International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2024; 7(2): 13-19
Received: 10-01-2024
Accepted: 19-02-2024

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Role of magnetic resonance imaging in rotator cuff lesions

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DOI: https://doi.org/10.33545/26644436.2024.v7.i2a.378

Abstract
Background: The shoulder joint is one of the most complicated and mobile joints of the body whose stability is primarily maintained by the rotator cuff muscles. The rotator cuff is a group of muscles and tendons which surround the shoulder joint inserting into the greater and lesser trochanters of the humerus, keeping the head of the upper arm bone firmly within the shallow socket of the shoulder. Lesions involving the rotator cuff muscles are one of the most common causes of shoulder pain and restricted shoulder mobility. Magnetic resonance imaging (MRI) plays an important role in the evaluation of the fine details associated with rotator cuff.
Materials and Methods: This study was undertaken from March 2023 to October 2023 in the Department of Radiodiagnosis, Narendra Modi Medical college, L.G hospital, maninangar, Ahmedabad. The study population consisted of 60 patients who underwent MRI of the shoulder joint.
Results: The study population consisted of 60 patients from 20 to 60 years of age showing a gradual increase in disease pathology with advancing age and a strong male predilection. Most common pathology involving rotator cuff was found to be tendinosis followed closely by partial tears. Of the tendons involved, most common was supraspinatus, followed by subscapularis, infraspinatus and teres minor.
Conclusion: In the workup of patients with shoulder pain, the role of imaging is to guide treatment decisions. MRI provides valuable information and for treatment planning to the orthopaedic surgeon regarding the status of tendons, bones, and joints. The diagnosis of a rotator cuff tear and its extent, full or partial thickness, can determine the line of patient management. A thorough knowledge of the rotator cuff's architecture and MR characteristics of rotator cuff tendons, acromion, and the abnormalities in these tendons is necessary for appropriate diagnosis.

Keywords: MRI of shoulder, rotator cuff tears, glenohumeral joint, acromion process, tendinosis

Introduction
The shoulder joint is a complicated joint in the body which comprises the humerus, clavicle, and scapula, and it has a greater range of motion than any other joint while remaining stable in everyday settings. The joint complex comprises three joints: the glenohumeral, acromioclavicular, and sternoclavicular. The glenohumeral joint is a true synovial ball-and-socket style joint formed between the humeral head and the glenoid fossa of the scapula and it allows for a broad range of abduction, adduction, flexion, extension, internal/medial rotation, external/lateral rotation, and circumduction at the shoulder joint. It is the most mobile joint in the human body. The articular surface of the humeral head is larger as compared to the glenoid fossa and that is a primary cause of instability in this joint. The joint stability is provided by a total of two set of the stabilizers – passive and active [3]. It is, however, also the least stable joint in the body and is the most dislocated diarthrodial joint
Rotator cuff is the most important active stabilizer of the glenohumeral joint. It consists of four muscles and their tendons, namely, supraspinatus, infraspinatus, subscapularis, and teres minor which are inserted at greater and lesser trochanter of head of humerus. It being predisposed to a variety of the external and internal stress factors, is commonly involved in shoulder lesions. The external factors that can affect it include trauma, and internal factors include primary impingement due to overlying acromion and acromioclavicular joint hypertrophy and secondary impingement due to glenohumeral joint instability [4]. It is also suggested that intrinsic degeneration is the primary cause of the rotator cuff tears [5]. The common disease processes involving the rotator cuff tendons include impingement, tendinopathies and tears [10].

Some of the modalities used for imaging of shoulder lesions include conventional radiography, ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI). During the diagnosis and evaluation of patients, it is also imperative to identify the condition, potential clinical consequences and report relevant observations.

Conventional radiography and computed tomography are useful in imaging of the bones that comprise the joint, such as degenerative changes in bones and joints, osteophytosis, fractures and spur formation. They are also useful in evaluating acromiohumeral distance and corac humeral interval, the value of which decreases when the underlying tendons are affected by disease pathology.

USG and MRI can evaluate soft tissue structures around shoulder joints, more specifically the cuff tendons. USG allows for real time imaging and thus has an advantage over MR, but is heavily dependant on operator efficiency. MRI has a better spatial resolution for soft tissue examination, such as tendon swelling and muscle tears. It also enables better tear characterisation. Recently, MRI is rapidly evolving as a modality of choice for imaging soft tissues around shoulder joint [6].

