Technical Note

Arthroscopic Technique for Headless Compression Screw Fixation of Large Bony Bankart Fractures in Anterior Shoulder Instability

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Abstract: A bony Bankart fracture is a common injury pattern in anterior shoulder instability. The fracture fragment size varies and the larger the fragment the more likely recurrent instability will occur. When a large bony Bankart fracture is present, surgical fixation is preferred. Both open and arthroscopic approaches exist with multiple fixation techniques including anterior-to-posterior screw fixation, suture anchor bridge fixation, and suture button fixation. Arthroscopic screw fixation is difficult, as the angle necessary to be parallel to the glenoid surface requires a far medial start point and places the nerve at risk. The use of a variable-pitch, headless compression screw placed from posterior to anterior avoids these risks. We describe an arthroscopic technique for glenoid fixation using a posterior-to-anterior, cannulated, variable-pitch headless compression screw for the treatment of an anterior BBF.

A bony Bankart fracture (BBF) occurs at the anterior-inferior rim of the glenoid during an anterior shoulder instability event.[1] This injury pattern is present in 22% of patients after an initial shoulder dislocation[2] and in up to 50% of patients after recurrent instability.[3] Fixing BBFs is preferred to avoid anterior glenoid bone loss, which is associated with recurrent instability at a threshold of 15% to 20% of the glenoid width.[4-7] If a BBF is treated nonoperatively, fragment resorption occurs in more than 50% of patients within 1 year. The smaller the BBF fragment, the greater the rate of resorption.[8]

Several surgical options exist to fix BBFs, including open reduction internal fixation, arthroscopic anterior-to-posterior screw fixation, arthroscopic suture anchor fixation termed the "bony Bankart bridge," and arthroscopic transosseous suture button fixation.[9-15] Open procedures have associated risks, including an increased risk of neurovascular injury, infection, and greater soft-tissue dissection compared with arthroscopic surgery.[16,17] Arthroscopic strategies generally involve suture anchor or button fixation because of the difficulty obtaining the correct trajectory for anterior-to-posterior screw fixation while avoiding neurovascular injury. Biomechanical studies suggest equivalent or greater movement with repetitive stress and lower load to failure with suture constructs compared with screw fixation.[18-20]

Variable-pitch headless compression screws are commonly used elsewhere in the body, such as the scaphoid, where it is difficult to obtain compression because of the fracture pattern and surrounding anatomy.[21] This screw has a finer pitch at the proximal end compared with the distal end of the screw, resulting in compression when placed across a fracture because of a greater distance traveled at the distal end with each turn.[22] In this Technical Note, we describe a technique for arthroscopic posterior-to-anterior, cannulated, variable-pitch headless compression screw fixation of a large anterior BBF. The aim is to detail the rationale and technical aspects of this procedure. The benefits of this technique include the use of a standard arthroscopic approach to obtain reduction and rigid fixation with compression while limiting the risk to the neurovascular structures inherent to screw placement from the front.

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Surgical Technique

Step 1: Preoperative Workup

Informed consent was obtained for this nonexperimental surgical innovation. The standard workup for glenohumeral instability includes a detailed history, physical examination, and radiographs (Fig 1). A large anterior inferior glenoid rim fracture is often visible on radiographs and should prompt computed tomography to evaluate the nature of the fracture fragment(s) and amount of glenoid involved (Fig 2). BBFs should be treated acutely to avoid fragment resorption, recurrent instability, and increased risk of nonunion associated with surgical fixation over 3 months after injury occurance.[8,23,24] One or two screws may be attempted, depending on the size and orientation of the fracture fragment.

Step 2: Surgical Positioning

After a general anesthetic is administered, an examination under anesthesia is completed. The patient is the positioned in the lateral decubitus position supported by a deflatable beanbag. The humeral head is translated laterally and placed in longitudinal traction using the 3-point shoulder distraction system (AR 1600M, STaR sleeve; Arthrex, Naples, FL). A large, slightly medialized, and superior posterior portal is established, and anterior-superior and midglenoid portals are placed under direct visualization in the rotator interval by an outside-in technique.[25] The posterior portal must be large enough to accommodate a transglenoid drill guide (Arthrex) and medial and superior enough to allow placement of the guide-hook across the glenoid face (Arthrex).

