

# Arthroscopic Elbow Osteocapsular Arthroplasty



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**Abstract:** Treatment of primary elbow osteoarthritis in the young active patient less than 50 years old presents a treatment challenge to the practicing orthopaedic surgeon. Following failure of nonoperative management, surgical goals are aimed at reducing pain and improving joint mobility from bony impingement. Arthroscopic osteocapsular arthroplasty is a viable treatment option with few post-operative limitations. In contrast, total elbow arthroplasty is considered a salvage option in this patient population given the activity restrictions imposed. Osteocapsular arthroplasty combines soft tissue and bony debridement, osteophyte/loose body removal, synovectomy, capsular release, and bony contouring of the humerus and ulna to allow impingement-free range of motion.

The prevalence of symptomatic elbow osteoarthritis in the male population older than 40 years is 3.5%.<sup>1,2</sup> The treatment of elbow arthritis in such young active patients can be challenging. Total elbow arthroplasty is considered a salvage option given limitations of implant longevity and restrictions from heavy lifting.<sup>3</sup>

Osteocapsular arthroplasty (OCA) combines soft issue and bony debridement, osteophyte/loose body removal, synovectomy, capsular release, and bony contouring of the humerus and ulna.<sup>1</sup> Several studies have demonstrated that OCA can minimize pain, improve range of motion, and reduce impingement.<sup>1,4-11</sup> However, arthroscopic OCA is not widely used given its technical challenges and potential for neurovascular injury. We present our technique for performing arthroscopic elbow OCA. The indication for surgery is elbow stiffness and terminal arc pain from osteophyte

impingement with a majority of preserved articular cartilage (Fig 1).

## Surgical Technique

### Anesthesia and Positioning

We provide general anesthesia to perform a post-operative neurologic examination. The patient is positioned in the lateral decubitus position on a bean bag. The nonoperative extremity is forward flexed, externally rotated, and placed on a padded arm board. A padded roll is placed under the patient's contralateral axilla. The operative extremity is draped over an elbow arm holder with the forearm perpendicular to the floor. Extremity mobility is assessed to ensure (1) the elbow can be adequately ranged to identify sites of impingement (Fig 2), and (2) that surgical instruments will not be impeded.

### Diagnostic Arthroscopy

After draping, all relevant surface anatomy is marked (Fig 3, A and B). The tourniquet is raised to 250 mmHg. The elbow joint is insufflated with 15 mL of normal saline through the lateral soft spot. The proximal anteromedial (PAM) portal is created by incising only skin with a No. 11 blade scalpel; a straight blunt clamp is used to spread soft tissues down to capsule to avoid trauma to the medial antebrachial cutaneous and ulnar nerves. A blunt trocar within an arthroscopic sheath is inserted with a trajectory toward the radiocapitellar joint; entry into the joint is confirmed by efflux of saline fluid. A standard 4.0-mm, 30° viewing arthroscope (Smith & Nephew, Andover, MA) is inserted (Fig 3C). The radial head, capitellum, coronoid, and coronoid

