Diagnostic Elbow Arthroscopy and Arthroscopic Anatomy

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Introduction

The arthroscope has proven itself to be the ideal tool for evaluation and treatment of intra-articular pathology about the elbow. Elbow arthroscopy has become useful for the removal of loose bodies [1–7], synovectomy [8, 9], lysis of adhesions [10, 11], excision of osteophytes [12, 13], debridement of osteochondritis dissecans lesions [5, 14–16], radial head resection [17], plica excision [18, 19], instability [20], septic arthritis [21], and diagnostic arthroscopy for complex elbow pain [5].

Advances in elbow arthroscopy have enabled surgeons to treat a broad spectrum of disorders that were once thought to be unsafe through arthroscopic techniques. Although technically demanding, recent advances in surgical technique, arthroscopic equipment, and an improved understanding of neurovascular and joint anatomy have made this procedure safer and more effective. More recently, indications have been expanded to include autograft replacement for osteochondritis dissecans, treatment of lateral epicondylitis, and reduction and fixation of fractures of the radial head, capitellum, and distal humerus. Elbow arthroscopy can also be useful in the treatment of posterolateral instability [22].

The potential advantages of treating elbow pathology arthroscopically include reducing iatrogenic insult by decreasing incision size, a more thorough evaluation of the intra-articular compartments of the elbow, and possibly reducing scarring and potential stiffness due to limited disruption of the capsule. The disadvantages center squarely on the technical requirements needed to safely and effectively perform the procedure due to the close proximity of neurovascular structures. Understanding of the anatomy of the elbow as well as the principles and techniques of elbow arthroscopy allows a surgeon to perform these procedures safely and effectively.

Anatomy

Prior to performing arthroscopic surgery of the elbow, a thorough understanding of the relevant anatomy must be obtained. Superficial landmarks can be palpated and marked for reference during surgery [23]. Starting posteriorly, the triceps tendon and olecranon can be palpated. Moving medially, the ulnar nerve should be palpated in the groove along the posterior aspect of the medial epicondyle. Flexing and extending the arm while palpating the ulnar groove is important to recognize whether the nerve subluxes out of the groove. A subluxable ulnar nerve is present in 16 % of the population [24]. Marking the course of the ulnar nerve is imperative to be reminded of the location of the nerve during arthroscopy. Laterally, the lateral epicondyle, radial head, and tip of the olecranon form a triangle marking the boundaries of the "soft spot" of the elbow.

Superficial nervous structures include the medial and lateral antebrachial cutaneous nerves. The lateral antebrachial cutaneous nerve, the termination of the musculocutaneous nerve, emerges from the distal portion of the biceps and travels laterally across the brachioradialis muscle proximal to the antecubital fossa. As it turns laterally, it branches and provides sensation for the lateral aspect of the forearm. The medial antebrachial cutaneous nerve travels along the medial arm with the basilic vein. It branches well proximal to the elbow joint and provides sensation to the medial aspect of the forearm. Damage to superficial nerves can be avoided by incising skin only and using blunt trocars [25].

The deeper neurovascular structures include the median, radial, and ulnar nerves and the brachial artery. The brachial artery emerges between the brachialis and biceps muscles lateral to the median nerve. It travels just medial to the biceps tendon and deep to the biceps aponeurosis. It bifurcates just

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distal to the joint at the level of the radial head. The median nerve travels along with the brachial artery along the anterior surface of the brachialis muscle. As it crosses the elbow joint, it is just medial to the brachial artery. As it enters the forearm, it courses just deep to the pronator teres but superficial to the deep head of the pronator. The ulnar nerve travels posterior to the medial intermuscular septum. At the level of the elbow, it courses posterior to the medial epicondyle and can often be palpated in this area. As it enters the forearm, the ulnar nerve travels between the flexor digitorum superficialis and the flexor digitorum profundus. The radial nerve curves posteriorly around the humerus and penetrates the lateral intermuscular septum well proximal to the elbow joint. It then travels between the brachialis and brachioradialis muscles. It branches into the superficial radial nerve and posterior interosseous nerve just proximal to the elbow joint. The superficial radial nerve passes into the forearm just deep to the brachioradialis. The posterior interosseous nerve continues distally and courses into the supinator muscle while curving around the lateral aspect of the radial head.

Fig. 20.1 Clinical photo of supine positioning of the arm in suspension for elbow arthroscopy

Arthroscopy Basics

Patient Positioning

Supine

Once the patient is positioned supine on the operating table, the operative extremity is lateralized on the operating table so that the shoulder is placed at the edge of the bed. The operative extremity is placed in 90° of shoulder abduction, 90° of elbow flexion, and neutral forearm rotation, and a non-sterile arm tourniquet is applied. The arm is suspended as illustrated in Fig. 20.1. The supine position offers the advantage of conversion to an open procedure if necessary and provides quick access to the patient's airway. Disadvantages of the supine position include the necessity of a suspension setup and the inability to easily visualize and work in the posterior compartment. Another disadvantage is that the arm is not rigidly stabilized in this suspended manner and requires an assistant to provide stability during the procedure (Fig. 20.1).

Prone

The prone position is an additional method of positioning. The greatest benefit of the prone positioning is the excellent access to the posterior compartment of the elbow. Direct visualization of the ulnohumeral joint from posterior is helpful for debridement of excess bone in cases of posterior impingement. The face and chest are padded and supported by a foam airway/head positioner and padded chest rolls. The nonoperative extremity is positioned in 90° of shoulder abduction and external rotation with the elbow in 90° of flexion. Often a special arm holder is used to optimize positioning of the operative arm. A non-sterile arm tourniquet is applied, and the arm is place in 90° of shoulder abduction and neutral rotation. The arm is supported at the mid-humeral level by a padded arm holder attached to the operating table allowing for flexion and extension of the arm during arthroscopy (Fig. 20.2a, b).

In the prone position, several advantages are realized. The elbow is easily manipulated from flexion to full extension. The posterior compartment of the elbow is easily accessible for numerous procedures directed by posterior pathology. Open procedures are easily performed if necessary. If the surgeon chooses to perform an open procedure, no change in positioning is needed for posterior procedures. Medial or lateral procedures can be carried out in the prone position by internally or externally rotating the shoulder and supporting the arm on a padded arm board (Figs. 20.3 and 20.4). Drawbacks of the prone position primarily relate to patient positioning, ventilation, and anesthetic options. It is imperative to support the head and face with foam padding to secure the airway, and chest rolls are needed to facilitate ventilation. Regional anesthesia is poorly tolerated and may not provide adequate anesthesia thus necessitating conversion to general anesthesia. In such cases, repositioning is necessary to establish an airway.

