Elbow Arthroscopy: Indications, Techniques, Outcomes, and Complications

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Abstract
Elbow arthroscopy is a tool useful for the treatment of a variety of pathologies about the elbow. The major indications for elbow arthroscopy include débridement for septic elbow arthritis, synovectomy for inflammatory arthritis, débridement for osteoarthritis, loose body extraction, contracture release, treatment of osteochondral defects and selected fractures or instability, and tennis elbow release. To achieve favorable outcomes after elbow arthroscopy, the surgeon should be aware of contraindications, technical considerations, anatomic principles, and the need for proper patient positioning and portal selection. Elbow arthroscopy is an effective procedure for the treatment of inflammatory arthritis, osteoarthritis, and lateral epicondylitis.

In recent years, increased understanding of the anatomy about the elbow and techniques of elbow arthroscopy have emerged. An increased familiarity with arthroscopy in general, and elbow arthroscopy in particular, now allows surgeons to expand the indications for this procedure. Nevertheless, arthroscopy remains a technique with limitations and risks, and recognizing these will help the surgeon understand how arthroscopy fits into surgical practice.

Indications
Indications for elbow arthroscopy include débridement for septic elbow arthritis, synovectomy for inflammatory arthritis, débridement for osteoarthritis, loose body extraction, contracture release, treatment of osteochondral defects and selected fractures or instability, and tennis elbow release, as well as for diagnostic purposes.

Contraindications
The potential for neurovascular injury in elbow arthroscopy is higher than in other joints because of the proximity of neurovascular structures to portals and the working field. Elbow arthroscopy ideally is considered when the surgeon has arthroscopic training or arthroscopic experience in other joints. Prior surgical management about the elbow is, in some patients, a relative contraindication to elbow arthroscopy.
ulnar nerve subcutaneous transposition is not necessarily a contraindication if the ulnar nerve is identified. However, prior submuscular or intramuscular ulnar nerve transposition is generally considered a contraindication. Some conditions or situations are not adequately addressed with arthroscopy and may be better addressed with an open procedure, such as arthritis with widespread joint changes, as evidenced by pain throughout the arc of motion.

**Surgical Technique**

Regional or general anesthesia may be used for the procedure. Patient positioning may be supine, prone, or the lateral decubitus position. With the lateral decubitus position, the patient is positioned on an inflatable beanbag with an axillary roll beneath the bottom arm, and the affected arm is placed in an arm holder. Care is taken to avoid pressure on or stretching of the brachial plexus, and the arm holder is positioned such that the upper arm is supported without impingement on the antecubital fossa. A tourniquet may be applied (Figure 1).

Standard knee arthroscopy equipment and instruments are used, such as a 30° 4.5-mm arthroscope. Solid nontrephinated cannulas are useful because trephinations allow the escape of fluid from the capsule and joint working area into the soft tissues. Standard arthroscopic biter, grasper, burr, and shavers are used during the procedure. Shaver suction tubing is, in general, not applied because even when the suction is turned off, some negative pressure is present in the tubing. Retractor devices are used as needed during the procedure.

**Portal Placement**

Standard elbow arthroscopy portals include the anterolateral, anteromedial, posterolateral, and direct posterior portals. Accessory portals include the soft spot portal (direct lateral portal), the distal ulnar portal, and accessory retraction portals in the anterior joint laterally and medially (Figures 2 and 3). Portals and bony and soft-tissue landmarks, including the radiocapitellar joint, the medial and lateral epicondyles, the intramuscular septum, and the olecranon, are marked before the procedure begins; fluid egress alters the surgeon’s ability to palpate these structures. The location of the ulnar nerve is marked, and any subluxation of the ulnar nerve is noted.

The tourniquet is inflated to 200 to 250 mm Hg. Using an 18-gauge needle, the joint is insufflated with 25 to 30 mL of saline through the direct lateral portal or at the first portal site placed; accurate placement into the joint is confirmed by slight extension of the elbow as fluid distends the joint.
The order of portal placement depends on the preference and experience of the surgeon and the pathology to be addressed.

