Technical Note

Elbow Ulnar Collateral Ligament (UCL) Repair Using Suture Augmentation, Anchors, and Bone Tunnels

Benjamin D. Crawford, M.D., Rami George Alrabaa, M.D., and Kenneth H. Akizuki, M.D.

Abstract: Ulnar collateral ligament (UCL) repair with suture augmentation has been increasingly used to treat UCL pathology in overhead athletes. For the appropriately indicated patient, UCL repair with suture augmentation without reconstruction has promising results. Advantages of repair with suture augmentation include earlier return to sport, low complication rate, and decreased operative time since there is no need for graft harvest. Previously reported techniques use suture anchors with high-tensile and collagen-coated nonabsorbable sutures. This article provides an alternative augmentation method using a combination of anchors and bone tunnels to obtain an isometric repair.

The ulnar collateral ligament (UCL) undergoes valgus stress during the throwing cycle in overhead throwing athletes.[1] Particularly among pitchers, UCL injury is a major cause of medial elbow pain, decreased throwing velocity, and decreased pitch control.[2] Depending on the athlete, some UCL tears can be treated with conservative management, including a combination of rest, bracing, and structured rehabilitation.[3] When conservative measures fail, or when a UCL tear occurs in an elite overhead thrower, surgical treatment is pursued in the form of UCL reconstruction or repair.[4]

UCL injury was considered career-ending among elite baseball pitchers until 1986, when Dr. Frank Jobe first described UCL reconstruction.[5] UCL reconstruction became the gold standard for treatment of these injuries shortly thereafter, with return to sport (RTS) rates ranging from 66.7% to as high as 97% in the current literature.[2] UCL repair was introduced as an alternative treatment option for these injuries in 1992[6]; however, more recent modifications have made UCL repair an effective treatment option for certain UCL injuries.[7,8]

A popular repair technique uses collagen FiberTape with the Internal Brace (Arthrex, Naples, FL) augmentation technique.[9-11] UCL repair with this technique has produced RTS rates comparable with UCL reconstruction, ranging from 87% to 96.7%.[12] With comparable RTS rates, low complication rates,[13] and quicker operative times without the need for graft harvest, UCL repair with suture augmentation is an increasingly popular alternative to reconstruction. A recent study reflects this as UCL repair increased from 10% annually in 2010 to 38% annually 2020 when compared with UCL reconstruction.[14]

Native UCL integrity and extent of injury should be evaluated before proceeding with UCL repair. An acute proximal or distal avulsion with an otherwise-healthy, intact UCL is amenable to repair whereas evidence of UCL attrition may be better treated with reconstruction. Patient factors such as level of competition, athletic goals, age, and desired time to RTS should also be considered when deciding between reconstruction and repair. UCL repair may be considered in athletes who wish to RTS in a shorter time frame than allowed by UCL reconstruction, with a reported average RTS of 6.7 months in a recent case series.[9]

In this article, we present an alternative method to UCL repair with suture augmentation that uses a combination of anchors and bone tunnels that we believe provides a more isometric repair than previously described methods.

From the Department of Orthopaedic Surgery, St. Mary's Medical Center (B.D.C., K.H.A.); and Department of Orthopaedic Surgery, University of California San Francisco (R.G.A.), San Francisco, California, U.S.A.

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 March 13, 2023; accepted May 28, 2023.

Address correspondence to Benjamin Crawford, M.D., Department of Orthopaedic Surgery, St. Mary's Medical Center, 450 Stanyan St., San Francisco, CA 94117. E-mail: benjamin.craw.d@gmail.com

2212-6287/23394

https://doi.org/10.1016/j.eats.2023.05.022

Surgical Technique (With Video Illustration)

Patient Positioning

The patient is placed in a supine position under general anesthesia. A standard hand table attachment is used, and a sterile tourniquet is applied high on the arm. A 6- to 8-cm incision is marked, centered over the medial epicondyle (Fig 1). The ulnar nerve is palpated and marked posterior to the medial epicondyle. A careful examination is performed to ensure the nerve does not sublux or dislocate with elbow range of motion. An Esmarch is applied, and the tourniquet is inflated.

Surgical Exposure

The incision is made through the skin and dermis. Superficial dissection is carried down through the subcutaneous tissues using bipolar cautery (Video 1). The medial antebrachial cutaneous nerve and/or branches are identified and protected. The medial intermuscular septum is identified and released from the medial epicondyle. The fascia over the common flexors is identified and the fascia is incised between the 2 heads of the flexor carpi ulnaris (FCU) in line with the muscle fibers. The FCU is split and bluntly dissected to expose the entire length of the underlying UCL from sublime tubercle to medial epicondyle (Fig 2). The substance of the UCL is then evaluated for its quality and integrity. If there is significant attrition of the UCL, then the patient may be better served with a reconstruction. If the quality of the tissue is deemed appropriate, we continue with repair with suture augmentation. The substance of the UCL is then incised from sublime tubercle to medial epicondyle, exposing the ulnohumeral joint.

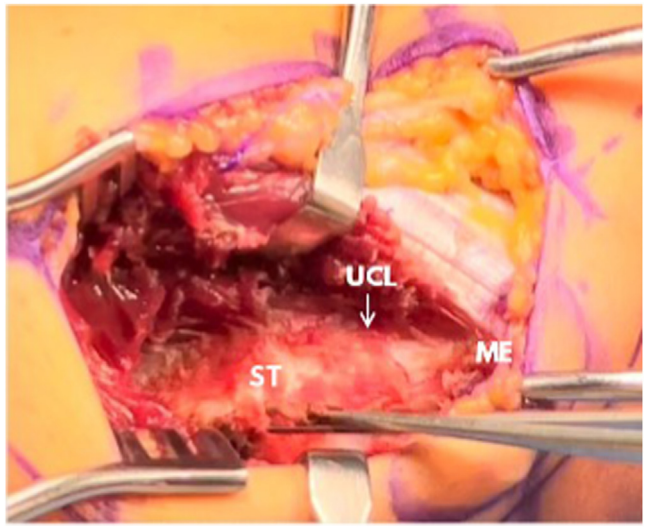

Fig 2. Right proximal medial elbow. The flexor carpi ulnaris raphe is incised and blunt dissection is performed to expose the underlying ulnar collateral ligament (UCL). The sublime tubercle (ST) and medial epicondyle (ME) are palpated and identified.

