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Abstract	The diagnosis of lateral elbow pain can be challenging to the examiner, due to the large number of diagnoses that are geographically located in this region. The lateral elbow can be defined proximally by the lateral aspect of the distal third humerus, distally by the proximal radius (head, neck, and bicipital tuberosity), anteriorly by the lateral trochlea ridge, and posteriorly by the crista supinatoris of the ulna. Of the many pathologies that exist in this region, the common differential diagnoses include lateral epicondylitis, radial/posterior plica impingement, osteoarthritis, loose bodies, fractures, rheumatoid arthritis, instability, and radial nerve entrapment [2, 11].	

56 Lateral Elbow Pain

Srinath Kamineni and Domingo Molina

56.1 Diagnosis

The diagnosis of lateral elbow pain can be challenging to the examiner, due to the large number of diagnoses that are geographically located in this region. The lateral elbow can be defined proximally by the lateral aspect of the distal third humerus, distally by the proximal radius (head, neck, and bicipital tuberosity), anteriorly by the lateral trochlea ridge, and posteriorly by the crista supinatoris of the ulna. Of the many pathologies that exist in this region, the common differential diagnoses include lateral epicondylitis, radial/posterior plica impingement, osteoarthritis, loose bodies, fractures, rheumatoid arthritis, instability, and radial nerve entrapment [2, 11].

A thorough history and physical examination is essential in determining the origin of lateral elbow pain. The interview aspect of the patient-doctor interaction is specifically targeted to decipher how a pathology began (acute versus chronic, or acute or chronic). The examiner should pay special attention to history of any unusual or out of the patient's normal routine activities, snapping, clicking, popping, and instability. Sometimes subtle and early pathologies are difficult for the patient to describe, with a more vague symptomatic complaint, e.g., "elbow feels weak and feels like falling when carrying a milk bottle" when lateral elbow instability is encountered early in the pathological progression. The vast majority of diagnoses are achieved in this phase of interaction with the patient, and the "devil is in the detail"! Patients often mention important facts as casual remarks, often overlooked by the nonobservant clinician, but prove to be valuable data. For example, a patient mentioning that the only unusual activity was taking a flight with pain felt when placing a bag in the overhead bin can be interpreted as posterior plica that was compressed in the posterior radiocapitellar articulation, while the elbow was loaded in compression by the bag and further by muscle contractions. Pain with daily activities and sports will give clues to particular pathologies of the lateral elbow. Once a detailed, targeted history is complete, and a differential diagnosis list is formulated, physical examination should be considered a means of corroborating one or more of the differentials. Rarely does a physical examination help to make a diagnosis; instead it helps to confirm and narrow a diagnosis, e.g., a clinical history can point to an elbow instability, and the physical examination will help differentiate between a valgus and posterolateral rotatory instability.

56.1.1 Inspection

Inspection should begin with a general inspection of body habitus, shoulder and elbow position,

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and any muscle wasting or trophic changes of the hand, aspects that are often forgotten and hence should be addressed early. In patients with a complaint of lateral elbow pain, all regions of the elbow should be inspected. Bruises, bumps (Fig. 56.1), scars, discolorations, muscle wasting, or fasciculations should all be considered, both with a static and a dynamically moving elbow. Inspection with the patient flexing and extending the elbow can reveal a loss of active motion, subluxing radial head, locking of the joint due to a loose body, and audible crepitus due to a degenerate articular surface. Special attention should be given to the lateral soft spot, a triangle formed by the radial head, olecranon, and capitellum. Swelling in the soft spot may be indicative of synovial proliferation or joint effusion [8].

56.1.2 Palpation

Every zone of the elbow and lateral elbow should be methodically felt for temperature, lightly palpated for structure identification and pain, and deep palpation only performed at the end of the examination if necessary or diagnostic doubts still exist. Tenderness to palpation over the anterior aspect of the distal lateral epicondyle is indicative of lateral epicondylitis due to ECRB (extensor carpi radialis brevis) involvement, while pain predominantly at the apex of the epicondyle is more likely to involve the EDC (extensor digitorum communis). Pain with palpation may help to differentiate certain geographically close etiologies such as lateral epicondylitis and radial tunnel syndrome or valgus extension overload syndrome from a posterolateral plica. Pain with palpation should also be noted when range of motion is performed, with a differentiation of mid-arc versus end-arc pains. The importance of the latter is that mid-arc pain indicates articular cartilage disintegrity while the latter may be due to abutment of the coronoid/radial head anteriorly in terminal flexion or the olecranon process posteriorly in terminal extension. Crepitus and tenderness to palpation of the radial head and radiocapitellar joint can indicate fracture, OCD, or articular fragmentation [8]. Loose bodies can occur from articular fragmentation in the young athlete with OCD or in older patients with loose bodies associated with arthritis [6].

