



# Arthroscopic Lateral Collateral Ligament Complex Reconstruction for Posterolateral Rotatory Instability of the Elbow, the Operative Technique

Cholawish Chanlalit, M.D., Nattakorn Mahasupachai, M.D., and Chidchanok Sakdapanichkul, M.D.

**Abstract:** Posterolateral rotatory instability is concerning pathology in patients with recalcitrant lateral elbow pain. An arthroscopic technique can be used to perform reconstruction of lateral collateral ligament for eradicating the instability and also to manage concomitant lesions in a simultaneous operation. Similar to the modified Broström procedure using an inferior extensor retinaculum to augment the lateral collateral ligament for lateral ankle instability, in our Technical Note, we use anconeus muscles and annular ligament to augment the lateral collateral ligament for elbow instability during the reconstruction, allowing all tissue to heal with the bone by using a knotless technique.

Lateral ulnar collateral ligament (LUCL) reconstruction with tendon graft was used previously<sup>1</sup> to improve posterolateral rotatory instability (PLRI) of the elbow; however, because this required open surgery, its disadvantages were donor-site morbidity and the destruction of the surrounding soft tissues.

Arthroscopic reconstruction of the lateral collateral ligament, such as imbricating the lateral collateral ligament (LCL) for tightening reported by Smith<sup>2</sup> and Savoie,<sup>3</sup> was developed to avoid the disadvantages of the reconstruction using tendon graft mentioned previously and showed successful results. Additional to this procedure, other procedures for eliminating concomitant pathologies, such as lateral epicondylitis, could be performed in the same operation via arthroscopy. Nevertheless, the quality of the LCL in chronic

condition is concerning.<sup>1</sup> A strategy to enhance LCL healing in chronic PLRI needs to be further investigated.

The modified Broström procedure used in ankle instability has shown successful results. This technique wraps tissue around LCL of the ankle, such as inferior extensor retinaculum, then fixes the whole soft tissue back to the bone.<sup>4</sup> According to the LCL anatomy of the elbow, annular ligament and LUCL form a broad insertion at the supinator crest.<sup>5</sup> Proximal pulling of the annular ligament may tighten the insufficient LUCL. Applying this concept, an arthroscopic LCL complex reconstruction technique is proposed in this study to improve the quality of the soft-tissue reconstruction in patients with the PLRI in elbow (Video 1).

## Surgical Technique (With Video Illustration)

The operation is performed with the patient in a lateral decubitus position. A pneumatic tourniquet is applied on the arm proximally. The arm is laid on the arm rest device with the elbow rest in 90° flexion in resting position to allow deep flexion and full extension (Fig 1).

First, a proximal anteromedial portal as a viewing portal and an anterolateral portal as a working portal are used for anterior compartment arthroscopic examination. At this step, concomitant pathologies can be managed, such as plica resection and tenotomy of extensor carpi radialis brevis in lateral epicondylitis. These procedures usually involve a 3.5-mm motorized shaver (Sterling Cuda blade; CONMED, Largo, FL) and

From the Center of Excellent in Upper Extremity Reconstruction and Sports Medicine, HRH Princess Maha Chakri Sirindhorn Medical Center, Faculty of Medicine, Srinakharinwirot University, Nakhon Nayok, Thailand.

The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

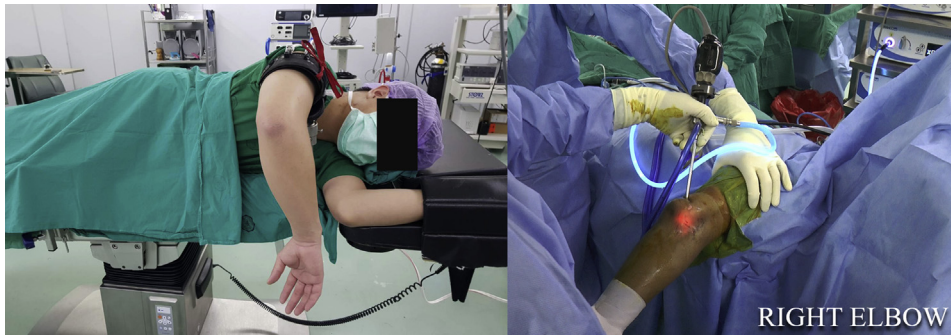
Received June 28, 2021; accepted August 15, 2021.

