Technical Note

Ulnar Collateral Ligament Reconstruction of the Elbow With Double Suspensory Fixation

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Abstract: Ulnar collateral ligament reconstruction of the elbow has evolved substantially since its introduction in 1974. Numerous variations of the surgery have been introduced, including modifications in tunnel creation, graft tensioning, and fixation. These changes have aimed to improve overall quality of the reconstruction; however, even the most commonly used techniques still present many challenges. We describe a technique for ulnar collateral ligament (UCL) reconstruction using bisuspensory button fixation and a single tunnel on both the ulnar and humeral sides. This technique avoids many of the most common complications and methods of failure of UCL reconstruction, provides immediate strong graft fixation, and offers the surgeon a technically less demanding procedure.

Dr. Frank Jobe first introduced his technique for ulnar collateral ligament reconstruction of the elbow in 1974.¹ Jobe’s original technique has been modified many times in attempts to improve graft tensioning and fixation strength. The first major change in technique was seen with the introduction of the modified Jobe technique, which used a muscle-splitting approach, avoiding the need to take down the flexor pronator mass from the medial epicondyle; increased tunnel size to improve ease of graft passage; and angled the humeral tunnel anteriorly to decrease the incidence of ulnar nerve damage and irritation.² The docking technique was developed to improve accuracy of tensioning and strength of fixation.³ This modification involved passing the graft into the humerus with only the attached sutures exiting 2 small holes proximally and being tied over a bone bridge.

These techniques require 2 bone tunnels in both the ulna and humerus, which can be technically challenging and increase the risk of tunnel collapse due to convergence. Additionally, these techniques require either the graft to be sutured to itself for fixation or sutures to pass over thin bone bridge and rely on knots for fixation of the graft. New techniques for UCL reconstruction have been described recently, using devices such as interference screws⁴ and buttons⁵⁻⁷ for graft fixation and tensioning.

This article describes a technique using buttons for fixation of the graft to the ulna and humerus, with pearls and pitfalls outlined in Table 1. This method offers many advantages over existing techniques (Table 2). Only 1 tunnel is made proximally and distally, for a less technically challenging procedure and reduced risk of fracture.

Surgical Technique

The Video is narrated with demonstration of the surgical technique.

Positioning

The patient is positioned supine on a standard operating table with an arm board. A nonsterile tourniquet is applied to the arm as proximal as possible. The forearm is supinated with the elbow slightly flexed to expose the medial elbow.
Graft Harvest and Preparation
The patient is carefully examined preoperatively for presence of palmaris tendon, which is found in \~88\% of the U.S. population.\(^8\) The location of the tendon on the wrist crease should be marked preoperatively with the patient awake and able to participate in the exam. Intraoperatively, a 1-cm transverse incision is made over the palmaris at the wrist crease. Forceps are passed under the tendon. Great care is taken to ensure that the median nerve is not accidentally harvested. The tendon is held under tension and palpated proximally. A second 1-cm transverse incision is made over the tendon as far proximally as it can be palpated. Forceps are then passed under the tendon in the proximal incision, and the process is repeated a third or fourth time. The tendon should be harvested as close to the tendon—muscle belly interface as possible to maximize graft length (Fig 1). The graft is cut under tension and removed from the forearm. It is then placed in a saline-soaked sponge on the back table to prevent desiccation.

In the event that a palmaris is not present, an allograft can be used. The authors of this Technical Note prefer gracilis tendon, 4.0 to 4.5 mm in thickness and \(\geq\) 120 mm in length.

Graft Preparation
The ideal final graft dimensions are 55 mm in length and 4.0 mm in thickness. The graft is folded twice for a triple-limbed graft (3-ply) over the suture loop of the ACL Tightrope RT (Arthrex, Naples, FL), and the ulnar ends of the graft are sutured with #2 high-strength suture in a Krakow stitch 2 cm in length. The button is then toggled down to sit firmly against the graft, and the toggling sutures are tied to each other to prevent the button from backing up (Fig 2). If the graft is of insufficient length, however, it is folded once for double thickness (2-ply). Once prepared, the graft is left under tension securely on the back table in a moist sponge.

