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Type of Shoulder Dislocation as a Predictor of the Suitable Injection Approach to MR Arthrography

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Abstract

Background: **Shoulder arthrography is an accurate method that can help in diagnosing several diseases. When shoulder arthrography is done in combination with magnetic resonance imaging (MRI), a more comprehensive assessment of the cartilaginous structures of the glenohumeral joint could be achieved.** ***Objective*****: To compare the anterior and posterior arthrography injection approaches through the detection of the widest joint space in cases of anterior and posterior shoulder dislocations and to identify the suitable approach for MR arthrography.** ***Subjects and Methods:*** **A total of eighty individuals were included in this study. The average age of patients was thirty-two years old. Magnetic resonant images were used in the comparison of the measures of anterior and posterior joint spaces in different types of shoulder dislocations.** ***Results:*** **On measuring anterior space with reverse Hill-Sachs depth, it was significantly larger in patients with posterior dislocation ($p < 0.05$), 16.93 mm versus 8.24 – 9.02mm, while posterior space with Hill-Sachs depth was significantly larger in patients with anterior dislocation ($p < 0.05$), 14.81 mm versus 5.9 – 8.2 mm.** ***Conclusion:*** **The anterior approach for MR arthrography in the case of posterior shoulder dislocation could be the optimized approach, and the posterior approach in the case of anterior shoulder dislocation could be the optimized approach. Further studies with a larger sample size are needed to confirm these results.**

Keywords**:** MR arthrography; Hill-Sachs depth; reverse Hill-Sachs depth; posterior shoulder dislocation; anterior shoulder dislocation

Introduction

Sudden trauma to the shoulder could get it out of position, additionally, an excessive rotation of the shoulder joint could pull the head of the humerus out of the glenoid cavity[1–2]. Partial dislocations where a part of the humerus is inside the glenoid space and another part is outside, may also take happen. The shoulder joint dislocations may occur anteriorly or posteriorly, completely, or partially due to the various-directions movement nature of the joint[3-4]. MRI displays high-quality soft tissue contrast and multi-planar accurate capability that has modernized the shoulder imaging technology for muscles, tendons, hyaline and fibrous cartilages, joint capsules, and bursae[5]. One of its advantages is its non-invasive diagnostic nature which enables imaging without the use of ionizing radiation[6]. Multiple reduction methods,

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particularly in low-equipped health facilities, are performed without using general anesthesia or muscle relaxants, this could lead to Hill-Sachs lesion due to the absence of muscle relaxants, to avoid subscapularis muscle medial traction of the humerus[7]. This might be a reason for the widening of joint space on the contrary side of the dislocation The Hill-Sachs lesion could be utilized to assist contrast material injection in MR arthrography and avoid the injury of the anterior structures during this process. Shoulder MR arthrography has demonstrated its ability to be the gold standard imaging procedure for the assessment of shoulder joint injuries and labor- ligamentous disorders[8-9]. The benefits of MR arthrography are especially obvious during the evaluation of acute injuries in young age, dynamic patients with somewhat minor degenerative joint disorder[10]. Bipolar bone loss involves a glenoid defect and a Hill-Sachs lesion in a shoulder with anterior instability. The effect of this condition on postoperative relapse after arthroscopic Bankart restoration is still uncertain[11-12]. We hypothesized that in MRI shoulder arthrography, the posterior injection of contrast in anterior glenohumeral instability is more feasible, and vice versa. The aim of our study, therefore, was to detect the widest joint space in patients who suffer from anterior and posterior shoulder dislocation to determine the suitable approach for MR arthrography.

Patients and Methods

The study is a retrospective cross-sectional one. We have included patients suffering from shoulder disorders who have been requested to perform MR-Arthrography and have been referred to MR-Unit of the radiology department-Suez Canal University Hospital. This study was approved by the Faculty of Medicine Suez Canal University institutional review board. A total of 80 patients were referred for MRI arthrography. Patients aged >18 years with recurrent shoulder dislocation.

Image analysis

Serial numbers of patients were placed in random order by one investigator and then all MR arthrography were independently reviewed at a workstation (Synapse PACS, FUJIFILM, Japan) by one radiologist with 16 years of experience in musculoskeletal radiology who was blinded with the patients' clinical information and arthroscopic results. The conventional MR images were performed in a neutral position. The anterior and posterior joint spaces were measured on axial MR images for the determination of the widest space, for the MR arthrography injection procedure. A circle was drawn over the border of the humeral head; the depth of the Hill-Sachs or reverse Hill-Sachs was measured as the distance between the deepest part of the depression and the border of the circle (Figures 1 & 2). The anterior and posterior joint spaces were measured as the distance between the anterior or posterior borders of the humeral head and the anterior or posterior capsule respectively (Figure 3).

