Ulnar Collateral Ligament (UCL) Reconstruction With Proximal Single-Tunnel Suspensory Fixation

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Abstract: Ulnar collateral ligament (UCL) reconstruction of the medial elbow is considered to be the gold standard for treating valgus instability seen in overhead throwing athletes. The first UCL construction was performed by Frank Jobe in 1974, and this procedure has evolved over time to include multiple techniques that improved the biomechanical strength of the graft fixation and maximize the rate of return to athletic competition for these patients. The most common UCL-reconstruction technique used today is the docking technique. The purpose of this Technical Note is to describe our technique, including pearls and pitfalls, which combines the many advantages of the docking technique with a proximal single-tunnel suspensory fixation technique. This method allows for optimal tensioning of the graft, allowing for secure fixation that relies on metal implants as opposed to tying sutures over a proximal bone bridge.

It is well known throughout the literature that the ulnar collateral ligament (UCL) is the primary restraint to valgus force. Repetitive overhead throwing can result in rupture or insufficiency of the UCL, manifesting as medial elbow pain and decreased throwing performance.[1,2] As a result of the recent increase in sports participation and awareness, the frequency of medial UCL injuries has been steadily increasing in the United States.[3,4] From 2000 to 2017, UCL surgeries have doubled in Major League Baseball and increased 14 times in Minor League Baseball.[5]

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There have been a variety of different techniques for UCL reconstruction described since it was first performed in 1974.[6-10] The docking technique is the most commonly used method for UCL reconstruction and has demonstrated biomechanical superiority and improved clinical outcomes when compared with other techniques.[2,11] Although these techniques have improved this procedure, recent studies have described decreased performance and workload in pitchers who do return to sport after UCL surgery,[12-15] along with inferior biomechanical properties when compared with the native UCL tissue.[16] Many of these current techniques concomitantly rely on fixation over a bone bridge, which may not be optimal for graft fixation.[17,18]

This article introduces a UCL-reconstruction technique that combines the many advantages of the docking technique with a proximal bone tunnel suspensory fixation technique as compared with a proximal fixation of tying suture over a bone bridge. The authors believe that this technique provides secure fixation of the graft and at the minimum an equivalence in biomechanical properties of the graft when compared with other current techniques.

Surgical Technique (With Video Illustration)

Patient Positioning and Anesthesia

A video overview of this procedure with narration can be found in Video 1. The patient is placed in the supine position on a standard operating table. General anesthesia is then induced, and the right upper

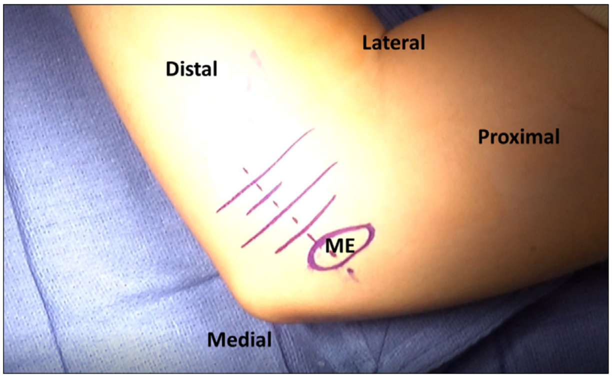

Fig 1. Right elbow in flexion and external rotation showing where the initial incision is made over the mid-distal portion of the medial epicondyle (ME).

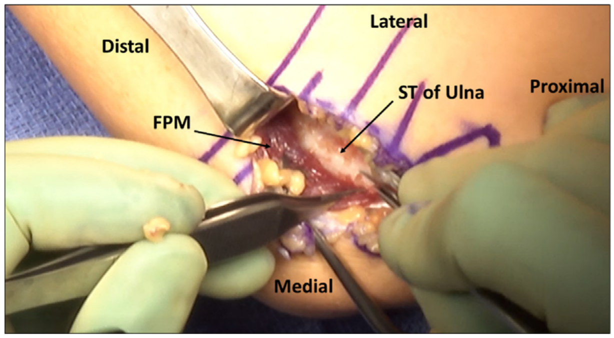

Fig 3. With right elbow in flexion and external rotation, the flexor pronator mass (FPM) is extended distally, exposing the sublime tubercle (ST) of the ulna and insertion of the ulnar collateral ligament remnant.

extremity is prepped and draped in a normal sterile fashion. It is then exsanguinated with a tourniquet, and a pneumatic arm level tourniquet is inflated to 250 mm Hg. The forearm is supinated with the elbow slightly flexed for exposure to the medial elbow.

