



# Traumatic Inferior Glenohumeral Dislocation Associated With Rotator Cuff Avulsion Fracture: Arthroscopic-Assisted Fixation: A Technical Note

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**Abstract:** Traumatic inferior glenohumeral dislocation with rotator cuff avulsion fracture rarely occurs and may cause chronic pain and diminished shoulder function. Several treatment options are available for this injury, such as open reduction internal fixation and arthroscopic-assisted reduction internal fixation. This technique describes a step-by-step technique to manage traumatic inferior glenohumeral dislocation with rotator cuff avulsion fracture using the simultaneous closed reduction procedure for traumatic inferior glenohumeral dislocation and the arthroscopic procedure with suture bridge technique for the treatment of rotator cuff avulsion fracture.

Shoulder dislocations occur frequently, but traumatic inferior glenohumeral dislocation of the shoulder accounts for only 0.5% of all incidences of shoulder dislocations.<sup>1</sup> The most common traumatic inferior glenohumeral dislocation results from forceful hyperabduction of the shoulder. The humeral neck is levered against the acromion, causing inferior displacement of the humeral head through the capsule tears. Such a dislocation may cause several complications similar to all shoulder injuries.<sup>1</sup>

Traumatic inferior glenohumeral dislocation may be associated with fracture of the coracoid, clavicle, acromion,

rotator cuff avulsion, and humeral head, as well as with neurovascular complications. Immediate closed reduction under intravenous sedation or anesthesia is required to avoid complications.<sup>2</sup> Traction–countertraction and the 2-step maneuver are the most commonly used reduction techniques. After reduction, the shoulder is immobilized for 3 weeks to allow healing of the soft tissues. However, secondary surgery may be necessary for rotator cuff repair, rotator cuff avulsion fixation, and scapulohumeral complex fixation if there are any other associated injuries.<sup>3</sup>

The treatment of rotator cuff avulsion fracture in traumatic inferior glenohumeral dislocation is based on the displacement degree and fragment size. The treatment varies from conservative, arthroscopic-assisted reduction internal fixation to open reduction. A patient with 3- to 10-mm fragment displacement can be treated with arthroscopic-assisted reduction internal fixation. A fracture with a large fragment of greater than 3 × 3 cm can be treated with screwing, whereas in small fragment and comminuted fractures, suture anchor fixation is preferred.<sup>4</sup>

The rarity of this pathology is caused by the combination of rotator cuff avulsion fracture and traumatic inferior glenohumeral dislocation. In this study, we describe how to manage this pathology, step by step, while performing the simultaneous closed reduction technique and the arthroscopic procedure using a suture bridge technique for rotator cuff avulsion avulsions.

## Surgical Technique (With Video Illustration)

In the preoperative setup, we place the patient in a beach-chair position and under general anesthesia. The

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*The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).*

*This study was supported by Review Article Writing Grant Universitas Padjadjaran to YSP No: 1959/UN6.3.1/PT.00/2021.*

*Received June 13, 2021; accepted August 6, 2021.*

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2212-6287/21873

<https://doi.org/10.1016/j.eats.2021.08.009>

**Table 1.** Pearls and Pitfalls

Surgical Step	Pearls	Pitfalls
1. Closed reduction under anesthesia	Reduction is easier because fracture of the rotator cuff avulsion (the deforming force disappears)	Associated fracture
2. Patient positioning: portal placement	Easier conversion to an open procedure	Difficult access to the inferior glenoid
3. Subacromial decompression, bursectomy, and hematoma removal	Remove the fracture hematoma and soft tissue around the fracture site to improve visualization and increase accurate reduction	Poor visualization is inevitable due to bleeding and displaced large rotator cuff avulsion fragments  Performing bursectomy using a shaver after the anchors are inserted may cause cutting of the suture material.
4. Fragment identification and mobilization	Reduction is easier after mobilizing the fragment	Inaccurate fragment reduction may occur if clean visualization of the fracture site is not obtained.
5. Intra-articular evaluation	Evaluate any associated injuries	
6. Medial-row anchor insertion and medial-row knot tying	Place the medial anchor just on the edge of the fracture line for an accurate reduction of a posterosuperior displaced rotator cuff avulsion fragment	Placement of the superior anchor on the cancellous bone at the fracture site causes the anchor to be pulled out
7. Lateral-row insertion	Careful attention to maintain the fracture gap is important when the lateral-row anchors are inserted into the bicipital groove	
8. Re-evaluation under C-arm	Intraoperative fluoroscopy in multiple planes is employed to confirm anatomic fracture reduction	Relying on arthroscopic visualization without fluoroscopy may lead to malreduction of the fracture