Statistical analysis

The variables were non-normally nonparametric distributed. The measurements were not adjusted for the patients' sex, age. The distribution of all categorical variables was presented in frequencies. Data were collected, coded then entered spreadsheet using Microsoft Excel 2010 for Windows, of the Microsoft Office bundle; 2010 of Microsoft Corporation, United States. Data were analyzed by IBM Statistical Package for Social Sciences software (SPSS). 25th edition. IBM, United States. Continuous data were expressed as mean standard deviation and categorical data as a percentage. Data were presented as tables. An Independent t-test was used to

compare between two groups' quantitative data expressed as mean and standard deviation. Results were considered statistically significant at a p-value of ≤ 0.05.

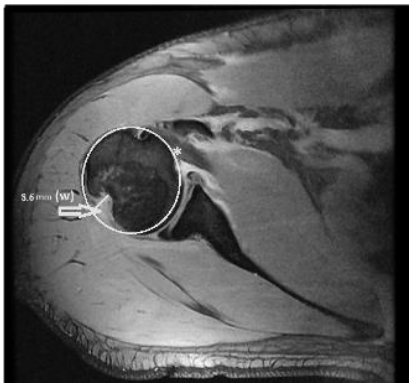

Figure 1: MR images of anterior dislocation of the right shoulder. Axial Gradient ECHO shows Hill-Sachs's lesion (→) The width of the Hill-Sachs lesion (W) measured 8.6 mm, with an anterior labral tear.

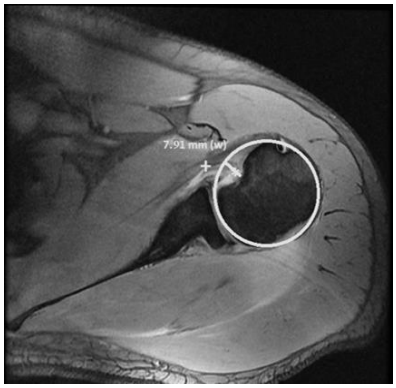

Figure 2: MR images of posterior dislocation of the left shoulder. Axial Gradient ECHO shows reverse Hill-Sachs lesion of the left humeral head The width of the Hill-Sachs lesion (W) measured 7.91 mm. on the axial image.

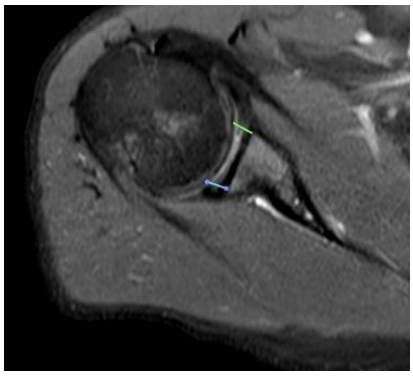

Figure 3: SPAIR MR of the Rt. shoulder in a patient with anterior dislocation showing the measurement of the anterior green line, and the posterior space the blue line.

Results

Males 51 (63.75%) were more frequent than females 29 (36.25%) in our study. Patients had a mean age of 32.5±3.5 years (range from 25 to 41 years old). All patients were presented with shoulder pain. Right side affection (61.75%) was more than the left side (38.75%). Figure 1. Regarding the examined site, there was much more right-sided patients rather than left sided (49/31). Patients had mean anterior space of 9.096 mm ±2.6 mm, posterior space 5.74±0.84 mm, Hill-Sachs width 8.83±0.59 mm, and reverse Hill-Sachs width 8.69 mm ± 0.64 mm Table (1). Patients with anterior dislocation had significantly larger posterior space (P+W) (14.81±1.46 mm), more than anterior space (A) (9.02±3.6 mm) while patients with posterior dislocation had significantly larger anterior space (A+W) (16.93 mm±2.74 mm) more than posterior space length (P) (5.51±0.75 mm) with a statistically significant difference Table (2).

Table 1: MRI measurements among the study group patients (n=80).		
Variable		Value
Anterior space (A) (mm)	Mean ± SD median (Range	9.096±2.6 8.65(5.6-13.8)
Posterior space (P) (mm)	Mean ± SD median (Range)	5.74±0.84 5.62(4.6-7.6)
Hill Sachs width (W) (mm)	Mean ± SD median (Range	8.76±0.62 9.06(7.8-9.4)

Table 2: MRI measurements among types of dislocation.			
Variable	**Anterior dislocation (n=31)**	**Posterior dislocation (n=49)**	**P-value**
Anterior space (A) (mm) mean±SD	9.02±3.6	8.24±2.1	0.023*[1]
Posterior space (p) (mm) mean±SD	5.98±0.87	5.51±0.75	0.011*[1]
Hill Sachs width (w) (mm) mean±SD	8.83±0.59	8.69±0.64	0.334[1]
Widest space length (mm) mean±SD	P + W 14.81±1.46	A + w 16.93±2.74	0.672[1]

