

Basics of Elbow Arthroscopy: Setup, Portals, and Technique

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Summary: Elbow arthroscopy remains a technically demanding procedure requiring a thorough understanding of the pertinent local anatomy. Arthroscopy of the elbow is currently an area of rapid innovation. Improvements in equipment, techniques, and anatomic understanding will lead to an inevitable increase in both diagnostic and therapeutic applications. **Key Words:** Elbow arthroscopy—Elbow positioning—Instrumentation—Elbow to portal placement—Operative techniques.

The elbow was once described as “unsuitable for examination” during initial attempts at elbow arthroscopy by Dr. Michael S. Burman in 1931, the father of elbow arthroscopy in the English medical literature. He stated that “The anterior puncture of the elbow is out of the question and the posterior puncture poor for our purposes.”⁵ He revised his opinion 1 year later and added the elbow to his list of “joints which can be visualized with an arthroscope.”⁶

The list of indications for arthroscopy of the elbow has grown steadily over the past 25 years. Although this remains a comparatively uncommon procedure for the general orthopedist, current equipment, techniques, and increasing clinical experience have made elbow arthroscopy a safe and effective tool for diagnosis and treatment of intra-articular problems. Arthroscopic experience and an exacting knowledge of the neurovascular anatomy of the elbow are prerequisites to establish a safe and reproducible surgical technique.

PREOPERATIVE EVALUATION

A complete history and thorough physical examination are performed. An evaluation of the ulnar nerve and its position in its groove preoperatively is verified.¹ All radiographs that include the anteroposterior or lateral and cubital

tunnel view (axial) are reviewed. The indications for surgery, risks, and benefits are reviewed with the patient.

ANESTHESIA

General anesthesia is the most common type of anesthetic used when performing arthroscopy of the elbow. It minimizes patient discomfort and apprehension, and allows for total muscle relaxation. Regional anesthesia may be used with an interscalene, axillary, or Bier block. Regional anesthesia has the disadvantage of not allowing an immediate postoperative evaluation of the neurovascular status of the limb. In the patient with regional anesthesia who is positioned prone, repositioning is required if the regional block fails and intubation is required. Local anesthesia has also been advocated, but its use remains limited.

PATIENT POSITIONING

The position of the patient on the operating table during elbow arthroscopy varies according to surgeon training and preference, and, at times, according to the nature and location of the intra-articular disease. Three positions are commonly used.

The supine position has been well described by Andrews³ and others. Hempfling¹⁰ first described and Poehling¹⁹ later popularized the prone position. We have used the recently described lateral decubitus position.¹⁵

Whichever position is used, the surgeon must have access to the entire elbow region with the ability to convert to an open procedure at any time. Positioning should permit the elbow to be in 90 degrees of flexion,

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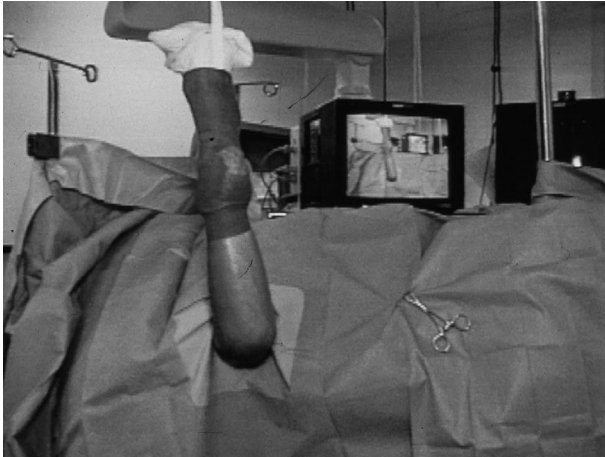


FIG. 1. The supine position with a traction apparatus attached to the arm. The elbow must be flexed to 90 degrees. (Copyright Kevin D. Plancher, M.D.)

minimizing intra-articular pressure.¹⁷ Extension of the elbow is required to maximize exposure to the posterior compartment. The advantages and disadvantages of each position are discussed below.

Supine

In the supine position the shoulder is abducted to 90 degrees of flexion to facilitate safe portal placement and joint examination (Fig. 1). An arm board may be placed alongside the operating table to help stabilize the arm, and an assistant is useful to stabilize and position the arm. Traction may not be necessary if an assistant positions the arm in the positions required.

Advantages of the supine position include ease of administration of anesthesia and airway access, direct access to the anterior compartment, and simple conversion should an open surgical procedure be required. The anatomy is more intuitively appreciated in this position, which simplifies the orientation of the intra-articular structures.

Disadvantages include the need for arm suspension devices and difficulty in accessing the posterior compartment. Suspension of the arm may cause some restriction when flexing and extending the elbow during the procedure. The suspended position of the elbow may be unstable and require the use of an assistant. Access to the posterior compartment requires extension and elevation of the elbow with placement of the arm across the body.

Prone

The prone position was created primarily to improve access to the posterior compartment of the elbow, and to achieve a more stable arm position without the cumbersome traction devices required in the supine position.

