Review

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Radiological characteristics of shoulder diseases in older adults, including adhesive capsulitis, rotator cuff tear, and osteoarthritis of the glenohumeral joint: a narrative review

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Shoulder diseases, including adhesive capsulitis, rotator cuff tear, and osteoarthritis of the glenohumeral joint, can significantly impair daily activities in older adult patients. This review aims to examine the radiologic findings associated with these shoulder conditions in older patients, providing insights for accurate diagnosis and effective treatment. Adhesive capsulitis, commonly known as frozen shoulder, leads to pain and restricted movement, thereby causing shoulder dysfunction. Recent advances in diagnostic technology have greatly enhanced the sensitivity and accuracy of diagnosing this condition through radiologic evaluations, including MRI, magnetic resonance arthrography (MRA), and high-resolution ultrasound. Rotator cuff disease is another frequent issue in older adults, with full-thickness tears occurring in 50%–80% of cases. Both MRI and MRA are highly sensitive and specific in identifying rotator cuff tears. Additionally, ultrasonography is recognized for its high sensitivity and specificity in detecting tears of the supraspinatus tendon. Although osteoarthritis of the glenohumeral joint is less commonly prevalent, its advanced stages can severely affect the function of the upper extremity. Plain radiography is typically the first imaging technique used to assess this type of osteoarthritis. As the condition worsens, CT is utilized to measure glenoid bone loss, glenoid version, and inclination, which are crucial for accurate surgical planning. Each imaging modality provides distinct benefits: plain radiographs for initial structural assessment, ultrasonography for real-time evaluation of soft tissues, MRI/MRA for detailed visualization of capsular and tendinous lesions, and CT for precise bony analysis.

Introduction

Background

Previous studies have indicated that shoulder pain affects approximately 20% of individuals over the age of 65, ranking it as the third most common source of pain following back and knee pain [1]. Common conditions associated with shoulder pain include adhesive capsulitis, rotator cuff tears, and osteoarthritis of the glenohumeral joint [2,3]. Without proper diagnosis and treatment, these shoulder pathologies may progress, leading to pain and functional impairment that complicates daily activities [4–8]. Advances in diagnostic techniques now allow for the identification of diseases causing shoulder pain with high sensitivity and accuracy through the use of MRI, magnetic resonance arthrography (MRA), and ultrasonography [9]. For glenohumeral joint arthritis, surgical planning can be facilitated by radiography and CT [10]. Therefore, it is essential for healthcare providers to be well-versed in the radiologic characteristics of common shoulder pathologies in older adults.

Objectives

This article reviews the radiologic findings associated with shoulder diseases in older adults, offering insights for accurate diagnosis and effective treatment.

Ethics statement

As this study was a literature review, it did not require approval from the institutional review board or individual consent.

Adhesive capsulitis

Plain radiography

Plain radiography typically shows no significant findings in patients with adhesive capsulitis [11]. Its primary utility is to differentiate diseases such as calcific tendinitis or osteoarthritis that may cause shoulder pain [12].

Ultrasonography

As technological advances in ultrasound have improved the accurate visualization of shoulder joint structures, it is increasingly being used to examine patients with adhesive capsulitis, leveraging its dynamic and non-invasive advantages [13]. The radiological characteristics observable in patients with adhesive capsulitis via ultrasound include the following.

- Coracohumeral ligament, inferior glenohumeral capsule thickening, and rotator interval abnormality (88% sensitivity and 96% specificity; Figs. 1, 2) [5,9,14,15]
- Thickening of the axillary pouch, as illustrated in Fig. 3, is a notable finding [16,17]
- Increased vascularity in the rotator interval [18]

Recently, a protocol for diagnosing adhesive capsulitis using ultrasonographic findings has been proposed. Ultrasonography is reported to be a valuable diagnostic tool for patients with

