



# Arthroscopic Removal of Extra-Articular Foreign Bodies From the Shoulder: Inside-Out Technique

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**Abstract:** Arthroscopic shoulder surgery can be performed for retrieval of bullets and retained metallic fragments in the glenohumeral and subacromial spaces. Previous case reports and case series have demonstrated the effectiveness of an arthroscopic approach over an open procedure, as it is less invasive, allows for improved inspection and documentation of the joint surfaces and periarticular structures, and potentially leads to a faster recovery. An arthroscopic approach for extracting foreign bodies from both the quadrilateral space and the posterior extra-articular space by first accessing the glenohumeral space has yet to be described. This inside-out technique may afford surgeons the potential for improved visualization and less morbidity compared with a traditional open posterior approach. We report a technique for an arthroscopic inside-out approach for removal of extra-articular foreign bodies retained in either the quadrilateral space or the posterior extra-articular space.

Retrieval of intra-articular and extra-articular bullets and metallic fragments is recommended due to the potential for lead toxicity (intra-articular), chondrolysis and mechanical abrasion from third-body wear, and irritation of adjacent anatomic structures.<sup>1-6</sup> Previous case reports and case series have identified the advantages of an arthroscopic approach for removal of bullets in the glenohumeral and

subacromial space, including less surgical morbidity, improved visualization of adjacent articular structures, and potentially a faster recovery than an open shoulder procedure.<sup>1,2,5,7</sup> We report a technique for an arthroscopic inside-out approach for removal of extra-articular foreign bodies retained in either the quadrilateral space or the posterior extra-articular space. Informed consent was obtained from the patients in the figures and video included in this manuscript.

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*The authors report the following potential conflicts of interest or sources of funding: G.G. reports royalties or licenses and consulting fees from Tigon Medical Inc. S.A.P reports consulting fees from Arthrex and Exactech. Full ICMJE author disclosure forms are available for this article online, as supplementary material.*

*The views expressed are those of the authors and do not reflect the official policy of the Department of the Army, the Department of Defense, or the U.S. Government. The investigators have adhered to the policies for protection of human subjects as prescribed in 45 CFR 46.*

*Received December 30, 2022; accepted February 25, 2023.*

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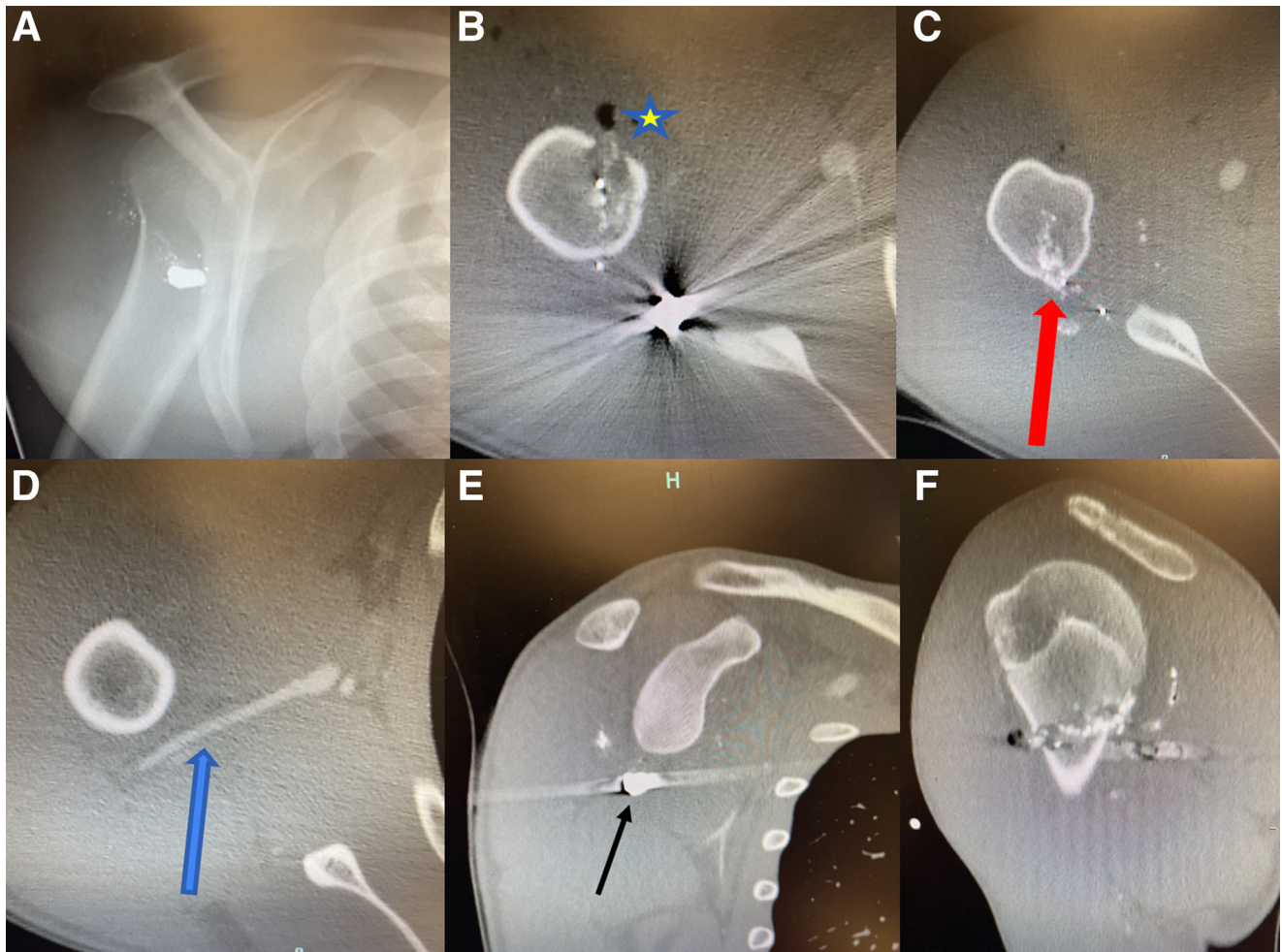
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*2212-6287/221705*