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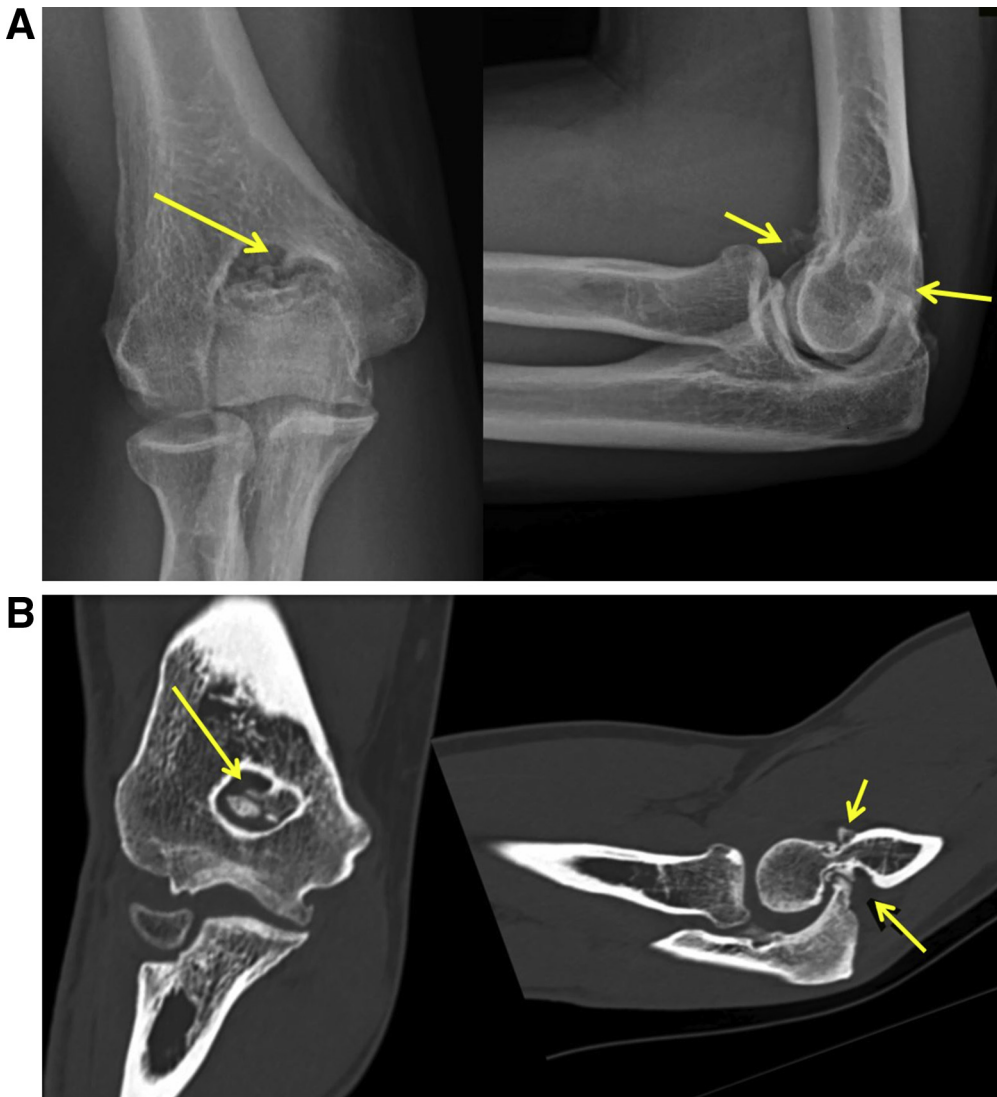
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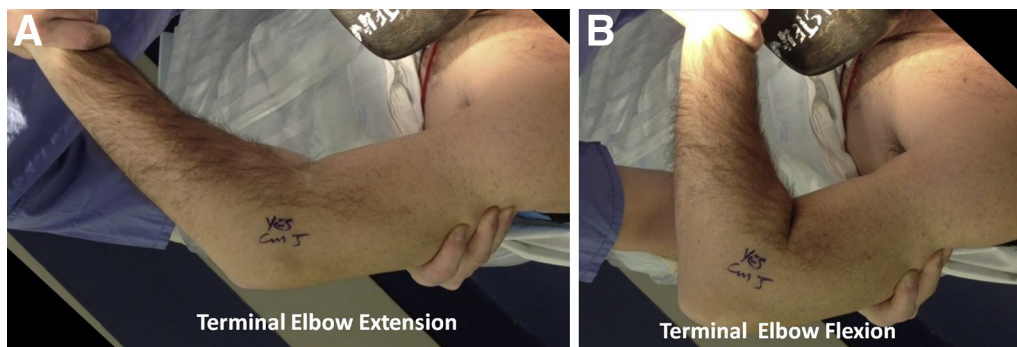
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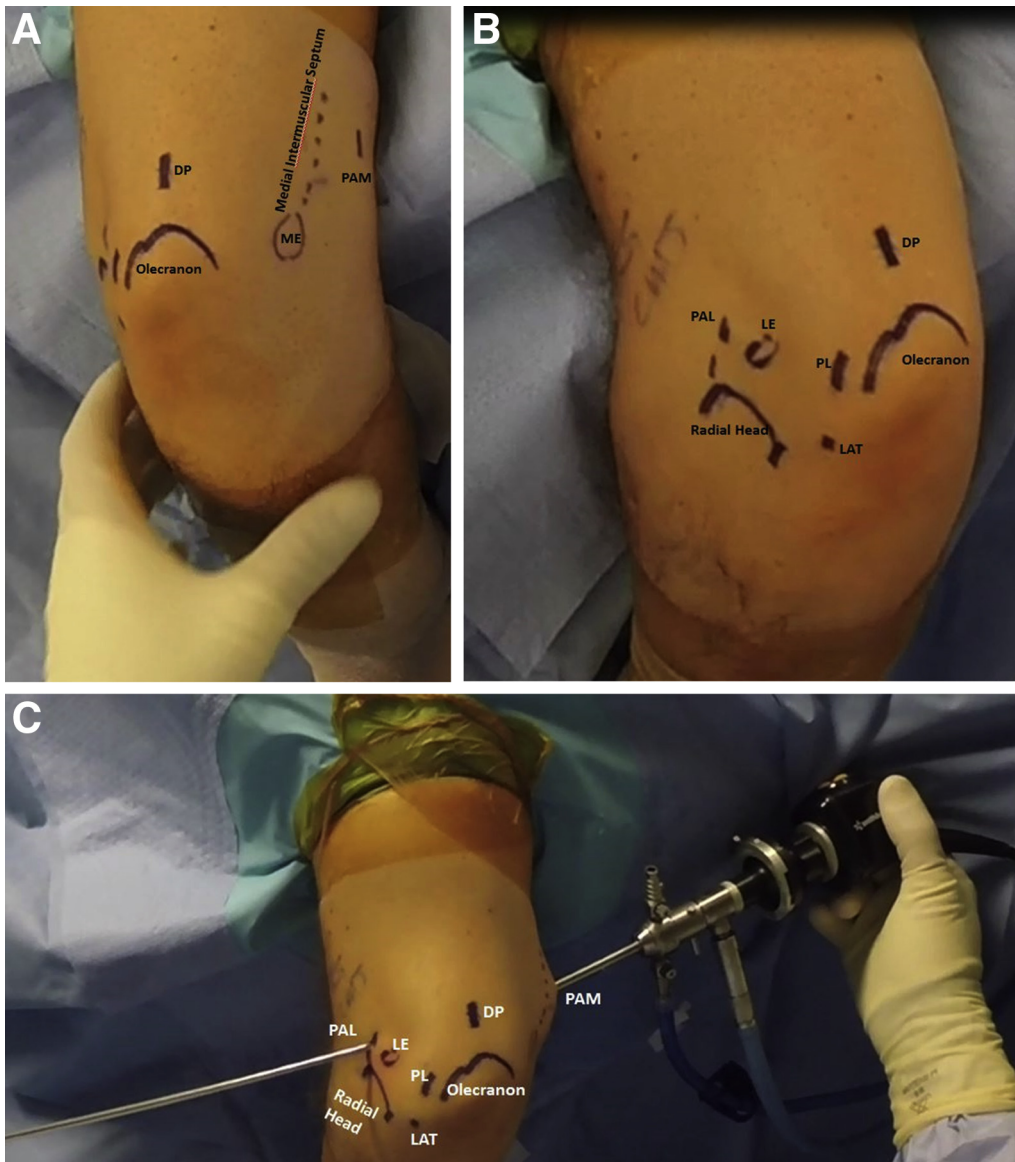
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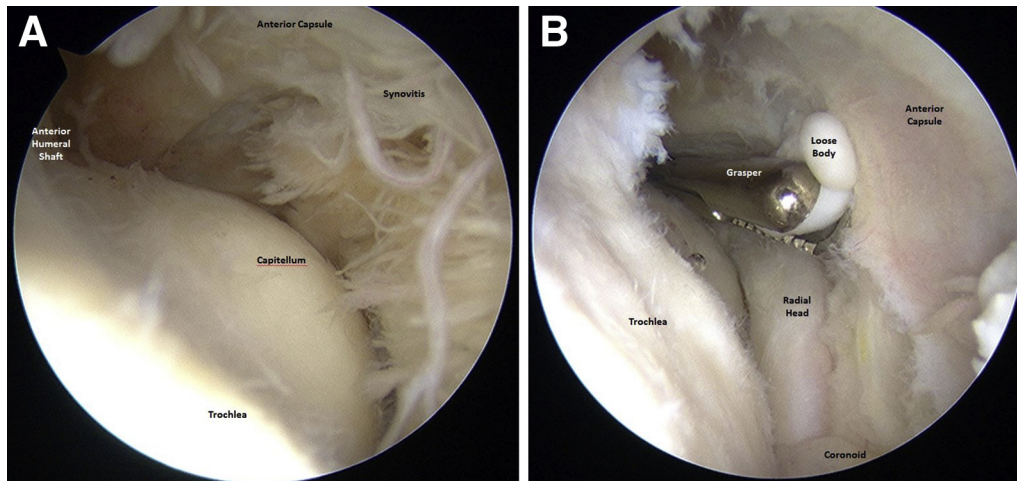
**Fig 1.** (A) Anteroposterior (AP) and lateral radiographs of the left elbow demonstrate degenerative changes with impinging osteophytes and preserved joint spaces. On the AP radiograph, the arrow shows olecranon tip and fossa osteophytes disrupting the normal contour of the olecranon fossa. On the lateral radiograph, yellow arrows indicate the presence of osteophytes in the anterior and posterior compartments of the elbow, filling portions of the coronoid and olecranon fossae. (B) Coronal and sagittal computed tomography (CT) slices provide better visualization of the intra-articular pathology as well as the bony morphology of the osteophytes, causing mechanical impingement during elbow extension and flexion. Loose bodies and osteophytes are seen in the olecranon fossa and coronoid fossa (arrows).



