Review Article

Surgical Approaches to the Elbow

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Abstract

Surgical exposures for complex injuries about the elbow are technically demanding because of the high density of neurologic, vascular, and ligamentous elements around the elbow. The posterior approaches (ie, olecranon osteotomy, triceps-reflecting, triceps-splitting, triceps-reflecting anconeus pedicle flap, paratricipital) include techniques used to navigate the area around the triceps tendon and anconeus muscle. These approaches may be extended to gain access to the entire joint. The ulnar nerve, the anterior and posterior capsules, and the coronoid process are addressed by means of a medial approach. Lateral approaches are useful in addressing pathology at the radial head, capitellum, coronoid process, and anterior and posterior capsules. These approaches may be combined to address complex pathology in the setting of fracture fixation, arthroplasty, and capsular release.

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The recent literature reports a growing recognition of complex injuries of the elbow, such as anteromedial coronoid fractures, capitellar fractures, and terrible triad injuries, as well as posterolateral and posteromedial rotatory instability.[1-9] The high density of neurologic, vascular, and ligamentous elements around the elbow makes surgical exposures technically demanding. Complex elbow pathology should be treated using methods that facilitate maximum exposure, whether via a posterior, medial, or lateral approach.

Skin Incisions

Surgical exposures of the elbow commonly involve a so-called universal posterior skin incision. This allows circumferential access by the creation of full-thickness skin flaps medially and laterally, as needed. In addition, it avoids the creation of skin bridges, which could interfere with future surgery. Another advantage of a long posterior skin incision is that it crosses fewer and smaller cutaneous nerves than do lateral or medial skin incisions of similar size. Thus, there is a lesser chance of symptomatic cutaneous nerve injury (eg, paresthesia, painful neuroma).[10] A potential limitation of the posterior approach is the creation of large skin flaps; hematoma or seroma formation may occur in the dead space underneath these flaps postoperatively. Evacuation of large hematomas or seromas may require a return to the operating room. In the setting of large posterior skin flaps, we typically use a drain for the first 24 hours postoperatively and follow a protocol of strict elevation of the elbow in extension for the first 48 hours for edema control.

Alternatively, separate medial and lateral skin incisions may be performed for isolated medial and lateral exposures, or they may be combined to gain access to both the anterior and the posterior compartments of the elbow. Prior surgical

procedures should be carefully noted preoperatively. It may be necessary to incorporate previous incisions to avoid creating narrow skin bridges, which are susceptible to skin necrosis and wound complications.

Patient Positioning and Surgical Setup

We routinely position the patient supine with a small stack of towels placed underneath the ipsilateral scapula and with the arm draped across the chest after sterile preparation. The use of a sterile tourniquet allows for ease of removal if more proximal exposure of the humerus is needed. A sterile draped Mayo stand may be brought in from the contralateral side to support the forearm. The advantages of supine positioning include ease of access for the anesthesia team, ease of fluoroscopic visualization of the elbow when it is brought out laterally and, if needed, the ability to perform simultaneous procedures or gain access to harvest iliac crest bone graft. A disadvantage of this positioning is that an additional assistant may be needed to hold the arm.

The operating table should be tilted slightly away from the surgeon to aid in maintaining arm position for visualization and exposure. This positioning is optimal for fixation of distal humerus and radial head fractures and medial or lateral ligament reconstruction. When intraoperative fluoroscopic visualization will be needed, the machine should be placed on the ipsilateral side. The elbow may be brought out laterally from the chest for full access to the fluoroscope during the procedure.

Supine positioning is also appropriate for medial ligament repair or coronoid fracture fixation. A hand table may be used on the ipsilateral side to position the arm more accurately for medial elbow exposure. Advantages of this setup include ease in placing the arm across the chest and the ability to remove the hand table if a greater degree of exposure through a posterior or lateral approach is needed. Alternatively, the patient may be positioned in the lateral decubitus position on a beanbag with the entire upper extremity draped free. The advantage of this position includes ease of access to the posterior elbow for fracture fixation without the need for extra assistants. However, adequate positioning of the fluoroscope may not be possible.

