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Improving the Assessment of Shoulder Joint Dislocation Through Additional Diagnostic Examinations

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Abstract: The shoulder (glenohumeral) joint is the most mobile joint in the human body and, consequently, the most susceptible to traumatic dislocation, accounting for approximately 45% of all major joint dislocations. More than 95% of shoulder dislocations are anterior and are frequently associated with Bankart (labral) and Hill–Sachs (humeral head) lesions. Although conventional radiography is sufficient for confirming dislocation and evaluating bony structures, it has significant limitations in detecting soft tissue injuries involving the labrum, rotator cuff, and capsuloligamentous complex. This article evaluates the diagnostic performance of additional imaging modalities used in the assessment of shoulder dislocation, including magnetic resonance imaging (MRI), magnetic resonance arthrography (MRA), computed tomography (CT) with three-dimensional (3D) reconstruction, computed tomography arthrography (CTA), and ultrasonography (US). The analysis demonstrated that CT remains the gold standard for assessing glenoid bone loss and Hill–Sachs defects, whereas MRI/MRA provides superior visualization of soft tissue injuries. The combined application of these imaging techniques significantly improves diagnostic accuracy and facilitates appropriate selection of conservative or surgical treatment strategies.
Keywords: shoulder dislocation, glenohumeral instability, Bankart lesion, Hill–Sachs defect, magnetic resonance arthrography, computed tomography, rotator cuff, recurrent dislocation risk, surgical treatment.

INTRODUCTION

The glenohumeral (shoulder) joint is the most mobile joint in the human skeleton, allowing movement in three planes: flexion–extension, abduction–adduction, and internal–external rotation. However, this remarkable mobility is accompanied by relatively poor osseous stability, as the glenoid cavity accommodates only approximately one-third of the humeral head, making the shoulder the joint most susceptible to traumatic dislocation.

According to recent epidemiological data, the incidence of anterior shoulder dislocation is 23.9 cases per 100,000 person-years, accounting for approximately 45% of all major joint dislocations. More than 95% of shoulder dislocations occur in the anterior direction, whereas the remaining 5% are posterior or inferior. Among military personnel, the incidence is substantially higher, ranging from 169 to 313 cases per 100,000 individuals, with approximately 29% of patients experiencing recurrent instability. In young athletes, the risk of recurrent dislocation may exceed 50% even after Bankart repair, highlighting the critical importance of accurate initial diagnosis for achieving favorable long-term clinical outcomes[1].

The two most common associated injuries in shoulder dislocation are Bankart lesions, characterized by detachment of the anteroinferior glenoid labrum, and Hill–Sachs defects, which are compression fractures of the posterolateral aspect of the humeral head. According to the literature, the reported incidence of Bankart lesions ranges from 18% to 100%, while Hill–Sachs defects occur in 58% to 83% of cases, with these variations largely depending on the diagnostic modality used, such as radiography, MRI, or arthroscopy. In recurrent shoulder dislocations, the prevalence of these injuries is even higher, reaching 85% for Hill–Sachs defects and 66% for Bankart lesions, emphasizing the clinical importance of accurate and comprehensive evaluation following the initial dislocation episode[2].

The conventional diagnostic approach, consisting of clinical examination and plain radiography, is generally sufficient to confirm shoulder dislocation, assess the success of reduction, and identify major fractures involving the proximal humerus, scapula, or clavicle. However, radiography has significant limitations in evaluating soft tissue structures, including the labrum, rotator cuff, and capsuloligamentous complex, and frequently fails to detect subtle osseous defects such as small Hill–Sachs lesions. Consequently, advanced imaging modalities—including magnetic resonance imaging (MRI), magnetic resonance arthrography (MRA), computed tomography (CT), and ultrasonography (US)—have been increasingly incorporated into routine clinical practice over the past decade to improve diagnostic accuracy and optimize treatment planning[3].

According to the 2024–2025 American College of Radiology (ACR) Appropriateness Criteria® for Acute Shoulder Pain, the use of additional imaging modalities is clinically justified in patients with suspected glenohumeral dislocation or instability, regardless of initial radiographic findings. This recommendation is particularly important for young and physically active patients experiencing a first-time shoulder dislocation, in whom advanced imaging plays a critical role in predicting the risk of recurrence and determining the need for surgical intervention[4].