**Portals**

**Anterolateral**

The anterolateral portal is placed just anterior to the radiocapitellar joint. More proximal placement increases the margin of safety rather than placement more distally (ie, closer to the posterior interosseous nerve). The anterolateral portal has the smallest margin of safe distance from a neurovascular structure; it is reasonable to create this portal first before fluid extravasation and distention alter palpable landmarks, although many surgeons prefer starting anteromedially.

For portal placement, the skin only is incised with a No. 15 blade and then dissected bluntly down to the joint. An egress of fluid confirms that the joint has been entered. A blunt trocar and an arthroscopy sheath are placed at the portal site.

**Anteromedial**

The anteromedial portal is located 1 to 2 cm anterior and 1 to 2 cm distal to the medial epicondyle; the portal traverses the flexor pronator mass and has a high margin of safety from neurovascular structures. This portal may be made after visualizing from the anterolateral portal and palpating to choose the appropriate portal site. The portal may be made by an inside-out technique by exchanging the camera for a blunt trocar and advancing it toward the medial skin. The skin is tented at the portal site, and after the incision for the portal is made, a second sheath may be introduced from the medial side, thus allowing for this working portal to be used. A switching stick is often useful when the viewing portal is switched from anterolateral to anteromedial.

**Accessory Anterior**

Accessory portals may be placed anteriorly for retraction. An anteromedial accessory portal is placed just anterior to the supracondylar ridge and intramuscular septum, 2 cm superior to the medial epicondyle. An anterolateral accessory portal is placed 2 cm superior to the lateral epicondyle, just anterior to the supracondylar ridge.

**Direct Lateral or Soft Spot**

The direct lateral portal is particularly useful to visualize and treat osteochondral defects. It is created through the center of a triangle made between the tips of the olecranon, lateral epicondyle, and radial head. The palpable soft spot is covered by the anconeus.

**Distal Ulnar**

The distal ulnar portal is particularly useful to visualize the posterior capitellum, especially for treatment of osteochondral defects (Figure 4). The distal ulnar portal is initiated in the skin 3 to 4 cm distal to the radiocapitellar joint. A blunt trocar and sleeve are placed and guided proximally along the lateral border of the ulna to enter the joint.

**Direct Posterior**

The direct posterior portal is placed 2 to 3 cm above the proximal edge of the olecranon. It traverses the thick triceps and requires making an incision through the skin and triceps. A blunt trocar is placed and abrades the posterior humerus to remove posterior olecranon fat to help create a visualization space; because this represents a potential space, removal of the fat and synovium is necessary to create space to visualize the posterior joint. It is useful to place the shaver and blindly shave at the olecranon fossa to remove tissue, taking care to avoid orienting the shaver toward the ulnar nerve.

**Posterolateral**

After creation of a working space, the posterolateral portal is used mostly for visualization. This portal is created nearly level with the proximal edge of the olecranon on the posterolateral surface. It offers a relative margin of safety provided that the position of the ulnar nerve is noted, and it has a high

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**Figure 4**  Intraoperative photograph demonstrating use of the distal ulnar portal to visualize osteochondral lesions. The arthroscope is in the distal ulnar portal, and the shaver is in the direct lateral or soft spot portal. (Reproduced with permission from the Mayo Foundation for Medical Education and Research, Rochester, MN.)
Complications
Joint space infection is unusual following elbow arthroscopy. However, because of the risk of the development of fistulae or persistent drainage from the joint, the use of sutures is recommended, as opposed to the use of thin adhesive strips alone, for closure of the portal sites.21

Although heterotopic ossification appears to be a less common occurrence after elbow arthroscopy than after open procedures, this complication does occur. The role of, dosage of, and compliance with prophylaxis for heterotopic ossification is uncertain.12,22

Published reports document injury to all major peripheral nerves about the elbow. In one series of 473 elbow arthroscopies, the ulnar nerve was most commonly involved, followed by the superficial radial nerve, posterior interosseous nerve, anterior interosseous nerve, and medial antebrachial cutaneous nerve, respectively.13,21,23-25

