Arthroscopic Fixation of Glenoid Rim Fractures After Reduction by Labral Repair

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Abstract: Surgical fixation of displaced, intra-articular glenoid fractures represents a clinical challenge. These fractures have traditionally been treated through open approaches to the glenohumeral joint; however, the morbidity associated with open surgery may be reduced with arthroscopic techniques. Previously described arthroscopic methods commonly use clamps and/or Kirschner wires to obtain and maintain provisional fixation. We describe our technique for minimally invasive, arthroscopic fixation of glenoid rim fractures using labral repair as an indirect reduction maneuver, followed by final fixation with an extra-articular screw. This method is safe, efficient, and reliable, and it can be used to approach a variety of intra-articular glenoid fractures.

Fractures of the scapula are relatively rare with an annual incidence of 10 per 100,000.[1] Of these, approximately 30% involve the glenoid cavity.[1] Although extra-articular scapular fractures are often managed nonoperatively, surgical intervention is typically indicated for displaced, intra-articular fractures of the glenoid, particularly if the articular stepoff is greater than 5 mm.[2] Glenoid fracture patterns can be characterized using the Ideberg classification system, which defines 5 primary types of intra-articular glenoid fracture.[1] The most common fracture pattern is type I (anterior glenoid fracture), and these injuries can be subclassified as either type IA (fracture fragment measures 5 mm or less) or type IB (fracture fragment measures greater than 5 mm).[1]

Displaced, intra-articular glenoid fractures have traditionally been treated with open reduction—internal fixation through an arthrotomy to obtain direct visualization and anatomic reduction. However, the exposure for this open approach is associated with several potential complications, including neurovascular injury, infection, postoperative stiffness, and prolonged recovery. As a result, there has been increased interest in the use of arthroscopic techniques to treat glenoid fractures, with several techniques and cases reported in the literature.[3-8] Most of these arthroscopic techniques entail the use of clamps and/or Kirschner wires to obtain and maintain provisional fixation.[3-6] Alternatively, Porcellini et al.[7] described an arthroscopic technique for stabilizing acute bony Bankart fractures using suture anchors that were placed in the glenoid along the rim fracture with the sutures passing around the fracture fragment and the adjacent capusular-labral complex. Sugaya et al.[8] modified this technique by stabilizing the fragment through labral fixation alone and then using augmentation sutures that are passed either through or around the fragment.

The purpose of this article is to describe an alternative technique for arthroscopic fixation of glenoid rim fractures using labral repair as an indirect reduction maneuver followed by an extra-articular screw for final fixation. This method can be used to achieve anatomic reduction and stable fixation of the glenoid while minimizing the risks associated with an open approach. The procedure is described in detail here and in the accompanying video (Video 1, Tables 1-3).

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Table 1. Key Points

- Preoperative radiographs and computed tomography scans are necessary to characterize the fracture pattern and identify any concomitant injuries.
- Appropriate fluoroscopic views should be obtained after patient positioning but before starting the procedure.
- Lateral decubitus positioning eliminates gravity as a deforming force on the fracture fragment.
- The use of a 70° arthroscope may improve visualization.
- Hematoma and callus in the fracture site should be thoroughly debrided before reduction.
- Precise portal placement with needle localization allows placement of anchors with appropriate starting position and trajectory.
- Use intraoperative fluoroscopy to confirm fracture reduction and screw placement.

Surgical Technique

Preoperatively, standard plain radiographs (Fig 1A-C) and computed tomography scans (Fig 1D) are obtained to characterize the glenoid fracture pattern. Magnetic resonance imaging can also be used to identify any concomitant injuries. Arthroscopic fixation can be planned provided that the patient is indicated for surgery and the fracture pattern is simple. After administration of regional anesthesia and performance of an examination under anesthesia, the patient is placed in the lateral decubitus position on a bean bag (Natus, Pleasanton, CA). An axillary roll is placed, the bean bag is insufflated, and all bony prominences are well padded. The operative extremity is prepped and draped in a standard fashion, placed in a STaR (Shoulder Traction and Rotation) Sleeve (Arthrex, Naples, FL), and connected to a 3-Point Shoulder Traction Tower (Arthrex). Although we prefer to perform this technique in the lateral decubitus position, the beach chair position could alternatively be used.