When suspecting lateral epicondylitis, the extensor carpi radialis brevis (ERCB) must be tested, by direct palpation over the anterior aspect of the lateral epicondyle. Pain with palpation over the apex of the lateral epicondyle is more indicative of the EDC variant of tennis elbow. In lateral epicondylitis, pain will occur over the lateral epicondyle when the examiner tests resisted wrist extension [25]. Lateral epicondylitis can mimic other pathologies such as radial plica impingement or posterior interosseous nerve (PIN) entrapment [20, 24].

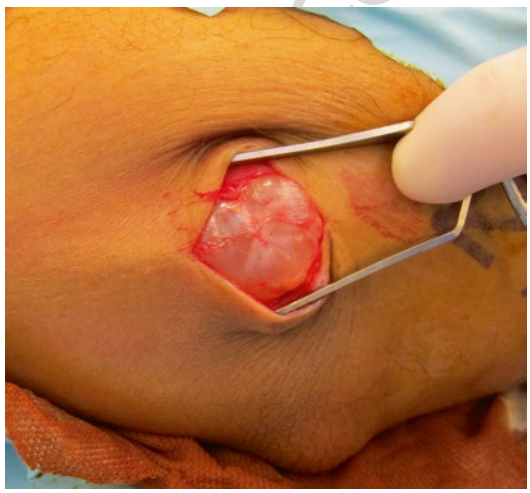

Fig. 56.1 Large lateral painful elbow ganglion, treated with a small open surgery

56.1.3 Arc of Motion

Assessing the arc of motion is critical in diagnosis of lateral elbow pain as well as determining the need for arthroscopic intervention. Flexion and extension of the elbow joint range from about 0° in extension (with the humerus and forearm linearly aligned) to 130–150° of flexion (with anterior soft-tissue contact between the arm and forearm). Longitudinal rotation of the forearm occurs between the proximal and distal radioulnar

joints with an arc of 85° of supination and 75° of pronation [15]. Functional range of axial rotatory motion of the elbow is 50° of supination and 50° of pronation. Loss of functional range of rotatory motion can be indicative of loose bodies, bony malunions, soft-tissue contractures, radiocapitellar osteochondritis, synovitis, and radial head fracture [3].

56.1.4 Stability

Lateral elbow pain can be indicative of joint instability; therefore, stability testing should be a key component during the examination. The most basic testing of instability is carried out with a simple valgus-varus stress test with the elbow in full extension and in 30° of flexion. The lateral ulnar collateral ligament (LUCL) is one of the many static soft-tissue stabilizers of the lateral elbow, in concert with the radial collateral ligament and the annular ligament. Some patients may have a feeling of instability as the elbow is brought from flexion to extension in supination [2]. The lateral pivot shift apprehension test as described by O'Driscoll can be used to assess posterolateral rotatory instability and LUCL incompetence [16]. The patient is placed supine with the arm held overhead. The forearm is supinated and stressed in a varus to valgus motion with axial compression, while the elbow is brought into flexion. If the patient has reproducible symptoms or apprehension, the test is considered positive. Posterolateral subluxation or dislocation of the radius and ulna from the humerus is indicative of posterolateral rotatory instability.

56.2 Exploration

Arthroscopy can be both a diagnostic and therapeutic modality. Imaging is used before instrumentation of the elbow to better assist in diagnosis of lateral elbow pain. Standard AP, lateral, and oblique radiographs can be used to look for bony abnormalities such as fractures, loose bodies, osteophytes, and malalignment. Stress views can be used to evaluate ligament laxity and assess need for further soft-tissue or dynamic imaging.

