



## EVALUATING SHOULDER JOINT PATHOLOGIES USING MRI: A PROSPECTIVE STUDY IN A TERTIARY CARE SETTING

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### Abstract

**Background:** Shoulder joint pain is a common musculoskeletal complaint, posing diagnostic challenges due to the complex anatomy and diverse pathologies of the shoulder. This study aims to evaluate the efficacy of Magnetic Resonance Imaging (MRI) in diagnosing various shoulder joint pathologies.

**Methods:** A prospective analysis was conducted at a tertiary care hospital, involving 100 patients with shoulder joint pain. The study spanned from January 2019 to December 2019. Patients aged 18 to 80 years, referred for shoulder MRI, were included, excluding those with metallic prostheses or known metabolic bone disorders. MRI examinations were performed using a GE Signa 1.5 Tesla system, and the data were analyzed using R software.

**Results:** The study group was predominantly male (78%), with the highest incidence of shoulder pathologies in the 21-30 age group (29%). The Supraspinatus tendon was most commonly affected (69% of cases). MRI findings included tendon tears, tendinosis, and joint effusions, with osteoarthritis of the acromioclavicular joint being the most common bone pathology (40%). Labral pathologies like Cartilaginous Bankart lesions were also significant.

**Conclusion:** MRI proves to be a crucial diagnostic tool in evaluating shoulder pathologies, offering detailed insights into soft tissue structures. The study highlights the prevalence of rotator cuff disorders, particularly in younger males. Future research with larger sample sizes and diverse populations is recommended for broader insights.

**Keywords:** Shoulder Pain, MRI, Rotator Cuff Disorders, Tendon Pathologies, Orthopedics, Diagnostic Imaging.

### AIMS AND OBJECTIVES

1. To study the pathologies of shoulder amongst the patients presenting with shoulder joint pain using MRI.
2. To classify of shoulder pathologies in terms of age, gender and symptoms amongst the patients

presenting with shoulder joint pain using MRI.

## INTRODUCTION

Shoulder joint pain is a prevalent musculoskeletal complaint, presenting a diagnostic challenge due to the complexity of shoulder anatomy and the wide array of potential pathologies. This study is anchored on the premise that Magnetic Resonance Imaging (MRI) plays a crucial role in the accurate diagnosis of these pathologies, offering unparalleled insights into soft tissue structures.

The shoulder joint, being one of the most mobile joints in the human body, is susceptible to various injuries and degenerative changes. Shoulder pain is the third most common musculoskeletal complaint in the general population, and accounts for 5% of all musculoskeletal consultations. It is second only to knee pain for referrals to the Orthopedics. Shoulder pain can be acute or chronic. Nonacute shoulder pain is a common medical condition, particularly in middle-aged and older adults<sup>1,2</sup>.

Conditions such as rotator cuff tears, impingement syndromes, labral tears, arthritis, bursitis, and even less common pathologies like infections or tumors, can all manifest as shoulder pain. Traditional diagnostic methods, including physical examination and conventional radiography, often fall short in providing a comprehensive view of these complex pathologies. With the development of new arthroscopic techniques for treating rotator cuff disorders, magnetic resonance imaging (MRI) has played an increasingly important role as a noninvasive test for determining which patients may benefit from surgery.<sup>3,4,5,6</sup> Although magnetic resonance imaging findings may be diagnostic in some cases, clinical co-relation with history and physical examination findings is critical.<sup>7</sup> MRI has become the gold standard for detecting both subtle and obvious internal derangement assessing overall joint structure. MRI is an excellent modality because of its multiplanar capability. MRI can provide information about rotator cuff disorders such as tendinosis, calcific tendinitis, tears, muscle atrophy and involvement of adjacent structures such as rotator interval, long head of biceps brachii tendon, all of which have implications for rotator cuff treatment and prognosis.<sup>8</sup>

The intricacy of shoulder pathologies and their prevalence across various age groups and genders necessitate a thorough investigation using advanced imaging techniques like MRI. This prospective study, conducted in a tertiary care setting, is designed to assess the range of shoulder pathologies in patients experiencing shoulder pain, exploring how these vary across different demographics and clinical presentations. By doing so, we aim to reinforce the pivotal role of MRI in the diagnostic algorithm of shoulder joint pathologies, potentially leading to more effective and tailored therapeutic interventions.

