Is MRI useful to assess labral reduction following acute anterior shoulder dislocation?

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**Introduction:** Better knowledge of the anatomical lesions following primary anterior dislocation of the shoulder could help to resolve the issue of the recommended position of immobilization. The aim of this study was to describe such early lesions and to evaluate labral reducibility in both external and internal rotation of the arm.

**Patients and methods:** Fifteen shoulders were investigated by MRI without intra-articular injection. The 15 patients (14 men and one woman) had a mean age of 28 years (range: 17—42 years). Labral lesions were classified on a system based on Gleyze and Habermeyer’s endoscopic assessment and reducibility was assessed on Itoi’s criteria.

**Results:** Constant hemarthrosis allowed an arthrogram type effect. The Hill-Sachs lesion was small in five cases, medium in eight cases and large in two. There were seven labral lesions of type I, seven of type II and one of type III. External rotation (mean: 30.6°; range: 15°—65°), reduced the labrum in six cases (40%).

**Discussion:** The present study failed to confirm the constant reduction of the labrum reported by Itoi, perhaps because external rotation was less than that obtained in his study (m = 52°; range: 35°—81°). Reduction was partly due to posterior migration of the hemarthrosis obtained by external rotation.

**Conclusion:** MRI assessment of labral reducibility after primary anterior shoulder dislocation may be considered for patients at high risk of recurrence, in order to decide the ideal position of immobilization.

**Level of evidence:** Level IV. Retrospective diagnostic study.

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Introduction

Anterior shoulder dislocation is the most frequent form of dislocation [1]. Recurrence is estimated at 50%, depending basically on age at initial dislocation and on bilateralization [2], and does not seem to be lowered by arm-to-the-trunk immobilization in adduction and internal rotation [2–4]. Itoi et al. suggested that the internal cephalic rotation induced by this conventional immobilization position was unsuitable for labral reduction, whereas immobilization in external rotation promoted coaptation and healing of Bankart lesions. This was argued on the basis of first an anatomic [5], then a radiological study [6], and subsequently confirmed [7]. Itoi’s two prospective clinical series later demonstrated that immobilization in external rotation reduced short and medium term recurrence [8,9]. Recurrence was not, however, abolished, and may be due to variable labrum reducibility between shoulders. The present study is:

• a prospective magnetic resonance imaging (MRI) analysis of endo-articular shoulder lesions secondary to initial anterior dislocation in young subjects;
• a comparison of labrum reducibility between immobilization under internal and maximal external rotation.

Patients and methods

Patients were prospectively recruited over an 8-month period in the emergency surgery department of Rennes University Hospital (France). Inclusion criteria were primary traumatic anterior shoulder dislocation in a patient aged between 15 and 45 years, without proximal humerus fracture or fracture-separation of the anterior glenoid rim. Fifteen of the 30 eligible patients agreed to MRI examination in the 8 days following the dislocation. There were 14 males and one female; mean age, 28 years (range: 17–42 years). Dislocation was associated with a sports accident in seven cases, a simple fall in six, a traffic accident in one, and without specified cause in one case. Reduction was under general anesthesia in three cases and analgesics and nitric oxide sedation in 12. Patients were immobilized in internal rotation and summoned for MRI, after information, within 8 days. MRI used a Philips 1.5 T (Royal Philips Electronics, Amsterdam, Netherlands) with axial proton density fat-saturated slices (PD Fat-Sat: slice thickness: 3 mm; space: 1 mm). Axial images were acquired in dorsal decubitus in three rotation positions: internal (hand on belly), neutral (hand to zenith), then maximal external. No intra-joint injection was used. Any hemarthrosis and its anterior or posterior location was recorded. The size of the Hill-Sachs notch was estimated from the ratio of its depth to the cephalic radius, and was counted as minimal for a ratio < 0.05, moderate for 0.05–0.15 and large for > 0.15. Labral lesions were classified on a system based on Gleyze and Habermeyer’s endoscopic assessment (Fig. 1) [10]. Labrum reducibility was analyzed on slices corresponding to the antero-inferior glenoid rim on separation (S) and displacement (D) criteria derived from those of Itoi (Fig. 2) [2]. Analysis was purely qualitative and validated by consensus between two examiners (MC, HT): the labrum was considered reduced when both S and D were normalized, unchanged when neither S nor D varied, and worsened when at least one of the two showed deterioration (Fig. 3). The reference position being neutral rotation, angle (1) corresponded to the cephalic rotation induced by maximal external upper-limb rotation in the MRI tunnel, measured retrospectively by two examiners as the mean of three consecutive values (Fig. 4). The influence of the external rotation angle on reduction was analyzed by non-parametric Wilcoxon and Mann-Whitney tests (SPSS 13.0 for Windows, SPSS Inc., Chicago, Illinois, USA), with the significance threshold set at 0.05.

