Technical Note

Arthroscopic-Controlled Reduction of Hill-Sachs Lesions: Treatment Option for Off-Track Lesions in Young Patients?

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Abstract: Large Hill-Sachs lesions (HSL) are currently treated via a remplissage procedure. Although the good stabilizing properties of this surgery are apparent, there are some disadvantages in terms of the functional outcome. In the following Technical Note, we present a method of arthroscopic-controlled reduction of HSL for anatomical restoration of the humeral head without functional limitations. For HSL reduction, we place a 1.6-mm K-wire in the central lesion under arthroscopic and fluoroscopic control from posterior to anterior in lateral drilling direction. Then, a 7-mm cannulated drill is used for preparing the reduction canal. Afterward, the HSL is reduced via bone tamp, also under arthroscopic and fluoroscopic control. No bone substitution material is used to fill the canal; only a standard wound closure is performed. Arthroscopic-controlled reduction of impacted humeral head fractures seems to be a possible and relatively easy way to perform an anatomical restoration of HSLs. Because the exact location of HSLs can vary slightly, the exact surgical setting might be slightly different each time. Biomechanical studies already show similar stabilizing properties of this procedure compared with established techniques but without losing external rotation. Further studies need to review the potential rate of humeral head necrosis or secondary loss of reduction.

The incidence of Hill-Sachs lesions (HSL) is reported to be 65% to 67% for initial dislocations and 84% to 93% for repeated dislocations.[1,2] The glenoid-track concept was introduced to assess the necessity of treating these HSLs, which are characterized as on-track and off-track lesions.[3,4]

Depending on the defect size of the HSL, treatment strategies generally include conservative and operative management.[5] Surgically, different methods have been described, such as tenodesis of the infraspinatus muscle (remplissage),[6] various techniques of humeroplasty,[7-10] or rotational osteotomy of the humeral head.[11] The latter was mainly used before the advent of arthroscopy and minimally invasive surgery.

Of these treatment options, remplissage is the current gold standard to address off-track HSLs. One of the advantages of the remplissage procedure is the significant stabilization of the shoulder joint. However, this tenodesis of the infraspinatus muscle is associated with a restriction of shoulder mobility, whereby the external rotation is particularly affected. In current literature, this is reported as a loss of 4° to 6°.[12,13]

Against this background, the indication for remplissage should always be critically examined and should be narrowly defined, especially in young, active patients.

Furthermore, none of the aforementioned techniques for Hill-Sachs treatment aims to restore the anatomical humeral head, which is why we present the following technique of arthroscopic-controlled reduction of HSLs.

Surgical Technique

Patient Evaluation

Before any surgical shoulder-stabilizing procedure is considered, a focused physical examination of the affected joint is needed, including the range of motion and specific instability tests like the apprehension, jerk, or Kim tests. Under these, the apprehension test has the

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greatest specificity (95%) for detecting anterior labrum tears in shoulder instability.[14]

Imaging

For adequate measurement of HSL a computed tomography scan is crucial. We here have a large unilateral (humeral) bone defect of 20.2 mm (Figs 1 and 2). With a glenoid diameter of 22 mm (Fig 3), the HSL is an off-track defect: 20.2 mm (HSL) >19.2 (glenoid track) (22.9 mm * 0.84), which is why we perform not only a standard Bankart repair but also address the HSL.

Indications

Indications for addressing HSL are off-track situations, which were introduced by the glenoid track concept.[15] This concept not only focuses on bony glenoid lesions but also takes humeral bone loss into account. We here present how to reduce the bony humeral defect in an arthroscopic-controlled way. Closed reduction of HSLs has already been described before in a cadaveric study by using a bone tamp.[16]

Surgical Technique

The patient is positioned in the beach-chair position using an adjustable arm holder (TRIMANO FORTIS; Arthrex, Naples, FL). Afterward, we perform a typical Bankart repair using 3 all-suture anchors (Knotless FiberTak, 1.8 mm; Arthrex, Fig 4). We then identify the HSL and place a 1.6-mm K-wire into the central defect coming from posterior in lateral drilling direction in oscillating drilling technique (Fig 5). On the ventral exit point of the K-wire, we placed a stab incision. After blunt soft-tissue mobilization of this portal, a 7-mm cannulated drill (DePuy Synthes, Warsaw, IN) is used to penetrate the first bone cortex of the humeral head under soft-tissue protection using a Twist-In Cannula (Arthrex; Fig 6).

