Original Article

Assessment of Shoulder Joint Derangements with Magnetic Resonance Imaging in Adult Nigerians

Abstract

Objectives: Shoulder pain secondary to various aetiologies is a common musculoskeletal complaint worldwide, and Magnetic Resonance Imaging (MRI) is the most accurate imaging method for evaluating shoulder pain in all age groups. While the patterns of shoulder MRI abnormalities in various demographics have been reported, data on sub-Sahara African populations are still sparse. This study aims to describe the imaging features and spectrum of shoulder joint pathologies on MRI in adult Nigerians. **Materials and Methods:** This was a retrospective review of the shoulder MRI of 100 adult Nigerians (with and without trauma) from September 2020 to December 2021. Their clinical data and shoulder MRI findings were extracted and analysed. Statistical significance was set at $P \leq 0.05$. **Results:** There were 64 males and 36 females aged 18–82 years. Right shoulder MRI was done in 53 subjects (53%), while the left shoulder was studied in 47 (47%). Supraspinatus tendinopathy (73%), acromioclavicular joint arthropathy (68%), and subacromial-subdeltoid (SASD) bursitis (64%) were the most frequently detected pathologies. Other demonstrated derangements include glenohumeral joint effusion (24%), long head of biceps tendon sheath effusion (18%), labral abnormalities (16%), subcoracoid bursitis (4%), Hill Sach's deformity (3%), anterior glenohumeral dislocation (2%), fatty degeneration of the supraspinatus/infraspinatus muscles (2%), adhesive capsulitis (1%), and other bony abnormalities (contusion, erosion, subchondral cysts). There was no significant difference in the frequency of shoulder abnormalities between the male and female subjects. **Conclusion:** Acromioclavicular joint arthropathy, SASD bursitis, and rotator cuff disorders were the dominant pathologies in the participants' shoulders.

Keywords: *Acromioclavicular joint, bursitis, internal derangement, magnetic resonance imaging, rotator cuff tendons and muscles, shoulder joint*

Bukunmi Michael Idowu, Stephen Olaoluwa Onigbinde[1], Babalola Ishmael Afolabi[2], Oghenetejiri Denise Ogholoh[3], Nkem Nnenna Nwafor[4], Tolulope Adebayo Okedere[5]

Department of Radiology, Union Diagnostics and Clinical Services Plc, Yaba, Lagos State, Nigeria, [1]Department of Anatomical Sciences, School of Medicine, St George's University, Grenada, [2]Department of Radiology, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Osun State, [3]Department of Radiology, Delta State University Teaching Hospital, Oghara, Delta State, [4]Department of Radiology, Faculty of Clinical Sciences, College of Health Sciences, University of Uyo, Uyo, Akwa Ibom State, [5]Department of Radiology, Clinix HealthCare, Festac Town, Lagos State, Nigeria

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Address for correspondence:
Dr. Tolulope Adebayo Okedere, Department of Radiology, Clinix HealthCare, 6 Ago Palace Way, Festac Town, Lagos State, Nigeria.
E-mail: okederetolulope@gmail.com

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Introduction

Optimal shoulder function is vital for everyday activities, because of the complicated anatomy of the shoulder joint, diagnosis of shoulder dysfunction can be challenging.[1] Clinical testing shows only moderate diagnostic accuracy for rotator cuff tears and other shoulder pathologies.[2]

Magnetic resonance imaging (MRI) is regarded as the standard imaging modality for many shoulder abnormalities due to its brilliant representation of soft tissue.[3,4] The spectrum of shoulder injuries is influenced by occupation and background systemic diseases.[5-7]

Shoulder pathologies that can be detected on MRI include articular cartilage defects, tendon impingement or tears or dislocation, adhesive capsulitis, labral tears, muscle abnormalities, neoplasms, post-surgical changes, and more[4,8] Non-invasiveness, lack of contrast exposure, non-ionising radiation, high resolution, and the ability to investigate a wide range of probable pathologic processes are just a few of the advantages of MRI.[9]

For patients with shoulder complaints, imaging could help to elucidate the cause, guide therapy (e.g., image-guided intervention), guide surgical approach (open versus arthroscopic), and for post-operative monitoring.[9,10]

Although MRI scanners are gradually becoming more available in Nigeria,[11,12] spine and brain MRIs still constitute the bulk MRI requests. Shoulder MRI requests accounted for only 0.2%–4.3% of all MRI requisitions in previous studies.[13,14] In Nigeria, MRI is still limited by factors like non-availability, frequent breakdowns,

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prohibitive cost, and low-field strength machines. Consequently, there is a lack of data on the MRI features of internal joint derangement in Nigerians.