Step 3: Diagnostic Arthroscopy, Fracture, and Anterior Capsular Mobilization

Diagnostic arthroscopy is performed. Preoperative imaging is correlated with intraoperative findings, specifically the fracture characteristics including size, comminution, and medialization. While viewing from the anterior-superior portal, the fracture is mobilized using a 15° tissue elevator (Fig 3, Video 1). Small fragments are removed from the joint to avoid loose intra-articular bodies postoperatively. The main fracture fragment must be completely free from the medial glenoid neck for anatomic reduction at the articular surface. Radiofrequency ablation is used to subperiosteally dissect along the anterior border of the fracture fragment, medial to the labrum, without detaching the inferior glenohumeral ligament to allow adequate visualization anteriorly (Fig 4, Video 1).

Step 4: Fracture Reduction and Preliminary Fixation

A 5-mm transglenoid drill guide is placed through the posterior portal and hooked over the fracture fragment under arthroscopic visualization. The transglenoid drill guide is then tightened by advancing the double-barreled guide down to the posterior glenoid rim to hold the reduction (Fig 5, Video 1). Two 0.16-inch Kirshner wires (K-wires) are placed through the double-barreled guide to maintain the reduction. The medial-lateral depth is judged via arthroscopic visualization of the K-wire exit point on the anterior aspect of the fracture fragment (Fig 6, Video 1). If one screw is planned, the inferior K-wire should be placed in the middle of the fracture fragment in a superior-inferior orientation, and a superior K-wire placed temporarily

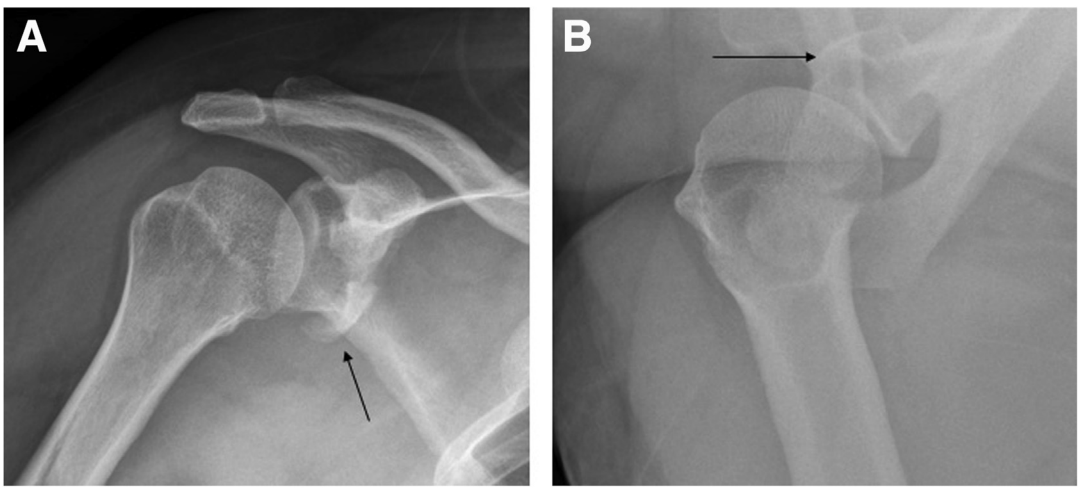

Fig 1. Preoperative workup includes orthogonal plain film radiographs. (A) Anterior-posterior radiograph of the right shoulder demonstrating a large, displaced, anterior inferior glenoid rim fracture (black arrow). (B) Axillary radiograph of the right shoulder demonstrating significant medialization of the displaced fracture fragment (black arrow).