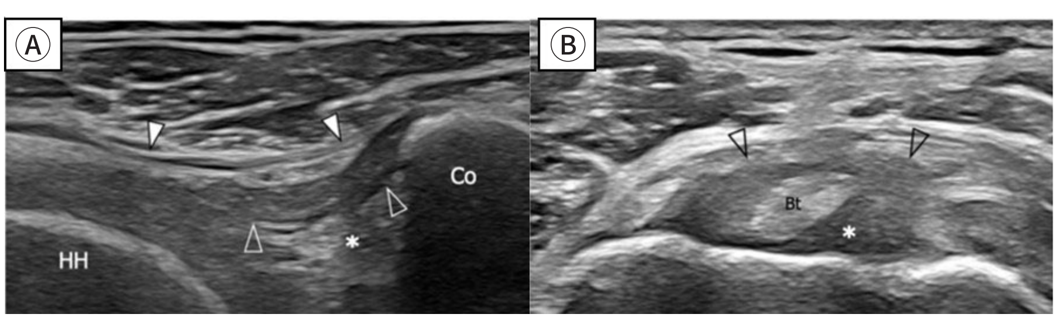

Fig. 1. Ultrasonography. Thickened coracohumeral ligament, oblique transverse image (A), short axis image (B). Adapted from Picasso et al. [5] with CC-BY.

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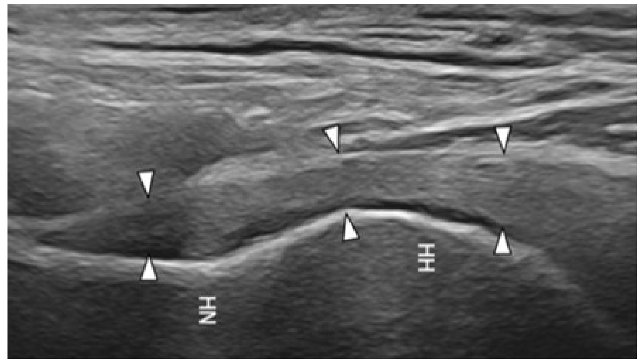

Fig. 2. Ultrasonography. Thickened inferior glenohumeral capsule, longitudinal image. Adapted from Picasso et al. [5] with CC-BY.

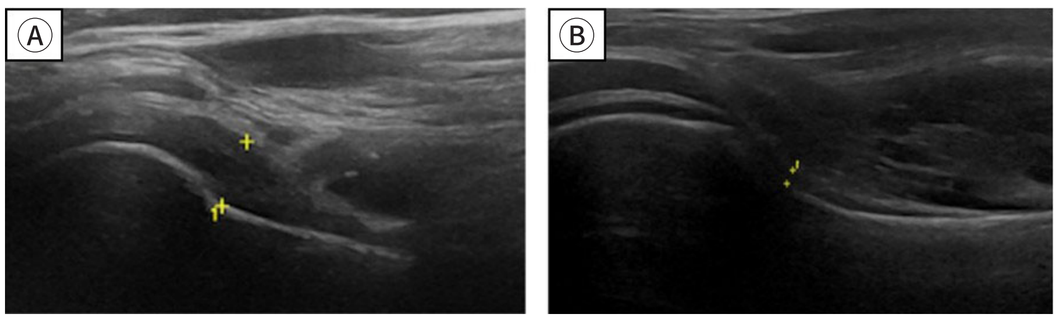

Fig. 3. Ultrasonography, oblique axial section. Thickened axillary pouch (A), normal axillary pouch (B). Adapted from Tue et al. [17] with CC-BY.

adhesive capsulitis (Fig. 4) [5].

MRI and magnetic resonance arthrography

MRI is considered the gold standard for assessing the entire glenohumeral capsule and pericapsular soft tissue in cases of adhesive capsulitis [5]. A recent systematic review and meta-analysis of MRI radiological characteristics in adhesive capsulitis identified six significant findings (Fig. 5) [5,19].

- Coracohumeral ligament thickening and fat obliteration of the rotator interval [5,20]
- Inferior glenohumeral ligament hyperintensity and thickening (85.3%–88.2% sensitivity and 88.2% specificity) [21]
- Obliteration of the subcoracoid fat triangle by hypointense synovium
- Contrast enhancement of the axillary joint capsule and the rotator interval [22]

MRI and MRA are crucial diagnostic tools for identifying specific radiologic characteristics of adhesive capsulitis, thereby playing a significant role in understanding the disease's nature [11].