Our literature search yielded no previous shoulder MRI study in Nigerians. Therefore, it became imperative to embark on this study to generate local data on the imaging features and spectrum of shoulder joint pathologies. This might be useful to radiologists, sports medicine physicians, orthopaedic surgeons, and physiotherapists. The objective of this study was to establish the prevalence, pattern, and spectrum of shoulder joint pathologies on MRI in our environment and juxtapose them to what had been reported in other climes.

Materials and Methods

This was a descriptive retrospective study—a review of the electronic radiological records of 100 patients who had undergone shoulder MRI in Lagos, Nigeria. The research ethics committee (UUTH/AD/S/96/VOL.XXI/440) approved the study protocol before the commencement of the study. Informed consent was waived because of the retrospective study design.

The inclusion criterion was all adult Nigerian patients with complete clinical information, MRI images, and radiologists' reports of shoulder MRI studies from September 2020 to December 2021. The exclusion criteria were inadequate clinical data, previous shoulder joint surgery, poor quality/degraded/incomplete MRI images, and incomplete study/inconclusive report.

The MRI scans (without gadolinium contrast) were performed on a 1.5 Tesla General Electric Optima MR scanner (GE Healthcare, Chicago, IL, USA) with a shoulder coil. Established standard scanning protocols were followed.[15] Image interpretation and diagnostic criteria adhered to the published glossary of terms, classifications, and criteria.[10,16-18]

The clinical history, biodata, and shoulder MRI findings were extracted into an Excel spreadsheet (Microsoft, Redmond, WA, USA) and analysed with IBM SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies and percentages. Mean values were compared with Student *t* test, while percentages were compared with Chi-square test and likelihood ratio test (for percentages <5). Statistical significance was $P \leq 0.05$.

Results

There were 100 subjects comprising 64 males and 36 females aged 18–82 years. The mean age was 46.61 ± 12.2 years. There was no statistically significant difference between the mean age of the male (45.66 ± 12.4 years) and female (48.31 ± 11.7 years) participants ($P = 0.298$). About 49 participants were <47 years old, while 51 were ≥47 years old.

The presenting complaints include pain (92; 92%), pain with restricted range of motion (6; 6%), pain and swelling (1; 1%), and restricted range of motion only (1; 1%). There was a history of trauma in 51 subjects (51%; 27 right shoulders and 24 left shoulders). The right shoulder was examined with MRI in 53 subjects (53%), while the left shoulder was studied in 47 (47%).

The glenoid labrum was normal in 84 subjects (84%), showed degenerative fraying in six (6%), and was torn in 10 subjects (10%). The labral tears and degenerative changes (except one tear and one degenerative change) were all seen in subjects older than 40 years.

The acromioclavicular joint (ACJ) was normal in 32 subjects (32%). The ACJ pathologies seen include ACJ capsular hypertrophy without subacromial impingement (13; 13%), ACJ hypertrophy with subacromial impingement (9; 9%), ACJ degenerative osteoarthritis (45; 45%), and ACJ dislocation (1; 1%).

There were 64 cases (64%) of subacromial-subdeltoid (SASD) bursitis and four cases (4%) of subcoracoid bursitis. There were 18 cases of long head of biceps tendon sheath effusion and only two of these were seen in subjects <40 years old. Glenohumeral joint (GHJ) effusion was present in 24 subjects (24%).

There was one instance of synovial thickening at the rotator cuff interval diagnosed as adhesive capsulitis. One case each of supraspinatus muscle fatty degeneration and infraspinatus muscle fatty degeneration was recorded. The anterior glenohumeral dislocation was present in 2 subjects (2%) and both cases were post-trauma.

