

The evaluation of magnetic resonance arthrography characteristics in finding shoulder joint injury lesions

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Summary

Objective: Evaluation of some characteristics of shoulder joint injury lesions by 3.0 Tesla magnetic resonance arthrography (MRA). **Subject and method:** 39 patients with shoulder joint injuries underwent MRA 3.0 Tesla, cross-sectional descriptive study from February 2012 to August 2017. **Result:** There were 29 of patients who had rotator cuff lesions, 74.4% respectively. In which, there were 38.5% of patients who had a partial rotator cuff tear, supraspinatus partial thickness tear was the most common with 80.0%. The most common lesion in stage 3 with partial tear classification by Ellman and Habermeyer were 60.0% and 66.7% respectively, the difference between the classified by its is statistically significant with $p < 0.05$ and kappa 0.86. The percent of patients with partial thickness bursal-side tear was the highest 53.3%, articular-side tear was 33.3%, interstitial tear was 13.3%, the difference between the classified by its is statistically significant with $p < 0.05$. There were 25.6% of patients who had a complete tear of rotator cuffs tendon, supraspinatus full thickness tear was the most common with 70.0%, retraction in stage I, which is the lowest in classification by Patte and Bateman both were 20.0%, (kappa = 1.0). Supraspinatus tendon edema were the most common with 71.8%. The labrum lesion with type IV was the most common with 71.4%, type I, II, III were 3.6%, 7.1%, 17.9% respectively. Soft Bankart was the most common with 57.1%, osseus Bankart 28.6%, various Bankart 14.3%. Anatomical labrum varies was 12.8%. Hill-Sachs lesions 25.6%. SLAP lesions were 53.8%, in which, type II was the most common with 57.1%. Inferior glenohumeral ligament lesion was the most common with 45.0%, the difference between the number lesions of glenohumeral ligaments was statistically significant with $p < 0.05$. Humeral head lesions were 71.8%, in which, osseus edema 100%. **Conclusion:** MRA was useful tools to gives a full and detailed assessment of the level and forms image lesions finding of shoulder join injuries.

Keywords: Magnetic resonance arthrography, shoulder, labrum, rotator cuffs.

1. Background

Shoulder joint injury is fairly common disease in clinical and is a major causes restricted movement of joints. In the United States of America in 2010, according to research by Zacchilli MA et al, shoulder joint injury rate is 23.9/100,000 people [9].

The main common lesions in the shoulder joint injury is the rotator cuffs and labrum. However, due

to the type of lesion morphology is very diverse and abundant, so the full review, exactly how much vulnerability is very important for treatment.

Currently, magnetic resonance imaging (MRI) has been widely and effectively applied in the medical diagnosis. Magnetic resonance imaging and MRI arthrography have many advantages in assessing small, complex lesions and that is the first choice before surgery.

Some studies show that the rate of damage to labrum and rotator cuffs varies among different patient groups [2], [6]. Rotator cuffs tear is common

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in older age group patients compare with labrum tear lesions due to recurrence shoulder dislocations. According to Tang Ha Nam Anh, supraspinatus and infraspinatus tear account for 10 - 40% of the over 40 years old population [1]. According to some studies, MRI arthrography with contrast agent for more detailed assessment of labrum and facial tendon tear. According to Chun KA et al (2010), a study of 202 patients, 100 patients with partial rotator cuff tear, resulting in 61 cases of partial facial joint tear, 24 cases of synovial tear, 11 in the case of both-sided tear, diagnostic sensitivity of 88.0%, specificity 82.0%, positive predictive value 88.0%, negative predictive value 83.0% [4].

However, there have not been any reports on the characteristics of magnetic resonance arthrography of the shoulder joint in patients with trauma in the domestic country.

Therefore, we conduct the project with the following objectives: *Study of 3 Tesla MR arthrography imaging characteristics for detecting shoulder joint injury lesions.*

2. Subject and method

2.1. Subject

Including 39 patients who were examined and treated at 108 Military Central Hospital, clinically had shoulder joint injuries and had magnetic resonance

imaging from shoulder joint with injectable contrast agent (MR arthrography).

2.2. Method

Research by progressive methods, cross-sectional description.

2.3. Research facilities

MRI machine included 3.0 Tesla Achieva, Phillips, Netherlands and 3.0 Tesla Discovery MR750w of GE, USA, with shoulder coils.

Pulse sequences and planes used: PD SPAIR axial, PD oblique coronal, T2W SPAIR oblique coronal, PD fatsat oblique sagittal. The slice thickness was 3mm.

Joint injection with needle puncture of 20 - 22 Gauge, 0.1ml gadolinium and 5ml lidocaine mixed with 10 - 15ml of normal saline.

3. Result

General features

The ratio by gender: Male/female was 2.9/1.