The aim of this study was to comparatively evaluate the diagnostic performance of contemporary imaging modalities—including magnetic resonance imaging (MRI), magnetic resonance arthrography (MRA), computed tomography (CT), computed tomography arthrography (CTA), and ultrasonography (US)—using evidence from open-access scientific literature. The study further sought to identify the strengths and limitations of each modality and to propose an improved, risk-based diagnostic algorithm for clinical practice. The relevance of this research is supported by three key factors: first, shoulder dislocation is one of the most common injuries encountered in traumatology and sports medicine; second, delayed or incomplete diagnosis substantially increases the risk of recurrent dislocation and chronic shoulder instability; and third, the absence of a standardized imaging strategy contributes to variations in diagnostic and therapeutic approaches across healthcare institutions.

RESEARCH METHODOLOGY

This study was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines using a Systematic Literature Review (SLR) approach. Scientific evidence was retrieved from PubMed/MEDLINE, PubMed Central (PMC), Cochrane Library, Google Scholar, ScienceDirect, SpringerLink, ClinicalTrials.gov, and the American College of Radiology (ACR) Appropriateness Criteria.

The literature search was performed using the keywords “shoulder dislocation,” “glenohumeral instability,” “Bankart lesion,” “Hill–Sachs lesion,” “MR arthrography,” “CT arthrography,” and other related terms. Original research articles, systematic reviews, and meta-analyses published between 2018 and 2025 and indexed in PubMed, Scopus, or Web of Science were included. An initial search identified more than 420 publications; 87 full-text articles were assessed for eligibility, and 24 high-quality studies met the inclusion criteria and were included in the final analysis. The selected evidence was comparatively evaluated based on diagnostic performance and imaging outcomes, and the findings were synthesized using a descriptive synthesis approach.The literature search was performed using the keywords “shoulder dislocation,” “glenohumeral instability,” “Bankart lesion,” “Hill–Sachs lesion,” “MR arthrography,” “CT arthrography,” and other related terms. Original research articles, systematic reviews, and meta-analyses published between 2018 and 2025 and indexed in PubMed, Scopus, or Web of Science were included. An initial search identified more than 420 publications; 87 full-text articles were assessed for

eligibility, and 24 high-quality studies met the inclusion criteria and were included in the final analysis. The selected evidence was comparatively evaluated based on diagnostic performance and imaging outcomes, and the findings were synthesized using a descriptive synthesis approach.

ANALYSIS AND RESULTS

According to the Global Burden of Disease (GBD) 2021 study, based on data collected between 1990 and 2021, the global burden of shoulder dislocation remains substantial, with the highest incidence observed among populations engaged in high levels of physical activity, particularly military personnel. Several studies have reported incidence rates ranging from 169 to 313 cases per 100,000 individuals in military populations, with approximately 29% of patients experiencing recurrent shoulder instability[5].

The incidence of anterior shoulder dislocation is 23.9 cases per 100,000 person-years, accounting for approximately 45% of all major joint dislocations, with more than 95% occurring in the anterior direction. A systematic review and meta-analysis involving 22 studies and 1,920 shoulders demonstrated that Hill–Sachs lesions were identified in 71% of first-time dislocations and 85% of recurrent dislocations ($p < 0.01$), whereas Bankart lesions were detected in 59% and 66% of cases, respectively ($p = 0.05$). Furthermore, Hill–Sachs lesions were significantly more common in complete dislocations (82%) than in subluxations (54%) ($p < 0.01$)[6].

Another comprehensive review reported that the incidence of Bankart lesions ranged from 18% to 100%, whereas Hill–Sachs lesions ranged from 58% to 83%, with these variations primarily attributable to differences in diagnostic methods, including plain radiography, magnetic resonance imaging (MRI), and arthroscopic evaluation. These findings indicate that reliance on plain radiography alone may result in a substantial proportion of associated injuries remaining undetected, potentially leading to inappropriate treatment decisions and an increased risk of recurrent shoulder instability[7].

The main characteristics, advantages, and limitations of the additional imaging modalities analyzed in this study are summarized in Table 1.

Table 1.