Rotator cuff tear

Plain radiography

Plain radiography is typically the first step in assessment due to its speed, low cost, and broad availability [23]. While it does not allow for direct evaluation of the rotator cuff, it can reveal

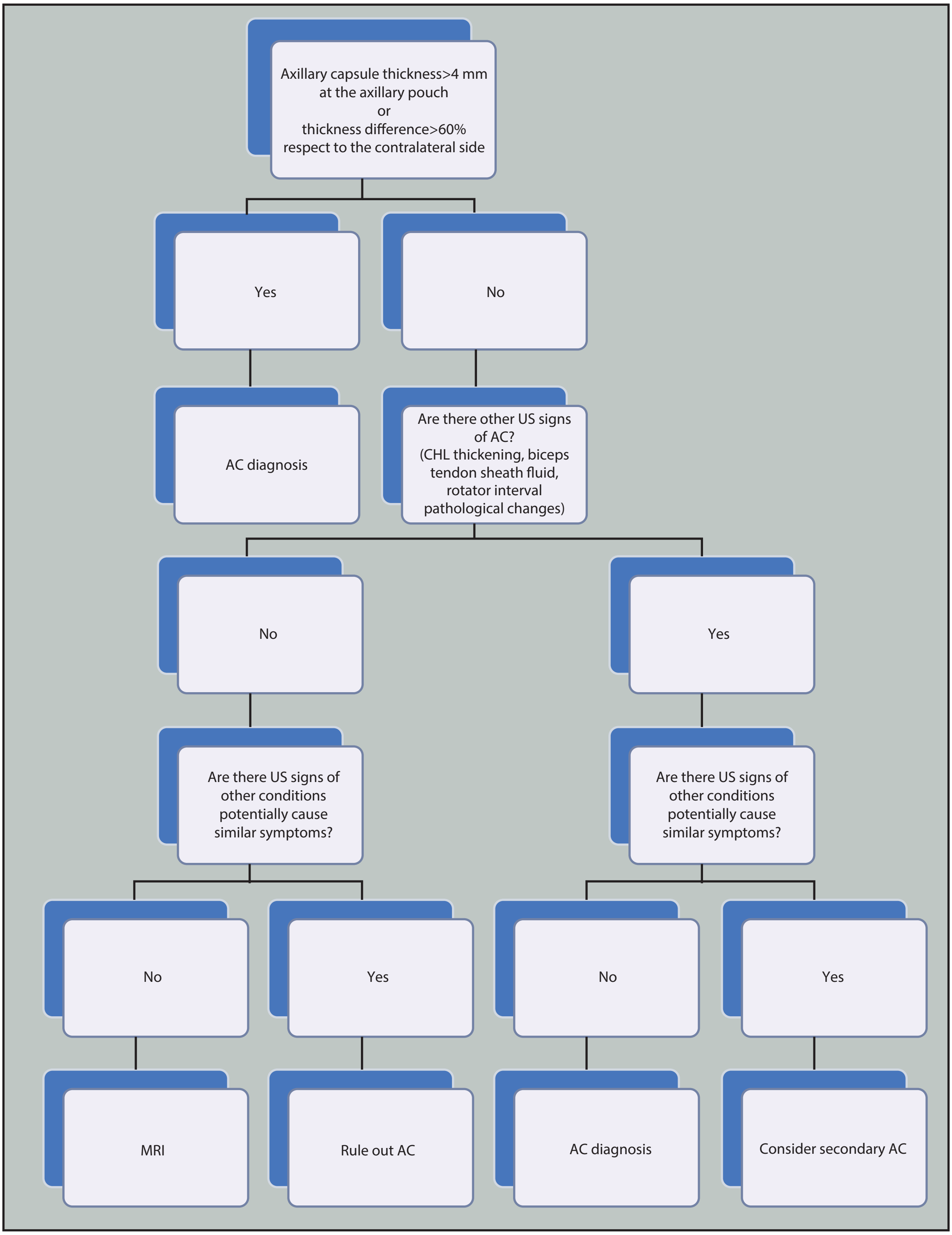

Fig. 4. Protocol for imaging evaluation using ultrasonography in patients with adhesive capsulitis. Adapted from Picasso et al. [5] with CC-BY.

osseous abnormalities linked to impingement. Anteroposterior, outlet, and axillary views are taken, and certain findings indicative of chronic rotator cuff tears can be observed on these radiographs (Fig. 6) [24].