procedure consists of 8 steps, as shown in [Video 1](#) and [Table 1](#).

### Closed Reduction Under Anesthesia

The patient is placed in a supine position and under anesthesia ([Fig 1](#)). We evaluate the reduction position with a C-arm using the traction–countertraction technique for the inferior glenohumeral dislocation ([Fig 2](#)). Then, the patient is examined via a C-arm evaluation to confirm the reduction of the glenohumeral joint ([Fig 3](#)).

### Patient Positioning: Portal Placement

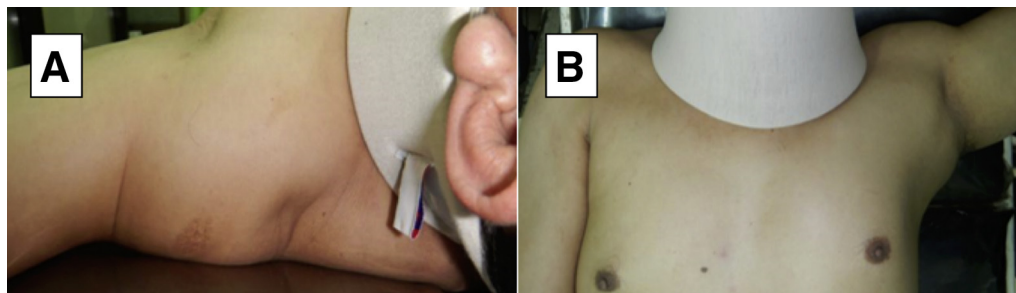
The -hair position is employed to allow the surgeon to explore associated injuries ([Fig 4](#)). The arm is then covered using a sterile drape.

### Subacromial Decompression, Bursectomy, and Hematoma Removal

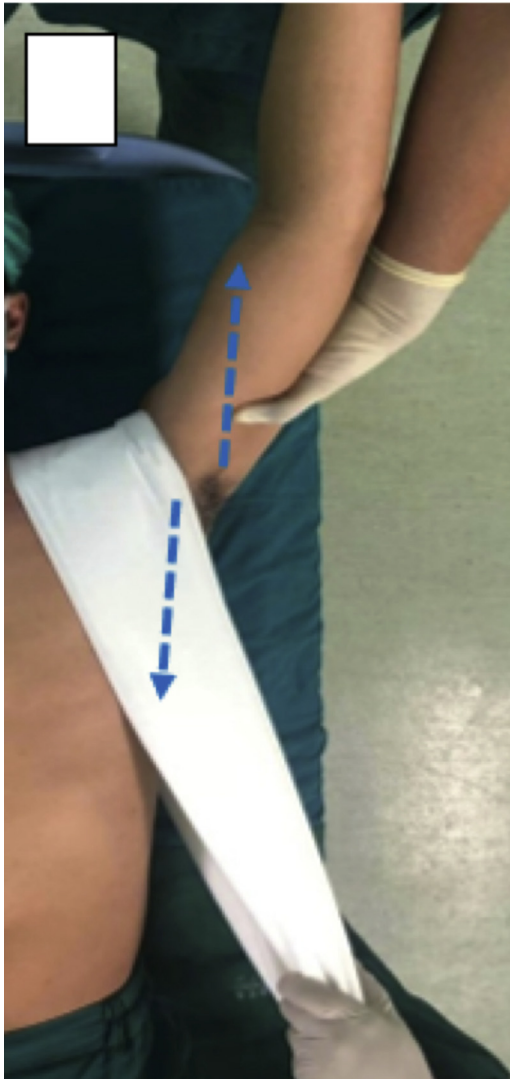
The arthroscope is inserted into the subacromial space through the posterior portal. Subacromial decompression, bursectomy, and hematoma removal are performed with the anterolateral portal as a working portal. Moreover, acromioplasty is performed if indicated. Subacromial decompression, bursectomy, and hematoma removal are performed to improve visualization ([Fig 5](#)).