Magnetic Resonance Imaging (MRI) has good spatial resolution for identifying tendon edema and tears in the rotator cuff and can be helpful in the future management of the rotator cuff lesions [8]. It is an accurate and sensitive modality to diagnose and characterise the rotator cuff lesions. It provides an accurate view of the associated findings such as acromion morphology and biceps lesions.

Aims and Objectives

1. To evaluate and describe the MRI characteristics of rotator cuff lesions.
2. To describe the rotator cuff lesions for the purpose of grading and management plan of the patients.

Materials and Methods

Study type

This was a hospital based prospective, descriptive and analytical study performed on 60 patients at tertiary care hospital.

Source of data

The study was performed in the Department of Radiodiagnosis, LG hospital and Narendra Modi Medical College with suspected rotator cuff lesions who were referred for MRI shoulder.

Duration of study

The study was undertaken between March 2023 to October 2023.

Sample size: 60 patients.

Inclusion criteria

Patients clinically suspected of possible rotator cuff lesions referred for MRI evaluation by respective clinicians.

Exclusion criteria

1. Postoperative cases with orthopaedic hardware were excluded.
2. Patients with claustrophobia, cardiac pacemakers, metallic foreign body, bio stimulators, neurostimulators, and cochlear implants in-situ were excluded.
3. Known case of rotator cuff lesions on treatment, patients with infective arthritis of shoulder joint.

Methods and imaging protocols

The patients identified based on inclusion and exclusion criteria were subjected to MR evaluation.

All relevant clinical history, physical and systemic examination findings were noted.

Patients were positioned supine with head towards the arm in neutral position. Adequate support for head and the limb was provided. All the scans were obtained using Siemens Magnetom Avanto 1.5 Tesla 18 Channel Whole body MR scanner.

1. T_1 weighted images were obtained in axial, coronal and saggital planes.
2. T_2 weighted images were obtained in axial, coronal and saggital planes.
3. PDFS and STIR images.

Data interpretation

Rotator cuff lesions were further classified into tendinosis, partial tear, and complete tears

1. Partial tears were seen as the focal area of increased signal intensity on PD fatsat and T_2 fatsat images with partial tendon disruption. Partial thickness rotator cuff tears will be considered when the fluid signals do not traverse the entire thickness of the tendon, as in the case of a partial-thickness tear.
2. Complete tears are seen as full-thickness tendon breach with increased signal intensity on PD fatsat and T_2WI. On T_1- and T_2-weighted images, a full-thickness rotator cuff tear will be defined as a focal, well-defined area of increased signal intensity spanning the entire tendon, from the bursa to the articular surface
3. Tendinosis is viewed as focal increased signal intensity on PD fatsat images without tendon breach [8].

Results and Discussion

The above study was carried out on a sample size of total 60 patients in whom, after inclusion and exclusion criteria were applied, data collection was done and the results were analysed as below.

The age cohort considered for the study included patients from 20 to 60 years old. Age distribution in the study population demonstrated decade specific distribution as shown below.