Magnetic resonance imaging (MRI) can be used to evaluate soft tissues and cartilage. MRI can assess tears of the lateral collateral ligament complex and the extensor carpi radialis brevis muscle. MRI may show a low signal in OCD lesions attached to subchondral bone and a high signal in lesions detached from underlying subchondral bone [23].

56.3 Rating Systems of Relevance

A classification system describes a particular pathology based on its characteristics and provides standardized objective data for diagnosis, treatment, and prognosis. Classification systems for disorders that mimic lateral elbow pain may be of benefit to arthroscopists during diagnosis and treatment.

Acute radial head fracture is an uncommon indication for elbow arthroscopy. Treatment of radial head fractures can be difficult and have potential complications such as pain and loss of elbow function. Classifying radial head fractures can aid in treatment and prognosis. Mason described three types of radial head fractures. Type I fractures are non-displaced fractures of the head or neck; type II fractures are displaced fractures (>2 mm) of the head or neck; and type III fractures are severely comminuted fractures of the radial head [12].

Articular injuries are encountered frequently during diagnostic arthroscopy as well as various imaging modalities. The ICRS developed a standardization system for cartilage injuries and the need for repair. ICRS OCD I lesions are stable with a continuous but softened area of intact cartilage. ICRS OCD II lesions have partial discontinuity but are still considered stable. ICRS OCD III lesions have complete discontinuity but are not yet dislocated (Fig. 56.2.) [7].

Lateral epicondylitis: Three types of pathologic changes in the ECRB tendon in lateral epicondylitis have been described in the literature. Inflammation and fraying of the tendon

