Arthroscopic Technique for Medial Epicondylitis: Technique and Safety Analysis

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Purpose: The goals of this study are to report on a novel arthroscopic technique for the treatment of medial epicondylitis and to further describe the anatomic relations between the site of arthroscopic debridement and both the ulnar nerve and medial collateral ligament (MCL) complex. **Methods:** Arthroscopic debridement of the medial epicondyle was performed on 8 fresh-frozen cadaveric specimens. Each specimen was dissected, and the shortest distance from the debridement site to both the ulnar nerve and MCL complex was measured with a 3-dimensional motion-tracking system. **Results:** The mean distance between the debridement site and the ulnar nerve was 20.8 mm (range, 14.4 to 25.1 mm), and the mean distance between the medial debridement site and the origin of the anterior bundle of the MCL was 8.3 mm (range, 5.9 to 10.4 mm). **Conclusions:** Our results suggest that arthroscopic debridement of the medial epicondyle can be performed with low risk of injury to the ulnar nerve or MCL complex. **Clinical Relevance:** This cadaveric study indicates a potential role for elbow arthroscopy in the surgical management of refractory medial epicondylitis.

There is an abundance of literature addressing the topic of arthroscopic debridement for the treatment of lateral epicondylitis.[1-4] There are even limited data that suggest advantages in return to work and function after arthroscopic lateral release compared with traditional open debridement.[4] Recalcitrant medial epicondylitis can likewise be managed operatively. The open treatment of medial epicondylitis has been well described.[5-8] However, to our knowledge, there are no published reports on the subject of arthroscopic release for the management of medial epicondylitis. It has been proposed that the close proximity of both the ulnar nerve and the medial collateral ligament (MCL) complex renders the arthroscopic debridement of the medial epicondyle unsafe.[6] The goals of this study are to describe a novel arthroscopic technique for the treatment of medial epicondylitis and to further delineate the anatomic relation between the site of arthroscopic medial debridement and both the ulnar nerve and MCL complex. We hypothesize that arthroscopic debridement of the medial epicondyle can be performed while maintaining a safe distance from the ulnar nerve and the origin of the MCL.

METHODS

Eight fresh-frozen cadaveric upper extremity specimens (four matched pairs) underwent arthroscopic evaluation and debridement of the origin of the flexor-pronator mass. No specimen was observed to have evidence of previous elbow surgery or gross bony deformity, and all specimens were therefore included in the study. Each specimen was amputated at the mid-humerus level, thawed to room temperature, and

rigidly mounted onto a suspension device by way of a C-clamp applied to the first metacarpal. Next, the elbow was positioned in neutral pronation at 90° of flexion and the proximal aspect of the humerus secured to the suspension device. This setup was designed to mimic the position of the arm during elbow arthroscopy performed in the supine position, with the shoulder in 90° of abduction and the elbow in 90° of flexion. No traction was used to obtain or maintain elbow position.

The elbow joint was distended with 20 mL of normal saline solution, and a No. 11 blade was used to create a 3-mm skin incision approximately 1 cm proximal and 1 cm anterior to the medial epicondyle. We inserted a blunt trocar and cannula into the elbow joint along the anterior surface of the distal humerus, first creating a medial portal. After insertion of a 2.7-mm 30° arthroscope to confirm safe entry into the elbow, a thorough joint space inspection was performed. Next, after removal of the arthroscope, a long switching stick was inserted through the medial cannula. The radiocapitellar joint was felt with the switching stick, which was then elevated slightly and advanced laterally through the joint capsule to a subcutaneous position. Once visualization confirmed subcutaneous positioning, a 3-mm skin incision was made approximately 1 cm proximal and 1 cm anterior to the base of the lateral epicondyle, thereby creating a lateral portal. The switching stick was further advanced out the lateral portal such that a single switching stick spanned the entire joint space, with one end protruding laterally and the other end medially. The switching stick was withdrawn laterally to allow the arthroscope back into the medial portal. Visualization of the lateral epicondyle is easily performed with the described approach. However, visualization of the medial aspect of the elbow is more difficult.

