Technical Note

Anconeus-Sparing Minimally Invasive Approach for Lateral Ulnar Collateral Ligament Reconstruction in Posterolateral Elbow Instability

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Abstract: Posterolateral elbow instability with an insufficiency of the lateral ulnar collateral ligament commonly results from elbow trauma. However, other etiologies such as iatrogenic injuries after primary surgical treatment for lateral epicondylitis or repetitive corticosteroid injections also may lead to a lateral ulnar collateral ligament insufficiency. In these cases, surgical treatment can help to restore posterolateral stability of the elbow. Besides the stabilizing effect of the ligamentous structures, the anconeus muscle is the most import active stabilizer against posterolateral elbow instability. Therefore, the aim of the present technique is to present an anconeus-sparing, minimally invasive approach to restore posterolateral stability. This technique may serve as an alternative for typically used all open access.

Posterolateral rotatory instability of the elbow has been described as the consequence of an insufficiency of the lateral ulnar collateral ligament (LUCL), most commonly following an elbow injury, such as a dislocation.[1] There are different mechanisms leading to an elbow dislocation. O'Driscoll et al.[1] describe the fall on the outstretched arm in supination leading to an semicircumferential rupture of the capsule-ligament structures starting from the LUCL and continuing along the anterior and posterior capsule, not infrequently leaving the medial collateral ligament intact, whereas other biomechanical and clinical studies describe that the simple elbow dislocation often leads due to an initial valgus stress to a rupture of the medial

collateral ligament without necessarily causing a lateral ligament injury.[2]

Regardless of the severity of elbow trauma with concomitant injuries to the capsule and common extensor tendon, the LUCL remains the main stabilizer against varus stress and posterolateral rotatory instability.[3] In addition, the chronic insufficient lateral collateral ligament is a clinically relevant pathology after an elbow dislocation.[4] However, other etiologies such as cubitus varus, iatrogenic injuries after primary surgical treatment for lateral epicondylitis, and repetitive corticosteroid injections also may lead to an LUCL insufficiency.[5]

Therefore, partial or complete disruptions of the LUCL complex often result in symptomatic posterolateral ulnoradialar joint (sub)luxation and may compromise sports, work, and activities of daily living. Often, patients do not present with a subjective instability but with lateral elbow pain and weakness or clicking.[6] In these cases, LUCL reconstruction is an adequate surgical technique to restore posterolateral elbow stability. The anconeus muscle represents one of the dynamic stabilizers of the elbow. Its orientation is similar to the LUCL. Therefore, different anatomic and electromyographic studies have identified the anconeus as a potential posterolateral stabilizer of the elbow. Moreover, anconeus tensioning has been shown to restore in vitro the stability of a posterolateral unstable elbow.[7] The aim of this Technical Note is to provide insights in an anconeus-sparing, minimally invasive surgical approach to perform a LUCL reconstruction.
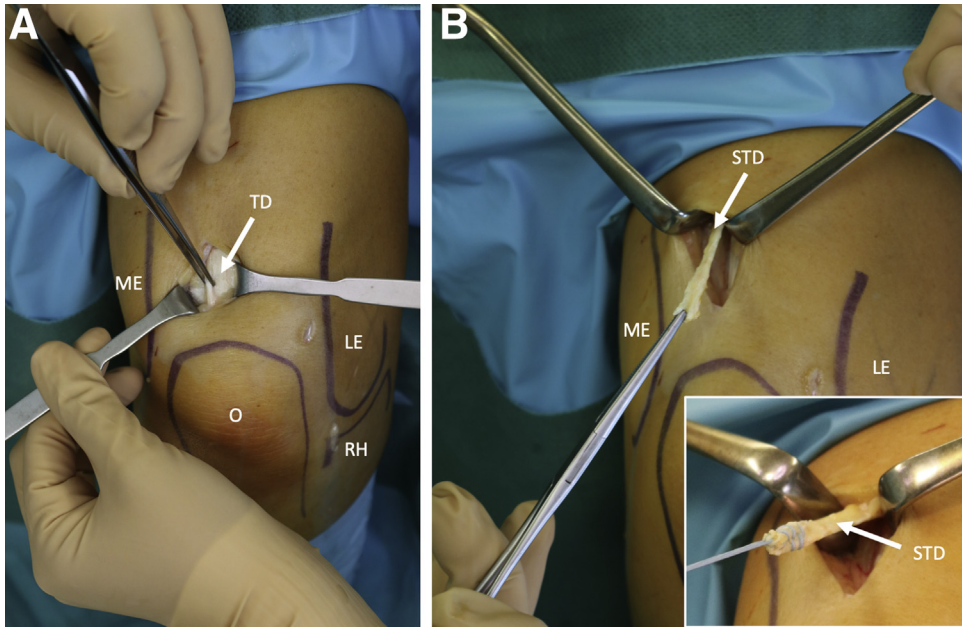
Fig 1. Right elbow with the patient in a lateral decubitus position. (A) A 4-cm dorsal incision is made approximately 2 cm proximal to the olecranon fossa. Approximately a 0.7- × 5- to 6-cm strip of the ulnar triceps tendon is incised. Care is taken not to incise the tendon too close to the bony tip of the olecranon. (B) The tendon is then detached from the olecranon side and (C) sutured with a nonabsorbable suture material in a baseball-stitch technique, following the proximal detachment of the graft. (LE, lateral epicondyle; ME, medial epicondyle; O, olecranon; RH, radial head; STD, striped triceps tendon; TD, triceps tendon.)

