14 The Role of Arthroscopy in Athletes with Ulnar Collateral Ligament Injuries

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Introduction

Medial elbow pain is common in the overhead throwing athlete. The diagnosis of medial ulnar collateral ligament (MUCL) injuries is mostly based on a history of medial elbow pain, physical exam findings, and imaging studies. The repeated valgus load that causes MUCL attenuation or rupture might also cause ulnar nerve symptoms, posterior impingement, formation of posteromedial osteophytes, formation of loose bodies, stress fractures of the ulna, lateral plica syndrome, trochlea chondromalacia, and less commonly capitellar osteochondritis dissecans (OCD) lesions. Operative treatment of MUCL insufficiency involves open graft reconstruction, but failure to address associated conditions may compromise outcomes of reconstruction. With direct visualization afforded by arthroscopy, the diagnosis and treatment of concomitant pathology may be accomplished at the time of MUCL reconstruction, making elbow arthroscopy a useful adjuvant in the evaluation and treatment of elbow pain in the overhead athlete. The objective of this chapter will be to review the indications and techniques of elbow arthroscopy in athletes with MUCL insufficiency.

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Diagnostic Arthroscopy

The diagnosis of ulnar collateral ligament (UCL) injury is based on clinical history, physical examination, and diagnostic tests including stress radiographs, ultrasound, and magnetic resonance imaging (MRI) arthrography. The physical exam for valgus instability can be difficult and is often unreliable [1]. Furthermore, Timmerman and Andrews found little difference between the clinical exam and exam under anesthesia, with neither particularly accurate in evaluating the stability of the ulnohumeral articulation. In Dr. Frank Jobe's landmark description of MUCL reconstruction for valgus instability, arthroscopy was not a routine element of the reconstructive procedure. Timmerman and Andrews, however, found the arthroscopic exam was most helpful in detecting instability in cases with equivocal clinical findings. Altchek's modification of the Jobe reconstruction (the "docking technique") included routine arthroscopy to improve the diagnosis and treatment of concomitant intraarticular pathology [2]. In a later publication by the same authors, arthroscopy was no longer routine but instead reserved for patients with preoperative exam findings of extension overload [3]. Whereas it was once considered to be an effective diagnostic tool in the evaluation of MUCL instability, that role has diminished significantly due to limited capacity to evaluate the appearance and function of the MUCL arthroscopically [3, 4].

Timmerman and Andrews showed that only the anterior 20–30 %, approximately 2–3 mm,

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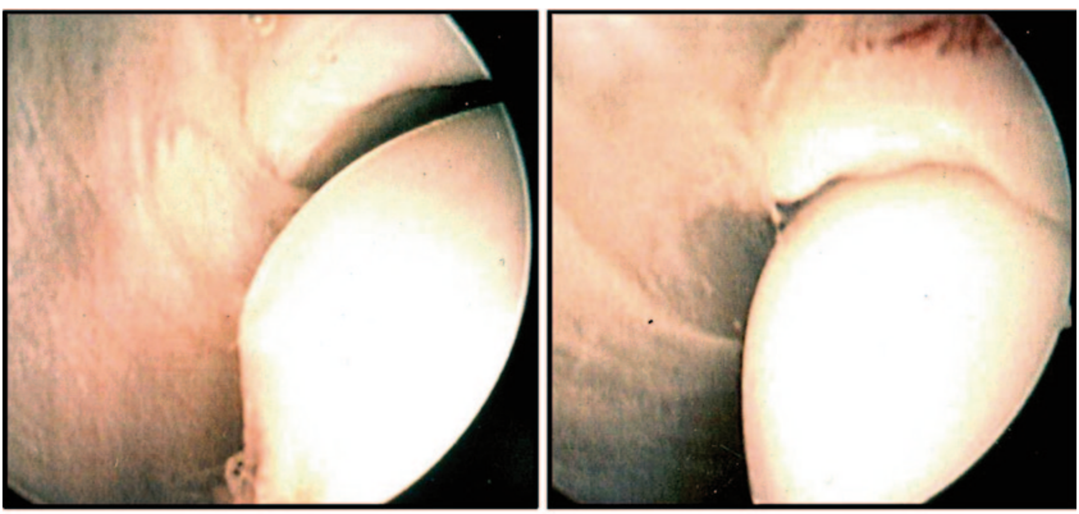
of the anterior bundle of the UCL could be adequately visualized with the arthroscope through the anterolateral portal. Meanwhile, the posterior 30–50 % of the posterior bundle could be visualized through the posterolateral portal [5]. Visualization was only slightly improved with a 70° scope, which offers a wider field of view around the corner of the ulna. Longitudinal cuts made by the researchers could not be visualized, which suggests that naturally occurring tears likewise may be missed. Following a transverse cut, only the most anterior aspect of the defect (2 mm) could be visualized. Based on these findings, the arthroscopic appearance of a normal ligament does not necessarily preclude the possibility of MUCL tear [5, 6].