*<https://doi.org/10.1016/j.eats.2023.02.049>*

## Patient Evaluation, Imaging, and Indications

Patients who present with gunshot wounds to the upper extremity with retained metallic fragments around the shoulder should undergo a thorough history and physical examination with documentation of neurovascular status. Standard radiographs are indicated to evaluate for fractures and the approximate location of retained metallic fragments (Fig 1A). A computed tomography scan is helpful to document the exact location of retained metallic fragments (Fig 1B-F). The indications for bullet removal include retained metallic fragments in the glenohumeral joint as well as fragments that are adjacent to anatomic structures that could lead to mechanical abrasion with resultant pain, shoulder dysfunction, or neurovascular compromise.



**Fig 1.** (A) Right shoulder scapular-Y radiograph demonstrating a retained bullet in the region just inferior to the glenoid. (B) Axial CT sequence demonstrating bullet in the axillary region; yellow star denotes the track of the bullet through the anterior cortex of the proximal humerus. (C) Axial CT image of the posterior proximal humerus cortical defect at the site of the bullet exit point. (D) Axial CT image of the posterior humeral circumflex artery traversing just distal to the location of the bullet. (E) Sagittal CT image demonstrating the bullet in the quadrilateral space. (F) Coronal CT image of the bullet traversing the proximal humerus from anterior to posterior. (CT, computed tomography.)

## Surgical Technique (With Video Illustration)

### Quadrilateral Space Foreign Body Removal

#### Step 1: Setup and Patient Positioning

The procedure is performed in the lateral decubitus position, which is our preference in cases in which the foreign body is either in the axillary pouch or the quadrilateral space. Lateral positioning facilitates access and visualization of the inferior glenoid and capsule in the axillary pouch. After general anesthesia, the patient is positioned on a peg board or bean bag, an axillary roll is placed, and all bony prominences are well padded. A shoulder examination under anesthesia is then completed and the operative arm sterilized and draped in the standard fashion. The operative arm is then placed in an articulating arm holder (SPIDER2 Limb

Positioner; Smith & Nephew, Andover, MA) for the purpose of traction and lateral translation of the humerus (Fig 2).