Posterior Approaches

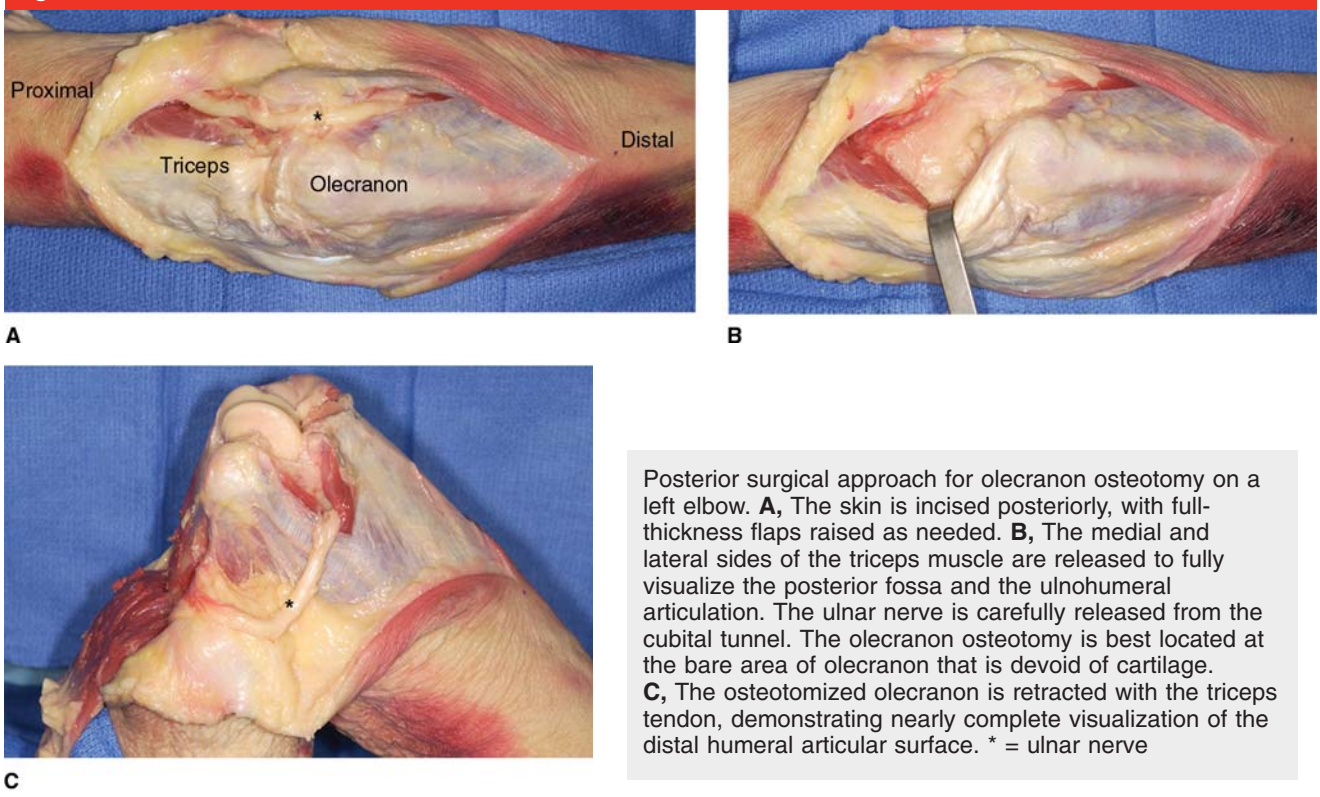
Posterior approaches to the elbow are indicated for procedures such as triceps tendon repair and total elbow arthroplasty, as well as open reduction and internal fixation of distal humerus fracture and olecranon fracture. Bony landmarks are marked, including the olecranon process and the subcutaneous border of the proximal ulna. The skin incision is begun proximal to the olecranon process centered on the triceps tendon. It is then taken distally to either the lateral or the medial side of the olecranon, according to surgeon preference, and is finished distally, following the subcutaneous border of the ulna. Full-thickness skin flaps are then developed. These are kept as thick as possible, with the deep plane consisting of the triceps fascia and epitenon proximally and the forearm fascia and ulnar periosteum distally. If the incision is extended on the medial side of the olecranon, care must be taken not to place the incision so far medially as to be directly over the cubital tunnel. Such placement may result in injury to the ulnar nerve, which is seated in the subcutaneous tissues (Figure 1).

The ulnar nerve is most easily found proximally between the medial intermuscular septum and the medial head of the triceps muscle. When the nerve will be transposed, it should be freed from proximal to distal to minimize damage to the motor branches. Articular branches are usually sacrificed; however, the first motor branch to the flexor carpi ulnaris (FCU) should be identified, mobilized, and preserved. The superficial fascia and the deep fascia of the FCU are identified and released. The distal edge of the medial intermuscular septum is palpated and excised to prevent tethering of the nerve after it is anteriorly transposed. The nerve is then placed into a subcutaneous pocket anterior to the medial epicondyle. Upon completion of the procedure, a suture is placed in the subcutaneous tissue and secured to the fascia. This is done to create a sling and prevent posterior subluxation of the nerve. The nerve should be palpated within the sling to confirm that there is not excessive tension within its soft-tissue surroundings. When the intent is to decompress the nerve rather than to transpose it, care should be taken to avoid destabilizing the nerve within the cubital tunnel. This is accomplished by leaving intact the soft-tissue constraints of the Osborne fascia.

