Purpose: To determine whether the radial component of the lateral collateral ligament (R-LCL) and extensor carpi radialis brevis (ECRB) are consistently visible, using a 70° arthroscope, as parallel structures in the extra-articular space of the elbow, and to evaluate the clinical outcomes of these techniques in a series of patients. Methods: An arthroscopic ECRB tendon release was performed between 2008 and 2010. Eighteen patients were retrospectively evaluated at a minimum of 24 months’ follow-up. The surgeon performed the ECRB release while protecting the R-LCL and viewing the structures extra-articularly with a 70° arthroscope through the anteromedial portal. Patients underwent surgery if they presented with localized tenderness and pain not responding to conservative treatment for 12 months and had magnetic resonance imaging scans indicating tendinopathy or degeneration. Arthritis, posterolateral rotatory instability, trauma, and previous surgeries were exclusion criteria. Intraoperative videos were reviewed and a clinical examination was performed by an independent reviewer at 24 months postoperatively. Patients were also evaluated with the Mayo Elbow Performance Score; Andrews-Carson score; and shortened Disabilities of the Arm, Shoulder and Hand questionnaire. Direct varus stress was applied in extension and flexion (40°), and the posterolateral pivot-shift and chair tests were performed. Results: Visualization with the 70° arthroscope through the anteromedial portal was successful in all of the cases (100%). Visualization of the residual ECRB tendon stump, as well as the posterior common extensor tendon, was also achieved 94% of the time. The final mean Mayo Elbow Performance Score and Andrews-Carson score were 82.5 (range, 60 to 100) and 185.3 (range, 125 to 200), respectively. The mean postoperative score on the shortened Disabilities of the Arm, Shoulder and Hand questionnaire was 20.14 (range, 5 to 57.5). Clinical tests showed stability in all the cases. Conclusions: The 70° arthroscope allows visualization of the ECRB insertion and R-LCL frontally and in parallel. A surgical plane could be created between the structures. The clinical outcome was good or excellent in 78% of the cases. Level of Evidence: Level IV, therapeutic case series.
Using a standard 30° arthroscope, previous authors have recommended avoiding resecting more posterior than the midline of the radial head, considering the U-LCL the only fundamental stabilizer of the elbow. Recent evidence supports the R-LCL as another crucial component to prevent PLRI. The standard arthroscopic approach of ECRB resection risks removing part of the R-LCL because this structure is primarily located anterior to the radial head midline. A 70° arthroscope allows the surgeon to switch from a "side/lateral" view (provided by the 30° arthroscope) to a "frontal" view that keeps the ECRB and R-LCL as parallel and independent (Figs 2 and 3). This allows the surgeon to look "around the corner" of the capitulum and visualize in the extra-articular space while the arthroscope is still positioned intra-articularly in the AM portal.

The purpose of the study is 3-fold: first, to evaluate whether the R-LCL and ECRB are consistently visible as parallel structures in the extra-articular space of the elbow when using a 70° arthroscope through the AM portal through a capsular window; second, to evaluate the possibility of developing an extracapsular surgical plane between the R-LCL and ECRB tendon (thus reducing the potential of damaging the R-LCL); and third, to evaluate a series of patients treated with this technique at 24 months’ follow-up for objective stability, clinical results, and quality of life. The hypothesis was that the R-LCL and ECRB would be visible in the surgical video as frontal and parallel structures in the extra-articular space of the elbow in a percentage equal or superior to 90% of the cases.

**Methods**

An arthroscopic ECRB release for the treatment of chronic lateral epicondylitis has been used at our institution since 2008. A retrospective analysis of the results was conducted at 24 months (minimum) after the procedure. All the procedures were performed by a single surgeon from 2008 to 2010.

Patients were scheduled for surgery according to specific inclusion criteria: preoperative physical examination showing localized tenderness at the common extensor origin on the lateral epicondyle and pain elicited from the common extensor origin during resisted extension of the wrist and the third metacarpal; preoperative magnetic resonance imaging reports and images showing ECRB tendinopathy or degeneration; and symptoms not responsive to at least 12 months of conservative treatment including ice, nonsteroidal anti-inflammatory drugs, a stretching program, cortisone injections, and physical therapy. Exclusion criteria were as follows: arthritis of the proximal radioulnar or...
radiocapitellar joint; preoperative LCL lesions or attenuation or clinical evidence of PLRI11; presence of other diseases, impaired sensation, paralysis, and all other neurologic conditions that would affect the outcome measure; and history of significant trauma to the affected lateral epicondyle and/or elbow surgery.