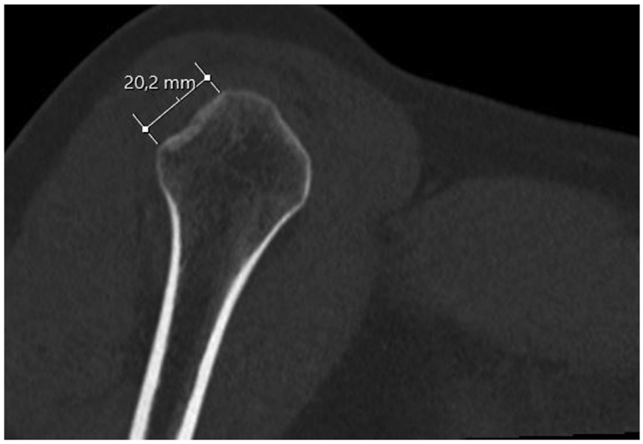

Fig 2. Three-dimensional reconstruction of a computed tomography scan in a patient lying on his back showing a right glenohumeral joint focusing on the Hill-Sachs lesion.

Afterwards, the impacted humeral head is reduced using a 7-mm bone tamp (Arthrex; Fig 7) under arthroscopic and fluoroscopic control (Fig 8, Video 1). Figure 9 provides an overview of the finally used arthroscopic portals needed for this procedure. Finally, all portals are closed in the standard manner.

Postoperative Rehabilitation

The patient is discharged after 2 days with the arm in an abduction sling of 45° for 4 weeks. A physiotherapy and hydrotherapy rehabilitation program is commenced that follows the Liotard protocol (immediate active auto-assisted rehabilitation) to recover shoulder range of motion.[17] For forward elevation, the patient is allowed to lift the arm actively (active automobilization) but with the support of the contralateral arm (assisted) to avoid excessive load on the operated shoulder. Active external rotation is limited to 10° for

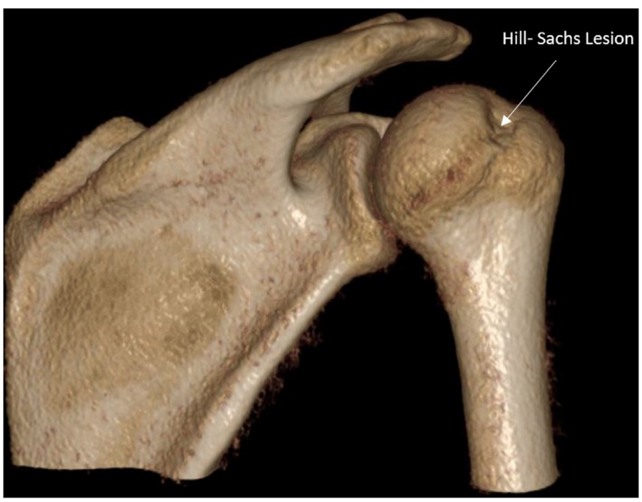

Fig 1. Computed tomography scan of a right shoulder in a patient lying on his back showing a Hill-Sachs lesion size of 20.2 mm in an anterior-posterior beam path.

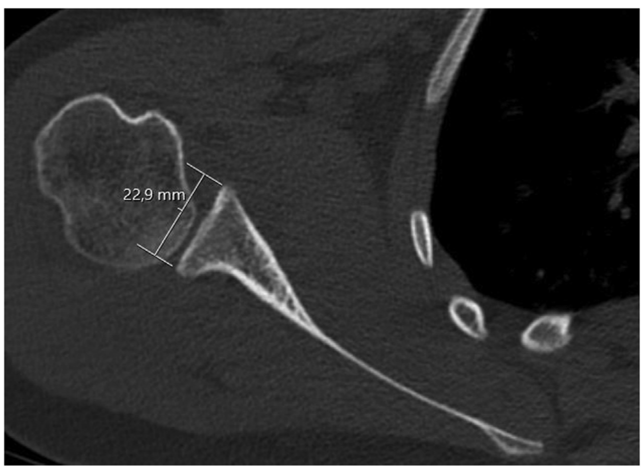

Fig 3. Axial view on the computed tomography scan in a patient lying on his back of a right glenohumeral joint measuring a glenoid diameter of 22.9 mm.