Address correspondence to Cholawish Chanlalit, M.D., Department of Orthopedics, 6th floor of Faculty of Medicine Building, Srinakharinwirot University, 62 Moo 7 Ongkharak, Ongkharak, Nakhon Nayok 26120. E-mail: [Chanlalit@hotmail.com](mailto:Chanlalit@hotmail.com)

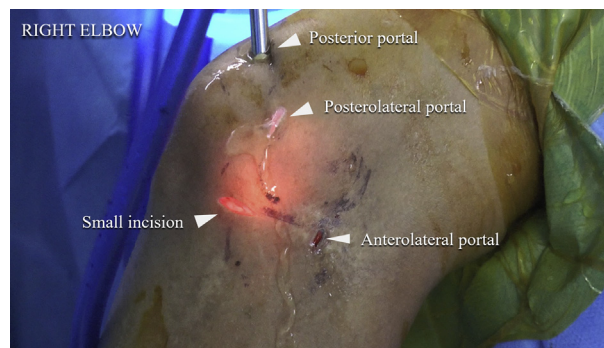
© 2021 by the Arthroscopy Association of North America. Published by Elsevier. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2212-6287/21964

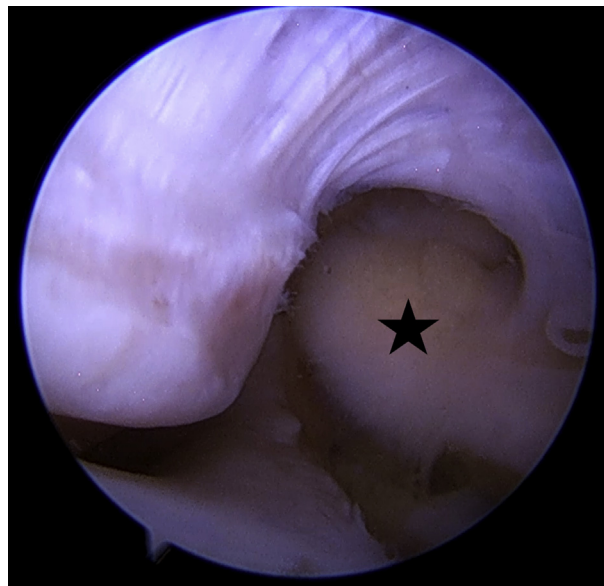
<https://doi.org/10.1016/j.eats.2021.08.026>



**Fig 1.** The patient is placed in the lateral decubitus position with arm support. A tourniquet is applied at most proximal arm. The operative elbow must be placed in a position that allows deep flexion and full extension.

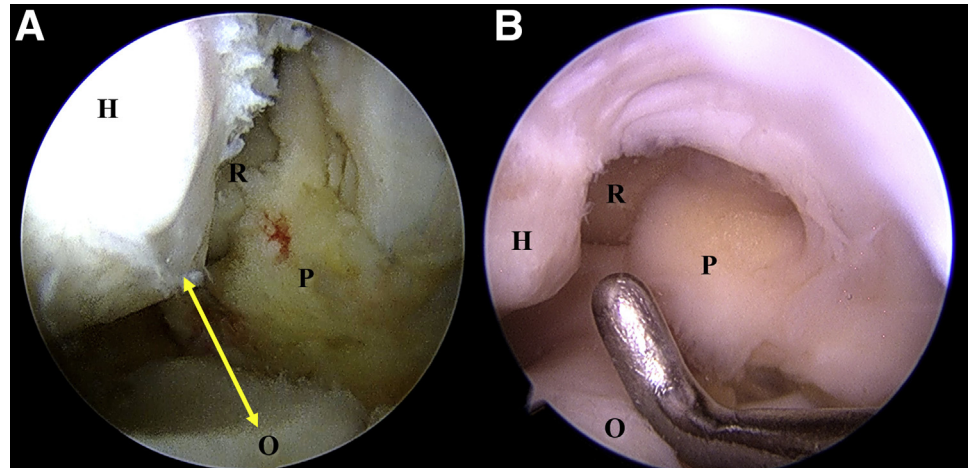


**Fig 2.** The posterior portal is a viewing portal and posterolateral is a working portal. A small incision is made for piercing a suture passer through the anconeus and annular ligament.