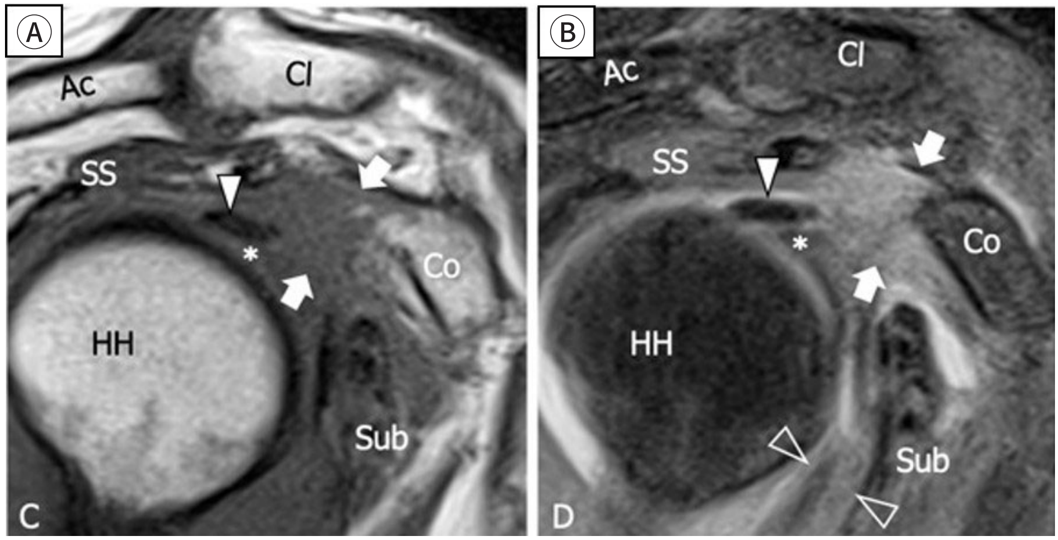

Fig. 5. Sagittal T1 and T2-weighted MRI scan. Fat obliteration (arrow), thickened and hyperintensity of the anteroinferior capsule (outlined arrowhead; A,B). Adapted from Picasso et al. [5] with CC-BY. SS, supraspinatus; Ac, acromion; Cl, clavicle; Co, coracoid process; Sub, subscapularis; HH, humeral head.

- Anteroposterior view: reduction of subacromial space, subacromial enthesophyte, and cystic change with sclerosis of the acromion and greater tuberosity [25]
- Outlet view: coracoacromial arch and the morphology of the anterior acromion (flat, curved, or hooked)
- Axillary view: Details of the glenoid, glenohumeral alignment, coracohumeral interval, and os acromiale [24]

Ultrasonography

Ultrasound is a crucial diagnostic tool with sensitivity and specificity comparable to 1.5T MRI, particularly effective in diagnosing full-thickness rotator cuff tears [26]. In cases of full-thickness rotator cuff tendon tears, the defect in the cuff typically appears hypoechoic or anechoic. This is accompanied by irregularities in the greater tuberosity and pitting caused by the tear (Fig. 7) [24,27].

MRI and magnetic resonance arthrography

MRI is effective in evaluating both bone and soft tissue, establishing it as a precise diagnostic tool for confirming rotator cuff pathology. MRA, on the other hand, shows almost perfect sensitivity and specificity in detecting full-thickness rotator cuff tears, with values nearing 100% [28].

Rotator cuff tendinopathy, two hallmarks (Fig. 8) [29,30]

- Abnormal increased signal within the substance of the cuff (without extension to the articular or bursal side)
- Swelling or increased thickness of the tendon

