Ultrasound-Assisted Posteromedial Portal Placement of the Elbow Joint to Prevent Ulnar Nerve Injury

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Abstract: Direct posterior and posterolateral portals are the standard portals used in posterior elbow arthroscopy. A posteromedial portal in the elbow is not recommended because of its proximity to the ulnar nerve. However, iatrogenic injuries to the ulnar nerve have been reported after elbow arthroscopy using the standard posterior portals, especially in posteromedial elbow joint pathologies. We present a surgical technique applicable to posteromedial elbow pathology by using ultrasound-assisted posteromedial portal placement of the elbow joint. Through this technique, the position of the ulnar nerve is identified prior to portal creation and the instruments are introduced from an ulnar to radial direction, thus avoiding ulnar nerve injury.

In posterior elbow arthroscopy, direct posterior and posterolateral portals are the standard portals used.[1-4] A posteromedial (PM) portal is not recommended because it lies close to the ulnar nerve.[5,6] Creation of a PM portal is only a relative recommendation when the ulnar nerve has been previously transposed anteriorly.[7] However, ulnar nerve injuries have been reported after posterior elbow arthroscopy using the standard posterior portals.[8-10]

One of the common causes of nerve injuries during elbow arthroscopy is direct trauma. Direct trauma can happen during portal placement or manipulation of instruments in the joint during the procedure.[3,5,11,12] In particular, elbow pathologies involving the PM compartment are susceptible to direct trauma to the ulnar nerve during arthroscopy. Medial deviation of instruments toward the cubital tunnel or just proximal to it may compress the ulnar nerve against the medial epicondyle.[11,13] Complete transection of the ulnar nerve may occur during PM debridement and capsular penetration.[8-10]

The purpose of this manuscript is to present our technique on ultrasound-assisted PM portal placement of the elbow joint to prevent ulnar nerve injury (Video 1). This technique may help the surgeon safely access the PM elbow compartment in PM elbow pathologies indicated for arthroscopic surgery.

Surgical Technique

General anesthesia is administered to the patient. Regional anesthesia is not recommended because any nerve deficit of the operated extremity in the

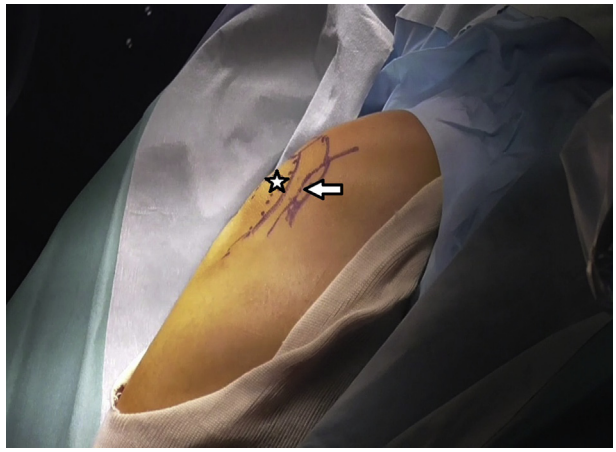

Fig 1. This image shows the surgical outline of the posteromedial side of the left elbow showing the olecranon tip (star) and the ulnar nerve (arrow).

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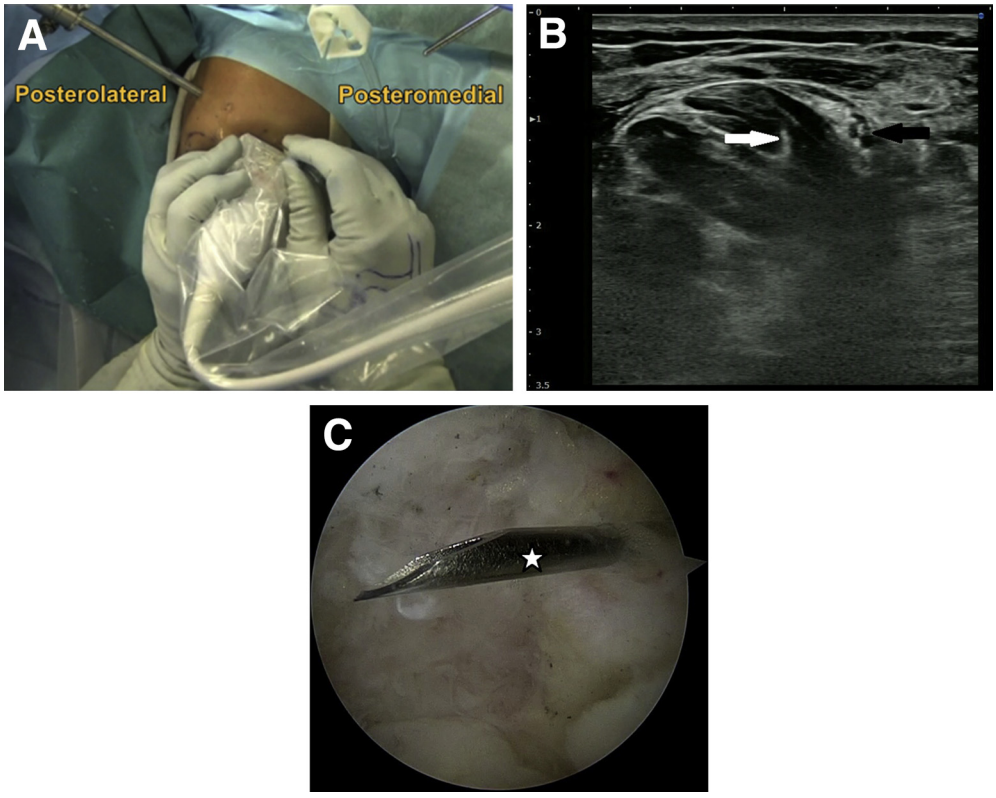