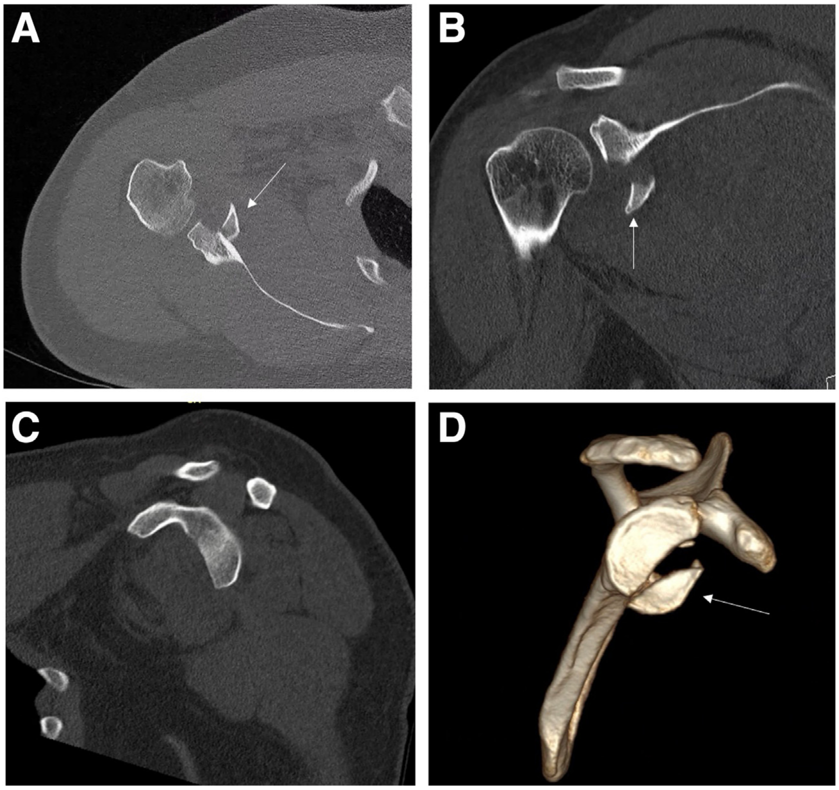

Fig 2. Advanced imaging includes a computed tomography (CT) scan to provide a detailed assessment of the fracture fragment(s) and amount of glenoid involved. (A) Select axial cut of a right shoulder CT demonstrating significant medialization of the major fracture fragment (white arrow). (B) Select coronal cut of a right shoulder CT demonstrating the extent of superior involvement of the glenoid rim fracture (white arrow). (C) Select sagittal cut of a right shoulder CT demonstrating 40% glenoid involvement. (D) Three-dimensional reconstruction of the right glenoid demonstrating one main displaced, anterior inferior fracture fragment (white arrow).

for rotational control while the single screw is advanced. Even if the fragment is too small for a second screw, a second one can be placed superior to the fragment and used to shuttle a suture through the cannulated screws for additional horizontal cerclage fixation.

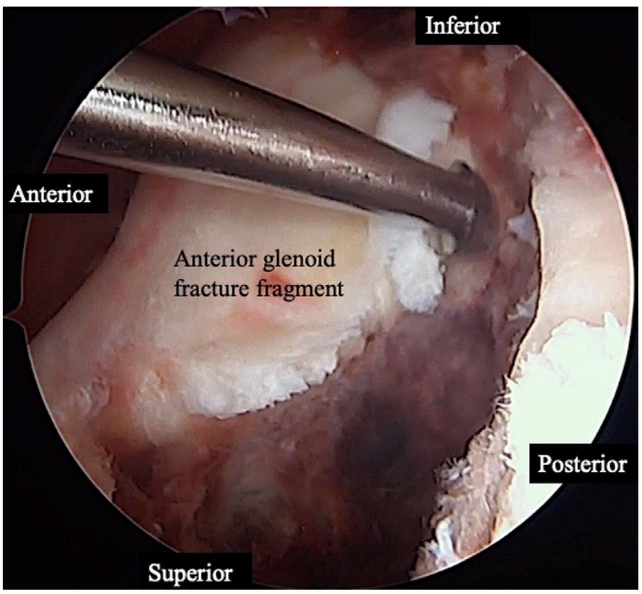

Fig 3. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating the mobilization of the glenoid fracture (labeled left) with associated labrum superiorly and inferiorly using a tissue elevator in the midglenoid portal.