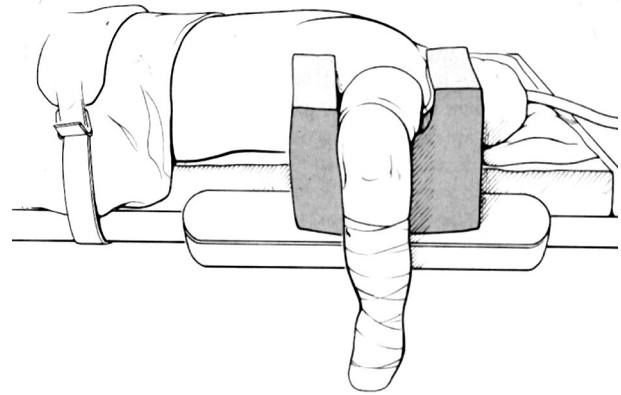


FIG. 2. The prone position. Note the use of arm board and limb holder to stabilize the upper extremity. (Copyright Kevin D. Plancher, M.D.)

The patient is positioned face down on two padded chest rolls with the abdomen free and the head and neck supported. The shoulder is abducted to 90 degrees and the forearm is allowed to hang freely with 90 degrees of flexion. The upper arm is supported with foam padding or rolled blankets (Fig. 2).

Advantages of the prone position include improved operative access to the posterior compartment of the elbow and a stable arm position that does not require traction or an assistant. The elbow in the prone position may be ranged from 0 to 120 degrees. Gravity in this position assists in displacing the anterior neurovascular structures away from the joint space. Conversion to an open procedure is readily available, although access to the anterior elbow may require repositioning of the patient.

The principal disadvantage of the prone position is inconvenience. Rolling the patient into the prone position requires an attention to detail to avoid complications of positioning. Patients undergoing regional anesthesia may be uncomfortable in this position. Patients with significant shoulder pathology or respiratory disorders may not be able to tolerate this position. Access to the patient for the anesthesiologist is limited, and patients requiring conversion to general anesthesia after failed regional or local blocks must be repositioned.

Lateral Decubitus

The lateral decubitus position was described as an alternative providing the arm stability lacking in the supine position.¹⁵ The lateral decubitus position avoids the inconvenience of the prone position because the patient is positioned with the involved side upward, with the arm flexed forward 90 degrees at the shoulder and internally rotated to hang over a padded bolster with the elbow in 90 degrees of flexion (Fig. 3). Care must be

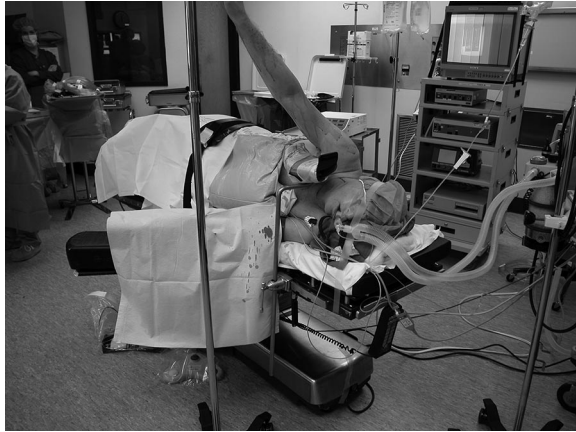


FIG. 3. Lateral decubitus position. Note the axillary roll. The patient is ready for sterile draping. (Copyright Kevin D. Plancher, M.D.)

taken that the bolster is not placed too distal on the upper arm because this may decrease available joint space.

Advantages of the lateral decubitus position are identical to those seen in the prone position but with better airway access for the anesthetist and less inconvenience for the surgeon in positioning the patient.

The principal disadvantages of this position are the need for an extra piece of equipment (padded arm bolster) and the occasional need for patient repositioning if open surgical procedures are required. Posterior incisions are well accommodated, but other approaches to the elbow will require a sterile Mayo stand or hand table to position the arm.

INSTRUMENTATION

The equipment required for arthroscopy of the elbow is similar to that used in standard knee arthroscopy. Although the 4.0-mm arthroscope is usually used, and is preferable for its wider field of view, the 2.7-mm scope should be available for the small elbow or for those with restricted motion. Arthroscopes should be available with 30 degree and 70 degree angulation. The sheath used with the arthroscope should be one designed specifically for that scope. Sheaths designed to accept both 30 and 70 degree scopes have an opening at the end of the sheath that extends proximal to the end of a 30 degree scope and may cause extravasation of fluid into the soft tissues outside the joint.¹⁶

Cannula systems need to be able to accommodate both sizes of arthroscopes, switching sticks, and blunt trocars. The use of plastic cannulas eliminates the need for repeated joint entries and will decrease the chance of soft tissue injury caused by repeated insult or fluid extravasation. We always use nonvented cannulas to prevent fluid extravasation.

Joint distension is essential for successful elbow arthroscopy and requires an 18-gauge spinal needle, 30-mL syringe, and intravenous tubing. Irrigation inflow must be regulated to ensure joint distension at all times. Gravity inflow may be used, but we prefer the use of a pressurized inflow system. The standard arthroscopic hand-held instruments should be available, including a No. 11 knife blade, hemostat, ruler, probes, grasping forceps, cutting forceps, punches with or without suction, osteotomes, and switching sticks.

The use of motorized instruments in the elbow requires care because of the proximity of the overlying neurovascular structures. The motorized shavers, burrs, and synovial resectors are all used through cannulas to protect soft tissues. Occasionally we use more specialized equipment including drills, reamers, lasers, electrocautery, K-wires, and cannulated screw sets. The need for additional equipment is determined by the requirement of each case.