Diagnostic arthroscopy with a 30° arthroscope (Stryker, San Jose, CA) is performed through a standard posterior portal to the glenohumeral joint. Two anterior portals through the rotator interval are then established with needle localization. We prefer to use a 5.5-mm cannula in one anterior portal and a 7.5-mm or 8-mm cannula in the other anterior portal (Arthrex). Viewing through the posterior portal and working through the anterior portal that provides the best angle, the glenoid fracture line is identified (Fig 2A) and gently debrided using an arthroscopic shaver (Smith & Nephew, Andover, MA). Care should be taken not to significantly displace the fracture because this could disrupt any labral tissue that remains intact. The labrum adjacent to the intact portion of the glenoid and the fracture fragment is meticulously evaluated with a probe. The fracture fragment is then mobilized to ensure that an anatomic reduction can be achieved (Fig 2B). If necessary, a 70° arthroscope (Stryker) may improve visualization.

The labrum at the junction of the intact glenoid and the fracture fragment is then addressed. For a complete fracture, there will be 2 such junctions at either edge of the fracture fragment. When performed correctly, labral repair at these sites indirectly reduces the glenoid fracture. First, a 3.0-mm SutureTak suture anchor (Arthrex) is placed in the rim of the intact portion of the glenoid near the fracture margin (Fig 2C). One limb of the suture from the anchor is then shuttled around the portion of the labrum that is attached to the fracture fragment using a 90° SutureLasso (Arthrex). The 2 limbs of the suture are tied using a sliding arthroscopic knot, thus creating a simple stitch around the labrum that indirectly reduces the glenoid fracture (Fig 2D). The same technique is then applied to the labrum at the opposite edge of the fracture. It is worth clarifying that suture anchors are only placed in the intact portion of the glenoid, not the fracture fragment. After labral repair, the fracture is inspected to ensure that an anatomic reduction has been achieved (Fig 2E).

The fracture is then fixed with an extra-articular screw. While viewing through the posterior portal, a 3.2-mm drill bit attached to a cordless driver (Stryker) is inserted through the anterior portal that provides the best angle. The drill bit is placed on the anterior glenoid rim under arthroscopic visualization and advanced toward the posterior glenoid neck, perpendicular to the fracture site. The starting point and trajectory of the drill bit are confirmed using intraoperative fluoroscopy to ensure safe placement. The drilled path is then

Table 2. Pitfalls and Complications

- Labral repair should not be attempted until after the fracture fragment is debrided and mobilized.
- During debridement and mobilization, care should be taken not to disrupt any intact labral tissue.
- Suture anchors should be placed in the intact glenoid and not in the fracture fragment.
- Anatomic fracture reduction should be ensured before final screw fixation.
- Avoid intra-articular penetration of the drill bit and screw by making use of arthroscopic and fluoroscopic guidance.
- To reduce the risk of neurovascular injury, do not drill past the cortex of the posterior glenoid neck or place a prominent screw.

Table 3. Equipment Required

- Intraoperative fluoroscopy
- Bean bag (Natus, Pleasanton, CA)
- STaR (Shoulder Traction and Rotation) Sleeve (Arthrex, Naples, FL)
- 3-Point Shoulder Traction Tower (Arthrex)
- 30° and 70° arthroscopes (Stryker)
- Arthroscopic shaver (Smith & Nephew, Andover, MA)
- 5.5-mm and 7.5-mm or 8.0-mm cannulas (Arthrex)
- 3.0-mm SutureTak suture anchors (Arthrex)
- 90° Suture Lasso (Arthrex)
- 3.2-mm drill bit and cordless driver (Stryker)
- Small fragment fracture fixation set (Synthes, West Chester, PA)