Early limitations with the arthroscopic exam of the MUCL led to the development of the arthroscopic "stress test," designed to evaluate the dynamic function of the ligament. The arthroscopic "stress test" [1] places a valgus stress across the ulnohumeral joint in 70° of flexion with the scope in the anterolateral portal (Fig. 14.1). Field et al. showed that opening of the medial ulnohumeral joint 1–2 mm required complete release of anterior bundle. By also releasing the posterior bands and/or placing the forearm in full pronation, one might see a greater ulnohumeral opening, but only after having released the anterior band [7]. Posterior bundle tears with/without partial anterior bundle tears did not create any discernible instability arthroscopically. Based on the findings in this study, the arthroscopic stress test has very limited ability to detect partial tears of the UCL, though the limitations of the test may simply reflect our inability to recreate in vivo forces of throwing. The stress test has not proven to be a particularly reliable test and rarely alters the diagnosis or treatment of MUCL insufficiency [3, 4]. The diagnosis of MUCL insufficiency is usually decided upon before heading to the operating room, based mostly on history, physical exam, and MRI findings [3, 4]. In a limited number of cases, one might find that an arthroscopic exam is helpful in choosing between ligament repair and reconstruction. With that said, isolated repairs are not common and probably because isolated repairs do not perform as well as repairs that are augmented by graft reconstruction [4, 8].

Though elbow arthroscopy has limitations as it relates directly to the treatment of MUCL tears, it has substantial utility when it comes to the diagnosis and treatment of the intra-articular pathology that is often associated with chronic MUCL insufficiency. The repeated valgus load of the pitching motion that causes MUCL at-



a b

Fig. 14.1 **a** Arthroscopic valgus stress test without stress. **b** Arthroscopic view showing opening of the ulnohumeral ligament consistent with UCL insufficiency tenuation or rupture might also cause ulnar nerve symptoms, lateral plica syndrome, posterior impingement, trochlea chondromalacia, formation of posteromedial osteophytes, formation of loose bodies, stress fractures of the ulna, ulnar nerve symptoms, and less commonly capitellar OCD lesions. Concurrent treatment of these conditions is important to the success of MUCL reconstruction surgery. Failure to adequately address concomitant elbow problems may compromise outcomes of MUCL reconstruction. Fortunately, awareness of the prevalence and presentation of MUCL injuries in the overhead throwing athlete has improved in the sports medicine community, and with better awareness and improved imaging techniques fewer chronic sequelae of MUCL insufficiency seem to accumulate. Nevertheless, elbow arthroscopy remains an indispensable skill set when treating the overhead throwing athlete.

Posterior Impingement

Chronic MUCL insufficiency in the overhead throwing athlete can result in valgus extension overload. Posterior impingement may develop from chronic valgus extension overload. Posterior impingement is a broad term further categorized into posterolateral impingement, posterior impingement, and posteromedial impingement. Arthroscopy has an essential role in the management of each.