Fig. 20.2 (**a**, **b**) Author's preferred setup for elbow arthroscopy in prone position with arm holder under mid-humerus giving plenty of room for range of motion during procedure

Fig. 20.3 Clinical photo shown demonstrating the ability to externally rotate the shoulder and support the forearm on the arm board in prone position for an open lateral approach to the elbow

Fig. 20.4 Clinical photo demonstrating the ability to internally rotate the shoulder and rest the forearm on an arm board to gain access to the medial elbow for an open procedure

Fig. 20.5 Lateral positioning of the arm in elbow arthroscopy (used with permission from Baker CL, Grant LJ. Arthroscopy of the elbow. Am J Sports Med. 1999;27:251–64)

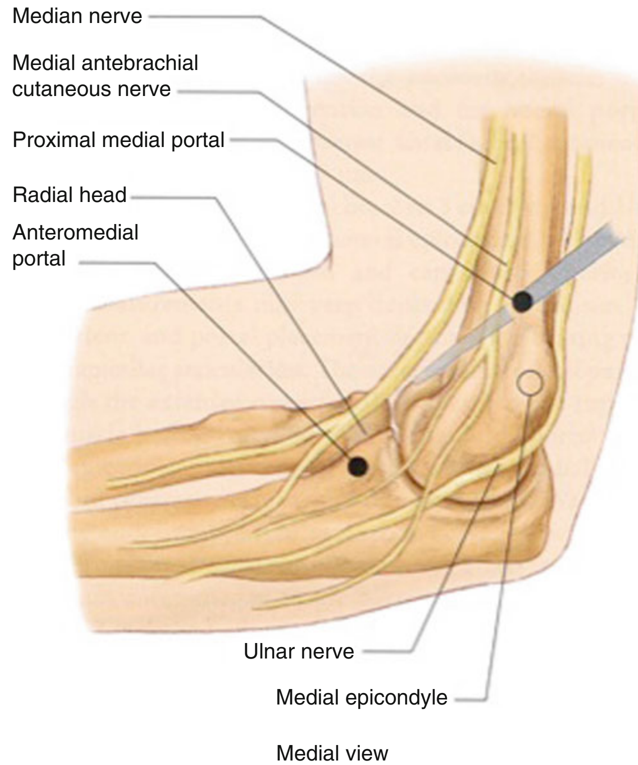

Fig. 20.6 The medial elbow with anteromedial and proximal anteromedial portals shown. The ulnar, median, and medial antebrachial nerves are all in close proximity to these portals as described above. Note that the proximal anteromedial portal is at increased distance from the median nerve as compared to the anteromedial portal (used with permission from Cole BJ, Sekiya JK. Surgical techniques of the shoulder, elbow, and knee in sports medicine. Philadelphia: Elsevier Saunders; 2008)

Lateral Decubitus

The aim of this position is to take advantage of the benefits of both the supine and prone position while avoiding the major pitfalls inherent to each setup. A beanbag is used to place the patient in the lateral decubitus position. An axillary roll is appropriately placed. The operative extremity is positioned over an arm holder or over a padded bolster with the shoulder internally rotated and flexed to 90°. The elbow is maintained in 90° of flexion (Fig. 20.5).

The elbow is maintained in the prone position thus affording the advantages of the prone position. Patient positioning is simplified with respect to prone positioning, and airway maintenance is easily monitored with adequate exposure for the anesthesiologist. Disadvantages include the need for a padded bolster and the potential inconvenience of repositioning should a need for an open procedure arise.

Portal Placement

A thorough understanding of the bony and neurovascular anatomy around the elbow is necessary prior to proceeding with elbow arthroscopy. After adequate positioning, prepping, and draping, the landmarks about the elbow should be palpated and marked with a sterile marker. The medial and lateral epicondyles, the olecranon, and radial head should be marked. Care should also be taken to palpate the ulnar nerve in its groove. It should be noted if the nerve is subluxed or subluxable prior to portal placement as this could lead to injury of the nerve. Its course should be marked with the sterile marker as well. It should also be noted that all positions for elbow arthroscopy allow for flexion of the elbow at 90°. This is vital because flexion moves the neurovascular structures anteriorly further from the joint and provides more space for portal placement [26].

Proximal Anteromedial Portal (Figs. 20.6 and 20.7)

The proximal anteromedial portal is made 2 cm proximal to the medial epicondyle and 1–2 cm anterior to the intermuscular septum. A nick in the skin is made, and the blunt tip trocar is advanced to the anterior surface of the humerus. The trocar is kept in contact with the anterior cortex and then slid distally to the elbow joint. This technique keeps the trocar posterior to the brachialis muscle therefore protecting the median nerve and brachial artery. Blunt dissection stays anterior to the medial intermuscular septum and thus anterior to the ulnar

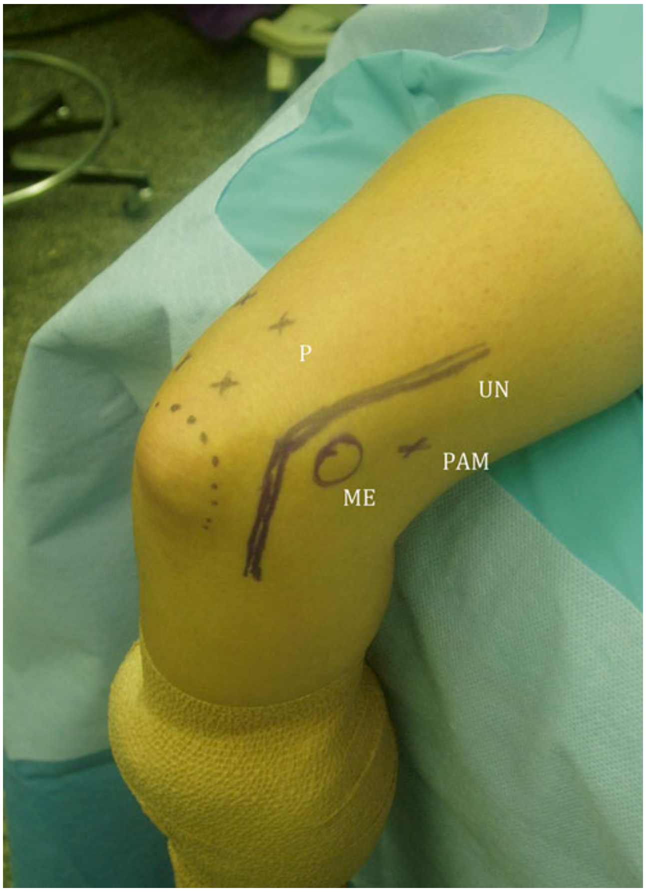

Fig. 20.7 Operative view of the medial elbow. *P* posterior portal, *PAM* proximal anteromedial portal, *UN* ulnar nerve, *ME* medial epicondyle (used with permission from Baker CL, Grant LJ. Arthroscopy of the elbow. Am J Sports Med. 1999;27:251–64)

nerve. Structures at risk during creation of this portal are the medial antebrachial cutaneous, median, and ulnar nerves. The medial antebrachial cutaneous nerve is at risk as it courses approximately 2.3 mm from the portal site. The median nerve is at risk as the trocar is advanced distally between the humerus and brachialis muscle. The average distance from the median nerve to the trocar tip is 12.4–22 mm [22, 27].

Relative contraindications to the creation of this portal include ulnar nerve subluxation or previous ulnar nerve transposition [22, 27, 28]. In the case of prior ulnar nerve transposition, this portal can be utilized if care is taken to identify the course of the nerve with dissection prior to trocar placement. In the absence of ulnar nerve subluxation or history of transposition, the ulnar nerve is located between 12 and 23.7 mm from the portal site and is hence not at risk so long as the trocar entry site is placed anterior to the intermuscular septum [22, 27].

This portal is easily reproducible and provides visualization of the entire anterior compartment from the medial to the lateral gutter. As such, it serves well as the initial portal in elbow arthroscopy.