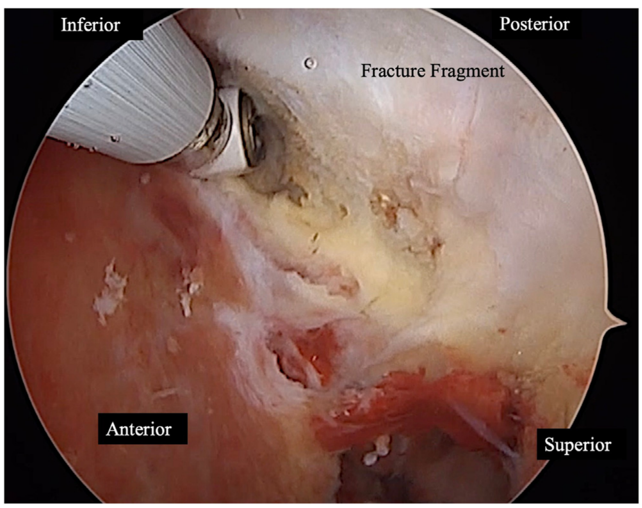

Fig 4. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating anterior subperiosteal dissection medial to the labrum without detaching the inferior glenohumeral ligament with radiofrequency ablation through the midglenoid portal to allow adequate visualization anteriorly.

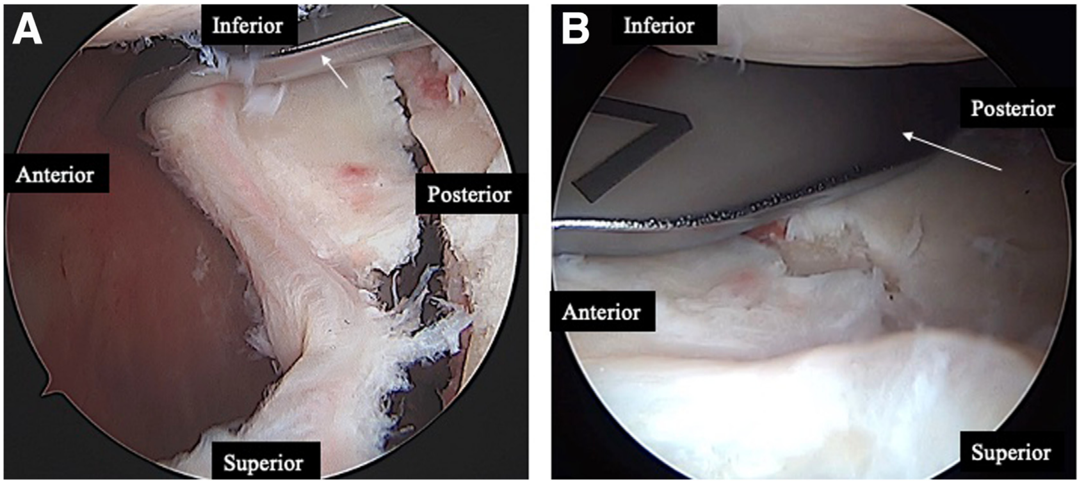

Fig 5. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating the reduction of the fracture fragment. (A) A 5-mm transglenoid drill guide (white arrow) is placed through the posterior portal and hooked over the anterior aspect of the fracture fragment under arthroscopic visualization to facilitate an anatomic reduction. (B) The transglenoid drill guide (white arrow) is then tightened by advancing the double-barreled guide down to the posterior glenoid rim to hold the reduction.