**Fig 3.** Through the posterior portal, a camera sheath is driven into the lateral gutter. This phenomenon is referred as a positive "drive-through sign." (Star, lateral olecranon plica.)

**Fig 4.** (A) Ulnohumeral gap (yellow line) is positive in the case that the ulnohumeral gap could be widened more than 2 mm with force forearm supination. (B) The picture demonstrates the gap measurement with probe while the elbow is extended and supinated. (H, humerus; O, olecranon, P, plica; R, radial head.)



a bipolar arthroscopic radiofrequency cautery (Edge with 90° probe; CONMED).

After the procedures in the anterior compartment, the posterior compartment is next examined. Direct posterior and posterolateral portals are used as viewing and working portals, respectively (Fig 2). Looking through the posterior portal, the camera sheath normally cannot be driven through the lateral gutter and radiocapitellar joint (Fig 3). Moreover, the ulnohumeral gap should not be able to be widened more than 2 mm or more than the length of arthroscopic probe tip (Fig 4). The LCL complex is considered attenuated when the lateral gutter can be driven through, which is called a positive “drive-through sign,” or the ulnohumeral joint can be

opened widely, which is called a positive “ulnohumeral gap widening sign.” Concomitant pathologies such as plica also are eradicated during this step (Fig 3).

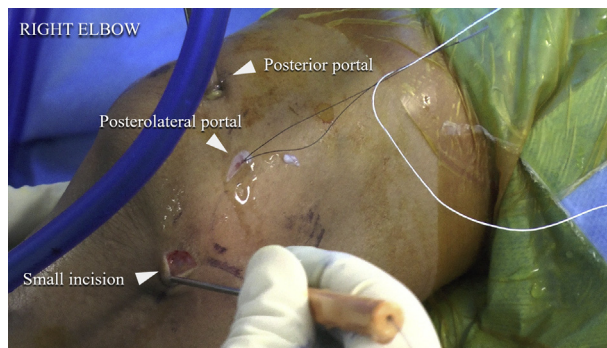
After the arthroscopic examination and management of concomitant lesions, the arthroscopic LCL complex reconstruction is then performed. The annular ligament is identified beneath the plica (Fig 5). A small skin incision is made posterior to the radial head for piercing a suture passer and for passing sutures (Fig 2). The suture passer (Banana SutureLasso; Arthrex, Naples, FL) is pierced through the lateral forearm fascia, anconeus muscle, capsule, annular ligament, and then finally into the joint (Fig 6). A lasso loop is then passed via the suture passer and retrieved to the posterolateral