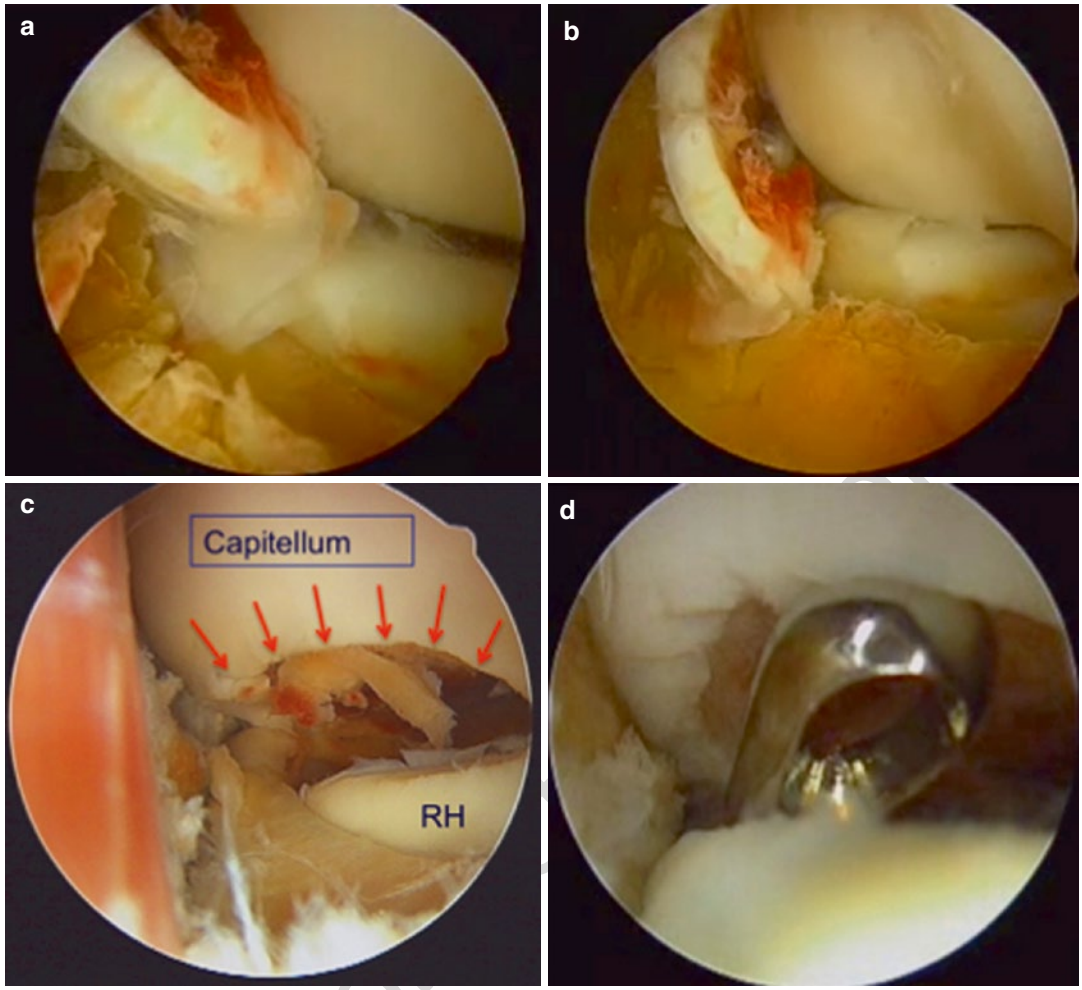

Fig. 56.2 (**a**) Large loose OCD lesion of the capitellum, (**b**) the loose body is removed by a grasper, (**c**) the defect on the inferior surface of the capitellum is well visualized with in situ fibrous debris, (**d**)

without frank tear are designated type I lesions; linear tears at the undersurface of the ECRB are designated type II lesions; partial or complete avulsions of the tendon are designated type III lesions (Fig. 56.3) [5].

Rettig et al. developed a method of classifying radiographic parameters in patients with *primary osteoarthritis* of the elbow. The absence of degenerative changes in the radiocapitellar joint is designated class I; class II primary OA exhibits mild joint space narrowing and mild ulnartrochlear arthrosis; class III is defined as the previously described radiographic changes plus radial head subluxation [19].

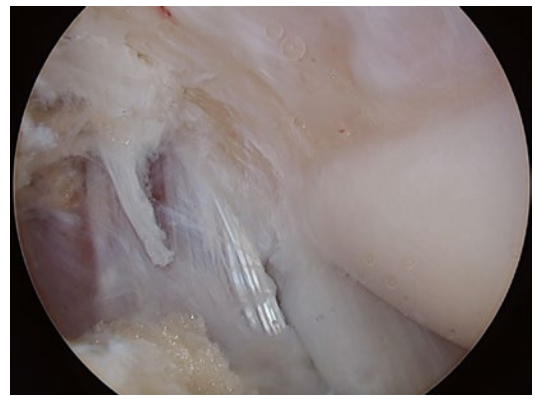

Fig. 56.3 Grade III frayed ECRB tendon with recalcitrant tennis elbow symptoms

56.4 Indications

Arthroscopy has become an effective modality in diagnosis and treatment of lateral elbow pain. Indications for arthroscopy in relation to lateral elbow pain include lateral epicondylitis, removal of loose bodies, posterolateral rotatory instability, acute radial head fracture, snapping plica excision, osteoarthritis, treatment of rheumatoid arthritis, joint contracture, and PIN entrapment [1]. However, few studies have compared outcomes of arthroscopy versus an open approach. In the treatment of lateral epicondylitis, arthroscopy has been shown to have similar functional outcomes as an open approach, with patients returning to work sooner and having less postoperative therapy needs [18].

56.4.1 Loose Bodies

Arthroscopy has long been used for the removal of loose bodies and is one of the common indications for loose body-associated joint locking and clicking. A complete diagnostic arthroscopy is often needed due to the migration of loose bodies between compartments [8]. Loose bodies can be either completely free of soft-tissue attachments, allowing free migration about the joint ("joint mouse"); tethered by soft-tissue attachments, making them less mobile; or firmly attached. Patients who underwent removal of loose bodies with associated OCD lesions reported significant improvement in symptoms (Figs. 56.4 and 56.5) [17].