#### Step 2: Portal Placement and Diagnostic Arthroscopy

A diagnostic arthroscopy is performed with use of a standard posterior viewing portal, 2 cm inferior and 1 cm medial to the posterolateral corner of the acromion. The anterior working portal is established in the rotator interval with the aid of a spinal needle under direct visualization. The portal is dilated and a 5-mm cannula is placed. Any retained metallic fragments in the joint are debrided with a motorized arthroscopic shaver (DePuy Mitek, Raynham, MA). The shaver is also used to debride any damaged synovium and articular surface cartilage.



**Fig 2.** Intraoperative photo of a patient positioned in the lateral decubitus with the SPIDER2 limb positioner for the purpose of removing a retained bullet in the quadrilateral space for this right shoulder.

### Step 3: Arthroscopic Removal of Extra-Articular Bullet

Using blunt dissection and a radiofrequency ablator (DePuy Mitek), the capsular rent is exploited to better expose the location of the bullet in the quadrilateral

space ([Video 1](#)). Next, the bullet is atraumatically grasped through the standard posterior portal and removed under direct visualization. If an inferior capsular rent is not apparent, the radiofrequency ablator is used to make a capsulotomy adjacent to the inferior labrum at the approximate location of the bullet. Then, blunt dissection and graspers are used to remove the retained metallic fragment under direct visualization.

### Posterior Extra-Articular Space Foreign Body Removal

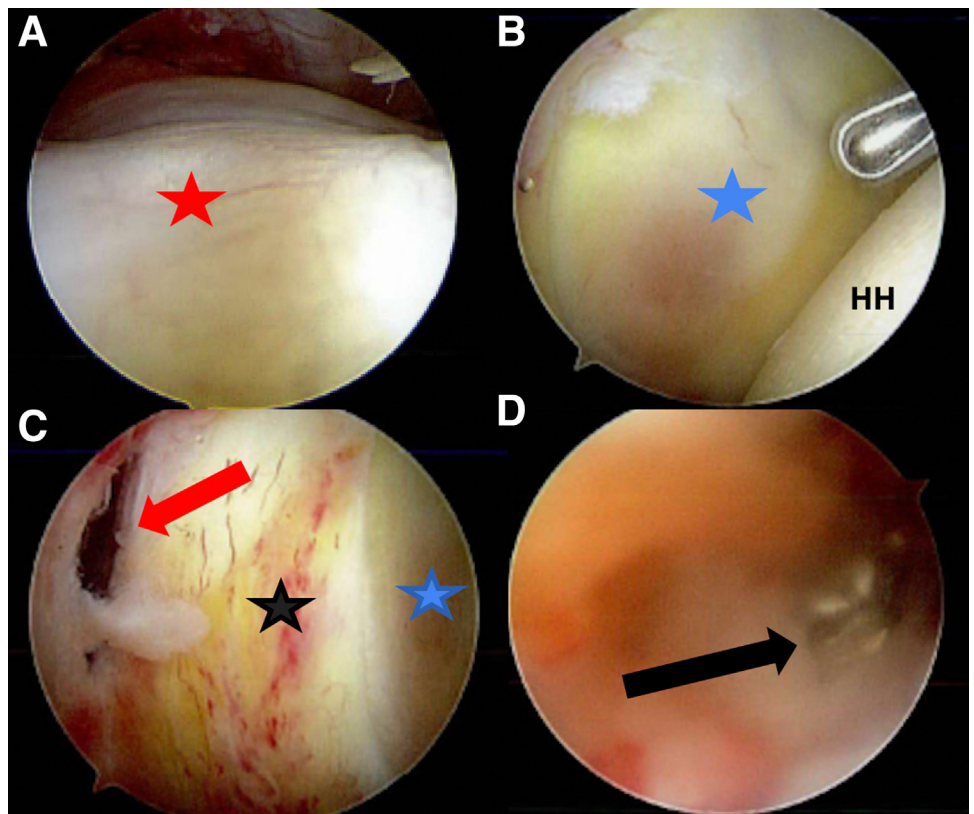
#### Step 1: Setup and Patient Positioning

In cases in which the foreign body is either in the subacromial space, or in a posterior extra-articular location, it is our preference to position the patient in the beach chair with an articulating arm holder (TRIMANO; Arthrex, Naples, FL).

