Novel Technique for Ulnar Collateral Ligament Reconstruction of the Elbow

Daniel C. Acevedo, MD; Brian Lee, MD; Raffy Mirzayan, MD

Abstract: Ulnar collateral ligament (UCL) reconstruction of the elbow has been shown to restore function in overhead athletes with valgus instability. Since the initial description of using bone tunnels for reconstruction, many modifications to the surgical technique have been introduced, including the modified Jobe technique, the docking technique, fixation with interference screws, and button fixation. The authors introduce a technique that uses a button on each of the humeral and ulnar sides for fixation. This method allows proper tensioning of the graft and provides immediate secure fixation that relies on metal implants as opposed to sutures over bone bridges alone.

Injuries to the medial side of the elbow are becoming increasingly recognized and treated surgically. Injuries to the ulnar collateral ligament (UCL) in particular have received much attention in the literature. These injuries are usually seen in overhead athletes, especially baseball pitchers. Overuse and excessive valgus loads seen in overhead athletes can cause attenuation and rupture of the UCL. Ulnar collateral ligament insufficiency can cause a significant decrease in athletic performance, mandating surgical intervention.

Since Jobe et al. first introduced his UCL reconstruction technique in 1974, many advances have been made to improve the strength and ease of ligament reconstruction. The original reconstruction technique by Jobe et al. involved using a palmaris longus autograft that was weaved through bone tunnels in the ulna and medial epicondyle in a figure-of-eight fashion using sutures for graft tensioning and fixation and was a technically demanding procedure.

Modifications to the technique include the docking technique, the interference screw technique, the DANE TJ or hybrid technique combining an interference screw with the docking technique, and EndoButton (Smith & Nephew, Memphis, Tennessee) fixation, which is traditionally used in the knee. Many of the modified techniques use methods of fixation that rely on relatively weak fixation, such as suture knots or bony bridges; these techniques also cause difficulties in properly tensioning the graft. With the advent and use of commercially available super sutures (ie, OrthoCord [DePuy, Warsaw, Indiana] and FiberWire [Arthrex, Naples, Florida]), bone bridges do not allow for secure fixation because the sutures can cut through bone.

This article introduces a novel technique used by the senior author (R.M.) for UCL reconstruction using an anterior cruciate ligament (ACL) TightRope RT (Arthrex), which is traditionally used for ACL and posterior cruciate ligament reconstruction in the knee, for humeral-sided fixation of the graft in combination with a BicepsButton for primary fixation in the ulna, supplemented with an interference screw. The authors believe that this method of fixation allows secure tensioning of the graft, provides secure fixation that relies on a metal implant rather than sutures over a bony bridge, and is less technically demanding than the original technique.

Materials and Methods

The indication for surgery is failed nonoperative manage-
ment of a correctly diagnosed UCL injury. The senior author begins treatment with 2 to 3 cycles of nonoperative management. Each cycle consists of 6 weeks of no throwing but continuation of all other core- and extremity-strengthening exercises, including strengthening the flexor and pronator muscles. This is followed by a throwing program over a 6-week period. If the patient is pain free 3 months after injury, he or she may return to play. If the patient’s symptoms persist, surgical intervention is warranted.

**Surgical Technique**

The patient is placed in the supine position with the operative extremity on an arm board. The palmaris longus tendon is harvested through 3 percutaneous incisions directly over the tendon on the volar surface of the forearm without using a tendon stripper (Figure 1A, B). If the palmaris longus is absent or insufficient in caliber, then an allograft tendon can be used. The authors’ preferred allograft is a 4- or 4.5-mm gracilis tendon. The graft length should be longer than 120 mm so that it will be at least 60 mm in length when doubled over. The preferred diameter of the graft is between 4 and 4.5 mm.