## MATERIALS & METHODS

This study was a prospective analysis conducted at [Your Hospital's Name], a tertiary care hospital, over a period from January 2019 to December 2019. The primary aim was to evaluate the pathologies of the shoulder joint in patients presenting with shoulder pain using Magnetic Resonance Imaging (MRI). We received approval from the Institutional Ethics Committee and the MUHS, ensuring all ethical guidelines and standards were strictly followed. Our study comprised 100 patients, who visited the orthopedic outpatient department (OPD) with shoulder pain and were clinically suspected to have shoulder pathologies. These patients were then referred to our department for further MRI examination.

Prior to the MRI examination, a thorough history was taken, and a clinical examination was conducted for each patient. The inclusion criteria for our study were as follows: patients of any gender, aged between 18 and 80 years, who were referred to the Radiodiagnosis Department for a shoulder MRI. We excluded patients with known metabolic bone disorders, those with metallic prostheses (like cardiac pacemakers or cochlear implants), patients with claustrophobia, those unwilling to undergo imaging, and patients with various implanted devices such as neural stimulators, brain aneurysmal clips, cochlear implants, ferromagnetic ocular foreign bodies, or other implanted medical devices like the Swan Ganz catheter, insulin pumps, metal shrapnel, or bullets.

Informed consent was obtained from each participant. This consent included the use of their imaging data for the study, with the assurance of adherence to privacy and confidentiality norms as outlined in Appendices I and II. The MRI examinations were performed using a GE Signa 1.5 Tesla MRI system. Our MRI protocol included various sequences: Survey or localizer sequence for planning, Coronal Oblique Proton Density (PD), Sagittal Oblique PD, Axial PD, Coronal T1-Weighted (T1W), Sagittal Oblique T2, Axial T2-Weighted (T2W), Coronal Oblique Short Tau Inversion Recovery (STIR), and Axial Gradient Recalled Echo (GRE).

For data analysis, we meticulously compiled the collected data on an MS Office Excel Sheet (version 2021). This data was then subjected to statistical analysis using R software. Our statistical methodology included descriptive statistics like frequencies, percentages for categorical data, and mean & standard deviation (SD) for numerical data. We set the level of statistical significance at  $p < 0.05$ , with an  $\alpha$  error of 5% and a  $\beta$  error of 20%, thereby providing a power of 80% to our study.

**OBSERVATIONS AND RESULTS**

In this study examining the use of MRI in patients with shoulder joint pain, the demographic and clinical characteristics of the 100 participants are presented in a detailed manner. The patient population is diverse, spanning various age groups, with a notable distribution across both shoulders and a significant skew towards male patients.

Age-wise, the participants are segmented into seven distinct groups ranging from 11 to 80 years. The predominant age group is 21-30 years, encompassing 29% of the total study cohort with 29 individuals. Following this, the 31-40 years age bracket comprises 19% of the sample, equating to 19 patients. The next two age groups, 41-50 and 51-60 years, are fairly close in representation, with 18 patients (18%) in the former and 15 patients (15%) in the latter. Both the youngest (11-20 years) and the 61-70 years groups each consist of 9 patients, forming 9% of the total population individually. The least represented age category is the 70-80 years group, with just a single individual, making up 1% of the participants.

Regarding the affected shoulder, the data indicates a higher incidence of right shoulder pain, affecting 58% of the patients (58 individuals). Conversely, the left shoulder is implicated in 42% of the cases (42 patients).

The gender distribution within the study presents a notable male predominance. Male patients constitute a substantial 78% of the total, accounting for 79 individuals. Female patients, on the other hand, represent 21% of the study group, totaling 21 participants.

**Table 1:** Demographic and Clinical Characteristics of Patients in the MRI Shoulder Joint Pain Study

Demographics	Number of patients	%	
<b>Age in years</b>	11-20	9	9
	21-30	29	29
	31-40	19	19
	41-50	18	18
	51-60	15	15
	61-70	9	9
	70-80	1	1
<b>Affected shoulder</b>	Left	42	42
	Right	58	58
<b>Gender</b>	Male	79	78
	Female	21	21

