

## Accuracy of Magnetic Resonance Arthrography in the Detection and Classification of Chronic Anteroinferior Labrum Lesions

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### ABSTRACT

**INTRODUCTION:** Bankart, and Bankart variant labrum lesions such as Perthes lesion and anterior labrum periosteal sleeve avulsion are different types of surgically treatable anteroinferior labral lesions contributing to shoulder instability. Successful outcome following arthroscopic surgery requires accurate lesion diagnosis, pre operative planning and deployment of accordant surgical technique. The purpose of our study was to retrospectively evaluate the accuracy of Magnetic Resonance Arthrography not only in the detection but also the classification of chronic antero-inferior labrum injuries by using arthroscopy as the reference standard.

**STUDY DESIGN & METHODS:** This study included 80 consecutive patients, 12 female with mean age of 28 year (range 17-

46) presenting with recurrent shoulder instability who underwent Magnetic Resonance Arthrography in neutral and abduction external rotation positions prior to arthroscopic stabilisation. The findings of a single dedicated musculoskeletal radiologist were compared with the arthroscopic findings of a single experienced shoulder surgeon.

**RESULTS:** Arthroscopic findings revealed 40 Bankart, 18 anterior labrum periosteal sleeve avulsion and 15 Perthes anteroinferior labrum lesions. Magnetic Resonance Arthrography detected 95.8% of overall labrum lesions with a sensitivity of 94% (0.86 to 0.98 ) and specificity 85.7% (0.46 to 0.99 ) and correctly classified 90% of labrum lesions with an accuracy of 93.8% (0.86-0.97) for Bankart lesions, 95% (0.88-0.98) for anterior labrum periosteal sleeve avulsion lesions and 95.5% (0.91-0.99) for Perthes lesions.

**CONCLUSION:** Our study demonstrates that Magnetic Resonance Arthrography in neutral and abduction and external rotation position can achieve high levels of accuracy in detecting and correctly classifying chronic anteroinferior labrum lesions. It emphasises its value in alerting the surgeon to the presence and the type of labrum lesion. This allows forward-planning the surgical technique to be employed for intra-operative detection, correct dissection and optimal fixation.

**Key words:** Shoulder MRA; Chronic shoulder instability; Glenoid labrum lesions; Bankart; Perthes; ALPSA

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### INTRODUCTION

Shoulder dislocations represent 50% of all major joint dislocations, with anterior dislocation being most common. The shoulder is an inherently unstable joint due to a shallow glenoid that only articulates with a small part of the humeral head compromising stability for motion. Anterior inferior dislocation is the most common, accounting for up to 97% of all shoulder dislocations with an incidence of 0.55 and

1.6 /1,000 person-years and a recurrence rate of 28.7%<sup>[1-2]</sup>. The resultant labral and ligamentous lesions are often complex and difficult to diagnose based on physical examination alone. Detection of labrum tears is frequently dependent on additional imaging<sup>[3]</sup>. Accurate imaging is crucial in the management of antero-inferior labrum lesions and many believe that labral tears are best evaluated with Magnetic resonance arthrography (MRA)<sup>[4,5]</sup>. Different types of labral injuries have been recognised with each lesion requiring a different surgical management approach, hence the importance of correctly classifying labrum lesions and allowing preoperative planning.

The purpose of our study, therefore, was to retrospectively evaluate the accuracy of MRA not only in the detection but also the classification of chronic antero-inferior labrum injuries by using arthroscopy as the reference standard.