Fig 2. Simultaneous pictures of the initial steps in ultrasound-assisted posteromedial portal placement. (A) Top view image of the left posterior elbow joint with the patient in prone position. A linear probe is held to view the short axis of the ulnar nerve. A pilot needle is slowly inserted inside the posteromedial elbow joint radial to the viewed ulnar nerve. (B) Short-axis real-time ultrasound image of the ulnar nerve (black arrow) and pilot needle (white arrow). The needle is inserted into the posteromedial elbow joint. (C) Corresponding arthroscopic image taken from the posterolateral viewing portal, showing insertion of the pilot needle (star) into the posteromedial elbow joint as a guide to create the posteromedial portal.

immediate postoperative period will not be promptly recognized. The patient is positioned prone with a bump placed anterior to the arm. After sterile preparation, surgical landmarks are outlined noting the location of the radial head, capitellum, olecranon tip, olecranon fossa, and the ulnar nerve (Fig 1).

After tourniquet application, the elbow joint is insufflated with 20 mL of saline using an 18-gauge needle in the soft spot portal or direct posterior portal. After performing all necessary procedures in the anterior joint space, we proceed to posterior joint arthroscopy. It is at this point that we make our PM portal along with the direct posterior and posterolateral portals in cases with PM pathology.

Using the SONIMAGE HS1 ultrasound machine with a 4- to 18-MHz linear probe (Konica Minolta, Tokyo, Japan), short-axis and long-axis images of the ulnar nerve are visualized. Based on the short-axis

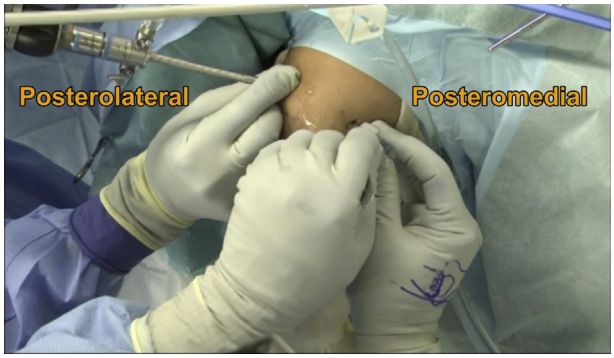

Fig 3. Top view image of the left elbow with the patient in a prone position. The image shows how a vertical incision down to the level of the joint is made close to the pilot needle to create the posteromedial portal of the elbow joint.

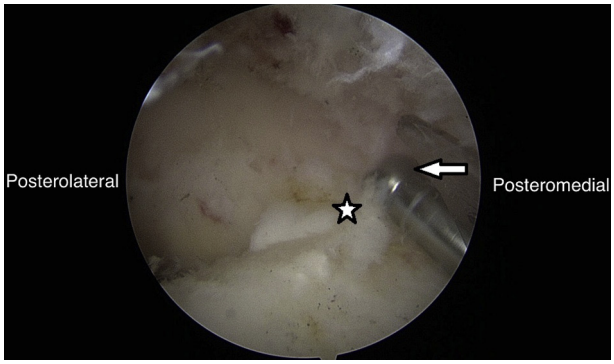

Fig 4. Arthroscopic image of the posteromedial joint in a left elbow viewed from the posterolateral portal. The posteromedial portal is used as the working portal. The posteromedial corner of the olecranon is safely accessed through the posteromedial portal without bumping into the ulnar nerve. The osteophyte at the posteromedial corner of the olecranon (star) is carefully burred in a medial to lateral direction. The tooth of the burr is oriented radially away from the medial gutter of the elbow (arrow).