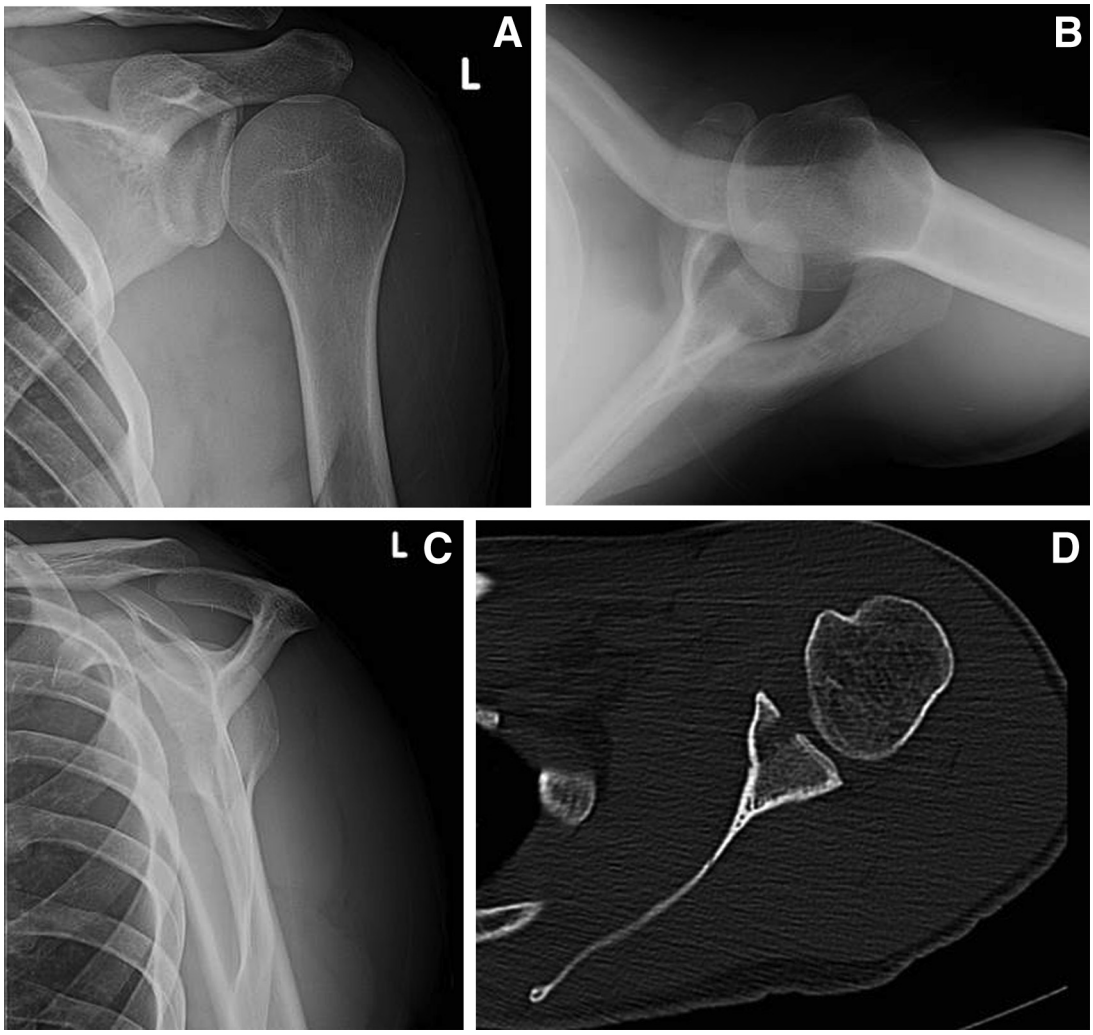

Fig 1. Preoperative (A) anteroposterior, (B) axillary, and (C) scapular-Y view radiographs, and (D) axial cut of computed tomography scan showing an intra-articular Ideberg glenoid fracture.

measured with a depth gauge, and a fully threaded 3.5-mm screw (Synthes, West Chester, PA) of appropriate length is advanced through the drilled path. Final reduction and screw placement are confirmed arthroscopically and fluoroscopically. Care must be taken to ensure that there is no intra-articular screw penetration.

Postoperatively, the patient is placed in a sling and is restricted from weight bearing for 6 weeks. Gentle range-of-motion exercises are initiated immediately to prevent postoperative stiffness. Follow-up radiographs are obtained at 3-week intervals to evaluate healing and make sure that there is no fracture displacement (Fig 3). Patients typically return to full activity at 16 weeks.

Discussion

Intra-articular glenoid fractures are a rare but challenging clinical problem. These fractures have traditionally been treated in an open fashion; however, the extensive exposure required to obtain an anatomic reduction and stable fixation through an arthrotomy may lead to significant morbidity, including neurovascular injury, infection, postoperative stiffness, and prolonged recovery. Accordingly, there has been increased use of arthroscopic techniques to facilitate reduction and fixation of intra-articular glenoid fractures.

Previously described arthroscopic techniques for glenoid fracture fixation typically use clamps and/or Kirschner wires to obtain and maintain provisional fixation before final screw fixation.[3-6] Appropriate placement of clamps and Kirschner wires may be difficult given the limitations imposed by the bony anatomy of the shoulder. In addition, placement of these provisional fixation devices may put adjacent neurovascular structures as risk.[9] In a cadaveric study, Marsland and Ahmad[9] showed that fixation devices placed from anterior to posterior injured the cephalic vein in 30% of specimens and placed the