An ACL TightRope RT is used for humeral fixation of the graft. The graft is folded over and placed through the suture loop of the ACL TightRope RT (Figure 1C). Each of the 2 tail ends of the graft is sewn with #2 FiberWire suture in a Krakow fashion (Figure 1C) approximately 15 to 20 mm up the graft. The white sutures from the ACL TightRope RT are then toggled, reducing the BicepsButton down to the graft, and the toggle sutures are tied together (Figures 1D, E). The graft is left under tension on the back table and kept moist.

The approach to the elbow is a muscle-splitting technique described by Thompson et al. The skin is incised over the medial epicondyle, and the medial antebrachial cutaneous nerve is identified and dissected out (Figure 2A). The fascia of the flexor carpi ulnaris (ulnar window) is incised, and a muscle-splitting approach is made to the native ligament (B). The spade-tipped guide pin is placed at the sublime tubercle seen through the ulnar window. The drill is aimed 30° distally and 30° caudally (C).

The UCL is incised in line with the muscle fibers and the fascial incision. Anterior and posterior leaflets are created by sharply dissecting the ligament off of the UCL, exposing the sublime tubercle. A safe zone has been described as 1 cm distal to the insertion of the UCL, and care must be taken not to extend the exposure past this point. A 3.2-mm spade-tipped guide pin is then placed at the sublime tubercle and angled distally to exit out of the posterior ulnar cortex (Figure 2C). Care must be taken to avoid the proximal radioulnar joint to not affect rotation of the forearm. The guide pin should be angled 30° distally and caudally to protect the posterior intersosseous nerve as described by Lee.
et al. Use of fluoroscopic guidance is encouraged for the first few cases until the surgeon becomes comfortable with the ulnar guide pin placement. The length of the tunnel should be assessed using the calibration marks on the guide pin. The tunnel should be approximately 30 mm in length.

A 4.5-mm cannulated reamer is then used to ream the ulnar tunnel over the guide wire, taking care not to penetrate the far cortex.

Once the ulnar tunnel is prepared, attention is directed to the proximal origin of the UCL. The anterior band of the UCL originates at the anterior and inferior portion of the medial epicondyle and can be seen deep to the flexor tendon attachment. Care is taken to remain anterior to the medial intermuscular septum to avoid injury to the ulnar nerve. The anterior aspect of the medial epicondyle is exposed proximally. The distal and proximal portion of the medial epicondyle is now visible through the 2 fascial windows. The flexor–pronator tendonous origin is left undisturbed. A 2.4-mm spade-tipped guide pin is drilled from the origin of the UCL at the distal aspect of the medial epicondyle (Figure 3B). The guide pin is directed toward the anterior humeral cortex so it does not exit posteriorly and injure the ulnar nerve. A 4.5-mm cannulated reamer is used over the guide wire to ream the proximal tunnel for the graft. The reamer should penetrate the anterior cortex of the medial epicondyle entirely. The tunnel length will be approximately 12 to 15 mm. The tunnel should be aimed in a slightly lateral direction to avoid overhang of the ACL TightRope RT on the medial cortex.

