The Egyptian Journal of Hospital Medicine (October 2017) Vol.69 (2), Page 1832-1837

The Role of Radiology in Anterior Shoulder Dislocation

Mohammed Alammari[1], Abdulmalek Rshood Al-Qwizani[2], Abdullah Fahad Alzayed[2], Aminah Abdulghany Sabbagh[1], Omar Abdulmohsen Alshadokhi[2], Al Qahtany. Faisal Hani M[3], Faisal Hammad Aldossary[2], Eyaad Talat Ghallab[4], Tariq Hamid Alfalag[5], Faisal Abdullah Alrwithey[6], Alzahrani Rashad Mohammed[7], Hamed Ali Hamed[8]

1 Battarjee Medical College, 2 Imam Mohammed Bin Saud Islamic University, 3 Imam Abdulrahman Bin Faisal University, 4 King Abdullah Medical Complex Jeddah, 5 Dow University of Health Sciences, 6 Taibah University, 7 Taif University, 8 King Khaled University

Corresponding Author: Mohammed Alammari - Dr.malammari7@gmail.com

ABSTRACT

Glenohumeral bone defects are a typical finding in shoulder dislocation and they are intensely connected with the reappearance of dislocation and failure following arthroscopic Bankart repair. Advanced imaging assessment should subsequently be performed in order to recognize, quantify and portray the bone defects. Despite the fact that magnetic resonance has significant value in the appraisal of the glenoid labrum and rotator cuff, computed tomography scan is the examination of choice for studying bone defects. The imaging methodology selected for shoulder dislocation relies upon its accessibility and the treatment plan for a specific patient. Radiography is economical and is promptly accessible. It ought to be executed as the underlying imaging examination in patients giving a clinical issue identified with the shoulder. It complements the other advanced methods and gives an outline of the bony components of the shoulder joint. In few patients, radiography obviates additional imaging.

Keywords: Bone Defect, Glenohumeral instability, Imaging, Shoulder dislocation, Radiography, Bankart lesion.

INTRODUCTION

The glenohumeral joint is fundamentally unstable as the large humeral head articulates with the small shadow glenoid fossa, and it is the most commonly dislocated joint [1]. Static stabilizers (glenoid labrum, capsule and glenohumeral ligaments) and dynamic stabilizers (rotator cuff and long head of the biceps) cooperate to guarantee the preservation of the stability of this joint [2, 3]. Disturbance of this complex balance triggers the beginning of intermittent shoulder dislocation. Glenohumeral bone instability are viewed as one of the primary driver of repeat of dislocation [4]. Various clinical and biomechanical studies have featured the part of these deformities in repetitive scenes of dislocation and dislocation after surgical treatment, demonstrating how they cause changes in the contact powers on the joints and lessen their resistance to dislocation [5, 6]. Avulsion of the glenoid labrum and inferior glenohumeral ligament complex (Bankart lesion) is the lesion frequently comes across after a first scene of anterior glenohumeral instability [7, 8]. Generally, the imaging methodology selected for shoulder dislocation relies upon its accessibility and the treatment plan for a specific patient [9, 10]. Radiography is economical and is promptly accessible. It ought to be executed as the underlying image examination in patients giving a clinical issue identified with the shoulder. It complements the other advanced methods and gives an outline of the bony components of the shoulder joint. In few patients, radiography obviates additional imaging [11, 12]. Magnetic resonance arthrography is the imaging modality of excellent to assess the labrum. It has the highest sensitivity and specificity of all obtainable modalities. Nevertheless, it is invasive and might not be needed in patients in whom surgery is not being deliberated as a treatment possibility [13, 14, 15].

