraspinatus. Other causes of rotator cuff tendinopathy like shoulder impingement syndrome were also seen in 8% our cases which is concordant with the observations of study conducted by Haris KD et al[15] and Onyambbu CK et al[16].

CONCLUSION

With the continuous advancement in imaging modalities, MRI has emerged as a reliable imaging tool which not only accurately identifies the cause of chronic shoulder pain but is sufficient enough to impart all the necessary information required for planning treatment of patient.

Rotator cuff pathologies are most frequent cause of shoulder pain with main culprit being supraspinatus tendon. However, with MRI various sorts of tears like partial thickness or full thickness tears, rim rent tears, delamination tears can be identified.

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