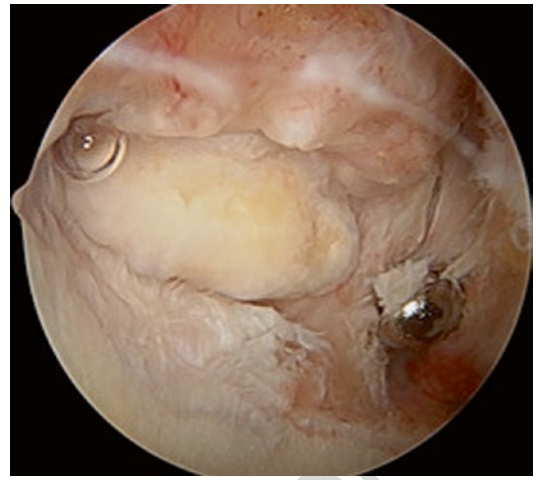

Fig. 56.4 Large radial head fossa loose body in situ, causing anterolateral impingement pain with elbow flexion

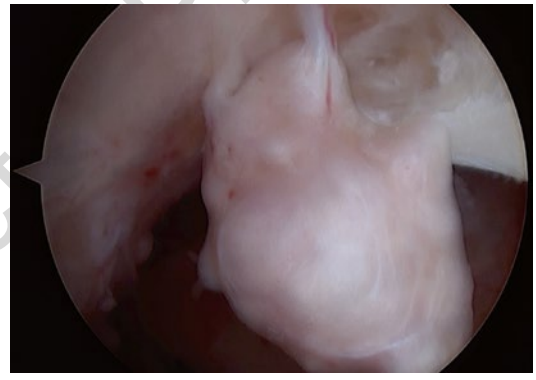

Fig. 56.5 Large loose body in the anterior elbow compartment

56.4.2 Posterolateral Rotatory Instability

Many patients with PLRI have lateral elbow pain and associated clicking, popping, or snapping when the elbow is brought from flexion to extension position in supination. Capsular repair can be accomplished with absorbable sutures with or without anchors [2]. Electrothermal shrinkage of the ligaments has been shown to reduce joint laxity on stress radiographs and eliminate instability [22]. Long-term results of such techniques of thermal shrinkage, which have been superceded in the shoulder, remain to be reported in the elbow.

56.4.3 Radial Head Fracture

Radial head fracture with severe comminution or delayed presentation may often be treated by excision of the radial head [26]. Arthroscopic excision of the radial head is preferred over an open approach in order to decrease chance of injury to the annular ligament, lateral stabilizers, and posterior interosseous nerve. Wijeratna et al.

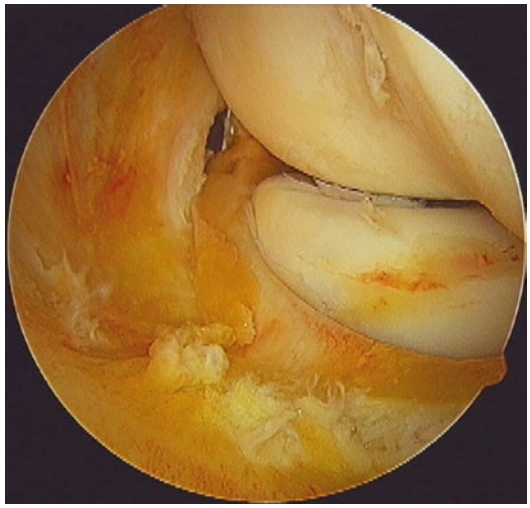

Fig. 56.6 Hemosiderin in elbow after an intra-articular fracture of the radial head

Fig. 56.7 Partially excised radial head

reported that arthroscopic excision of the radial head has comparable results to open excision (Figs. 56.6 and 56.7).

56.4.4 Lateral and Posterolateral Plica

The possibility of a posterolateral plica must be entertained when patient undergoes unsuccessful treatment for lateral epicondylitis (Fig. 56.8). Lateral elbow pain with snapping or popping during flexion and extension seen in plica must also be differentiated from loose bodies, PLRI, and medial subluxation of the triceps over the medial epicondyle [20]. Arthroscopy is indicated for the diagnosis of snapping plica as many of the aforementioned conditions can mimic similar symptoms (Fig. 56.9).

56.4.5 Osteoarthritis

A painful elbow with restricted motion that has failed nonoperative therapy, which includes physical therapy, arthritis medication, and splinting, might be an indication for arthroscopy. Synovectomy, debridement, capsular excision, osteophyte removal, olecranon fossa fenestration, and possible radial head excision have been used in the arthroscopic treatment of osteoarthritis [21]. Savoie et al. noticed a significant increase in range of motion after large loose bodies and bone spurs were removed. In comparison with open debridement, arthroscopy avoids the vast majority of iatrogenic injury to adjacent muscle-tendon complexes, which will also allow for increased motion in the acute postoperative period (Figs. 56.10, 56.11, and 56.12).