At follow-up, a retrospective arthroscopic high-definition video analysis was performed by an independent examiner (a fellowship-trained shoulder and elbow specialist) who did not participate in the original surgery. Patients were considered eligible for follow-up if intraoperative videos as well as standard preoperative radiographs and magnetic resonance imaging scans were available. Given the retrospective nature of the study design, no specific ethical board approval was obtained.

Surgical Technique

The patient was placed in a modified lateral decubitus position with the operative arm positioned in 100° of flexion/90° of abduction at the level of the shoulder by an arm holder. The elbow was positioned in 90° of flexion, with the forearm hanging free to gravity. A non-sterile pneumatic tourniquet was positioned high in the axilla and inflated to 250 mm Hg after limb exsanguination. Before establishment of the portals, 30 to 50 mL of sterile saline solution was injected to distend the elbow joint by using an 18-gauge needle inserted through the soft-spot portal.

A proximal AM portal was created 2 to 3 cm proximal to the medial humeral epicondyle and 1 cm anterior to the intramuscular septum. Insertion of a 30° arthroscope into this portal allows intra-articular diagnostic evaluation of the anterior compartment. The proximal anterolateral portal is located approximately 3 cm proximal and 1 cm anterior to the lateral epicondyle. This portal was used to insert a retractor aimed toward the radiocapitellar joint to protect the posterior interosseous nerve, which lies just anterior to the capsule at this level. Instruments were introduced through the anterolateral portal located 1.5 to 2 cm proximal and 1 cm anterior to the lateral epicondyle. At this point, the R-LCL was not identifiable as an isolated structure but appeared as a thickening of the capsule (Fig 2A).

A limited anterolateral V-shaped capsulotomy was performed with a hooked electrocautery device introduced through the anterolateral portal (Figs 2B and 2C) under visualization with a 30° arthroscope. The superior arm of the V was performed parallel to the distal humerus, whereas the inferior arm was parallel and anterior to the R-LCL. The R-LCL was seen as a thickening of the capsule and better visualized by tensioning the capsule in pronation. If visualization was still difficult, an ideal location of the R-LCL was projected and capsulotomy was performed anterior to that. Care was taken to perform the capsulotomy with the forearm in pronation to tension the R-LCL and facilitate the protection of this structure. Pronation also offers a second advantage of moving the posterior interosseous nerve further medial to the surgical area. The inferior limit of the capsulotomy was approximately 0.5 to 1 cm superior to the radial head.

The 30° arthroscope was then switched to a 70° arthroscope, and the arthroscope was advanced into the window created by the capsulotomy. This offered a frontal view of the most lateral aspect of the lateral compartment with the capsule/R-LCL defining the articular side and the tendon fibers of the ECRB on the extracapsular side (Fig 3).

Maintaining a 70° view from the AM portal, the surgeon performed an accurate soft-tissue dissection between the capsule/R-LCL and ECRB with a 4.5-mm shaver (Fig 4) through the anterolateral portal. This allowed an accurate definition of the surgical plane (Fig 4) between the ECRB and R-LCL. These 2 structures were clearly visualized as distinct and independent to increase the level of safety while proceeding with resection. The hook electrode was then advanced through the anterolateral portal. The shape of this
device allows the surgeon to “hook” the ECRB tendon and perform release from the inner/anterior part to the outer/posterior aspect approximately 1 cm from the proximal bone insertion (Fig 5). This technique allows protection and complete preservation of the R-LCL.

After ECRB tendon release, the posterior common extensor origin was assessed. This is located as an independent structure more posterior to the ECRB tendon at the very end of the 70° optic field. The tendon was probed to check the integrity of the common extensor origin (Fig 6).

A suction drain was placed at the end of the procedure and was removed the day after the procedure. During the first 48 hours, active elbow, wrist, and hand range of motion was encouraged. As symptoms regressed, stretching exercises were initiated, and at 4 to 6 weeks from surgery, the patient began a strengthening program.