Conventional magnetic resonance imaging (MRI) delivers a good overview of shoulder lesions and anatomy, mainly the soft-tissue structures. On the other hand, it is less precise than magnetic resonance arthrography for delineation of insignificant labroligamentous lesions allied with shoulder dislocation [16]. Computed Tomography (CT) arthrography mainly has been superseded by MR arthrography. CT arthrography is typically utilized when MRI is not accessible. It is beneficial in presenting bony lesions and anterior and posterior labral and capsular lesions [17]. Glenohumeral instability can be categorized more by underlying causes: atraumatic, macrotraumatic, and microtraumatic. They can similarly be characterized by the several degrees of subluxation or dislocation. Further subdivisions contain direction and voluntary/involuntary mechanisms. A first time acute shoulder dislocation can moreover represent the first presentation of recurrent dislocation. Patients may be categorized into the following 2 clinical categories, which denote the 2 ends of a broad spectrum:

Received:11 / 7 /2017
Accepted: 20/7 /2017
DOI : 10.12816/0040610

- Patients with traumatic unidirectional instability with a Bankart lesion who need surgical intervention (TUBS)
- Patients with no history of trauma (a traumatic sort) who have multidirectional and bilateral instability and who also undertake rehabilitative treatment or are treated surgically with inferior capsular imbrication (AMBRI)

Traumatic anterior glenohumeral instability represents 95% of glenohumeral instability perceived in clinical practice [18].

The study was approved by the Ethics Board of King khalid University.

Anterior Shoulder Dislocation

Anterior shoulder dislocations are frequently the outcome of direct or indirect trauma, with the arm constrained into snatching and external rotation. This is by a wide margin the most continuous sort of shoulder dislocation and signifies to over 90% of injuries. Of single acute dislocations, 40% end up plainly intermittent because of related harm of the encompassing ligamentous and capsular structures that stabilize the joint [9, 15]. The most essential structure stabilizing the shoulder, one that limits gross anterior-inferior subluxations and dislocation, is the inferior glenohumeral ligament (IGHL). This ligament structures is a sling with discrete anterior and posterior bands. It is remiss when the humerus is in the impartial position, and it permits typical shoulder movement. The ligamentous complex ends up plainly rigid in abduction and external rotation and, in this manner, balances out the joint at the end range of shoulder movement in the abduction external rotation (ABER) direction [19]. All through a dislocation, forces surpass the limit that the ligamentous complex can endure, prompting tears or extending. This might prompt laxity and instability [20]. Disappointment of the IGHL may happen at the insertion site (40%), in the ligamentous substance (35%), and at the humeral insertion site (25%). Avulsions are seen regularly in the anterior band and the anterior feature of the axillary pouch, while ligamentous substance tears are more typical in the back part of the axillary pouch.

Bankart lesions denote failure of the IGHL at the glenoid insertion. IGHL capsule laxity denotes intrasubstance ligamentous failure, though humeral avulsions of the GHL (HAGL) denote failure of the IGHL at its humeral insertion. The MGHL is regularly inattentive or infantile and assumes a minor part. Tears of the GHL may happen without related labral tears and furthermore may cause shoulder instability. In a Bankart lesion, the scapular periosteum separations as the labroligamentous ligaments are avulsed from the glenoid. In Bankart variants, the scapular periosteum rests intact comparative to the labroligamentous complex. If the labroligamentous complex is displaced medially and moved inferiorly, rolling up on itself, the lesion is known as an ALPSA lesion. An ALPSA lesion is allied with more plain injury [21].

The individual occurrence of a Hill-Sachs lesion is pathognomonic of anterior instability and is realized in 50% of patients. The necessity to identify the lesion is reduced if other pathognomonic outcomes exist (ie, anterior instability found on physical examination or Bankart lesion). The Hill-Sachs lesion defines a representative defect of the posterolateral surface of the humeral head and represents a compression fracture [22]. The resultant lesion is subjective by the patient's age at dislocation and the period since the initial dislocation.

Young and Adults patients	Older patients
Anteroinferior labroligamentous complex avulsion (Bankart lesion) Bennett lesion HAGL lesion Perthes lesion ALPSA lesion Surgical reconstruction	Paucity of Bankart lesions HAGL lesion Supraspinatus tendon (30% of tears in older patients) Fracture of the greater tuberosity (one third of older patients) Conventional imaging (no need for arthrography) Treatment usually conservative Avulsion of the subscapularis and capsule from the lesser tuberosity (one third of older patients)

Intra-articular loose bodies are common and need surgical intervention. Most unattached bodies are composed of bone, cartilage, or both. They might similarly comprise of fat, fibrous tissue, blood or fibrin [23].

