Technical Note

Arthroscopic Modified Elbow Lateral Collateral Ligament Imbrication: An Operative Technique

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Abstract: When the lateral collateral ligament (LCL) complex fails to support the radiocapitellar and ulnohumeral joints in advanced stages of insufficiency, the patient experiences posterolateral rotatory instability (PLRI). Open lateral ulnar collateral ligament repair with a ligamentous graft has been the standard treatment for PLRI. Despite producing good clinical stability rates, this method is associated with significant lateral soft-tissue dissection and a lengthy recovery period. By fastening the LCL to its humeral insertion, arthroscopic imbrication of the LCL can increase stability. The senior author modified this technique. With the aid of a passer, the LCL complex, lateral capsule, and anconeus may be weaved with a single (doubled) suture, secured with a Nice knot. LCL complex imbrication may be used to restore stability and improve pain and function in patients with grade I and II PLRI.

The radial collateral ligament, annular ligament, and lateral ulnar collateral ligament (LUCL) compose the lateral collateral ligament (LCL) complex. When the LCL fails to support the radiocapitellar joint in the early phases of instability and the ulnohumeral joint in the later stages, posterolateral rotatory instability (PLRI) of the elbow develops, which was initially identified by O'Driscoll et al.[1] in 1991.

Trauma is the most common cause of chronic lateral complex insufficiency: Up to 20% of individuals acquire chronic PLRI after a simple elbow dislocation.[2] Traditional treatment for chronic PLRI has been open LUCL reconstruction with a ligamentous graft. Despite the fact that this approach produces high clinical stability rates, it is accompanied by considerable lateral soft-tissue dissection and a lengthy recovery period.

By retying the LCL to its humeral insertion, arthroscopic plication of the LCL can improve posterolateral rotatory stability.[3-6] Smith et al.[6] pioneered arthroscopic plication of the LUCL as a minimally invasive procedure in 2001. Their technique entails threading 4 to 7 distinct absorbable sutures through the tissue posterior to the lateral epicondyle from the lateral ulnar border. The LCL may then be effectively plicated after knot tying.[6] This approach was later amended by van Riet[7] by integrating the entire LCL complex, lateral capsule, and anconeus into a single (doubled) suture. We present, in detail, a modification of this arthroscopic imbrication of the LCL complex to restore posterolateral rotatory stability and improve pain and function in patients with grade I and II PLRI.

Technique

The procedure is carried out with the patient in the lateral decubitus position (Video 1). A proximal pneumatic tourniquet is placed on the arm. The arm is resting on an arm-rest device, with the elbow resting in 90° of flexion to allow for deep flexion and full extension (Fig 1).

The patient is first examined while under general anesthesia. The pivot-shift, forceps grip, and posterior drawer tests, as well as assessments of range of motion and varus and valgus stress, are all performed and

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The authors report the following potential conflicts of interest or sources of funding: C.K. is a consultant for DePuy Mitek. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received September 15, 2022; accepted January 19, 2023.

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2212-6287/221213

https://doi.org/10.1016/j.eats.2023.01.009

reported. The bony landmarks of the elbow and the ulnar nerve course are drawn, and the joint is insufflated (Fig 2). The LCL complex and its insertion can be identified by applying varus stress to the elbow. The joint is insufflated with saline solution, and the procedure may start by viewing the posterior compartment or, if the anterior compartment of the joint is to be inspected, an anteromedial portal can be created.

Regarding the posterior side, the scope is introduced into the posterior compartment through a high posterolateral portal created just lateral to the triceps, approximately at the same height as the olecranon tip. The scope is pointed first to the ulnar gutter. A portion of the medial collateral ligament (MCL) posterior band may be seen. Part of the anterior band may also be seen in certain cases. Under a direct view of the medial joint line, valgus tension can be applied, and when the MCL is intact, the medial joint gap does not open. We test the medial stability after establishing a trans-tricipital portal by bringing a 4-mm trocar between the medial side of the olecranon tip and the trochlea. If it does not open up, then the MCL is intact (Fig 3). The olecranon tip and olecranon fossa are visualized. If there is pathology, it is addressed through the central posterior (trans-tricipital) portal.

Fig 1. Positioning of patient in lateral decubitus position, left operated elbow, for standard elbow arthroscopy.

Fig 2. Elbow arthroscopy with patient in lateral decubitus position, right operated elbow. The bony landmarks of the elbow are drawn, and the joint is insufflated.

Thereafter, the scope is pushed into the radiohumeral gutter. To remove any synovium that is blocking the view, a soft spot portal is created. The arthroscopic rotatory instability test, drive-through sign, and trocar test, performed from the posterior compartment, help validate the diagnosis of PLRI[7,8] (Fig 4). Hypersupination with varus stress on the forearm will show the radial head subluxating posteriorly on the capitellum and the radiocapitellar joint line widening. Longitudinal pressure on the forearm may reveal more radiohumeral joint space gapping, the so-called pull test. An indirect indicator of lateral laxity is also the occasional sagging of the annular ligament.