The humeral head was normal in 78 subjects (78%). The humeral head abnormalities detected include Hill Sach's deformity (3; 3%), subchondral cysts (9; 9%), humeral head contusion/ bone oedema (3; 3%), and bone erosion (7; 7%).

About 92 participants (92%) had normal glenoid processes. Glenoid contusion/bone oedema (5; 5%) and Bankart's lesion (3; 3%) were seen in the remaining glenoid processes. There was one case of deltoid muscle tear. The subscapularis, teres minor, and biceps brachii muscles were normal in all the participants. The articular cartilage was normal in all the subjects.

Table 1 is a summary of the shoulder MRI abnormalities detected in the study population. SASD bursitis, subscapularis tendon disorders, and glenohumeral joint (GHJ) effusion were significantly more prevalent in participants older than 47 years (47 years was used as cut-off because the mean age of all participants was 46.6 years) [Table 2]. Table 3 shows the types of tendon abnormalities. Partial-thickness tear was the most prevalent abnormality affecting the rotator cuff tendons. Tendinopathy most frequently affects the supraspinatus tendon (SST) and subscapularis tendon (SCT).

Table 1: Shoulder MRI abnormalities in the study population

Parameters	Frequency	Percentage (%)
SST tendinopathy	73	73%
ACJ abnormality	68	68%
SASD bursitis	64	64%
SCT tendinopathy	34	34%
IFST tendinopathy	24	24%
GHJ effusion	24	24%
Humeral head abnormality	22	22%
LHBT tendinopathy	19	19%
LHBT sheath effusion	18	18%
Labral abnormality	16	16%
Glenoid abnormality	8	8%
TMT tendinopathy	4	4%
Subcoracoid bursitis	4	4%
AGD	2	2%
Adhesive capsulitis	1	1%
Deltoid muscle tear	1	1%
SSM fatty degeneration	1	1%
IFSM fatty degeneration	1	1%

ACJ: acromioclavicular joint, AGD: anterior glenohumeral dislocation, GHJ: glenohumeral joint, LHBT: long head of the biceps tendon, IFSM: infraspinatus muscle, IFST: infraspinatus tendon, SASD: subacromial-subdeltoid, SCT: subscapularis tendon, SSM: supraspinatus muscle, SST: supraspinatus tendon, TMT: teres minor tendon

Table 2: Shoulder MRI abnormalities by age

Parameters	<47 years (*N* = 49) *n* (%)	≥47 years (*N* = 51) *n* (%)	*P* value
SASD bursitis	25(51.0%)	39(76.5%)	0.042*
Subcoracoid bursitis	1(2.0%)	3(5.9%)	0.430
Labral abnormality	6 (12.2%)	10 (19.6%)	0.438
ACJ abnormality	31(63.3%)	37(72.5%)	0.397
SST tendinopathy	32(65.3%)	41(80.4%)	0.008*
SCT tendinopathy	13(26.5%)	21(41.2%)	0.135
IFST tendinopathy	7(14.3%)	17(33.3%)	0.180
TMT tendinopathy	0(0)	4(7.8%)	0.062
LHBT tendinopathy	7(14.3%)	12(23.5%)	0.174
GHJ effusion	6(12.2%)	18(35.3%)	0.007*
Humeral head abnormality	12(24.5%)	10(19.6%)	0.077
Glenoid abnormality	6(12.2%)	2(3.9%)	0.095

*Statistically significant at $P < 0.05$
ACJ: acromioclavicular joint, GHJ: glenohumeral joint, LHBT: long head of the biceps tendon, IFST: infraspinatus tendon, SASD: subacromial-subdeltoid, SCT: subscapularis tendon, SST: supraspinatus tendon, TMT: teres minor tendon
**47 years was used as cut-off because the mean age of all participants was 46.6 years

There was no statistically significant difference in the frequency of shoulder abnormalities between the male and female subjects. SASD bursitis was significantly more prevalent in the right shoulder, while the left shoulder had a significantly higher proportion of SST, SCT, and infraspinatus (IFST) tendon abnormalities [Table 4]. SASD bursitis and rotator cuff tendon abnormalities (SST, SCT, IFST) were significantly more prevalent in the post-traumatic shoulders [Table 5]. Figures 1–4 are illustrative cases of the preponderant MRI findings.