Approach

A longitudinal incision is made over the mid-distal portion of the medial epicondyle with a #15-blade scalpel and extended 6 cm distally (Fig 1). This incision is performed carefully to avoid crossing the path of the ulnar nerve. The subcutaneous tissues are then dissected bluntly, and branches of the medial antebrachial cutaneous nerve are identified, protected, and retracted distally.

Split of the Flexor Mass

The flexor pronator mass is then identified and divided between the anterior two-thirds and posterior one-third of the muscle mass, with the overlying fascia being divided with a #15-blade scalpel (Fig 2). The underlying muscle is then bluntly divided, exposing the UCL of the elbow. The split in the flexor pronator mass at the junction of the middle one-third and the posterior one-third of the flexor pronator mass is extended distally, exposing the sublime tubercle of the ulna and insertion of the UCL remnant (Fig 3). The native UCL is then split longitudinally at the midline with a #15-blade scalpel.

Tunnel Preparation

Attention is then turned to the UCL insertion site on the sublime tubercle of the ulna. Converging, 3-mm drill tunnels are placed on both sides of the native UCL insertion site on the sublime tubercle and connected using small, curved curettes (Fig 4). The curved curette is then inserted into one tunnel and visualized through the other tunnel to confirm tunnel convergence. A 3.5-mm drill tunnel is then placed at the medial epicondyle at the native origin of the UCL and

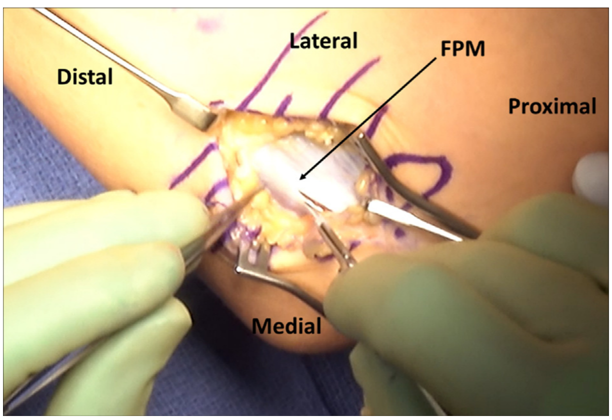

Fig 2. Right elbow in flexion and external rotation. The overlying fascia of the flexor pronator mass (FPM) is separated, and then the FPM is identified and divided between the anterior two-thirds and posterior one-third of the muscle mass.

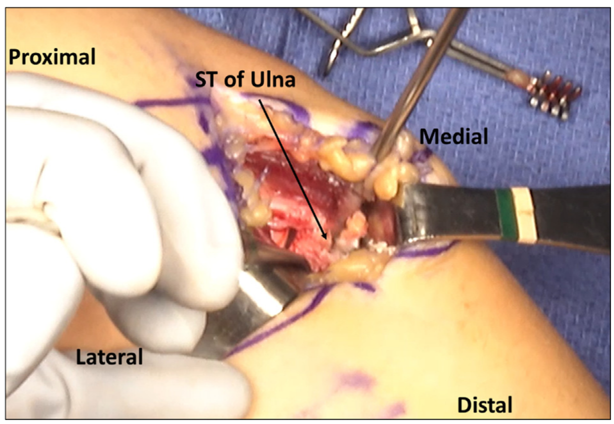

Fig 4. With the right elbow in flexion and external rotation, converging 3-mm drill tunnels are placed on both sides of the native ulnar collateral ligament insertion site on the sublime tubercle (ST) of the ulna. Tunnels are connected using small, curved curettes for ulnar graft placement.