Nerve injury is more common in patients with rheumatoid arthritis because the capsule is thinned or absent, in profound preoperative contractures, and in distorted anatomy. Neurovascular injuries following elbow arthroscopy may be underreported, and even with careful technique, the risk of neurovascular injury cannot be entirely eliminated.13

Arthroscopic Synovectomy for Inflammatory Arthritis
Synovectomy is an effective treatment of inflammatory arthritis of the elbow that is refractory to medical management. Whereas synovectomy is traditionally performed with open surgery, arthroscopic synovectomy is gaining in popularity because of its less invasive nature. Relative to other arthroscopic procedures of the elbow, synovectomy for rheumatoid arthritis has an increased risk of causing nerve injury because of the distorted anatomy and the thin, weak joint capsule, which normally helps protect the neurovascular structures.21

History and Physical Examination
Pain, swelling, and stiffness are commonly reported with persistent synovitis. It is important to review the underlying disease process and the treatment to date. Examination typically reveals a boggy swelling postero-laterally that is the result of synovitis and effusion. Motion should be documented, and the quality of the end points of motion should be evaluated. A soft end point suggests synovitis or capsular contracture, whereas a firm end point indicates osseous impingement. Limitation in rotation may be the result of radial head deformity or distal radioulnar joint disease. The function of the posterior interosseous and ulnar nerves should be documented because these nerves may be compressed by synovitis. It is critical to locate the ulnar nerve and evaluate it for any subluxation to help avoid injury.

Imaging
Evidence of joint destruction on plain radiographs predicts the efficacy of synovectomy for rheumatoid arthritis.26 In the Mayo Clinic Classification, grade I has no osseous changes; grade II has narrowing of the joint space with normal architecture; grade III has damage to the subchondral architecture of the joint, such as thinning of the olecranon or resorption of the trochlea or capitellum; grade IV has gross destruction of the joint; and grade V is ankylosis. CT best defines the osseous anatomy. MRI demonstrates the extent of synovitis (Figure 5) and nonossified loose bodies.

Indications and Contraindications
Rheumatoid arthritis is the most common indication for arthroscopic synovectomy of the elbow.26-29 Synovectomy is considered in the setting of persistent, painful synovitis despite good medical management. Patients with some preserved articular cartilage and only mild bony deformity (Mayo grades I and II) are the best candidates for arthroscopic synovectomy.27 Younger patients with more advanced disease (Mayo grade III) who are not candidates for elbow arthroplasty also should be considered. Arthroscopic synovectomy is effective in patients with hemophilia who have recurrent elbow hemarthroses despite the use of prophylactic factor replacement.30,31 Arthroscopic synovectomy also may be used for psoriatic arthritis and acute septic arthritis.32
Surgical Technique

Following surgical setup of the patient, a nonaggressive full radius resector is used to preserve the integrity of the capsule, thus reducing the risk of nerve injury. Retractors are used as needed on the capsule or muscles to improve visualization. It is important that the shaver not be turned on until it is confirmed that the instruments are within the joint because extensive synovitis may result in a poor initial view. Synovium is removed while the capsule is preserved (Figure 6). In inflammatory arthritis, the capsule is typically thin and easy to inadvertently penetrate or resect, thus lowering the margin of safety. Particular caution is used when removing the synovium anterior to the radial head because of the proximity of the posterior interosseous nerve; caution also is advised in the posteromedial gutter near the ulnar nerve.

The radial head usually can be retained. Excision is reserved for patients with a stable elbow and a radial head deformity that is impeding rotation. Impinging osteophytes are removed with a burr or an osteotome. The anterior and/or posterior capsule is released or resected if the patient desires improved motion and has persistent stiffness following synovectomy and osteophyte débridement. A bulky soft dressing is applied for comfort.

Postoperative Management

Synovectomy alone is performed as an outpatient procedure, followed by management consisting of early active range of motion. The patient is instructed to remove the bulky dressing 48 hours postoperatively and apply light dressings on the portal sites. Sutures are removed at 10 days, and physical therapy is initiated if motion recovery is slow. Patients undergoing a concomitant capsulectomy are admitted for 48 hours for early active and passive motion with a continuous brachial plexus block. Management of selected patients with more severe stiffness consists of using a continuous passive motion machine to facilitate the recovery of joint motion. A nighttime static progressive extension splint is used for 12 weeks to retain extension.