Discussion

Shoulder symptoms, secondary to shoulder disorders, are common in clinical practice. Shoulder pain is the third most frequent musculoskeletal complaint, affecting 7% to 26% of people.[19,20] This study intended to describe the internal derangements of the shoulder in adult Nigerians using MRI.

Acromioclavicular joint arthropathy (68%) and SASD bursitis (64%) were the most frequently detected pathologies. Rotator cuff tendon tears (SST = 55%, SCT = 23%, IFST = 19%, TMT = 3%) and rotator cuff tendon tendinopathy (SST = 18%, SCT = 11%, IFST = 6%, TMT = 1%) were also common.

In comparison, a previous clinic-radiographic study of shoulder pain syndrome in 66 Nigerians (using physical examination ± radiographs) identified adhesive capsulitis (36.4%), rotator cuff dysfunction (16.7%), and subacromial bursitis (10.6%) as the most common abnormalities. The drawback of clinical evaluation is instantiated by the inability to assign a specific diagnosis to 22.7% (15/66) of the patients.[21]

Rotator cuff tears (64.3%), subacromial bursitis (52.4%), Bankart's lesion (23.8%), synovial chondromatosis (11.9%), and SLAP lesion (9.5%) were the preponderant pathologies in the study by Ringshawl *et al*.[22] in Srinagar, India. The observed disparities might be partly due to their enrolment of only patients with chronic symptoms (defined as chronic shoulder pain for >6 weeks).

Similar to the findings of this study, acromioclavicular joint (ACJ) arthropathy was the most common finding (85%) by Mohamed *et al*.[23] in Shbine Elkoom, Egypt. Lalani and Shetti[24] in Karnataka, India, also reported ACJ arthropathy in 25% of 80 patients, while Chaudhary *et al*.[25] found ACJ arthrosis in 19.8% of 100 patients. MRI is an essential diagnostic tool for various ACJ pathologies, including ACJ degeneration (including acromial and clavicular spurs), sprain, ligament tears, capsular hypertrophy, joint effusion, and osteoarthritis. MRI offers simultaneous assessment of the ACJ, glenohumeral joint, and rotator cuff pathology (impingement).[16]

SASD bursitis was the second most common MRI finding in this study. The SASD bursa, the largest bursa in the body, has two component bursae (the subacromial and the subdeltoid) which, in 95% of people, communicate via a strip of connective tissue.[26] The bursa is most usually affected by shoulder disease.[16] SASD bursitis is often due

Table 3: Types of tendon abnormalities (tendinopathy)

Parameters	SST *n* (%)	SCT *n* (%)	IFST *n* (%)	TMT *n* (%)	LHBT *n* (%)
Normal	27 (27%)	66 (66%)	75 (75%)	96 (96%)	81 (81%)
Tendinosis	18 (18%)	11 (11%)	6 (6%)	1 (1%)	0
PTT	48 (48%)	23 (23%)	18 (18%)	3 (3%)	0
FTT	7 (7%)	0	1 (1%)	0	0
LHBTSE	NA	NA	NA	NA	18 (18%)
LHBTD	NA	NA	NA	NA	1 (1%)
Total	100	100	100	100	100

FTT: full-thickness tear, LHBT: long head of the biceps tendon, LHBTD: long head of the biceps tendon dislocation, LHBTSE: long head of the biceps tendon sheath effusion, IFST: infraspinatus tendon, PTT: partial-thickness tear, SCT: subscapularis tendon, SST: supraspinatus tendon, TMT: teres minor tendon

Table 4: Shoulder MRI abnormalities by laterality (right Shoulder vs. Left shoulder)