Rotator cuff tear

- Supraspinatus

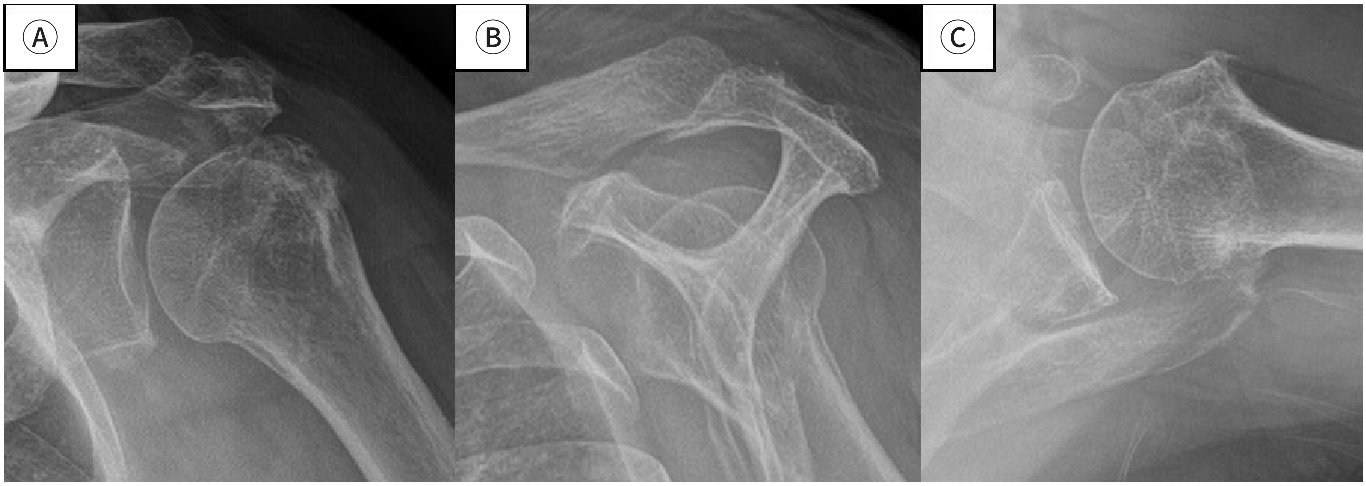

Fig. 6. Plain image. True anteroposterior view (A), outlet view (B) and axillary view (C). Provided by the authors.

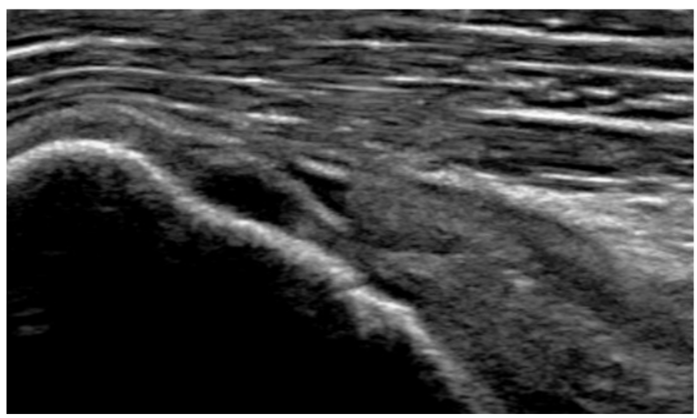

Fig. 7. Longitudinal plane ultrasound image of supraspinatus tendon. Anechoic gap and pitting due to tear. Provided by the authors.

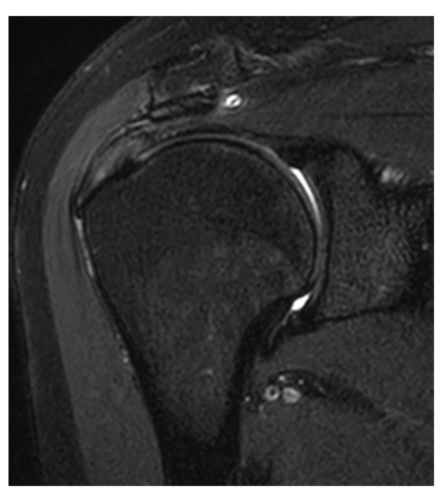

Fig. 8. Oblique coronal fat-suppressed T2-weighted MRI scan. Abnormal high signal and focal swelling of the supraspinatus tendon. Provided by the authors.

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The most commonly observed radiological feature in full-thickness rotator cuff tears is high signal fluid intensity extending from the glenohumeral joint to the subacromial bursa (Fig. 9) [31]. In approximately 10% of patients, a low-signal tear is noted when the humeral head migrates superiorly, resulting in an absence of cuff tissue between the humeral head and the subacromial bursa [30].

- Subscapularis

Subscapularis tendon tears are relatively difficult to detect using MRI. These tears most commonly begin in the upper third of the tendon and tend to progress caudally (Fig. 10) [32–34].

- Infraspinatus and teres minor

Infraspinatus tears typically occur alongside supraspinatus tendon tears, with oblique coronal and sagittal fat-suppressed T2-weighted images being the most effective for detection, similar to those used for the supraspinatus tendon [35]. Isolated tears of the infraspinatus have been reported to be rare [36].