## Surgical Technique (With Video Illustration)

All patients received detailed information about the technique before surgery. The patient is placed in a lateral decubitus position with the shoulder flexed about 90° and the upper arm resting on an adjustable arm holder (TRIMANO; Arthrex GmbH, Munich, Germany) with an elbow platform.

A diagnostic arthroscopy of the elbow is first performed to evaluate the bony articulating surfaces and the instability of the elbow. A Wissinger rod is used to perform a "drive-through" test through the radiocapitellar joint. The rod is then placed in front of the coronoid process and levered to stress the LUCL and to evaluate the posterolateral stability. Moreover, a posterior drawer test under arthroscopic visualization is performed to confirm the instability. With an easy movement, the elbow platform can be flipped to bring the elbow and forearm in a horizontal working position.

A 4-cm dorsal incision is made approximately 2 cm proximal to the olecranon fossa. The triceps fascia is identified. Approximately a 0.7- × 5- to 6-cm strip of the ulnar triceps tendon is incised. Care is taken not to incise the tendon to close to the bony tip of the

Fig 2. Right elbow with the patient in a lateral decubitus position. (A) A 3- to 4-cm incision is made at the ulnar side and the forearm fascia is incised, the upper border of the anconeus muscle (yellow arrow) is identified and retracted posteriorly, (B) completely preserving its origin and insertion and exposing the ulnar insertion of the lateral ulnar collateral ligament (yellow asterisk). (LE, lateral epicondyle; O, olecranon; RH, radial head.)
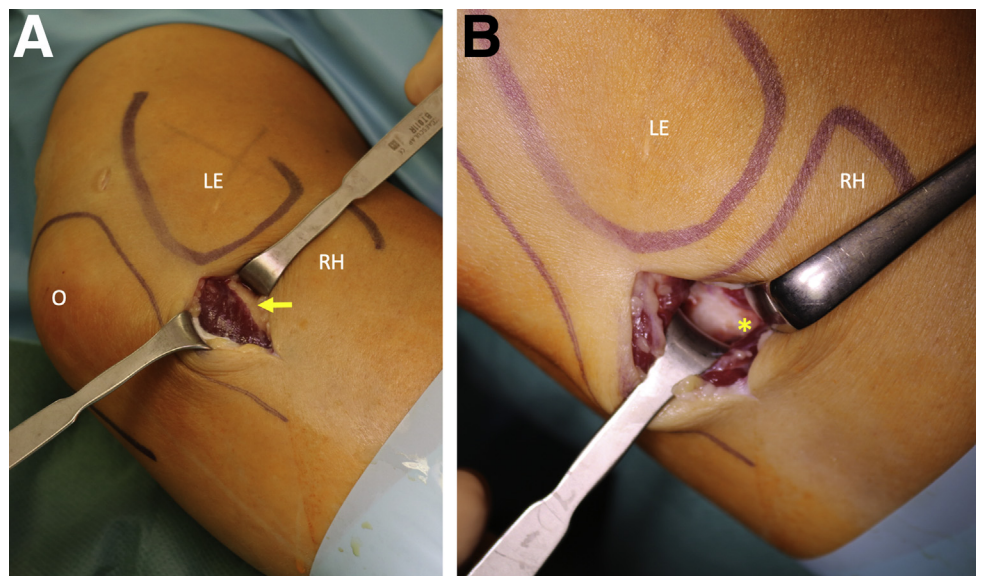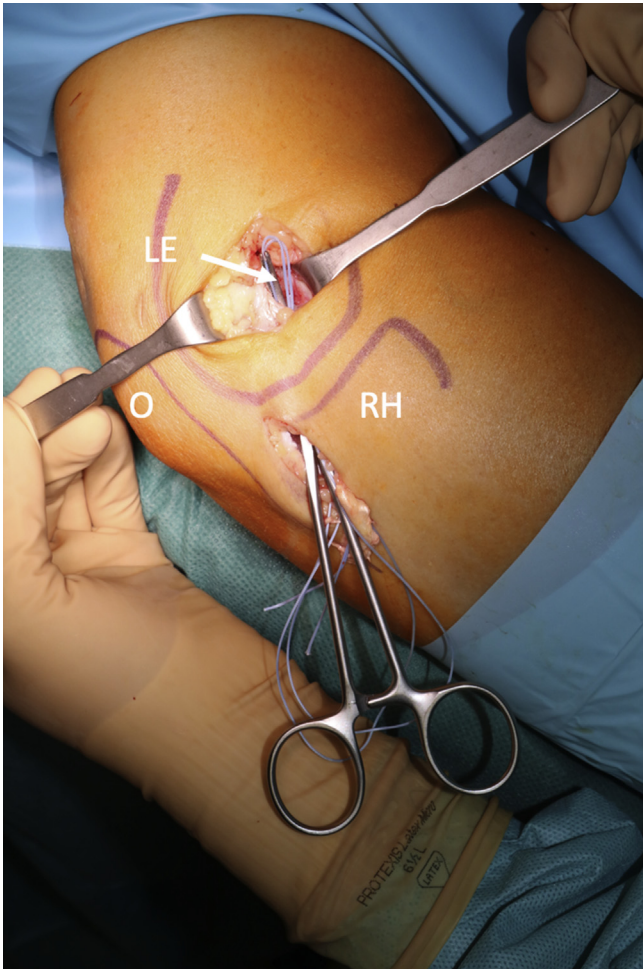
Fig 3. Right elbow with the patient in a lateral decubitus position. After ulnar fixation of the tendon graft, the free suture limbs are shuttled superficial to the capsule and the remnants of the lateral ulnar collateral ligament, but underneath the extensor tendons proximally using blunt dissection following the upper border of the anconeus and brought out proximally. (LE, lateral epicondyle; O, olecranon; RH, radial head).