Average age 45.0 ± 13.8 years old, the youngest patients was 19 years old, the oldest patient was 70 years old.

Right shoulder: 69.2%, left: 30.8%, right/left ratio: 2.3/1.

Table 1. Characteristics imaging of the rotator cuff lesions on MR arthrography

Lesions		No of cases (n = 39)	Rate (%)
Rotator cuff tear	Yes	29	74.4
	No	10	25.6
Partial-thickness tears	No lesions	24	61.5
	Supraspinatus tendon	12	30.8
	Supras. and infraspinatus tendon	1	2.6
	Supras. and biceps tendon	1	2.6
	Infras. and subscapular tendon	1	2.6
Full-thickness tears	No lesions	29	74.4
	Supraspinatus tendon	7	17.9
	Biceps tendon	3	7.7

Comment: There were 74.4% of rotator cuff tear, partial-thickness tears had 15 cases, accounts for 38.5%; full-thickness tear 10 cases, accounts for 25.6%. Supraspinatus tendon tear was the most common, partial-thickness tear accounted for 30.8%, full-thickness tear accounted for 17.9%.

Table 2. Gradual partial-thickness tear of the rotator cuff

Classification		No of cases	Ratio (%)	p
Ellman	Grade 1	5	33.3	<0.05
	Grade 2	1	6.7	
	Grade 3	9	60.0	
Habermeyer	Grade 1	5	33.3	<0.05
	Grade 2	0	0.0	
	Grade 3	10	66.7	
Position	Articular surface tear	5	33.3	<0.05
	Interstitial tear	2	13.3	
	Bursal surface tear	8	53.3	

Comment: The difference between the number of patients by grades and position was statistically significant with $p < 0.05$. Comparison of differential diagnosis between Ellmans and Habemayer classifications by grade was very high agreement, kappa 0.864.

Table 3. Gradual full-thickness tear of the rotator cuff

Classification		No of cases	Rate (%)	p
Patte	Stage 1	2	20.0	>0.05
	Stage 2	4	40.0	
	Stage 3	4	40.0	
Baterman	Stage 1	2	20.0	>0.05
	Stage 2	4	40.0	
	Stage 3	4	40.0	

Comment: The difference stages in both Patte and Baterman classification was not statistically significant with $p > 0.05$. Comparison of the retraction tendon diagnosis between Patte and Baterman found that there was no difference between 2 classifications, kappa 1.

Table 4. Evaluation of labral lesions on MR arthrography

Patients		No of cases	Rate (%)	p
Associated lesions				
Type of lesion	Type 1	1	3.6	<0.05
	Type 2	2	7.1	
	Type 3	5	17.9	
	Type 4	20	71.4	
Bankart lesion	Bankart	8	57.1	<0.05
	Osseus Bankart	4	28.6	
	Bankart varies	2	14.3	
Labral anatomy varies	Yes	5	12.8	<0.05
	No	34	87.2	
Hill-Sachs lesion	Yes	10	25.6	<0.05

	No	29	74.4	
SLAP lesion	Yes	21	53.8	>0.05
	No	18	46.2	

Comment: Type 4 labral lesions were the most common, accounting for 71.4%, Bankart accounted for 57.1%. The differences between groups of lesions were statistically significant with $p < 0.05$, except SLAP lesions.

Table 5. Some characteristics imaging of other lesions

Lesions	No of cases (n = 39)	Rate (%)
Supraspinatus tendon edema	28	71.8
Middle glenohumeral ligament	9	23.1
Inferior glenohumeral ligament	13	33.3
Humeral head lesions	28	71.8
Humeral head edema	28	71.8

Comment: The inferior GHL was the most common, accounting for 45.0%. The difference between GHL lesions was statistically significant with $p < 0.05$. Signs of bone edema was seen in 100% of patients with humeral head lesions.

4. Discussion

4.1. General features

The 39 patients who was performed MR arthrography, the male/female ratio was 2.9/1. The higher ratio of men than women may be due to the military hospitals (men soldier higher than women), on the other side the sports and traffic accidents are more common in men than in women. Pham Hong Ha (2009), a study of 52 patients with recurrent shoulder dislocation, with 81.1% of men and 18.9% of women. Research of Zacchilli (2010) on 8940 patients, the rate of male 72.8%, female 27.2% [2], [9]. The average age of the study group was 45.0 ± 13.8 years, the youngest was 19 years old, the oldest was 70 years old. According to Pham Hong Ha's study of 52 patients, the age group met was 16 - 53 years old, of which 90.9% concentrated in the age group of 16 - 30 years old. Zacchilli study (2010), 100% of patients aged 15 - 59. The study of Zlatkin MB (2004) on 160 patients, the common age was under 40 years old [2], [9], [10]. The shoulder joint injuries are mainly in the working age, so the right diagnosis and timely treatment will contribute to restoring the working capacity, improving the quality of life for patients. The injury of the right

shoulder is 69.2%, the left shoulder is 30.8%, this may be due to the more right-hand dominant. Kashani (2008), studied 35 patients, right shoulder 54.3%, right side dominant 54.3% [6]. According to Zacchilli (2010) in 8984 patients, the right side shoulder rate 51.4%, left side shoulder 48.4%, both side 0.2% [9].