## MATERIALS AND METHOD

The focus of this review was on chronic labral lesions. This study included 80 consecutive patients, 12 female with mean age of 28 year (range 17-46) presenting with recurrent shoulder instability who underwent MRA prior to arthroscopic stabilisation. Images were acquired with a 1.5T magnet following fluoroscopic guided posterior injection of gadolinium and using standard spin echo T1-weighted sequences with fat suppressed images in all planes, in neutral and abduction external rotation (ABER) positions. The pre-operative MRA findings were reported by a dedicated MRA musculoskeletal radiologist and recorded in our hospital digital archive system. Capsulo-ligamentous and labral lesions were retrieved and compared retrospectively with the predominant arthroscopic findings of a single experienced shoulder surgeon focusing on antero-inferior labrum and capsular injuries. Both radiologist and surgeon followed the same labrum lesion classification described as (a) Bankart lesion when labrum was avulsed and displaced laterally with complete periosteal detachment, (b) Perthes lesion when the labrum was avulsed with minimal displacement and intact periosteum and (c) anterior labrum periosteal sleeve avulsion (ALPSA) when the labrum was avulsed and markedly displaced medially on the anterior aspect of the glenoid neck with intact periosteum and absent labrum on the glenoid rim Figure 1.

Arthroscopic findings were used as a reference for MRA findings. Overall predictive values to assess the MRA diagnostic accuracy in the detection of labrum lesions were calculated. In addition the ability of the MRA to classify each type of labral lesions and the 95% confidence intervals were calculated.

## RESULTS

In this study arthroscopy of 80 patients showed 73 patients with chronic labral lesions and 7 patients with antero-inferior capsular redundancy. Their classification and incidence is depicted in table 1.

MRA detected 95.8% (70/73) of labrum lesions, 4 cases showed no labrum tear, and 6 cases had only capsular redundancy.

MRA correctly classified 90% (66/73) of labrum lesions, of which 36 as Bankart, 15 as Perthes and 15 as Alpsa lesions (Table 2).

Statistical analysis was based on values shown in table 3.

MRA predictive values in the overall detection of labral lesions showed a sensitivity of 94% (0.86-0.98), and specificity of 85.7% (0.46-0.99) (Table 4).

MRA predictive values of in correctly classifying labrum lesions showed an accuracy of 93.8% (0.86-0.97) for Bankart lesions, 95% (0.88-0.98) for ALPSA lesions and 95.5% (0.91-0.99) for Perthes lesions (Table 5).

**Table 1** Incidence of chronic antero-inferior labrum injuries.

Arthroscopy	incidence	(%)
Bankart	40	54.70%
ALPSA	18	24.60%
Perthes	15	20.50%
redundant capsule	7	8.70%
total labrum tears	73	91%

**Table 2** MRA Detection and Classification of chronic antero-inferior Labrum lesions.

	MRA		MRA	
	detected	(%)	correctly classified	(%)
Bankart	37		36	90%
ALPSA	16		15	83.30%
Perthes	17		15	100%
redundant capsule	6			
total labrum tears	70	95.80%	66	90%