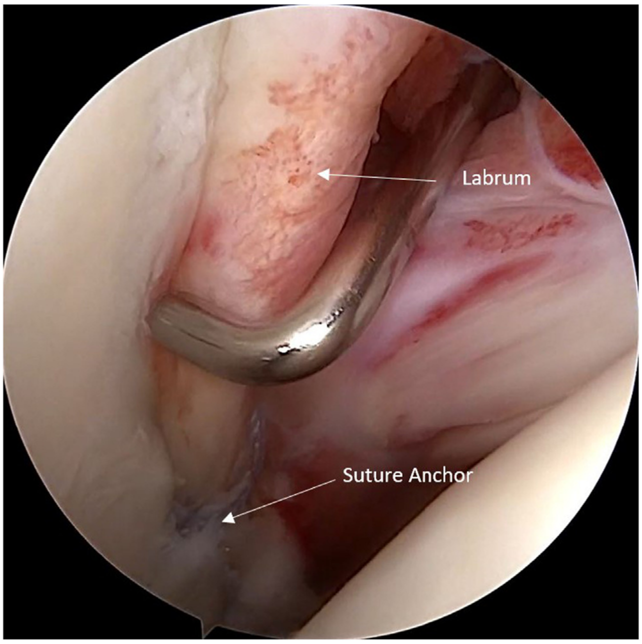

Fig 4. Arthroscopic view in the beach-chair position showing the refixed anterior labrum from a posterior view in a right shoulder with deep, caudally oriented anchors (1.8 mm) and an arthroscopic hook for stability testing of the refixed labrum.

the first 3 weeks postoperatively and then gradually increased. Internal rotation is allowed and abduction is limited to 45° for the first 3 weeks and then increased to 80°. After 6 weeks postoperatively, the patient is allowed to return to free active shoulder mobilization. Return to sports is allowed after 8 weeks, with high-risk activities undertaken freely after 4 months.

Discussion

Arthroscopic-controlled reduction of impacted humeral head fractures seems to be a feasible procedure for anatomical reconstruction of the humeral bone cortex. The advantages of this intervention are mainly a greater functional outcome since we have no tenodesis of the infraspinatus tendon. Because such a procedure is performed in younger patients, a better external rotation might be of greater interest. Furthermore, we have no interference with soft-tissue structures because no artificial material remains in situ postoperatively (Table 1).

There are some risks and factors that need to be considered when performing arthroscopic-controlled reduction of HSLs: first, such a procedure is only possible in acute situations, when the fracture is still mobile and not already consolidated. Second, good bone quality provides better reduction results and covers the risk bone cortex penetration with the bone tamp (Table 1).

Then, adjacent soft tissue needs to be secured. Therefore, the starting point for the bone tamp entrance can be placed relatively lateral to the biceps tendon without getting in trouble with the distally running neurovascular structures, as already shown by Kazel et al.[16]

Nevertheless, if we have to address off-track lesions as the result of shoulder instability, all available operative options should be considered. We know that shoulder instability is a multifactorially influenced injury. In addition to bony issues, the character of the patient's soft tissue has a high impact on shoulder stability. For instability grading, the Gerber classification has throughout been accepted.[18] Although we are discussing traumatic shoulder dislocations here, the severity of the traumatic event that leads to shoulder dislocation can vary widely, which is why a conscientious preoperative examination should not only involve anterior capsule stress tests like the apprehension test but also focus on joint laxity in a contralateral stability testing. In 30% of all dislocation cases, we find an