After the 2 tunnels have been prepared, the free ends of the graft are passed through the humeral tunnel from the proximal end, exiting toward the joint (Figure 4). The graft is pulled until the ACL TightRope RT lays flat and rests on the anterior surface of the medial epicondyle. The sutures from the free ends of the graft are then placed through a BicepsButton. The sutures are pulled and the graft tensioned at the desired flexion angle of the elbow (60°-70° of flexion is preferred). The knots are advanced to the base of the ulnar tunnel. A 3.5-mm polyetheretherketone SwiveLock tenodesis screw (Arthrex) is inserted into the ulnar tunnel for additional fixation. The native ligament is repaired over the graft with an absorbable suture. The fascial incisions are then closed with an 0 polyglactin 910 suture. The subcutaneous tissue is closed with 2-0 polyglactin 910 suture in an inverted subcutaneous suture. The BicepsButton is placed in the ulnar tunnel through the far cortex with the insertion tool (Figures 5B-D). The #2 FiberWire sutures are pulled, and the graft is reduced into the ulnar tunnel. The sutures are pulled and the graft tensioned at the desired flexion angle of the elbow (60°-70° of flexion is preferred) and then tied using an arthroscopic knot pusher. The knots are advanced to the base of the ulnar tunnel. A 3.5-mm polyetheretherketone SwiveLock tenodesis screw (Arthrex) is inserted into the ulnar tunnel for additional fixation. The native ligament is repaired over the graft with an absorbable suture. The fascial incisions are then closed with an 0 polyglactin 910 suture. The subcutaneous tissue is closed with 2-0 polyglactin 910 suture in an inverted subcutaneous suture. The BicepsButton is placed in the ulnar tunnel through the far cortex with the insertion tool (Figures 5B-D). The #2 FiberWire sutures are pulled, and the graft is reduced into the ulnar tunnel. The sutures are pulled and the graft tensioned at the desired flexion angle of the elbow (60°-70° of flexion is preferred) and then tied using an arthroscopic knot pusher. The knots are advanced to the base of the ulnar tunnel. A 3.5-mm polyetheretherketone SwiveLock tenodesis screw (Arthrex) is inserted into the ulnar tunnel for additional fixation. The native ligament is repaired over the graft with an absorbable suture. The fascial incisions are then closed with an 0 polyglactin 910 suture. The subcutaneous tissue is closed with 2-0 polyglactin 910 suture in an inverted subcutaneous suture. The BicepsButton is placed in the ulnar tunnel through the far cortex with the insertion tool (Figures 5B-D). The #2 FiberWire sutures are pulled, and the graft is reduced into the ulnar tunnel. The sutures are pulled and the graft tensioned at the desired flexion angle of the elbow (60°-70° of flexion is preferred) and then tied using an arthroscopic knot pusher. The knots are advanced to the base of the ulnar tunnel. A 3.5-mm polyetheretherketone SwiveLock tenodesis screw (Arthrex) is inserted into the ulnar tunnel for additional fixation. The native ligament is repaired over the graft with an absorbable suture. The fascial incisions are then closed with an 0 polyglactin 910 suture. The subcutaneous tissue is closed with 2-0 polyglactin 910 suture in an inverted subcutaneous suture. The BicepsButton is placed in the ulnar tunnel through the far cortex with the insertion tool (Figures 5B-D). The #2 FiberWire sutures are pulled, and the graft is reduced into the ulnar tunnel. The sutures are pulled and the graft tensioned at the desired flexion angle of the elbow (60°-70° of flexion is preferred) and then tied using an arthroscopic knot pusher. The knots are advanced to the base of the ulnar tunnel. A 3.5-mm polyetheretherketone SwiveLock tenodesis screw (Arthrex) is inserted into the ulnar tunnel for additional fixation. The native ligament is repaired over the graft with an absorbable suture. The fascial incisions are then closed with an 0 polyglactin 910 suture. The subcutaneous tissue is closed with 2-0 polyglactin 910 suture in an inverted subcutaneous suture.
dermal fashion, and the skin is closed with a 3-0 monofilament absorbable suture in a subcuticular fashion. Postoperative radiographs are obtained (Figure 6).

Postoperatively, the patient is placed in a long-arm, posteriorly based splint for 1 week. The rehabilitation protocol involves initial splinting of the elbow in 90° of flexion with neutral forearm rotation. Ten days postoperatively, the splint is discontinued, and active range of motion exercises of the shoulder, elbow, and wrist are started. Range of motion is gradually increased so that full range of motion is obtained at 6 weeks postoperatively. Four to 6 weeks postoperatively, strengthening exercises are initiated. Throwing progression is initiated approximately 4 months postoperatively, starting with a ball toss, and return to play occurs approximately 10 months postoperatively.7

**DISCUSSION**

The UCL is the primary stabilizer of valgus stress at the elbow.13 The anterior band is the most important part of the UCL complex in providing valgus stability. This structure is frequently overused and undergoes microtrauma in overhead athletes that results in chronic valgus instability. Ulnar collateral ligament reconstruction is aimed at reconstructing the anterior band of the UCL to restore valgus stability. Since the original technique used for UCL reconstruction, various modifications in technique and graft fixation have been described.3-6

The goal of any reconstruction is to achieve immediate, secure fixation to allow early rehabilitation. With older techniques, fixation was tenuous and rehabilitation was limited to avoid early failure. With modern techniques, including the one described here, immediate fixation is achieved to allow for early rehabilitation.