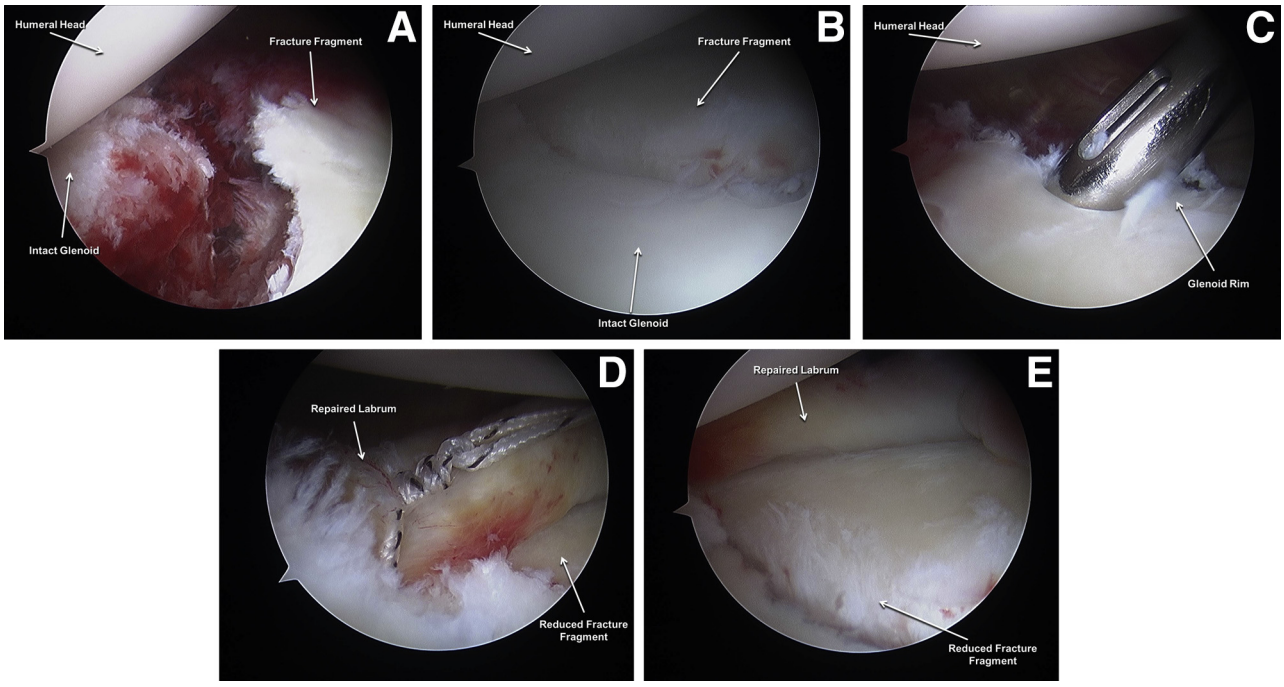

Fig 2. (A) Viewing the left shoulder in the lateral decubitus position through a standard posterior portal, the intact glenoid and fracture fragment are easily visualized. (B) Arthroscopic view from the posterior portal showing the anatomic reduction of the glenoid fracture after debridement and mobilization. (C) Arthroscopic view from the posterior portal showing placement of a suture anchor in the rim of the intact portion of the glenoid near the fracture margin. (D) Arthroscopic view from the posterior portal showing repair of the anteroinferior labrum. (E) Arthroscopic view from the posterior portal showing the final reduction of the glenoid fracture.

musculocutaneous nerve and the inferior branch of the suprascapular nerve at significant risk.

In contrast, Porcellini et al.[7] described an all-arthroscopic technique for stabilizing acute bony Bankart fractures using suture anchors. In their method, the anchors were placed in the intact glenoid through the rim fracture and the sutures were passed around the fracture fragment and the adjacent capusular-labral complex.[7] They reported excellent results in their series of patients with bony Bankart lesions less than 3 months old and involving less than 25% of the glenoid.[7] Sugaya et al.[8] later described a method for stabilizing anterior glenoid fracture fragments through labral fixation. In contrast to our technique, they augmented their repair with additional sutures passed either through or around the fracture fragment,[8] rather than with an extra-articular screw.

The present technique uses arthroscopic labral repair with suture anchors to obtain an anatomic reduction and provisional fixation of the glenoid fracture followed by final fixation with an extra-articular screw. Compared with an open approach to the glenoid, this technique is minimally invasive and provides earlier recovery with less stiffness. The risk of infection is reduced that is caused by decreased surgical time and diminished exposure. Blood loss is also significantly less with this arthroscopic technique compared with an open approach. As opposed to previously described arthroscopic techniques, this method does not require provisional placement of clamps and/or Kirschner wires, which can be difficult to place given the surrounding bony anatomy and which can put adjacent neurovascular structures at risk. Finally, final fixation with an extra-articular screw may provide more robust fixation than techniques using suture anchors alone. This method may not be used if the fracture fragment cannot be mobilized using arthroscopic techniques. In addition, if the fracture pattern is complex with multiple fracture lines, an open approach may be preferable.