Radiography

Radiographs are used to diagnose dislocations of the shoulder (Figure 1) [24].

They can represent the following:

- Presence of a Hill-Sachs lesion (Figure 2)
- Subglenoid new bone formation
- Presence of bony abnormality of the anterior or posterior rim
- Presence of fractures
- Degenerative changes in the joint

Figure 1. Anterior shoulder dislocation radiograph comparative to the glenoid fossa.

Figure 2. The postero lateral feature of the humeral head (Hill-Sachs defect):Anterior dislocation.

Radiographs help in making the conclusion as well as in deciding if the progressions may enhance with treatment. The West Point axillary view is useful for identifying the extent and presence of a Hill-Sachs lesion when it is not seen on anteroposterior, internally rotated, and Y-scapular or axillary views. The anteroposterior, inside turned view is helpful for showing the nearness and size of a Hill-Sachs defect. Superior projections including the adjusted Didiee, West Point observations, Stryker, and, Hermodsson have been improved to expand the affectability of radiography in recognizing the lesions. The West Point axillary view is helpful for distinguishing the degree and nearness of a Hill-Sachs lesion when it is not seen on anteroposterior, axillary perspectives, and Y-scapular or internally rotated.

Computed Tomography

The presentation of CT arthrography permitted imaging of the capsular components and enhanced perception of the labrum. This method enhanced show of the articular and synovial surfaces, the long head of the biceps ligament, and intra-articular free bodies. CT can help in deciding the direction of instability and capsulolabral complex damage after an intense incident of injury. Besides, complexities of posttraumatic dislocation might be recognized on CT examines. CT arthrography can exhibit the significant reasons for instability (bony, ligamentous, cartilaginous labral, or capsular) [25, 26]. The cartilaginous labrum can be believed to be mostly isolates from the bony glenoid. The labrum might be destroyed and torn, degenerated, or even missing (Figure 3).

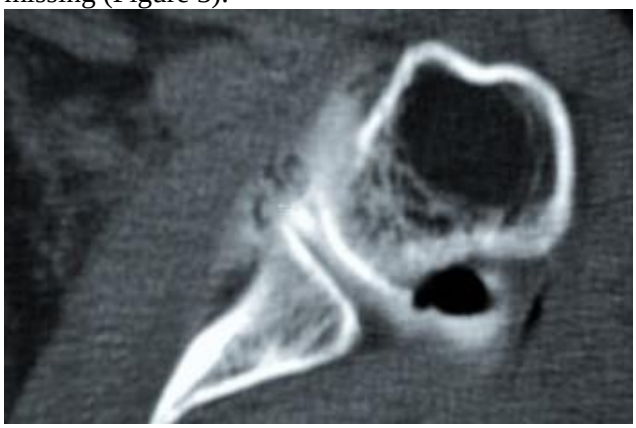

Figure 3. CT arthrogram of the shoulder indicates an undisplaced tear of the anterior glenoid labrum.

CT findings incorporate inconsistency of the scapular insertion site, demonstrating swelling and drain in the acute stage. Furthermore, acute capsular tears are obvious as a result of extravasation of difference medium or capsular excess. Ectopic calcification and solidification coming about because of rupture of the scapular periosteum regularly are found in the chronic phase. Damage to the capsule might be inconspicuous, despite the fact that in a few patients, detachment is articulated and stripped medially to the scapular neck. The subscapularis bursa broadens medially underneath the coracoid procedure, and the opacified bursa typically shapes a sharp progress with the scapular attachment of the capsule over or at the glenoid notch. Stripping of the capsule in anterior instability outcomes in loss of the boundary, and a huge recess is shaped over the scapular neck, which is confirmed utilizing conservative double contrast arthrography. As formerly stated, this finding is not fit correlated with anterior instability. Loose bodies are imagined

as filling defects in the joint space that are outlined completely by contrast material (Figure 4).