Results

Hemarthrosis was constant and allowed an arthrographic effect for labrum analysis (Fig. 3). In six cases, it was limited to the posterior joint pouch, and in nine was anterior and posterior, in which case external rotation always pushed the hemarthrosis towards the posterior pouch, abolishing the dead space between labrum and glenoid rim. The posterior notch was likewise constant: minimal in five cases, moderate in eight and large in two, and systematically associated with contusion or cephalic blood infiltration causing intraosseous hypersignal. Labral lesions were constant: seven type I, seven type II and one type III. From Table 1, it can be seen that labral reduction was improved in external rotation in six cases (40%) and worsened in internal rotation in two. Mean cephalic external rotation (α1) was 30.2° (range: 15°–65°), with no correlation between rotational amplitude and successful reduction (P = 0.2).
Figure 2  Analysis of labrum reduction on Itoi’s criteria [6]. Separation (S) is defined as anterior labral detachment, and displacement (D) as its migration under the glenoid cup. The present study considered the labrum as reduced if both criteria were normalized (see left).

Figure 3  Examples of labrum reduction. Left: shoulder in internal rotation, labrum both separated from the anterior glenoid cavity (S criterion) and medialized (D criterion). Right: both criteria are normalized in external rotation. NB: coaptation of subscapular muscle body on the glenoid cavity, pushing the hemarthrosis towards the posterior joint pouch. In this case, the cephalic notch is moderate.

Figure 4  MRI measurement of cephalic external rotation (α1) was performed on slices corresponding to the three upper-limb rotation positions. Reproducibility of the MRI slice level was checked by tracing circles of increasing diameter and superimposing them on the MRI images, thus also determining the center of the head. Angle α1 was calculated from the neutral rotation view (middle image, hand to the zenith), based on the line between the center of the humeral head and the anterior edge of the bicipital groove. NB: forward displacement of hemarthrosis, in this case rather small, under internal rotation (right image). In this case, the position of the labrum was considered as unchanged in external rotation (left image), despite a slight lateralization of the tip.
Laboral lesions were mainly types I and II, in agreement with ligament detachment (periarticular blood extravasation). There was no MRI evidence of additional transfixing capsular lesion or of humeral displacement following primary dislocation. The hemarthrosis was constant, but of variable volume. There is thus a range of arguments in favor of improved labrum reduction under external rotation. The improvement is related to inferior structure tension, inducing labrum traction and coaptation by evacuating the hemarthrosis towards the posterior articular pouch [12]. Increased pressure at the labrum/bone interface was shown to peak at 45° lateral rotation, in a cadaver study [13].

Discussion

The present series was small and lacked quantification of the reproducibility of the cephalic rotation parameter and of the qualitative assessment of labral reduction. Also, the mean cephalic external rotation angle, at 30.2° (range: 15°—65°), was less than Itoi’s values in his MRI study of six primary dislocations (m = 52°; range: 28°—81°) [2] — although this difference is hardly significant, given the small number of cases, and may be due to one patient with extreme hyperlaxity (81°) in Itoi’s series, and by his use of external arm-to-the-trunk rotation as opposed to our use of a bent elbow position limited by the narrowness of the MRI tunnel.