Principles

Before commencing with elbow arthroscopy some simple but extremely important tenants must be understood. First, the elbow should be marked out before any incisions before any fluid be used to distend the joint. Surface landmarks that should be marked include the lateral epicondyle, medial epicondyle, radial head, capitellum, and olecranon. The ulnar nerve should be palpated and marked as well. It is extremely important to know if the nerve subluxes from the cubital tunnel. Second, locating the soft spot on the lateral side of the elbow is important. It is at the center of the triangle comprised by the lateral epicondyle, the radial head, and the olecranon process to distend the joint. Utilizing an 18-gauge needle through the soft spot and into the joint, the elbow capsule is distended with 20 to 30 mL of saline solution. This helps move the neurovascular structures away from the area of the starting lateral portal. Third, all incisions about the elbow during arthroscopic procedures are only through skin. All deeper dissection through the subcutaneous tissue are made with blunt trocars only after hemostats are used to spread the subcutaneous tissue in a longitudinal direction to move sensory nerves out of the way. Finally, cannulas are used to maintain the portal tract and to avoid multiple capsular punctures as well as a 2.7-mm arthroscope.

Portal Anatomy

The numerous portals described for the elbow are based on avoiding the many neurovascular structures around the elbow. In addition to location, technique is important when creating portals. In the elbow, all portals

are created with the joint fully distended with fluid. Distension of the capsule moves the neurovascular structures away from the joint, and thus farther away from injury when the trocar is introduced. Any cannula introduced is left in place throughout the procedure to avoid the risks of multiple passes through the soft tissues, and to decrease the possibility of fluid extravasation.

Anterior portals are all established with the elbow in 90 degrees of flexion, but posterior portals require some extension. We use a blunt trocar to penetrate the elbow joint to avoid damage to the articular surfaces. All incisions are made through the skin, followed by blunt dissection with a straight hemostat to avoid injury to any of the cutaneous nerves about the elbow.

Debate continues on the subject of which portal to use as a starting point. The descriptions of elbow arthroscopy performed in the supine position have traditionally begun with the anterolateral portal. Recent anatomic studies^{12,13,23,25} have shown that the radial nerve lies much closer to the anterolateral portal than the median nerve

does to the anteromedial portal. Because of this it is currently recommended that the first portal be created medially because there is more room for variation in portal placement. Many surgeons continue to use the anterolateral portal to begin the procedure with very satisfactory results. The starting point is a matter of preference and experience when the surgeon is familiar with the local anatomy.

The six most common elbow arthroscopy portals are the direct lateral, superomedial, anterolateral, anteromedial, posterolateral, and straight posterior.

Direct Lateral Portal (Midlateral Portal)

The direct lateral portal, or “soft spot portal,” serves as the standard initial site for distention of the joint before the arthroscope is inserted into the elbow. It is at the center of the triangle made of the radial head, lateral epicondyle and the olecranon (Fig 4A, B). This portal is excellent for viewing the posterior compartment, but not for the anterior compartment. The capitellum, radial

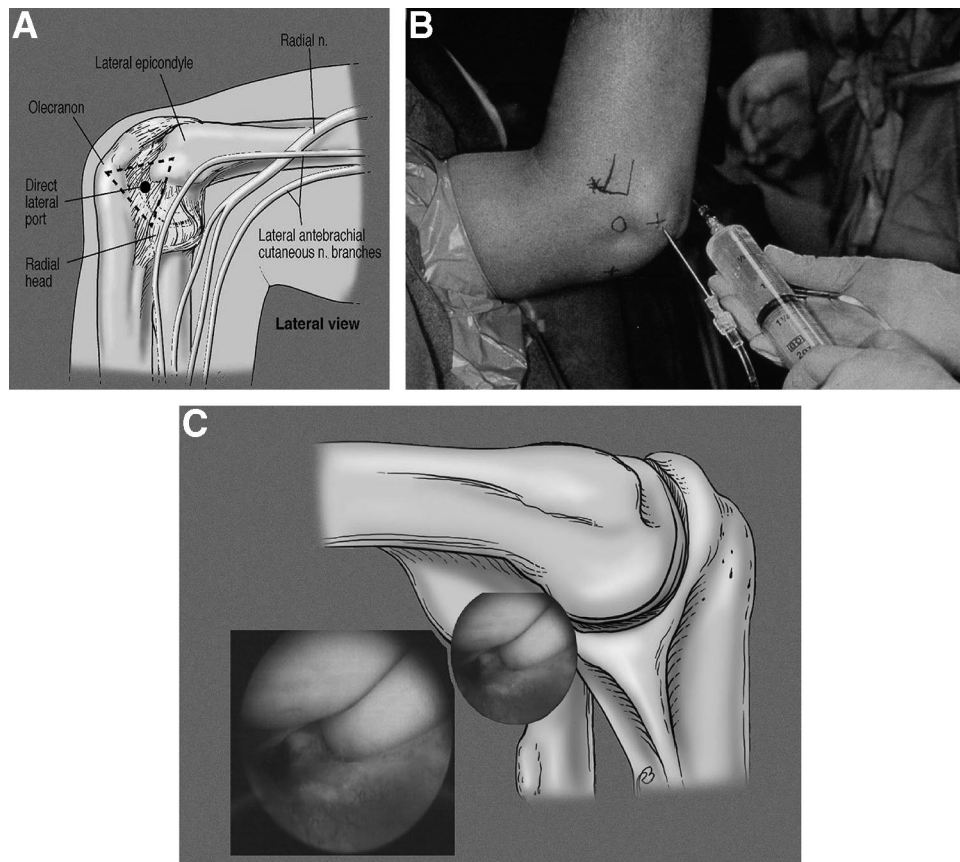


FIG. 4. The midlateral portal. (A) The soft spot of the lateral elbow in a triangle defined by the radial head, olecranon, and lateral epicondyle. (B) An 18-gauge spinal needle inserted into the soft spot. The radial head and lateral epicondyle have been marked. (C) Arthroscopic view of the inferior aspect of the radiocapitellar joint viewed from the midlateral portal. (Copyright Kevin D. Plancher, M.D.)