We routinely transpose the ulnar nerve anteriorly into a subcutaneous pocket in the setting of fracture fixation for complex elbow fractures and total elbow arthroplasty. For posttraumatic contracture release, we routinely decompress the cubital tunnel retinaculum and leave the nerve in situ.

Posterior approaches for the purpose of fracture fixation and arthroplasty represent different ways to navigate around the extensor mechanism. Examples of such approaches are the olecranon osteotomy, triceps-reflecting (ie, Bryan-Morrey), triceps-splitting, triceps-reflecting anconeus pedicle flap, and paratricipital.[11]

Figure 1



Posterior surgical approach for olecranon osteotomy on a left elbow. **A,** The skin is incised posteriorly, with full-thickness flaps raised as needed. **B,** The medial and lateral sides of the triceps muscle are released to fully visualize the posterior fossa and the ulnohumeral articulation. The ulnar nerve is carefully released from the cubital tunnel. The olecranon osteotomy is best located at the bare area of olecranon that is devoid of cartilage. **C,** The osteotomized olecranon is retracted with the triceps tendon, demonstrating nearly complete visualization of the distal humeral articular surface. * = ulnar nerve

Olecranon Osteotomy

Olecranon osteotomy affords optimal visualization of the distal humerus articular surface for the treatment of intra-articular fractures. This approach may be best in terms of offering maximum exposure for intra-articular distal humerus fractures. Wilkinson and Stanley[12] compared the amount of distal humerus articular surface exposed with olecranon osteotomy, a triceps-splitting approach, and a triceps-reflecting approach. Olecranon osteotomy exposed more articular surface (57%) than did either the triceps-splitting approach (35%) or the triceps-reflecting approach (46%). Potential disadvantages to this approach are nonunion at the osteotomy site and formation of intra-articular adhesions because of the added intra-articular insult. In addition, when total elbow arthroplasty is needed rather than open reduction and internal fixation, the procedure may be compromised by the need to repair the osteotomy with the cemented prosthesis in place.

A posterior skin incision is used, and full-thickness skin flaps are created medially and laterally. Following identification and protection of the ulnar nerve, a capsulotomy is done on both the medial and the lateral sides of the olecranon at the midportion of the greater sigmoid notch. In a standard olecranon osteotomy, the medial triceps and the anconeus muscle are divided. This denervates the anconeus muscle, which receives its innervation through a terminal branch of the radial nerve passing from proximal to distal through the triceps. We prefer the Mayo modification, which preserves the anconeus muscle.[13,14] This modification uses an anconeus flap in continuity with an olecranon osteotomy. In this technique, the anconeus is detached as a flap from distal to proximal until the osteotomy site is reached. The proximal olecranon fragment and the anconeus are retracted proximally together to expose the distal humeral articular surface.

The osteotomy is created with an oscillating saw in a chevron configuration, typically with the apex pointed distally. An osteotome is used to complete the procedure so that a portion of the osteotomy site is serrated. This serrated area will provide improved interdigitation of the fragments for fixation at the end of the procedure.

The olecranon osteotomy site heals reliably with few complications.[15] However, hardware at the tip of the olecranon is often symptomatic, and subsequent removal of hardware at that location is common.[15]

When a cannulated screw or Kirschner wires (K-wires) are used, it is advantageous to place the hardware on the

proposed olecranon fragment before performing the osteotomy. This ensures anatomic creation of the tract for the hardware, which, in turn, facilitates optimal alignment of the osteotomy site at the end of the procedure. We use either two K-wires or a 6.5- or 7.3-mm cannulated screw and washer with an 18-gauge tension band wire. The drill hole for placement of the wire is located at a distance from the olecranon osteotomy equal to that of the distance of the osteotomy site to the tip of the olecranon. The osteotomy should be repaired by advancing the K-wires into the anterior ulnar cortex distal to the coronoid process. After the K-wires have reached the anterior cortex, they are backed out approximately 5 mm and bent 180°, then tapped back until they are buried under the triceps tendon. The triceps may then be sutured over the wires to discourage backout. Alternatively, a precontoured olecranon plate may be used.[16]