**Fig 2.** (A) The patient is placed in the lateral decubitus position with the arm draped over an elbow arm holder. Prior to prepping and draping, the examination under anesthesia is performed to confirm passive range of motion. The patient's terminal passive elbow extension is shown; the viewpoint is from that of the surgeon looking down at the extremity from the head of the bed as an assistant maximally passively extends the elbow. (B) The patient's terminal passive flexion is shown; the viewpoint is from that of the surgeon looking down at the extremity from the head of the bed as an assistant maximally passively flexes the elbow.



**Fig 3.** (A) The bony and soft tissue landmarks as well as potential portals to be used are marked after positioning in a lateral decubitus position and draping with the arm bent over an arm holder. The view is of the posterior elbow. On the medial side of the elbow, the olecranon tip, medial epicondyle (ME), and medial intermuscular septum are marked after palpation. Potential portals include (1) the proximal anteromedial portal (PAM) marked 2 cm proximal to the ME and anterior to the medial intermuscular septum, and (2) the direct posterior portal (DP) marked 2 cm proximal to the olecranon tip in the midline of the triceps tendon. The top of the photo is toward the shoulder, and the bottom edge of the photo is toward the hand; medial is to the right, and lateral is toward the left. (B) In a similar manner, on the lateral side of the elbow, the relevant bony landmarks and potential portals are marked including the olecranon tip, the radial head, and the lateral epicondyle (LE). Potential portals to be used are: the DP portal, the posterolateral (PL) portal approximately 1.5 cm from the proximal edge of the olecranon just lateral to the triceps tendon, the proximal anterolateral (PAL) portal approximately 1.5 cm proximal to the LE and 1 cm anterior to the lateral intermuscular septum, and the direct lateral portal (LAT), which the “soft spot” formed between the LE, radial head, and olecranon. This image is taken from the viewpoint of the surgeon looking down onto the posterior aspect of the elbow with the patient in the lateral decubitus position; the top of the photo is toward the shoulder and the bottom of the photo is toward the hand, with the lateral facing left and the medial facing right. (C) In a similar manner, on the lateral side of the elbow, the relevant bony landmarks and potential portals are marked including the olecranon tip, the radial head, and the lateral epicondyle (LE). Potential portals to be used are the DP portal, the posterolateral (PL) portal approximately 1.5 cm from the proximal edge of the olecranon just lateral to the triceps tendon, the proximal anterolateral (PAL) portal approximately 1.5 cm proximal to the LE and 1 cm anterior to the lateral intermuscular septum, and the direct lateral portal (LAT) which the “soft spot” formed between the LE, radial head, and olecranon. This image is taken from the viewpoint of the surgeon looking down onto the posterior aspect of the elbow with the patient in the lateral decubitus position; the top of the photo is toward the shoulder and the bottom of the photo is toward the hand, with the lateral facing left and the medial facing right.



**Fig 4.** (A) Viewing from the PAM portal, the anterior compartment of the elbow is evaluated. Specifically, the anterior radio-capitellar articulation is seen. Extensive synovitic fronds descending from the anterior capsule obscure visualization of the radiocapitellar joint in the top right. The anterior humeral shaft is to the left, the radial head to the right, and the ulnohumeral and radiocapitellar articulations are at the bottom of the image but obscured by synovitis. (B) Viewing from the PAM portal, the anterior compartment of the elbow is evaluated. Specifically, the anterior radio-capitellar articulation is seen. Extensive synovitic fronds descending from the anterior capsule obscure visualization of the radiocapitellar joint in the top right. The anterior humeral shaft is to the left, the radial head to the right, and the ulnohumeral and radiocapitellar articulations are at the bottom of the image but obscured by synovitis.

fossa are submaximally visualized given the extensive synovitis (Fig 4A).