To increase visualization of the medial joint space, a second medial capsular entry site (by use of the same skin incision) was created according to the following technique. The camera and cannula were removed from the medial portal as the switching stick was advanced across the joint from lateral to medial. Extreme care is taken to maintain the position of the switching stick along the anterior aspect of the distal humerus. As the switching stick was advanced medially through the capsule, a second capsular entry site was created adjacent to the anterior cortex of the humerus. Once through the medial capsule, the switching stick was advanced subcutaneously to exit the previously made medial skin incision. Next, the cannula and arthroscope were inserted through the

lateral portal over the switching stick; the cannula for the shaver was likewise advanced into the medial joint space through the second capsular entry site as the switching stick was withdrawn medially. This sequence is the preferred technique of the senior author, who generally prefers to start medially so that the joint can be thoroughly inspected before approaching the anteromedial side of the elbow. Alternatively, the anterior compartment can be approached by creating the initial entry site with an anterolateral portal in the sulcus between the radial head and the capitellum, 1 cm distal and 1 cm anterior to the lateral epicondyle.

The flexor-pronator origin on the anterosuperior aspect of the medial epicondyle was visualized through the laterally placed 2.7-mm 30° arthroscope. The "pathologic lesion" is the area where the deep flexor-pronator fibers (pronator teres and flexor carpi radialis tendons) insert onto the anteromedial epicondyle and is located just proximal to the MCL complex. Intra-articular inspection of the coronoid process serves as the landmark to begin debridement proximally and medially (Fig 1), by use of a 2.9-mm full-radius shaver inserted through the medial cannula. A partial capsulectomy was carried out, starting at the anteromedial aspect of the distal humerus (Fig 2). As debridement continues medial and posterior, a "cliff view" from the arthroscope gives excellent visualization of the flexor-pronator origin on the anterosuperior
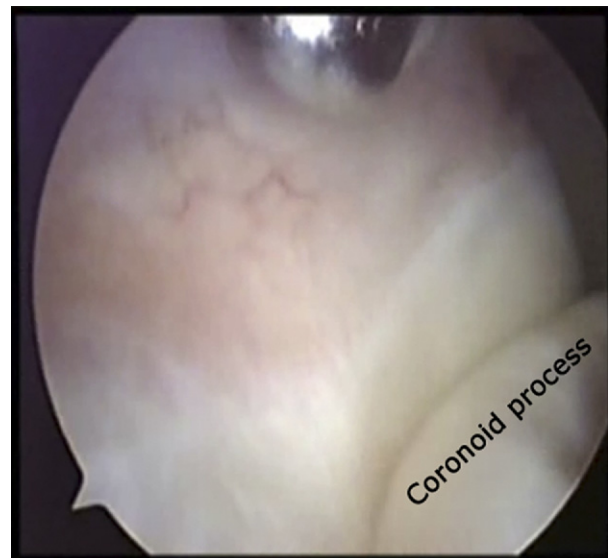

FIGURE 1. Arthroscopic view of medial aspect of a right elbow with a 30° arthroscope viewing from laterally. The coronoid process is shown distally, with the shaver resting on the anteromedial humerus.
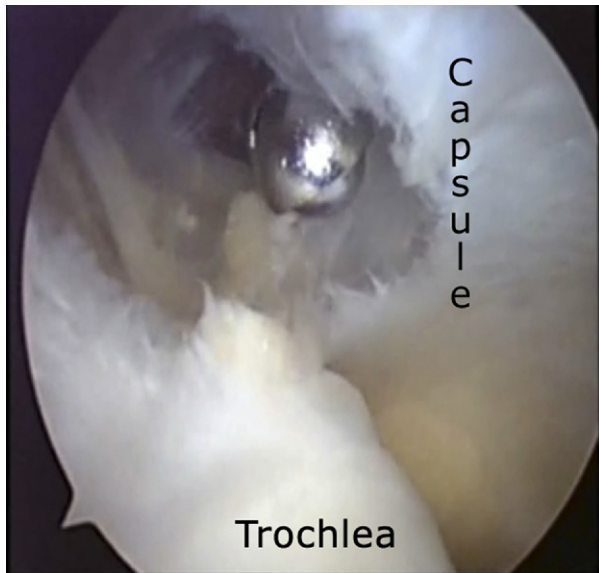
FIGURE 2. A full-radius shaver is used to complete a partial capsulectomy before the debridement continues medially and posteriorly.
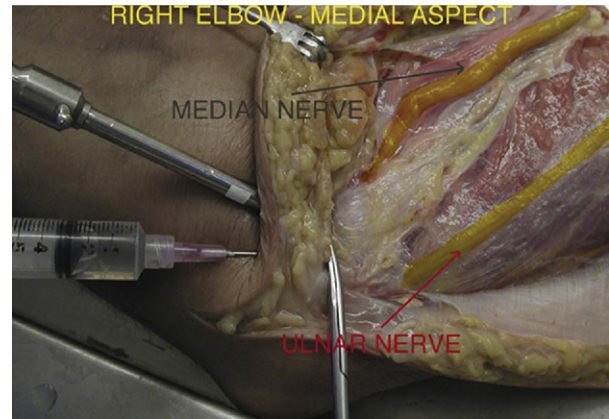