Posterolateral Impingement

Posterolateral impingement can present with lateral gutter pain with throwing, palpation, moving valgus stress test, flexion, and extension. These are also findings associated with an olecranon stress fracture or loose body, therefore one must also consider them among the differential diagnoses. The underlying cause of posterolateral impingement is not well known, though it is generally believed that valgus laxity occurring with MUCL insufficiency leads to reduced resistance to valgus loading, increases in radiocapitellar contact pressures and perhaps symptomatic entrapment of the plica. The posterolateral type impingement may involve the lateral gutter plica or radiocapitellar plica (meniscus). Exam findings include lateral gutter pain with palpation, moving valgus stress test, flexion, extension, and the flexion-pronation test. The flexion-pronation test, described by Antuna and O'Driscoll, is a provocative exam test in which the pronated elbow is passively flexed from an extended position. One might find reproducible, painful snapping of plica over the radial head elicited with this maneuver, usually between 90 and 110° of flexion [9]. Akagi and Nakamura demonstrated in a patient with plica impingement that with $<90°$ of flexion the synovial fold is in the joint and that it slips distally over the radial head with flexion $>100°$ [10]. MRI is helpful in making the diagnosis of posterolateral impingement and might reveal thickened or nodular plicae. There is limited data correlating plica size and symptoms, though thickness ≥ 3 mm and nodularity are suggestive of plica syndrome.

Arthroscopic findings in a patient with symptomatic lateral gutter plica include frayed margins, hypertrophy, capillary infiltration with hyperemia, and lateral ulnar chondromalacia. Arthroscopic findings of radiocapitellar plica syndrome are similar but with anterolateral radial head chondromalacia—from snapping back and forth over the radial head—as opposed to the lateral ulna (Fig. 14.2). For the majority of cases, the scope is best placed in the posterolateral portal and instruments in the direct posterior radiocapitellar portal. The author's preferred method of plica resection is to place the scope in the posterolateral portal and shaver through the direct posterolateral portal or midradiocapitellar portal. The scope may also be placed in the direct posterolateral portal and shaver through the midradiocapitellar portal. Care should be taken to preserve the anconeus muscle fascia. We might suggest using minishavers because they remove less fascia and allow better access to the ulnohumeral joint, radiocapitellar joint, and the lateral margin of the radial head.

Outcomes of arthroscopic treatment of posterolateral impingement are generally good. Antuna et al. reported on 14 patients with

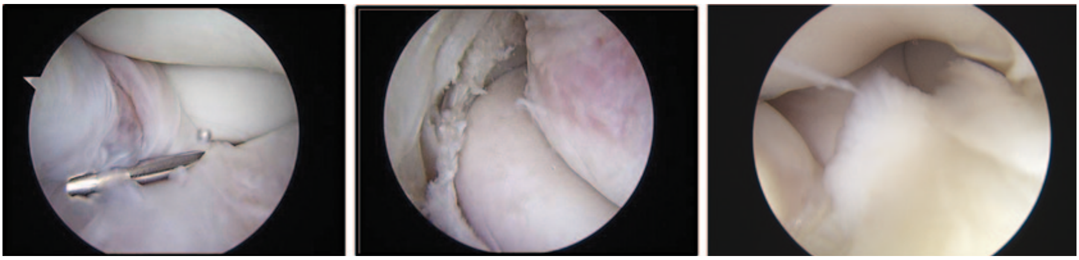


Fig. 14.2 **a** Arthroscopic view of radiocapitellar plica. **b** Chondral damage evident secondary to abrasion of plica against capitellum. **c** Lateral gutter plica

posterolateral impingement in which 54 % had a positive flexion-pronation test, 93 % had chondromalacia visualized arthroscopically, and 86 % excellent outcomes following arthroscopic excision. Kim et al. reported on 12 patients in which 25 % had a positive flexion-pronation test, 58 % had chondromalacia, and 92 % excellent result with arthroscopic resection [9].