Arthroscopic Video Evaluation

The safety and efficacy of the procedure were assessed by an independent examiner (a fellowship-trained shoulder and elbow surgeon who did not take part in the surgery) reviewing the full high-definition video recordings and scoring them based on 4 yes/no questions:

1. Was the surgeon able to establish a frontal view of the lateral elbow compartment with the R-LCL and ECRB centered in the optic field as parallel structures?
2. Was a clear plane between the ECRB and R-LCL developed during the case?
3. Was there clear visualization of complete ECRB resection, including the whole tendon stump distally and the residual portion at the origin proximally?
4. Did the surgeon identify and probe the posterior common extensor tendon after ECRB release under direct visualization from the AM portal with a 70° arthroscope?
Follow-Up Data Collection and Evaluation

Patients were clinically evaluated at a minimum of 24 months after surgery by the same independent examiner. Stability was assessed and recorded by the same independent examiner with varus stress applied in extension and at 40° of flexion, as well as the posterolateral pivot-shift and chair tests. Two limb-specific scores and one quality-of-living score were also used: Mayo Elbow Performance Score (MEPS)12; Andrews-Carson elbow score13; and score on the shortened Disabilities of the Arm, Shoulder and Hand questionnaire.12,14 Means and variable ranges were calculated.

Results

Eighteen patients with chronic lateral epicondylitis underwent arthroscopic ECRB resection and were included in the study according to the inclusion/exclusion criteria (out of a series of 27 patients). There were 5 men and 13 women with a mean age of 46 years (range, 25 to 59 years). The median postoperative follow-up period was 24 months (range, 24 to 30 months). There were 11 right elbows (61%) and 7 left elbows (39%). Of the patients, 17 (94%) were right hand dominant and 1 (6%) was ambidextrous (Table 1).

There were no intraoperative or early postoperative complications. Of the cases, 4 (22%) presented with a capsular tear, and in 3 cases (16%), an associated synovial plica of the posterior radiocapitellar joint was addressed.

During video analysis, the first and second yes/no questions were answered positively (yes) in all the cases (100%). The third and fourth questions received 17 of 18 positive (yes) responses (94%). In 1 case the video did not allow a clear view of the tendon stump, as well as the most posterior aspect of the lateral compartment.

All elbows were clinically stable to ligamentous testing at final follow-up. No apprehension was reported by any patient during the chair test.

The mean postoperative MEPS was 82.5 (range, 60 to 100), with 1 patient (6%) achieving an excellent result, 14 patients (78%) having a good result, and 3 patients (16%) having a fair result. On the basis of the Andrews-Carson score, the outcome of surgery was excellent in 15 patients (83%), good in 1 (6%), and fair in 2 (11%). One of the 2 patients with a fair result reported a postoperative transient loss of extension that slowly resolved with a rehabilitation program, and the other patient reported a moderate loss in strength that partially limited her sport activity. The mean postoperative Andrews-Carson score was 185.3 (range, 125 to 200). The mean postoperative shortened Disabilities of the Arm, Shoulder and Hand score was 20.14 (range, 5 to 57.5) (where 0 is the maximum score and 100 is the minimum score).

Discussion

There is currently no clear consensus on the optimal treatment of lateral epicondylitis, but numerous options are available.3,4,15-20 Approximately 92% of the cases are self-limiting, with a typical episode lasting 6 to 24 months.21 A surgical approach can be indicated in chronic cases. According to the classic open approach, identification and excision of the degenerative tendon tissue of the ECRB are undertaken.9,19,20,22

The advantage of an arthroscopic technique is the detection and treatment of 69% of the associated pathologies, such as synovial pathology (mainly plicae), loose bodies, or degenerative tissue.22 A standard 30° camera shows the ECRB tendon and the LCL in its radial and annular components at the edge of the optic field of view. However, the ECRB tendon and R-LCL

Table 1. Patient Series and Results

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F, female; M, male; QuickDASH, shortened Disabilities of the Arm, Shoulder and Hand questionnaire.
are overlapping close to the epicondyle, and a clear distinction of the tissue planes with a 30° viewing angle is not achievable.\textsuperscript{2} The R-LCL partially obscures the ECRB tendon. Previous authors have recommended not resecting more posterior than an ideal line passing through the center of the radial head.\textsuperscript{7,8} This approach risks resecting part of the R-LCL to allow visualization “around the corner” or, conversely, performing an under-resection of the most posterior ECRB tendon fibers because of inadequate visualization of this area.

