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Distractor Application and Dry Arthroscopy to Improve Articular Visualization During Scapula Fracture Surgery Via a Posterior Approach

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Summary

Intra-articular glenoid displacement is an indication for open reduction and internal fixation of scapular fractures. However, direct visualization of the glenoid is limited, and articular reductions are typically performed and assessed using extra-articular cortical reduction reads and fluoroscopic imaging. In this technique, we describe the application of a distractor for direct visualization of the glenoid articular surface. In this way, anatomic reduction of the glenoid articular surface can be assessed and achieved. Additionally, we discuss the use of a portable, dry arthroscopy when needed. This technique has resulted in good-to-excellent articular reductions by adjusting extra-articular reads that appeared adequate prior to intra-articular visualization. This technique is safe, requires minimal extra set-up or instruments, and results in good-to-excellent articular reductions.

Manuscript

Introduction

Scapular fractures with intra-articular extension and displacement, like any other peri-articular fracture, benefit from anatomic reduction to restore function and preserve long-term joint survival. Typically these fractures are Ideberg types IIb, III, IV, and V.[1] As such, 2-4 mm of glenoid intra-articular step-off is often used as an indication for open reduction internal fixation (ORIF). [2,3] Patient outcomes are improved significantly in these types of fractures following anatomic reduction.[2,4] However, direct visualization of the intra-articular reduction is limited using the modified Judet technique.[5-8] Often extra-articular cortical reduction reads and fluoroscopy are used as surrogates to assess articular reduction. Proposed solutions to obtain direct articular visualization include a separate anterior incision or use of arthroscopy.[9,10] However, additional surgical approaches require extra time, as well as the possibility of increased morbidity and positioning or room rearrangement. Scapula ORIF often occurs in a trauma room where access to arthroscopy may not be easily available, and the staff may not be well-trained to use this equipment. Using a distraction technique, some of these challenges can be overcome.

To achieve anatomic articular reductions during ORIF of the scapula, we have developed a surgical technique to allow for direct palpation and visualization of the glenoid within the modified Judet surgical approach. The purpose of this paper is to describe our surgical technique and report our results using this technique in a consecutive series of scapula fractures with intra-articular extension.

Technique

Positioning

After anesthetic induction and intubation, the patient is positioned lateral with the operative scapula up using a suction bean bag on a radiolucent flat table. The entire forequarter, including the operative extremity and shoulder girdle are then prepped and draped. The operative extremity is rested over a padded Mayo stand with 90 degrees of shoulder forward elevation and abduction.

Surgical approach

A standard modified Judet approach is performed as previously described.[5,11] One limb of the incision is along the scapular spine. The other limb is along either the medial border (standard modified Judet) or along the lateral border (reverse modified Judet) based on fracture pattern involving one area more than the other. The posterior head of the deltoid is released as needed off the scapular spine and tagged with multiple #5 braided, non-absorbable sutures in a rip-stop fashion. The posterior deltoid is then mobilized and the interval between the infraspinatus and teres minor is visualized. The infraspinatus can then be mobilized to allow fracture cleaning, but it is necessary to protect its innervation from the suprascapular nerve. In some fracture patterns requiring maximal exposure, the infraspinatus can be released from the medial border of the scapula and mobilized superiorly on its neurovascular pedicle to allow additional visualization.

Intraoperative intra-articular visualization

The extra-articular reduction, especially without a direct cortical reduction read, may not correlate with an anatomic articular reduction. Even with fluoroscopy, the articular reduction can be misleading without direct visualization. As such, in scapular fractures with intra-articular involvement, we access the joint for direct visualization and palpation. A small joint distractor (DePuy Synthes, West Chester, PA) is used with a 3 mm Schanz pin placed into a stable intact segment with dense bone, typically near the base of the scapular spine or into the scapular spine, depending on the fracture pattern and planned fixation construct. A second pin is placed into the humeral head just off the articular surface in the interval between the infraspinatus and teres minor (Figure 1). A capsulotomy is made along the posterior rim of the glenoid after the joint is gently distracted to help avoid injury to the articular surface and labrum. The articular fracture read can then be visualized, palpated and anatomically reduced (Figure 2).

