Technical Note

Anatomic Reduction and Fixation for Glenoid Fractures: The Kissing Anchor Technique

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Abstract: Up to one fifth of glenoid fractures are intra-articular and associated with recurrent anterior dislocation. Surgery is often the indicated treatment, and as with many other articular fractures, it aims for a perfectly congruent and flush reconstruction of the articular surface to avoid the onset of secondary degenerative joint diseases. The purpose of this paper is to describe a reproducible, simple arthroscopic technique that uses suture anchors to fix the glenoid fragment with a strong and stable construct called "kissing anchors." This method provides the advantages of both direct and indirect stabilizing effects. It applies 2 anchors, one inside the fragment and the other inside the fracture bed, to stabilize and fix the fragment, and is adequately associated with labrum refixation, which provides the construct with increased stability. However, a surgeon willing to apply it should already be confident with basic shoulder arthroscopy and should have performed an appropriate amount of arthroscopic shoulder stabilizations.

Glenoid fractures are uncommon injuries, accounting for 10% of all scapular fractures.[1] Up to one fifth are intra-articular and are often associated with recurrent anterior dislocation.[2] Moreover, bone fragments may displace under muscular traction or as a result of the trauma,[2] compromising the residual joint stability even more. Therefore, it is generally accepted that the presence of a bulky fragment, a displacement of >10 mm, or joint instability are indicators for surgery[1,3]; the surgeon should aim for a perfectly congruent and flush reconstruction of the articular surface, to avoid secondary degenerative diseases, as with any other articular fractures.

Several techniques have been described in the past decades.[2-8] Tauber et al.[5] successfully reported about fragment fixation with 2.7-mm cannulated screws under arthroscopic guidance. Sugaya et al.[3] and Porcellini et al.[2] developed a suture anchor technique from Bankart lesion repair using suture anchors, which was recently modified by Corradini et al.,[7] exploiting ligamentotaxis. Other Technical Notes also demonstrated the feasibility of more technically demanding fragment stabilizations.[4]

The purpose of this paper is to describe a reproducible, simple arthroscopic technique using suture anchors to fix the fragment with a strong and stable construct called "kissing anchors" that takes advantage of both direct and indirect stabilizing effects.

Surgical Technique

The presented technique is proposed for patients suffering from a glenoid fracture involving about one third of the articular surface, and for those deemed at risk of fragment comminution if using standard and larger fixation hardware (e.g. screws). It is not indicated for an already comminuted fracture or in the presence of a small bony fragment for which a bony Bankart repair would be more appropriate. Preoperative imaging is essential for optimal management. X-rays are needed for the first diagnosis of the glenoid fracture, showing the presence of the fragment, its eventual dislocation, and its size. Computed tomography (CT) scans are mandatory, along with 3-dimensional (3D) reconstructions, to confirm the appropriateness of the indication. 3D and 2D CT scans of the case treated in the Video are shown in Figure 1.