head, and the radioulnar articulation are best seen with this portal. This portal is familiar to most physicians as the site of joint aspiration of the elbow. The portal passes between the anconeus and triceps muscle. This is a relatively safe portal with the only neurovascular structure at risk with the direct lateral portal is the posterior antebrachial cutaneous nerve, which passes within an average of 7 mm (Fig. 4A).²

After introduction of the arthroscope, pronation and supination of the forearm allow for identification of the radial head and most of the articular surface. The inferior aspect of the radial head and capitellum as well as the radioulnar joint may be seen (Fig. 4C). Visualization through this portal proceeds posteriorly along the undersurface of the capitellum to view the posterolateral capsule, tip of the olecranon, and lateral ridge of the trochlea. The scope may also be introduced between the olecranon and the trochlea to view the trochlea as well as the trochlear notch of the olecranon.

This portal may be established first for an initial joint inspection. Leakage of irrigation fluid into the relatively thin surrounding soft tissues in this location may be troublesome, and it may be better to delay the use of this portal.²³ The midlateral portal is most useful in visualizing the radioulnar joint and the inferior surfaces of the radial head and capitellum and allows for easy removal.

Superomedial Portal

The superomedial portal, or proximal medial portal, is located approximately 2 cm proximal to the medial epicondyle. Variations of this portal have been proposed by Lindenfeld¹² (1 cm proximal and 1 cm anterior) and Baker⁴ (2 cm proximal and 2 cm anterior) (Fig. 5A). This portal is excellent for visualization of the anterior compartment of the elbow viewing the radial head by pronating and supinating the patients forearm. This portal can be helpful as a working portal when viewing through the anterolateral portal as well as a high-flow irrigation portal when viewing from the posterolateral portal. It is extremely important to insert the arthroscopic sheath anterior to the intramuscular septum, maintaining contact with the anterior humerus and directing the trocar toward the radial head during insertion (Fig. 5B). The median nerve lies within 19 mm from the portal in the distended joint but only 12 mm when the joint is not distended. The ulnar nerve is an average of 21 mm from the cannula in this portal. When the elbow is flexed at 90 degrees, the medial antebrachial cutaneous nerve is 6 mm away.²

The elbow joint is distended with fluid to increase the distance from the trocar to the anterior neurovascular structures. As the trocar penetrates the joint capsule it

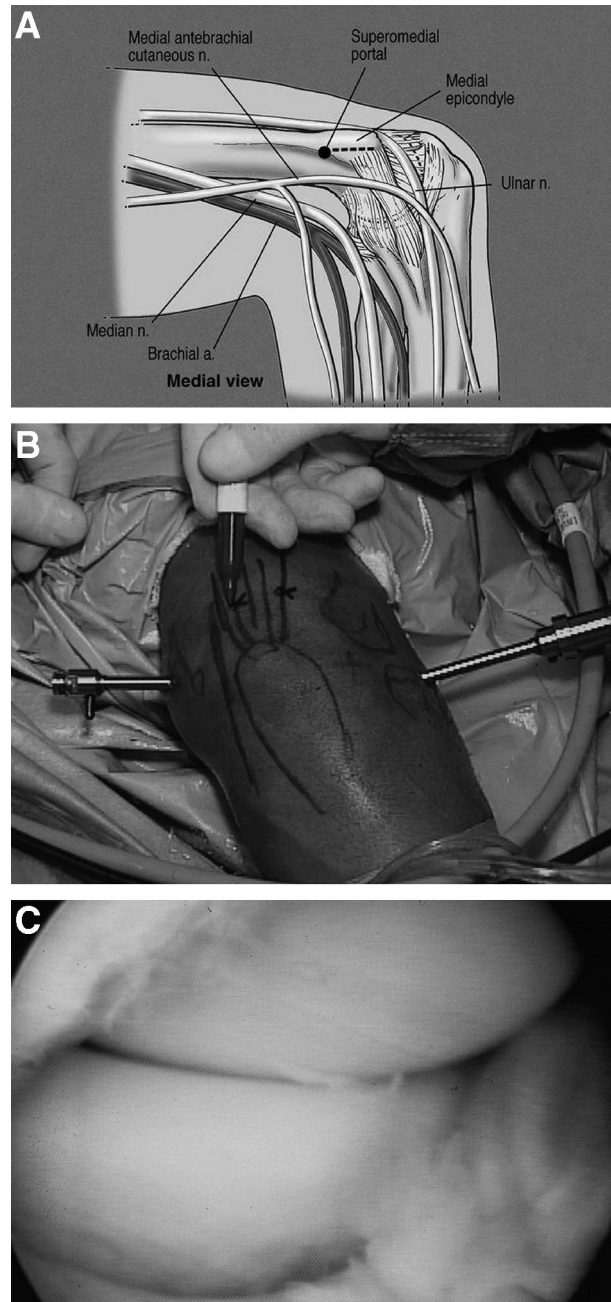


FIG. 5. The proximal medial portal. (A) Superomedial portal. Note proximity of the portal to medial antebrachial cutaneous nerve. (B) The trocar is in the proximal medial portal. The location of the medial epicondyle and the ulnar nerve are marked on the arm. (C) Arthroscopic view of the anterior compartment showing the radiocapitellar joint. (Copyright Kevin D. Plancher, M.D.)

should remain in contact with the anterior cortex of the humerus to minimize risk of injury to the median nerve. The trocar can then penetrate the tendinous portion of the flexor or pronator muscle mass and enter the joint along-

side the brachialis. Studies show the median nerve is between 12.4 mm²³ and 22.3 mm¹² from the cannula in the proximal medial portal.