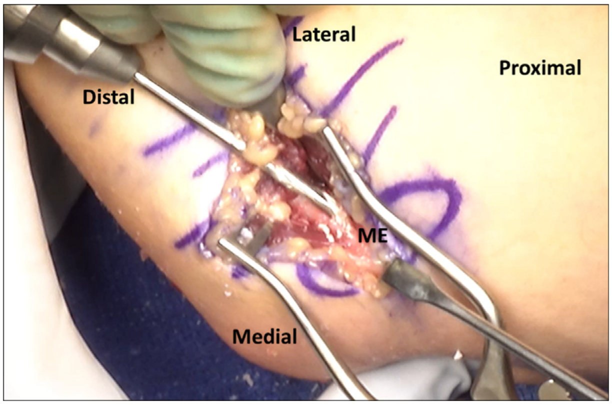

Fig 5. With the right elbow in flexion and external rotation, a 3.5 mm-drill tunnel is placed at the medial epicondyle (ME) at the native origin of the ulnar collateral ligament and drilled unicortically to the posterior cortex of the ME. Oscillation of the drill can mitigate the risk of damage to the soft tissue.

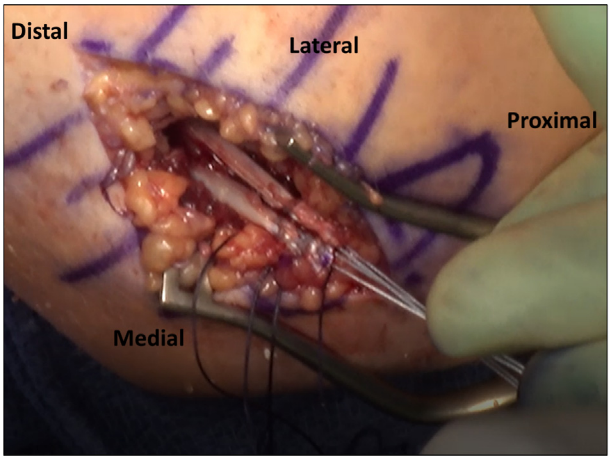

Fig 7. The right elbow is brought through full range of motion to test the isometry of the gracilis autograft.

drilled unicortically to the posterior cortex (Fig 5). A 1.6-mm drill tunnel is then placed through the medial epicondyle drill tunnel and advanced through the posterior cortex.

Graft Harvest and Preparation

Although our preferred graft choice is contralateral gracilis, a palmaris longus autograft or other allograft tendons can be used. The contralateral lower extremity is exsanguinated with a 6″ tourniquet and inflated to 250 mm Hg. A longitudinal 4-cm incision with a #15-blade scalpel is made directly over the pes anserinus, and the subcutaneous tissue is bluntly divided with tenotomy scissors. Branches of the infrapatellar branch of the saphenous nerve are then identified using blunt dissection. The sartorius fascia is divided longitudinally at its proximal margin for 1.5 cm, and the gracilis tendon is identified and divided at its tibial attachment. A locking 0-VICRYL suture (Ethicon Inc., Cincinnati, OH) is then placed at the distal margin of the gracilis, and a tendon stripper is used to harvest the gracilis tendon. The wound is then irrigated and closed.

Graft Passage and Fixation

Two locking sutures of 0 FiberWire (Arthrex, Naples, FL) are placed on one end of the autograft. A Hewson suture retriever is then placed distally to proximally through the medial epicondyle bone tunnel. Then, a 0-VICRYL suture (Ethicon Inc.) is placed proximally to distally to be used as a passing suture for the graft. The sutured end of the gracilis autograft is then passed through the ulnar drill tunnel using the 0-VICRYL

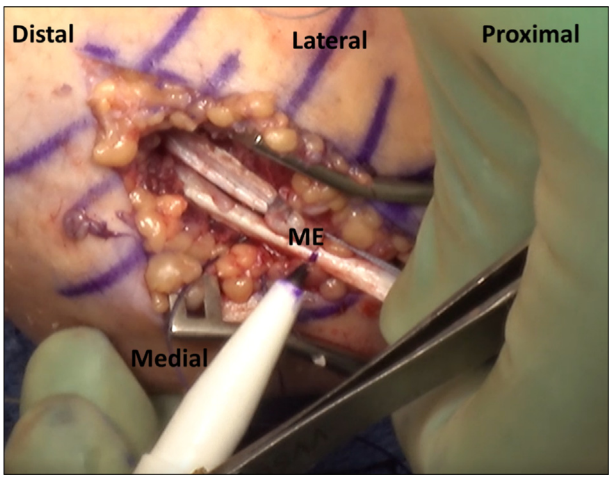

Fig 6. With the right elbow in 30° of flexion and varus stress, the opposite portion of the gracilis autograft is measured against the medical epicondyle (ME) and cut to the appropriate length to avoid the graft from bottoming out in the bone tunnel.