Fig 4. Right elbow with the patient in a lateral decubitus position. At the humeral side, a part of the common extensor origin along with a part of the extensor carpi radialis is sharply elevated proximally to expose the lateral epicondyle with the origin of the lateral ligamentous complex. The anatomic origin of the LUCL is identified on the humerus, and a Kirschner wire is inserted perpendicularly. Subsequently, the remaining sutures are wound around the Kirschner wire and the elbow is brought into full extension and full flexion to test for the isometric insertion of the LUCL on the humerus. (LUCL, lateral ulnar collateral ligament; RH, radial head.)

olecranon (Fig 1). The remaining defect of the triceps tendon is closed side to side using absorbable sutures.

Two separate incisions of 3 to 4 cm are made, one on the humeral side and one on the ulnar side, thus affording a minimally invasive anconeus-sparing approach. At the ulnar side, the forearm fascia is incised, and the anconeus muscle is identified and retracted posteriorly, completely preserving its origin and insertion (Fig 2). At the humeral side, a part of the common extensor origin along with a part of the extensor carpi radialis is sharply elevated proximally to expose the lateral epicondyle with the origin of the lateral ligamentous complex and the upper quarter of the capitulum. A 3.2-mm monocortical drill hole is made in the proximal ulna distal to the radial neck at approximately a 60° angle to the long axis of the ulna.
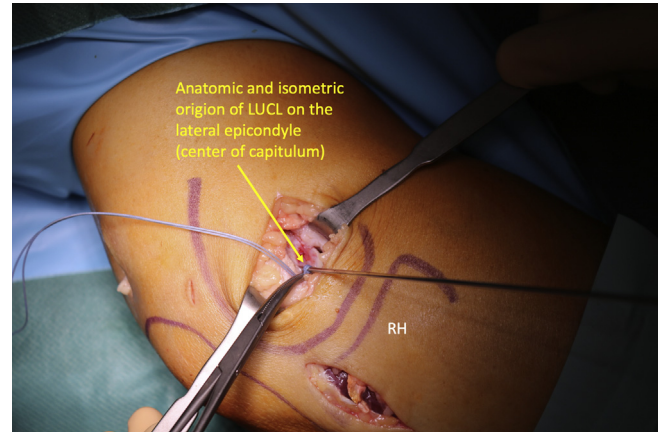
The triceps graft is armed at one side with nonabsorbable no. 2 sutures and the sutures are placed in a 2-mm flip button (BicepsButton; Arthrex GmbH). The button is inserted in the drill hole and flipped under the cortex of the ulna. By pulling on the sutures and tying them, the graft is fixed epiosseously. The suture limbs are then shuttled superficial to the capsule and the remnants of the LUCL, but underneath the extensor tendons proximally using blunt dissection following the upper border of the anconeus and brought out proximally (Fig 3). The anatomic origin of the LUCL is identified on the humerus and a Kirschner wire is inserted perpendicularly (Fig 4). This point usually lies close to the center of curvature of the capitulum.