### Anterior Compartment Debridement

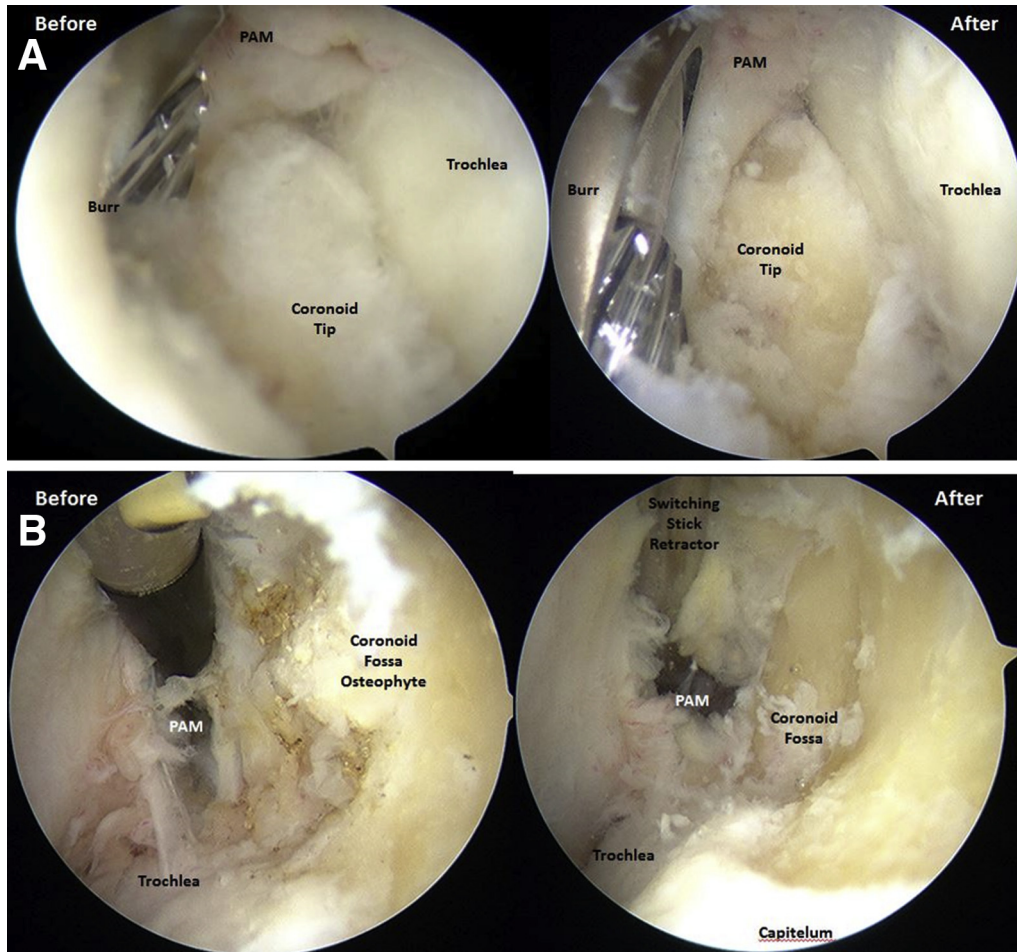
A proximal anterolateral (PAL) portal is created 1 to 2 cm proximal to the lateral epicondyle and 1 cm anterior to the lateral intermuscular septum. A guide pin is inserted at the portal site and triangulated to assess for adequacy in location. A series of sequentially larger dilators (Arthrex Elbow Arthroscopy Set, Naples, FL) is inserted over the guide pin to facilitate passage of instruments. The working space can be increased by stripping the anterior capsule off the anterior humerus with a sweeping motion with a switching stick through the PAL portal. A 3.5-mm arthroscopic shaver (Smith & Nephew) is introduced to debride accessible synovitis. If visualization is still difficult, then a retractor switching stick can be inserted in an accessory PAL (aAL) portal site 1.5 cm proximal to the original PAL portal. Suction on the shaver must be precisely controlled to avoid drawing in the anterior capsule and overlying median nerve and brachial artery. Outflow suction from the arthroscope can be used to bring loose bodies into view. The shaver is also used to reduce the size of large loose bodies so they may be extracted through the proximal AL portal.