**Fig 5.** The annular ligament (black arrow) is identified after resection of lateral olecranon plica.



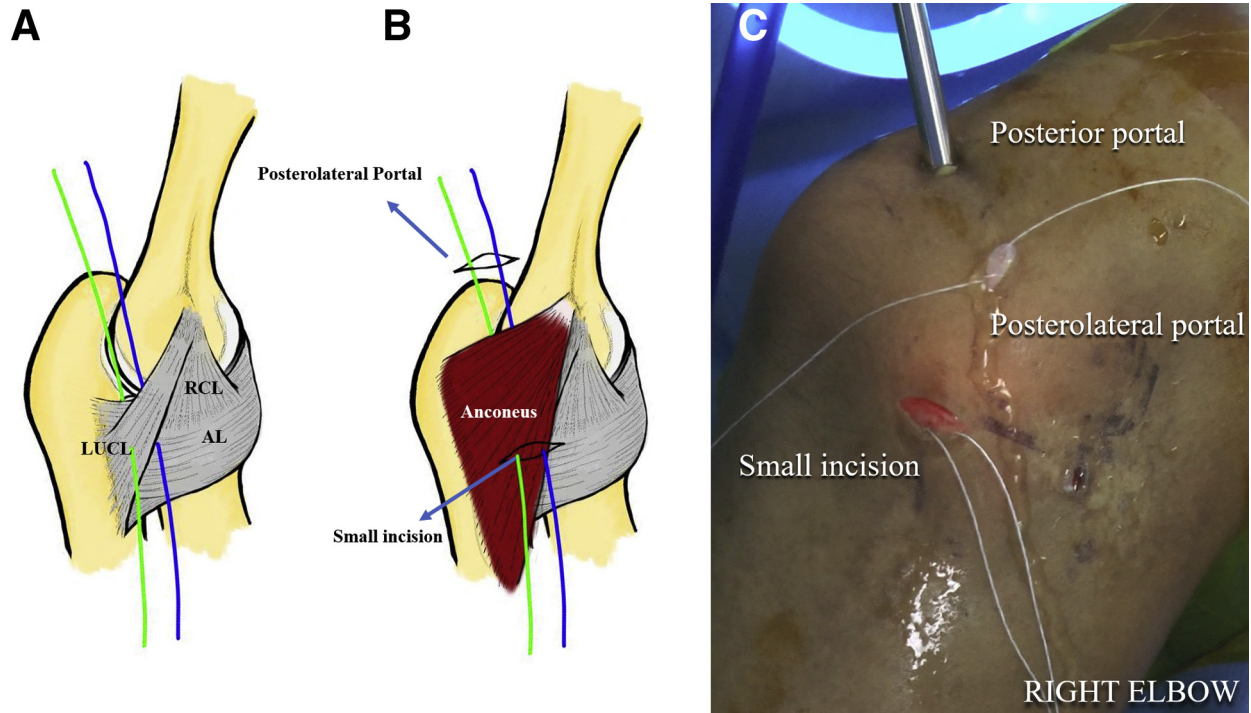
**Fig 6.** From the mini-incision posterior to radial head, a suture passer is used to pierce through the lateral forearm fascia, anconeus muscle, capsule, and annular ligament and then is retrieved out to the posterolateral portal.



**Fig 7.** A No. 2-0 Hi-Fi is retrieved back from the posterolateral portal to the small incision.



**Fig 8.** Viewing from posterior portal, the No. 2-0 Hi-Fi is passed through posterolateral portal to the annular ligament then throughout the small incision.



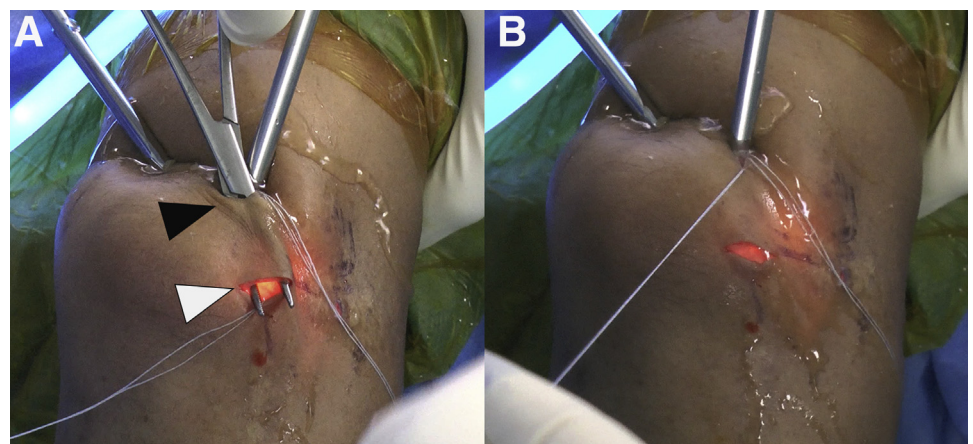
**Fig 9.** (A-B) Diagrams show the position of the No. 2-0 Hi-Fi sutures. From the posterolateral portal, the sutures go through the annular ligament, anconeus muscle, and then out at the small incision. (C) The elbow after the sutures are passed. (AL, annular ligament; LUCL, lateral ulnar collateral ligament; RCL, radial collateral ligament.)