Reduction and Fixation

Reduction and fixation techniques are based on fracture patterns and use typical techniques. The distractor can also be used as a reduction tool as well to correct lateralization of the scapular body if it has occurred. Performing the capsulotomy early allows for fracture reductions to be adjusted as needed to prioritize anatomic articular reduction. Additionally, fixation near the joint can be confirmed to be extra-articular using fluoroscopy and direct visualization. This is especially salient when placing screws from lateral border into the coracoid along the subchondral glenoid as these screws are at risk of breaching the articular surface.

Clinical Series

A consecutive series of 19 patients with scapula fractures that involve the glenoid from 2017 – 2021 were retrospectively reviewed. Indications for surgery included intra-articular extension involving the posterior aspect of the glenoid with minimum of 2mm of glenoid incongruity or gap. All patients were treated with the described distractor application technique. The average age of the patients was 51 years old (range, 27 – 88 years). Classification and initial articular displacement of the injury based on CT is noted in a **Table, see Supplemental Digital Content 1.** Postoperative radiographs were obtained for all patients (Figure 5) and 8 patients had a postoperative computed tomography (CT) scan. For those patients with preoperative and postoperative CTs, articular glenoid fracture displacement on averaged improved from 7.78 mm (SD 2.65 mm) on the axial views and 10.16 mm (SD 5.66 mm) on the coronal reformats to 1.87 mm (SD 1.18) and 1.37 mm (SD 0.97 mm), respectively. The average follow-up was 5 months (range, 0.5 to 14 months) with 15 fractures at union at their last follow-up. Union was defined as radiographic bony healing and resolution of clinical symptoms. There were no infections, nerve injuries, or unplanned secondary surgeries. Two patients with more severe articular injuries developed early post-traumatic osteoarthritis. One patient presented on a subacute basis, approximately six weeks after injury, and was found to have post-traumatic articular loss of the central portion of the glenoid during intraoperative intra-articular evaluation. The second patient was found to have articular comminution with both loose and impacted osteochondral fragments with minimal subchondral bone that were not amenable for fixation.

Discussion

Scapular fractures with intraarticular involvement are uncommon injuries that can develop chronic shoulder instability or early degenerative joint disease if anatomic articular congruity is not achieved.[12-15] Different techniques have been described to obtain intra-articular visualization. Specialized retractors can be inserted if the anterior glenoid rim is intact to improve visualization and navigated screws can be placed with specific instrumentation.[16] An additional anterior counter incision along the deltopectoral interval can be utilized to aid with reduction and gain direct visualization of the glenoid.[6,17] However, the increased exposure is still somewhat limited and requires either additional approaches or specialized equipment.

The use of arthroscopy has also been described as an adjunct to increase visualization.[18-20] Commonly there is capsular disruption that can make joint distention more challenging and increase the degree of soft tissue fluid extravasation.[10] Traditional arthroscopy requires additional set up and familiarity with arthroscopic instrumentation as well. Newer small-caliber, portable arthroscopes alleviate some of these issues and can be performed without need for water pressure.

The greatest strengths of our described technique are the efficiency and ease with which direct visualization of the glenoid can be obtained to assess articular reduction. Performing the posterior capsulotomy through the modified Judet approach takes no additional exposure and is safe. The application of the small joint distractor, an instrument often readily available in trauma centers, takes minimal additional time, allows for visualization and palpation of the joint surface through the capsulotomy, and did not result in any complications. The use of the distractor is similar to the use of the distractor in posterior wall fractures, and this technique can be utilized in other posterior approaches to the glenoid.[21] The concavity of the glenoid makes it more challenging to directly visualize anterior articular fracture reads; however, these can be easily palpated with distractor application. If further visualization is required, an off-the-shelf dry arthroscopy unit, can by employed. We do not use this for every case but only when a distinct articular fracture line cannot be visualized through the capsulotomy.