### Fragment Identification and Mobilization

The viewing portal is from the anterolateral portal and the working portal is from the anterior and posterior portal for further evaluation of rotator cuff fracture. The mobility of the fractured and torn rotator



**Fig 1.** Patient with inferior glenohumeral dislocation of left shoulder at the emergency ward. (A) Arm in the hyperabduction position and elbow flexion. (B) Anterior view of the left shoulder.



**Fig 2.** Reduction of shoulder dislocation: axial traction and countertraction. Axial traction is applied to the left arm, and parallel countertraction is applied with sheet wrapped over the left shoulder.

cuff tendon are evaluated using an arthroscopic grasper. A combination of shaver and burr (DYONICS ELITE Acromionizer Burr; Smith & Nephew, Andover, MA) is then used to repair the fracture site to a native anatomical contour. This step allows the creation of a bleeding bone surface conducive to healing. Fracture reduction is confirmed via fluoroscopy after an anatomic reduction is performed using the grasper. If the fragment displacement is negligible and the fragment size is more than  $3 \times 3$  cm, we perform fixation using a percutaneous screw under fluoroscopic guidance with arthroscopic assistance. If the fragment displacement is 3 to 5 mm from the junction between the humeral head articular cartilage, and the fragment size is less than  $3 \times 3$  cm or comminuted, we prefer reduction and fixation with suture bridge technique.

### Intra-articular Evaluation

Viewing from the anterolateral portal with a standard  $30^\circ$  arthroscope is adopted to perform diagnostic arthroscopy from the mobilized rotator cuff avulsion fragment. We perform intra-articular evaluation and identify the tear of the long head of the biceps tendon, circumferential labral tear, and bone and articular cartilage continuity.

### Medial-Row Anchor Insertion and Medial-Row Knot-Tying

A posterolateral portal is created for visualization purposes, and a switching stick is used to shift the camera to the posterolateral viewing portal. The anterolateral working portal is used for suture management and anchor placement. A partially threaded 7-mm cannula is inserted into the anterolateral portal to avoid interposition of the soft tissues. The medial fracture line is then reidentified. Two single-load medial-row suture anchors are placed at the end of the articular and raw surface of the greater tuberosity (GT) fracture. The second medial anchor is inserted 1.5 cm posterior to the first anchor, and the sutures are passed through the intact cuff attached to the GT fragments. The suture strands of the medial-row anchors are then tied with a sliding knot under direct visualization.