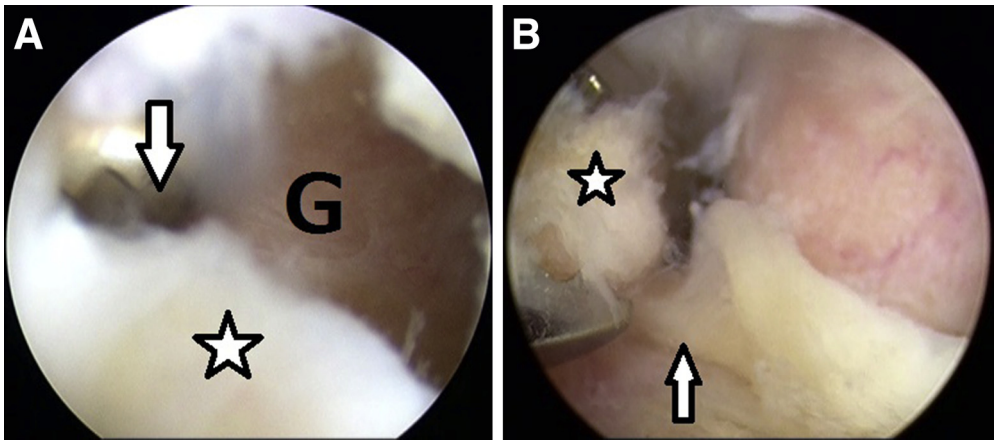

Fig 5. Arthroscopic image of the posteromedial joint in a right elbow viewed from the posterior portal. The posteromedial portal is used as the working portal. (A) The posteromedial loose fragment of the olecranon (star) is being released with a shaver (arrow) inserted from the posteromedial portal. The ulnar groove (G) is in close proximity. (B) A grasper is then used to remove the loose fragment (star) from the medial side of the olecranon tip (arrow).

image, a 22-gauge needle is inserted into the radial side of the ulnar nerve by a perpendicular approach (Fig 2 A and B). Insertion of this pilot needle in the PM portal is also monitored using the posterolateral viewing portal (Fig 2C). A skin incision is made close to the pilot needle and then deepened to the level of the capsule (Fig 3).

Next, a slotted cannula (Arthrex Japan, Tokyo, Japan) is inserted into the PM portal in a medial to lateral direction directed toward the olecranon fossa. A handheld shaver (Arthrex Japan) with a Torpedo shaver blade (Arthrex Japan) and a ClearCut Burr (Arthrex Japan) is then safely shuttled inside the PM portal. The teeth of the shaver or burr should be facing