portal. A No. 2-0 high-molecular-weight polyethylene core suture (Hi-Fi suture; CONMED) is then passed via the lasso from the posterolateral portal back to the small incision (Fig 7). The second suture is performed in the same fashion 0.5 to 1.0 cm apart from the first suture. At this moment for both sutures, one end is at the posterolateral portal and the other is out at the small incision (Figs 8 and 9).

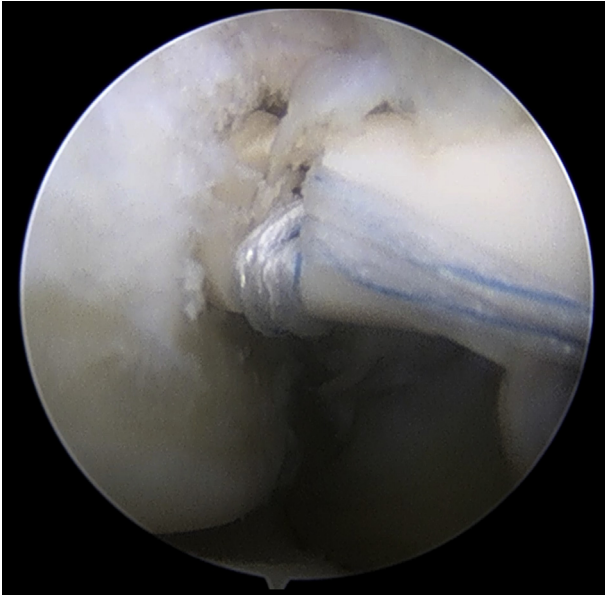
A subcutaneous tunnel is created from the previous small incision to the posterolateral portal. The suture ends that are out at the small incision opening are passed through this subcutaneous tunnel and then out to the posterolateral portal (Fig 10). At this moment,

the sutures are wrapping around the lateral forearm fascia, anconeus muscle, capsule, and annular ligament.

A knotless suture is used for tightening these soft tissues. A bone tunnel is created and prepared at posterior to the lateral epicondyle for inserting a 2.8-mm PopLok Anchor (CONMED) via posterolateral portal (Fig 11). The 4 ends of the sutures are put into the PopLok Anchor before it is applied to the tunnel via the posterolateral portal. The sutures are then tightened to wrap the mentioned soft tissue to the lateral epicondyle with the elbow in extension posture (Fig 12). Then the PopLok Anchor is locked and unnecessary suture ends are cut. The ulnohumeral gap widening sign and the



**Fig 10.** (A-B) Subcutaneous tunnel, created by using a clamp, is for passing the suture end from the small incision (white arrow) to the posterolateral portal (black arrow).



**Fig 11.** Posterolaterally, the PopLok anchor is applied to a bone tunnel that is created posteriorly to the center of lateral epicondyle.

drive through sign should be negative after this procedure (Fig 13). The pearls and pitfalls of tunnel creation and soft-tissue tensioning are mentioned in Table 1.

Postoperative rehabilitation is performed after the operation (Table 2). The operated elbow is protected with a hinge elbow brace for 6 weeks. The elbow is allowed for full flexion but limited extension at 45°, 30°, and full extension at 0, 2, and 4 weeks postoperatively, respectively. The isometric arm muscle strengthening is allowed immediately after the operation. At 6 weeks postoperatively, a forearm extensor strengthening exercises are allowed. At 12 weeks postoperatively, pivot activities such as chair raise and push up are allowed.