The proximal medial portal provides visualization of the entire anterior compartment, especially the distal portion. The radial head and capitellum are identified first to provide orientation (Fig. 5C). The annular ligament can also be seen. The coronoid process and its articulation with the trochlea can easily be visualized. The coronoid fossa may also be visualized, along with the medial and lateral gutters. There is some difficulty accessing the proximal capsule and the lateral gutter when compared with the anteromedial portal.

The proximal medial portal is often the first portal established when the patient is in the prone or lateral decubitus position. There is excellent access to the anterior compartment and the portal we believe like others is safer than the standard anteromedial portal.²³ In addition to being located farther from the median nerve, the approach is relatively parallel to the nerve, thus decreasing risk of injury. The nerve is also protected by the substance of the brachialis muscle.

Anteromedial Portal

The anteromedial portal is placed 2 cm distal and 2 cm anterior to the medial epicondyle (Fig. 6). The initial incision is made through skin and is followed by blunt dissection to protect the medial antebrachial cutaneous nerve, which passes within 0 to 5 mm of the cannula.²³ The medial antebrachial cutaneous nerve is at the greatest risk of injury with this portal. This portal penetrates the common

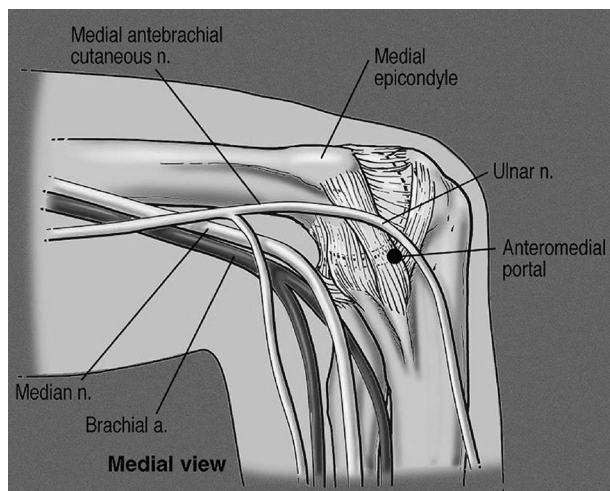


FIG. 6. The anteromedial portal. The anatomy of the anteromedial portal illustrating the proximity of the median nerve, brachial artery, and medial antebrachial cutaneous nerve. (Copyright Kevin D. Plancher, M.D.)

flexor origin and the brachialis before entering the joint. The elbow is maintained in 90 degrees of flexion and the trocar is directed toward the center of the joint, anterior and medial to the medial epicondyle. The most important step before portal placement is palpation of the ulnar nerve to make sure that it is not subluxed anteriorly. The median nerve is an average of 7 mm from this portal.²³ Lynch and associates found that the cannula to the median nerve was an average distance of 4 mm in the nondistended joint and 14 mm when the joint was distended.

This portal provides a view of the anterior compartment, as was described for the proximal medial portal. The radial head, capitellum, annular ligament, radial fossa, coronoid process, trochlea, coronoid fossa, and capsule may be inspected.

This portal is used first when the patient is in the supine position. The anteromedial portal can be created from inside-out using either needle localization or a switching stick technique. Several studies have argued the safety advantage of creating the superomedial portal primarily to this portal.^{12,13,25}

Anterolateral Portal

The anterolateral portal originally described by Andrews and Carson³ was located 3 cm distal and 1 cm anterior to the lateral epicondyle of the humerus. Other surgeons have moved further anterior approximately 2 to 3 cm anterior to the lateral epicondyle.^{1,22} Although it was noted that these measurements represent approximations, anatomic studies^{12,13,15,25} have shown that 3 cm is usually too far distal and places the trocar perilously close to the radial nerve. We make our portal in the sulcus, which is palpated between the radial head and the capitellum, usually 1 cm distal and 1 cm anterior to the lateral epicondyle (Fig. 7A). This portal is placed within the sulcus, between the radial head and capitellum anteriorly. The radial nerve is approximately 3 mm to this portal even in distended specimens.¹² The trocar is aimed toward the center of the joint. The arthroscope will pass anterior to the radial head, penetrating the extensor carpi radialis brevis and the lateral capsule deep to the radial nerve (Fig. 7B). With the elbow flexed and the joint distended, Andrews³ reported an average distance of 7 mm between the radial nerve and the cannula without joint distension. Lindenfeld and Stothers²³ reported an average distance of 2.8 mm and 4.9 mm, respectively. Lynch¹³ noted an average distance of 4 mm in the nondistended elbow joint, which increased to 11 mm with the joint distended, illustrating the importance of creating portals in a joint distended with fluid. Superficially, the posterior antebrachial cutaneous nerve is an average 2 mm from the arthroscopic sheath from this portal.¹³