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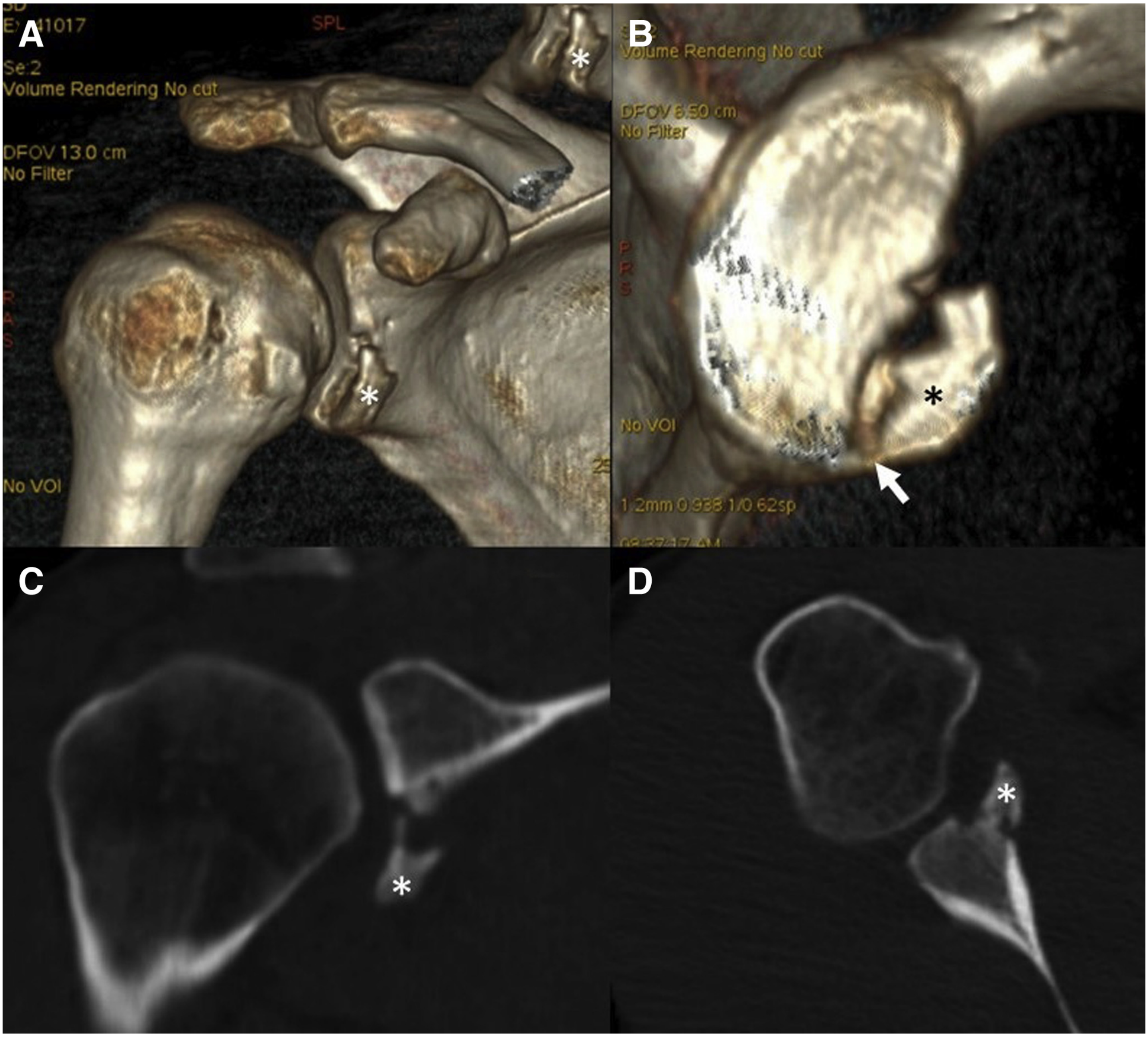

Fig 1. Computed tomography images of the right shoulder presented in the case. (A) 3-Dimensional (3D) reconstruction, frontal view. (B) 3D reconstruction, lateral view. (C) 2D coronal scan at the fracture site. (D) 2D transverse scan at the fracture site. Images show a medially dislocated bulky fragment (*), detached from the subequatorial anterior-inferior portion of the glenoid, with a smaller third fragment in between. Its most distal portion shows a minimal displacement (arrow in B), suggesting continuity with the capsular-labral complex.

Preparation

The surgery is performed under blended anesthesia: an interscalenic block procedure with ultrasound guidance in the presurgical room and general anesthesia in the surgical room before the patient is positioned. This combination allows for controlled hypotension during the whole procedure, with a mean maximum systolic pressure of 90 mmHg, providing a cleaner work space and reducing surgical time. The patient is positioned in lateral decubitus, stabilized in a bean bag, with a dorsal tilt of 30° with the glenoid surface parallel to the floor as a reference. A sterile surgical field is prepared after standard skin disinfection, and sterile skin traction is applied and connected to the traction system. A secondary, perpendicular traction garment is applied to increase distraction of the joint space, along with a removable sterile cushion placed between the arm and the thorax, for better maneuverability.