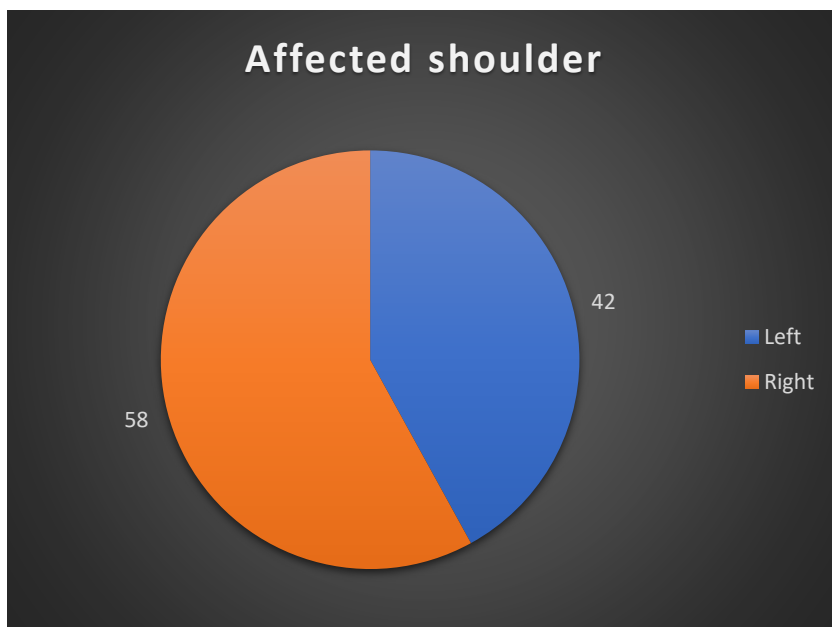


Figure 1: Affected side of shoulder

Table 2: MRI Findings in Shoulder Tendon Pathologies Among Patients with Shoulder Joint Pain

	Supraspi natus	Infraspi na tus	Subscap ularis	Teres minor	Biceps tendon
<b>Partial tear</b>	29	2	1	0	0
<b>Complete tear</b>	8	1	0	0	0
<b>Tendinosis</b>	38	2	5	1	0
<b>Edema</b>	2	0	0	0	0
<b>Sprain</b>	2	1	1	1	0
<b>Normal</b>	<b>21</b>	<b>94</b>	<b>93</b>	<b>98</b>	<b>100</b>

In this comprehensive analysis of shoulder tendon pathologies among 100 patients with shoulder joint pain, MRI findings reveal a varied incidence of conditions across different tendons. The Supraspinatus tendon exhibited the most diverse range of pathologies. Partial tears were noted in 29 patients, and complete tears were observed in 8 cases. Tendinosis, indicating tendon degeneration, was particularly prevalent in this group, affecting 38 patients. Additionally, 2 cases each of edema and sprain were identified, while 21 patients showed a normal Supraspinatus tendon.

In contrast, the Infraspinatus and Subscapularis tendons demonstrated fewer abnormalities. The Infraspinatus tendon had 2 instances of partial tears, 1 of complete tear, 2 of tendinosis, and 1 sprain, with the majority of patients (94) showing normal tendon condition. The Subscapularis tendon presented with just 1 partial tear, 5 cases of tendinosis, 1 sprain, and 1 edema, leaving 93 patients with a normal tendon.

The Teres Minor tendon showed the least variation, with 98 patients having a normal tendon, 1 patient with tendinosis, and 1 with a sprain. Remarkably, the Biceps Tendon was consistently normal across all 100 patients, with no instances of tears, tendinosis, edema, or sprain.

Table 3: Comprehensive Analysis of Shoulder Joint Pathologies in Patients Undergoing MRI

Shoulder joint Pathologies		Number of patients	%
<b>TENDON INVOLVED</b>	Supraspinatus	69	69
	Supraspinatus+ Subscapularis	7	7
	Supraspinatus+ Infraspinatus	2	2
	Supraspinatus+ Teres minor	0	0
	Supraspinatus+ Infraspinatus+ Subscapularis	1	1
	Normal tendon	21	21
<b>EFFUSION</b>	Joint effusion	14	14