An arthroscopic grasper (Arthrex Elbow Arthroscopy Set) is introduced into the PAL portal to remove loose bodies (Fig 4B). The loose bodies are securely gripped by the grasper and removed with a twisting pronation/supination maneuver. The loose body must be securely

grasped so it does not become dislodged in the extra-articular tissues. Control of loose bodies may be achieved by (1) percutaneous insertion of an 18-gauge spinal needle, or (2) creation of an aAL portal for passage of an arthroscopic retractor, switching stick, or Freer elevator.

### Contouring of Coronoid and Coronoid Fossa

While visualizing from the PAM portal, a 3.5 mm shaver is inserted through the PAL portal to debride the coronoid of overlying tissue. Osteophytes present in the coronoid fossae and around the radiocapitellar joint should be debrided as well and an ablation device can isolate the coronoid tip from anterior capsule. Once the native contour of the coronoid is visualized, an arthroscopic burr (Smith & Nephew) is introduced through the PAL portal to debride sharp osteophytes and sclerotic bone (Fig 5 A and B). An aAL portal may be created for insertion of a retractor to elevate the anterior capsule away from the joint and increase working space. For precise control, shorten the grip on the burr by holding it at the shaft. To visualize the entire coronoid tip, the elbow should be flexed. Contour the coronoid and fossa until the normal shape has been restored. Burring the osteophytes in the coronoid fossa should continue up to the cartilage margin of the trochlea and any soft osteophytic bone should be removed. Osteophyte burr resection depth is adequate once the hard cortical bone beneath the osteophytes is encountered. If there is difficulty in getting the shaver/burr over the radial head to access the coronoid



**Fig 5.** (A) Viewing from the PAM portal, the anterior compartment of the elbow is evaluated. Specifically, the anterior radiocapitellar articulation is seen. Extensive synovitic fronds descending from the anterior capsule obscure visualization of the radiocapitellar joint in the top right. The anterior humeral shaft is to the left, the radial head to the right, and the ulnohumeral and radiocapitellar articulations are at the bottom of the image but obscured by synovitis. (B) Viewing from the PAM portal, the anterior compartment of the elbow is evaluated. Specifically, the anterior radiocapitellar articulation is seen. Extensive synovitic fronds descending from the anterior capsule obscure visualization of the radiocapitellar joint in the top right. The anterior humeral shaft is to the left, the radial head to the right, and the ulnohumeral and radiocapitellar articulations are at the bottom of the image but obscured by synovitis. (C) Viewing from the PAM portal, the anterior compartment of the elbow is evaluated. Specifically, the anterior radiocapitellar articulation is seen. Extensive synovitic fronds descending from the anterior capsule obscure visualization of the radiocapitellar joint in the top right. The anterior humeral shaft is to the left, the radial head to the right, and the ulnohumeral and radiocapitellar articulations are at the bottom of the image but obscured by synovitis.

tip/fossa, then the PAL portal may be used for visualization while the PAM portal is used for instrumentation.

### Anterior Capsulotomy

Use the shaver to detach the capsule proximally from the medial and lateral supracondylar ridges of the humerus. An arthroscopic biter with blunt nose for capsular dissection (Arthrex Elbow Arthroscopy Set) is introduced through the PAL portal to further resect adhesions. A plane is developed between the brachialis muscle and anterior capsule with the blunt nose of this

biter. Then the arthroscopic biter is used to perform a capsulotomy from lateral to medial, limited distally by the radiocapitellar joint to avoid injury to the posterior interosseous nerve (Fig 5C). The arthroscope is then switched to the PAL portal and the arthroscopic biter is introduced into the PAM portal to complete the capsular incision medially. The medial extent of the release should not go beyond the medial intermuscular septum to avoid injury to the ulnar nerve. Anterior capsular release is complete once the brachialis muscle fibers are visualized. The elbow is ranged to assess adequacy of capsular release and lack of anterior bony impingement.

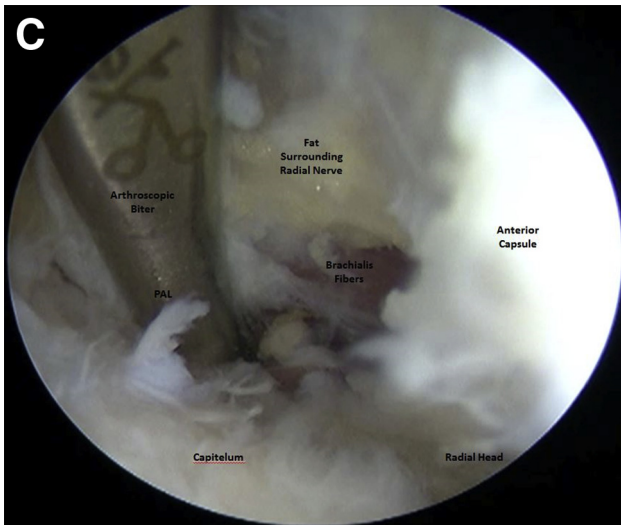


Fig 5. Continued.