Step 5: Screw Fixation and Labral Restoration

The K-wires should be placed just through the anterior fragment cortex to facilitate screw length measurement by subtraction using a free K-wire of the same length. The K-wires are overdrilled with a 2.5-mm cannulated drill. A 3.5-mm variable pitch, headless compression screw (Arthrex) is then placed by hand while maintaining the reduction with the transglenoid guide. A grasper is placed through the midglenoid portal to stop the K-wire from advancing with the screw as it is inserted (Fig 7, Video 1). The screw tip may temporarily distract the anterior fracture fragment as it makes contact, but once the threads obtain purchase, the fracture fragment will reduce and compress. Avoid spinning the fracture fragment once the screw threads have obtained purchase by using the second K-wire to provide rotational control. An elevator through the midglenoid portal can provide further fragment stabilization while the screw is advanced (Fig 8, Video 1). The screw tip should be visualized at the anterior border of the fracture fragment before the K-wires are removed (Fig 9, Video 1). Suture anchors may be placed at the superior and inferior borders of the fracture fragment to repair the adjacent labrum and provide further rotational stability (Fig 10).

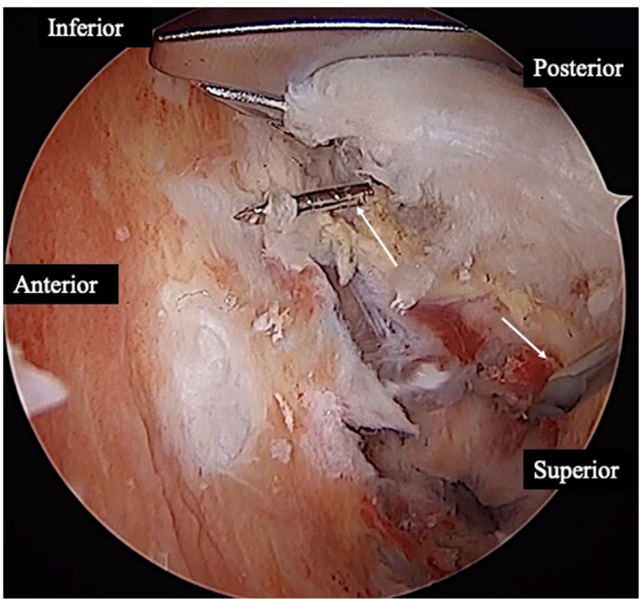

Fig 6. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating two 0.16-inch Kirshner wires (K-wires, white arrows) placed through the double-barreled guide to maintain the reduction, with care to position the K-wire at approximately the mid- medial-lateral depth of the anterior fracture fragment. The medial-lateral depth is judged via arthroscopic visualization of the K-wire exit point on the anterior aspect of the fracture fragment.

Step 6: Rehabilitation Protocol

A sling is worn for 6 weeks with passive pendulum exercises initiated immediately postoperatively, and progressive passive range of motion (ROM) at 3 weeks. Postoperative radiographs and computed tomography scan are completed to confirm appropriate reduction and fixation (Figs 11 and 12). ROM is restored at 8 weeks. If radiographs at that time confirm fracture healing, active ROM is initiated. Strengthening is added at 16 weeks and full return to activity is permitted at 6 months.

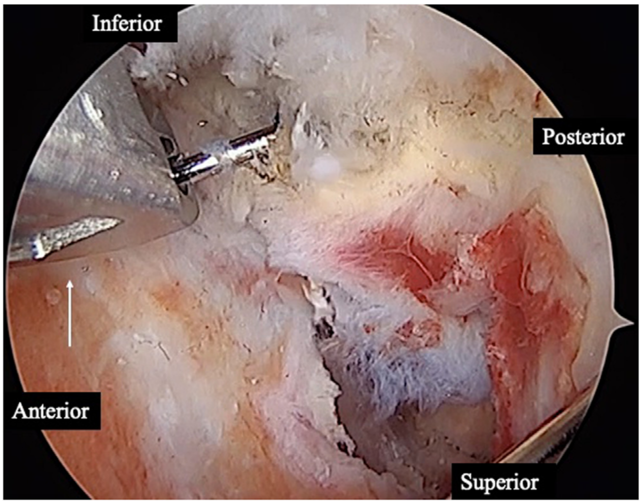

Fig 7. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating placement of a 3.5-mm variable pitch, headless compression screw (Arthrex) while a grasper (white arrow) through the midglenoid stops the Kirshner wire from advancing with the screw as it is inserted.