In summary, intra-articular glenoid fractures present an opportunity to use arthroscopic techniques that reduce the risks and morbidity of open procedures. Labral fixation can reliably be used to obtain and maintain an anatomic reduction before final screw fixation. This technique obviates the need for provisional fixation with clamps and/or Kirschner wires, which are often difficult to place and pose significant risk to adjacent neurovascular structures. This technique can be used to manage a variety of intra-articular glenoid fractures with minimal risk to the patient and excellent radiographic and functional results.

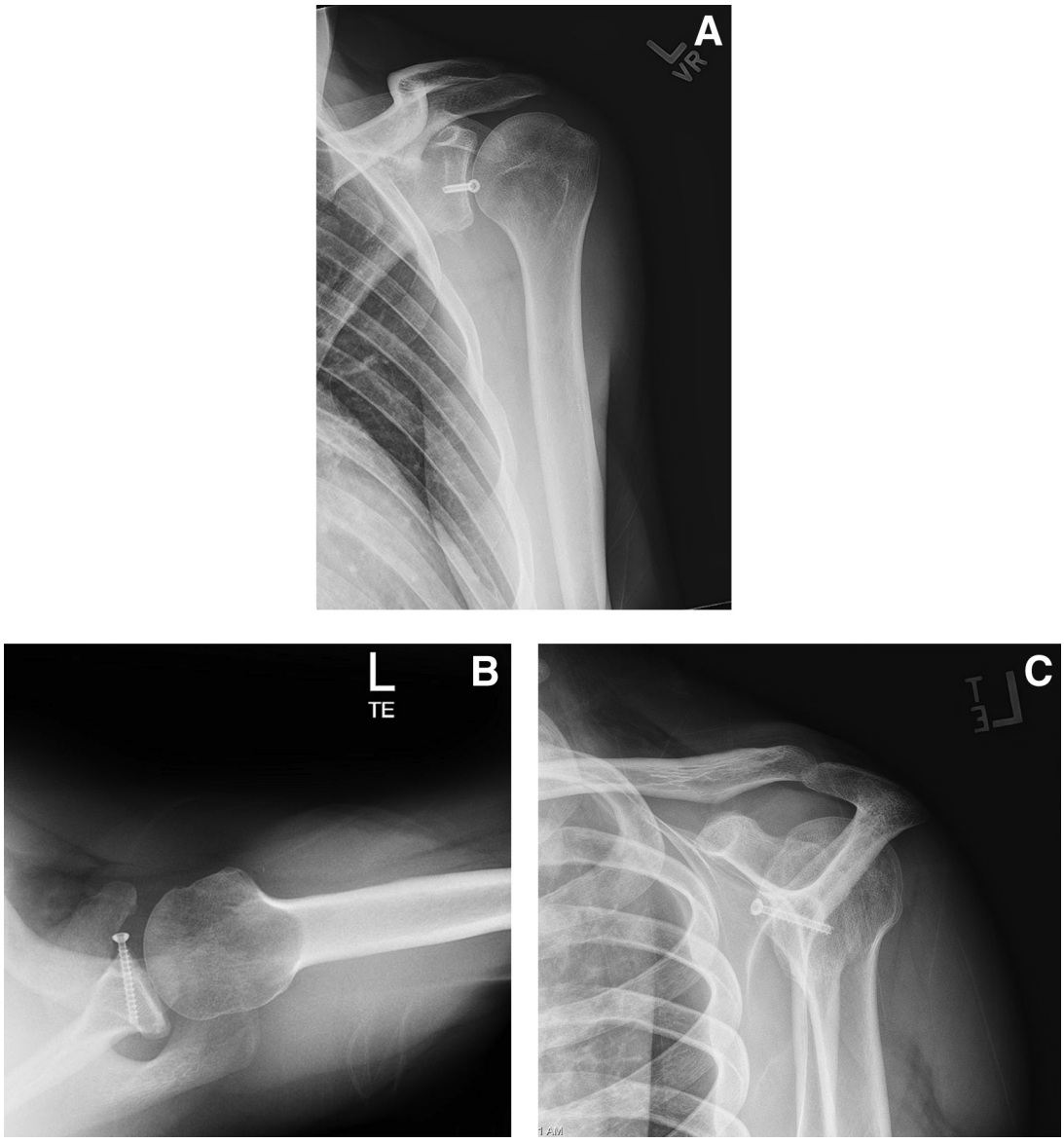

Fig 3. Postoperative (A) anteroposterior, (B) axillary, and (C) scapular-Y view radiographs showing anatomic reduction and stable fixation of the glenoid fracture.

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