Anteromedial Portal (Figs. 20.6 and 20.7)

This portal is placed 1–2 cm anterior and 2 cm distal to the medial epicondyle [29]. A nick in the skin is made, and the blunt tip trocar is advanced through the flexor mass aiming for the radial head taking care to stay between the humerus and the brachialis. With the trocar anterior to the medial epicondyle and the ulnar nerve in its normal anatomic position, the ulnar nerve should not be at risk. The greatest risk is to the medial antebrachial cutaneous which passes 1–2 mm from the portal site [22]. Risk of injury can be minimized by incising skin only and using the blunt trocar for the subcutaneous dissection [25, 27]. The median nerve travels approximately 7–14 mm away from the portal site and is at less risk of injury if the surgeon maintains dissection posterior to brachialis [22, 30]. The standard anteromedial portal is therefore almost twice as close to the median nerve as the proximal anteromedial portal determined by the difference between the anatomical measurements mentioned above, 7–14 mm away from the portal in standard anteromedial portal versus 12–23.7 mm away from the portal in the proximal anteromedial portal. The proximal anteromedial portal presents a safer alternative to standard anteromedial portal therefore minimizing the risk of a devastating median nerve injury.

Proximal Anterolateral Portal (Fig. 20.8)

The proximal anterolateral portal in addition to the proximal anteromedial portal can also be used as a starting portal [9, 31, 32]. It is established 2 cm proximal and 2 cm anterior to the lateral epicondyle. This portal was developed as an alternative to the standard anterolateral portal, due to the portal providing greater safe distance from the radial nerve [22, 31]. Anatomic studies with the elbow in 90° of flexion and distended with fluid at the time of proximal anterolateral portal creation reveal a safe distance between 9.9 and 14.2 mm between the trocar and radial nerve [22, 31]. This distance is markedly decreased to 4.9–9.1 mm when the standard anterolateral portal is created [22, 31]. The lateral antebrachial cutaneous nerve passes 6 mm from this portal site [22].

As the trocar is advanced distally, toward the elbow joint, the brachioradialis and brachialis muscle are pierced prior to entering the lateral joint capsule. With the arthroscope placed into the cannula, the anterior capsule, lateral gutter, radial head, capitellum, coronoid, and anterolateral aspect of the ulnohumeral articulation can be visualized. It is believed by some authors that the proximal anterolateral portal provides improved visualization of the lateral aspect of the joint [31].

Anterolateral Portal (Fig. 20.8)

The anterolateral portal was originally described as being made 1 cm anterior and 3 cm distal to the lateral epicondyle [18]. As the blunt trocar is introduced, it passes through the extensor carpi radialis brevis muscle before traversing the lateral joint capsule. This portal position is limited in its

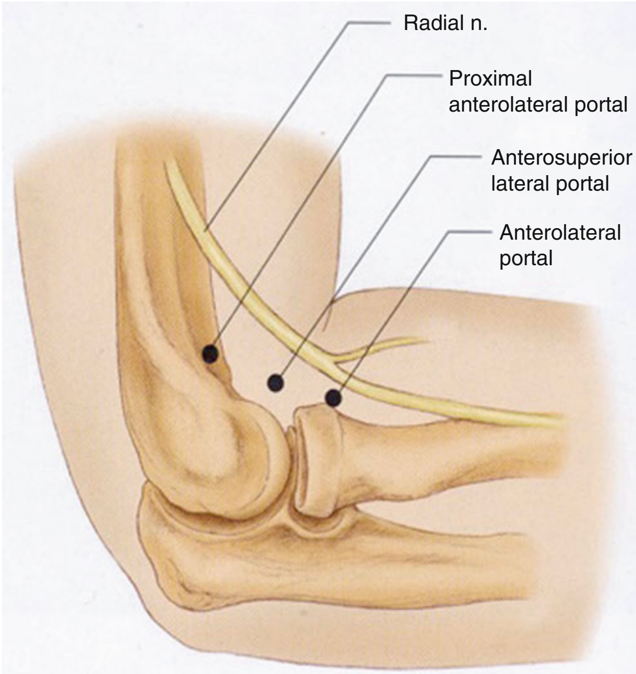

Fig. 20.8 Lateral view of the elbow with anterolateral and proximal anterolateral portals shown. Note that the proximal anterolateral portal is at increased distance from the radial nerve as compared to the anterolateral portal (used with permission from Cole BJ, Sekiya JK. Surgical techniques of the shoulder, elbow, and knee in sports medicine. Philadelphia: Elsevier Saunders; 2008)

capabilities with respect to the lateral joint. However, it permits visualization of the anteromedial aspect of the joint including the trochlea, coronoid fossa, coronoid process, and medial aspect of the radial head [31]. Care must be taken not to place the portal distal to the radial head, as the posterior interosseous nerve courses 1–1.5 cm from the radial head around the radial neck. Furthermore, care should be taken not to make the portal distal to the radial head as this can endanger the radial nerve. The radial nerve passes 5–9 mm from this portal site [22, 27, 28].

An inside-out technique allows the arthroscope in the anteromedial or proximal anteromedial portal to be advanced over the radial head and pressed firmly against the joint capsule lateral to the radial head. The camera is exchanged in the cannula for a switching stick which is advanced through the extensor carpi radialis brevis until it tents the skin. Incision is made over the switching stick, and cannula is inserted over the switching stick. This portal provides good access to the radial head and allows visualization of the annular ligament.

Direct Lateral Portal (Figs. 20.9, 20.10, and 20.11)

Also known as the soft spot portal, this portal is often used for the initial insufflation of the joint with an 18-gauge needle. It is found in the soft spot in the triangle marked by the lateral epicondyle, radial head, and tip of the olecranon.

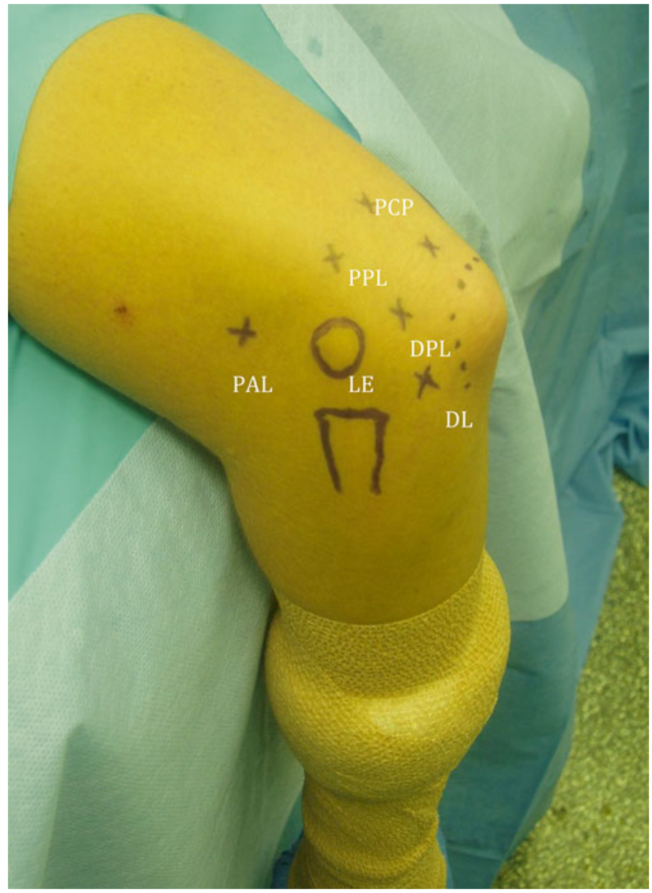

Fig. 20.9 Operative view of the lateral elbow. *PCP* proximal central posterior portal, *PPL* proximal posterolateral portal, *DPL* distal posterolateral portal, *DL* direct lateral portal, *PAL* proximal anterolateral portal, *LE* lateral epicondyle

This portal is fairly safe with regard to neurologic structures with the sole risk being injury to the posterior antebrachial cutaneous nerve which courses approximately 7 mm away [33]. The biggest risks of this portal are the risk of fluid extravasation into the soft tissues and postoperative portal drainage [22, 23, 28].