FIGURE 4. Medial perspective of elbow leaving cannula in place during initial stages of open dissection after arthroscopic debridement. The syringe is in the medial epicondyle.

aspect of the medial epicondyle (Fig 3). Subsequent debridement and decortication of the flexor-pronator origin were performed until the superficial fibers of the anterior band of the MCL were visualized. All arthroscopic procedures were performed by 2 of the authors, both attending orthopaedic surgeons.

After thorough arthroscopic debridement, all 8 cadaveric specimens were dissected. The medial cannula remained in place during the initial surgical dissection (Fig 4). An anterior arthrotomy was used so as not to disturb the medial structures. Next, the ulnar nerve was identified in the cubital tunnel through a direct medial approach, similar to that used for an ulnar nerve transposition or neurolysis (Fig 5). With the specimen still rigidly suspended, a 3-dimensional mo-

tion-tracking system (Optotrak 3020 system; Northern Digital, Waterloo, Ontario, Canada) was used to measure the closest distance between the ulnar nerve and the debridement zone, as indicated by the underlying decorticated area (Fig 6). All measurements were performed by 1 author.

The Optotrak 3020 system uses 3 cameras and a digitalizing stylus to which 6 infrared light-emitting diodes are attached. First, the stylus was placed at the center of the decorticated area; next, it was placed on the ulnar nerve at its closest point to the decorticated area. The Optotrak cameras capture the infrared signal emitted from each stylus and calculate the linear distance between these 2 points. The distance from each camera (x, y, z) to each stylus (1, 2) is presented as a series of coordinates in 3-dimensional space (x_1, x_2, y_1, y_2, z_1, z_2). The distance between each stylus (in millimeters) was calculated according to the formula $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$. Within our working distance, the precision for a 95% repeatabil-

FIGURE 3. Arthroscopic view showing medial epicondyle flare (yellow arc) and appearance of flexor-pronator mass after debridement.
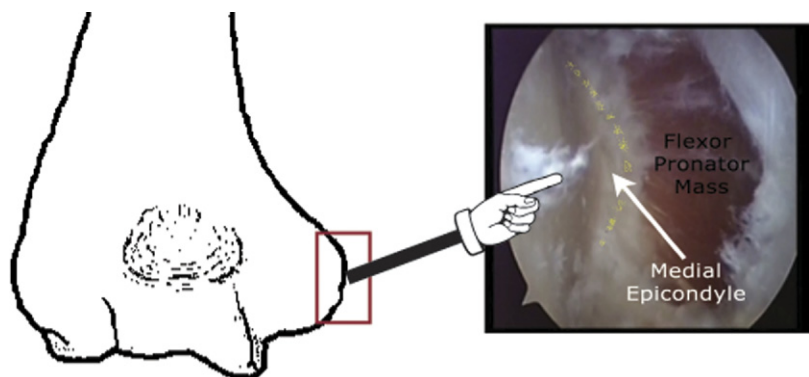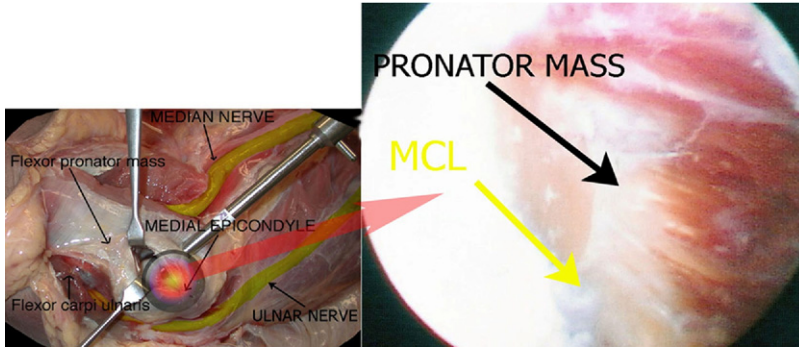
FIGURE 5. Dissection of area of debridement with corresponding arthroscopic view of same area.