Portal Placement, Diagnostics, and Debridement

The first arthroscopic portal is a standard posterior-lateral one through the soft spot. An anterior-medial portal is then created under direct visualization

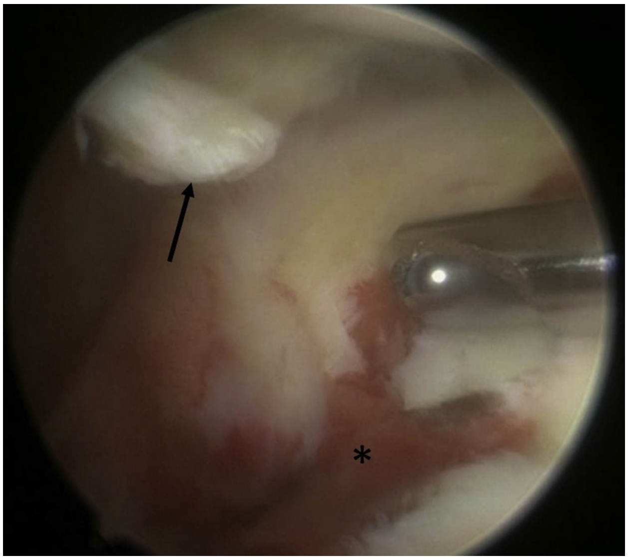

Fig 2. Intraoperative view, right shoulder, lateral decubitus, anterior-superior portal view. A motorized shaver is introduced in the joint by the posterior portal and is used to complete debridement at the fracture site, removing blood clots (*), smaller and irreparable portion of the labrum (arrow), and loose bodies.

(outside-in technique), and an 8.25-mm Twist-In cannula (Arthrex, Naples, FL) is positioned. After thorough diagnostic arthroscopy, a motorized shaver is introduced in the latter portal, and comprehensive debridement is carried out, removing blood clots, smaller irreparable portions of the glenoid labrum, and free chondral/osteochondral fragments (Figure 2 and Video 1 00:05). A third portal is created at this point: an anterior-superior one passing through the superior margin of the rotator's interval, above the origin of the long head of the biceps tendon, medially enough to reach the most distal aspect of the glenoid. Another 8.25-mm cannula is positioned, and the arthroscope is switched to this portal.

Fracture Reduction and Fixation

A Liberator/Elevator tool (ConMed, Utica, NY) is inserted into the anterior-medial portal and used to liberate the meshed and impacted anterior-inferior glenoid fragment, adherent to the glenoid neck, to allow maneuvering. This is carried out until subscapularis fibers are visualized. The anchor's cannulated drill guide is inserted into the joint by the posterior-lateral portal, and a hole is produced in the fragment while an anterior counterforce is applied for increased stabilization. This hole will begin immediately underneath the subchondral layer of the fragment, running medially, ending close to the anterior-medial cortical bone layer. A double-loaded soft anchor (Suture Fix; Smith & Nephew, Watford, UK) is then applied into the fragment. A second anchor is applied from the anterior-medial portal, with the same steps, to the corresponding entry point on the glenoid bone, right underneath the articular surface (Figure 3 and Video 1 01:22). Sutures are retrieved through the posterior-lateral portal. To reduce possible errors in suture management, after retrieving 1 suture limb from the fragments' anchor, a

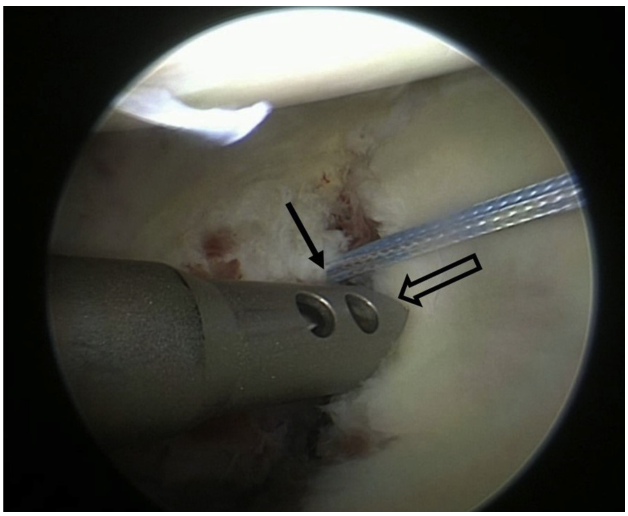

Fig 3. Intraoperative view, right shoulder, lateral decubitus, anterior-superior portal view. The first soft anchor was inserted by the posterior portal into the fracture fragment (filled arrow). The second anchor was positioned in the fracture bed (empty arrow), in a position specular to the first one, creating the kissing anchor construct.