Triceps-reflecting

The Bryan-Morrey triceps-reflecting approach is performed by releasing the triceps tendon, forearm fascia, and periosteum as one unit from medial to lateral off the olecranon.[17,18] The ulnar nerve is identified and protected, after which a periosteal elevator is used to dissect the triceps muscle from the posterior humeral cortex. With a scalpel, the forearm fascia, periosteum, and triceps tendon are reflected directly off the olecranon from medial to lateral as a continuous sleeve. The triceps may be removed with a thin wafer of bone to facilitate bone-to-bone, rather than tendon-to-bone, healing at the triceps insertion site. Proximally, the entire extensor mechanism and posterior capsule are reflected as one unit from the distal humerus. The extensor mechanism is retracted laterally, and the elbow is flexed to expose the joint. The ulnar nerve should be monitored closely to avoid inadvertent traction injury as the triceps is retracted laterally during exposure. For total elbow arthroplasty, the medial and lateral collateral ligaments are also released off the distal humerus. At the end of the procedure, the triceps tendon is repaired back to the olecranon by means of two transosseous drill holes placed in a cruciate configuration. One additional drill hole is placed between the two holes in a transverse orientation using nonabsorbable suture. The triceps repair should be protected for 6 weeks postoperatively, during which time the patient must avoid active elbow extension against resistance.

Triceps-splitting

Triceps-splitting approaches may be limited proximally by the location of the radial nerve at the posterior one third of the humeral shaft. As with the triceps-reflecting approach, triceps-splitting approaches should be performed only after the ulnar nerve has been identified and protected. A posterior skin incision is made, and full-thickness skin flaps are created medially and laterally. The triceps tendon is identified several centimeters proximal to its insertion on the olecranon. In the triceps-splitting approach as described by Campbell,[19] a longitudinal incision is made from the proximal triceps muscle to the distal triceps tendon across its insertion on the proximal olecranon. The elbow joint is exposed as the anconeus is reflected subperiosteally and laterally off the proximal ulna, and as the FCU is reflected medially off the proximal ulna.

The Van Gorder approach is performed by separating the triceps muscle from the tendon, after which the triceps is transected as an inverted V.[20] This technique allows V- to Y-plasty lengthening of the musculotendinous unit. This may be necessary to optimize elbow flexion during capsular release in a stiff elbow. The triceps tendon is repaired with nonabsorbable suture at the end of the procedure. Postoperatively, the patient must avoid active elbow extension against resistance and passive stretching in positions of terminal elbow flexion for at least 6 weeks.

Triceps-reflecting Anconeus Pedicle Flap

The triceps-reflecting anconeus pedicle flap approach[21] requires a longer skin incision than is used during a standard posterior approach. The posterior skin incision is extended distally along the subcutaneous border of the ulna. The anconeus muscle is identified along the lateral aspect of the subcutaneous border of the ulna and is released by sharp subperiosteal dissection from its insertion on the proximal lateral ulna. As the incision is continued proximally, the anconeus muscle is released in its entirety from the ulna. The muscle is dissected off the annular ligament and the lateral collateral ligament complex, both of which are preserved. The dissection extends proximally underneath the triceps muscle, the posterior supracondylar ridge, and the distal humerus.

The Bryan-Morrey approach is used during the medial portion of this exposure. An incision is made on the subcutaneous border of the ulna. With a scalpel, the triceps insertion is carefully reflected from the tip of the olecranon from medial to lateral. The dissection from the medial side should progress laterally such that the distal planes of dissection meet on the ulna beneath the anconeus and the proximal tissue planes meet on the posterior surface of the humerus. The anconeus and triceps pedicle is reflected proximally to afford visualization of the distal humerus. Full flexion of the elbow per-

mits nearly the same exposure to the distal humerus as an olecranon osteotomy, with the exception of a small area consisting of the anterior trochlea.[21] The anconeus muscle can be completely detached from the distal lateral humerus and olecranon because its proximal vascular pedicle, the medial collateral artery, remains intact.[22] Postoperatively, the patient is allowed to perform active and passive motion of the elbow. However, the patient must avoid active elbow extension against resistance for a minimum of 6 weeks.

Paratricipital

The paratricipital approach as described by Alonso-Llames[11] has the advantage of maintaining the triceps insertion undisturbed, and it eliminates the risk of postoperative triceps insufficiency. This approach is commonly used for irreparable distal humerus fracture in elderly patients for whom a total elbow arthroplasty is planned. The approach is also useful for open reduction and internal fixation of distal humerus fractures. Visualization may be compromised by the presence of the intact triceps unit over the elbow joint.

A posterior skin incision is made, and the ulnar nerve is identified and protected. Medially, the tissue plane between the medial intermuscular septum and the medial side of the olecranon and triceps tendon is developed. Laterally, the plane between the lateral intermuscular septum and the anconeus muscle, which is in continuity with the lateral aspect of the triceps, is developed. The dissection between the medial and lateral tissue planes meets at the posterior humeral cortex as the triceps muscle is released from the humerus. The triceps tendon may be retracted medially or laterally, and fracture fixation is performed by retracting the triceps unit in either direction. Placing the elbow into an extended position relaxes the triceps and may result in improved visualization of the posterior elbow.