When establishing this portal, the trocar is advanced through the anconeus muscle, and entry to the lateral elbow joint is attained through the posterior elbow capsule. Visualization of the radioulnar joint and inferior aspect of the radial head and capitellum can be achieved through this portal site. In addition, this portal provides a safe entry site for instrumentation of the radiocapitellar joint and lateral gutter. Due to the risk of soft tissue extravasation, it is advisable to delay making this portal until near the end of the operation.

Posterior Portals (Figs. 20.12 and 20.13)

Multiple posterior portals can be established based on the pathology. These include the proximal and distal central posterior portals as well as the proximal and distal posterolateral portals. The distal central posterior portal is made in

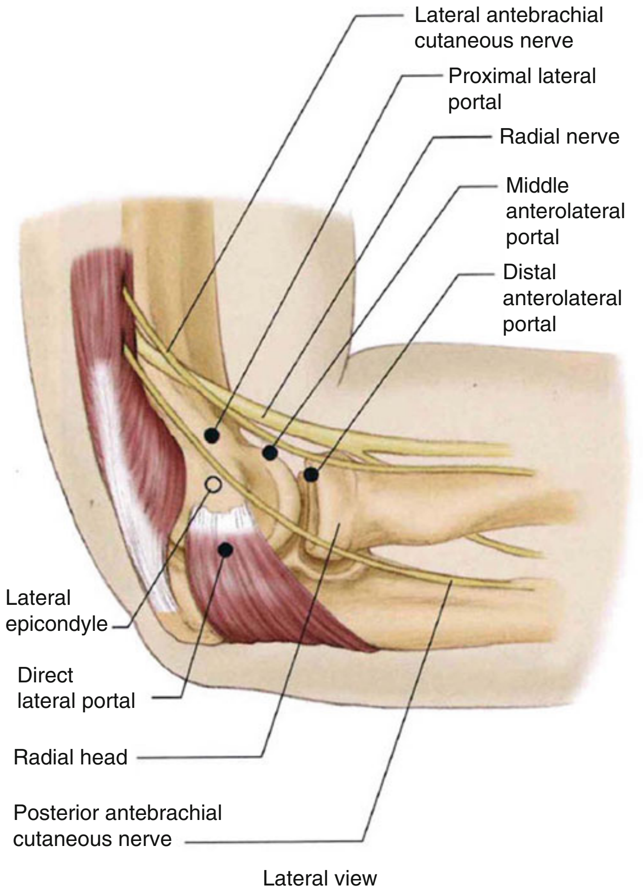

Fig. 20.10 Schematic of lateral view of the elbow with the direct lateral portal shown which is located in the soft spot marked by the lateral epicondyle, radial head, and tip of the olecranon (used with permission from Cole BJ, Sekiya JK. Surgical techniques of the shoulder, elbow, and knee in sports medicine. Philadelphia: Elsevier Saunders; 2008)

Fig. 20.11 Operative view of the lateral elbow. Instrument pointing to the lateral soft spot and location of the direct lateral portal (used with permission from Baker CL, Grant LJ. Arthroscopy of the elbow. Am J Sports Med. 1999;27:251–64)

the midline, 3 cm proximal to the olecranon tip, through the triceps tendon [23, 34]. Additionally a more proximal central posterior portal can be made 1–2 cm proximal to the distal central posterior portal (4–5 cm proximal to the olecranon tip). The skin is incised, and a blunt trocar is then inserted into the olecranon fossa. The joint capsule is very close to the joint in this position with the elbow flexed. Therefore, it is helpful to have an inflow cannula already placed in one of the anterior portals to allow for maximal joint distension. Furthermore, after the trocar is inserted, the edge of the cannula needs to be advanced down to the bone. It often helps to turn the cannula while advancing, using the tip like a cutting tool to help penetrate the capsule in this region. If the trocar is removed without cannula advancement, the tip of the cannula will still be outside the joint capsule due to the length of the trocar tip. Adequate placement can be confirmed by the return of fluid out of the cannula with removal of the trocar. Care should be taken when visualizing or working in the medial gutter as the ulnar nerve lies just superficial to the joint capsule in this region. These portals provide visualization of the posterior aspect of the ulnohumeral joint, the olecranon fossa, and the medial and lateral gutters [35]. Several common procedures can be performed through the portal sites including the removal of olecranon spurs and loose bodies and contouring or humeral fenestration of the olecranon fossa for ulnohumeral arthroplasty [28, 35].

The proximal and distal posterolateral portals are very similar to and are often used interchangeably with the central posterior portals. The distal posterolateral portal is made 3 cm proximal to the tip of the olecranon, just lateral to the triceps tendon. The proximal posterolateral portal is made 4–5 cm from the tip of the olecranon, just lateral to the triceps tendon. The trocar is advanced toward the olecranon fossa, and advancement of the cannula through the capsule must be carried out as previously described. However, when making this portal, it is sometimes helpful to bring the elbow to 45° of flexion in order to relax the triceps and posterior capsule [22]. These portals also offer visualization of the ulnohumeral joint as well as the medial and lateral gutters. From this position, the arthroscope can often be advanced into the lateral gutter in order to visualize the radiocapitellar joint and posterior aspect of the radial head. Again, care must be taken to avoid injury to the ulnar nerve when instrumenting the medial gutter as it transverses

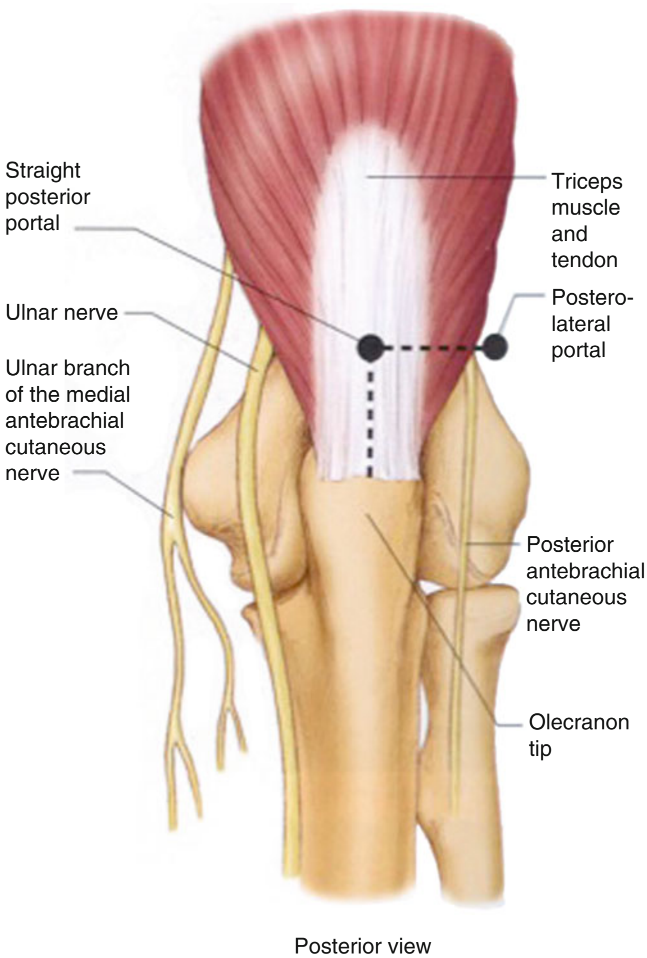

Fig. 20.12 Schematic of the posterior elbow with the distal central posterior portal (named in this figure as straight posterior) and distal posterolateral portal shown (used with permission from Cole BJ, Sekiya JK. Surgical techniques of the shoulder, elbow, and knee in sports medicine. Philadelphia: Elsevier Saunders; 2008)

obliquely just superficial to the medial capsule of the elbow [35] (Fig. 20.13).