In the case of the teres minor, tears are reported in only 0.9% of cases and typically occur

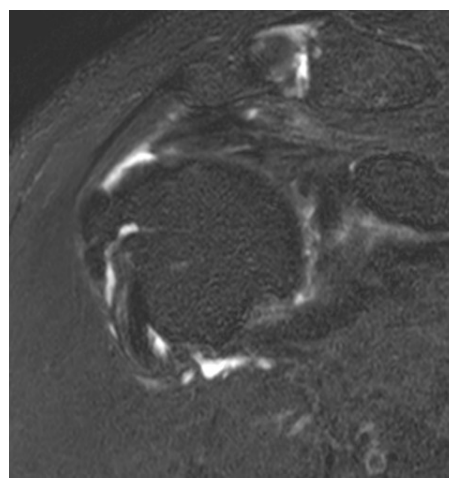

Fig. 9. Oblique coronal fat-suppressed T2-weighted MRI scan. Fluid signal intensity.

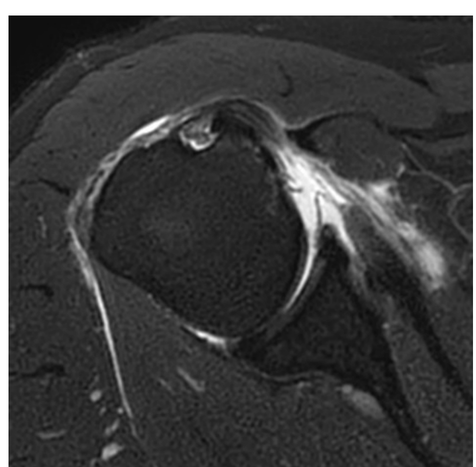

Fig. 10. Oblique sagittal and axial fat-suppressed PD-weighted MRI scan. Subscapularis full-thickness tear. Provided by the authors.

alongside tears in the supraspinatus and tears [37]. The integrity of these muscles is best assessed using oblique sagittal fat-suppressed T2-weighted images [38].

- Fatty infiltration of rotator cuff muscles

Fatty infiltration is characterized by a reduction in the elasticity of the torn rotator cuff, resulting from lipid deposition in the muscle tissue of chronic tears [39]. Therefore, fatty infiltration in the rotator cuff muscles independently influences surgical outcome [40]. The severity of this condition can be classified based on the muscle signal observed in sagittal oblique T1-weighted MRI scans (Table 1; Fig. 11) [41,42].

Table 1. Goutallier classification

Grade	Muscle description
0	Normal
I	Some fatty streaks
II	Amount of muscle is greater than fatty infiltration
III	Amount of muscle is equal to fatty infiltration
IV	Amount of fatty infiltration is greater than muscle