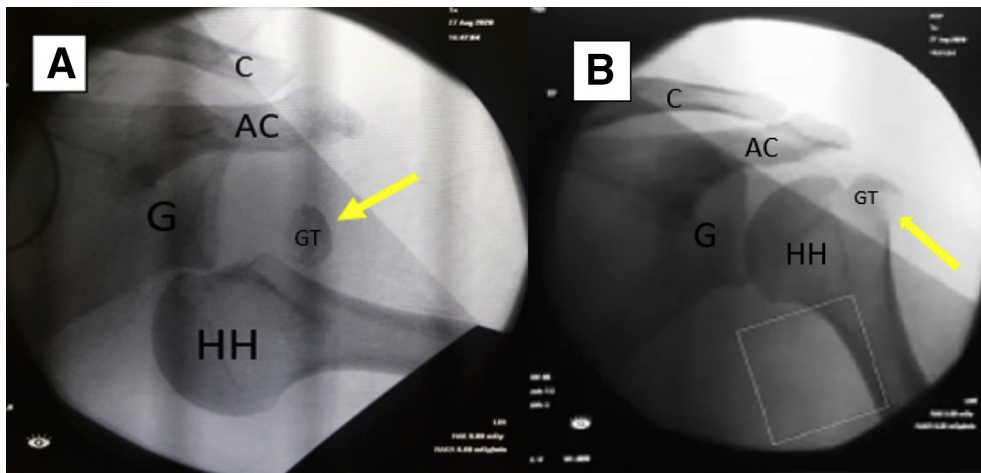
### Lateral-Row Insertion

Two double-loaded lateral-row FOOTPRINT Ultra Suture Anchor 4.5 mm (Smith & Nephew) are then placed in the cortex of the humerus 5 mm distal to the lateral edge of the GT fragment or in the sulcus bicipital area (the most substantial part of the proximal humerus bone). One limb from both sutures of each lateral-row anchor is passed through the intact cuff between the medial row of the sutures and the medial aspect of the fracture fragments. The pilot holes for a knotless suture anchor are directly prepared in line with the medial anchors and 5 mm distal to the lateral edge of the GT fragment. A suture limb from each medial suture anchor is then threaded through the eyelet on the distal end of the driver. With constant tension applied, 2 FOOTPRINT PK 4.5 mm (Smith & Nephew) suture anchors with 2 ultrabrids are inserted into the pilot hole using the suture bridge technique (Fig 6).

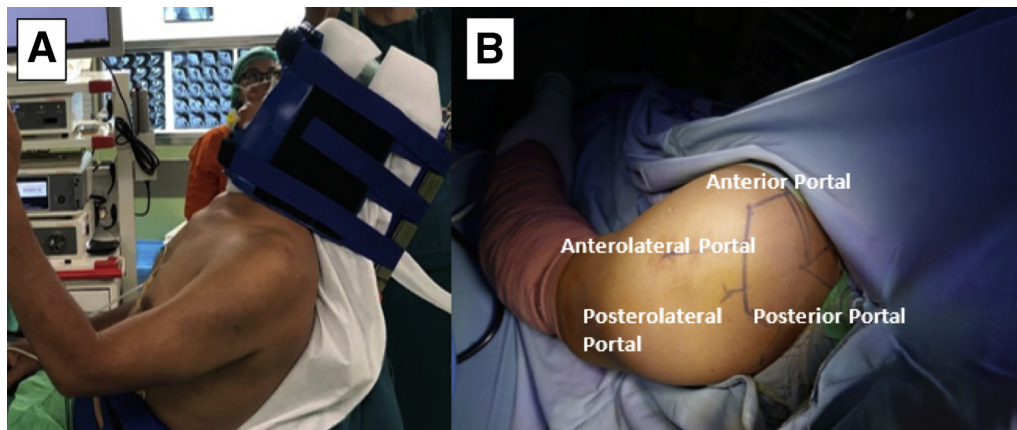
### Re-evaluation Under C-Arm

Intraoperative fluoroscopy in multiple planes is adopted to confirm anatomic fracture reduction. The anterolateral anchor is guided into place using a driver and rotated clockwise to achieve bony fixation while maintaining adequate tension. The remaining suture limbs are cut using an INCISOR Plus ELITE 4.5 mm (Smith & Nephew), and the procedure is repeated for the placement of the posterolateral anchor. Therefore, the shoulder is mobilized through passive range of