The sutures are wound around the Kirschner wire, their length is fixed temporarily with a hemostat, and the elbow is cycled through the range of motion, confirming that the length and consequently the tension of the sutures remain constant throughout. This point may be corrected if necessary. This is the most important step of the surgery. Once this point can be confirmed to be isometric, a 4.5-mm hole is drilled, making approximately an angle of 30° upwards to the axis of the elbow. Via an additional hole drilled posteriorly, the passing sutures can be retrieved to allow tensioning the graft if necessary. The graft length is adjusted in order that in full tension about 5 mm of its end will be pulled in the drill hole and this free end is armed with no. 2 nonabsorbable sutures. A 5.5-mm knotless anchor (SwiveLock; Arthrex GmbH, Munich,
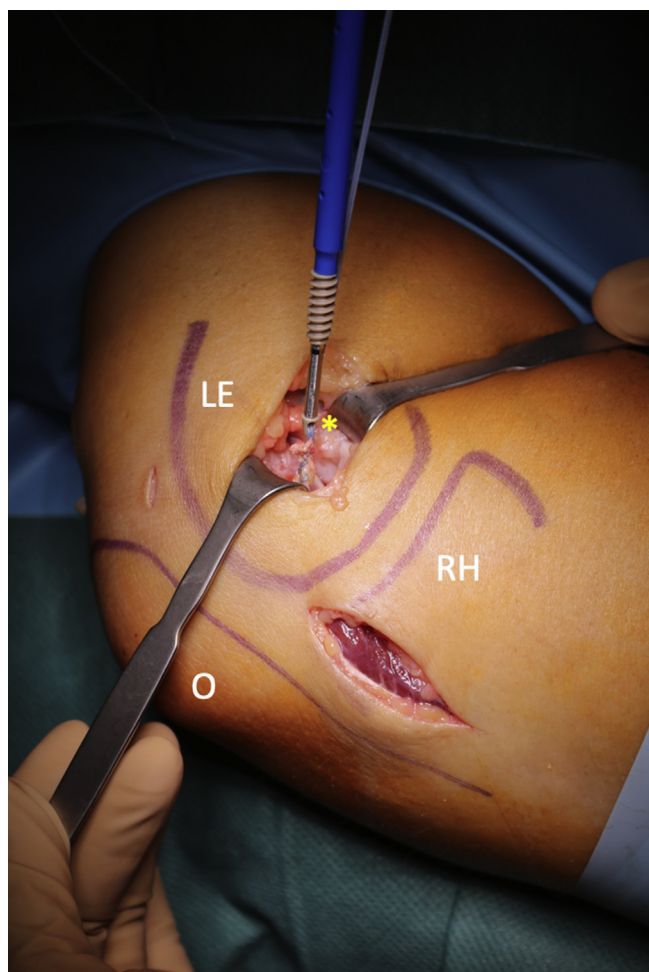
Fig 5. Right elbow with the patient in a lateral decubitus position. After drilling a 4.5-mm hole along to the axis of the trochlea, a 5.5-mm knotless anchor (SwiveLock; Arthrex) loaded with the sutures is inserted, with care taken to tighten the anchor and the graft with the elbow in a reduced position (yellow asterisk = suture and graft are attached to the anchor). (LE, lateral epicondyle. O, olecranon. RH, radial head.)