Posteromedial Impingement

Posteromedial impingement is the most common diagnosis (51 %) for which arthroscopic elbow surgery is performed in athletes [11]. Andrews and Timmerman noted that posterior extension injury was the most common diagnosis associated with MUCL injuries [12]. In their group of baseball players treated with elbow arthroscopy for posteromedial impingement, MUCL injuries were initially underestimated. Among the patients requiring a second surgery, 25 % required MUCL reconstruction.

Posteromedial impingement may develop as a course of chronic valgus extension overload. Overload is caused by the combination of medial elbow tension, lateral compression, and valgus extension. Wilson and Andrews describe a wedging effect of the olecranon into the olecranon fossa, with abutment of the medial outer rim of the olecranon and inner rim of the olecranon fossa of the humerus [13]. MUCL insufficiency that increases valgus laxity alters both the contact pressure and area on the posteromedial olecranon and partially explains the development of posteromedial olecranon osteophyte formation [14]. The impingement appears to occur during late acceleration, ball release, and early follow-through phases of throwing. Physical exam findings may include pain in extension and valgus stress. Crepitance and/or loss of elbow extension may also be seen. In the throwing athlete, posteromedial impingement should focus the physician's attention towards instability.

Posterior medial gutter synovitis may occur in isolation or along with other posterolateral pathology. This condition usually resolves without surgery. In the senior author's experience, this condition may respond to injections and is rarely treated with synovectomy.

Posterior Impingement

Repetitive hyperextension of the elbow may also cause a discrete form of posterior impingement. This injury pattern is seen in softball players and other repetitive hyperextension activities that can create pain in extension. Radiographic findings include osteophyte/reactive lesions of the olecranon tip and thickening of the bone bridge between the coronoid and olecranon fossae. UCL tears are usually not present in association with this process. Primary osteoarthritis (OA) may develop predominately in the posterior elbow creating posterior impingement, though this is seen almost exclusively in males between the 4th and 6th decades [15].

Trochlear Chondromalacia

MUCL insufficiency that increases valgus laxity leads to an increase in total contact pressure on the PM trochlea while decreasing the overall contact area and shifting it medially [16]. Trochlear chondromalacia may be detected on high resolution, high field, thin section MRI with intra-articular contrast on sagittal and axial sequences, appearing as subchondral edema signal, insufficiency stress patterns, osteochondral collapse, and/or marginal exostosis. When confirmed arthroscopically, these lesions typically only require debridement and/or chondroplasty (Fig. 14.3). Formal microfracture is rarely necessary. In order to improve visualization and protect the ulnar nerve during this procedure, one might consider maintaining the elbow at 45–90° of elbow flexion, using a curved retractor, using a 2.7 mm micro-shaver, and briefly increasing the fluid pressure manually. Here we stress the importance of leaving the posteromedial capsule intact, which is facilitated by use of the smaller shaver and momentarily increasing fluid pressure.

Olecranon Exostosis and Fragmentation

Repetitive stress on the posteromedial olecranon may cause stress reactions, stress fractures of the posteromedial tip or transversely through the more proximal process, and exostosis formation/fragmentation. Olecranon exostosis formation was found in 24 % of asymptomatic professional baseball pitchers and in 50 % of players aged 30–35 years [17]. Exostoses and fragmentation may be detected on preoperative imaging. Conventional X-rays views may underestimate the actual fragment size. The senior author presented a radiographic technique using an anteroposterior (AP) view of the elbow with the patient seated, the shoulder abducted 90°, externally rotated 40°, and elbow flexed 140° [17]. This X-ray view may provide a more accurate estimate of the size and location of medial olecranon exostoses.