**Table 3** Statistic values.

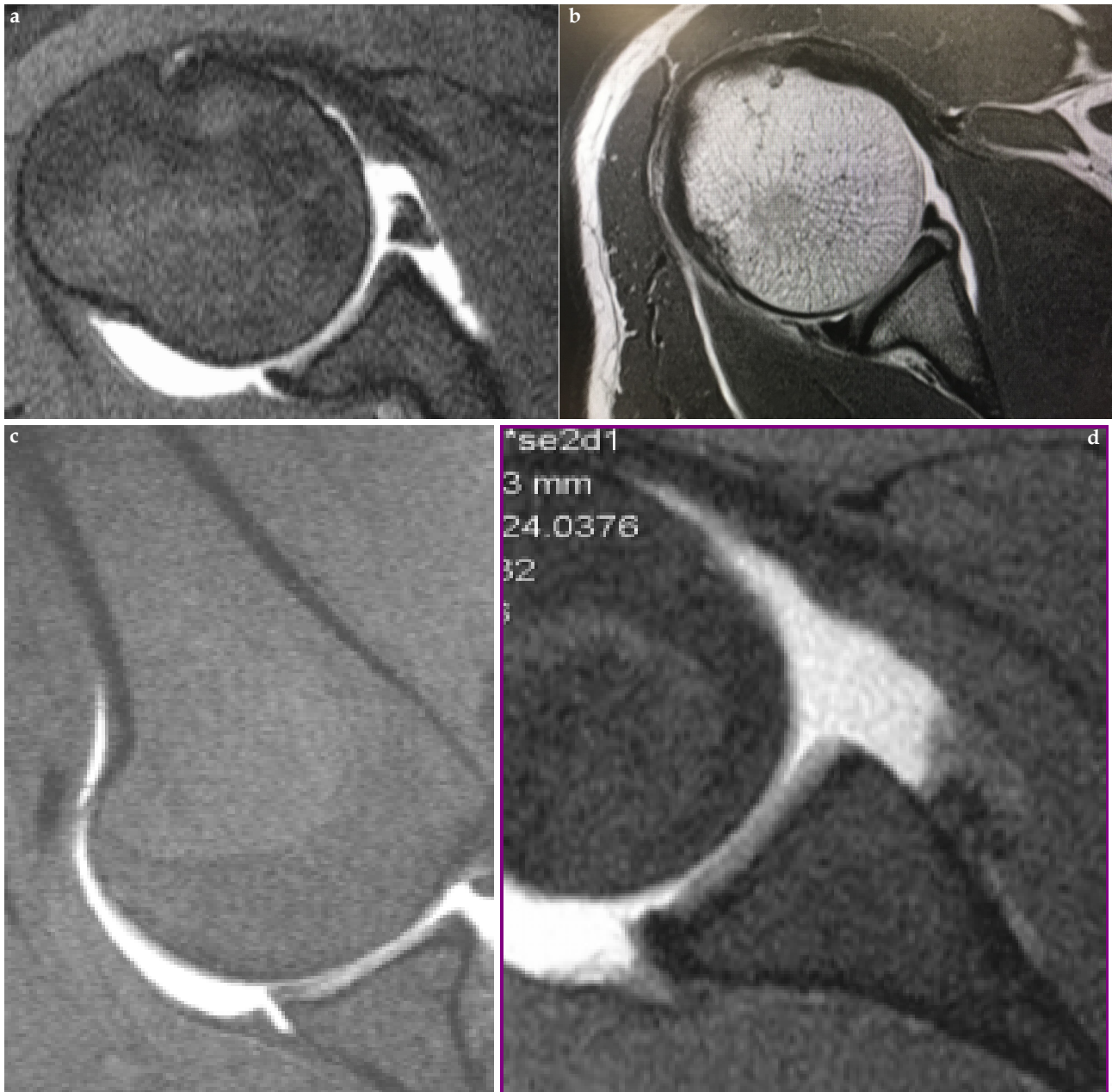
MRA	Labrum lesions	MRA results	True Positive	True Negative	False Positive	False negative
Detection	All labral lesions	70	69	6	1	4
Classification	Bankart	37	36	40	1	4
	ALPSA	16	15	65	2	0
	Perthes	17	15	65	1	3

**Table 4** Overall predictive values of MRA in the Detection of Labral lesions. \* 95% CI: Confidence Interval.

Overall Predictive values	95% CI *	
Sensitivity	94%	(0.86 to 0.98)
Specificity	85.70%	(0.46 to 0.99)
Positive Predictive value	98.50%	(0.92 to 0.99)
Negative Predictive Value	60%	(0.26 to 0.87)
Accuracy	86.20%	(0.76 to 0.92)

**Table 5** Predictive values of MRA in correctly classifying Labral tears. \* 95% CI: Confidence Interval

Predictive values	Bankart lesion	95% CI
Sensitivity	90%	(0.76 to 0.96)
Specificity	97.50%	(0.86 to >0.99)
Positive Predictive value	97.30%	(0.84 to >0.99)
Negative Predictive Value	91%	(0.78 to 0.96)
Accuracy	93.80%	(0.86 to 0.97)
Predictive values	ALPSA lesion	95% CI
Sensitivity	83%	(0.59 to 0.94)
Specificity	98.50%	(0.91 to >0.99)
Positive Predictive value	93.80%	(0.69 to >0.99)
Negative Predictive Value	96%	(0.87 to 0.98)
Accuracy	95.20%	(0.88 to 0.98)
Predictive values	PERTHES Lesion	95% CI
Sensitivity	100%	(0.76 to 1.00)
Specificity	97%	(0.89 to 0.99)
Positive Predictive value	88%	(0.64 to 0.97)
Negative Predictive Value	100%	(0.76 to 1.00)
Accuracy	95.50%	(0.91 to 0.99)