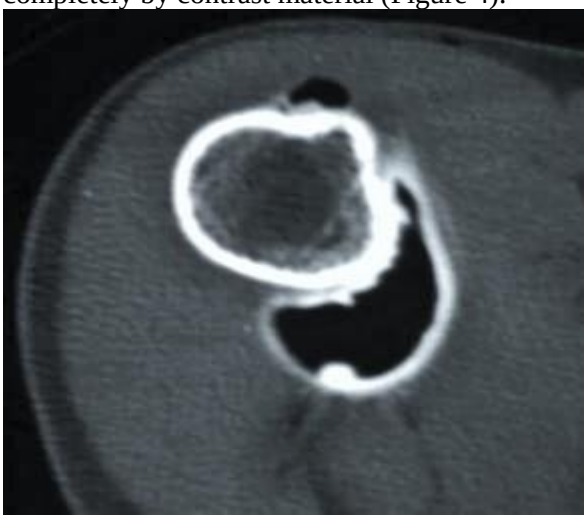

Figure 4. CT arthrogram of the shoulder displays a loose body in the axillary recess.

Magnetic Resonance Imaging

MRI findings can be allocated into those validated on conventional MRIs and those demonstrated on MR arthrograms [27, 28]. The essential finding of a Bankart lesion on axial MRI is a zone or band of strange indicator power, which is expanded on proton density– weighted images, T2-weighted image (T2WI) and T2*- weighted image (T2* WI). This zone isolates the anteroinferior capsulolabral complex from the osseous glenoid edge (Figure 5).

On the off chance that the dislocation is recent, a radiation is regularly current, and separation of the labroligamentous complex might be pictured. Axial T1 weighted image (T1WI) or T2WI might indicate subchondral bone changes, which exhibit low signal intensity on T1WI and high signal intensity on T2WI.Minor separations, named partial Bankart lesions, might seem to contain the glenoid labrum alone on axial images. These will probably be related with subluxational instabilities.

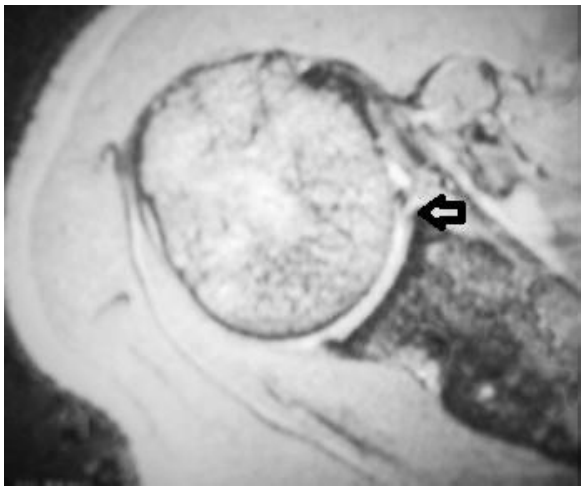

Figure 5. MRI scan of the shoulder displays a small tear of the anterior labrum

In chronic recurring instability, the labrum deteriorates and is probably going to be notably lessened in size or to be thoroughly missing. Linear tears of the labrum substance and deformity of the labrum might be seen to be harmed by the effect of the humeral head. Expanded signal intensity of the anteroinferior labrum substance after acute trauma or in the repetitive stage signifies edema, labrum degeneration or granulation tissue. In spite of the poor meaning of the labrum without a radiation, signal changes in the signal intensity of the capsulolabral complex at the glenoid junction are proven on gradient echo images and proton density weighted images.

An ordering classification for abnormal labral intensity has been formulated for conventional MRI as follows:

- Type 1- Increased signal with no surface extension, representing internal degeneration without tear.
- Type 2 - Blunted or frayed labrum with normal dark intensity.
- Type 3 - T1 or T2 signal extends to the surface.
- Type 4 - Combination of abnormal morphology with type 2 features and increased signal intensity extending to the surface with type 3 features.

A helpful finding for isolating an acute Bankart lesion from a chronic Bankart lesion is expanded signal intensity in the short-tau inversion recovery (STIR) images, subchondral bone on fat-suppressed or fast spin-echo T2WIs. Gadolinium-based contrast agents (gadopentetate dimeglumine, gadoversetamide, gadobenate dimeglumine, gadoteridol, gadodiamide) have been associated to the improvement of nephrogenic fibrosing dermopathy (NFD) or nephrogenic systemic fibrosis (NSF). The ailment has arisen in patients with moderate to end stage renal ailment subsequent to being given a gadolinium based contrast agent to improve MRI or magnetic resonance angiography scans [29].