Parameters	Right (*N* = 53) *n* (%)	Left (*N* = 47) *n* (%)	*P* value
SASD bursitis	34 (64.2%)	30 (63.8%)	0.008*
Subcoracoid bursitis	2 (3.8%)	2 (4.3%)	0.639
Labral abnormality	10 (18.9%)	6 (12.8%)	0.313
ACJ abnormality	34 (64.2%)	34 (72.3%)	0.320
SST tendinopathy	36 (67.9%)	37 (78.7%)	<0.0001*
SCT tendinopathy	13 (24.5%)	21 (44.7%)	<0.0001*
IFST tendinopathy	9 (17.0%)	15 (31.9%)	0.002*
TMT tendinopathy	2 (3.8%)	2 (4.3%)	0.316
LHBT tendinopathy	10 (18.9%)	9 (19.1%)	0.239
GHJ effusion	11 (20.8%)	13 (27.7%)	0.294
Humeral head abnormality	12 (22.6%)	10 (21.3%)	0.068
Glenoid abnormality	1 (1.9%)	7 (14.9%)	0.953

ACJ: acromioclavicular joint, GHJ: glenohumeral joint, LHBT: long head of the biceps tendon, IFST: infraspinatus tendon, SASD: subacromial-subdeltoid, SCT: subscapularis tendon, SST: supraspinatus tendon, TMT: teres minor tendon
*Statistically significant at $P < 0.05$

Table 5: Shoulder MRI abnormalities from trauma

Parameters	Trauma (*N* = 51) *n* (%)	No Trauma (*N* = 49) *n* (%)	*P* value
SASD bursitis	39 (76.5%)	25 (51.0%)	0.008*
Subcoracoid bursitis	3 (5.9%)	1 (2.0%)	0.316
Labral abnormality	10 (19.6%)	6 (12.2%)	0.315
ACJ abnormality	37 (72.5%)	31 (63.3%)	0.320
SST tendinopathy	48 (94.1%)	25 (51%)	<0.0001*
SCT tendinopathy	20 (39.2%)	14 (28.6%)	<0.0001*
IFST tendinopathy	19 (37.3%)	5 (10.2%)	0.002*
TMT tendinopathy	3 (5.9%)	1 (2.0%)	0.316
LHBT tendinopathy	12 (23.5%)	7 (14.3%)	0.239
GHJ effusion	10 (19.6%)	14 (28.6%)	0.294
Humeral head abnormality	15 (29.4%)	7 (14.3%)	0.068
Glenoid abnormality	4 (7.8%)	4 (8.2%)	0.953

ACJ: acromioclavicular joint, GHJ: glenohumeral joint, LHBT: long head of the biceps tendon, IFST: infraspinatus tendon, SASD: subacromial-subdeltoid, SCT: subscapularis tendon, SST: supraspinatus tendon, TMT: teres minor tendon
*Statistically significant at $P < 0.05$

to rotator cuff disorder, ACJ arthropathy, synovitis, or rheumatoid arthritis. SASD bursitis has been demonstrated to contribute to pain in patients who undergo shoulder surgery and in the general populace.[16] Kvalvaag *et al*.[27] reported that bursitis co-existing with tendinosis leads to poorer outcome when managed conservatively. The reported prevalence of SASD bursitis in previous studies is 9%–60.7%.[22,23,25,28-30]

Rotator cuff tendon tears affected mainly the supraspinatus tendon (55%), followed by the subscapularis tendon (23%). The SST was also the most torn tendon in most of the previous studies reviewed (up to 96.5% prevalence in the study of Ravikanth *et al.*)[23,25,28,30-34] The supraspinatus tendon is the most commonly damaged of the four rotator cuff tendons. This is because it lies (alongside the SASD) predominantly in the anatomically narrow supraspinatus outlet. Contact between the tendon and the superior boundary of the supraspinatus outlet, formed by the coracoacromial arch (comprising the coracoid process, acromion, and coracoacromial ligament), can cause subacromial impingement.[34] Furthermore, the supraspinatus tendon counteracts downward motion in both relaxed and weight-bearing shoulders, predisposing it to injury.[35] Multifactorial intrinsic factors (senile degeneration, hypovascularity, inflammation, and tendon microtrauma) and extrinsic factors (type III acromial shape, acromial spurs, os acromiale, and sports) also predispose to rotator cuff tears.[33]