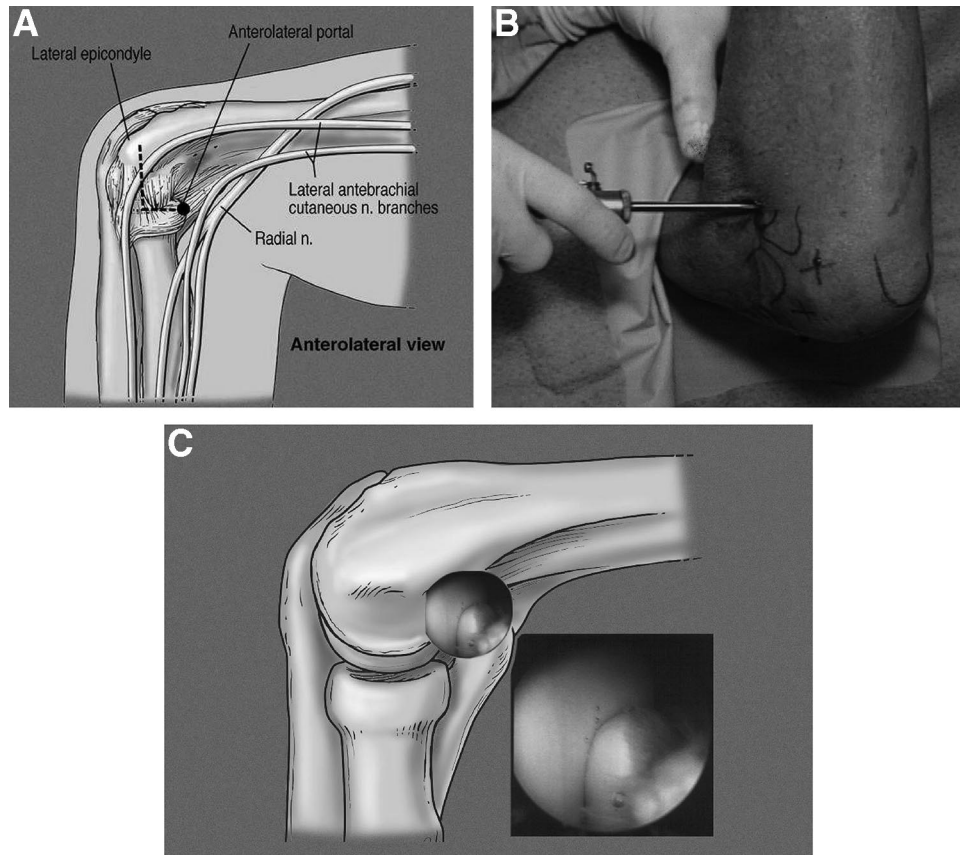


FIG. 7. The anterolateral portal. (A) The anterolateral portal illustrating the proximity of the radial nerve and lateral antebrachial cutaneous nerve. (B) Arthroscope in the anterolateral portal with the radial head, lateral epicondyle, and soft spot portal marked on the skin. (C) Arthroscopic view of the medial aspect of the anterior compartment from the anterolateral portal. The coronoid process and trochlea are well visualized. (Copyright Kevin D. Plancher, M.D.)

This portal allows visualization of the medial side of the elbow joint (Fig. 7C). The articulation of the coronoid and trochlea is noted, and flexion and extension will allow further inspection of the coronoid process, brachialis insertion, and coronoid fossa. The medial aspect of the radial head and the anterior aspect of the radioulnar joint may also be visualized. Field et al.⁸ concluded that the ulnar collateral ligament can rarely be seen arthroscopically, and that this view cannot be improved with valgus stress if the anterior band of the ligament is competent.

The anterolateral portal is used by some surgeons as the initial portal, especially when the surgery is performed with patient in the supine position.³ Other surgeons, citing recent studies indicating that it is safer to establish the superomedial portals first,^{12,13,25} use an inside-out technique to create this portal.

To use the inside-out technique, the arthroscope is placed in the anteromedial or proximal medial portal and is advanced lateral to the radial head, replaced with a

blunt rod that is pressed against the anterolateral joint capsule to tent the overlying skin. A skin incision is made over the rod, and a cannula is passed over the rod, into the joint. Care is taken to avoid locating this opening too far anterior to the radial head to avoid an injury to the radial nerve.

Posterolateral Portal

The posterolateral portal has the largest are of safety anatomically. Access can be established anywhere along the joint line posterior to the midlateral portal.¹⁶ The posterolateral portal is located approximately 3 cm proximal to the tip of the olecranon. It is superior and posterior to the lateral epicondyle at the lateral border of the triceps muscle (Fig. 8A, B). When establishing this portal, the elbow is held in 20 to 30 degrees of flexion allowing the triceps tendon and posterior capsule to relax while directing the cannula of the toward the olecranon fossa. If a 70 degree arthroscope is used, the ulnar collateral ligament can be inspected with this portal.