Limitations of the study are present. The overall case series is small. Additionally, the small arthroscope is not always employed. It's use may confound the relationship between the distractor and quality of reduction in those patients.

Conclusion

Scapular fractures with intra-articular displacement benefit from anatomic reduction. Like other peri-articular fractures, this can be assessed with direct visualization as fluoroscopy can be misleading and cartilage injuries can be potentially addressed concomitantly. The glenoid is a difficult joint to view through the standard modified Judet approach. Our technique of posterior capsulotomy through the modified Judet approach and application of a distractor facilitates direct visualization and/or palpation of the glenoid efficiently without adding burdensome time, additional surgical approaches, or extensive equipment. Furthermore, if visualization of specific anterior articular lines cannot be obtained, the use of a small off-the-shelf, dry arthroscopy unit can be implemented. Overall, the technique has resulted in altering articular reductions previously thought to be excellent on fluoroscopy alone. This direct visualization assists in anatomic reductions following these high-energy fractures.

Table, Supplemental Digital Content 1 -http://links.lww.com/JOT/B920

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Table, Supplemental Digital Content 1. Patient demographics, injury characteristics, imaging results, and clinical complications. N/A = not available.

Figure 1. Application of the distractor. A) Clinical photos of distractor applied with pins in medial scapula (at confluence of spine and body) and in humeral head. B,C) Fluoroscopy imaging before (B) and after distraction applied (C).

Figure 2. Application of the distractor and joint visualization after the capsulotomy.

Figure 3. Use of Nanoscope. A) The Nanoscope, a 1.9 mm arthroscope. Note, syringe filled with saline provides fluid necessary for flushing, otherwise a dry arthroscopy. B) Portable viewing screen.

Figure 4. View of the joint surface with Nanoscope. A) Intraoperative image of glenoid step-off. B) Improved reduction of glenoid following reduction adjustment.

Figure 5. Intra-articular scapula fracture with associated clavicle fracture. A,B,C) Preoperative radiographs. D,E) Preoperative CT scan. F) Preoperative 3D reconstruction from CT. G) Intraoperative fluoroscopy. H,I) Postoperative radiographs. J,K,L) Postoperative CT scan. M) Postoperative 3D reconstruction from CT.