Germany) (Fig 5) is used to push the end of the graft in the drill hole in an interference screw fashion, with care taken to tighten the anchor and the graft with the elbow in a reduced position. To avoid knot irritation of the skin, the common extensors are repaired using the nonabsorbable sutures from the anchor with knots tied on the deep tendon surface, and the fascia is closed using absorbable sutures. The wounds are closed in layers (Video 1).

Postoperatively, an immobilization splint is applied with the elbow flexed up to 90° and the forearm mid-prone. The joint is braced for 14 days for soft-tissue consolidation; afterwards, an elbow brace with a 30° extension block allowing free flexion is used for another 2 weeks. The extension block is removed afterwards, and the brace is removed 6 weeks after the operation (Table 1).

Table 1. Specific Postoperative Rehabilitation and Training Protocol for LUCL Reconstruction after Posterolateral Elbow Instability

Time Point	Aftercare and Rehabilitation Program
Brace	Fixed elbow brace in 90° of flexion and full pronation for 14 days
1 d	• cryotherapy, passive motion of shoulder and wrist
	• active fist training using a soft ball (active ball compression and relaxing)
1-2 wk	• elbow immobilization in 90° of flexion and full pronation
	• active shoulder and wrist mobilization
	• posture training
	• lymphatic drainage and cryotherapy
3-4 wk	• adjustable elbow brace with 30 extension block in full pronation, free active flexion
	• active elbow mobilization in brace
	• start with physiotherapy
	• active pro- and supination in 90 of elbow flexion
	• no weights and no training against resistance
5 wk	• removal of pronation and extension block
6-11 wk	• isometric training of elbow extension and flexion muscles within the closed training chain without brace
	• no varus or valgus stress
	• capsular stretching
	• active muscle training
	• slow transition to full weight bearing (no heavy loads)
	• after surgeon consultation removal of elbow brace
>12 wk	• no contact sport and heavy loads until 6 months postoperatively

LUCL, lateral ulnar collateral ligament.

Discussion

This technique provides a minimally invasive approach to reconstruct the LUCL in patients with posterolateral elbow instability. Biomechanical data have shown that the humeral most isometric insertion point of the LUCL is between the 3:00- and 4:30-o'clock position on a circle on the lateral epicondyle.[8] Therefore, there is no need for an extensive debridement or weakening of the common extensor origin at the epicondyle. In this technique, only 25% of the circle need to be visualized to identify the center of the circle and the isometric area. The anconeus muscle has been lately described as an important stabilizer of the elbow, preventing posterolateral instability and serving as an active lateral ligament of the elbow.[7] The advantage of

Table 2. Pearls and Pitfalls of the Anconeus-Sparing, Minimally Invasive Approach for Lateral Ulnar Collateral Ligament Reconstruction in Posterolateral Elbow Instability

Pearls	Pitfalls
• limited exposure due to 3-incision technique	• malpositioning of the humeral isometric center
• protection of anconeus	• maldetermination of needed graft length
• optimal identification of anatomic landmarks due to separate incisions	• incorrect identification of layers for graft passage

Table 3. Advantages and Disadvantages of the Anconeus-Sparing, Minimally Invasive Approach for Lateral Ulnar Collateral Ligament Reconstruction in Posterolateral Elbow Instability

Advantages	Disadvantages
• maximal protection of active stabilizers (extensors and anconeus muscle) • limited, minimally invasive exposure but easy to extend • reliable and reproducible technique	• malpositioning of the graft due to insufficient exposure is possible • correct identification of the layer between the capsule and the extensor tendons is mandatory

this approach is the maximal preservation of the anconeus muscle origin and insertion and reduces dissection around this important structure, thereby avoiding denervation or injury to its vascular supply. Since the origin and insertion points and the graft harvesting are done using separate incisions, there is no compromise regarding accuracy of the intervention. A risk of this technique may be that the surgeon cannot find the right layer for graft passage. It is very important to pass the graft superficial to the capsule and the remnants of the LUCL to be able to restore physiological movement. Moreover, no compromises regarding the correct identification of the respective insertion points should be made due to the smaller incisions. However, in case of uncertainty regarding graft positioning, it is easy to connect the 2 incisions to a more extensive approach. Limitations to this technique are patients suffering from advanced osteoarthritis or major cartilage defects. Posterolateral stabilization may cause an overtightening of the posterolateral elbow and therefore induce more pain. See also Tables 2 and 3. In

conclusion, this technique allows accurate graft placement and fixation with maximal protection of the active elbow stabilizers like the common extensor tendons and the anconeus muscle.

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