Anterior instability on MR arthrography

MR arthrography becomes an option, supposing that fluoroscopy or sonography is accessible to guide needle placement for the intraarticular injection of contrast material. Few referring physicians are pleased with conventional MR, while others prefer arthrographic MR and the diagnostic confidence provided by intraarticular contrast material. MR arthrography has the most convincing part in the appraisal of more youthful people with suspected instability, when subtle labral-ligamentous abnormalities have significant effects on shoulder function, administration, and

prognosis [30]. Provocative positioning moves, incorporating imaging in both internal and external rotation, ABER, flexion-adduction and internal rotation (FADIR), and adduction-internal rotation (ADIR), have been recommended to enhance perception of the labral-ligamentous complex [31]. Even though ABER positioning was primarily referred as increasing sensitivity in the diagnosis of articular sided rotator cuff lesions [32], it is currently perceived as enhancing the detection of non-displaced anteroinferior labral tears at the attachment site of the IGL [30, 31] (Figure 6). In a study of 256 patients, ABER images improved the diagnostic performance of MR arthrography from 48% to 89% sensitivity [31]. Utilized alone to assess the anteroinferior labral-ligamentous complex, ABER images demonstrated the same accuracy as the full complement of arthrographic MR sequences [33]. FADIR can enhance evaluation of the posterior labrum and capsule, though ADIR might have benefits to ABER in discriminating between different Bankart subtypes [34].

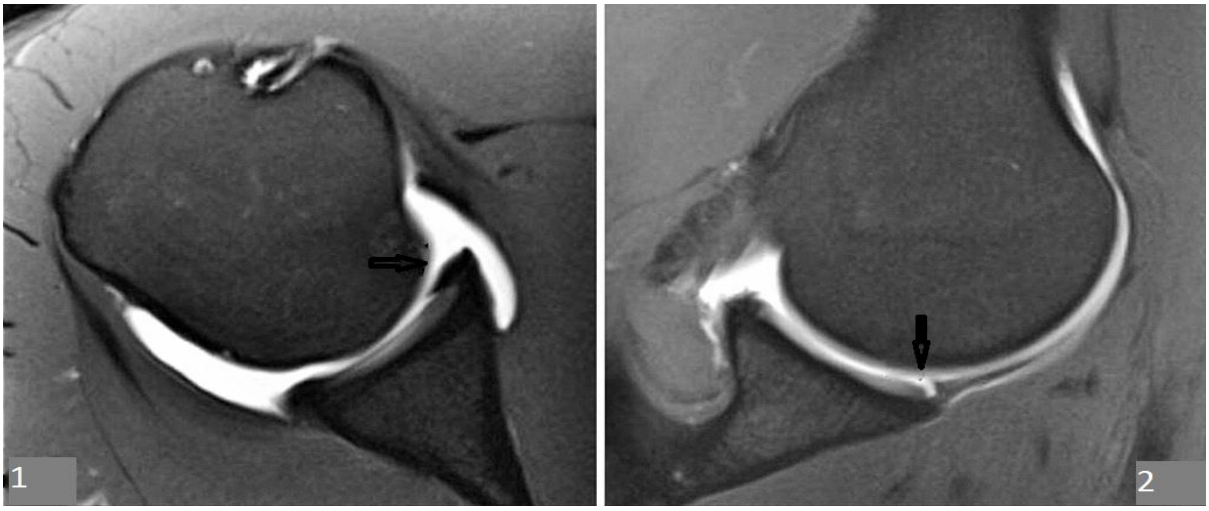

Figure 6. Axial fat-suppressed image shows an intact anterior labrum (arrow). ABER image shows an avulsion of the anterior labrum with an intact glenoid periosteum and capsule.

CONCLUSION

Glenohumeral instability includes a broad spectrum of clinical complaints and presentations. The diagnosis could be noticeable to the referring physician; however, frequently it is unanticipated. Radiologists must similarly keep in mind that the history of one time dislocation is not the same as shoulder instability.