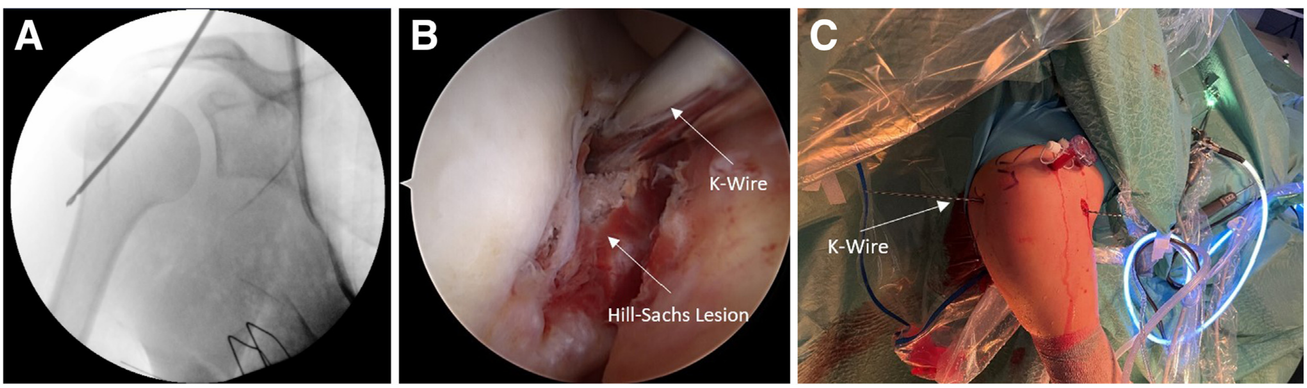

Fig 5. (A) Intraoperative fluoroscopic image in the beach-chair position showing a 1.6-mm K-wire placed in the central defect. (B) Intraoperative arthroscopic image in beach-chair position showing a 1.6-mm K-wire placed in the central defect. (C) Intraoperative image in the beach-chair position showing a 1.6-mm K-wire placed in the right shoulder from posterior to anterolateral.

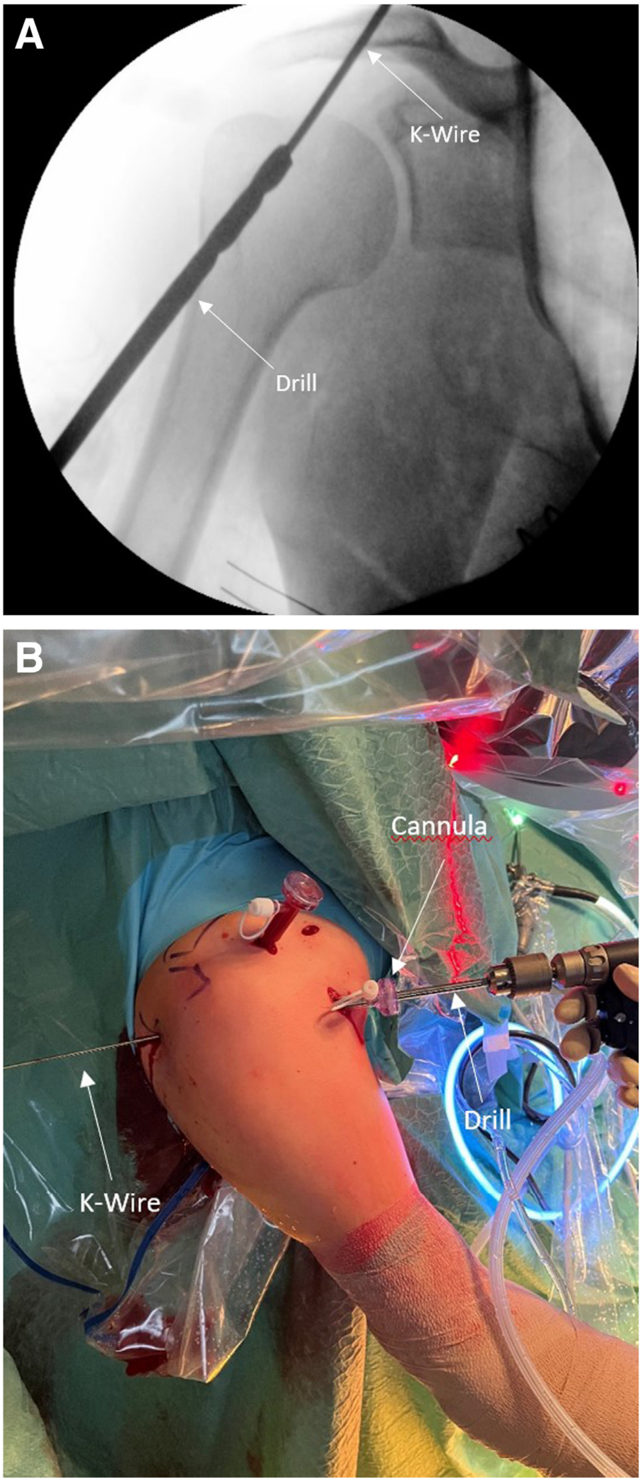

Fig 6. (A) K-wire–guided drilling (7 mm) of the first bone cortex under fluoroscopic control in the beach-chair position. (B) K-wire–guided drilling (7 mm) of the first bone cortex with soft-tissue protection using a twist-in cannula in the beach-chair position.