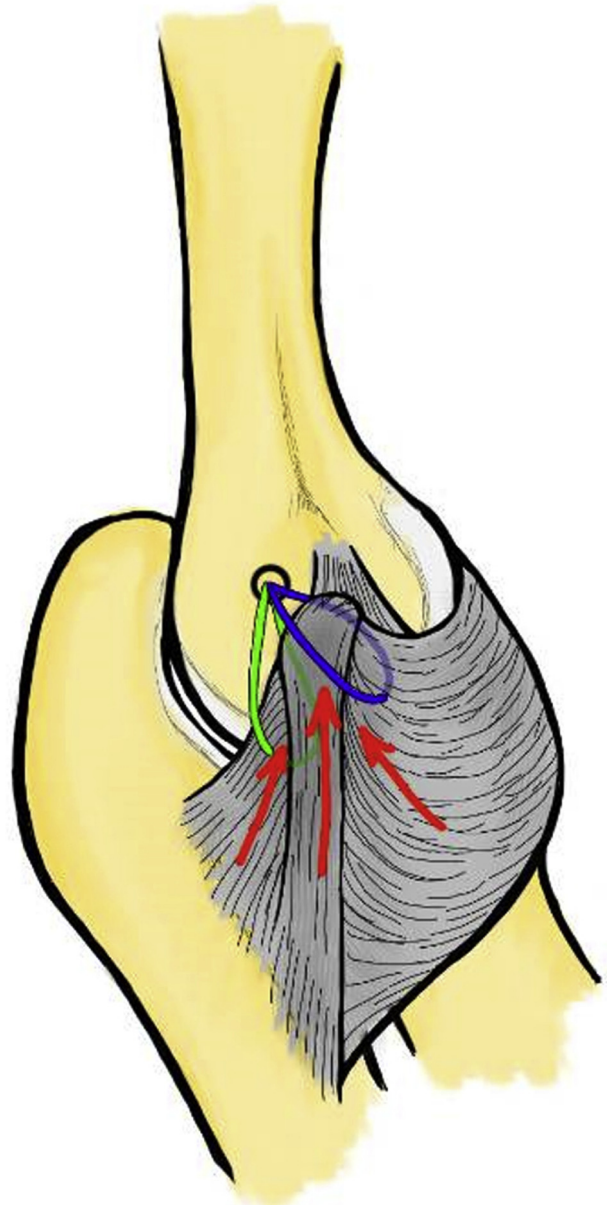
### Discussion

In the past, PLRI of elbow was improved by several tendon graft–reconstruction techniques.<sup>1</sup> Recently, arthroscopic reconstruction without tendon graft was developed to avoid donor-site morbidities and open wound to minimize soft-tissue damage.<sup>2,3</sup> Despite the arthroscopic techniques of imbrication or plication of chronic insufficient collateral ligament, the problem with the soft-tissue quality and the irritation from suture knot prominence is concerning (Fig 14 A and B).

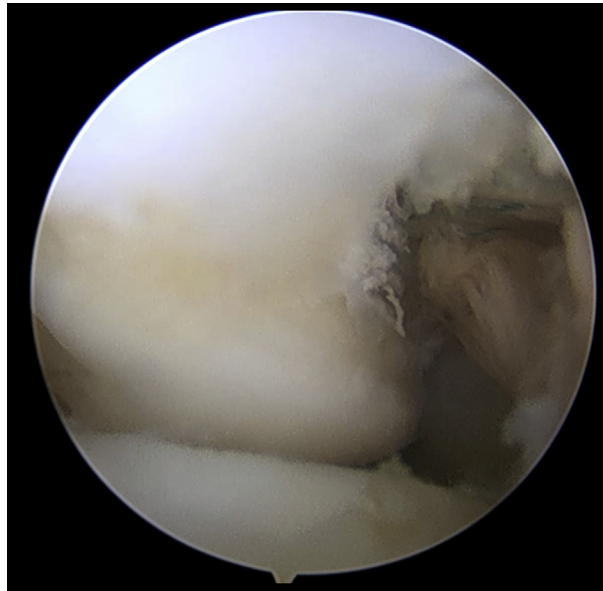
The ankle and elbow work similarly as a hinge joint. The arthroscopic modified Broström technique demonstrates the concept of using the retinaculum for improving the quality of reconstructed tissue to correct the lateral ligament instability in ankle.<sup>4</sup>