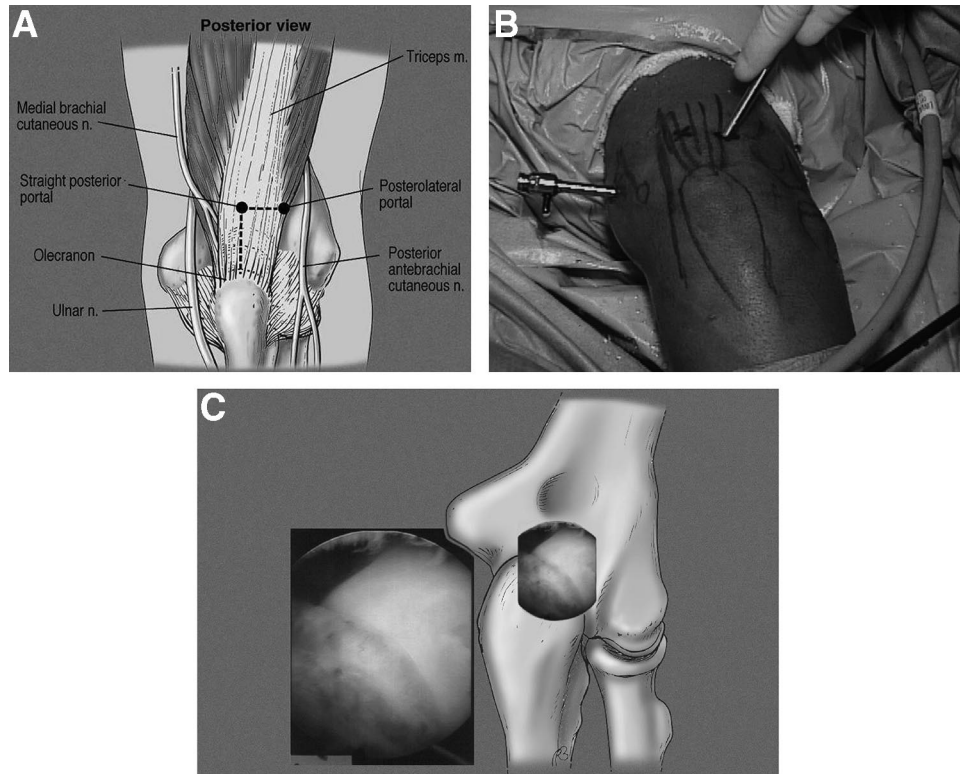


FIG. 8. The posterolateral and straight posterior portals. (A) Line drawing illustrating the anatomy of the posterolateral and straight posterior portals. (B) Arthroscope placed in the posterolateral portal with the ulnar nerve, olecranon, triceps, radial head, and lateral epicondyle marked on the skin. An empty cannula remains in the proximal medial portal. (C) Arthroscopic view of the posterior compartment from the posterolateral portal. (Copyright Kevin D. Plancher, M.D.)

The nearest structures when making a skin incision are the posterior antebrachial cutaneous and the lateral brachial cutaneous nerves. The trocar is directed toward the center of the olecranon fossa and will pass lateral to the triceps tendon to penetrate the posterolateral capsule. The medial brachial cutaneous nerve and posterior antebrachial cutaneous nerves are an average of 25 mm from this portal.²³ The ulnar nerve is also 25 mm from this portal if the cannula is kept lateral to the posterior midline.

The posterolateral portal provides the best access to the posterior compartment (Fig. 8C). This portal provides a view of the tip of the olecranon and the olecranon fossa. The scope may also be advanced medially to visualize the vertical fibers of the proximal portion of the ulnar collateral ligament. This portal can also be used to inspect the medial and lateral gutters for loose bodies. Caution must be exercised in the medial gutter because the ulnar nerve has a very thin cover in this location.

Straight Posterior Portal

The straight posterior portal, or transtriceps portal, is established 3 cm medial to the posterolateral portal in the

entry is in the midline of the triceps if a second posterior portal is necessary. This portal passes through the musculotendinous junction of the triceps muscle. The tendon is quite thick at this point and therefore a knife will be needed to penetrate the tendon directly into the joint. This portal is created with the elbow partially extended. The posterior antebrachial cutaneous nerve is 23 mm away and the ulnar nerve is 25 mm from this portal when the elbow is distended.

This portal is excellent for removing impinging olecranon osteophytes and loose bodies from the posteromedial compartment. A complete synovectomy of the posterior compartment can be done from this portal. This portal also allows visualization of the olecranon fossa, olecranon tip, and posterior trochlea. This portal and the posterolateral portal may require the use of the smaller arthroscope.

Accessory Portals

The transhumeral portal provides another point of entry into the anterior compartment. The straight posterior portal is created as described above, and a fenestration technique is used to gain access to the anterior

compartment.²⁰ This may be as simple as resecting a membrane or may involve the use of drills, reamers, and arthroscopic burrs. Creation of this portal will not affect the structural integrity of the humerus if the medial and lateral columns remain intact. This procedure is used in patients who have had an ulnar nerve transposition, in whom anteromedial access is restricted.²³

Proximal Lateral

Several alternative approaches to the lateral aspect of the anterior elbow have been described. The proximal lateral, proximal anterolateral, anterosuperior lateral, and straight lateral^{7,21,23} are all alternative approaches to the elbow. The proximal lateral portal has been shown to be the safest and most effective portal. Stothers et al.²³ found that a cannula in this portal is an average of 9.9 mm from the radial nerve, compared with a distance of 1.4 mm for the traditional anterolateral portal. The incision is made 2 cm proximal to the lateral epicondyle of the humerus. Care is taken to avoid the anterior branch of the posterior antebrachial cutaneous nerve. The trocar is directed to the center of the elbow along the anterior aspect of the humerus, piercing the brachioradialis and brachialis before entering the joint. The proximal lateral portal is used to visualize the anterior radiohumeral joint, the medial and lateral sides of the joint, the lateral gutter, and the lateral aspect of the radial head and capitellum.

OPERATIVE TECHNIQUE

A routine method of examination of the elbow joint should be established regardless of the individual techniques preferred. Routines help standardize a procedure and eliminate careless oversights. The video monitor, video recorder, light source, irrigation system, and motorized shaver are placed opposite the surgeon. A Mayo stand is placed at the foot of the table for the necessary surgical instruments.