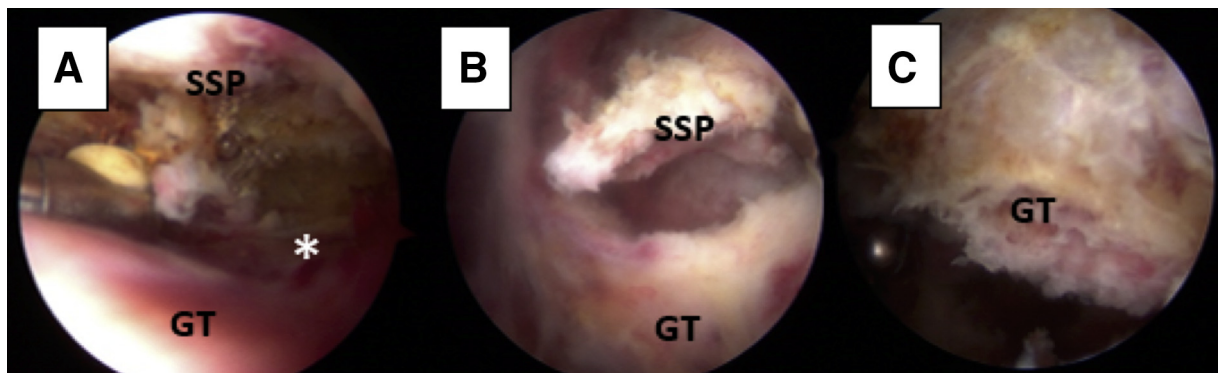




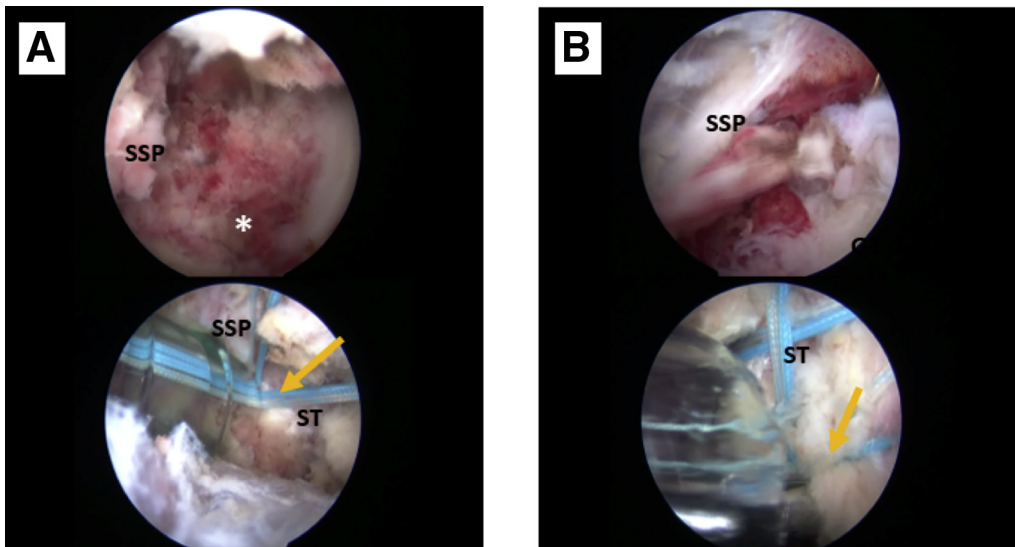
**Fig 3.** Radiograph of the left glenohumeral joint. (A) C-arm of the left inferior glenohumeral joint dislocation with a greater tuberosity fracture (yellow arrow). (B) The humeral head back into position, we can see there is still a greater tuberosity fracture with slight displacement. (AC, acromion; C, clavicular; G, glenoid; GT, greater tuberosity; HH, humeral head.)



**Fig 4.** (A) Beach-chair position. (B) Portal placement for arthroscopy-assisted reduction fixation.



**Fig 5.** The left-sided rotator cuff avulsion fracture is visualized using the arthroscope in the anterolateral portal. (A) After the anterolateral working portal was established, the subacromial space pathology was addressed using a curette (\*). (B) The rotator cuff avulsion callus was removed using an arthroscopic shaver. (C) Debridement to its native anatomic contour of rotator cuff avulsion. (GT, rotator cuff avulsion; SSP, supraspinatus.)