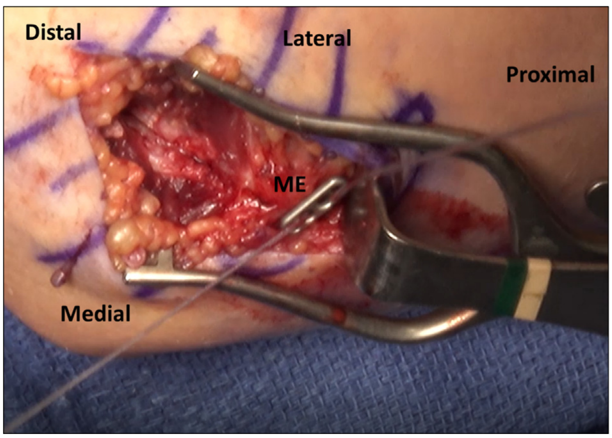

Fig 8. With the right elbow in flexion, external rotation, and varus stress, one limb of the 0 FiberWire from each graft end was tied with 7 alternating half hitches. More anterior placement of the suture button on the medial epicondyle (ME) will mitigate the risk of future ulnar neuritis.

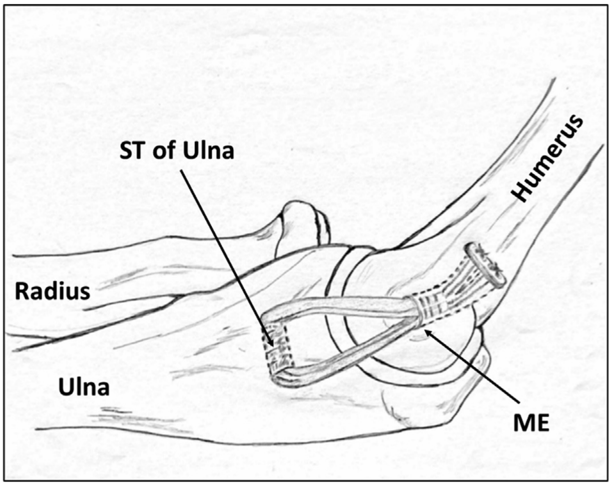

Fig 9. Illustration of the ulnar collateral ligament reconstruction technique using 2 distal converging bone tunnels tensioned over a proximal single-tunnel suspensory fixation with a metal suture button to secure the gracilis autograft. (ME, medial epicondyle; ST, sublime tubercle.)

passing suture (Ethicon Inc.). The elbow is placed in 30° of flexion with varus stress while the opposite portion of the gracilis autograft is measured against the medical epicondyle and then cut to the appropriate length (Fig 6). Two 0 FiberWires (Arthrex) are then placed in locking suture fashion on the other end of the autograft. After this, a Hewson suture passer is used to pass the repair sutures through the posterior cortex of the medial epicondylar tunnel. The isometry of the graft is then assessed (Fig 7).

Ligament Reconstruction

After fixation of the graft, the wound is irrigated with normal saline. The elbow is flexed and externally rotated with varus stress, and one limb of the 0 FiberWire (Arthrex) from each end of the graft was tied with 7 alternating half hitches (Fig 8), ending up with a total of 2 knots over a 4-mm × 12-mm ENDOBUTTON (Smith & Nephew, Memphis, TN) (Fig 9).

Wound Closure

The remnants of the native UCL fibers were repaired of the UCL reconstruction graft using 2-0 VICRYL suture (Ethicon Inc.). The flexor pronator fascia is then closed with a running 3-0 VICRYL suture (Ethicon Inc.). After, the tourniquet was released and superficial wounds were closed with 3-0 Nylon sutures (Ethicon Inc.) in a vertical mattress fashion. Pearls and pitfalls associated with the procedure are noted in Table 1.