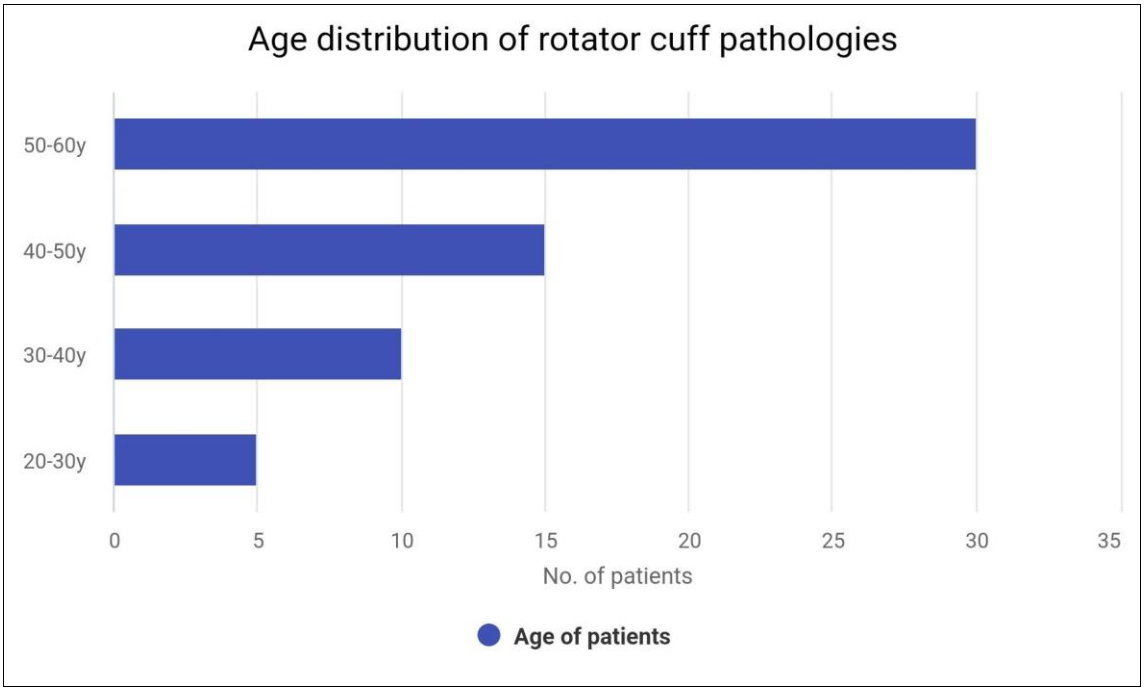


Fig 1: Age wise distribution of rotator cuff lesions

The age distribution of rotator cuff lesions hence showed a gradual rise in incidence with an increase in the mean age of population.

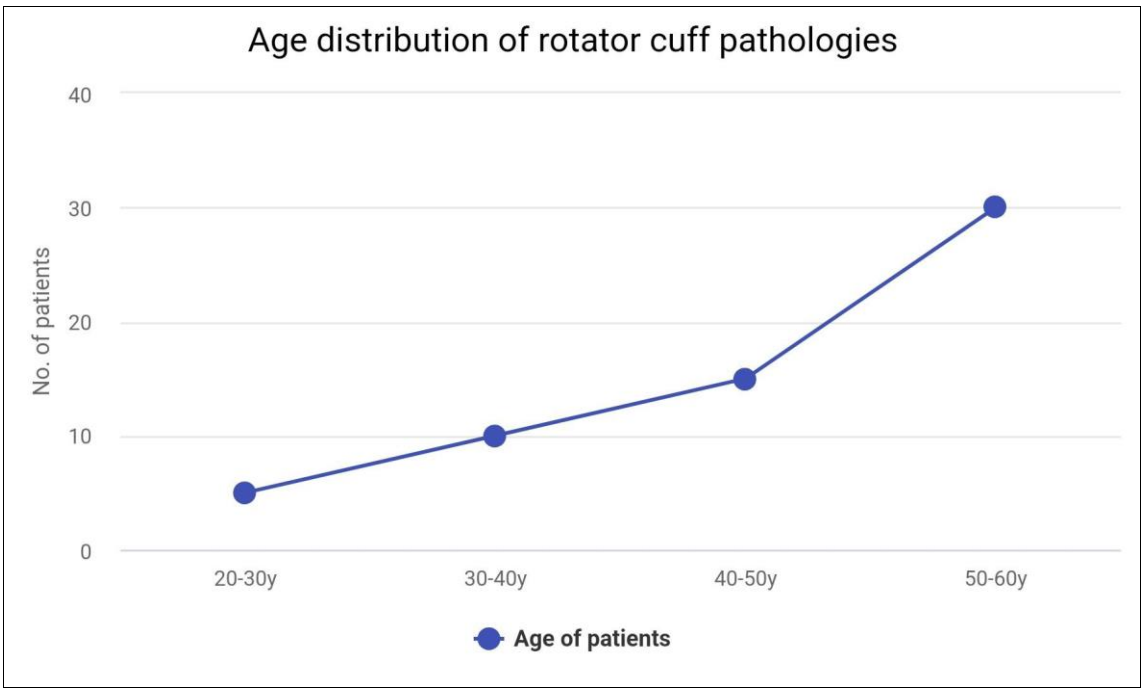


Fig 2: Linear graph showing a steady increase in disease pathology with age.

However, observations from the study indicated that while partial and complete tears were more common in older age groups, tendinosis was more commonly encountered in younger age groups.

When considering the gender specific incidence of the lesions, it was found that there was a strong male predilection with 50 out of 60 patients (84%) being male and 10 out of 60 patients (16%) being female.