Comparative Characteristics of the Principal Imaging Modalities Used in the Evaluation of Shoulder Dislocation

Imaging Modality	Description and Clinical Purpose	Main Advantage
Plain Radiography	Initial imaging modality used to confirm shoulder dislocation, assess reduction, and detect major fractures	Rapid, inexpensive, widely available, and the first-line imaging technique
Computed Tomography (CT) with 3D Reconstruction	Evaluates glenoid bone loss and quantifies Hill–Sachs defects	Considered the **gold standard** for assessing bony lesions; however, it involves ionizing radiation
Magnetic Resonance Imaging (MRI)	Assesses the labrum, rotator cuff, and capsuloligamentous structures	Radiation-free with excellent soft tissue visualization
Magnetic Resonance Arthrography (MRA)	MRI performed after intra-articular contrast injection	Considered the **gold standard** for detecting labral and capsular injuries

Computed Tomography Arthrography (CTA)	CT performed after intra-articular contrast injection	Nearly equivalent to MRA in detecting SLAP lesions, Bankart lesions, and glenoid rim fractures
Ultrasonography (US)	Evaluates full-thickness rotator cuff tears	Cost-effective, provides real-time imaging, and allows dynamic assessment

According to the American College of Radiology (ACR) Appropriateness Criteria for Acute Shoulder Pain, plain radiography is recommended as the initial imaging modality for the evaluation of acute shoulder pain and remains the primary method for identifying suspected fractures. When radiographic findings are normal or inconclusive, additional imaging techniques—including ultrasonography (US), magnetic resonance imaging (MRI), non-contrast computed tomography (CT), magnetic resonance arthrography (MRA), and computed tomography arthrography (CTA)—may be employed to further characterize the underlying pathology. The guideline also specifically addresses suspected glenohumeral dislocation or instability (Variant 4), recommending the use of advanced imaging regardless of whether the initial radiographic findings are positive, negative, or equivocal[8].

Another important clinical recommendation is that, although the diagnosis of chronic anterior shoulder instability is primarily based on the patient's history and physical examination, imaging confirmation is essential. While plain radiography and CT provide valuable information regarding osseous abnormalities, magnetic resonance arthrography (MRA) remains the gold standard for pre-arthroscopic assessment. Furthermore, both CTA and MRA demonstrate nearly equivalent diagnostic accuracy in detecting SLAP tears, Bankart lesions, and Hill–Sachs lesions. However, CTA may provide slightly greater accuracy in identifying glenoid rim fractures and anterior labroligamentous periosteal lesions (ALPSA lesions), making it a valuable alternative for detailed evaluation of bony pathology[9].

In a retrospective controlled study published in 2025 by researchers from the Technical University of Munich, imaging findings obtained from both CT and MRI were compared in 61 patients with a mean age of 45 ± 19 years. The results demonstrated excellent agreement between two-dimensional (2D) MRI and 2D CT in measuring key osseous parameters, including glenoid diameter, glenoid defect width, Hill–Sachs lesion size, and bony bridge, as well as in the classification of on-track and off-track lesions. These findings are of considerable clinical significance. Although CT has traditionally been regarded as the gold standard for evaluating osseous defects, MRI, which does not involve ionizing radiation, represents a reliable alternative, particularly for younger patients and for cases requiring repeated follow-up examinations[10].

In addition, the SALTO (Shoulder Dislocation: Assessment of Lesions, Trajectories and Outcomes) prospective cohort study was designed to evaluate patients aged 16 years and older presenting with a first-time anterior shoulder dislocation. In this study, CT is used for the systematic assessment of glenoid bone loss, whereas MRI is employed to characterize soft tissue injuries. The study design reflects the current consensus within the scientific community that CT for bony lesions and MRI for soft tissue injuries should be considered complementary imaging modalities rather than competing techniques. Their combined use is expected to improve prediction of recurrent shoulder instability and optimize long-term functional outcomes[11].

A retrospective observational study conducted in the United Kingdom between 2021 and 2024 involving 148 patients aged 40–60 years evaluated the implementation of national imaging guidelines for assessing rotator cuff injuries following shoulder dislocation. The results showed that 68 patients (45.9%) underwent additional cross-sectional imaging using MRI or ultrasonography (US), of whom 30 patients (44.1%) had radiologically confirmed rotator cuff tears.

These findings are clinically significant because the risk of rotator cuff tendon tears following shoulder dislocation is substantially higher in patients over 40 years of age than in younger individuals, emphasizing the importance of performing additional imaging in this age group to avoid missed diagnoses[12].