Unfortunately, injury to the LCL complex resulting in PLRI has been reported after both open and arthroscopic release of the common extensor origin.\textsuperscript{5,6} Some authors have attributed the cause of PLRI to the U-LCL.\textsuperscript{11} However, anatomic studies have indicated that more than half of the cadavers lacked an obvious and thick U-LCL.\textsuperscript{23} A recent arthroscopic cadaveric model series has shown that the U-LCL can be transected without inducing PLRI of the elbow and that both injuries to the R-LCL and the U-LCL are necessary to cause significant PLRI.\textsuperscript{9} This observation is supported by a recent in vivo study on the isometric point of the lateral ligament of the elbow.\textsuperscript{10} The authors highlight that the R-LCL is essentially isometric whereas the U-LCL is not isometric in the flexion-extension arc. They conclude that the R-LCL appears to be more important than the U-LCL in preventing PLRI. All of these findings reinforce the need for a technique that can preserve as much of the R-LCL as possible.

In our series the 70° arthroscope allowed us to visualize the ECRB insertion and the LCL from the frontal plane in all of the cases (100%). A surgical plane between these structures was created in all the cases and was visible in the video analysis, leaving the ligament on 1 side and the tendon on the other. In 17 of 18 cases (94%), the examiner was able to clearly detect the ECRB release and the tendon stump together with the most posterior fibers of the common extensor origin.

Baumgard and Schwartz\textsuperscript{24} reported the retrospective results of 37 lateral epicondyle percutaneous releases. The results were rated as excellent (no symptoms under any circumstances) in 91% of cases, fair (improvement but still symptomatic) in 0%, and unsatisfactory (no improvement) in 9% after a mean follow-up period of 34 months (range, 14 to 81 months). In the report of Lakhey et al.\textsuperscript{25} on 17 patients (21 elbows) treated with percutaneous extensor tenotomy, they reported excellent and good results in 76.2% of cases (20 elbows), satisfactory results in 19% (4 cases), and poor outcomes in 4.8% (1 elbow). There was another case series of percutaneous release for epicondylitis with similar results.\textsuperscript{15}

Baker et al.\textsuperscript{22} reported similar success with arthroscopic treatment of tennis elbow. In their series of 37 patients with 39 tennis elbows treated arthroscopically, 95% of cases showed improvement after a 34-month follow-up. Thirteen of their patients returned for objective follow-up. The mean MEPS of this subgroup was 93.6 of 100, and grip strength averaged 96% of the strength of the unaffected limb.

Grewal et al.\textsuperscript{26} showed favorable results, with 30 of 36 subjects reporting improvement with surgery. The final mean MEPS was 78.6 ± 16.5 (22 good to excellent, 9 fair, and 5 poor). Owens et al.\textsuperscript{27} reported similar results in their 16 patients who underwent an arthroscopic release for lateral epicondylitis. The clinical outcomes of our patients were good to excellent in 16 of 18 cases (78%), showing the efficacy of the procedure. The overall results in our cohort are comparable to those of other authors who used both a standard 30° arthroscopic approach and percutaneous treatment for chronic lateral epicondylitis.

**Limitations**

Despite the advantages of the technique described, gaining confidence with an arthroscopic approach and particularly the 70° arthroscope is usually a lengthy process. This type of procedure requires more equipment, with an increase in operative time and costs. The study presents some limitations. The series is limited, not randomized nor blinded. No preoperative outcomes were recorded to assess the clinical improvement at follow-up. Moreover, no specific analysis of the preoperative conservative treatment and the way these elements could have affected the final outcome was conducted. Intraoperative videos were reviewed by a single observer; however, this is not a validated method of analysis. Because of the limited number of patients, only descriptive statistics were used.

**Conclusions**

The 70° arthroscope allows visualization of the ECRB insertion and R-LCL frontally and in parallel, satisfying the hypothesis criteria. A surgical plane could be created between the structures. This eliminates “blind angles” and decreases the potential of releasing part of the R-LCL or suboptimal visualization. The clinical outcome was good or excellent in 78% of the cases.

**References**