Since elbow and ankle work similarly as a hinge joint, the concept of the modified Broström procedure used in

ankle instability can possibly be applied to the PLRI of elbow. The arthroscopic modified Broström procedure used the inferior extensor retinaculum to improve the quality of the reconstructed soft tissue that was responsible for the lateral ligament stability of ankle.<sup>4</sup> In improving the PLRI of elbow with this concept, the annular ligament, anconeus muscle, and its fascia played a similar role with the inferior extensor retinaculum. A pulling of the annular ligament increased the tightness of substituted LCL complex and thus improved the biomechanical functions of the LUCL complex that was attached to the supinator crest.<sup>5</sup> The wrapping of the anconeus muscle also increased soft tissue healing.



**Fig 12.** A diagram demonstrates the pulling of annular ligament for tightening the lateral collateral ligament complex.



**Fig 13.** The posterolateral gutter is narrowed and cannot be driven through. The ulnohumeral gap is closed.

**Table 1.** Pearls and Pitfalls

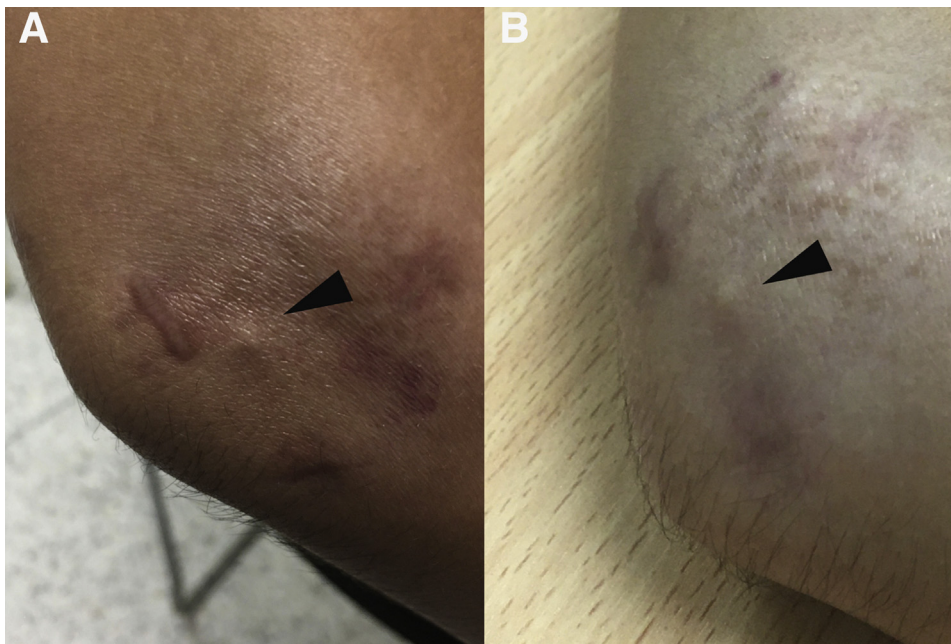
<ol style="list-style-type: none"> <li>1. Tightening all the reconstructed tissue to the posterior aspect as much as possible and placing the PopLok Anchor at posterior and inferior to the lateral epicondyle of humerus is recommended.</li> <li>2. The indicator of sufficient tension during tightening of the reconstructed soft tissue is the obliteration of the wide ulnohumeral joint space and the gutter. It is not by seeing all the soft tissue attached to the bone.</li> </ol>
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Table 2.** Specific Postoperative Rehabilitation and Training Protocol