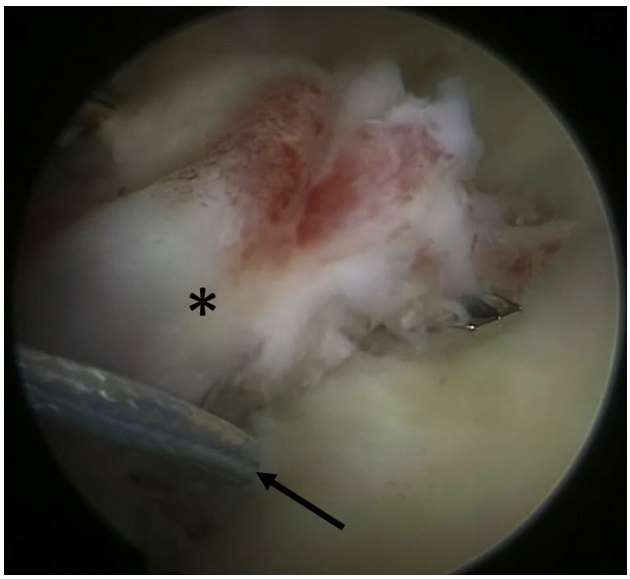

Fig 4. Intraoperative view, right shoulder, lateral decubitusl anterior-superior portal view. Labrum (*) refixation is the last step of the procedure. In this case, standard stabilization was carried out with a third soft anchor (arrow).

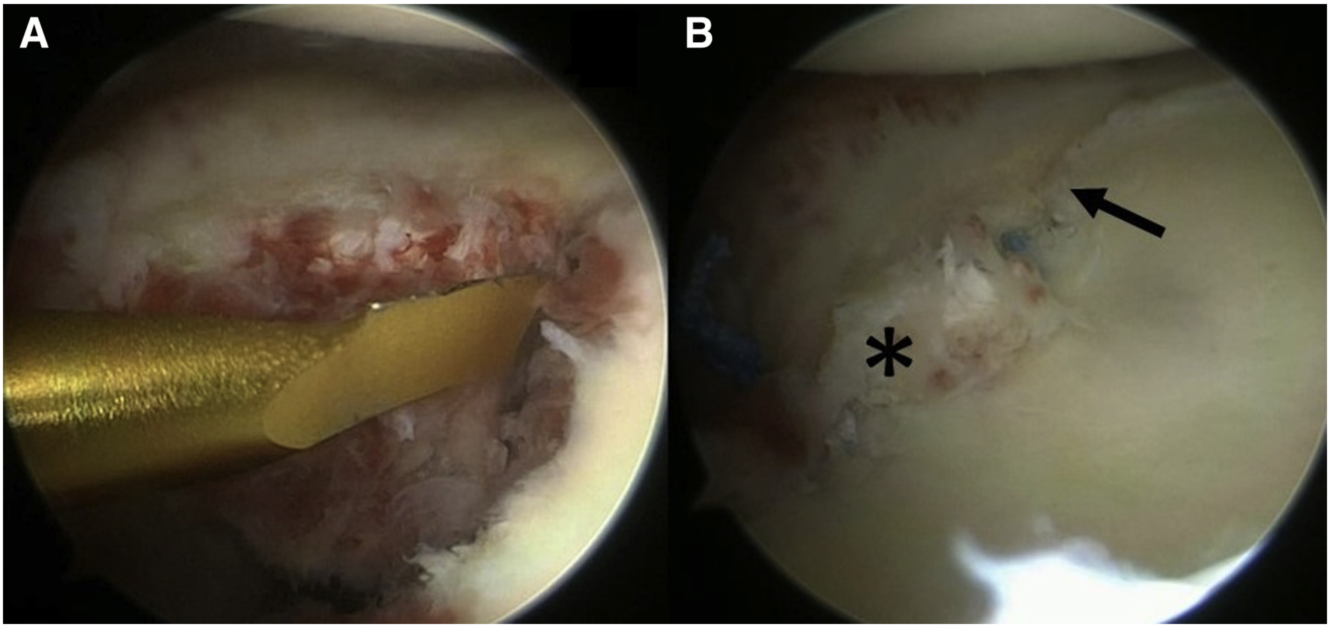

Fig 5. Intraoperative view, right shoulder, lateral decubitus, anterior-superior portal view. Comparison between the intra-articular situation at the beginning of the procedure (A) and the end (B). Anatomic reduction is noted with flush articular surface (arrow), along with the bump obtained by labrum refixation (*).