**Fig 6.** Left shoulder in the beach-chair position. Arthroscopic view of the glenohumeral joint space from the posterior portal. (A) Debridement using the shaver. Asterisk (\*) indicates the supraspinatus footprint. (SSP, supraspinatus tendon.) As the SSP is held in the anatomic position with the arthroscopic grasper via the anterolateral portal, a suture passing device via the anterior portal is passed through the supraspinatus tendon. Final view of the first anchor placement (arrow). (B) View through the posterior portal of the completed anterolateral anchor (arrow) after the ends of the suture have been cut. (ST, suture tape.)

motion, showing a stable, reduced fixation construction under both arthroscopy and fluoroscopy visualization (Fig 7).

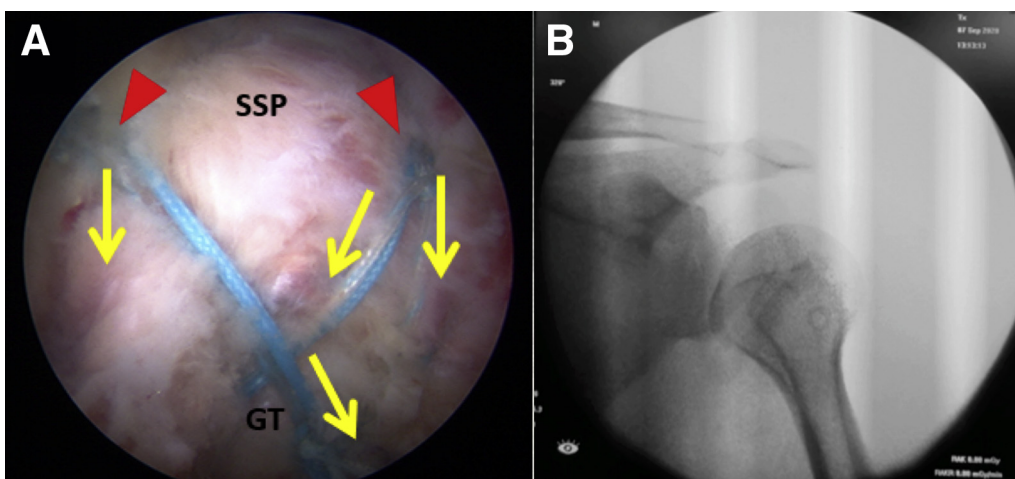
### Postoperative Rehabilitation

Patients wear a sling with an abduction pillow. Passive shoulder range of motion is initiated immediately 14 days after surgery in more comminuted or less-stable situations or if the repair is secured. We immediately begin an active range of motion of the elbow, wrist, and fingers. Active shoulder range of motion is

initiated 4 to 6 weeks postoperative as clinical examination and radiographic follow-up order. At 6 weeks postoperatively, resisted elbow flexion exercises are started. Shoulder strengthening exercises are initiated at 8 weeks postoperatively.

### Discussion

Over the last 2 decades, there have been many advancements in managing displaced rotator cuff avulsion fractures.<sup>4</sup> The advantages of performing arthroscopy-assisted techniques are direct visualization, low infection



**Fig 7.** (A) View of the left shoulder through the anterolateral anchor of the completed repair; the construct avoids over-reduction and under-reduction as the fragments are secured on both the medial and lateral sides. The arrows indicate the lateral row of the suture anchors, and the arrowheads indicate the medial row of the suture anchors. (GT, rotator cuff avulsion; SSP, supraspinatus tendon.) (B) Left shoulder re-evaluation using C-arm post GT fixation; the fragment is back into position (arrow).