Results

A paucity of data documents the outcomes of arthroscopic synovectomy for rheumatoid arthritis, and there is even less information for other conditions. Arthroscopic synovectomy is less invasive than open synovectomy, which may speed recovery and reduce postoperative pain. Elbow arthroscopy allows the experienced surgeon to better visualize all areas of the elbow and address intra-articular pathology. Non-randomized reports suggest that the outcomes of arthroscopic synovectomy are comparable to those of open synovectomy. The results deteriorate with time and are better in patients who have preserved articular cartilage and no significant osseous destruction.

Using arthroscopic synovectomy for hemophilic arthropathy decreases the frequency of recurrent hemorrhosis. Nerve injuries, recurrent synovitis, and persistent pain have been reported after arthroscopic synovectomy.

Arthroscopic Débridement for Osteoarthritis

Arthroscopic treatment of elbow osteoarthritis is becoming more prevalent. Although the elbow joint is more technically demanding than other joints, results for treatment of osteoarthritis are encouraging.

Indications

Arthroscopy is helpful for patients with significant loss of motion at the end range of extension and flexion. Most patients with osteoarthritis of the elbow report loss of motion more frequently than they do pain. Pain typically occurs only when there is osteophyte impingement at the end of motion. Mid-arc pain generally is not reported because cartilage is often preserved at the ulnohumeral articulation. Significant loss of cartilage often occurs at the radiocapitellar joint, but patients often do not report pain with pronation or supination. On the basis of these findings, radial head excision should be performed sparingly in patients with osteoarthritis.
Arthroscopy may often improve motion after an extensive débridement but, similar to open release, it cannot restore the elbow range of motion to normal. In patients who lack only a few degrees of flexion or extension, nonsurgical management should be pursued, and the patient should be counseled accordingly. In addition, patients who have pain throughout the arc of motion may have widespread joint changes that may be better addressed with an alternative procedure, such as joint resurfacing.

Preoperative Examination and Imaging
Motion is documented, and the status of the major peripheral nerves is assessed. Patients are specifically queried about pain throughout or at the end of the arc of motion, if there is locking or catching (suggestive of loose bodies), and any ulnar nerve symptoms. Provocative maneuvers at the cubital tunnel are performed because patients may be unaware of concomitant ulnar neuropathy. Radiographs are obtained to help determine the overall extent of arthritic changes. CT, particularly three-dimensional reconstructions, is helpful to view the location of osteophytes for surgical planning. If most of the osteophyte formation is posterior, then the surgical procedure is best started in the olecranon fossa, followed by anterior débridement.

Technique
In most patients, the preferred technique is to start anteriorly because there is often more osteophyte formation at this location. In addition, the radial nerve is the neurovascular structure closest to the work area, and it is best to complete anterolateral débridement before the development of joint swelling from arthroscopic fluid. Anteriorly, osteophytes in the coronoid and radial head fossae are removed according to the preoperative CT through an anteromedial working portal while visualizing from the anterolateral portal (Figure 7). The capsule may be released or excised. Once the medial half of the joint has been addressed, a switching stick is used to move the camera to the medial side of the joint, and osteophytes and loose bodies are removed from the lateral side. Care should be taken not to excise the capsule over the area of the radial nerve and the posterior interosseous nerve. Osteophytes should be removed from the tip and the medial aspects of the coronoid.

After the anterior aspect of the joint is completed, a posterior approach can be performed. A direct posterior portal located at the midproximal margin of the olecranon fossa provides an excellent working portal for the placement of a shaver or burr. Visualization of the posterior fossa is often difficult initially until a portion of the fat pad is removed with the shaver. During this débridement, the shaver should avoid the medial aspect of the joint to prevent contact with the ulnar nerve. After removal of the synovium and fat to allow visualization, viewing is usually conducted from the direct posterior portal, and the posterolateral portal is used as a working portal located just lateral to the olecranon; this allows for good visualization of the olecranon fossa.