ity limit of the Optotrak 3020 system has been measured at 0.29 mm.[9]

Next, the entire MCL complex was carefully dissected such that the anterior and posterior bundles, as well as the transverse band, were visualized fully. With the specimen still in the suspension device, the stylus was again placed at the center of the decorticated area and then moved to the most proximal aspect of the anterior bundle of the MCL complex. The linear distance between the stylus probes was again calculated by the Optotrak system according to the previously described formula.

RESULTS

Four matched cadaveric pairs (3 female and 1 male) with a mean age of 58 years were included in this
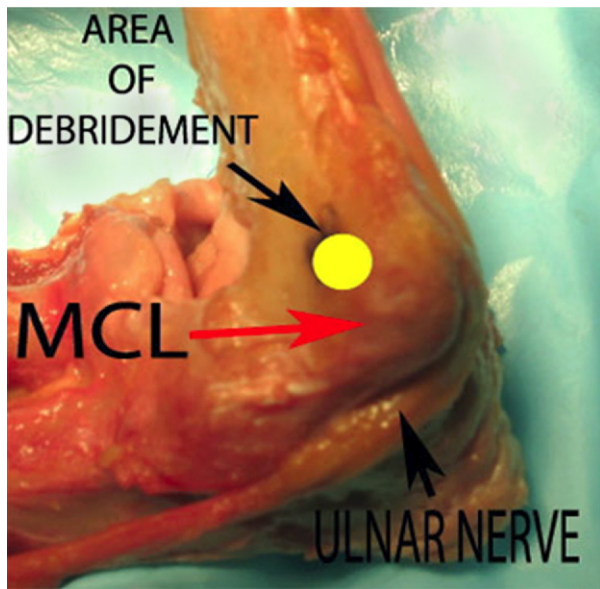

FIGURE 6. Medial perspective showing relation of area of debridement and location of MCL and ulnar nerve.

study. In all 8 specimens, dissection allowed complete visualization of the decorticated area of the medial epicondyle, the ulnar nerve, and the MCL complex. No obvious injuries to the ulnar nerve or the MCL complex were observed. The mean distance between the center of the decorticated area on the medial epicondyle and the ulnar nerve was 20.8 mm (range, 14.4 to 25.1 mm). Similarly, the mean distance between the center of the decorticated area on the medial epicondyle and the most proximal portion of the MCL complex was 8.3 mm (range, 5.9 to 10.4 mm). All distances measured are summarized in Table 1.

DISCUSSION

The initial management of epicondylitis uses conservative measures. Provocative maneuvers should be avoided, and a short course of anti-inflammatory medications or corticosteroid injection may be indicated. An initial period of rest (with or without the aid of pharmacologic agents) is followed by a formal rehabilitation program and gradual return to activity. Adjunct therapies include the use of counterforce bracing and ultrasound.