Options for positioning the patient have been discussed previously. We use the lateral decubitus position. Once anesthesia has been administered and the patient has been positioned on the table, a padded tourniquet is placed as proximal as possible on the upper extremity. The elbow is examined, and range of motion and evidence of instability are documented. The hand and forearm are wrapped with Coban or an elastic bandage to maintain compression. The Coban wrap prevents fluid extravasation into the arm and provides space for fluid extravasation at the completion of the procedure.

After the elbow is prepared and draped in a sterile manner, the surface landmarks and portal locations are drawn with a marking pen. Laterally, the radial head,

lateral humeral epicondyle, and olecranon are drawn on the skin. Medially, the olecranon, medial humeral epicondyle, and medial intermuscular septum are marked.

Distension of the elbow capsule is performed with an 18-gauge spinal needle inserted into the soft spot of the elbow located in the triangle formed by the olecranon, radial head, and lateral humeral epicondyle, and 25 mL of sterile normal saline is injected. Joint distension can be detected, and an intra-articular position is confirmed when fluid is freely returned through the inserted needle.

The capacity of the joint capsule has been reported to be 23 ± 4 mL with capsular ruptures known to occur at relatively low intra-articular pressures.¹⁷ Thus, despite occasional references in the literature to injecting 40 to 60 mL, we think that it is better to safely avoid the risk of capsular rupture by limiting fluid infusion to 25 mL.

We begin arthroscopy of the elbow with the proximal medial portal as described above. Intra-articular placement of the cannula is confirmed by fluid return. The arthroscope is placed through the cannula to examine the anterior compartment. Evaluation of the radial head and capitellum, pronating and supinating the forearm to see most of the surface of the joint, completes this investigation. The lateral capsule and anterior capsule are inspected next, and the arthroscope is then withdrawn to inspect the coronoid process, trochlea, and coronoid fossa. These structures are better assessed from the lateral side, and an anterolateral portal is created using an inside-out technique.

A switching stick may be advanced through the lateral capsule to provide localization from inside-out, or an 18-gauge needle is inserted anterolateral to the radiocapitellar joint and the portal is created under direct vision. From the anterolateral portal, the medial capsule, coronoid process, trochlea, and coronoid fossa are inspected. The anterolateral portal is used to introduce instruments. If the radiocapitellar joint or the lateral gutter is of primary concern, we establish a midlateral portal.

Inspection of the posterior compartment is accomplished through a posterolateral portal. If this inspection is incomplete or if a working portal is required posteriorly, a straight posterior portal is also created.

At the conclusion of the procedure the joint is irrigated, the tourniquet is deflated, and the elbow is placed through a range of motion with the in-flow cannula in place to drain the joint. All portals are closed with suture material, and a soft dressing is applied. Local anesthetics are not given because this may create a confusing neurovascular examination postoperatively. Immobilization is generally not required, and immediate motion is encouraged.

COMPLICATIONS

Elbow arthroscopy is still considered with apprehension by many orthopaedic surgeons, although there are few documented complications. The proximity of neurovascular structures near portals and working instruments, especially anteriorly, make the dangers self-evident. Savoie²¹ reported in a 1993 review of 465 cases of elbow arthroscopy in the literature that there were 16 reported complications, for an overall rate of 3.6% (he noted, however, that not all of the reports addressed complications and that this number may actually be higher).

Injuries to the nerves crossing the elbow joint are the most frequently reported complications. Although often transient, these neurologic injuries may be devastating. The radial nerve is susceptible during the creation and use of the anterolateral portal, and injuries to the radial or posterior interosseous nerves have been reported by several investigators.^{11,13,18,24} The median nerve passes nearby the anteromedial portal, and transient dysfunction has been reported^{3,13} as well as one case of median nerve transection while performing a synovectomy. The ulnar nerve is located posteromedially and thinly covered by synovial and ligamentous tissue. Ulnar nerve dysfunction has been reported after local use of motorized instruments, and after the use of multiple medial portals for osteophyte resection.²¹ Neuromas of the cutaneous nerves have also been reported.¹³

Infection and persistent drainage are guarded against but rarely reported.^{15,21} Other complications, including loss of motion, arthrofibrosis, heterotopic ossification, and instrument breakage, are very unusual.

Standard precautions should be followed to minimize complications. The elbow should be placed in 90 degrees of flexion and fully distended before the creation of any anterior portal. Anatomic landmarks should be carefully outlined, and all portals should be created under direct vision or with an inside-out technique when possible. A complete history and physical examination should be completed preoperatively. Assessment of any alteration in the patient's anatomy (subluxing or transposed ulnar nerve, heterotopic ossification, previous fracture, significant osteophyte formation, and so forth) must be noted before performing arthroscopy of the elbow.

The literature indicates that elbow arthroscopy has a higher rate of complications than arthroscopy in any other joint. Complications are often secondary to inexperience, poor technique, and a lack of anatomic precision when creating portals. As orthopaedic surgeons gain experience and refine the techniques of arthroscopic procedures in the elbow, the procedure will become safe, reliable, and reproducible.

SUMMARY

An established, routine examination of the elbow joint, along with precision in the initial marking of anatomic landmarks, will allow the arthroscopist to avoid complications and oversights associated with elbow arthroscopy.

Elbow arthroscopy remains a technically demanding procedure requiring a thorough understanding of the pertinent local anatomy. Arthroscopy of the elbow is currently an area of rapid innovation. Improvements in equipment, techniques, and anatomic understanding will lead to an inevitable increase in both diagnostic and therapeutic applications.

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