**Table 2.** Advantages and Disadvantages

Advantages	Disadvantages
Small incision	Need advanced arthroscopy technique
No need for further surgery (plating or hardware removal surgery)	Longer operation time than the open technique More complicated surgery
Low infection risk	Lower fixation power than with plate fixation
Shorter hospital stay	
Minimal soft-tissue damage	
Can be used as diagnostic tools	

risk, superior intraarticular fracture reduction, fixation accuracy, and potentially improved clinical outcomes (Table 2).<sup>4,5</sup>

Several studies reported the surgical indications for rotator cuff avulsion fractures. The goal of surgical treatment is to restore the shoulder's normal anatomy and allow early motion through firm fixation.<sup>6</sup> Several surgical methods were reported, including cannulated screw fixation, plate fixation, and open or arthroscopic suture anchor fixation.<sup>7</sup> One method alone, namely, cannulated screw fixation, is insufficient for adequate reduction and fixation, especially in patients with osteoporosis.<sup>6,7</sup> The plate fixation method is adequate for fixation, but if the bone quality is poor, an avulsion fracture may occur through the screw hole.<sup>8</sup> Deltoid dissection is unavoidable, and axillary nerve injury and inaccurate reduction due to the surrounding rotator cuff may concern the open technique.<sup>6</sup> Arthroscopy enables a less-invasive reduction of the posterolateral displaced fracture fragment, evaluation and simultaneous treatment of other lesions such as labral and rotator cuff injuries, and reduced radiation hazard.<sup>2,3</sup> There are some reports of concomitant rotator cuff injuries or labral injuries with isolated rotator cuff avulsion fractures. Arthroscopic techniques allow us to reduce and fix the fracture, and satisfactory early clinical results of this technique have been reported in several studies.<sup>5,9</sup> Several reports on large displaced rotator cuff avulsion fracture fixation with an arthroscopic technique have also been reported.<sup>1</sup>

In case of the large and communitive rotator cuff avulsion fragments, the lateral anchors are hard to fix compared with the conventional suture bridge technique because the lateral anchors need to be located more distally. Axillary nerve injury may be observed. Lateral anchor placement can be a problem because the distal part of the proximal humeral bone is stronger and narrower. Thus, the lateral anchor near the bicipital groove is recommended the lateral anchor placement while the rotator cuff avulsion fragment is posteriorly displaced. In a retrospective study, Liao et al.<sup>10</sup> reported on many patients who were treated surgically for

displaced rotator cuff avulsion fractures. In that study, they compared the double-row suture bridge technique and the arthroscopic implantation of suture anchors with open reduction and internal fixation using a proximal humeral locking plate via the deltopectoral approach.<sup>4</sup> They found that both techniques were effective for fracture healing, and both groups had few complications.<sup>5</sup> However, the arthroscopic-assisted technique group had superior results regarding shoulder flexion and abduction postoperatively and required less time in the operating room. Some limitations also may exist regarding the arthroscopic-assisted rotator cuff avulsion fracture fixation (Table 2). This procedure requires considerable technical skills, and there is a long learning curve.<sup>7</sup> The study conducted by Lin et al. compared 2-screw fixation (TS), a suture bridge technique using knotless suture anchor fixation (SB), double-row suture anchor fixation (DR), and methods, which resulted in a mean force of cyclic loading to create 3 mm of displacement significantly different among all three groups (SB > DR > TS).<sup>5,10</sup>

The authors can effectively treat rotator cuff avulsion fractures with traumatic inferior glenohumeral dislocation, considering the fractures described in this report.<sup>10</sup> From this study, the authors believe that the simultaneous closed reduction and arthroscopic suture bridge repair techniques for large and comminution rotator cuff avulsion fracture with traumatic inferior glenohumeral dislocation obtain good results with less injury to the soft tissues.<sup>11</sup>

### Acknowledgments

The authors thank Enago ([www.enago.com](http://www.enago.com)) for English-language review.

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