The purpose of this chapter is to emphasize the arthroscopic anatomy to allow for safe portal placement to enable the surgeon to safely and effectively perform elbow arthroscopy. The following two case examples illustrate a proper portal placement and diagnostic arthroscopy of the elbow.

Case 1

A 53-year-old female complains of pain in her left elbow. She is left-hand dominant. In the past, she was an intercollegiate softball player. Her main complaint is pain at terminal flexion and extension. The pain interferes with her daily activities now and prevents her from being active in her recreational softball league. She takes anti-inflammatories daily and now gets no pain relief from medications.

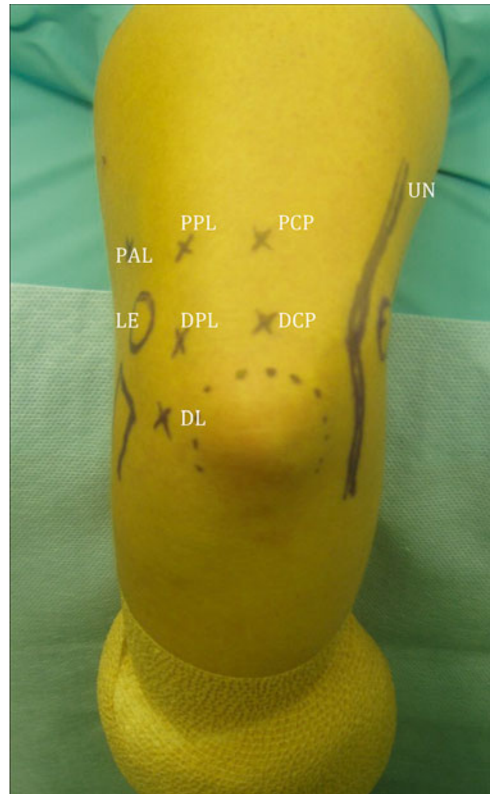

Fig. 20.13 Operative image of the posterior of the elbow showing portals including proximal and distal straight posterior portals and the proximal and distal posterolateral portals. *PCP* proximal central posterior portal, *DCP* distal central posterior portal, *PPL* proximal posterolateral portal, *DPL* distal posterolateral portal, *DL* direct lateral portal, *PAL* proximal anterolateral portal, *LE* lateral epicondyle, *UN* ulnar nerve

Physical Exam

Left upper extremity: The left elbow active and passive range of motion is −30° of extension to 130° of flexion. She has pain at the end point of extension and flexion of her elbow. She has full forearm supination and pronation equal to the right upper extremity. The left elbow is stable to varus and valgus stress. She has crepitus throughout the elbow range of motion. Neurovascular exam in the left upper extremity is unremarkable.

Imaging

Radiographs (Figs. 20.14 and 20.15): Views of the left elbow include AP and lateral views, which reveal osteophyte formation of the olecranon tip and anterior process of coronoid.

MRI (Figs. 20.16, 20.17, and 20.18): Images demonstrate pathology in the elbow of the patient. Figure 20.16 demonstrates a sagittal view of the elbow with osteophytes seen posterior along the olecranon and olecranon fossa as well as

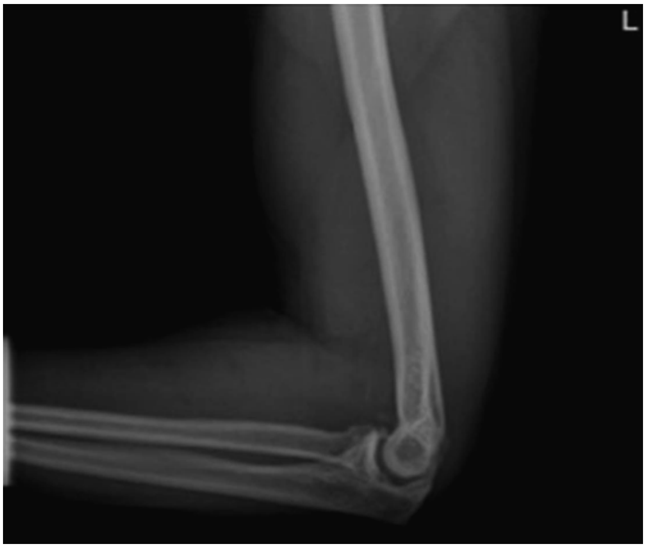

Fig. 20.14 Lateral radiograph of the left elbow

Fig. 20.15 AP radiograph of the left elbow

anteriorly in the coronoid fossa which causes decreased range of motion in our physical exam. Figures 20.17 and 20.18 are both axial MRI image T1 sequence and T2 sequence, respectively. The images both demonstrate osteophytes seen along the olecranon fossa in addition to osteophytes lining the olecranon.

Fig. 20.16 Sagittal T2 MRI image demonstrating osteophyte formation posteriorly around the olecranon fossa, on the tip of the olecranon, and anteriorly around the coronoid tip and coronoid fossa

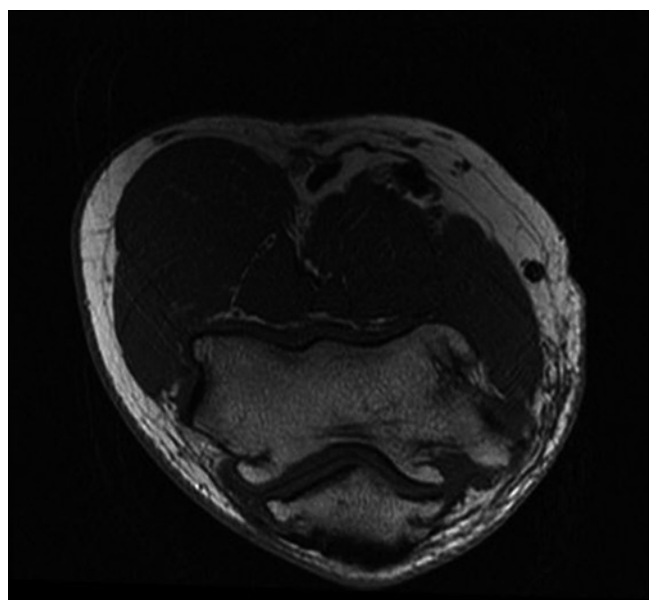

Fig. 20.17 Axial T1 MRI image demonstrating osteophytes along the articulation of the olecranon posteriorly and the olecranon fossa more anterior

After the patient had failed conservative treatment, risks and benefits of the procedure of elbow arthroscopy with extensive debridement was discussed with the patient. She elected to proceed with elbow arthroscopy.