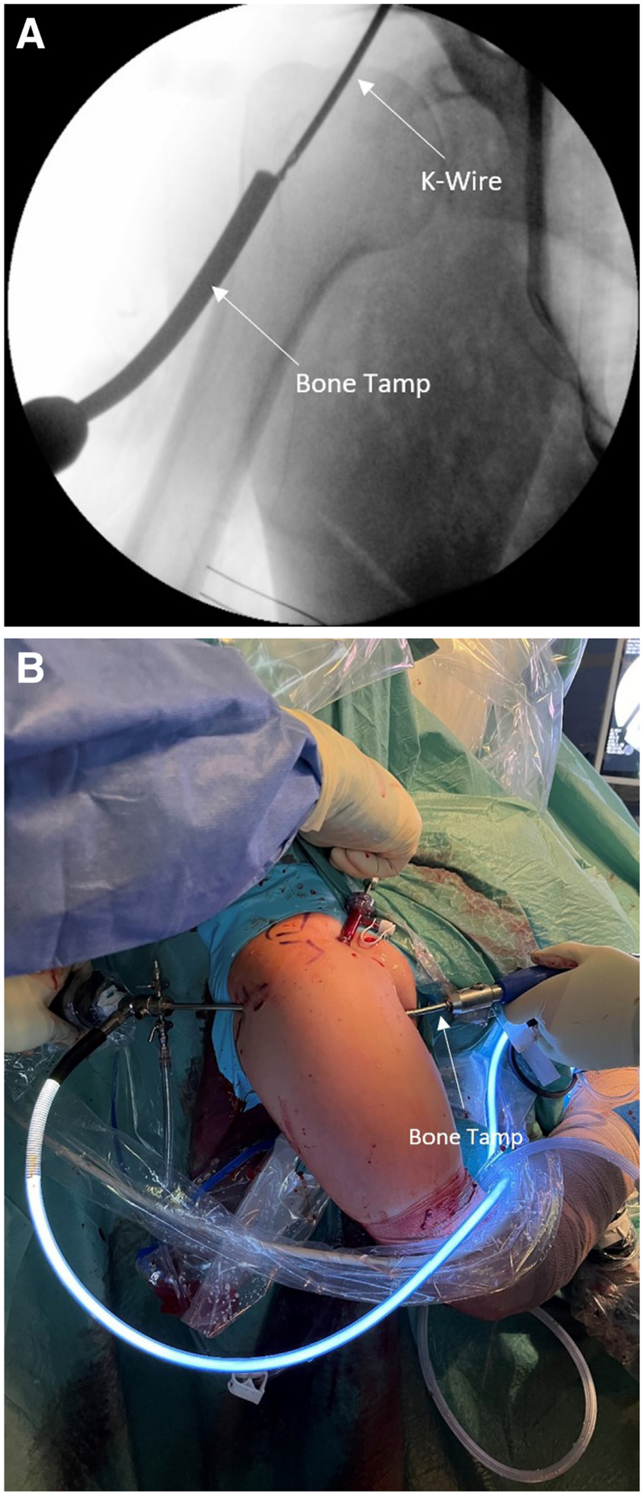

Fig 7. (A) Reduction of the impacted humeral head using a 7-mm bone tamp under fluoroscopic control in the beach-chair position. (B) Reduction of the impacted humeral head using a 7-mm bone tamp in the beach-chair position.

unidirectional instability with accompanying hyperlaxity (type B3).[18] These patients benefit not only from an encompassing anterior capsule-labral refixation but also from an additional posterior soft-tissue stabilization like an infraspinatus tenodesis. In these cases, Hill-Sachs reduction might not be the best treatment