We proceed with the surgical procedure once the indication has been validated. A 14-gauge needle is threaded with a polydioxanone (PDS) II suture

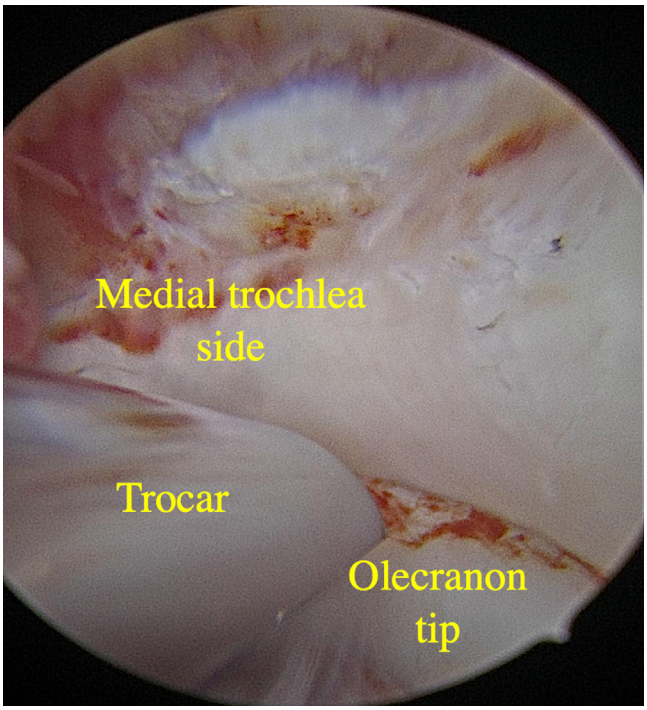

Fig 3. Elbow arthroscopy, right elbow in lateral decubitus position, with view of posterior compartment. Medial ligament complex instability is checked by trying to open the space between the medial trochlear side and the olecranon via a trocar.

(Ethicon, Somerville, NJ). This is then placed in the center of the lateral epicondyle (Fig 5). Its position has been marked before joint insufflation; thus, it should be

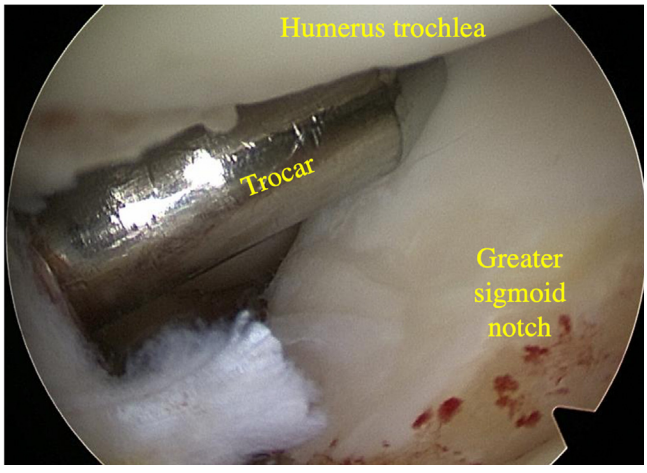

Fig 4. Elbow arthroscopy, left elbow in lateral decubitus position, with view from posterolateral gutter. The modified drive-through sign is assessed (performed by a trocar). An attempt is made to open the space between the trochlea and the greater sigmoid notch (behind the coronoid process). A positive sign is present when easily passing the trocar to the anterior elbow compartment and opening up the ulnohumeral joint.

Fig 5. Elbow arthroscopy, left elbow in lateral decubitus position, showing first step of lateral collateral ligament imbrication technique: proximal 14-gauge needle insertion at lateral epicondylar area. The needle, after being fed the polydioxanone suture, is pointed toward the posterolateral gutter. Then, one polydioxanone suture end passes through and is pulled from the soft spot portal.

rechecked because of the swelling. The needle is directed to the radiohumeral gutter, and the suture is shuttled into the joint under direct observation. By use of a grasper, the suture is pulled through the soft spot portal, and the needle is removed.

The subcutaneous boundary of the ulna is then palpated. On the supinator crest, the LUCL is inserted near the base of the radial head. The 14-gauge needle is then introduced posterior to the LUCL insertion directly on the bone and into the radiohumeral gutter, and a CHIA Percpasser (DePuy Mitek) is driven through the needle (Fig 6). The CHIA device is drawn through the soft spot portal and knotted with the end of the PDS suture that was inserted from the lateral epicondyle via the same technique as with the CHIA device. The PDS is then pulled so that the knotted CHIA end exits the lateral epicondylar area. The knot

Fig 6. Elbow arthroscopy, right elbow in lateral decupitus position, showing second step of lateral collateral ligament imbrication technique: distal 14-gauge needle insertion. The needle (yellow arrow) is inserted just posterior to the lateral ulnar collateral ligament site and is pointed toward the posterolateral gutter. A CHIA Percpasser will be threaded through the needle, will reach the posterolateral gutter, and will be pulled from the soft spot portal.