TABLE 1. *Distance Between Debridement Site of Medial Epicondyle and Both MCL Complex and Ulnar Nerve*

	Debridement Site to MCL (mm)	Debridement Site to Ulnar Nerve (mm)
Specimen No.		
1	6.0	14.4
2	10.4	16.8
3	9.7	25.1
4	8.6	20.4
5	5.9	21.2
6	8.7	24.6
7	7.9	23.0
8	9.2	21.3
Mean (range)	8.3 (5.9-10.4)	20.8 (14.4-25.1)

Surgical intervention is indicated for persistent pain and dysfunction despite at least 3 to 6 months of conservative management and possibly sooner in elite throwing athletes with medial-sided pathology.[6] The most widely accepted surgical technique includes the excision of pathologic tissue, repair of the resulting defect, and reattachment of the flexor or extensor origin.[7] Residual strength deficits remain a common concern after the open management of both medial and lateral epicondylitis.[7]

Elbow arthroscopy is a technically demanding procedure that offers potential advantages over open techniques for the treatment of recalcitrant lateral epicondylitis.[4] Arthroscopic release of lateral epicondylitis may permit an abbreviated postoperative rehabilitation program and earlier return to work.[5] Additional advantages include the preservation of the common extensor origin and intra-articular examination of the elbow.[10] One recent publication addresses the question of durability after arthroscopic release of lateral epicondylitis, suggesting that initial success at a mean of 2.8 years was maintained at a mean long-term follow-up of 130 months.[11]

No such studies investigating the arthroscopic treatment of medial-sided elbow pathology exist. In addition to injury of the MCL complex, infection and the risk of harm to nearby neurovascular structures remain common concerns. In 2001 Kelly et al.[12] reported their results of 473 consecutive elbow arthroscopies. Complications included deep infection in 4 elbows, prolonged drainage or superficial infection in 33, persistent contracture of 20° or less in 7, and transient nerve palsy in 12. Of these transient nerve palsies, 5 involved the ulnar nerve, 4 involved the superficial radial nerve, and 1 each involved the posterior interosseous nerve, medial antebrachial cutaneous nerve, and anterior interosseous nerve.[12]

Advances in surgical technique have broadened the indications for and improved the safety of elbow arthroscopy.[13-16] The second medial capsular entry site (by use of the same skin incision) is what makes our technique unique. We believe this "mobile portal" allows improved access to the anterosuperior medial epicondylar ridge and the tendinous origin of the flexor-pronator mass.

To further minimize injury to surrounding anatomic structures, a body of research focusing on arthroscopic portal placement and portal relation to nearby neurovascular structures has been detailed in the literature.[17-22] Direct measurements to neurovascular structures other than the ulnar nerve were not conducted as a part of this study. However, our medial portal mirrors that described by Unlu et al.,[22] and our lateral portal closely approximates the mid-anterolateral portal described by Field et al.[19] Unlu et al. describe a superomedial portal established 1 cm proximal and 1 cm anterior to the medial epicondyle. With the arm in 90° of flexion, only the medial antebrachial nerve was determined to be less than 1 cm from the superomedial portal (7 ± 2.6 mm), with the median nerve (13.8 ± 2.6 mm), ulnar nerve (16.2 ± 2.2 mm), and brachial artery (17.6 ± 3.3 mm) at progressively further distances.[22] The mid-anterolateral portal of Field et al. is placed 1 cm directly anterior to the lateral epicondyle. The mean distance between this portal and the radial nerve with the elbow in 90° of flexion is 9.8 mm.[19] Controlled and accurate placement of arthroscopic portals can help minimize injury to adjacent structures at risk.

We anticipate that as surgeon experience with elbow arthroscopy continues to grow, so will the number of indications. Nevertheless, it has been stated that the close proximity of the ulnar nerve and the MCL complex renders the arthroscopic treatment of medial epicondylitis unsafe.[6] Our results suggest that arthroscopic treatment of medial epicondylitis may be performed with a low risk of injury to the ulnar nerve or MCL. This procedure involves the debridement of pathologic tissue associated with the flexor-pronator mass and underlying capsule, as well as a variable amount of decortication. According to Baker et al.,[23] decortication may not be necessary in the arthroscopic treatment of lateral epicondylitis, particularly in cases of shorter duration that lack sclerotic bone at the tendinous insertion site. However, for the purposes of this study, aggressive decortication of the underlying bone was performed to facilitate later identification of the flexor-pronator origin.