Even so, the present study shed light on anatomic lesions following primary dislocation. The hemarthrosis was constant, but of variable volume. There was no MRI evidence of additional transfixing capsular lesion or of humeral ligament detachment (periarticular blood extravasation). Labral lesions were mainly types I and II, in agreement with endoscopic series for primary dislocation [7,10]. This constancy is in line with literature reports [11], but there was also a recruitment bias linked to our emergency department context, filtering out spontaneous reductions in cases of hyperlaxity, where labral lesions are doubtless less frequent.

The rate of definite reduction was 40% (6/15), significantly lower than the 100% obtained in Itoi’s series of six cases [6] and Seybold’s of 34 [12]. Moreover, two of the six cases of reduction in the present series showed loss of reduction in internal as compared to neutral rotation, the other nine showing no clear difference in labrum reduction between the three rotation positions. The discrepancy is probably due to the more limited external rotation obtained in the present than in other series [7,11]. It may also be due to stricter analysis criteria, reduction counting only when both separation and displacement were normalized: on these criteria, the reduction rate in Itoi’s series of six trauma cases would fall to 50%. In Seybold’s series, reduction was deemed to be improved in all the cases, but the S and D parameters were reported as means rather than on a case-by-case basis. Seybold did, however, introduce two supplementary criteria: labral lesions were classified as Bankart lesions if the labrum was both detached from the glenoid and the capsule and periosteum, and as Perthes lesions if the periosteal and capsular attachments to the labrum were conserved (Fig. 1). Anterior capsuloligamentary plastic deformation was further classified in four stages according to the extent of local MRI hypersignal. Reduction was shown to be maximal in Perthes lesions free of anterior plastic deformation [12].

There is thus a range of arguments in favor of improved labrum reduction under external rotation. The improvement is related to inferior structure tension, inducing labrum traction and coaptation by evacuating the hemarthrosis towards the posterior articular pouch [12]. Increased pressure at the labrum/bone interface was shown to peak at 45° lateral rotation, in a cadaver study [13].

Conclusion

The present study confirmed the constancy of joint lesions following primary shoulder dislocation, but found poorer and less reliable labrum reducibility than reported in the literature. Changing the immobilization protocol in primary dislocation may be envisaged, but runs up against cultural resistance and issues of technical feasibility. The optimal external rotation angle, moreover, remains to be defined. Ideally, candidates for such immobilization — i.e., patients with demonstrated reducible detachment on MRI — should be identified. Systematic MRI is not affordable but may be considered in patients statistically most liable to recurrence.

Conflicts of interest

None.

Table 1 Qualitative analysis of labrum reduction (separation and displacement) obtained under external (amplitude given by the α1 angle on MRI) and internal rotations compared with neutral rotation. Type of labrum lesion on a classification based on that of Gleyze and Habermeyer [10].

<table>
<thead>
<tr>
<th>Patient</th>
<th>Type of labrum lesion</th>
<th>α1 (°) (external rotation)</th>
<th>Reduction in external rotation</th>
<th>Reduction in internal rotation</th>
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<tbody>
<tr>
<td>1</td>
<td>II</td>
<td>35</td>
<td>Achieved</td>
<td>Unchanged</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td>20</td>
<td>Achieved</td>
<td>Unchanged</td>
</tr>
<tr>
<td>3</td>
<td>II</td>
<td>22</td>
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<td>Unchanged</td>
</tr>
<tr>
<td>4</td>
<td>II</td>
<td>50</td>
<td>Achieved</td>
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<tr>
<td>5</td>
<td>I</td>
<td>32</td>
<td>Achieved</td>
<td>Worsened</td>
</tr>
<tr>
<td>6</td>
<td>II</td>
<td>40</td>
<td>Achieved</td>
<td>Worsened</td>
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<tr>
<td>7</td>
<td>I</td>
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</tr>
<tr>
<td>8</td>
<td>I</td>
<td>35</td>
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<tr>
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<tr>
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<td>15</td>
<td>I</td>
<td>18</td>
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Worsened: the reduction is worse in internal rotation than in neutral position.
References