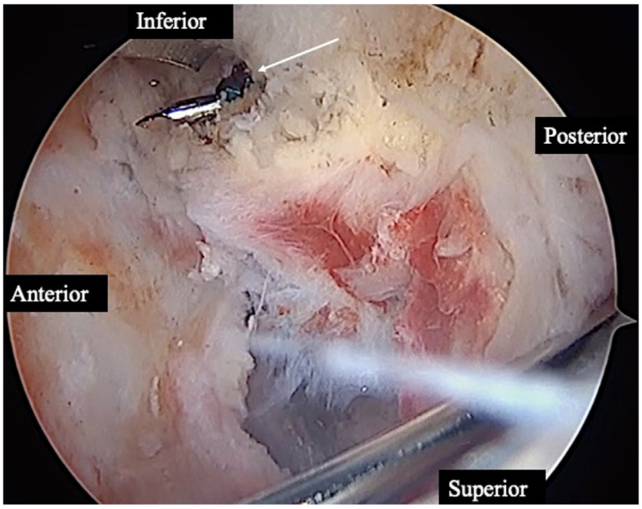

Fig 9. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating the screw tip (white arrow) past the anterior border of the fracture fragment before the K-wires are removed to ensure optimal fixation.

Discussion

Previous studies classify BBFs based on size.[13,26,27] Kim et al.[26] classify BBFs as small if they make up less than 12.5% of the glenoid width, medium if they are between 12.5% and 25%, and large if they make up more than 25% of the glenoid width. Nolte et al.[23] describe an algorithm for surgical management based on fragment size. For large BBFs, an open approach with cannulated screw fixation or arthroscopic double-row suture anchor repair, known as the "bony Bankart bridge" by Millett and Braun,[12] has been reported to have good clinical outcomes in previous studies.[13,28,29] Posterior-placed variable-pitch screws may provide superior bony compression compared with suture fixation, but further studies are needed.

This report describes the rationale, technique, and limitations of arthroscopic management of large

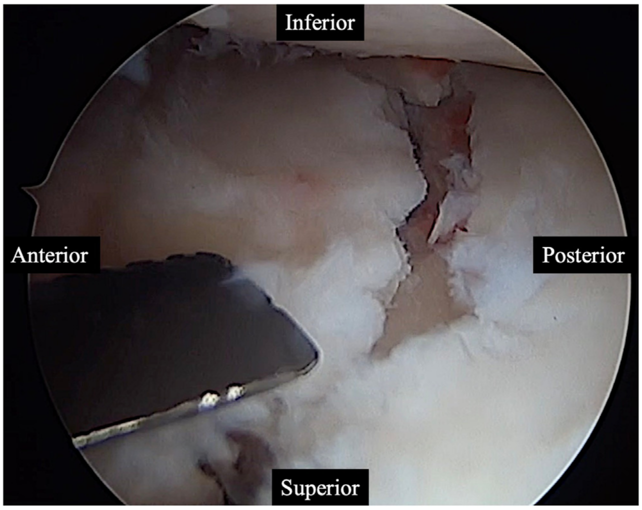

Fig 8. View from the anterosuperior portal of a right shoulder in the lateral decubitus position demonstrating maintenance of the reduction while the screw is progressed. Comminution of the articular cartilage may result in cartilage loss and visible subchondral bone at the fracture edge. In this case, the superior and inferior fracture ends aid the reduction assessment.