	Bicipital groove fluid	8	8	
	Bursal	16	16	
	Joint and Bicipital groove	8	8	
	Joint and Bursal	8	8	
	Bicipital Groove and bursal	11	11	
	Effusion in all spaces	20	20	
	No effusion	15	15	
<b>Bone pathologies</b>	Osteoarthritis of acromioclavicular joint	40	40	
	Osteoarthritis of glenohumeral joint	9	9	
	Hill Sachs	19	19	
	Edema	13	13	
	Acromioclavicular subluxation	9	9	
	Acromioclavicular dislocation	0	0	
	Glenohumeral subluxation	2	2	
	Glenohumeral dislocation	0	0	
	Osteomyelitis	4	4	
	Fracture	1	1	
	Contusion	4	4	
	Avulsion fracture	4	4	
	Benign tumor	1	1	
	Malignant tumor	1	1	
	<b>All pathologies of shoulder joint</b>	Rotator cuff disease	79	79
		Glenohumeral joint instability	19	19
Labral injuries		19	19	
Traumatic injuries		30	30	
Degenerative pathologies		44	44	
Adhesive capsulitis		43	43	
Acromioclavicular joint pathologies		49	49	
Infectious pathologies		4	4	
Bursitis		4	4	
Inflammatory etiology		1	1	
<b>Acromio-clavicular pathologies</b>	Degenerative	40	40	
	Subluxation	9	9	
	Dislocation	0	0	

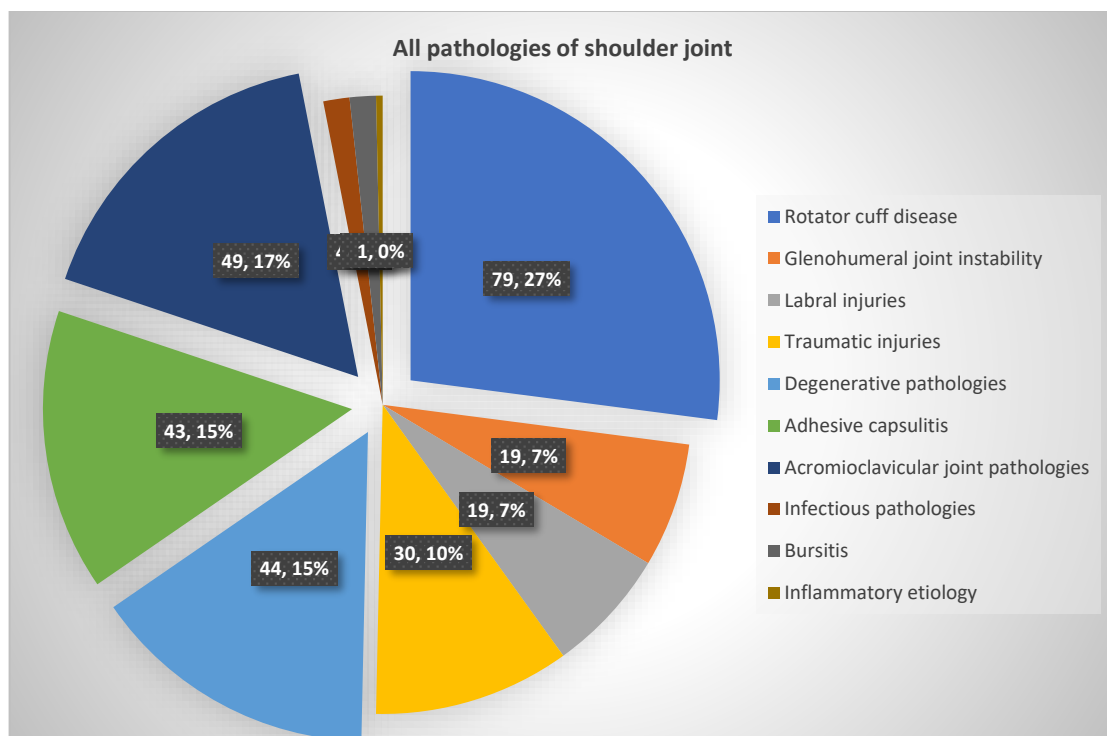


Figure 2: Pie diagram showing All pathologies of Shoulder

**Table 4:** Distribution and Characteristics of Labral Pathologies in MRI Shoulder Study

Labral Pathologies	Number of patients	% among all studied patients	% wise distribution among only labral pathologies
Bony Bankart	3	3	16
Cartilaginous Bankart	11	11	58
SLAP tear	2	2	10
Perthes lesion	2	2	11
GLAD	1	1	5