Approach
A curved 5-cm incision is made over the medial epicondyle. Blunt dissection is carried out, and branches of the medial antebrachial cutaneous nerves are identified and protected. The flexor mass is identified, and a muscle splitting approach through the flexor carpi ulnaris (“ulnar window”)\(^5\) is used in line with the muscle fibers from the medial epicondyle to the sublime tubercle. The ulnar nerve is not routinely dissected out or released unless the patient is experiencing ulnar nerve symptoms preoperatively. Once the UCL is exposed, it is split longitudinally in line with the incision, and anterior/posterior leaflets are created and elevated off of the sublime tubercle (Fig 3). The UCL should be split for its entire length so that both its origin and insertion are visible. Attention is then turned to the anterior aspect of the distal humerus. A separate fascial incision is made anterior to the medial intermuscular septum (“humeral window”).\(^5\) Using an elevator, muscle fibers of the

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**Table 1. Pearls and Pitfalls**

| Pearls | Pitfalls |
|--------|----------|
| 1. Mark the insertion of palmaris longus (PL) in preoperative area | 1. Do not use a tendon stripper to harvest PL |
| 2. Use stab incisions to harvest PL | |
| 3. Dissect out and protect the median antebrachial cutaneous nerve | |
| 4. Use a muscle-splitting approach | |
| 5. Split native ulnar collateral ligament (UCL) in line with fibers | |
| 6. Start ulnar guide pin slightly distal to sublime tubercle | |
| 7. Aim the guide proximally initially | |
| 8. Change orientation to aim 30°’s distally as guide is inserted to avoid guide pin skiving off the tubercle | |
| 9. Feel the dorsal ulnar border when aiming the guide pin distally | |
| 10. Ream a 30- to 35-mm unicortical ulnar tunnel | |
| 11. Expose the origin of UCL from medial epicondyle | |
| 12. Origin is typically a sharp edge; use a rongeur or elevator to flatten the origin so that the pin does not skive off when started | |
| 13. Aim the humeral guide pin to exit slightly lateral on the anterior surface of the medial epicondyle to prevent the button from overhanging medially | |
| 14. Tie the toggling sutures of the ACL TightRope RT button to keep the graft apposed to the button | |
| 15. Tension the graft with elbow at 90° flexion | |

**Table 2. Advantages and Disadvantages**

| Advantages | Disadvantages |
|------------|---------------|
| 1. Single ulnar and humeral tunnels | 1. Cost |
| 2. Immediate robust fixation to allow aggressive early rehabilitation | 2. Risk of medial epicondyle fracture if tunnel not centered |
| 3. Decreased risk of tunnel convergence/fracture | |
| 4. Easier method for tensioning the graft | |
pronator mass are elevated to expose the anterior surface of the medial epicondyle. Dissection should only be anterior to the intermuscular septum to avoid injury to the ulnar nerve.

**Tunnel Preparation**

The humeral tunnel is created by first exposing the UCL origin on the medial epicondyle and flattening that surface with an elevator. A 2.4-mm guide pin is then placed from the origin of the UCL and directed proximally and laterally, exiting on the anterior aspect of the medial epicondyle that was previously exposed (Fig 4). The pin should be aimed laterally to prevent the button from being prominent or hanging over the medial epicondyle. The humeral tunnel is reamed bicortically line-to-line with the graft diameter (typically 4.5 mm) (Fig 5). To create the ulnar tunnel, a 3.2-mm spade-tipped guide pin (Arthrex) is inserted into the ulna bicortically, starting just distal to the sublime tubercle (Fig 6). Because the sublime tubercle slopes down distally, the pin is initially aimed 30° proximally, so the pin can be perpendicular to the tubercle and will prevent it from slipping off. As the pin is inserted into the bone, the direction of the pin is gradually changed to 30° distally, and it exits the dorsal cortex of the ulna, avoiding the proximal radioulnar joint. A 5.5-mm cannulated reamer is used to ream the tunnel over the guide wire (Fig 7).

**Ligament Reconstruction**

The ulnar end of the graft with the free sutures is passed first in a proximal to distal direction through the humeral tunnel (Fig 8). The graft is pulled until the button rests flat on the anterior surface of the humerus (Fig 9). The free sutures on the ulnar end of the graft are passed through a BicepsButton (Arthrex) and loaded on the inserter (Fig 10). The button is then passed through the ulnar tunnel and flipped on the far cortex of the tunnel by pulling on all 4 suture limbs.
The graft is reduced into the tunnel by toggling the free suture limbs in a tension-slide fashion (Fig 12). The graft is tensioned with the elbow in 90° flexion, ensuring no varus load is being placed on the elbow. An arthroscopic knot pusher is used to tie a knot and pushing it to the base of the ulnar tunnel, keeping the graft tensioned (Fig 13). A 4.75-mm Biocomposite SwiveLock (Arthrex) interference screw is placed into the tunnel (Fig 14). The 2 flaps of the native UCL are then repaired over the graft using an #0 absorbable suture followed by superficial soft tissue and fascial closure.