Another retrospective audit study conducted between 2021 and 2024, involving 100 patients, evaluated the clinical management of shoulder dislocations. Anterior dislocation was observed in 83% of patients, posterior dislocation in 16%, and inferior dislocation in 1%. Closed reduction performed under anesthesia was successful in 98% of cases. Furthermore, 97% of patients underwent imaging both before and after reduction, with CT and MRI being widely used to identify associated injuries, including Hill–Sachs lesions, greater tuberosity fractures, and rotator cuff tears. These findings highlight the essential role of advanced imaging in the comprehensive evaluation and management of traumatic shoulder dislocations[13].

A study investigating injuries to the biceps pulley complex—the ligamentous structure stabilizing the long head of the biceps tendon—following traumatic anterior shoulder dislocation included 33 patients (14 females) with a mean age of 48.0 ± 19 years. All participants underwent 3-Tesla magnetic resonance imaging (MRI) within one week after the dislocation. The results demonstrated biceps pulley injuries in 17 patients (52%), including combined tears of the superior glenohumeral ligament (SGHL) and coracohumeral ligament (CHL) in 11 patients (33%). Notably, all 17 patients with biceps pulley injuries also presented with partial-thickness rotator cuff tears, indicating a strong association between these two pathologies following traumatic shoulder dislocation. Furthermore, patients with biceps pulley injuries were significantly older than those without such injuries, with a mean age of 52 ± 12 years, confirming that advanced age is an important risk factor not only for rotator cuff tears but also for injuries of the biceps pulley complex[14].

These findings indicate that focusing solely on Bankart and Hill–Sachs lesions is insufficient. A comprehensive MRI evaluation should also include assessment of the long head of the biceps tendon, capsular injuries, and the rotator cuff, particularly in middle-aged and older patients, in whom these associated injuries occur more frequently and may significantly influence treatment decisions and functional outcomes.

Based on the evidence synthesized in this review, an improved, risk-based, multi-stage diagnostic algorithm for the evaluation of shoulder dislocation is proposed (Table 2). The algorithm is developed in accordance with the principles of the American College of Radiology (ACR) Appropriateness Criteria and is supported by the current evidence from the analyzed scientific literature[15] .

Table 2. Proposed Risk-Based Multi-Stage Diagnostic Algorithm for the Evaluation of Shoulder Dislocation

Stage	Clinical Procedure	Purpose / Criteria
1	Clinical examination (deformity, range of motion limitation, and neurovascular assessment) combined with initial plain radiography (before and after reduction)	To confirm the direction of dislocation, identify major fractures, and verify successful reduction
2	For first-time dislocation, young or physically active patients, or suspected recurrent instability—perform MRI (or ultrasonography (US) for rotator cuff assessment when resources are limited)	To evaluate the labrum, capsuloligamentous complex, and rotator cuff

3	If Hill–Sachs lesions or glenoid bone loss are suspected on MRI, or when surgical planning is required—perform CT with three-dimensional (3D) reconstruction	To accurately quantify bone loss and classify lesions as on-track or off-track
4	In cases of complex or equivocal labral or capsular pathology—perform magnetic resonance arthrography (MRA) or computed tomography arthrography (CTA)	To achieve precise pre-arthroscopic evaluation and optimize surgical planning
5	In patients older than 40 years, perform dedicated assessment of the rotator cuff using MRI or ultrasonography (US)	To detect age-related rotator cuff tendon tears at an early stage
6	Assess the risk of recurrent instability based on patient age, level of sports activity, and the extent of Hill–Sachs and Bankart lesions, followed by multidisciplinary consultation	To support evidence-based decision-making between conservative and surgical treatment

CONCLUSION

The systematic review demonstrated that clinical examination and plain radiography alone are insufficient for the comprehensive evaluation of shoulder dislocation. According to the reviewed literature, the incidence of Bankart lesions ranges from 18% to 100%, whereas Hill–Sachs lesions occur in 58% to 100% of cases. MRI/MRA provides superior assessment of soft tissue injuries, while CT remains the most accurate modality for evaluating osseous defects, making both techniques essential for selecting the appropriate treatment strategy.

The findings indicate that the most effective diagnostic approach is the combined use of CT and MRI, tailored to the patient's age, activity level, and type of shoulder dislocation. In particular, MRI evaluation of the rotator cuff is recommended for patients over 40 years of age, whereas CT and/or MRA should be performed in patients at high risk of recurrent instability. This comprehensive imaging strategy can reduce the incidence of recurrent dislocations, optimize surgical decision-making, and improve long-term functional outcomes. Future research should focus on the implementation of artificial intelligence–based diagnostic algorithms and standardized imaging protocols to further enhance the evaluation and management of shoulder dislocation.

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