Figure 1

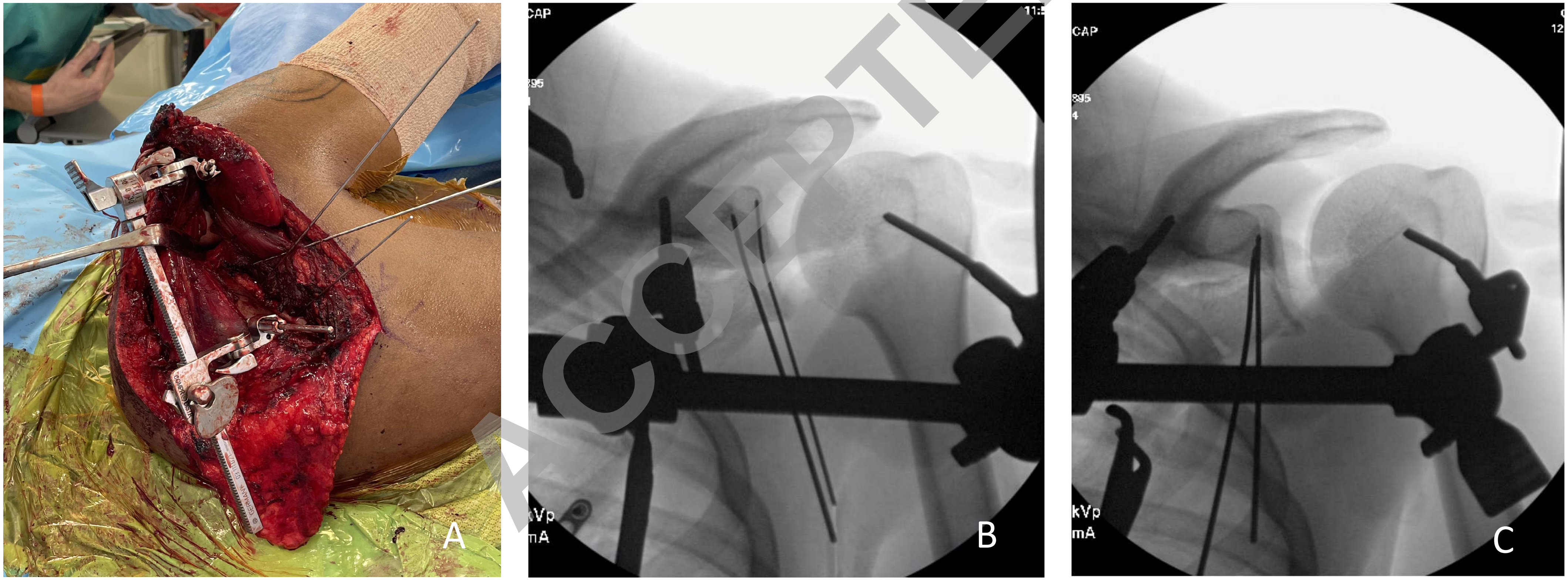

Figure 2

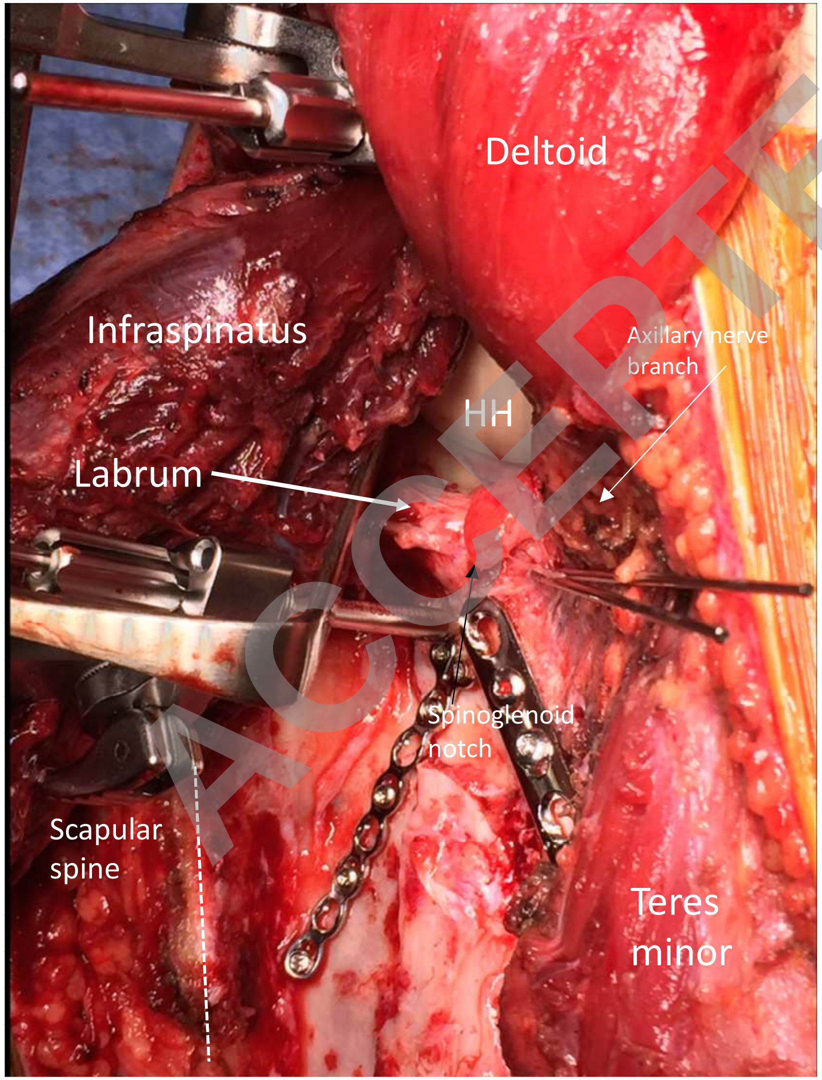
Deltoid
Infraspinatus
Axillary nerve branch
HH
Labrum
Spinoglenoid notch
Scapular spine
Teres minor