Tendinopathy is an umbrella term for tendon degeneration, disease, or disorder. Pain, swelling, and impaired performance are hallmarks of tendinopathy.[36] It has also been defined as a disorder characterised by discomfort in and around a tendon caused by repetitive activities and diminished function caused by the healing process failing to regenerate the tendon effectively.[37-39] Even though the prevalence of SST tendinopathy (19.2%) reported by Onyambu *et al*.[33] in Kenya is similar to ours (18%), unlike their study, however, tendinopathy was not the most

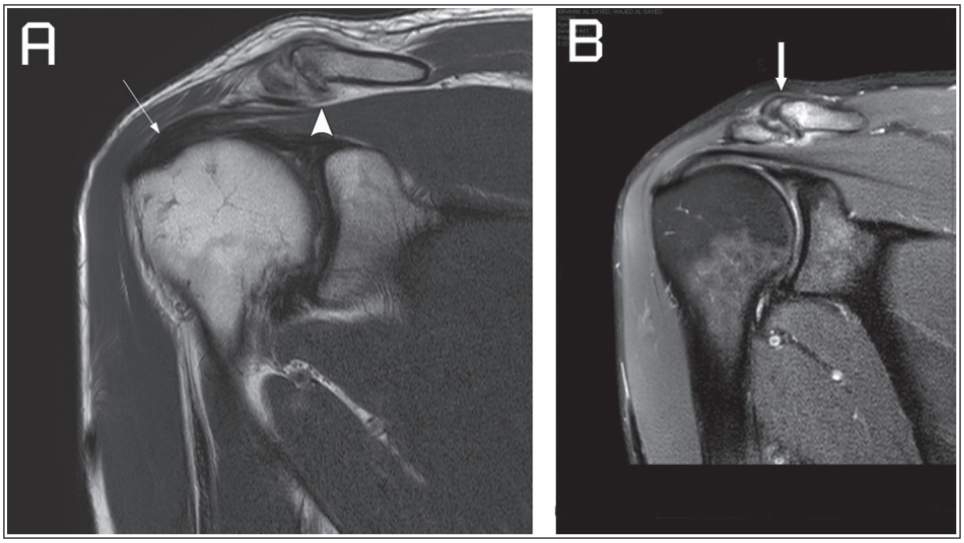

Figure 1: T1W (A) and Fat-saturated proton density-weighted (B) coronal sections of the shoulder showing acromioclavicular joint hypertrophy with periarticular marrow oedema (thick arrow), hooked acromion with effacement of the subacromial fat plane (arrowhead), and thickened supraspinatus tendon (tendinosis) with a heterogeneous signal (thin arrow)

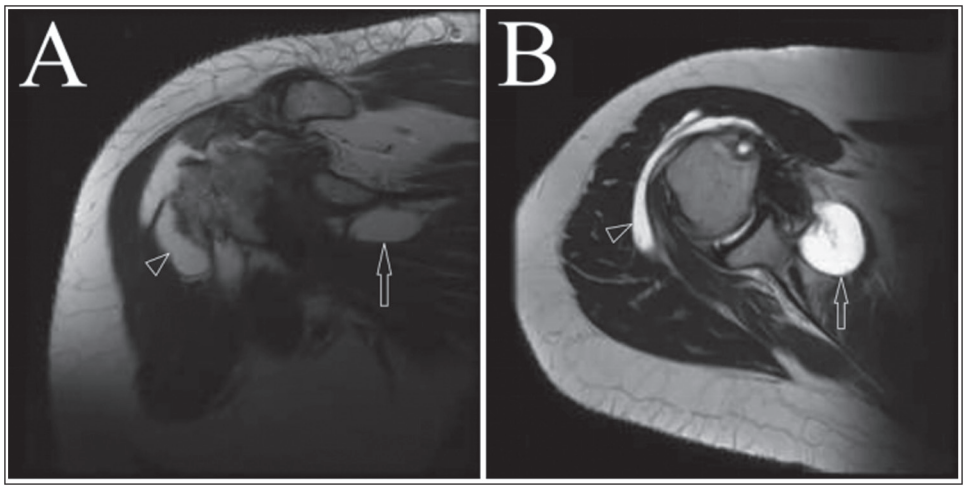

Figure 2: T2W coronal (A) and T2W axial (B) sections of the shoulder showing large subdeltoid (arrowheads) and subacromial (arrows) bursitis