Medial Approaches

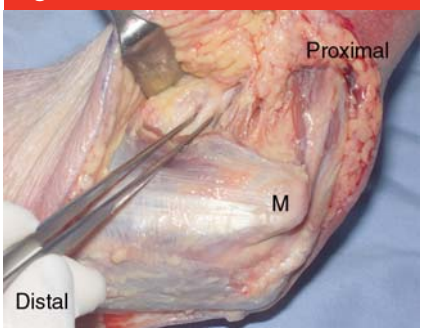
Medial approaches are useful for capsular release of stiff elbows and reconstruction of medial collateral ligament injuries. There are also medial approaches specific to coronoid fracture fixation.

Hotchkiss

The medial Hotchkiss approach, described for capsular release of stiff elbows, originally incorporated a longitudinal posteromedial skin incision.[23] The skin incision can be modified based on the need to expose other structures or to accommodate scars from prior exposures. Identification of the ulnar nerve is necessary for adequate and safe medial exposure. The nerve should be identified proximally, and subsequent dissection should be carried distally. In revision surgery and in cases with a prior ulnar nerve transposition, it is especially helpful to identify the nerve in a normal area, usually more proximally, before dissection is done within scar tissue. Once the nerve is safely identified, the medial supracondylar ridge is palpated along with the overlying medial intermuscular septum. The medial antebrachial cutaneous nerve, found on the fascia anterior to the septum, should be protected to prevent postoperative neuroma formation.

The medial intermuscular septum is identified, along with the medial supracondylar ridge. The brachial fascia is incised along the anterior aspect of the septum, and the flexor-pronator group is released from the supracondylar ridge. The flexor group is split longitudinally at the distal aspect, taking care to leave the posterior aspect of the FCU origin intact on the medial aspect of the distal humerus. The brachialis, flexor carpi radialis, and pronator teres muscles are elevated off the anterior capsule. Sufficient elevation of these muscles makes it possible to see across to the lateral aspect of the anterior elbow joint. A cuff of tissue may be left on the ridge so that the muscle group can be repaired at the end of the procedure. Subperiosteal dissection is performed deep to the brachialis to protect the brachial artery and the median nerve. The anterior band of the medial collateral ligament is preserved beneath the FCU (Figure 2).