Figure 3

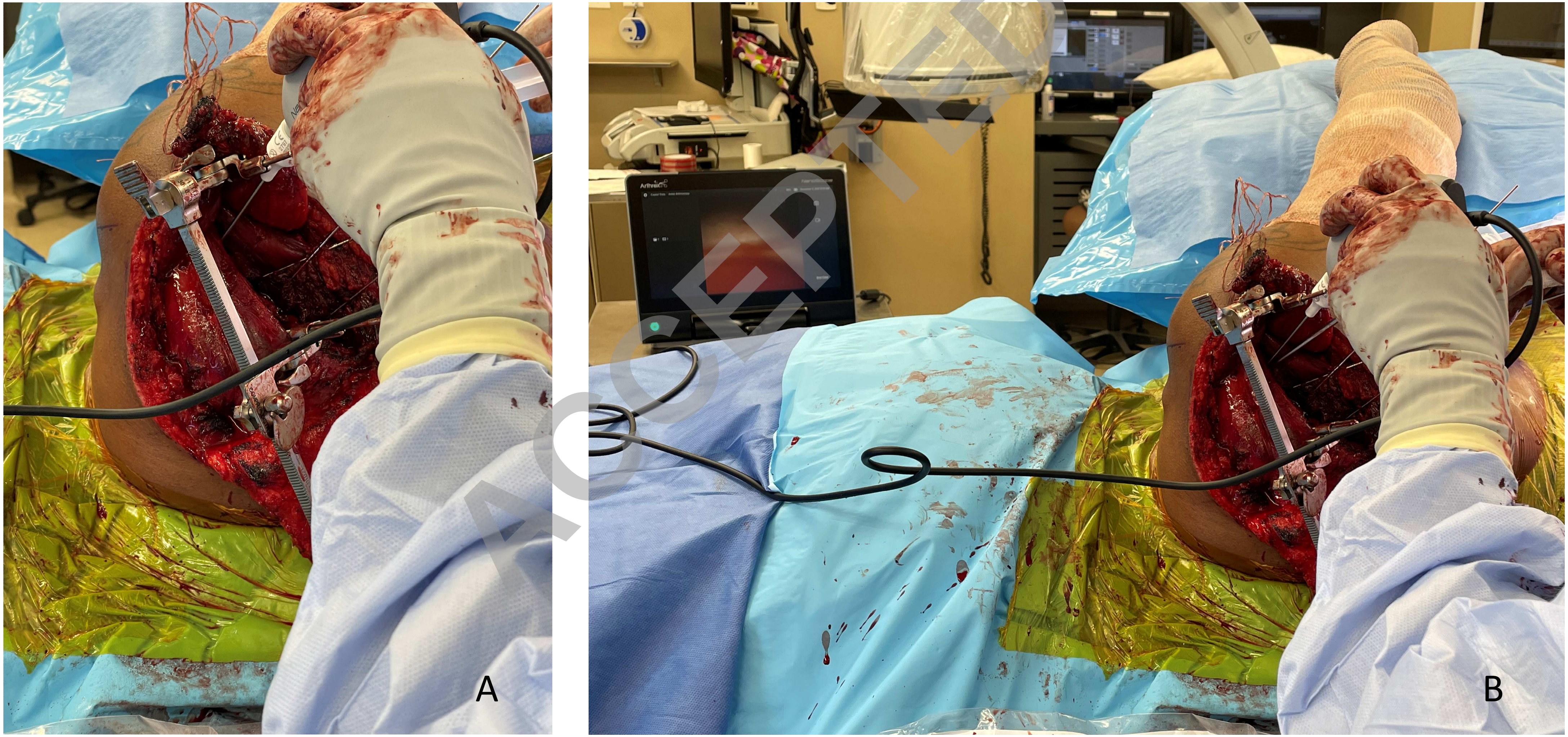

Figure 4

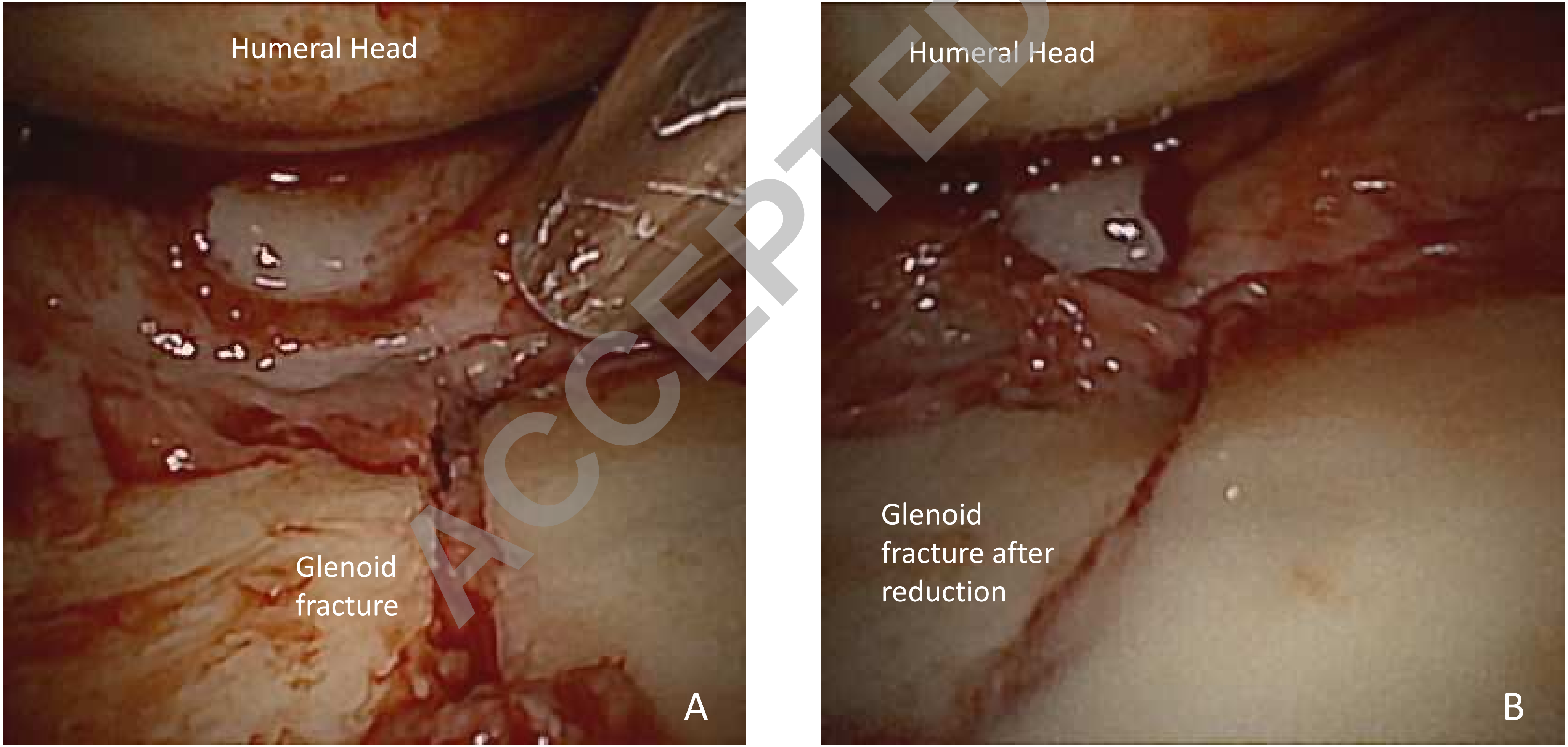
Humeral Head
Glenoid fracture
A
Humeral Head
Glenoid fracture after reduction
B
ACCEPTED

Figure 5