Hill-Sachs width showed insignificant differences between our study groups of dislocation (p>0.05), while on measuring anterior space with Hill Sachs width (A+W), it was significantly larger in patients with posterior dislocation (16.93±2.74 mm) than anterior space (8.24±2.1mm) with p-value<0.001, while posterior space with Hill Sachs width (P+W) was significantly larger in patients with anterior dislocation (14.81±1.46 mm) than anterior space (9.02± 3.6 mm) with p-value<0.001. The available space for the anterior inject tion approach was significantly larger for patients with posterior dislocation and reverse Hill-Sachs lesion (p <0.05), 16.93 mm *vs.* 8.24 – 9.02 mm. The available space for the posterior injection approach was significantly larger for patients with anterior dislocation and Hill-Sachs lesion (p < 0.05), 14.81 *vs.* 5.9–8.2 mm (Table 3). On measuring anterior space with reverse Hill-Sachs width, it was significantly larger in patients with posterior dislocation, while posterior space with Hill-Sachs width was significantly larger in patients with anterior dislocation.

Table 3: The total available anterior and posterior joint spaces		
	Anterior dislocation With Hill-Sachs lesion	Posterior dislocation With reverse Hill-Sachs lesion
Available space with anterior approach (mm)	A 9.02±3.6	A +W 16.93±2.74
Available space with posterior approach (mm)	P+W 14.81±1.46	P 8.24±2.1

Discussion

Most the physicians nowadays prefer MR arthrography and the diagnostic confidence provided by intra-articular contrast material. It has the most realistic part in the assessment of younger patients with presumed shoulder instability when minor labral-ligamentous defects have significant effects on shoulder function and prognosis. However, as is the case in many interventional procedures it's important to define. The lowest risky, safe, and highly successful guidelines for our patients, with a

focus of shoulder arthrography procedure, we have many factors limiting joint access, such as coracoid process, disturbed anatomy with patients suffering anterior boney banket lesions, or intravenous injection. We worked to determine the widest joint space in patients suffering from anterior and posterior shoulder dislocation to determine the suitable approach for MR arthrography. To minimize the risk and increase the injection success rate, by defining the widest joint space in patients suffering from recurrent anterior and posterior shoulder dislocation determine the suitable approach for MR arthrography**.** Our hypothesis is grounded on the fact that the most common complication of shoulder dislocation is Hill-Sachs lesions, which represent a depression fracture in the humeral head, that will result in widening of the potential joint space for contrast material injection. However, this will need to either externally rotate the arm in case of anterior dislocation, or to internally rotate the arm in case of reversed Hill-Sachs association. The internal or external rotation also has an added value as it moves the capsular insertion away from the injection track to facilitate the capsular puncture[13]. On measuring the Joint space for anterior injection was significantly larger for patients with posterior dislocation and reverse Hill-Sachs lesion 16.93 mm and the available joint space for posterior injection approach was significantly larger for patients with anterior dislocation and Hill-Sachs lesion 14.81 mm versus**.** Throughout our study, ten of our patients (12.5%) had a posterior dislocation and 70 had an anterior dislocation (87.5%). A 29 were female patients (36.25%) and 51 were males (63.75%). The success rate of the reported injection approach among the anterior approach group was 84.2% versus 89.5% in the posterior approach group. There was a non-statistically significant difference in the mean number of trials for the anterior and posterior approaches, while the mean volume injected with the anterior approach was significantly lower than that of the posterior approach group (P-Value: 0.006). In anterior shoulder dislocation, the posterior approach has a slight advantage over the anterior approach regarding the injected volume of the contrast medium. However, there were better results yet non-statistically significant regarding the anterior and posterior approaches accuracy, pain tolerance, and the number of trials.

Limitations of the study

First, small sample size. Second, lower number of patients with posterior shoulder dislocations. Finally, the lack of application of the study observation by performing the injection technique. The appropriateness of the approach of injection is not only controlled by the accessible joint space, but the joint injection procedure also requires specific skills from the radiologist who perform the examination. Therefore, further studies are necessary to fully determine the value of MR arthrography for these subtypes of lesions.

Conclusion

The anterior space for anterior injection technique was significantly larger for patients with posterior dislocation and reverse Hill-Sachs lesion and the posterior space for posterior injection approach was significantly larger for anterior dislocated patients with Hill-Sachs lesion. According to our results, the posterior injection technique is recommended for MR arthrography in patients with an anterior shoulder dislocation and Hill-Sachs lesion, otherwise, the anterior injection approach should be performed.

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