Hill-Sachs fracture is an imaging indicator of dislocation but ought not to be taken as a signal of instability without other supportive irregularities. Image findings rely on the clinical scenario: acute first-time shoulder dislocation, chronic instability without repeated dislocation, or chronic instability with repeated dislocation.

Imaging abnormalities that happen in the acutely traumatized shoulder are considerably dissimilar from those that characterize the chronic unstable joint. The aim of imaging relies on the clinical scenario. Image explanation and reporting might require underlining the identification of lesions for diagnosis, or the characterization of lesions for treatment preparation. As a result, the choice to use CT, CT arthrography, MR, or MR arthrography also depends on the clinical scenario and aim of imaging.

REFERENCES

1. **Shah AS, Karadsheh MS and Sekiya JK(2011).** Failure of operative treatment for glenohumeral instability: etiology and causes. **Arthroscopy**,27:681–94.
2. **Rowe CR, Patel D and Southmayd WW(1978).** The Bankart procedure: a long-term end-result study. **J Bone Joint Surg**. ,60:1–16.
3. **Chen AL, Hunt SA, Hawkins RJ *et al.*(2005):** Management of bone loss associated with recurrent anterior glenohumeral instability. Am J Sports Med. ,33:912–925.
4. **Burkhart SS, De Beer JF(2000).** Traumatic glenohumeral bone defect and their relationship to failure of arthroscopic Bankart repairs: significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. Arthroscopy,16:677–694.
5. **Itoi E, Lee SB, Berglund LJ, Berge LL *et al.*(2000).** The effect of a glenoid defect on anteroinferior stability of the shoulder after Bankart repair: a cadaveric study. J Bone Joint Surg. ,82A:35–46.
6. **Lynch JR, Clinton JM, Dewing CB *et al.*(2009).** Treatment of osseous defects associated with anterior shoulder instability. J Shoulder Elbow Surg., 18:317–328.
7. **Thomas SC, Matsen FA(1989).** 3rd An approach to the repair of avulsion of the glenohumeral ligaments in the management of traumatic anterior glenohumeral instability. J Bone Joint Surg.,71A:506–513.

8.Taylor DC, Arciero RA (1997). Pathologic changes associated with shoulder dislocations. Arthroscopic and physical examination findings in first-time, traumatic anterior dislocations. Am J Sports Med. ,25:306–311.

9.Griffith JF, Antonio GE, Yung PS, Wong EM, Yu AB, Ahuja AT *et al.*(2008). Prevalence, pattern, and spectrum of glenoid bone loss in anterior shoulder dislocation: CT analysis of 218 patients. AJR Am J Roentgenol. , 190(5):1247-54.

10.Saupe N, White LM, Bleakney R, Schweitzer ME, Recht MP, Jost B *et al.*(2008). Acute traumatic posterior shoulder dislocation: MR findings. Radiology,248(1):185-93.

11.Murray PJ, Shaffer BS(2009). Clinical update: MR imaging of the shoulder. Sports Med Arthrosc. , 17(1):40-8.

12.Chetouani M, Ropars M, Marin F, Huten D, Duvauferrier R, Thomazeau H(2010). Is MRI useful to assess labral reduction following acute anterior shoulder dislocation?. Orthop Traumatol Surg Res. , 96(3):203-7.

13.Hottya GA, Tirman PF, Bost FW *et al.* (1998).Tear of the posterior shoulder stabilizers after posterior dislocation: MR imaging and MR arthrographic findings with arthroscopic correlation. AJR Am J Roentgenol.,171(3):763-8.

14.Roger B, Skaf A, Hooper AW *et al.*(1999). Imaging findings in the dominant shoulder of throwing athletes: comparison of radiography, arthrography, CT arthrography, and MR arthrography with arthroscopic correlation. AJR Am J Roentgenol.,172(5):1371-80.

15.Willemsen UF, Wiedemann E, Brunner U *et al.*(1998). Prospective evaluation of MR arthrography performed with high-volume intraarticular saline enhancement in patients with recurrent anterior dislocations of the shoulder. AJR Am J Roentgenol. , 170(1):79-84.

16.Tirman PF, Feller JF, Janzen DL *et al.* (1994).Association of glenoid labral cysts with labral tears and glenohumeral instability: radiologic findings and clinical significance. Radiology,190(3):653-8.