Figure 2

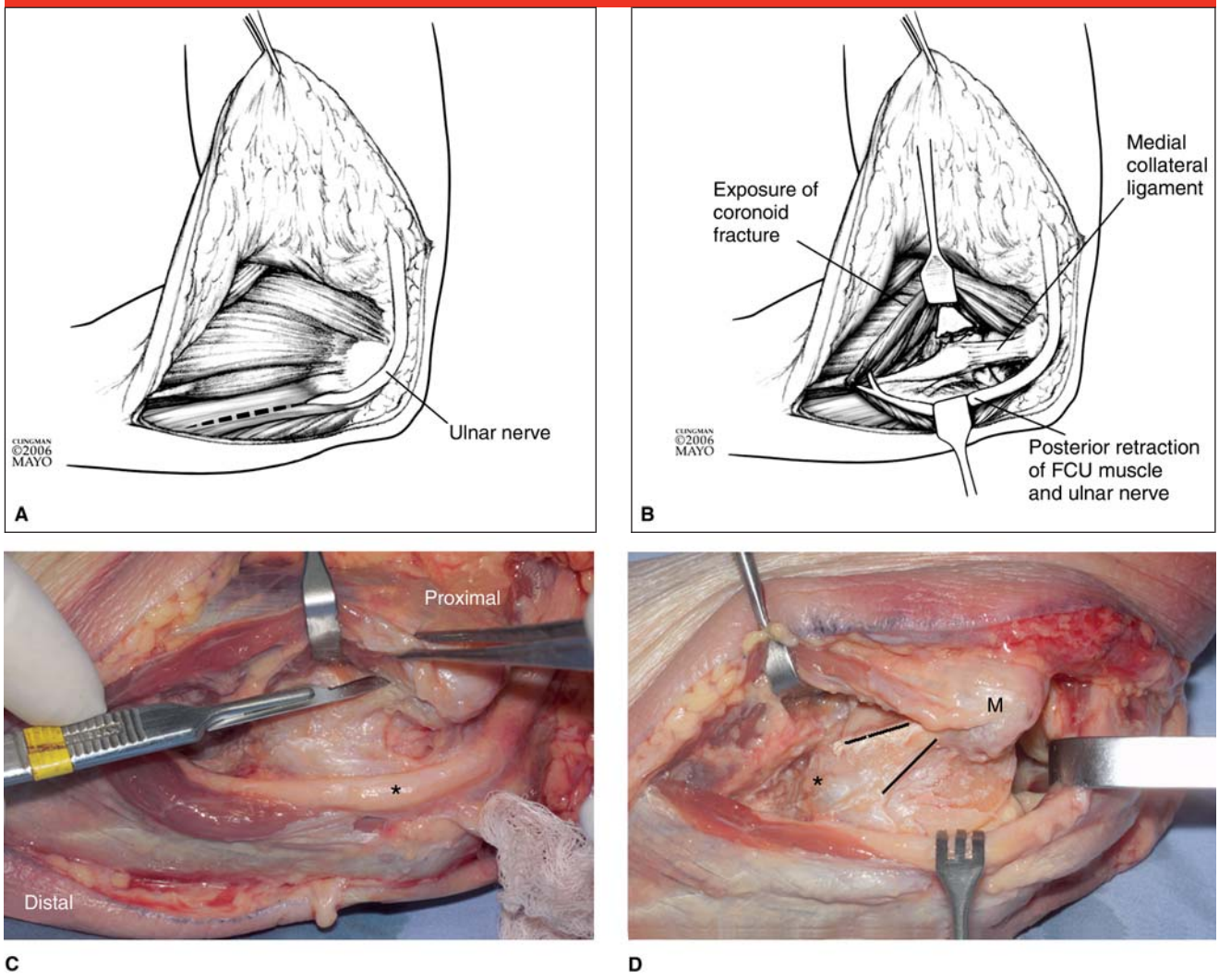


Medial surgical approach on a right elbow. The median nerve is found lateral and deep to the flexor pronator group, between the biceps and brachialis muscles (within the forceps in this photograph). M = medial epicondyle

Medial Coronoid Approach for Fracture Fixation

The medial coronoid process can be easily exposed through the floor of the cubital tunnel. A posterior or medial skin incision is used to expose the ulnar nerve. The nerve may be anteriorly transposed or gently retracted posteriorly during fracture fixation. Alternatively, it may be secured to a fasciocutaneous sling during fracture fixation to avoid excessive manipulation and inadvertent traction. The nerve may be left in place provided that there are no concerns for neuropathy and provided

Figure 3

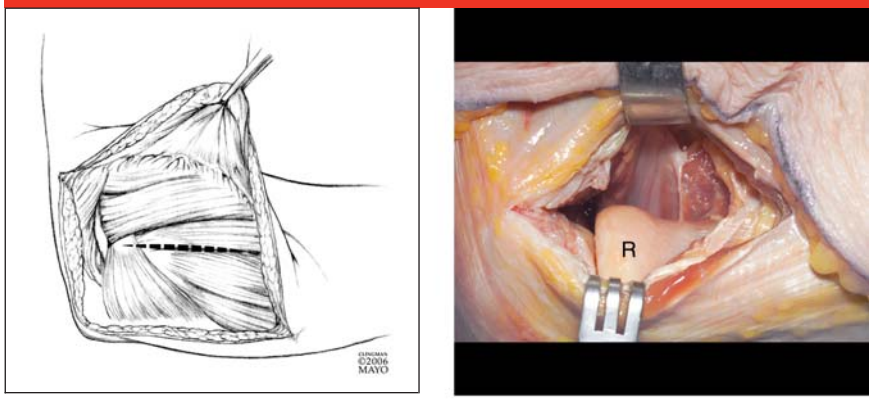


Medial approach to the coronoid process on a right elbow. **A,** Illustration demonstrating how the flexor carpi ulnaris (FCU) is split between the two heads (dashed line) to enable in situ release of the ulnar nerve. **B,** Illustration demonstrating the cubital tunnel retinaculum following release of the ulnar nerve. The floor of the cubital tunnel is exposed as the ulnar nerve is gently retracted posteriorly. **C,** Intraoperative photograph showing the ulnar nerve (*) after it has been carefully dissected off of the anterior band of the medial collateral ligament (MCL). **D,** Intraoperative photograph. The anterior band of the MCL lies between the lines. The base of the coronoid process (*) is exposed. The posterior and transverse bands of the MCL have been excised for the purpose of illustration. Reflection of the humeral head of the FCU laterally and superiorly allows nearly full visualization of the anterior bundle of the MCL. This exposure affords complete access to the coronoid process and the MCL as well as limited access to the posterior fossa. M = medial epicondyle. (Panels A and B reproduced with permission from the Mayo Foundation of Medical Education and Research, Rochester, MN.)

that it is not destabilized.