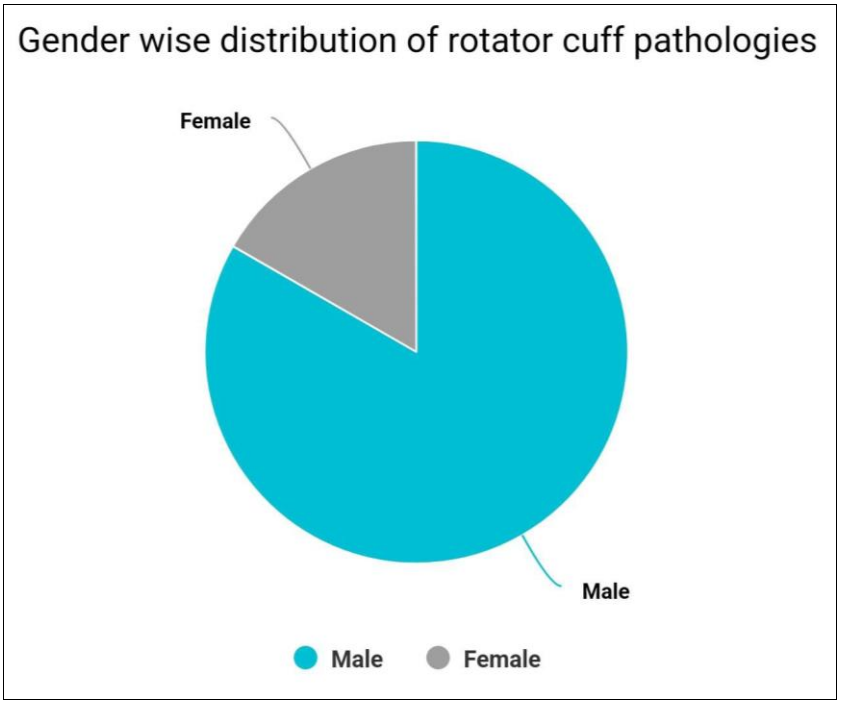


Fig 3: Graphical depiction of gender distribution of rotator cuff lesions.

When considering the involvement of specific rotator cuff tendons in pathological process, it was found that supraspinatus tendon was most commonly involved, with 36 out of 60 patients having supraspinatus pathology (60%). Decreasing order of involvement was as follows, with subscapularis being next in frequency of involvement (25%), followed by infraspinatus (10%). Teres minor was least commonly involved tendon with only 5% of study population showing its involvement.