In 8 cadaveric specimens we found the ulnar nerve to be a minimum of 14 mm (mean, 20.8 mm; range, 14.4 to 25.1 mm) from the center of the debridement zone of the flexor-pronator origin, which is located on the anterior supracondylar ridge. This is consistent with the fact that the entire anterior-posterior width of the medial epicondyle lies between the site of debridement and the ulnar nerve. Nevertheless, the importance of obtaining a thorough preoperative history and performing a thorough physical examination must be stressed. Patients should be questioned about previous elbow surgeries (in particular, ulnar nerve transposition) and examined for evidence of healed surgical incisions and ulnar nerve subluxation. Repeat examination under anesthesia is likewise recommended. Any evidence of ulnar nerve subluxation that occurs

either preoperatively or after the induction of anesthesia should be an indication for open management. Patients should be counseled accordingly at the time of surgical consent.

The MCL complex consists of an anterior and a posterior bundle, as well as a transverse band. In 1992 O'Driscoll et al.[24] studied the origin of the MCL complex in 10 cadaveric specimens. Their findings indicate that the ligament complex originates from the central 65% of the anteroinferior aspect of the medial epicondyle, and no attachment to the medial condyle of the distal humerus was noted. Similarly, when visualized intra-articularly with an arthroscope, the flexor-pronator origin was found to be more proximal on the medial epicondyle than the anteroinferior insertion of the anterior bundle of the MCL complex.[24] Given their close proximity, it is reasonable to assume that the MCL complex is at risk for injury during arthroscopic debridement of the flexor-pronator origin. Injury to the MCL complex (especially the anterior bundle) may then predispose the patient's elbow to valgus instability. Our results indicate that the distance between the center of the decorticated area and the most proximal portion of the MCL is a minimum of 5.9 mm (mean, 8.3 mm; range, 5.9 to 10.4 mm). By understanding the anatomy of the soft-tissue attachments to the medial aspect of the distal humerus and restricting the debridement of the flexor-pronator origin to the anterosuperior quadrant of the medial epicondyle, risk of injury to the MCL complex can be minimized.

There were several limitations to this study including the small number of specimens and the potential for anatomic variation in cadaveric tissue because of the lack of muscle tone. Once the ulnar nerve with its surrounding soft-tissue envelope is transected proximally, it becomes a static structure that is no longer subject to posteromedial compressive forces and translation during elbow flexion. It can be hypothesized that with the addition of posteromedial soft-tissue compressive forces in vivo, the ulnar nerve may be at increased risk for subluxation and injury.

A second limitation with cadaveric specimens is the lack of pathologic tissue to guide debridement. After the initial partial capsulectomy, debridement and decortication started at the origin of the flexor-pronator mass and continued until the superficial fibers of the MCL complex were identified. In vivo debridement with or without decortication can be limited to include diseased soft tissue—"tendinosis" and underlying sclerotic bone. Accordingly, our measurements were made from the center of the debridement zone, which

is believed to more closely represent the origin of the flexor-pronator mass. Alternative or additional measurements could have included the diameter or radius of the debridement zone, as well as the distance from the edge of the debridement zone to the superficial fibers of the anterior band of the MCL complex. However, each of these measurements would also be biased by the excessive, purposeful decortication in vitro, although having 1 surgeon responsible for the debridement may have reduced variability.

Valgus stress testing could have been performed both before and after the procedure as a means of directly assessing elbow stability. Instead, we rely upon surrogate measurements and gross visual inspection. Lastly, by restricting our debridement to the anterosuperior quadrant of the medial epicondyle, it is unclear whether this treatment will be as effective as the more traditional open release. The best indication for arthroscopic release of medial epicondylitis may be refractory disease with maximum tenderness to palpation at the anterosuperior quadrant of the medial epicondyle.

CONCLUSIONS

The results of this study suggest that arthroscopic debridement of the medial epicondyle can be performed with a low risk of injury to the ulnar nerve or MCL complex.

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