The two heads of the FCU are split. The anterior half is retracted anteriorly, and the posterior half is retracted posteriorly to expose the coronoid process. The anterior band of the medial collateral ligament is usually attached to a large anteromedial coronoid fragment. Care should be taken not to detach the ligament from this fragment. In the presence of intact capsular attachments, the surgeon can judge fracture reduction based on realignment of the metaphyseal fracture fragments. Dissection of the FCU muscle fibers from the medial collateral ligament is begun distally, and the muscle should be brought proximally to avoid damaging the ligament and potentially destabilizing the elbow. The insertion of the MCL on the sublime tubercle should be identified. The coronoid process will be in the deep portion of

Figure 4



A B

A, Illustration demonstrating the Kaplan (lateral) approach to the right elbow, which involves splitting the extensor communis group (dashed line). Special care must be taken to avoid damaging the lateral antebrachial cutaneous nerve, which travels within the fat at the distal aspect of this incision. **B,** Intraoperative photograph demonstrating excellent exposure of the radial head (R) and neck. Pronating the forearm during retraction of the anterior structures will reduce tension on the posterior interosseous nerve. (Panel A reproduced with permission from the Mayo Foundation of Medical Education and Research, Rochester, MN.)

the wound, anterior to the ligament (Figure 3). When the coronoid process fragment is large, the FCU may be reflected anteriorly using subperiosteal dissection from the proximal ulna, including the flexor-pronator mass proximally, as described by Taylor and Scham.[24] Care must be taken to protect the ulnar nerve, which may need to be transposed to minimize postoperative or posttraumatic ulnar neuritis.

Lateral Approaches

The lateral approach to the elbow has become a standard means to gain access for contracture release and to manage fractures on the lateral side of the elbow, such as of the radial head and the capitellum. Variations of the lateral exposure include the Kaplan, the Kocher, and the lateral column.

Kaplan

The Kaplan approach provides excellent exposure of the radial head without interruption of the lateral ulnar collateral ligament (LUCL).[25] With the elbow at 90° of flexion, the skin incision is begun at the tip of the lateral epicondyle and is extended distally approximately 3 to 4 cm toward Lister's tubercle. This approach uses the superficial interval between the extensor digitorum communis and the extensor carpi radialis longus and brevis. At the deep level, the incision splits the lateral annular ligament complex but remains anterior to the LUCL along the equator of the radiocapitellar joint.

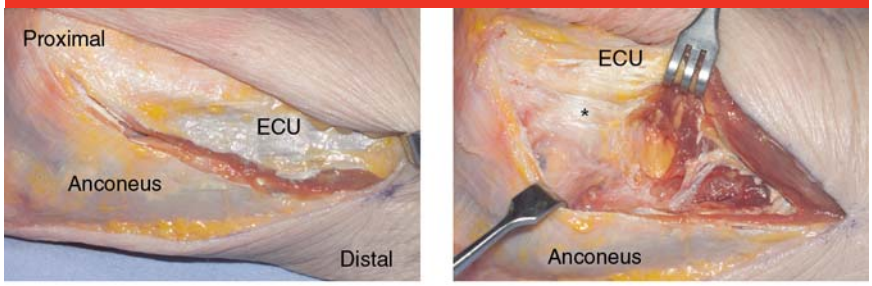
One pitfall of the Kaplan approach is locating it too anterior and causing inadvertent injury to the posterior interosseous nerve (PIN). The forearm should be pronated to maximize the distance from the PIN.[26] Another limitation of this approach is that distal extension can endanger the PIN[27] (Figure 4). Yet another disadvantage of the Kaplan approach is that an associated lateral collateral ligament tear can be more difficult to repair because it requires release of the remaining extensor digitorum communis on the lateral epicondyle down to the isometric point.

Kocher

A more widely known approach to the radial head is through the Kocher interval, between the extensor carpi ulnaris (ECU) muscle and the anconeus.[28] The skin incision extends from several centimeters above the lateral epicondyle and curves distally over the ulnar border of the ECU muscle belly. The fascia is incised from the lateral epicondyle distally following the junction of the ECU and anconeus. Often there is a fat stripe defining this interval. The ECU is retracted anteriorly, and the anconeus is retracted posteriorly. The capsule is incised along the anterior border of the LUCL, about 1 cm above the supinator crest. Palpation of the radiocapitellar joint is helpful, as is making the incision along the equator of the capitellum. Care should be taken to preserve the lateral collateral ligament complex, which lies below the equator of the capitellum, and to avoid destabilizing the elbow[9] (Figures 5 and 6).

The Kocher approach can be extended both proximally and distally, as in the case of an LUCL reconstruction. Proximal dissection is achieved by elevating the common extensor tendon off the supracondylar ridge. The radial nerve may be found proximally approximately 8 to 10 cm above the lateral epicondyle as it crosses the lateral intermuscular septum from the spiral groove.[29] Distally, the PIN is found in the area of the radial neck approximately 3 to 4 cm distal to the radiocapitellar joint with the forearm in supination.[26] Diliberti et al[26] demonstrated that this distance increases with pronation because the nerve travels in a line closer to parallel with the long axis of the radius.