17. Zlatkin MB, Bjorkengren AG, Gylys-Morin V *et al.*(1998). Cross-sectional imaging of the capsular mechanism of the glenohumeral joint. AJR Am J Roentgenol. , 150(1):151-8.

18. Bencardino JT, Gyftopoulos S, Palmer WE(2013). Imaging in anterior glenohumeral instability. Radiology,269(2):323-37.

19.Stoller DW(1997). MR arthrography of the glenohumeral joint. Radiol Clin North Am. , 35(1):97-116.

20.Palmer WE, Brown JH, Rosenthal DI(1994). Labral-ligamentous complex of the shoulder: evaluation with MR arthrography. Radiology,190(3):645-51.

21.Fujii Y, Yoneda M, Wakitani S *et al.*(2006). Histologic analysis of Bony Bankart lesions in recurrent anterior instability of the shoulder. J Shoulder Elbow Surg. ,15:218–223.

22.Saliken DJ, Bornes TD, Bouliane MJ, Sheps DM, Beaupre LA(2015). Imaging methods for quantifying glenoid and Hill-Sachs bone loss in traumatic instability of the shoulder: a scoping review. BMC Musculoskelet Disord. , 18. 16:164.

23.Rapariz JM, Martin-Martin S, Pareja-Bezares A, Ortega-Klein J(2010). Shoulder dislocation in patients older than 60 years of age. Int J Shoulder Surg., 4(4):88-92.

24.Saliken DJ, Bornes TD, Bouliane MJ, Sheps DM, Beaupre LA (2015). Imaging methods for quantifying glenoid and Hill-Sachs bone loss in traumatic instability of the shoulder: a scoping review. BMC Musculoskelet Disord.,16:164.

25.Peh WC, Campbell C, Kelly IG *et al.* (1994).The role of computerized tomography in shoulder arthrography. J R Coll Surg Edinb. , 39(3):190-5.

26.De Maeseneer M, Van Roy F, Lenchik L *et al.* (2000).CT and MR arthrography of the normal and pathologic anterosuperior labrum and labral-bicipital complex. Radiographics, 20:S67-81.

27.Seeger LL, Yao L, Gold RH(2015). Diagnosis of glenoid labral tears: a comparison between magnetic resonance imaging and clinical examinations. Am J Sports Med., 25(1):141-4.

28.Faria RS, Ribeiro FR, Amin Bde O, Tenor Junior AC, da Costa MP, Filardi Filho CS *et al.* (2015).Acromioclavicular dislocation: postoperative evaluation of the coracoclavicular ligaments using magnetic resonance. Rev Bras Ortop.,50 (2):195-9.

29.McArthur C, Welsh F, Campbell C(2013). Posterior dislocation of long head of biceps tendon following traumatic anterior shoulder dislocation: imaging and intra-operative findings. J Radiol Case Rep.,7 (9):19-26.

30.Shankman S, Bencardino J, Beltran J(1999). Glenohumeral instability: evaluation using MR arthrography of the shoulder. Skeletal Radiol .,28(7):365–382.

31.Cvitanic O, Tirman PF, Feller JF, Bost FW, Minter J, Carroll KW(1997). Using abduction and external rotation of the shoulder to increase the sensitivity of MR arthrography in revealing tears of the anterior glenoid labrum. AJR Am J Roentgenol.,169(3):837–844.

32.Tirman PF, Bost FW, Steinbach LS *et al.*(1994). MR arthrographic depiction of tears of the rotator cuff: benefit of abduction and external rotation of the arm. Radiology,192(3):851–856.

33.Schreinemachers SA, van der Hulst VP, Jaap Willems W, Bipat S, van der Woude HJ(2009). Is a single direct MR arthrography series in ABER position as accurate in detecting anteroinferior labroligamentous lesions as conventional MR arthography? Skeletal Radiol.,38(7):675–683.

34.Song HT, Huh YM, Kim S *et al.*(2006). Anterior-inferior labral lesions of recurrent shoulder dislocation evaluated by MR arthrography in an adduction internal rotation (ADIR) position. J Magn Reson Imaging,23(1):29–35.