4.2. Characteristics imaging of the rotator cuff lesions on MR arthrography

According to domestic and foreign studies, it is the most comprehensive survey method to assess the lesions of the shoulder joint. In particular, with a machine with high magnetism as 3.0 Tesla, with high organizational resolution will give specific assessment and vulnerability details.

Characteristics imaging of the rotator cuff lesions on MR arthrography

The rotator cuff is composed of an intrinsic deep muscular group consisting of the supraspinatus tendon, infraspinatus, subscapular and teres minor tendon. Due to the intimate connection of the long head biceps tendon to the supraglenoid labral complex so when evaluated it is also classified as a rotator cuff.

According to the results of the study in Table 1, we found that the rotator cuff lesions included tendon tear and edema seen in 29 cases in 39 patients, accounting for 74.4%, of which there were 25 cases with rotator cuff tears accounting for 64.1%, including partial-thickness tear met 15 cases;

full-thickness tear was met 10 cases, not partial tear met 24 cases, not completely tear met 29 cases. In cases of partial or complete tendon tear, the proportion of the supraspinatus accounted for the

majority, with full-thickness tear accounts for 17.9%, corresponding to 70.0% of patients with complete tear; partial tear accounts for 30.8%, equivalent to 80.0% of the patients with partial tear.



Figure 1. Partial-thickness tear (on the left side) and full-thickness tear (on the right side) of supraspinatus tendon on MR arthrography [5]

Our research is consistent with the evaluation results of domestic and foreign studies. According to Roy JS et al (2015) in a meta-analysis, it was found that the magnetic resonance and magnetic resonance arthrography in the diagnosis of complete rotator cuff tear have both sensitivity and specificity more than 90.0%; the diagnosis of the partial tear has a specificity of over 90.0%, but the sensitivity is lower than about 67.0% - 83.0%, the study also concluded that and there is no difference between conventional magnetic resonance and magnetic resonance arthrography in assessments of the complete rotator cuff tear [8]. According to Phan Chau Ha (2006), in 46 patients, there were 25 cases of rotator cuff tear, accounts for 54.3% [2]. According to Tang Ha Nam Anh, supraspinatus and subsupraspinatus tear account for 10 - 40% of the over 40 years old population [1]. Partial and complete tear of the supraspinatus tendon are the most common. This may be explained by the anatomical location combined with trauma mechanism usually made the supraspinatus tendon damage and tension effect was more frequent than others tendon [2], [5], [7].

Gradual of partial and full thickness rotator cuff tear

Assessing the partial tear according to Table 2 shows, the grade 3 lesion is most common in both classifications, according to Ellmans, there was 9 patients, accounting for 60.0%, according to the Habermayer there was 10 patients, accounting for 66.7%. The comparison of the differential diagnosis between Ellmans and Habermayer by group found a very high agreement between the two classifications with kappa was 0.86. Particularly, interstitial partial tear was the least common with 2 cases, accounting for 13.3%; synovial surface was the most common with 53.3%, articular surface was accounted for 33.3%. The difference between the number of patients assessed by grade and position was statistically significant with $p < 0.05$.

Evaluation of full-thickness tear according to Table 3 shows that, all patients with complete tear were given tendon retraction, the degree of tendon retraction was relatively equal in degrees and similarities between Patte and Bateman. A consistent comparison of differential diagnostics

between Patte and Batterman is very high, with kappa = 1. Patte D (1990) observes that the system of the tendon retraction classification contributes to the evaluation details of the rotator cuff tear and during patient follow-up [5].

There are actually other classification, but these were the most basic ones. According to the research results, there was not much difference between the grades, so it is advisable to apply one type of grading classification at a facility to evaluate and agree on the treatment direction. The conclusions of the study are consistent with other studies at domestic and foreign research [2], [5], [7].

Research results are consistent with domestic and foreign studies. The study of Dang Thi Bich

Nguyet on 79 patients, there was 40.5% with rotator cuff tear and has up to 37.5% of patients with full-thickness tear. According to Sharma G (2017), magnetic resonance has 89.6% sensitivity, 100% specificity, 100 positive predictive value, 83.3% negative predictive value in the diagnosis of full-thickness tear. Patients with complete tear was indicated as an intervention only when clinical and diagnostic imaging permits [7].

Characteristics imaging of the labral lesions on MR arthrography

The labral lesions in the study group was quite diverse in characteristics and morphology.