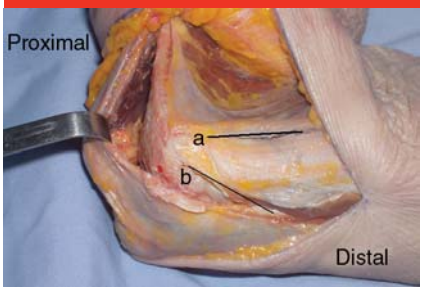
Figure 5



A B

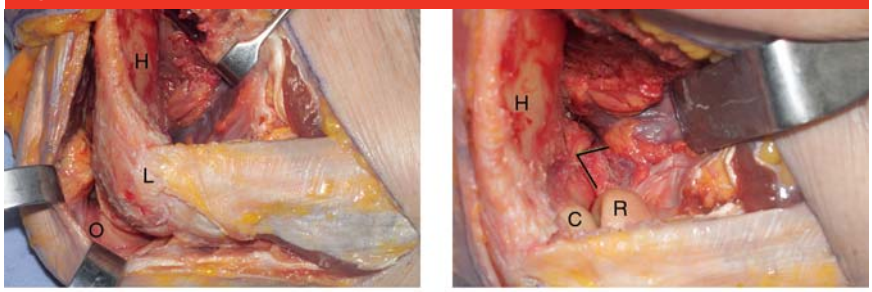
The Kocher approach on a right elbow. **A,** This approach lies between the anconeus muscle and the extensor carpi ulnaris (ECU) muscle. Care must be taken to develop this interval between the lateral collateral ligament (LCL) complex and the ECU. **B,** The capsule (*) is seen deep to this interval. The capsule should be incised anterior to the equator of the radial head to preserve the LCL complex.

Figure 6



Lateral view of a right elbow demonstrating the relative location of the Kaplan approach (line a) and of the Kocher approach (line b).

Figure 7



A B

The lateral column approach on a right elbow for the release of extrinsic elbow contracture. **A,** The dissection is continued proximally on the anterior and posterior sides of the lateral humerus. The surgeon must be mindful at all times of the lateral collateral ligament origin. The brachioradialis muscle is elevated anteriorly to allow full visualization of the anterior joint. **B,** The tip of the coronoid process (within the lines drawn on this photograph) may be seen within the depth of the wound. C = capitellum, H = humerus, L = lateral epicondyle, O = olecranon, R = radial head

Lateral Column

The lateral column procedure has been described for the treatment of extrinsic contracture of the elbow.[30] It consists of arthrotomy, release of the anterior and posterior capsule, and excision of osteophytes through a lateral approach to regain motion. It may be done in conjunction with the medial Hotchkiss approach for severe contractures,[23] as an alternative to a large posterior skin incision.

The lateral skin incision that is made is the same as that for the proximal one half of the Kocher incision, extending from 6 cm proximal to the epicondyle to 3 cm distal to it. The origin of the extensor radialis longus muscle and distal fibers of the brachioradialis muscle are released from the lateral column of the distal humerus. This provides direct access to the superolateral aspect of the capsule. The brachialis muscle is swept from and separated from the anterior capsule with a periosteal elevator. A blunt-angled retractor is placed anteriorly to protect the brachialis muscle, the radial nerve, the median nerve, and the brachial artery. The lateral aspect of the anterior capsule is grasped and excised as far medially as can be safely visualized. The medial aspect of the capsule is incised to complete the release.

It may be necessary to address the posterior compartment of the elbow. In this case, the triceps muscle is released off the lateral column of the humerus with a periosteal elevator, adhesions from the triceps muscle belly are released off the posterior humerus, the posterior capsule is excised, and the olecranon fossa is cleared of scar tissue. Care must be taken when moving medially at the level of the olecranon fossa underneath the triceps to protect the ulnar nerve along the posteromedial border of the triceps muscle (Figure 7).

Summary

Several surgical approaches exist for addressing pathology about the elbow. A posterior incision may require large skin flaps to navigate around the triceps muscle and tendon and, if necessary, around to the anterolateral and anteromedial sides of the elbow. Variations of medial and lateral approaches may be very effective provided that the surgeon has a thorough understanding of the location of the ulnar and radial

nerves as well as of the respective collateral ligament complexes. An appreciation of the relevant neurovascular and ligamentous structures is critical to safely performing surgical procedures about the elbow.

References

Evidence-based Medicine: No level I or II prospective, randomized studies are cited. References 1-12, 14-18, 20-27, and 30 are level III and IV case-control or cohort studies.

Citation numbers printed in **bold type** indicate references published within the past 5 years.

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