In the posterior joint, in addition to the obvious bony spur on the tip of the olecranon, bone formation occurs on the sides of the olecranon. This can be difficult to resect. On the medial side of the joint, the ulnar nerve is at risk. During work in the area, the ulnar nerve may be protected by a retractor; if the patient has coexisting ulnar neuropathy, then an open, in situ release of the nerve allows for direct protection. Use of a burr in this area has the potential to wrap up soft tissue quickly and should be considered with caution.

In the olecranon fossa, a thick osteophyte often divides the fossa into two parts and acts as a block to extension. A burr working directly through a posterolateral portal may be used to remove this common osteophyte.

Ulnar Nerve Release
During arthroscopy of the osteoarthritic elbow, the ulnar nerve may need to be addressed. In the patient with preoperative ulnar neuropathy, a small incision is made at the beginning of the procedure, and an in situ release of the ulnar nerve is performed. When mild neuropathy is present, an
allarthroscopic release of the nerve can be performed. In patients who preoperatively cannot flex past 90°, an open ulnar release is advocated. There is no consensus of opinion on this additional procedure in asymptomatic patients, but it is recognized that surgical release of the ulnar nerve itself is not without risk.

**Postoperative Care**

After surgery, a soft compressive dressing is applied from the midarm to the wrist. Patients are instructed to rest the elbow and return in 48 hours for removal of the dressing. Management then consists of instructing patients to move the elbow; if they are able to do so through at least a 45° arc of motion, they are given hinged static splints to help stretch and maintain the range of motion gained at surgery. A small percentage of patients will have too much pain to be able to move the elbow; these patients are candidates for an axillary block and continuous passive motion for 48 hours.

At 48 hours after surgery, patients are instructed to use the elbow for all activities of daily living. If in the first 2 or 3 postoperative weeks patients are unable to maintain the gains in motion achieved in the operating room, then gentle manipulation under anesthesia has proven to be an effective option.

The results of elbow arthroscopy for osteoarthritis are generally favorable. Most studies demonstrate improvements in motion and function; it should be anticipated, however, that full restoration of motion is unlikely, particularly terminal extension. Likewise, series suggest difficulty with restoration of pronosupination. No studies have shown advantages compared with open treatment. Unfortunately, the risk of nerve injury cannot be eliminated, and neurovascular complications may occur with either open or arthroscopic elbow surgery.

**Arthroscopic Treatment of Lateral Epicondylitis**

The origin of the extensor carpi radialis brevis (ECRB) has been implicated as the source of pathology in lateral epicondylitis. Surgical treatment is most commonly directed at excision of the pathologic tissue.41-46

**Anatomy**

For arthroscopic management, it is important to understand the anatomy of the extensor tendon origins at the humeral epicondyle; the location of the ECRB tendon origin has been defined relative to intra-articular landmarks.17

At the elbow, the extensor carpi radialis longus (ECRL) overlies the proximal portion of the ECRB such that the ECRL must be elevated anteriorly to visualize the superficial surface of the ECRB. A thin film of areolar connective tissue separates the two structures. The ECRB origin is entirely muscular along the lateral supracondylar ridge of the humerus. The muscle origin has a triangular configuration with the apex pointing proximally. In contrast, the origin of the ECRB is entirely tendinous. Whereas the ECRB blends with the origin of the extensor digitorum communis when dissected from a distal-to-proximal direction using the tendon undersurface, it can be separated from the extensor digitorum communis back to the humerus. The anatomic origin of the ECRB is located just beneath the distal-most tip of the lateral supracondylar ridge. The footprint is diamond shaped and measures approximately 13 mm by 7 mm (Figure 8). At the level of the radiocapitellar joint, the ECRB is intimate with the underlying anterior capsule of the elbow joint, but it is easily separable at this level. Using these data, an arthroscopic technique was designed for lateral epicondylitis.