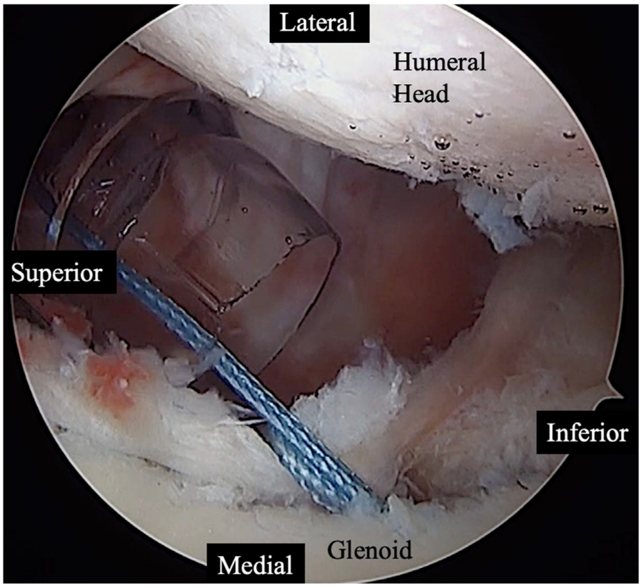

Fig 10. View from the posterior portal of a right shoulder in the lateral decubitus position demonstrating repair of the anterior labrum and the superior aspect of the fixed bony Bankart fracture with a knotless 1.8-mm FiberTak (Arthrex) suture anchor.

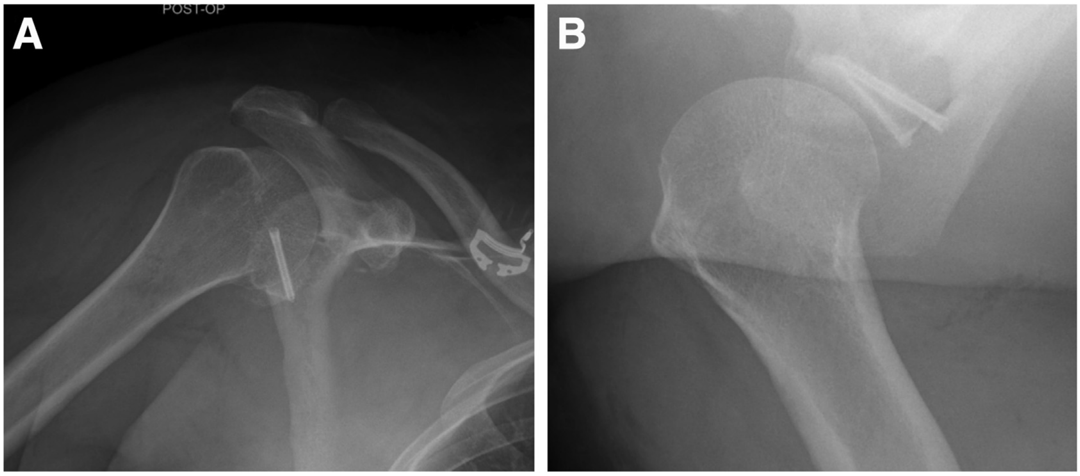

Fig 11. Postoperative plain film radiographs to assess reduction and fixation. (A) Anterior posterior radiograph of the right shoulder demonstrating satisfactory reduction and screw fixation. (B) Axillary radiograph of the right shoulder demonstrating satisfactory reduction and screw fixation.