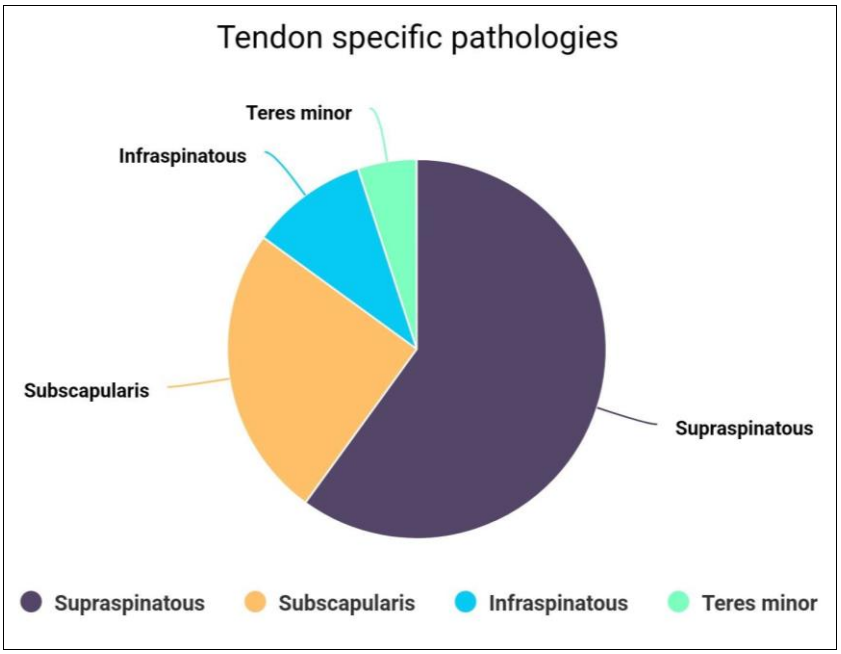
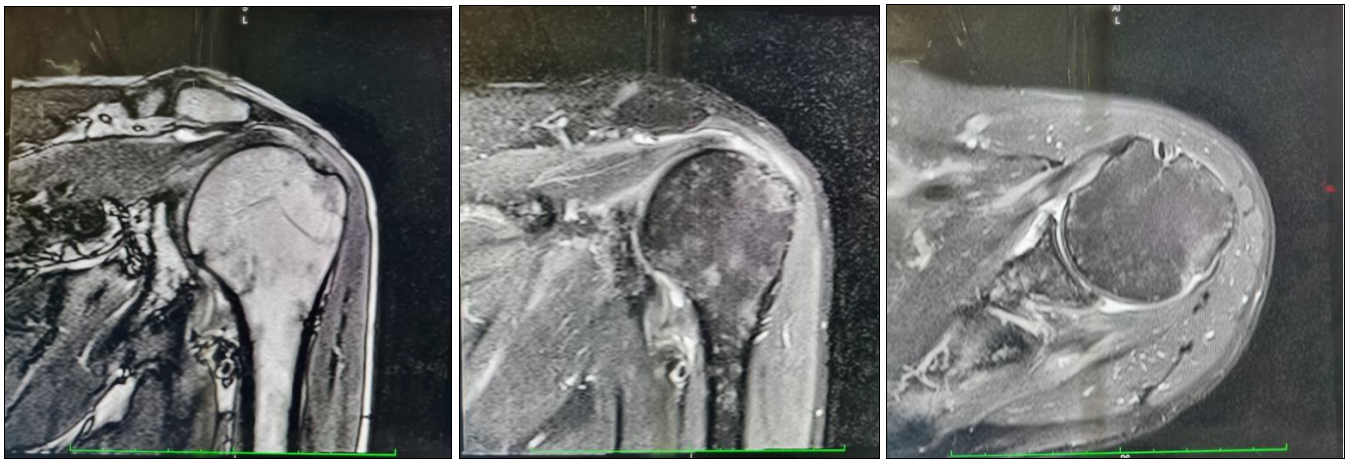


Fig 4: Percentage wise involvement of different tendons.

The above findings are consistent with a study of cadaver shoulders in which De Palma *et al*. found that supraspinatus injury was the most common, and its severity increased with age [7].

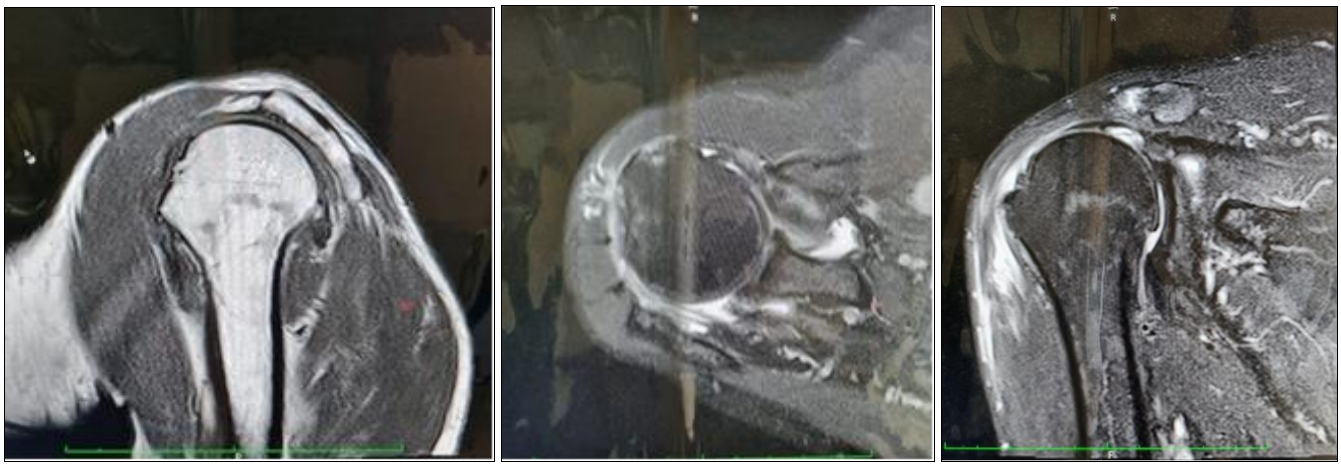
When considering the specific disease process involving each tendon, the following observations were made.