The objective of arthroscopic treatment is to remove loose fragments and restore the normal shape of the olecranon. The posterior impingement view, described above and depicted in Figure 14.4, helps define the size of the posterior medial exostosis to be removed. Excessive olecranon resection can negatively affect the results of elbow surgery [12] and one should avoid resecting more than 3 mm of the normal posterior medial margin. Kamineni showed in a biomechanical model that 3 mm incremental olecranon resection created stepwise valgus angulation, and that resection greater than 3 mm may jeopardize MUCL function due to added strain on the ligament [16]. These findings challenged the rationale of removing any amount of normal bone. An adequate resection may be facilitated by using 2–3 working portals and moving the scope, instruments and retractors between them as needed. The two primary portals are the posterior central and posterolateral portals, and a good accessory portal is the high posterolateral portal (Fig. 14.5). Resection may be performed using sharpened miniosteotomes and small bone cutting shavers

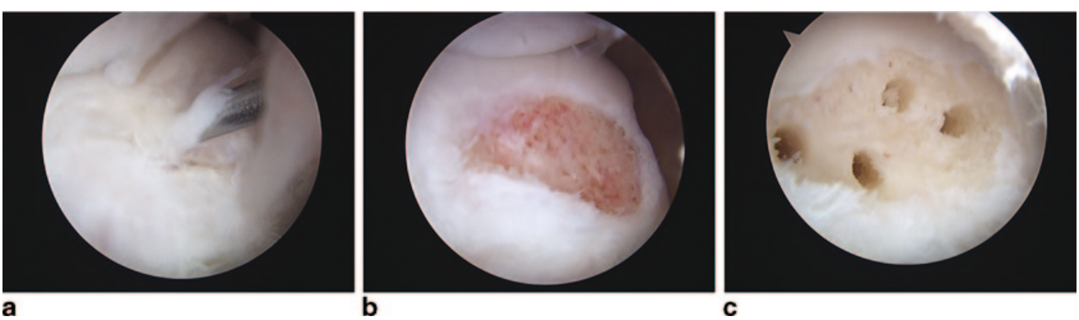


Fig. 14.3 **a** Trochlear chondral lesion. **b** Trochlear chondral lesion delineated after debridement. **c** Microfracture of the lesion

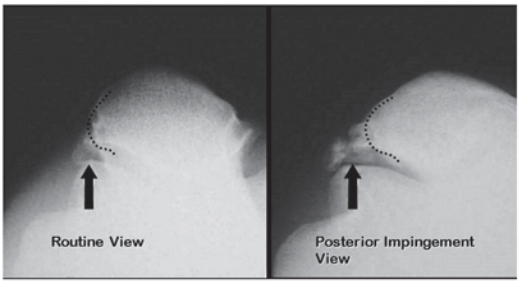


Fig. 14.4 Posterior impingement view defining posterior medial exostosis

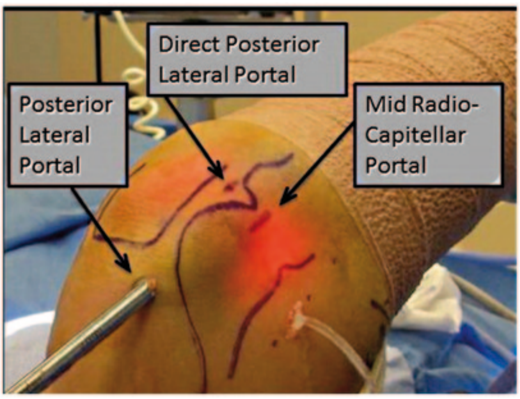


Fig. 14.5 Posterior portals most commonly used to remove posterior medial exostosis

(used with a retractor). We recommend using retractors to protect the ulnar nerve and switching portals as often as needed for visibility and access. We recommend against using suction or burrs due to the tendency to over-resect. We might also recommend clearing all bone fragments and debris after resection and closing the deep layer of all posterolateral portals. As shown in Table 14.1, the outcomes in terms of return to play following olecranon resection are generally good.