differently colored suture from the glenoid anchor is retrieved. At this point, a sliding knot can be tied, and the fractured fragment is anatomically reduced and fixed into the fracture bed.

Last, a third soft anchor is applied at the most superior portion of the fracture site, reducing the avulsed anterior labrum into its anatomic position with a standard repair (Figure 4; Video 1 02:20; and Figure 5), indirectly improving stability of the fracture's fixation by ligamentotaxis.[3,7] Postoperative imaging is shown in Figure 6.

Rehabilitation

Advised postoperative management requires standard dressing and 4 weeks of immobilization using a shoulder sling with 10° to 15° or arm abduction and neutral rotation. Passive mobilization can start after 3 weeks, limited to 100° of forward flexion and 90° of abduction. Assisted active rehabilitation programs for full range of motion recovering, strengthening, and proprioception can be initiated by the week 6, progressively, allowing light activities and noncontact sports by 3 months, and more demanding activities and sports by 4 months.

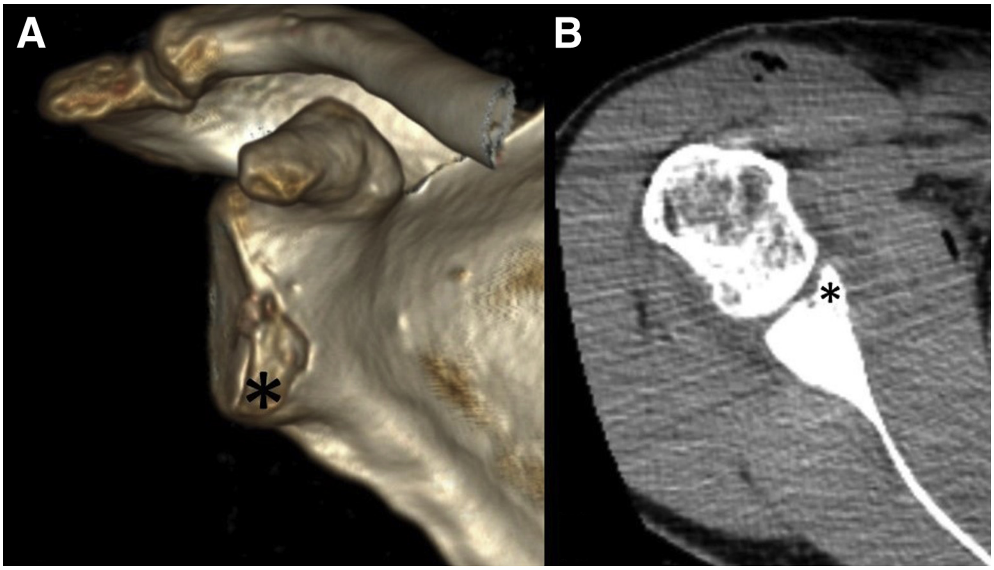

Fig 6. Postoperative imaging of the right shoulder presented in the case. (A) 3-Dimensional computed tomography (CT), anterior view. (B) 2-Dimensional CT, transverse scan. Fracture fragment (*) is reduced anatomically on the glenoid.

Table 1. Advantages and Disadvantages

Advantages	Disadvantages
Anatomic reduction	Traction mechanism of stabilization
Direct and indirect stabilization	May require a bony augmentation technique in the event of a complication
No sutures on articular surface	Not for beginner shoulder arthroscopists
Feasible with very small anchors	
Standard arthroscopic setting	
No need for hardware removal	

Discussion

The presented technique offers several advantages (Table 1), namely: anatomic reduction with a stable fixation system, both direct and indirect stabilization, the absence of sutures on the chondral surface, the use of soft anchors, the absence of temporary or permanent hardware, the use of standard arthroscopic portals, and the general advantages of arthroscopic techniques.