Internal Brace
An internal brace construct can easily be incorporated by passing a LabralTape (Arthrex) through the ACL Tightrope RT button, which is brought through the humeral tunnel along with the graft and secured into the ulnar tunnel with the SwiveLock.

Postoperative Protocol
The patient is placed in a posterior long-arm sling in 90° flexion and neutral wrist rotation for 10 days. The splint is removed on the first postoperative visit, and active range of motion is initiated. Strengthening exercises can begin once the patient has no pain, with full range of motion typically at 4 to 6 weeks. Light
Throwing exercises using a tennis ball are permitted at 3 to 4 months, and a structured rehabilitation program is carried out, allowing athletes to return to play at a mean of 9 months postoperatively. Postoperative radiographs demonstrate the tunnel and button positions (Fig 15).

**Discussion**

The described method offers several advantages over previously described techniques. Most other techniques require >1 bone tunnel in the ulna and humerus, which increases technical difficulty and the risk of fracture, accounting for 14% of reconstruction failures.10 Our technique uses 1 tunnel in the ulna and 1 in the humerus, making it more technically easier and reducing the risk of tunnel fractures.

The most common failure method for UCL reconstruction is failure at the suture–graft interface. By using adjustable buttons, fixation does not rely on the graft being sutured to itself. On the ulnar side, the graft is sutured to the biceps button; however, this fixation is supplemented by an interference screw which would serve as a backup should the suture–graft interface fail.11

An additional advantage of this technique is its overall technical ease for the operating surgeon. Tensioning of the graft can be difficult with traditional UCL reconstruction techniques that require the graft to be sutured to itself. The present method replaces that difficult step with the much simpler mechanism of tensioning over a button. Tunnel creation is also
simplified, as only 1 tunnel is created in the ulna and humerus, compared with other techniques requiring 2 tunnels in each bone. Even the relatively simpler docking and double-docking techniques, which use 1 reamed tunnel, still require an additional 1 or 2 tunnels to be made in both the humerus and ulna for suture passing. As a result, our technique decreases the likelihood of complications arising during tunnel creation. The risks and disadvantages of this technique include medial epicondyle fracture if the tunnel is not centered in the medial epicondyle, as well as the cost of implants.

This technique provides the patient with strong immediate fixation on both ends of the graft. Use of an interference screw not only increases strength of fixation in the ulna, but also increases stiffness to the construct by shortening of the graft’s working length with aperture fixation. The clinical outcomes of this technique have been recently reported by Mirzayan et al.,11 with significant improvements in Kerlan Jobe Orthopaedic Clinic upper extremity outcome scores, visual analogue scale, and single assessment numeric evaluation and >85% return to sport at a mean of 9 months.11

Fig 11. The medial aspect of a left elbow with patient in the supine position demonstrating how the button is then passed through the ulnar tunnel and flipped on the far cortex of the dorsal surface of the ulna. *Medial epicondyle.

Fig 12. The medial aspect of a left elbow with patient in the supine position demonstrating how the suture limbs (red and blue dashed arrows) are toggled to reduce the graft into the ulnar tunnel. *Medial epicondyle.

Fig 13. The medial aspect of a left elbow with patient in the supine position demonstrating how an arthroscopic knot pusher is used tie knots and advance them to the bottom of the tunnel. The graft is tensioned with the elbow flexed to 90°. *Medial epicondyle.

Fig 14. The medial aspect of a left elbow with patient in the supine position demonstrating how the eyelet from the SwiveLock (Arthrex) is removed and 1 suture limb from the ulnar tunnel is passed through it and inserted until it is flush with the opening of the ulnar tunnel. *Medial epicondyle.
Fig 15. Anteroposterior (A) and lateral (B) radiographs demonstrating the humeral button and tunnel placement (black arrows) and the ulnar tunnel and button placement (white arrows).

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