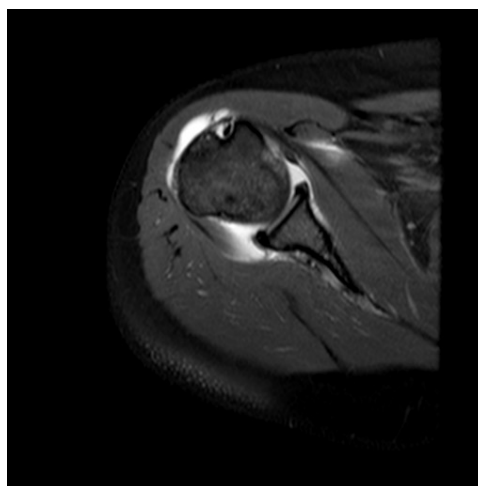
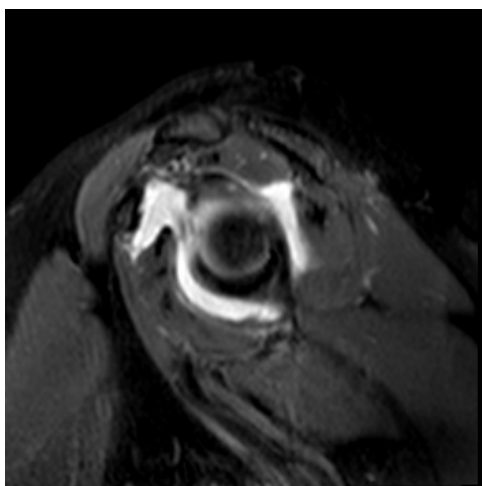


Figure 2. Labrum image in axial and sagittal plane on MR arthrography
(Source: Tran Thi N., 42 years old, female, ID 15253703)

Table 4 shows that, type IV labral density lesion accounts for the majority with 20 patients accounting for 71.4%, type II accounting for 17.9%; Bankart lesions met 14 cases, of which Bankart cartilage accounted for the most 57.1%, osseus Bankart accounted for 28.6%, Bankart variants 14.3%. Hill-Sachs lesions met in 10 cases, accounting for 25.6%. SLAP lesion accounted for 53.8%, the most common SLAP lesion was type II, accounting for 57.1%. According to a study by Porcellini (2009) on 245 patients, 88.0% of anterior labral tears. According to a study of Pham Hong Ha (2009) on 52 patients, 78.3% had labral lesions. According to Pham Ngoc Hoa et al. (2009), a study of 29 patients

with recurrent shoulder dislocations had 73% of the labral lesion. According to David S (2004), Bankart lesions accounted for about 90.0% of the labral tear with under 40 years old and accounted for 50% of patients with shoulder dislocations [2], [5], [7], [8]. In our study, there were no cases of posterior labral lesions, which may be due to anatomical structure combined with a predominantly traumatic mechanism leading to dislocated joints. In addition, the labral lesion in the upper position has little effect on mobility, so the patient does not go to the doctor, nor does it require surgery.

Some characteristics imaging of other lesions on MR arthrography

In addition to the main lesions assessed including the rotator cuff and labrum, the combined lesions in the shoulder joint injury are also diverse. As Table 5 shows, tendon edema inflammation is quite common, especially the most common tendon edema was supraspinatus tendon, accounted for 71% of all patients in the study. The middle and inferior GHL were respectively 23.1% and 33.3%, the difference in number of GHL lesions was statistically significant with $p < 0.05$. Damage to the humeral head includes fractures, edema, loss of bone under the cartilage caused by pressure, formation of small bone cysts inside the humeral head, accounts for 71.8% and 100% patients with humeral head damage had edema signs. The study results are consistent with the authors at domestic and foreign research [2], [5], [7], [8].

5. Conclusion

Through study characteristic magnetic resonance arthrography on 39 patients with shoulder joint injury, we had some conclusions:

Rotator cuff tear met 74.4%, with partial and complete tear was 38.5% and 25.6%; supraspinatus tear were most common, accounting for 80.0% and 70.0%, respectively. The diagnostic appropriateness of partial tear according to Ellman and Habermeyer and completely tear according to Patte and Bateman is very high, with kappa coefficients 0.86 and 1 respectively. Synovial surface tendon tear was the most common with 53.3%, the tear position difference is statistically significant with $p < 0.05$

Bankart cartilage lesion is the most common, accounting for 57.1%. Hill-Sachs lesions met 25.6%. SLAP lesions met 53.8%, of which type 2 was the most common, accounting for 57.1%. Type IV cartilage lesions were the most common with 71.4%. The difference in the number of OCCT ligament lesions was statistically significant with $p < 0.05$.

Magnetic resonance arthrography is a useful diagnostic imaging tool for fairly complete and

detailed assessment of the types of the shoulder joint injury patients.

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