The extensive mobilization of the fracture fragment allows the surgeon to visualize the correct reduction to restore anatomy and identify both entry points needed to position the kissing anchors construct. This configuration creates compression forces pointed toward each other, which should not displace the fragment despite its dimensions. One of the risks the authors wanted to avoid is, in fact, the mobilization of the most medial portion of the fragment when it is large, which is thought to be more frequent if sutures surround the fragment. This mobilization happens because suture tensioning and knot tying create a fulcrum at the anchor entry point when it is more central on the articular surface, unbalancing the compression forces acting on the fragment so that its lateral portion is more compressed than the medial, which then is lifted from its fracture bed. This could also be one of the reasons that fragment size is a limitation for other techniques.[2,3,6,7]

Along with the direct stabilization provided by the kissing anchors construct, the standard repair of the remaining detached labrum offers and an additional, yet indirect, stabilization effect owing to ligamentotaxis, it being attached to the fracture's fragment.[3,7] It may also be possible to speculate minimal correction of the rotation of the fragment when the knots on the labrum are tied, which reasonably perfects the definitive position, making flush the chondral surfaces. Another advantage is that this technique does not leave sutures on the chondral surface,[2-8] thus reducing the occurrence of secondary degenerative disease.

Several other advantages depend on the anchors chosen. Soft anchors are made solely of suture. The first reason for this choice is to reduce the risk of iatrogenic comminution of the fragment, which is higher when using screws,[5] which are larger. Also, using these anchors did not require any supplementary drilling in the fragments, as needed for temporary fixation[5,6] or to create a transosseous suture.[8] Moreover, it is not necessary to respect any particular angle of implantation while drilling the anchor holes: the only important factor for proper implantation is to drill on both surfaces at the same level in regard to the articular layer, so that the construct will exert proper compressive force on the fracture. Also, while it is recommended to not violate the cortical layer while drilling the fragment, if that does happen, it will not affect the final result, because

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
• Debride the fracture site from loose bodies that can interfere with the reduction.	
• Tilt the fragment margin posteriorly and laterally, orienting it parallel toward the anchor guide direction.	
• Soft anchors will work perfectly, stabilizing the fragment even if the cortical wall is drilled, contrary to other devices.	
• Apply an anterior counterforce with a periosteal elevator to the fragment while drilling the anchor hole and during anchor insertion.	• The correct anchor position on the fracture fragment is just underneath the subchondral layer. This position will provide a stronger grip by the anchor, lowering the chances of pullout; however, achieving perfect positioning may be challenging.
• Inserting the anchor in the fragment is a critical step, which can be complicated by the intrinsic instability of the fragment itself, as it can move while tapping and result in a null deployment.	

Table 3. Risks and Limitations

Risks	Limitations
Iatrogenic comminution of the fragment while drilling or anchor tapping	Comminuted fracture
Soft anchor null deployment due to guide malalignment caused by fragment's instability	Fractures with a fragment larger than 1/3 of the articular surface
	Fractures with a small fragment (approximately <1 cm)

those anchors would curl up and provide an identical effect.

Finally, the presented technique was performed by arthroscopy with standard portals and instrumentation, like a typical bony Bankart repair. Thus the surgery can identify and treat concomitant intra-articular lesions, avoid the risk of nerve and vessel injury, avoid periosteum stripping to facilitate bone union, help identify and reduce smaller fragments with the aid of magnification, and reduce the incidence of secondary stiffness.

The technique is simple, reproducible, and straightforward. Surgical pearls and pitfalls are reported in Table 2. It also presents some risks and limitations, listed in Table 3, of which the most important is iatrogenic comminution of the fragment, which can happen during its manipulation or during anchor insertion and may result in the need to convert to open surgery or a more demanding advanced shoulder procedure such as the bony augmentation. Therefore, a surgeon willing to apply this technique should already be confident with basic shoulder arthroscopy and have already performed an appropriate number of arthroscopic shoulder stabilizations.

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