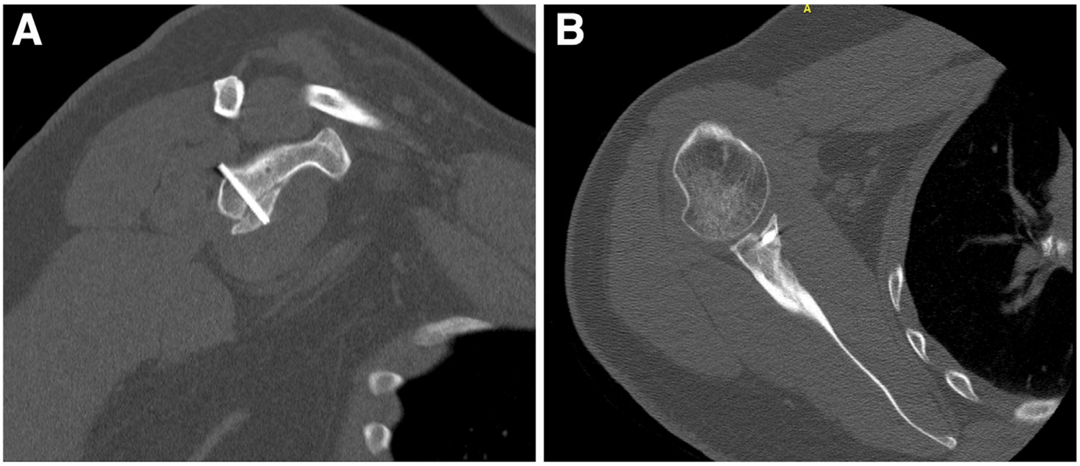

Fig 12. Postoperative computed tomography (CT) scan to confirm reduction and fixation. (A) Sagittal-cut CT scan of a right shoulder demonstrating appropriate reduction and screw placement. (B) Axial-cut CT scan of a right shoulder redemonstrating appropriate reduction and screw fixation.

BBFs with posterior-to-anterior, cannulated, variable-pitch headless compression screw fixation (Table 1). Benefits of the reported technique include rigid bony fixation with compression to facilitate primary bone healing with minimal associated soft-tissue morbidity while minimizing the risk of neurovascular injury inherent to placing screws from anterior (Table 2). Limitations include the potential for an increased learning curve, risk of intraoperative BBF fragmentation, postoperative fragment osteolysis, and symptomatic hardware. Biomechanical studies are needed to assess the rigidity of compression with a variable-pitch headless compression screw in the setting of anterior shoulder instability. Long-term studies are needed to analyze the clinical outcomes and adverse events of the reported technique for BBF fixation.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: J.M.T. reports a relationship with Arthrex and DePuy Synthes Mitek Sports Medicine that includes consulting or advisory. J.M.T. is also on the board of the Arthroscopy Association of North America, Presidential line. All other authors (A.J.H. and S.V.T.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 1. Pearls and Pitfalls of Arthroscopic Posterior-to-Anterior Cannulated Variable-Pitch Screw Fixation for Bony Bankart Fracture in Shoulder Instability

Pearls	Pitfalls
Wide exposure and removal of nonstructural articular and bony fragments.	Inadequate exposure and failure to remove small fragments will make subsequent reduction and fixation difficult and could result in further articular damage postoperatively due to free intra-articular bodies.
Large, medial, and superior posterior portal to facilitate transglenoid guide placement.	Attempting single-screw fixation in small BBF or multiple screw fixation in a medium BBF
Subperiosteal dissection of the anterior aspect of the fracture fragment with radiofrequency ablation to facilitate arthroscopic visualization of K-wire and subsequent screw placement.	Lack of attention to fracture fragment distraction as screw is advanced may result in loss of reduction.
A second K-wire should be placed for rotational control of the fragment even if only one screw is planned.	Failure to obtain 2 points of fixation in the fragment even if only temporizing may result in rotation of the fragment during screw advancement.
Placement of a second screw, even if superior to the fragment, allows passage of suture for horizontal cerclage around fragment	

BBF, bony Bankart fracture; K-wire, Kirshner wire.

Table 2. Advantages and Disadvantages of Common Fixation Strategies for Bony Bankart Fractures

	Advantages	Disadvantages
Open reduction, anterior-to-posterior screw fixation	No arthroscopic proficiency necessary, rigid fixation for primary bone healing.	Exposure technically difficult in well-muscled individuals, infection risk, neurovascular injury risk, osteolysis risk.
Arthroscopic suture-button fixation	Low infection risk, less soft-tissue morbidity, 2 buttons often possible.	Biomechanically potentially inferior to screw or cerclage fixation.
Arthroscopic “bony Bankart Bridge”	Low infection risk, less soft-tissue morbidity, biomechanically superior to suture buttons.	Less-rigid fixation compared with screws, suture on glenoid articular surface if cartilage preserved.
Arthroscopic posterior-to-anterior screw fixation	Low infection risk, less soft-tissue morbidity, rigid fixation with compression for primary bone healing.	Technically challenging to place 2 screws.

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