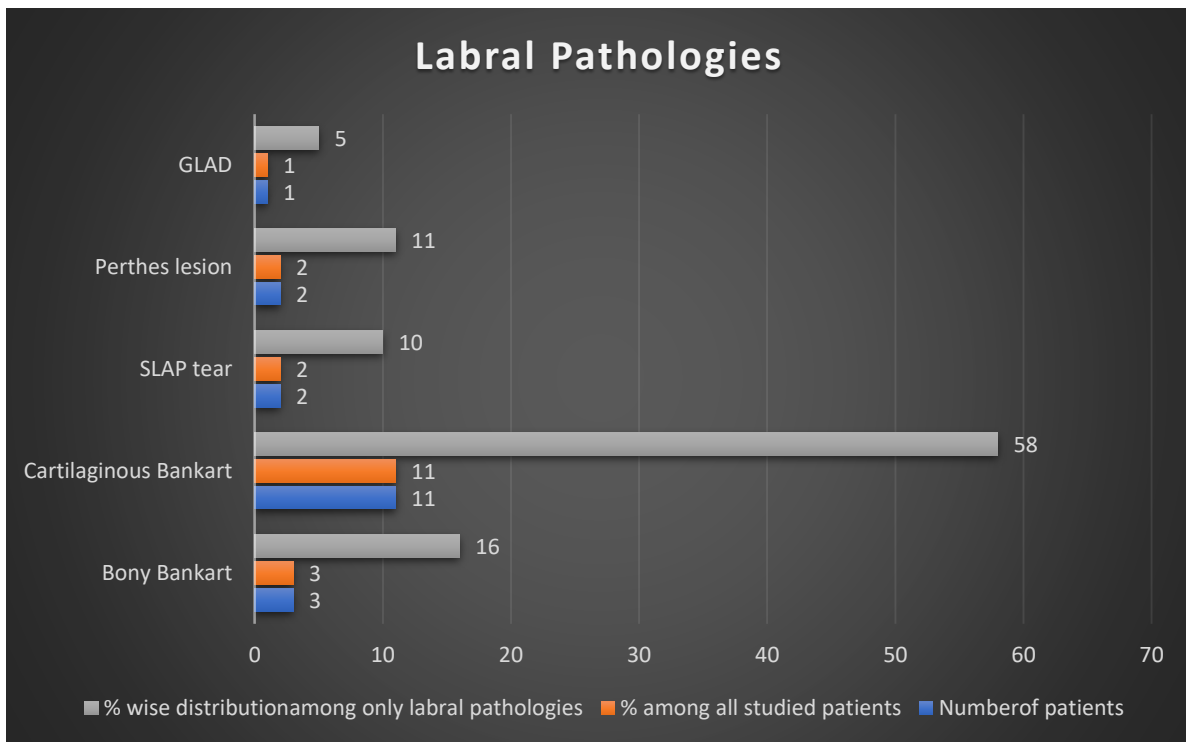
Labral pathologies are critical in understanding shoulder dysfunctions, and the data is presented in terms of the number of patients affected, the percentage of these pathologies in the total studied patient group, and their distribution percentage among only labral pathologies.

The most common labral pathology identified was the Cartilaginous Bankart lesion, found in 11 patients, constituting 11% of the total study population and representing 58% of the labral pathologies. This type of lesion indicates a detachment of the labrum and adjacent cartilage from the glenoid, commonly associated with shoulder dislocation.

Bony Bankart lesions, which involve a bony injury to the glenoid along with the labral tear, were observed in 3 patients. This accounts for 3% of the overall study group and 16% of the labral pathologies. These lesions are significant as they often necessitate surgical intervention due to the involvement of bone.

SLAP (Superior Labrum Anterior and Posterior) tears, involving the superior part of the labrum, were found in 2 patients. This represents 2% of the total patient cohort and 10% of labral pathologies. These tears are particularly important as they can affect the attachment of the biceps tendon.

Perthes lesions, characterized by a labral tear with an intact periosteum, were also identified in 2 patients. This accounts for 2% of all patients and 11% of the labral pathologies. This type of lesion can often be mistaken for a normal variant, thus highlighting the importance of detailed MRI analysis. Lastly, the GLAD (Glenolabral Articular Disruption) lesion, a combination of a superficial tear of the anterior labrum and articular cartilage injury, was found in 1 patient, making up 1% of the total and 5% of labral pathologies. This rare lesion is indicative of anterior shoulder instability.