56.4.6 Lateral Epicondylitis (Tennis Elbow)

Arthroscopic release of the ECRB tendon is indicated when a patient has failed a conservative therapy program. Various results are reported due to difficulty in determining the origin of the ECRB through the arthroscope [1]. Baker et al. reported that 97 % were "much better" or "better" and 3 % were no better after arthroscopic surgery [5]. Proper patient selection, experience in elbow arthroscopy, and knowledge of surgical exposure are necessary for successful patient outcomes in the treatment of lateral epicondylitis (Fig. 56.3).

56.4.7 Rheumatoid Arthritis

Pain, restricted range of motion, and failed response to antirheumatic medications are indications for synovectomy in the rheumatic

Fig. 56.8 Clinical test for a posterolateral symptomatic plica: demonstration of pain elicited when the posterolateral soft spot is compressed with the elbow moved into terminal extension

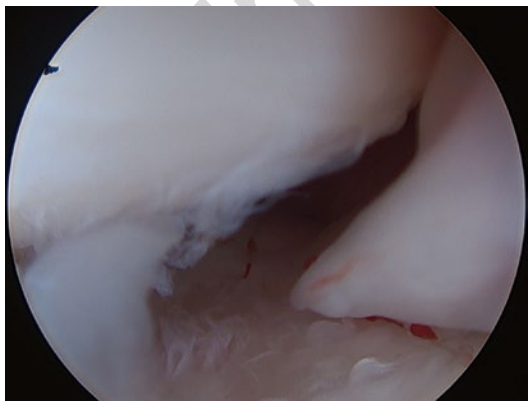

Fig. 56.9 Lateral elbow plica with central injection caused by mechanical irritation with an associated degenerate RCJ

elbow. Joint stiffness, infection, and wound breakdown have been associated with open synovectomy [9]. Kang et al. demonstrated positive outcome arthroscopic synovectomy in patients with arthritic elbows of Larsen grades 1, 2, and 3 [9]. Arthroscopic synovectomy can delay progression of arthritis in the elbow, improve functional scores, and reduce pain. It should be borne in mind that the aggressive pannus related to rheumatoid disease can often erode and perforate the joint capsules, with the potential for greater vulnerability to nerve and vessel injury during arthroscopic debridement procedures.

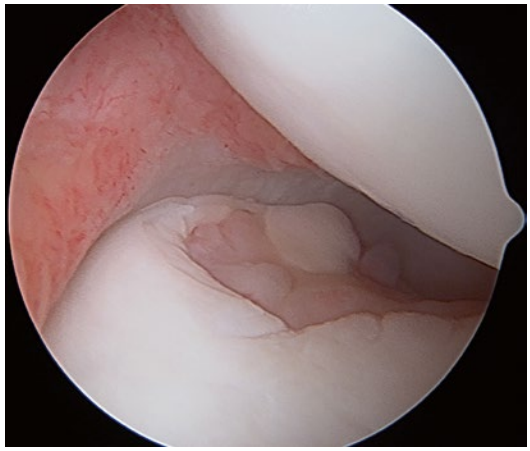

Fig. 56.10 Degenerate radial head with incongruity with pain and surrounding synovitis

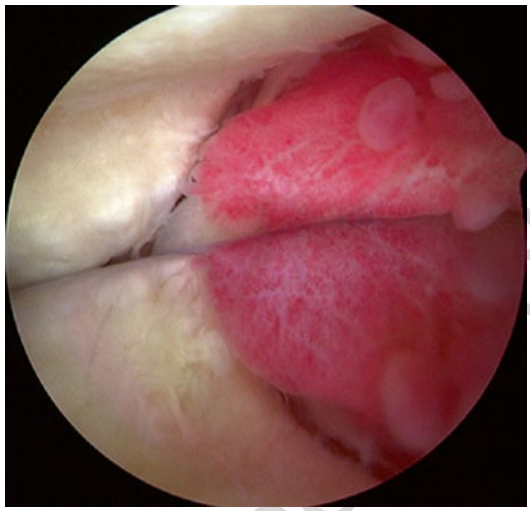

Fig. 56.11 Synovitis in relation to abnormal distal humeral bony erosion due to imperfectly implanted prosthetic radial head