### Posterior Compartment Debridement

A posterolateral visualization portal is created along the lateral border of the triceps, approximately 1.5 cm proximal to the olecranon tip. A direct posterior (DP) working portal is created in the midline of the triceps tendon, approximately 3 cm proximal to the olecranon tip. A 3.5 mm shaver is used to debride the hypertrophic tissue found in the posterior compartment (Fig 6A). Loose bodies are removed from the olecranon fossa with a grasper. Loose bodies encased in fibrous

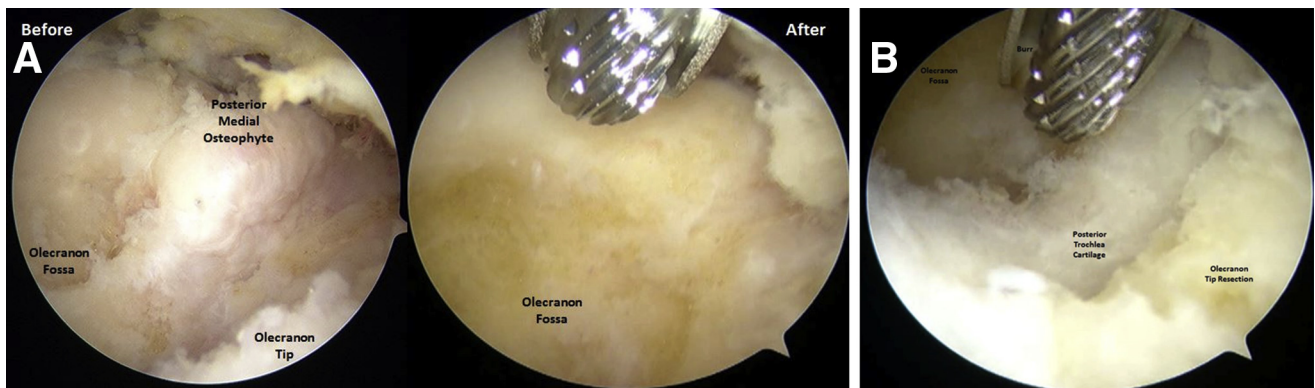
tissue are initially freed with an arthroscopic osteotome (Arthrex Elbow Arthroscopy Set) and subsequently retrieved with the grasper. Any remaining adhesions in the posterolateral gutter should be released with a shaver. When working in the posteromedial gutter, cautery and suction are avoided given the proximity of the ulnar nerve. Satisfactory olecranon bone debridement is achieved when the articular cartilage on the trochlea can be easily visualized with 45° flexion.

### Contouring of Olecranon and Olecranon Fossa

A burr and arthroscopic osteotome are used to remove sclerotic osteophytes from the olecranon. Care is taken to not remove any native bone from the olecranon to avoid creating iatrogenic instability. The burr is then used to contour the olecranon fossa (Fig 6B). To re-create a normal olecranon fossa, expose the hard cortical floor and walls of the fossa and then circumferentially remove osteophytes and fibrous tissue from the surrounding margins. A 10-mm acorn-shaped reamer (Smith & Nephew) can be used (see Video 1). Range of motion should be assessed to ensure no posterior sites of bony impingement remain.

### Postoperative Protocol

All incisions are closed with No. 4-0 nylon sutures and the elbow is splinted to accentuate extension. Radiographs are done in the recovery room (Fig 7), and an upper extremity neurologic examination is done to assess for nerve injury. The patient is discharged home