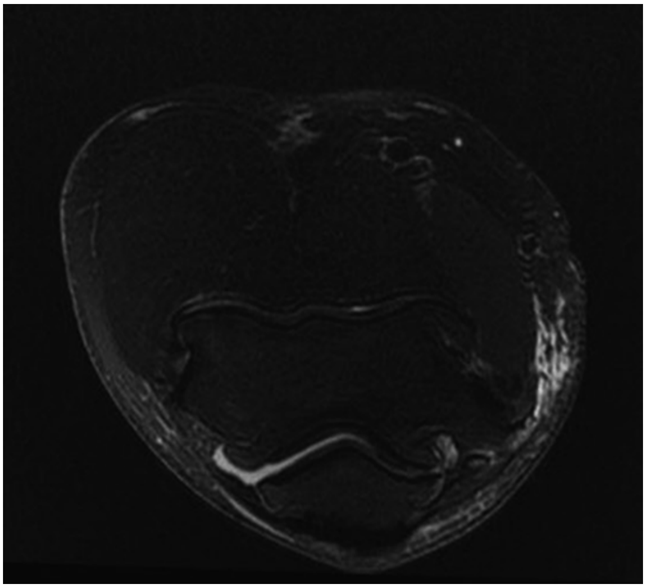

Fig. 20.18 Axial T2 MRI again demonstrating osteophytes lining the olecranon fossa with corresponding osteophytes along the periphery of the olecranon

Fig. 20.19 Operative image shown with syringe injecting saline into the straight lateral portal in the soft spot

Surgical Technique

After prone positioning, a tourniquet is placed on the upper arm taking care to place tourniquet proximal enough to ensure exposure for portal placement after draping. A non-sterile upper arm tourniquet is applied. An arm holder is attached to the operating table, which supports the arm at mid-humerus (Figs. 20.2a, b and 20.5). A Chloraprep™ (CareFusion, San Diego, CA) solution is used to prep the arm and forearm. An impervious, sterile stockinet is applied to the hand and covered with self-adherent Coban™ (3M, St. Paul, MN) to seal the hand and forearm contents from the operative field. Standard sterile draping is conducted followed by exsanguination of the limb with an esmarch bandage. The tourniquet is inflated. After prepping and draping, bony landmarks are marked with a sterile marker. Also, the ulnar nerve is palpated and marked in the ulnar groove. The ulnar nerve is evaluated for subluxation. An 18-guage spinal needle is introduced into the straight lateral portal site, and the joint is insufflated with 20–30 cm^3 of sterile saline until resistance is felt (Fig. 20.19).

The proximal anteromedial portal (Figs. 20.4 and 20.6) site is established; the portal is placed 2 cm proximal to the medial epicondyle and 1–2 cm anterior to the intermuscular septum [18]. A blunt trocar with 4.5 mm metal cannula is introduced through a nick made in the skin with a No. 11 blade knife and advanced distally toward the radiocapitellar joint. The trocar is advanced palpating the intermuscular septum to ensure the surgeon is anterior to this structure. Next, the trocar is advanced to make contact with the anterior aspect of the humerus. Palpation of the anterior humerus while advancing ensures protection of the anterior neurovascular structures, by the brachialis muscle. An egress of fluid with trocar removal confirms intra-articular placement. The 30° 4.0 mm arthroscope is introduced, and a diagnostic arthroscopy of the anterior compartment ensues.

The proximal anteromedial portal, if appropriately placed, permits a systematic evaluation of the medial gutter, trochlea, coronoid process, anterior capsule, capitellum, radial head, and lateral gutter. The radiocapitellar joint is assessed for instability and articular cartilage damage with pronation and supination aiding the evaluation. Next, the 30° arthroscope lens is rotated to facilitate evaluation of the anterior capsule and extensor carpi radialis brevis tendon insertion. The coronoid and trochlea are then evaluated by withdrawing the scope and repositioning the lens of the arthroscope.

Next, the surgeon establishes a proximal anterolateral portal. An "outside-in" technique is used for starting this portal which includes advancing a spinal needle bat the site described for this portal: 2 cm proximal to the lateral epicondyle and 2 cm anteriorly. The spinal needle is removed, and a No. 11 blade knife is used to incise the skin only. A blunt trocar and cannula are inserted into the elbow while maintaining constant contact with the anterior humeral cortex as the trocar is advanced. An alternative method of starting the anterolateral portal is by placing a switching stick within the anteromedial cannula and advancing through the joint and

Fig. 20.20 Operative image showing the technique of placing switching stick within the cannula and advancing through the joint and piercing musculature until it is tenting the skin. When it can be palpated subcutaneously, make a small incision over the top of the switching stick. Advance switching stick out the newly made portal and place a cannula over the switching stick. The switching stick can now be removed while the arthroscope is placed in the new cannula

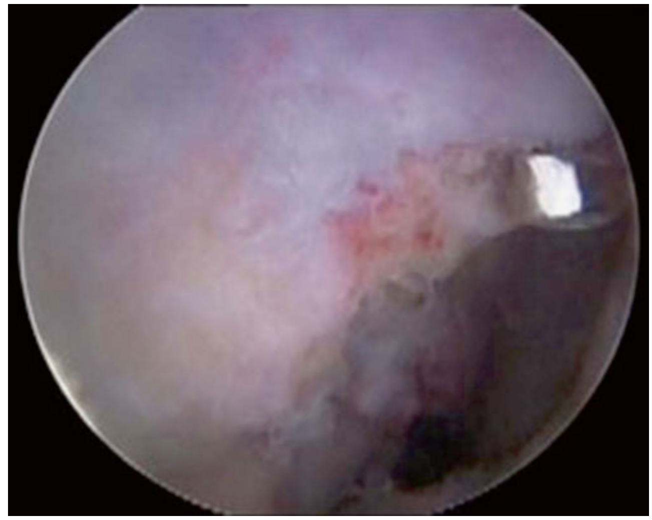

Fig. 20.21 Arthroscopic photo viewing in the anterior compartment demonstrating the removal of the anterior humeral osteophyte in the center of the screen with burr

piercing musculature until it is tenting the skin on the lateral side and placing a cannula over the switching stick (Fig. 20.20). The switching stick can now be removed while being replaced by the arthroscope. The diagnostic arthroscopy ensues with the camera in the proximal anterolateral portal including a systematic evaluation of the lateral gutter, radial head, capitellum, anterior capsule, trochlea, coronoid process, and medial gutter as discussed above.

Arthroscopy of the anterior compartment can also begin from the proximal anterolateral portal. Starting in the proximal anterolateral portal requires starting the portal with an "outside-in" technique as directed in the above discussion of the proximal anterolateral portal. Diagnostic arthroscopy can be pursued from the lateral side of the elbow progressing medially. The proximal anteromedial portal is most safely made by inserting a switching stick into the proximal anterolateral portal and advancing across the joint penetrating capsule and tinting skin in the appropriate area for the proximal anteromedial portal as discussed above. Use a knife to make a small incision over the switching stick advancing the switching stick forward. Insert a cannula over the switching stick to begin working from the portal.

Once the proximal anterior portals are established, diagnostic arthroscopy confirmed the patient to have a large osteophyte on the coronoid tip as well as a corresponding osteophyte on the distal humerus. A burr was then inserted through the anterolateral portal and was used to remove the osteophytes from the anterior humerus and the coronoid tip (Fig. 20.21). This completed the work in the anterior compartment.