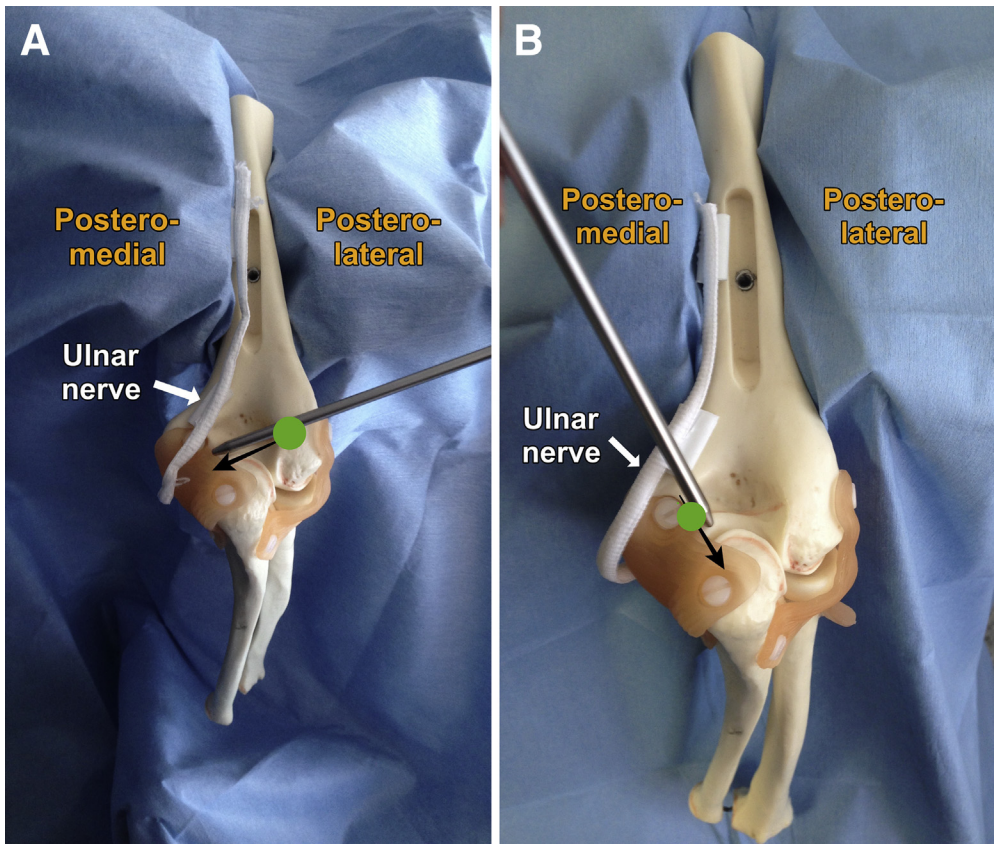

Fig 6. (A, B) Elbow models viewed posteriorly and depicting the differences in the angle of approach (black arrow) between the posterolateral portal and the posteromedial portal (green circle). (A) There is a high risk of damaging the nerve when approaching the posteromedial space from the posterolateral portal. (B) Angle of approach when using the posteromedial portal. Instruments are introduced from medial to lateral inside the joint, thus deviating away from the ulnar nerve.

Table 1. Advantages and Disadvantages of Ultrasound-Assisted Posteromedial Portal Placement of the Elbow Joint

Advantages	Disadvantages
No radiation exposure	Requires high-frequency ultrasound device
Confirms presence or absence of ulnar nerve subluxation or dislocation (provides precautionary measures during posteromedial portal placement)	Operator dependent
Provides visualization of needle and confirmation of its distance from the ulnar nerve (prior to portal placement)	Increases operative time
Provides real-time imaging of the ulnar nerve during posteromedial portal placement (thus avoiding iatrogenic injury)	Steep learning curve

toward the radial side of the elbow away from the ulnar nerve, which lies on the medial side (Fig 4).

Figure 5 are images from a different case with a posteromedial loose fragment of the olecranon tip. Figure 5A shows the fragment being released from surrounding scar tissue using a shaver inserted from the posteromedial portal, and Figure 5B shows the loose fragment being removed with a grasper (Arthrex Japan) from the posteromedial portal.

Final inspection is done through all areas of the posterior elbow joint to verify that no loose body or spur is left. After drainage of infused saline, the portals are thoroughly irrigated and closed with no. 3-0 nylon using a horizontal mattress suture. Compressive sterile dressing with bandage is applied on the elbow. In the immediate postoperative period, motor and sensory evaluation of the ulnar nerve can be performed (Video 1).

Discussion

As previously stated, direct trauma is one of the causes of nerve injury in elbow arthroscopy. Direct trauma to the nerve occurs in two phases during elbow arthroscopy: portal placement and manipulation of instruments inside the elbow joint. Using standard posterior portals in elbow arthroscopy cases with PM lesions has a tendency to cause injury to the ulnar nerve. Previous studies have noted that manipulation of instruments that deviate medially in the posterior elbow compresses the ulnar nerve against the medial epicondyle or may injure it.[11,13] Our technique enables us to use a medial to lateral angle of approach of introducing and manipulating instruments in the posterior elbow, solving this problem (Fig 6).

However, to change this lateral to medial angle of approach means creating a PM portal to achieve a medial to lateral angle of approach. Placement of this new portal is close to the ulnar nerve, which may injure the nerve during portal creation. To address this problem, an ultrasound can be used, because a guide for safe portal placement is in our technique.

Ultrasound-assisted PM portal placement has become vital in providing an effective and safe method of achieving the following: (1) identifying the position of the ulnar nerve adjacent to the prospective PM portal site; (2) confirming the absence of ulnar nerve instability through dynamic scanning; and (3) providing real-time imaging of the ulnar nerve during PM portal placement. Intraoperative use of ultrasound is not new in arthroscopy. It has been used in several arthroscopic techniques for shoulder, hip, foot, and carpal tunnel.[14-17]

Table 1 lists the advantages and disadvantages of our technique. Table 2 shows the additional safety measures used in our technique. These safety measures were adopted from the recommendations of available elbow arthroscopy literatures.[4,18-20]

We find the use of ultrasound-assisted PM portal placement in the elbow joint effective and safe for elbow arthroscopy in cases with PM lesions. It ensures safe location of the PM portal, which enables the instruments to be introduced in an ulnar to radial angle, preventing ulnar nerve injury.

Table 2. Ancillary Safety Measures of Ultrasound-Guided Posteromedial Portal Placement

- Outline anatomic landmarks before joint distention
- Use a pilot needle to define the point of posteromedial portal incision
- Visualize pin insertion under both ultrasound and arthroscopy
- Introduce instruments with caution in the posteromedial portal
  - Angle of approach is from medial to lateral direction toward the olecranon fossa
  - The teeth of the shaver or burr should be facing away from the ulnar nerve and medial gutter
- Exercise cautious debridement
  - Avoid using suction as it may draw the capsule and ulnar nerve into the working field
  - Clearing the working space improves visualization of the posteromedial compartment

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