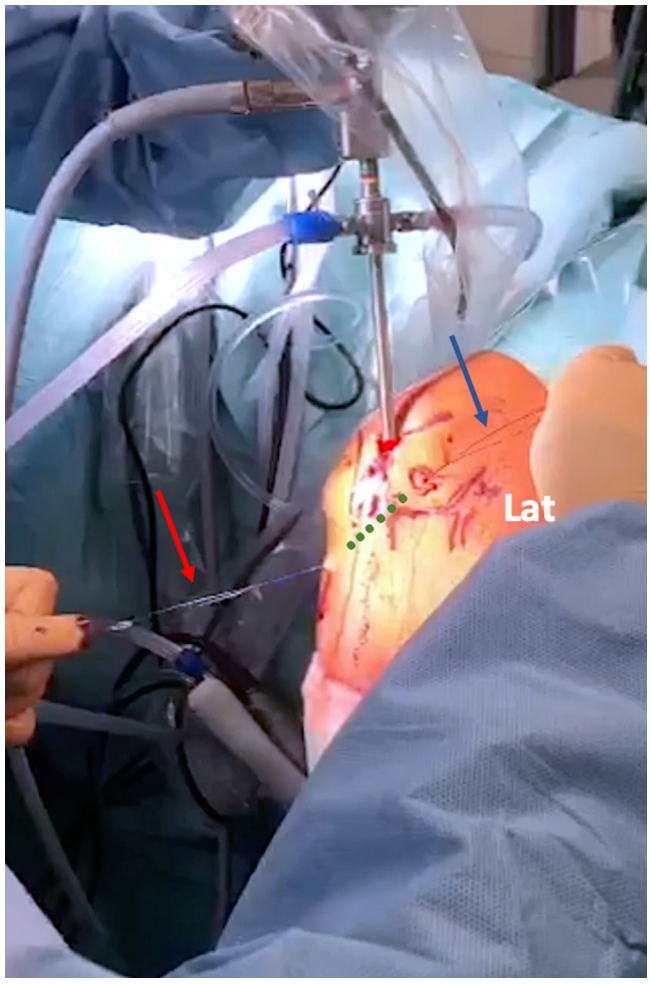

Fig 7. Elbow arthroscopy, right elbow in lateral decubitus position, showing end of third step of lateral collateral ligament imbrication technique. Looped polydioxanone suture is shown running throughout the length of the lateral ulnar collateral ligament (*red* and *blue arrows*). (Lat, lateral.)

is cut, and subsequently, a looped PDS II suture is loaded onto the CHIA device and pulled through the LUCL insertion site so that both ends of the looped PDS exit this site. At this stage, the loop of the PDS suture rests out of the lateral epicondyle center point, and both of its ends are coming out of the LUCL insertion area (Fig 7). It should be noted that modifications exist on how to guide the looped PDS, for example, by using another commercially available passer or lasso device or, as published by Kohlprath et al.,[4] by using an additional PDS suture.

Consequently, a small clamp is used to retrieve the looped part and both ends of the PDS suture subcutaneously through the soft spot portal. The loop and ends are tensioned with the elbow flexed at 60° and in full pronation (Fig 8). Proper tension is confirmed when the results of the drive-through sign and arthroscopic rotatory instability test are negative. Then, the arthroscope is pulled back, and a Nice knot may be placed to avoid multiple knots, which cause irritation. The lateral capsule, anconeus, and LCL complex are tightened and reinforced by the sutures in this way, and scope reinsertion and probe examination may finally attest that the drive-through sign result is negative. Thereafter, all ports are closed with a No. 3-0 nylon suture, and a posterior splint is placed for comfort for the first 48 postoperative hours. Then, a dynamic brace is used for 6 weeks. Extension up to 30° is permitted for 4 weeks. From the fifth postoperative week, full extension is permitted with the use of a dynamic brace to avoid supination for overall 6 weeks. Pearls and pitfalls of the described procedure are found in Table 1; advantages and disadvantages are listed in Table 2.