**Fig 6.** (A) A posterior compartment arthroscopy is performed viewing from the posterolateral (PL) portal and working through the direct posterior (DP) portal. The synovitis and posterior joint capsule are debrided with a shaver to expose the olecranon fossa. Ablation device is used to clear the tissue from the osteophytes in the fossa and from the olecranon tip. Ablation is kept away from the ulnar nerve and the cubital tunnel. The “Before” image (on the left) demonstrates a posteromedial osteophyte encroaching on the olecranon fossa. Using a 4.0-mm hooded burr, 10-mm acorn burr and osteotomes the osteophytes are removed and the underlying native cortical bone is exposed, as seen in the “After” image (on the right). The orientation is such that proximal is toward the top of the image, distal to the bottom, medial to the right, and lateral to the left. (B) The olecranon tip is commonly resected using an arthroscopic osteotome through the DL portal with the elbow in 45° extension. Ablation is used to expose the proximal 1 cm of the tip. Final contouring of the olecranon after osteophyctomy is done using the 4.0-mm burr with the elbow in extension to prevent injury to the posterior trochlear cartilage. Satisfactory olecranon bone debridement is achieved when the articular cartilage on the trochlea can be visualized with 45° flexion. At the conclusion of debridement and contouring, the elbow should be taken through a ROM to assess for any remaining sites of impingement. A gentle manipulation in extension can help release any remaining anterior compartment contracture. The image orientation is proximal toward the top of the image, distal to the bottom, medial to the right, and lateral to the left.



**Fig 7.** The olecranon tip is commonly resected using an arthroscopic osteotome through the DL portal with the elbow in 45° extension. Ablation is used to expose the proximal 1 cm of the tip. Final contouring of the olecranon after osteophyctomy is performed using the 4.0-mm burr with the elbow in extension to prevent injury to the posterior trochlear cartilage. Satisfactory olecranon bone debridement is achieved when the articular cartilage on the trochlea can be visualized with 45° flexion. At the conclusion of debridement and contouring, the elbow should be taken through a ROM to assess for any remaining sites of impingement. A gentle manipulation in extension can help release any remaining anterior compartment contracture. The image orientation is proximal toward the top of the image, distal to the bottom, medial to the right, and lateral to the left.

the same day. At the 2-week postoperative visit, sutures are removed and aggressive physical therapy for elbow range of motion is initiated (Fig 8).



**Fig 8.** Postoperative range of motion of the left elbow in flexion (top) and extension (bottom) demonstrating significant improvement in motion to near-normal elbow motion.

## Discussion

The treatment of primary elbow osteoarthritis in the active patient less than 50 years old is challenging. OCA is a viable option for these patients with elbow stiffness and terminal arc pain. Results following this procedure, whether done open or arthroscopically, have generally been excellent.<sup>1,4-11</sup> Arthroscopic OCA can be technically challenging but also affords the benefits of arthroscopic over open surgery.<sup>12</sup> Pearls and pitfalls of the procedure are outlined in Table 1.

The benefits of arthroscopic OCA are decreased soft tissue dissection, decreased postoperative pain, and quicker rehabilitation (Table 2).<sup>12</sup> Improved

**Table 1.** Pearl and Pitfalls of Arthroscopic Elbow Osteocapsular Arthroplasty

Pearls and Pitfalls
• Simulation of surgical elbow ranging prior to prepping and draping can minimize positioning issues during the case.
• Spinal needles can be used to control loose bodies prior to grasping.
• Use accessory portals for placement of retractors to protect neurovascular structures.
• Suction should be avoided adjacent to the anterior capsule to prevent drawing anterior neurovascular structures toward the suction.
• Perform anterior capsulotomy distal to radial head to minimize injury to posterior interosseous nerve.
• Inspection of the radiocapitellar joint is critical as lack of necessary debridement can lead to failure to achieve maximal motion.
• Suction should be avoided in the posteromedial gutter to avoid injury to the ulnar nerve.
• When contouring bone, demarcation between pathologic and normal tissue must be recognized to avoid removing excess bone.
• Dynamic ranging of the elbow should be performed during the case to identify any and all sites of impingement.

**Table 2.** Advantages and Disadvantages of Arthroscopic Elbow Osteocapsular Arthroplasty

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Advantages
<ul style="list-style-type: none"> <li>• Decreased soft tissue dissection</li> <li>• Decreased postoperative pain</li> <li>• Quicker recovery</li> <li>• Better cosmetic results</li> <li>• More complete intra-articular visualization</li> </ul>
Disadvantages
<ul style="list-style-type: none"> <li>• Technically demanding procedure</li> <li>• Risk for neurovascular injury</li> <li>• Limited visualization depending on patient anatomy and pathology</li> <li>• Cannot release ulnar nerve arthroscopically</li> <li>• May require conversion to open elbow release</li> </ul>

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visualization through an arthroscope can be debated—elbows can be contracted and, thus, limit the number of portals that can be safely accessed and/or limit the quality of visualization. The risk of arthroscopic OCA is neurovascular injury when creating portals and establishing working space.<sup>12-15</sup>

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