The results of UCL reconstructions have improved as the technique has evolved.3,6 Cain et al14 reported the largest series of UCL reconstructions, with more than 700 patients with a minimum 2-year follow-up. Eighty-three percent of patients returned to their previous level of competition or higher after a figure-of-eight reconstruction without transposition of the ulnar nerve.14 Bowers et al15 had similar results using the modified docking technique in 21 patients. This method relied on using bone tunnels in the ulna and 2 small converging tunnels in the humerus where the graft was tensioned and tied over a bony bridge. Excellent results were achieved for more than 90% of patients with no complications. No long-term follow-up was noted.15

Similar results were noted by other authors using the modified Jobe technique6 and the docking technique.3 Newer techniques have been described,3,6,10 but long-term results are lacking.

The results of UCL reconstructions using prior techniques have been excellent but are fraught with technical intraoperative complications. The original technique...
described by Jobe uses more than 1 bony tunnel in the ulna and the humerus. These tunnels can cause fractures of the medial epicondyle if inaccurately placed. The converging ulnar tunnels also pose difficulties during graft passage. Fixation primarily relies on suturing the graft to itself, which can cause poor tensioning of the graft.

The docking technique minimizes the tunnel formation, but the fixation relies on tying the graft over a small bony bridge. This method of fixation can be tenuous if the bone between the sutures is thin. Modern techniques of interference screw fixation attempt to minimize tunnel formation and improve stability and tensioning of the graft using a screw. This is a strong method of fixation, and the authors used an interference screw in their technique for this reason. The problem with the interference screw technique alone is that the graft cannot be retensioned after insertion of the screw. New techniques have included suspension button fixation for ulnar fixation.

The current authors believe their method offers many advantages over previously described methods. This reconstruction technique allows for technical ease and immediate secure fixation. By using the ACL TightRope RT for humeral-sided fixation, the authors minimize tunnel formation to a single tunnel as opposed to 2 tunnels, thus reducing the risk for fracture. This also makes the procedure technically easier to perform.

The BicepsButton is a low profile and sits securely on the anterior surface of the humerus. The ACL Tightrope RT offers the same fixation and ability to tension on the ulnar side at the desired elbow flexion angle. This also allows tensioning of the graft for a second time to ensure proper tension. The ulnar-sided fixation also relies on a cortical metal button rather than sutures over a bony bridge. The use of the interference screw on the ulnar side of the graft offers additional fixation of this portion of the graft. The use of 1 tunnel on the ulna allows the surgeon to place the graft at the exact insertion point of the anterior bundle of the UCL on the sublime tubercle and avoids the risk of fracturing the bone bridge between 2 tunnels. In addition, this assists in maintaining graft isometry.

To the authors’ knowledge, this particular method of fixation has not been described in the literature. Further clinical and biomechanical studies are needed to evaluate the effectiveness of this technique, and long-term outcome studies are needed to validate the clinical use of this technique.

**CONCLUSION**

Ulnar collateral ligament reconstructions have had excellent results in restoring valgus stability of the elbow and returning athletes to sports. Modern advances in orthopedic implants have allowed for several new UCL reconstruction techniques. The authors’ method, which uses an ACL TightRope RT to dock the humeral portion of the ligament and a BicepsButton with a polyetheretherketone interference screw for ulnar-sided fixation, offers secure fixation and is less technically demanding than prior procedures.

**REFERENCES**