For supraspinatus tendon, tendinosis was the most common occurence, found in 16 out of 36 patients (44%) followed closely by partial tears (40%). The incidence of complete tears was found to be in 6 out of 36 patients (16%).



Coronal T_1WI Coronal T_2WI Axial T_2WI

Fig 5: Patchy hyperintense signals involving supraspinatus tendon, indicative of partial supraspinatus tear.



Saggital T_1WI Axial PD-FSE Coronal T_2WI

Fig 6: Complete tear of supra and infraspinatus tendons with partial tear of subscapularis tendon.

A similar trend was observed for subscapularis and infraspinatus tendons, with tendinosis found in 7 out of 15 patients (46%) with subscapularis lesions and 3 out of 6 (50%) with infraspinatus lesions. Partial tears were seen in 6 out of 15 patients (40%) with subscapularis lesions and 2 out of 6 (33%) in patients with infraspinatus lesions with complete tears being present only in 2 out of 15 (13%) of patients with subscapularis lesions and 1 out of 6 (16%) patients with infraspinatus lesions.

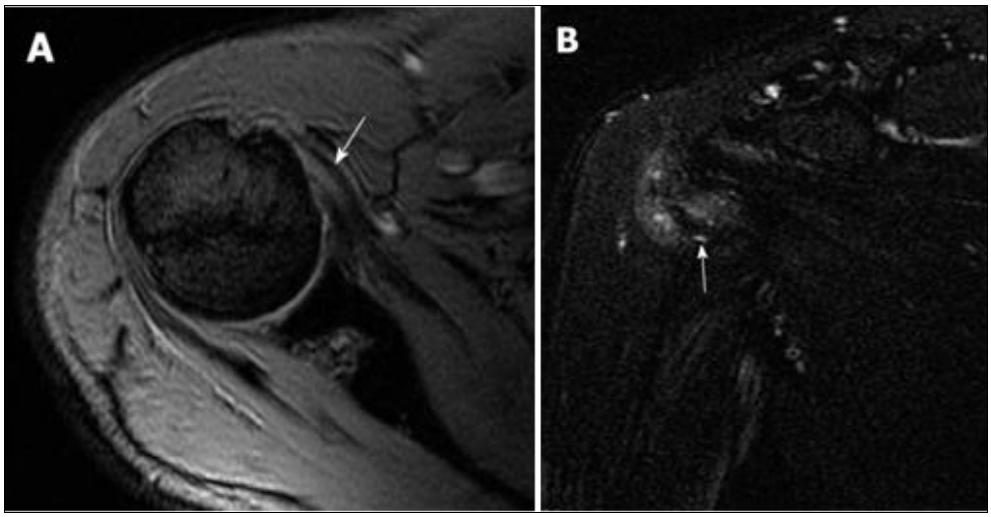


Fig 7: Subcapsularis tendinosis. a) axial section image showing focal hyperintensity within subscapularis tendon with fibres thickening. b) Coronal oblique fat sat image showing high signal within lower fibres of subscapularis tendon.