#### Step 2: Portal Placement and Diagnostic Arthroscopy

First, the arthroscope (Arthrex) is inserted through a posterolateral portal into the subacromial space ([Fig 3A](#)). An arthroscopic bursectomy is conducted to provide additional visibility and confirmation that the bullet is not retained in this space. Next, the glenohumeral joint is accessed through a standard posterior portal ([Fig 3B](#)). A direct anterior portal is established in

**Fig 3.** (A) Viewing from the lateral subacromial portal. Arthroscopic photo of the subacromial space for a right shoulder (red star: bursal side of the posterior superior rotator cuff). (B) Arthroscopic photo of this right shoulder with no damage to the glenohumeral articular cartilage (blue star: glenoid). (C) Viewing from the anterior superior portal with the 70° arthroscope. Arthroscopic photo of the right shoulder demonstrating a rent in the posterior superior glenohumeral capsule where a bullet entered (red arrow) (blue star: glenoid; black star: posterior capsulolabrum). (D) Arthroscopic photo taken with the 70° arthroscope visualizing the retained bullet in the posterior extracapsular space. (HH, humeral head.)



**Table 1.** Advantages/Disadvantages

Advantages of arthroscopic removal
Minimally invasive
Allows documentation and management of adjacent articular structures.
Disadvantages
Technical difficulty
Potential for damage to the axillary nerve in the quadrilateral space if visualization and exposure are not optimal

the rotator interval. An anterolateral viewing portal is created with an outside-in technique allowing for the insertion of a 70° arthroscope (Arthrex). This facilitates visualization of the posterior extra-articular space, which can be accessed through a rent in the posterior capsule and fascia.

### Step 3: Arthroscopic Removal of Extra-Articular Bullet

Using blunt dissection and an arthroscopic grasper (Arthrex), a rent in the posterior fascia is exploited to allow for better visualization of the bullet (Fig 3 C and D). Subsequently, the bullet is atraumatically grasped through the posterior portal and removed in its entirety from the posterior extra-articular space. After bullet removal, any loose debris are removed from the glenohumeral joint.

## Discussion

This Technical Note demonstrates an arthroscopic approach for the removal of pericapsular foreign bodies in the quadrilateral space and posterior extra-articular space. This inside-out technique highlights the feasibility and safety of the procedure, importance of patient positioning, and advantages over a traditional open posterior approach to the shoulder (Table 1). This includes improved visualization and decreased morbidity.

Extracapsular arthroscopic access to the inferior glenohumeral joint in close proximity to the axillary nerve is rarely indicated. Millet et al. examined the surgical outcomes of 29 young, active patients (30 shoulders) with symptomatic glenohumeral arthritis undergoing the so-called comprehensive arthroscopic management procedure, which includes axillary nerve neurolysis. This procedure can be performed in either the beach-chair or lateral decubitus position, and there are advantages and disadvantages for both.<sup>8-13</sup> The lateral

**Table 2.** Pearls/Pitfalls

Pearls
Lateral decubitus position may provide optimal access to the axillary pouch and the quadrilateral space
Use a radiofrequency ablator oriented away from the axillary nerve to exploit a capsular rent or release the inferior capsule to expose the quadrilateral space
Pitfalls
Lateral decubitus position may be more challenging if conversion to open procedure is needed

decubitus position affords adequate access and exposure of the inferior glenoid and axillary pouch in the management of young patients with shoulder instability. However, this procedure could also be performed in the beach-chair position, and surgeons should position the patient based on their preference and training. The advantage of using this approach to access the foreign body in the quadrilateral space is demonstrated in Video 1, guided by preoperative planning with advanced imaging (Table 2). In contrast, for access to the posterior extra-articular space, the lateral decubitus or beach-chair position is appropriate. It is our preference to use the beach-chair position for cases involving accessing the subacromial space or posterior extracapsular space.

Although in the quadrilateral foreign body removal procedure presented, there was the advantage of a capsular rent from where metallic fragments entered the joint, this procedure is possible without that present and would have required a small inferior capsular release to identify the foreign body.

In conclusion, an arthroscopic inside-out technique for extracting foreign bodies from both the quadrilateral space and the posterior extra-articular space is safe, feasible, and less morbid than a traditional open posterior approach. Patient positioning is crucial to improve visualization in these select rare cases. Surgeons should use the positioning with which they are most comfortable and that allows optimal access to axillary pouch and posterior extra-articular space.

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