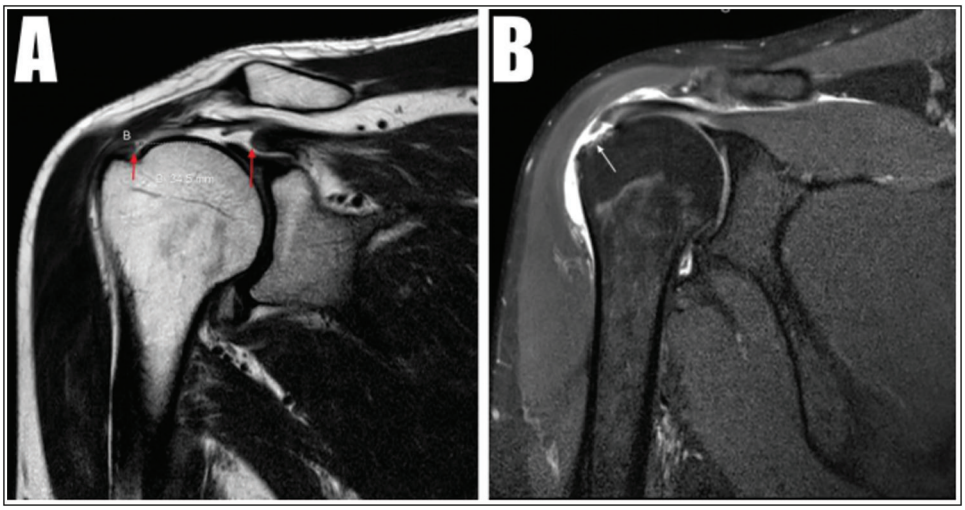

Figure 3: Full-thickness tear of the supraspinatus tendon (SST) in two different subjects: (A) T2W coronal shoulder MRI showing wide discontinuity of the SST with a fluid-filled gap (3.5 cm) between the torn ends (red arrows), and (B) proton density-weighted fat-saturated coronal section revealing a complete discontinuity of the SST at its insertion site (white arrow) into the irregular greater tuberosity (the tendon gap is filled with fluid which is continuous with the subdeltoid bursa)

Figure 4: Proton density-weighted fat-saturated axial section of the shoulder revealing a thickened subscapularis tendon (arrowhead) with increased intrasubstance signal intensity and peritendinous fluid (partial tear)

prevalent abnormality in the index study. On the whole, the point prevalence of rotator cuff tendinopathies in this study (1%–18%) is within the range of 2.4%–21% derived from a systematic review.[40]

Onyambu *et al*.[33] noted that the right shoulder had more pathologies than the left in their study, which they attributed to the preponderance of right-hand dominance. Mohamed *et al*.[23] also stated that in their study of 100 patients, 79 complained of right shoulder pain, while 21 had left-sided pain ($P < 0.0001$). In this study, 53 right, and 47 left shoulders were examined; unfortunately, the subjects' hand dominance could not be determined retrospectively. However, a pathology comparison between the right and left shoulders revealed that SASD bursitis was significantly more on the right side. In contrast, SST, SCT, and IFST tendon pathologies were more common in the left shoulders.

The limitations of this study stem primarily from its retrospective data. An arthroscopic correlation could not be done. The participants' occupation, handedness, and engagement in sporting activities could also not be determined. Also, confounding by systemic diseases (diabetes mellitus, HIV/AIDS, etc.) with shoulder complications could not be eliminated.

In conclusion, MRI with a shoulder coil and optimised sequences was useful for assessing the painful and or dysfunctional shoulder girdle in our locality. Acromioclavicular joint arthropathy, SASD bursitis, and rotator cuff disorders were the dominant pathologies in participants' shoulders.

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Conflicts of interest

There are no conflicts of interest.

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