Leaving the inflow in the proximal anteromedial portal for insufflation, the distal posterolateral portal was established. When the arthroscope is introduced, the olecranon fossa will come into view. Turning the angle of the scope to look inferiorly will bring the tip of the olecranon into view. The fossa and olecranon were both found to have large osteophytes. The elbow was extended to bring the olecranon tip into contact with the fossa which demonstrated impingement resulting in the decreased range of motion the patient was experiencing clinically. The ulnohumeral articulation can be followed medial into the medial gutter. Care should be taken when instrumenting the medial gutter, as the ulnar nerve lies immediately superficial to the joint capsule in this area. The arthroscope can be retracted back to the olecranon fossa, and then, once again following the ulnohumeral articulation, the lateral gutter can be inspected. The arthroscope can be advanced into the lateral gutter, and the angle of the scope can be rotated to look laterally. In doing so, this will bring the radiocapitellar joint into view showing the posterior aspect of the radial head. The patient demonstrated pathology related to the osteophytes causing impingement posteriorly.

After diagnostic arthroscopy of the posterior compartment, a proximal central posterior portal was established under spinal needle localization. This portal allowed excellent visualization of the olecranon osteophyte. Likewise, an inspection of the olecranon fossa is important to remove any potential osteophytes in the fossa, which may be impeding motion. Due the large size of the osteophyte, the decision was made to perform the excision with a small osteotome. A distal posterolateral portal was established by an "outside-in" technique to aide in excising the osteophyte. The osteotome was introduced through the distal posterolateral portal and viewed from the proximal central posterior portal. After excision of the osteophyte with the osteotome back to the native olecranon, the pieces of bone were removed with an arthroscopic grasper. Last, the burr was used to delicately complete the excision of the osteophyte and to remove a shallow layer of osteophytes from the olecranon fossa. Viewing from the proximal central posterior portal, medial and lateral gutters were again viewed to confirm there were no remaining bony fragments. By extending the elbow under direct visualization from either the distal posterolateral or proximal central posterior portals, the surgeon can confirm full extension has been gained.

Intraoperative fluoroscopy was used at the end of the arthroscopy in flexion and extension to confirm excision of the anterior and posterior osteophytes.

Case 2

A 34-year-old gentleman presented to the clinic for evaluation of his left elbow. He is left-hand dominant. He had a previous history of an elbow dislocation when he was 17. He does not complain of instability, but he does complain of catching and locking while he is performing jujitsu.

Physical Exam

The elbow active and passive range of motion is −10° of extension to 130° flexion. With repeated range of motion, a mechanical block is experienced intermittently, and the patient experiences a loss of extension at −45°. The patient has full supination and pronation, which is equal to the right extremity. The left elbow was stable to varus and valgus stress. Stability tests including a lateral pivot shift test and moving valgus stress test were negative. He has crepitus throughout the range of motion. Neurovascular exam of the left upper extremity is unremarkable.

Imaging

Radiographs (Figs. 20.22 and 20.23): AP/lateral radiographs of the left elbow demonstrate multiple loose bodies and osteophytes lining the olecranon as well as the coronoid and anterior humerus.

CT scan (Figs. 20.24 and 20.25): A CT scan was obtained to outline the specific bony anatomy and visualize extent of osteophytes for arthroscopic planning. Selected images from the CT scan show multiple large intra-articular loose osteochondral fragments with osteophytes and arthrosis along bony surfaces. Figure 20.24 is a sagittal reconstruction of left elbow CT scan demonstrating significant bony impingement from olecranon osteophyte as well as a loose body visualized posterior to the olecranon tip. Figure 20.25 is a 3-D reconstruction image, which shows many loose bodies and osteophytes along the articular margin of the olecranon as well as the proximal ulna, radial head, and humerus.

Fig. 20.22 AP radiograph of the left elbow

Fig. 20.23 Lateral radiograph of the left elbow

Fig. 20.24 Representative image selected from CT scan

Fig. 20.25 3-D reconstruction from left elbow CT scan

The patient failed all conservative treatment and requested arthroscopic surgery to remove loose bodies and also removal of osteophytes.

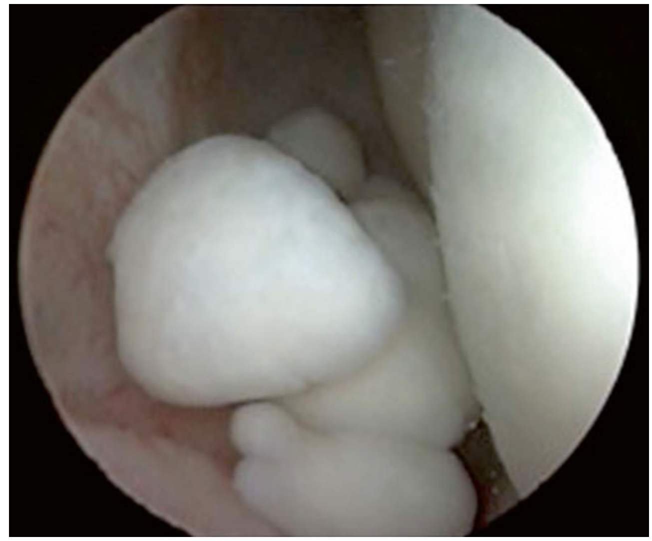

Fig. 20.26 Multiple large loose osteochondral loose bodies are visualized in the anterior compartment of the elbow

Fig. 20.27 A grasper is utilized for the removal of a large loose body from the anterior compartment of the elbow

Surgical Technique

The patient was prepared for surgery and in the prone position and setup for arthroscopy as described above. Arthroscopy began by making the proximal anteromedial portal as described above with an "outside-in" approach. Once the proximal anteromedial portal was established, a diagnostic arthroscopy ensued as described above viewing from medial to lateral. Large loose bodies were visualized in the anterior compartment as shown in the clinical photo in Fig. 20.26. Next, a proximal anterolateral portal was established by an "outside-in" approach with a spinal needle. A grasper is introduced through the proximal anterolateral portal and used to remove loose bodies as shown in Fig. 20.27.

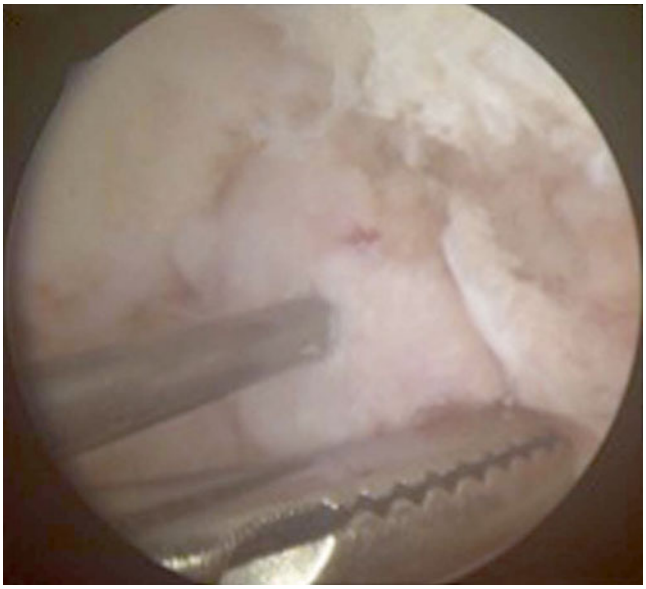

Fig. 20.28 A spinal needle can be used to skewer a large loose body in the posterior compartment of the elbow to facilitate retrieval with a grasper

Should the size of the osteochondral fragment or loose body exceed that of the cannula, it may necessitate piecemeal removal or the use of a motorized shaver. In certain cases, the grasper can be used to pull the cannula and fragment through the soft tissue. This can be accomplished by rotating the grasper as it is removed from the soft tissues while maintaining firm grasp on the fragment. Alternatively, a spinal needle may be needed to skewer and stabilize the loose body for retrieval with a grasper (Fig. 20.28).