Postoperative Protocol

Immediately after surgery, a long arm protective splint is applied to the right upper extremity, which is removed at the first postoperative visit. Next, a hinge elbow brace is applied allowing range of motion from 60° to 120° for the first 3 weeks with no valgus stress. Forearm, wrist, and grip strengthening can be initiated at 4 weeks' postoperatively. Range of motion can be gradually increased until full range of motion is allowed at 7 weeks' postoperatively, and the hinge elbow brace can be removed at 8 weeks. A TheraBand-strengthening program is initiated at 6 weeks postoperative state and continued through 9 weeks, where a full weight-training strength program is started. An interval throwing program is started at 4 months postoperatively, and athletes can expect a full return to sport approximately 9 to 12 months after reconstruction.

Discussion

The goal of UCL reconstruction is aimed at returning the biomechanical properties of the native UCL tissue and achieving secure fixation to allow for early rehabilitation. As this procedure has evolved, current techniques have achieved immediate fixation while improving the biomechanical profile closer to that of the native tissue.[16,19-21] Recent literature has shown that UCL reconstruction has outcome rates as high as 83% to 90% postoperatively for patients returning to their previous level of competition, although rates vary based on the technique used.[16,22,23]

The ideal UCL-reconstruction technique should be equivalent in strength to the native ligament. Previous

Table 1. Pearls and Pitfalls Regarding the UCL-Reconstruction Technique Using a Proximal Single-Tunnel Suspensory Fixation

Pearls	Pitfalls
Identifying the ulnar nerve and knowing its location relative to the tunnel drilling	Not identifying the medial antebrachial nerve during initial exposure
Placing the medial epicondyle bone tunnel more proximal and anterior relative to the ulnar nerve to avoid having the metal fixation device cause ulnar neuritis	Avoiding intra-articular penetration of the ulnar bone tunnel while making sure to clean all bony debris out of the ulnar tunnel with curved curettes for ease of graft passage
Being aware of the ulnar nerve while passing the graft through the ulnar bone tunnel	Avoiding capturing the ulnar nerve while passing the graft through the ulnar tunnel
Tying 2 separate sets of half-hitched knots may provide optimal graft fixation	Avoiding throwing sutures through the same collagen fibers of the tendon

UCL, ulnar collateral ligament.

Table 2. The Advantages and Disadvantages Regarding the UCL-Reconstruction Technique Using a Proximal Single-Tunnel Suspensory Fixation

Advantages	Disadvantages
Suspensory fixation can reduce potential complications of bone bridge failure	Placing a metal suspensory fixation device near the ulnar nerve has the capability of causing ulnar neuritis
Ensures optimal securing of graft fixation in attempt to ensure optimal elbow biomechanics	Suture knots placed on the metal suspensory fixation device can lead to soft-tissue irritation and/or ulnar neuritis

UCL, ulnar collateral ligament.

studies have reported that the ultimate failure torque of the modified docking technique is inferior when compared with the native UCL, with the average failure torque being 4.9 to 23.8 N-m.[8,16,19,20,24] This technique allows for optimal securing of the graft fixation while other techniques using interference screws for graft fixation may be limited by not being able to re-tension the graft. The docking technique, while minimizing tunnel formation, relies on tying suture over a small bone bridge for graft fixation which comes with potential complications.[17,18] The proximal single-tunnel suspensory fixation technique uses a metal device with suture knots on the proximal side of the medial epicondyle. This has the potential to result in ulnar neuritis; however, the senior author has noted no accounts of this complication and advises a more proximal/anterior implant placement to avoid this complication. This technique allows for a secure humeral graft fixation while still using all the advantages that the docking technique provides (Table 2).

UCL reconstruction has shown excellent results in restoring valgus instability in overhead throwing athletes, with patient outcomes continually improving with refinements regarding technique. The authors technique uses all the advantages of the docking technique while using proximal suspensory fixation to optimize secure graft fixation. Further outcomes and biomechanical studies are needed to validate this described technique, whereas long-term studies are vital to ensuring the efficacy of this technique.

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