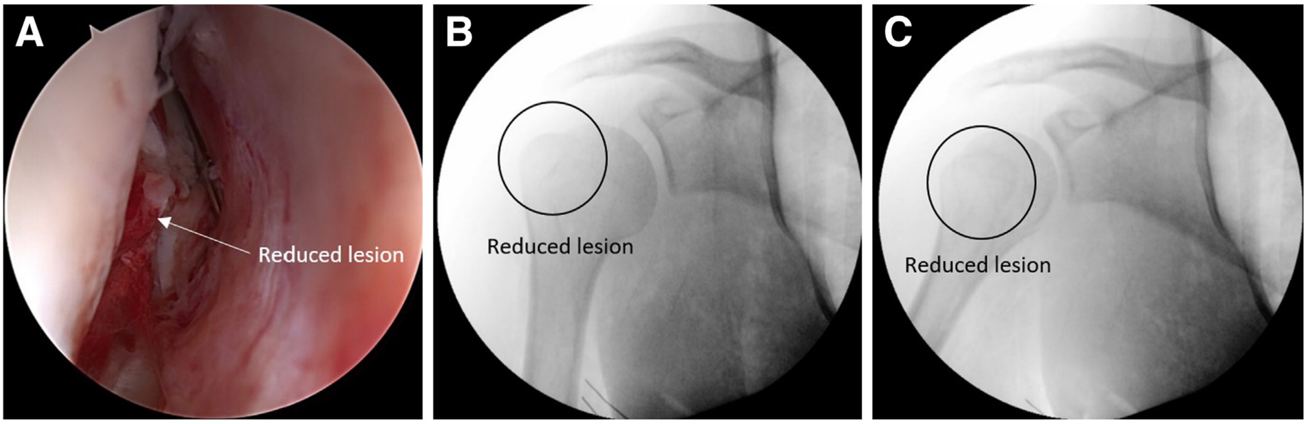

Fig 8. (A) Arthroscopic view of the reduced HSL in the beach-chair position. (B) Fluoroscopic view of the reduced HSL in anterior-posterior beam path in the beach-chair position. (C) Fluoroscopic view of the reduced HSL in axial beam path in the beach-chair position. (HSL, Hill-Sachs lesion.)

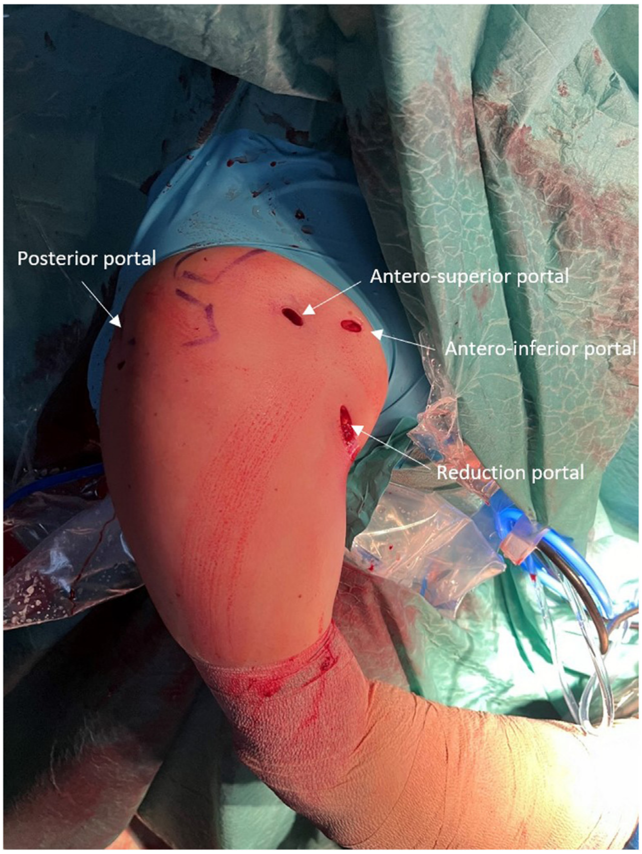

Fig 9. Intraoperative setting: the beach-chair positioning with standard posterior viewing portal and 2 anterior working portals superior and inferior. The bone tamp reduction was performed using a caudally oriented incision.

option in terms of shoulder stabilization and secondary dislocation prophylaxis (Table 1). Therefore, we recommend to consider this procedure only for patients without associated hyperlaxity.

Concerning the biomechanical properties of bony reduction of impacted humeral head fractures, in 2017 Garcia et al.[19] showed that arthroscopically assisted reduction provided similar joint stability compared with a remplissage procedure. For final clinical recommendation of this technique, long-term studies should focus on postoperative humeral head necrosis and secondary loss of correction.

Table 1. Advantages and Disadvantages of Arthroscopic-Controlled Reduction of Acute Hill-Sachs Lesion

Advantages	Disadvantages
Better external rotation	Performed only in acute lesions
Addresses the lesion directly in an anatomic way	No treatment of capsular instability
No interference with muscular or other soft-tissue structures	Risk of humeral head necrosis or secondary loss of correction
Direct, cheap, and comparable examination of the result via radiograph	Need for good bone quality
No artificial material remaining in situ	

Disclosures

All authors (M.O., A.S., R.S.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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