**Figure 1** a : Bankart lesion; b : Perthes lesion axial view; c : Perthes lesion in ABER view; d: ALPSA lesion.

## DISCUSSION

The clinical and imaging diagnosis of chronic labral tears can be challenging. The role of magnetic resonance imaging in chronic shoulder instability is to assist the surgeon in preoperative planning with the aim to optimize patient treatment and improve surgical outcome. The results of our study appear to fulfill these expectations showing high accuracy of MRA in the overall detection of anteroinferior labrum lesions, comparable to previous reports. A recent meta-analysis reported greater diagnostic accuracy of MRA over Magnetic imaging without contrast (MRI) for the overall detection of labral lesions with MRA-sensitivity 88%, specificity 93% vs. MRI sensitivity 76% vs. specificity 87%<sup>[4]</sup>.

Since Bankart described the ‘essential lesion’ in shoulder instability different types of labrum injuries have been recognized in the arthroscopic and imaging literature. A more detailed classification of the labrum lesions has been reported, and several Bankart variants such as Perthes lesion and Alpsa lesion have been described<sup>[3,6,7]</sup>.

In MRA joint capsule distension and the presence of contrast material between the labrum and the glenoid results in a better visualisation and classification of Bankart and Bankart variants (Perthes and ALPSA) which may otherwise go unnoticed. The ability to depict these patterns offers a clear diagnostic advantage particularly in patients with chronic symptoms<sup>[3]</sup>. However very few reports have included in their results the classification of anteroinferior labral lesions and all have noticed the difficulty in estimating Perthes and ALPSA variants with low sensitivity 50% and 71% respectively<sup>[5,8,9]</sup>. It has been suggested to acquire images in the abduction with external rotation (ABER) position. This position stresses the anterior labrum and ligamentous complex and if a tear is present contrast fluid is seen to track into it<sup>[6,7,9,10]</sup>.

To our knowledge our study is the first to use the ABER position (MRA-ABER) to classify chronic labrum lesions in recurrent shoulder instability and calculate the predictive values of each subtype with high accuracy (Bankart: 93.8%, Perthes: 95.5%, Alpsa: 95.2%) (Figure 1).

The importance of the bankart variants detection and classification is paramount to the surgeon. In Perthes lesion the labrum is detached from the glenoid surface but not displaced and unless the surgeon is aware of its presence it may be difficult to diagnose per operatively. If an ALPSA lesion is not diagnosed an incorrect repair may lead to an arthroscopic failure rate twice that of Bankart lesion (15% to 19% vs 7%)<sup>[11,12]</sup>.

A limitation of this study is that the high rates of accuracy may be due to the experience of a dedicated musculoskeletal radiologist and a senior arthroscopic surgeon both using the same labrum lesion classification as reported in radiology and orthopaedic surgical literature. It has been shown however that the diagnostic performance of shoulder MRA depends on the training level and experience of the performing radiologist<sup>[13]</sup>. We believe that awareness and use of the labrum classification by the surgeon increases the reference standard and mitigates any differential verification bias.

## CONCLUSION

Our study has shown that by using MRA in neutral and ABER position can achieve high levels of accuracy in detecting and correctly classifying chronic anteroinferior labrum lesions. It also emphasises the value of MRA in alerting the surgeon to the presence and the type of labrum lesion. This allows forward-planning the surgical technique to be employed for intra-operative detection, correct dissection and optimal fixation.

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