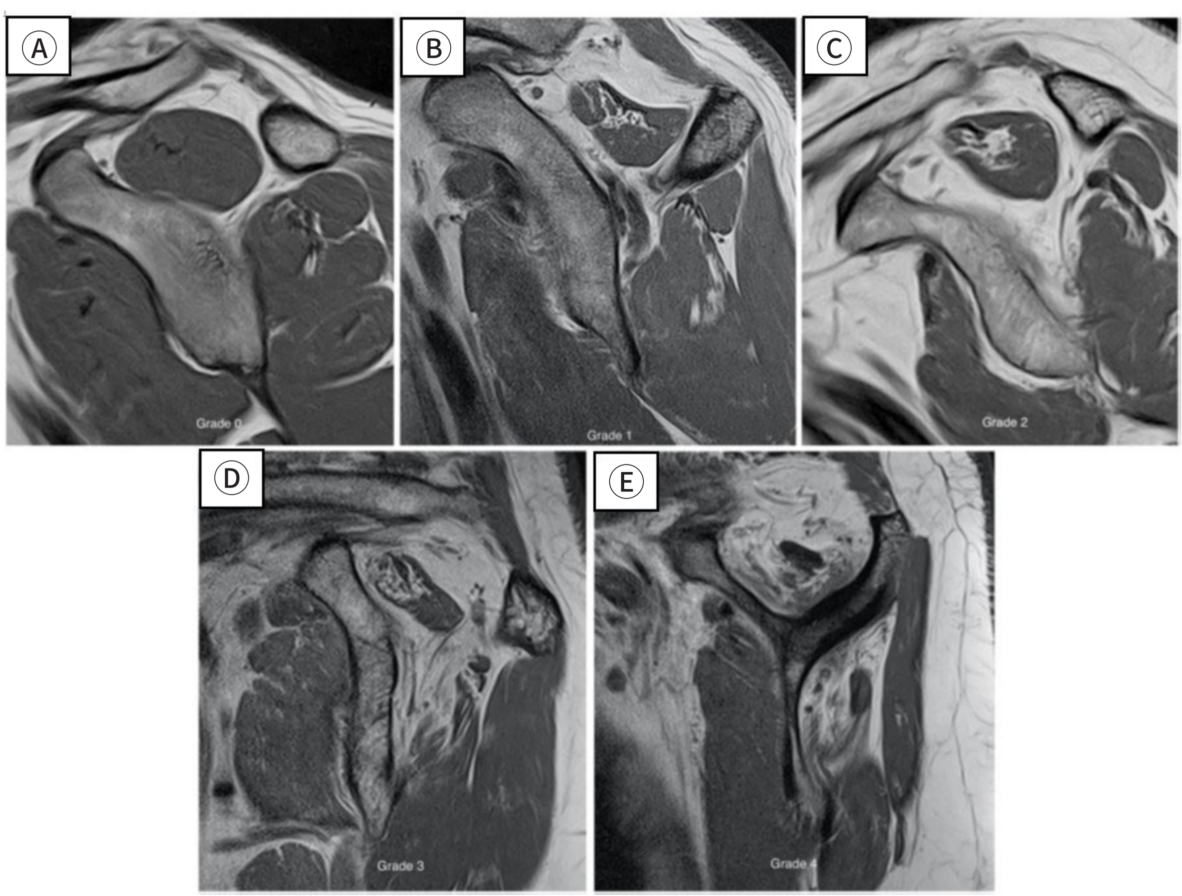

Fig. 11. Fatty infiltration. Normal (A), grade I (B), grade II (C), grade III (D), grade IV (E). Adapted from Yubran et al. [42] with CC-BY.

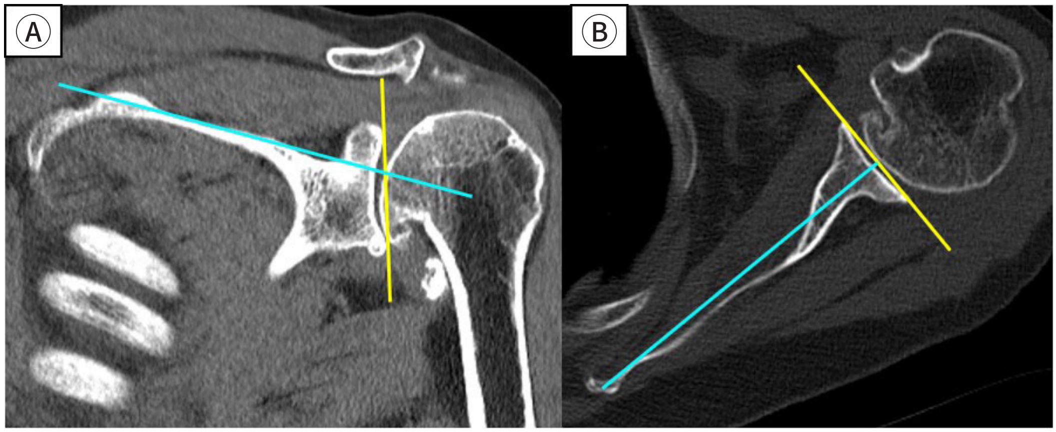

Fig. 12. CT: glenoid inclination (A), glenoid version (B). Provided by the authors.

Osteoarthritis of the glenohumeral joint

Plain radiography

Plain radiography is often the initial imaging modality used, incorporating anteroposterior (internal rotation), true anteroposterior (Grashey external rotation), outlet, and axillary views. These views are essential for assessing joint space narrowing, osteophytes, subchondral cysts, subchondral bone irregularities, glenoid bone stock, and glenoid version [10].

CT

Evaluating the precise bone stock of the glenoid—including bone loss, version, and inclination—is challenging with plain radiography due to overlapping structures. Therefore, CT is utilized for preoperative planning of arthroplasty (Fig. 12) [43].

Conclusion

To accurately diagnose and manage shoulder diseases in older adults, it is crucial to evaluate the unique radiological features of each condition. This evaluation guides the appropriate course of treatment, ranging from conservative approaches to surgical interventions. Advanced diagnostic modalities, including MRI (or MRA), known for their high sensitivity and specificity, are essential. Additionally, ultrasonography is pivotal in identifying the radiological characteristics specific to shoulder diseases in this patient group. Understanding the key findings in each case of shoulder disease is vital for effective diagnosis and management.

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