After removal of loose bodies, osteophytes were removed from the anterior humerus and coronoid tip with high-speed burr. The elbow was then flexed until the coronoid made contact with the anterior humerus to confirm appropriate removal of osteophytes. With completion of the anterior compartment arthroscopy, the inflow was maintained in the proximal anteromedial portal, and posterior compartment arthroscopy began by making a distal posterolateral portal. With the arthroscope in the distal posterolateral portal, a diagnostic arthroscopy was performed. A large osteophyte on the olecranon process impeded extension. The osteophyte was excised with the combination of high-speed burr and small osteotome. Osteophyte formation in the olecranon fossa was also excised with the use of high-speed burr. Extension of the elbow was confirmed to be restored.

Conclusion

Elbow arthroscopy has an expanding role in elbow surgery, and the indications are increasing. A thorough knowledge of elbow anatomy is vital to prevent complications. Perhaps one the most common indications for elbow arthroscopy as demonstrated in the cases above is arthrosis and loose body removal. The success rates of arthroscopic loose body removal from the elbow approach 90 % when performed safely and methodically [3].

References

1. McKenzie PJ. Supine position. In: Savoie FH, Field LD, editors. Arthroscopy of the elbow. New York: Churchill Livingstone; 1996. p. 35–9.
2. Morrey BF. Arthroscopy of the elbow. In: Anderson LD, editor. Instructional course lectures, vol. 35. Rosemont, IL: American Academy of Orthopaedic Surgeons; 1986. p. 102–7.
3. O'Driscoll SW. Elbow arthroscopy for loose bodies. Orthopaedics. 1992;15:855–9.
4. O'Driscoll SW. Elbow arthroscopy: loose bodies. In: Morrey BF, editor. The elbow and its disorders. 3rd ed. Philadelphia, PA: Saunders; 2000. p. 510–4.
5. O'Driscoll SW, Morrey BF. Arthroscopy of the elbow: diagnostic and therapeutic benefits and hazards. J Bone Joint Surg Am. 1992;74:84–94.
6. Savoie FH. Arthroscopic management of loose bodies of the elbow. Oper Tech Sports Med. 2001;9(4):241–4.
7. Savoie FH. Guidelines to becoming an expert elbow arthroscopist. J Arthroscopic Relat Surg. 2007;23(11):1237–40.
8. Andrews JR, Baumgarten TE. Arthroscopic anatomy of the elbow. Orthop Clin North Am. 1995;26:671.
9. Wiesler ER, Poehling GG. Elbow arthroscopy: introduction, indications, complications, and results. In: McGinty JB, Burkhart SS, Jackson RW, et al., editors. Operative arthroscopy. 3rd ed. Philadelphia, PA: Lippincott-Raven; 2003. p. 661–4.
10. Byrd JW. Elbow arthroscopy for arthrofibrosis after type I radial head fractures. Arthroscopy. 1994;10:162–5.
11. Jones GS, Savoie FH. Arthroscopic capsular release of flexion contractures (arthrofibrosis) of the elbow. Arthroscopy. 1993; 9:277–83.
12. O'Driscoll SW. Arthroscopic treatment for osteoarthritis of the elbow. Orthop Clin North Am. 1995;26:691–706.
13. Ogilvie-Harris DJ, Gordon R, MacKay M. Arthroscopic treatment for posterior impingement in degenerative arthritis of the elbow. Arthroscopy. 1995;11:437–43.
14. Baumgarten TE, Andrew JR, Satterwhite YE. The arthroscopic evaluation and treatment of osteochondritis dissecans of the capitellum. Am J Sports Med. 1998;26:520–3.
15. Ruch DS, Cory JW, Poehling GG. The arthroscopic management of osteochondritis dissecans of the adolescent elbow. Arthroscopy. 1998;14(8):797–803.
16. Savoie FH, Field LD. Basics of elbow arthroscopy. Tech Orthop. 2000;15(2):138–46.
17. Menth-Chiari WA, Ruch DS, Poehling GG. Arthroscopic excision of the radial head: clinical outcome in 12 patients with post-traumatic arthritis after fracture of the radial head or rheumatoid arthritis. Arthroscopy. 2001;17(9):918–23.
18. Andrews JR, Carson WG. Arthroscopy of the elbow. Arthroscopy. 1985;1:97–107.
19. Clarke R. Symptomatic lateral synovial fringe of the elbow joint. Arthroscopy. 1988;4:112–6.
20. Smith 3rd JP, Savoie FH, Field LD. Posterolateral rotatory instability of the elbow. Clin Sports Med. 2001;20(1):47–58.
21. Thomas MA, Fast A, Shapiro DL. Radial nerve damage as a complication of elbow arthroscopy. Clin Orthop Relat Res. 1987;215: 130–1.

22. Savoie 3rd FH, O'Brien MJ, Field LD, Gurley DJ. Arthroscopic and open radial ulnohumeral ligament reconstruction for posterolateral rotatory instability of the elbow. Clin Sports Med. 2010;29(4):611–8.
23. Poehling GG, Ekman EF, Ruch DS. Elbow arthroscopy: introduction and overview. In: McGinty J, Caspari R, Jackson R, et al., editors. Operative arthroscopy. 2nd ed. Philadelphia, PA: Lippincott; 1996. p. 821–8.
24. Poehling GG, Ekman EF. Arthroscopy of the elbow. In: Jackson D, editor. Instructional course lectures, vol. 44. Chicago, IL: AAOS; 1994. p. 214–23.
25. Childress HM. Recurrent ulnar nerve dislocation at the elbow. Clin Orthop. 1986;108:168.
26. Baker CL, Grant LJ. Arthroscopy of the elbow. Am J Sports Med. 1999;27:251–64.
27. Lindenfeld TN. Medial approach in elbow arthroscopy. Am J Sports Med. 1990;18:413.
28. Adolfsson L. Arthroscopy of the elbow joint: a cadaveric study of portal placement. J Shoulder Elbow Surg. 1994;3:53–61.
29. Plancher KD, Peterson RK, Breezenoff L. Diagnostic arthroscopy of the elbow: set-up, portals, and technique. Oper Tech Sports Med. 1998;6:2–10.
30. Stothers K, Day B, Reagan WR. Arthroscopy of the elbow: anatomy, portal sites, and a description of the proximal lateral portal. Arthroscopy. 1995;11:449–57.
31. Field LD, Altchek DW, Warren RF, et al. Arthroscopic anatomy of the lateral elbow: a comparison of three portals. Arthroscopy. 1994;10:602–7.
32. Savoie FH, Field LD. Anatomy. In: Savoie FH, Field LD, editors. Arthroscopy of the elbow. New York: Churchill Livingstone; 1996. p. 3–24.
33. Aboud JA, Ricchetti ET, Tjoumakaris F, Ramsey ML. Elbow arthroscopy: basic setup and portal placement. J Am Acad Orthop Surg. 2006;14:312–8.
34. Poehling G, Whipple T, Sisco L, Goldman B. Elbow arthroscopy: a new technique. Arthroscopy. 1989;5:222.
35. Lyons TR, Field LD, Savoie FH. Basics of elbow arthroscopy. In: Price CT, editor. Instructional course lectures, vol. 49. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2000. p. 239–46.