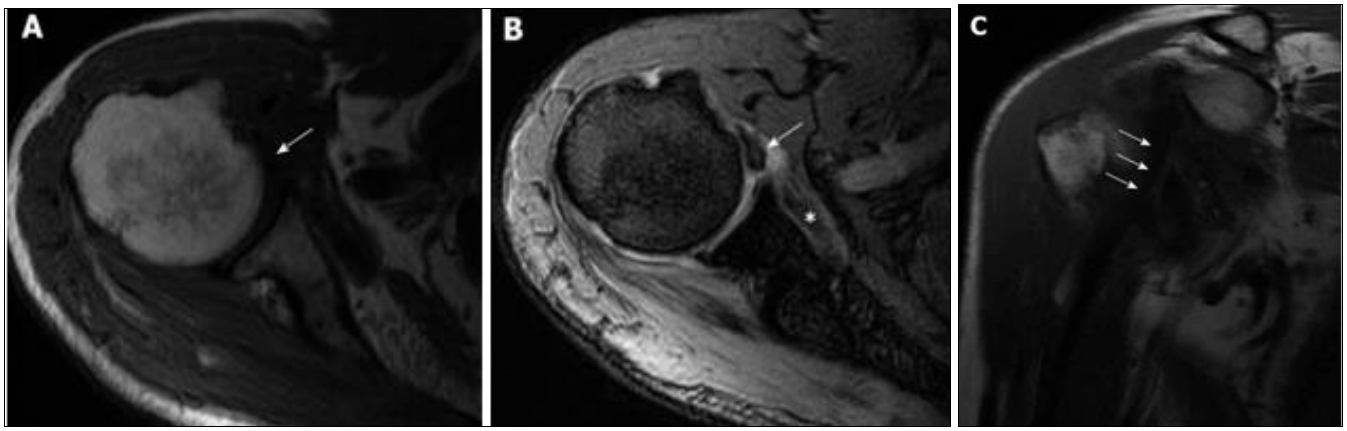


Fig 8: a) Axial T_1 weighted image, b) Axial gradient echo image, c) coronal oblique T_1 weighted image show complete tear of subscapularis tendon with tendinous thickening and high signal.

The least commonly involved tendon being teres minor, the trend showed 1 out of 3 patients (33%) involvement by tendinosis and 2 out of 3 (66%) by partial tears. In the study conducted, no incidence of complete tears of teres minor muscles were found.

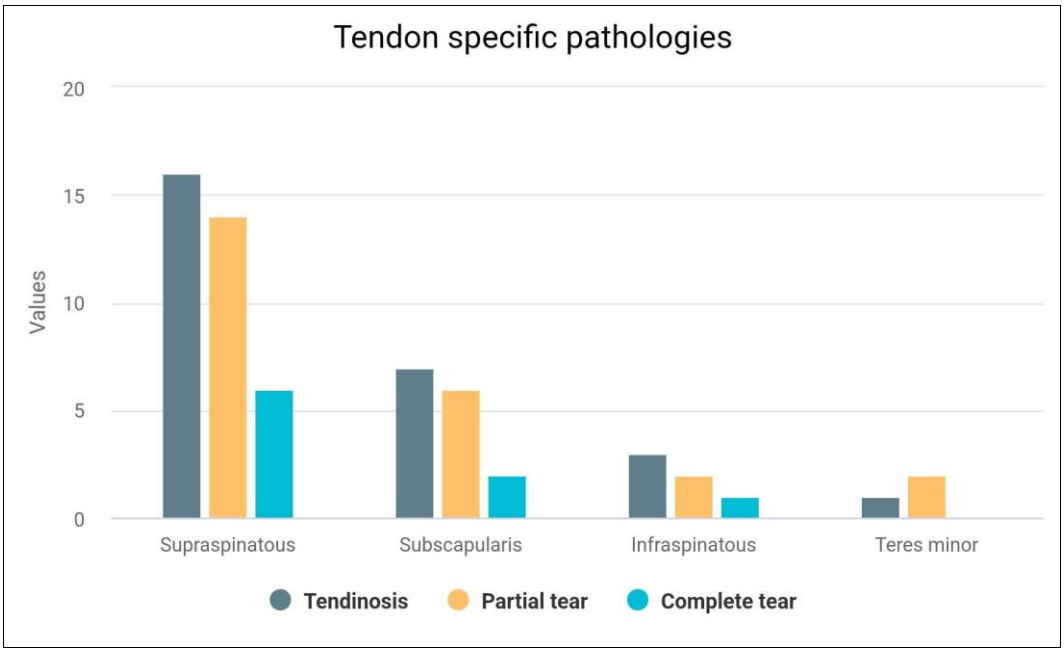


Fig 9: Tendon specific lesions in the study population

Conclusion

MRI has a very important role in diagnosis, grading, evaluation and treatment planning of injuries of rotator cuff, the fact that is further confirmed by the above study [6]. It is therefore sensible to conclude that it be used as a first line modality in suspected cases of rotator cuff tears and lesions. MRI provides valuable information to the referring clinician or surgeon regarding the status of tendons, bones and joints. A thorough knowledge of rotator cuff architecture, function and disease processes is also required.

Acknowledgement

Not available.

Author's Contribution

Not available.

Conflict of Interest

Not available.

Financial Support

Not available.

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How to Cite This Article
Rathod P, Rajput MD, Sangat D. Role of magnetic resonance imaging in rotator cuff lesions. International Journal of Radiology and Diagnostic Imaging. 2024;7(2):13-19.