Postoperative Timeline	Aftercare and Rehabilitation Program
First day	<ul style="list-style-type: none"> <li>• Posterior long arm slab                             <ul style="list-style-type: none"> <li>◦ Elbow flexion 45°</li> <li>◦ Neutral forearm rotation</li> </ul> </li> </ul>
1-6 weeks	<ul style="list-style-type: none"> <li>• Hinge elbow brace after swelling subsides                             <ul style="list-style-type: none"> <li>◦ Full flexion</li> <li>◦ Extension block at 45°</li> </ul> </li> <li>• Reducing the extension block angle to 30° and 0° at second and fourth week, respectively</li> <li>• Shoulder, wrist, and hand exercise</li> <li>• Avoid varus stress to the elbow</li> </ul>
7-12 weeks	<ul style="list-style-type: none"> <li>• Avoid shoulder abduction while elbow is having varus force from the gravity</li> <li>• Remove the hinge elbow brace</li> <li>• Full range of motion</li> <li>• Forearm flexors and extensors stretching and isometric strengthening exercise</li> <li>• Upper limb proprioceptive exercise</li> </ul>

**Table 3.** Advantages and Disadvantages

Advantages	Disadvantages
<ol style="list-style-type: none"> <li>1. Avoidance of the graft donor-site morbidities compared with tendon graft—reconstruction techniques</li> <li>2. Less soft-tissue dissection</li> <li>3. Avoidance of violation at osteoligamentous junction that contains proprioceptive nerve ending</li> <li>4. No irritation from suture knot prominence</li> </ol>	<ol style="list-style-type: none"> <li>1. Requirement in accumulation of experience in working on the posterolateral gutter</li> <li>2. Too much tension during soft-tissue tightening leads to difficult range of motion exercise during early post-operative period</li> </ol>



**Fig 14.** Suture knot prominence beneath skin in arthroscopic lateral collateral ligament imbrication with “knot-tying” techniques.

Moreover, a previous study showed there were proprioceptors on these soft tissues and became more condensed at the bone–ligament junction.<sup>6,7</sup> Therefore, in this new study, wrapping and pulling all the soft tissues toward the bone with implant could possibly preserve the proprioception and also enhance the recovery of the sensory nerve endings.

Even though the techniques for improving the PLRI of elbow in this study provided many benefits, there were limitations. The techniques required an accumulation of surgeon experience in working on the lateral gutter. There has been no comparative study of biomechanics or clinical result with the previous imbrication technique (Table 3).

To summarize, the arthroscopic LCL complex reconstruction technique in this study is an alternative in treating the PLRI of elbow. It creates fewer complications than open ligament reconstruction, which resulted in donor-site morbidity and large soft-tissue dissection. The concept of modified Broström procedure enhanced proprioception and quality of reconstructed soft tissue. A knotless technique could eradicate the pain caused by knot irritation under skin.

## References

1. Anakwenze OA, Kwon D, O'Donnell E, et al. Surgical treatment of posterolateral rotatory instability of the elbow. *Arthroscopy* 2014;30:866-871.
2. Smith JP 3rd, Savoie FH 3rd, Field LD. Posterolateral rotatory instability of the elbow. *Clin Sports Med* 2001;20:47-58.
3. Savoie FH 3rd, O'Brien MJ, Field LD, et al. Arthroscopic and open radial ulnohumeral ligament reconstruction for posterolateral rotatory instability of the elbow. *Clin Sports Med* 2010;29:611-618.
4. Rigby RB, Cottom JM. A comparison of the “All-Inside” arthroscopic Broström procedure with the traditional open modified Broström-Gould technique: A review of 62 patients. *Foot Ankle Surg* 2019;25:31-36.
5. Bozkurt M, Acar Hİ, Apaydin N, et al. The annular ligament: An anatomical study. *Am J Sports Med* 2005;33:114-118.
6. Benjamin M, Toumi H, Ralphs JR, Bydder G, Best TM, Milz S. Where tendons and ligaments meet bone: attachment sites ('entheses') in relation to exercise and/or mechanical load. *J Anat* 2006;208:471-490.
7. Kholinne E, Lee HJ, Lee YM, et al. Mechanoreceptor profile of the lateral collateral ligament complex in the human elbow. *Asia Pac J Sports Med Arthrosc Rehabil Technol* 2018;14:17-21.