Loose Bodies

Loose bodies may cause painful mechanical symptoms and produce crepitus, tenderness, and motion loss. Radiographs routinely underestimate the presence/quantity of loose bodies [18, 19].

Table 14.1 Outcomes in terms of return to play following olecranon resection

Rossenwasser AANA 1991	83 %
Rossenwasser AANA 1991	74 %
Ward JHSurg 1993	78 %
Andrews AJSM 1995	73 %
Fideler JSES 1997	74 %
Hepler Arthroscopy 1998	95 %
Reedy Arthroscopy 2000	85 %
Cohen Arthroscopy 2011	77 %

Loose bodies may appear anterior, posterior, lateral, and rarely medial (Fig. 14.6). Treatment usually involves simple fragment removal unless the fragment is needed for OCD repair.

Capitellar Osteochondral Dissecans

Capitellar osteochondral dissecans lesions are rarely seen in association with UCL injury, however the treating physician must be prepared to manage such lesions if they occur. With larger OCD lesions, it may be best to treat the OCD first and stage the UCL reconstruction at a later time. The diagnosis and treatment of OCD of the

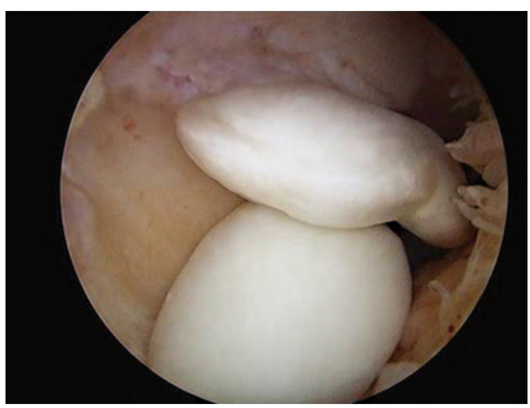


Fig. 14.6 Multiple loose bodies in lateral gutter

capitellum is a lengthy discussion unto itself and is beyond the scope of this chapter.

Surgical Technique

Elbow arthroscopy can be quite technically demanding and each physician may have his/her own learning curve. As it is with other disciplines in orthopedics, it is important in elbow arthroscopy that the treating surgeon understand his/her learning curve and commit only to procedures that fall under that curve. It is very helpful to be able to use multiple patient positions, including the supine cross body, supine suspended, lateral decubitus, and prone. It is important to be comfortable performing arthroscopy in the supine position when performing arthroscopy in conjunction with MUCL reconstruction. We recommend this position in order to avoid the need to reposition and re-drape when the time comes to reconstruct the MUCL. When arthroscopy is indicated in conjunction with UCL reconstruction, we recommend performing the arthroscopic portion of the procedure before the open portion. Associated arthroscopic procedures are usually simple and relatively short, e.g., plica excision, loose body removal, chondroplasty. There are circumstances in which it might be best to perform the open procedure prior to arthroscopy. For instance, when performing a contracture release surgery or complex arthroscopic procedures in combination with ulnar nerve neurolysis, it is probably best to perform the nerve surgery before the arthroscopic procedure.

Portal placement is an essential step to successful elbow arthroscopy. The standard portals used are the high (proximal) anterior medial, high anterior lateral, posterior central, posterior lateral, posterior direct radiocapitellar. Accessory portals might include a high posterior lateral and midradiocapitellar portal. The first arthroscopic portal is usually anterior, unless one expects to perform the entire procedure through posterior portals.