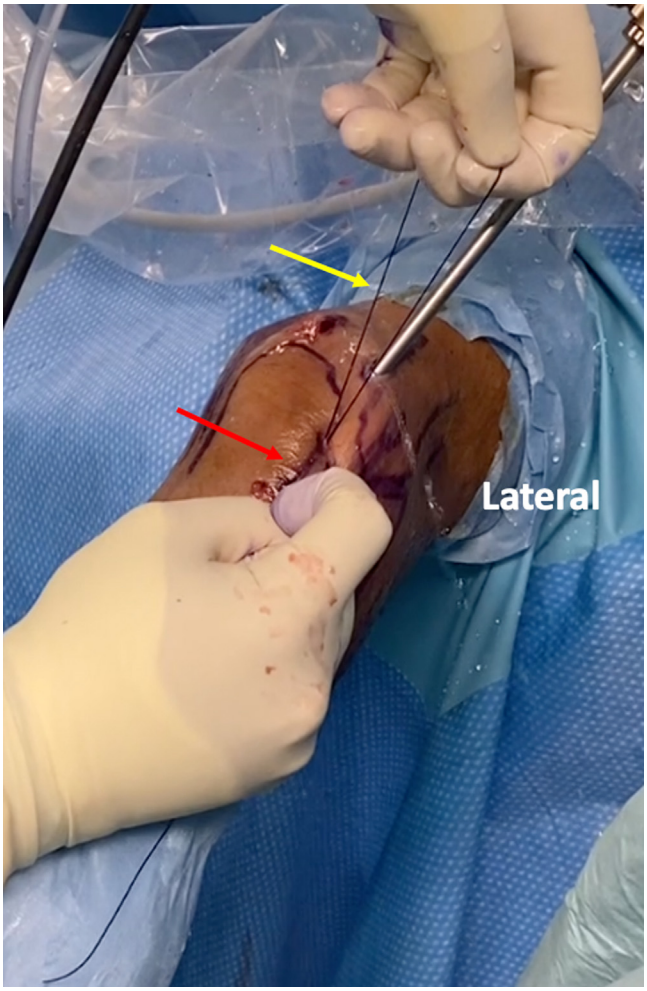

Fig 8. Elbow arthroscopy, right elbow in lateral decubitus position, showing final step of lateral ulnar collateral ligament imbrication technique. The tension of the looped polydioxanone suture is checked at 60°, and a Nice knot is then performed to secure and finish the imbrication.

Discussion

Arthroscopic LCL imbrication is a viable alternative to open LUCL reconstruction in selected patients while maintaining a high rate of postoperative clinical stability.[4] This procedure is appropriate for patients with grade I PLRI (radiographic radial head subluxation with hyper-supination) or grade II PLRI (coronoid perching on the humerus). The key to success with this approach, as always, is patient selection: patients with objective mild to moderate symptoms of instability and discomfort but no recurring frank dislocations.[4] Considering the technique of Smith et al.,[6] which uses 4 to 7 strands of suture, this change makes the technique faster and simpler while also reducing the number of subcutaneous knots, which could result in soft-tissue irritation.[9]

It could be argued that treating patients having low- and moderate-grade PLRI with open LCL reconstruction is an unduly aggressive approach, especially when minimally invasive techniques produce similar results. In their original technique article, Smith et al.[6] reported satisfactory results in more than 20 patients, and in the cohort study of Kohlprath et al.,[4] 18 of 19 elbows (95%) remained stable. Other techniques of LCL plication using an anchor to further reinforce the LCL complex have also shown favorable outcomes.[3,10] This compares well with the documented clinical stability rates of open reconstruction (0%-14%).[11-14]

A problem with the described technique that a few patients may notice is subcutaneous knot irritation, which we overcame by using a Nice knot. Because the LCL complex is directly subcutaneous, 4 strands of PDS suture create a prominent knot underneath the soft spot portal. However, this is favorable compared with the complications of LUCL reconstruction and tendon graft harvesting with open surgery, for example, donor-site pain, heterotrophic ossification, or greater postoperative pain.[15] However, it should also be noted that working on the lateral gutter requires sufficient surgeon experience. Another limitation is that there has been no comparative investigation of the biomechanics or clinical results with open approaches for grade I or II PLRI.

Table 1. Pearls and Pitfalls of LCL Imbrication Technique

Pearls
Associated pathology that may be contributing to instability should be treated.
A direct posterolateral portal should be used to increase the view.
Stability should be tested under direct arthroscopic view with the ARI, pull, and trocar tests.
To allow complete reduction, the scope should be pulled back before the sutures are tied.
Pitfalls
This technique has not been proved successful in cases of severe instability.
Knot irritation may be present.

ARI, arthroscopic rotatory instability; LCL, lateral collateral ligament.

Table 2. Advantages and Disadvantages of LCL Imbrication Technique

Advantages
Minimally invasive technique—no open procedure
No extra cost because no anchors are needed
Avoidance of postoperative stiffness owing to small amount of surgical trauma
Disadvantages
Only for stage I and II PLRI
Arthroscopic skills learning curve required to perform procedure

PLRI, posterolateral rotatory instability.

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