**Technique**

The patient is positioned in the lateral decubitus position. It is often helpful to start with portal placement on the anteromedial side because it allows for visualization of the lateral joint, and a modified anterolateral portal is established using an inside-out technique. This portal is placed 2 to 3 cm above and anterior to the lateral epicondyle, slightly more proximal than a standard anterolateral portal. The purpose of the modified placement is to allow for instrumentation down to the tendon origin, rather than entering the joint through the ECRB tendon itself.

Any lateral synovitis is débrided with a resector. The lateral capsule is then released. Occasionally, a disruption of the underlying capsule from the humerus is identified. More commonly, the capsule is intact although small linear tears may be present. It is easier to release the lateral soft tissues in layers using a monopolar thermal device. With this method, the capsule is first incised or released from the humerus. When it retracts distally, the ECRB tendon is visualized posteriorly, and the ECRL, which is principally muscular, is visualized more anterior. As stated, the ECRB tendon spans from the top of the capitellum to the midline of the radiocapitellar joint.

After the capsule is adequately resected, the ECRB origin is released from the epicondyle (Figures 8 and 9), starting at the top of the capitellum and carried posteriorly. The lateral collateral
Shoulder and Elbow

The ligament is not at risk if the release is kept above the midline of the radiocapitellar joint. On average, adequate resection of the ECRB must include approximately 13 mm of tendon origin from anterior to posterior. Care is taken to drive the scope in adequately to view the release down to the midline of the radiocapitellar joint. Typically, the entire ECRB retracts distally away from the humerus.

Care is taken not to release the extensor aponeurosis that lies behind the ECRB tendon. This structure is visualized as a striped background of transversely (longitudinally) oriented tendon and muscular fibers much less distinct than the ECRB. It is located posterior to the ECRL. If the aponeurosis is violated, débridement will alter the subcutaneous tissue about the lateral elbow.

Results

In recent years, interest in the arthroscopic treatment of lateral epicondylitis has increased. However, the results of arthroscopic treatment of this condition have been variable across series, possibly as a result of increased difficulty in identifying the ECRB origin through the arthroscope. In one study, a consecutive series of 36 patients with recalcitrant lateral epicondylitis were treated with arthroscopic release. On average, patients required 4 weeks to return to regular activities and 7 weeks to return to full work duties. Ten patients (28%) reported continued pain with strenuous activities and repetitive use of the affected arm, and the treatment was considered a failure in two patients (6%) who continued to have substantial pain.

Arthroscopic release of the ECRB appears to be an effective option for the surgical treatment of chronic lateral epicondylitis that has failed to respond to nonsurgical management. Knowledge of the anatomy, including the extensor tendon origins as visualized from an intra-articular perspective, is essential for effective surgical release. Further series will determine how this treatment option fits into the armamentarium for management of this condition.

Illustrations of the view from the medial portal (left) and the relationship of the extensor tendon origins when viewed intra-articularly (right). The tendons are located outside (behind) the elbow capsule. The capsule is released from the lateral humerus margin, allowing visualization of the tendinous origins behind. The extensor carpi radialis longus (ECRL) is more anteriorly located and is muscular. The extensor carpi radialis brevis (ECRB) is more posterior. Note that the ECRB footprint origin is diamond shaped and located between the midline of the joint and the top of the humeral capitellum beneath the most distal extent of the supracondylar ridge. The ECRB is released from the top of the capitellum to the midline of the radiocapitellar joint. LCL = lateral collateral ligament. (Courtesy of Mark S. Cohen, MD, Chicago, IL.)

Intraoperative arthroscopic view from the anteromedial portal demonstrates the completed extensor carpi radialis brevis (ECRB) release, which has retracted distally. The muscular extensor carpi radialis longus (ECRL) is behind the ECRB release. (Courtesy of Mark S. Cohen, MD, Chicago, IL.)
Summary
Elbow arthroscopy is a useful tool to address pathology about the elbow; published studies to date document its effectiveness to address inflammatory and degenerative arthritis and lateral epicondylitis. It is important to understand the limitations of this technique, as well as potential complications and alternative procedures.

References


**Video Reference**