The initial anterior portal may be made either medial or lateral, and there is debate on this subject [20, 21]. Surgeon preference and patient diagnosis may determine which is most suitable. The three commonly described anteromedial portals are the standard anteromedial, proximal anteromedial, and midanteromedial portals. The standard anteromedial portal offers excellent visualization of the anterolateral elbow joint but is probably most commonly used for capsular retractors. As described by Andrews and Carson, it is located 2 cm anterior and 2 cm distal to the prominence of the medial epicondyle. The median nerve-to-sheath distance averages between 6 and 14 mm for this portal [22]. The high or proximal, anteromedial portal is described as 2 cm proximal to the prominence of the medial epicondyle and just anterior to the medial intermuscular septum [23]. Some have described it as much as 2 cm anterior to the septum [21]. This portal provides visual access to the lateral joint structures though perhaps less visualization of superior capsular structures, the lateral capitellum, and the radiocapitellar joint space in comparison to the standard anteromedial portal [22]. The midanteromedial portal is a modification of the proximal anteromedial portal and is located 1 cm proximal and 1 cm anterior to the prominence of the medial epicondyle [24].

The distal anterolateral portal is less commonly used than the other lateral portals due to safety concerns and is typically reserved for retraction. It is located 3 cm distal and 1 cm anterior to the prominence of the lateral epicondyle. The midanterolateral portal is most useful for visualizing the medial elbow structures and debridement of the anterior radiocapitellar joint surfaces. It is located 1 cm anterior to the prominence of the lateral epicondyle and just proximal to the anterior margin of the radiocapitellar joint space. The high or proximal, anterolateral portal is thought to provide the most extensive evaluation of the joint, especially when viewing the radiocapitellar joint [22, 25]. It is located 1–2 cm proximal to the prominence of the lateral epicondyle.

The posterior portals are relatively safer than the anterior portals. The posterior central portal is commonly the initial posterior portal and provides visualization of the olecranon fossa, olecranon tip, posterior trochlea, and the medial recess. It is typically located 2–4 cm proximal to the olecranon tip and midway between the medial and lateral condyles. The posterolateral portal can provide a view of the olecranon fossa, olecranon tip, and posterior and central trochlea, medial recess, lateral recess, and the posterior radiocapitellar joint. It is located 3 cm proximal to the olecranon and through the lateral border of the triceps tendon. The direct posterolateral portal may also be known as the midlateral portal, the dorsal lateral portal, or the soft spot portal. This portal typically provides the best view of the radiocapitellar joint. It is located at the center of the triangle defined by the prominence of the lateral epicondyle, prominence of the olecranon, and the radial head. The lateral radiocapitellar portal is a difficult portal to create and use due to limited space. It is useful in the management of capitellar OCD lesions and radiocapitellar chondral injuries. It is located at the radiocapitellar joint line where an 18 gauge needle may be used to localize the appropriate portal position.

Elbow arthroscopy requires specialized instrumentation. We recommend the availability of a minishaver system, curved 3.2 mm retractors, sharpened miniosteotomes, sharpened minicurettes (3-0, 4-0), and beaver blades.

Rehabilitation Considerations

When one or multiple arthroscopic procedures described above are performed in conjunction with MUCL reconstruction, the risk of postoperative stiffness increases. Motion recovery should be the first priority for therapists. At the time of surgery, we might recommend thoroughly irrigating the joint and extending the elbow to evacuate any hemarthrosis before final ligament fixation. Postoperatively, we do not recommend shortening the immobilization period unless microfracture is performed, in which case we recommend limiting motion or continuous passive motion (CPM) to 10–50° of motion for the first 10 days, then 40–100° for 10 days.

Conclusion

The throwing motion places extreme stresses across the elbow, which may result in medial, lateral, and posterior pathology. Clearly the focus of this text is on the medial-based pathology, namely: UCL insufficiency. However, failure to treat radiocapitellar changes and/or posterior impingement may result in suboptimal outcomes. For this reason, knowledge of elbow arthroscopy is critical when treating throwing athletes. Portal placement is critical to avoid neurovascular injury. Furthermore, a thorough understanding of elbow biomechanics as they relate to the throwing athlete is necessary to help guide treatment.

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