**Figure 3:** Bar diagram showing Labral pathologies of Shoulder

## DISCUSSION

This study comprehensively evaluated the role of Magnetic Resonance Imaging (MRI) in diagnosing shoulder joint pathologies, emphasizing its superiority over conventional imaging techniques. MRI, especially with the advent of surface coils, has established itself as a sensitive and specific modality for assessing musculoskeletal abnormalities. The direct multiplanar imaging capability of MRI is notably superior to the single plane capability of computed tomography (CT), particularly for the complex soft tissue structures of the shoulder.

Our study involved 100 patients experiencing shoulder joint pain, with a diverse age range from 18 to 80 years and a mean age of  $39.36 \pm 1.484$  years. The peak incidence of rotator cuff disorders was found in the second and third decades of life, aligning with various literature, including Needell et al.'s study on asymptomatic shoulders, which reported a higher incidence of tendinosis in younger populations and more tears in older age groups.<sup>9</sup> Consistent with these findings, our study observed a higher frequency of tendinosis in younger patients and an increase in degenerative diseases with age. Traumatic injuries and glenohumeral instability were also more prevalent in younger patients. The gender distribution in our study indicated a male predominance (79% male, 21% female), echoing Chaudhari P.'s findings of a higher incidence in males.<sup>10</sup> The right shoulder was predominantly affected (58%), supporting Urwin M. et al.'s conclusion of a higher prevalence of rotator cuff tears in the dominant arm.<sup>11</sup>

MRI findings revealed that the Supraspinatus tendon was the most commonly affected, followed by Subscapularis and Infraspinatus, with the Teres minor being the least involved. This finding is consistent with Jerosch et al.'s study, which also found the Supraspinatus to be the most frequently affected tendon.<sup>12</sup> DePalma et al.'s examination of cadaver shoulders corroborated this, showing an increase in incidence and degree of tear with age.<sup>13</sup>

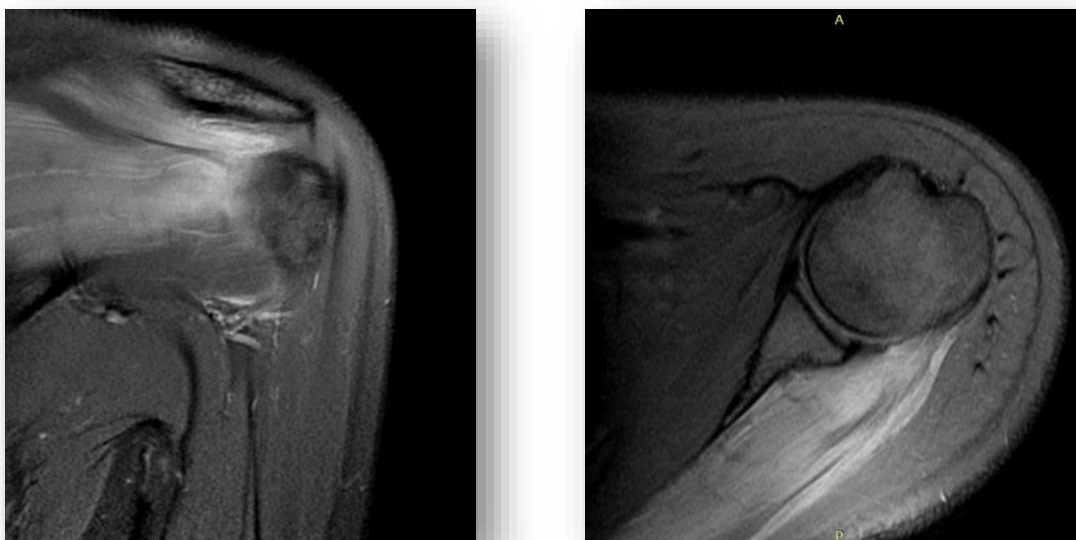
Our study also highlighted various types of tendinopathies, characterized by moderately hyperintense signals within the tendon on T1 weighted images and proton density images, aligning with the characteristics described in previous literature.<sup>14-19</sup> We noted that 38% of Supraspinatus tendons, 2% of Infraspinatus, 5% of Subscapularis, and 1% of Teres minor tendons showed signs of tendinosis. Regarding full-thickness tears, our findings showed a 9% incidence, predominantly in the Supraspinatus tendon. This is in line with Farley et al.'s study, which also noted retraction as a common finding in full-thickness tears.<sup>20</sup>