56.4.8 Nerve Compression

Compression of the radial nerve along the elbow often is misdiagnosed as lateral epicondylitis or posterolateral plica. Fibrous bands at the radiocapitellar joint, the medial edge of the ECRB, the leash of Henry, the proximal fascia of the supinator, and the distal edge of the supinator are possible areas of radial nerve compression, specifically the posterior interosseous nerve (PIN). Diagnostic arthroscopy is indicated when a patient has continued pain and other sources of lateral elbow pain have been excluded. Nerve decompression via arthroscopy is only indicated when the PIN is compressed due to anatomical or mass structures and when the operator has a significant experience with arthroscopic nerve decompressions [14]. The common and safer route would be an open PIN release (Fig. 56.13).

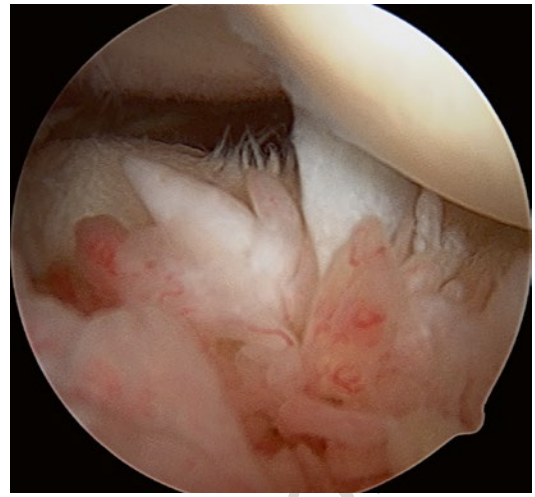

Fig. 56.12 Florid synovitis

56.5 Techniques

Although it is beyond the scope of this chapter to teach all the necessary arthroscopic skills, some helpful tips for arthroscopy are included.

1. When moving the arthroscope from medial to lateral, a time-saving technique is to pass a switching stick between the anteromedial and anterolateral portals, thereby allowing quick reintroduction of the cannula to the opposite portal.
2. To stop loose bodies being displaced away from the grasper to the fluid inflow/outflow, either turn off fluid while trying to grasp it or push the arthroscope onto the loose body, thereby trapping it against a periphery. The latter makes visualizing the gasping motion more tricky. An alternative would be to stabilize the loose body with a needle.

Fig. 56.13 PIN release through a small surgical open approach

3. When resecting synovitis, especially rheumatoid related to the anterolateral capsule, turn off suction, and orient the shaver blade away from the capsule, to minimize the danger of drawing the PIN and perineural fat into the shaver.
4. Do not use cannulas to prevent fluid from escaping the joint during an arthroscopic procedure. It is better not to retain fluid in the joint under pressure, which can lead to fluid extravasation into surrounding forearm soft tissues.
5. When using radio-frequency probes, do not use prolonged periods of cautery/coagulation. The fluid can heat up very quickly leading to articular cartilage injury. Always uses small focused pulses close to the target tissue, being aware of neurovascular anatomy.

56.6 Complications

Complications of elbow arthroscopy have been known to include superficial infection, contracture, temporary nerve palsy, and persistent drainage from portal sites [10]. Deep infection was noted to occur in about 0.8 % of elbow arthroscopies [10].

In the treatment of lateral epicondylitis, the most common complication is incomplete release of the ECRB [13]. During the excision of a snapping plica, the annular ligament as well as the articular surface to the radial head and capitellum can be damaged through a posterolateral portal [4]. Neurovascular damage is a known complication during radial head excision for acute fracture. Fracture may alter anatomy and pose potential risk of damage to the radial and posterior interosseous nerves during portal placement [26].

Nerve injuries occur frequently in elbow arthroscopy. Kelly et al. noted that the use of retractors and exploration of nerves reduced nerve injuries [10].

Complications from treatment of lateral elbow pathologies can be reduced by knowledge of three-dimensional anatomy, proper portal placement, and surgical experience.

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