The study also delved into acromioclavicular joint anatomy and pathology, observing a distribution of acromion types consistent with Bigliani and colleagues' classification.<sup>21</sup> Osteoarthritis of the acromioclavicular joint was a common occurrence, as also observed in studies by Hari Ram, Ravinder Kumar, and Link TM et al.<sup>22,23</sup>

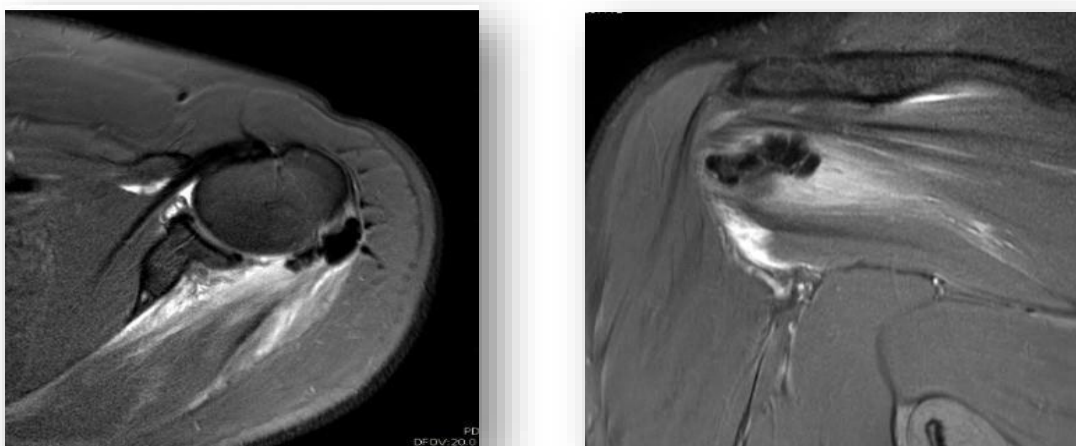
Bone pathologies like edema, osteoarthritis, contusion, avulsion fracture, and infective etiologies such as osteomyelitis were also noted, aligning with Hari Ram, Ravinder Kumar's findings.<sup>22</sup> Labral pathology and Hill Sachs lesions were present in 19% of cases, consistent with findings in the studies by Dr. Shailaja Prashanth, Dr. Naveen Kumar, and Runkel et al.<sup>24-25</sup>

Our study's results underscore the importance of MRI as a diagnostic tool for shoulder pain, offering comprehensive visualization and accurate identification of various pathologies. MRI's sensitivity to alterations in bone marrow and fluid in joint spaces makes it a preferred choice over plain radiography and bone scintigraphy for shoulder evaluations. The study corroborates the growing body of research supporting MRI's effectiveness in diagnosing a wide spectrum of shoulder disorders, affirming its status as an indispensable tool in orthopedic diagnostics.





**Figure 4:** A. axial PD fat sat and B. coronal PD fat sat image of shoulder showing edematous infraspinatus muscle suggestive of Parsonage turner syndrome.



**Figure 5:** A. axial PD fat sat and B. coronal PD fat sat image of shoulder shows focal areas of low signal typically located near the infraspinatus tendon insertion with adjacent peri calcific inflammation.

## CONCLUSION

This study highlights the importance of Magnetic Resonance Imaging (MRI) in diagnosing shoulder joint pain, encompassing a varied group of 100 patients. The findings indicate a higher incidence of shoulder pathologies in younger males, particularly in rotator cuff disorders like Supraspinatus tendon involvement. MRI's superior capability in revealing these pathologies surpasses traditional imaging methods, especially in soft tissue assessment.

However, the study has limitations, including its sample size and lack of longitudinal follow-up, which could provide further insights into pathology progression and treatment efficacy. Additionally, a more in-depth correlation between MRI findings and clinical outcomes would be beneficial.

Future studies should aim for larger, more diverse populations and longitudinal research to expand these findings. Correlating MRI results with clinical outcomes and exploring advanced MRI



techniques could enhance diagnostic accuracy and patient care in orthopedics. This study underlines the critical role of MRI in orthopedic diagnostics, paving the way for improved clinical practices.

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