UCL Repair and Suture Augmentation

Attention is then turned to the UCL insertion at the sublime tubercle, where overlying soft tissue and periosteum is debrided. Care is taken to identify and preserve the ulnar nerve, which is directly posterior to the sublime tubercle. A 3.5-mm nonabsorbable suture

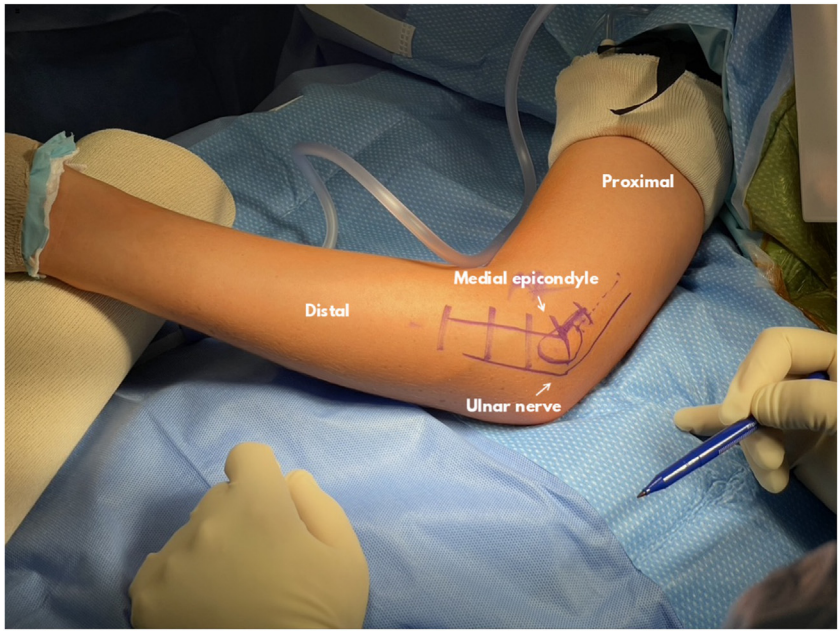

Fig 1. Right medial elbow. The patient is positioned supine and a hand table attachment is used. A 6-cm incision is marked over the medial epicondyle. The ulnar nerve is palpated and marked.

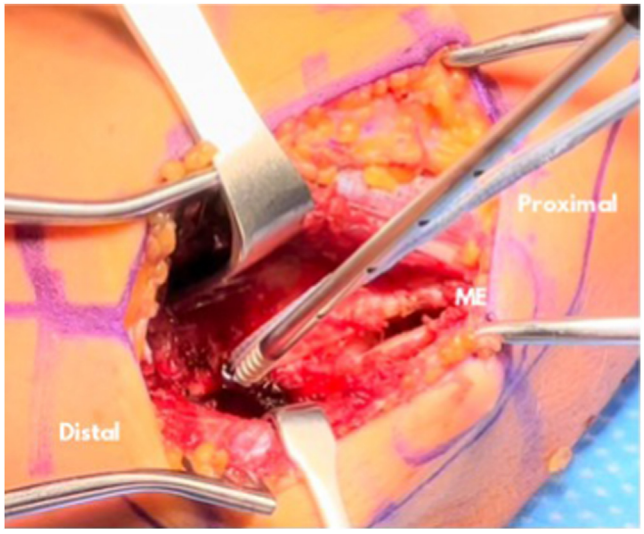

Fig 3. Right medial elbow. A 3.5 mm SwiveLock anchor (Arthrex) is inserted with 2-mm FiberTape (Arthrex) and FiberWire (Arthrex) at the distal insertion of the ulnar collateral ligament on the sublime tubercle. (ME, medial epicondyle.

anchor (SwiveLock; Arthrex) loaded with 2-mm collagen coated FiberTape (Arthrex) and 0 FiberWire (Arthrex) is placed at the UCL attachment at the sublime tubercle (Fig 3). Next, attention is turned to the medial epicondyle. A 3.5-mm drill hole "closed tunnel" is then made in the "elbow" of the medial epicondyle directed proximally (Fig 4A). Care is taken to ensure this 3.5-mm tunnel is only unicortical. Next, 2 converging 2.5-mm drill holes are created from proximal to distal to converge with the 3.5-mm "closed tunnel" in similar fashion to the humeral docking technique for UCL reconstruction[15] (Fig 4B). The two 2.5-mm tunnels that are created to converge with the central 3.5-mm tunnel are created so that one tunnel is medial, and the other tunnel is anterior (Fig 4C). The tunnels are created so that there is an adequate bone bridge of at least 15 mm between the tunnels. If the surgeon plans to transpose the ulnar nerve anteriorly, then the 2 tunnels are cheated more posteriorly so that the suture knots are further away from the anteriorly transposed nerve. A Hewston suture passer is used to pass a 2-0 suture (VICRYL; Ethicon, Somerville, NJ) throughout each bone tunnel with the loop of the suture exiting distally through the larger 3.5 mm drill hole to serve as shuttle suture later. A SutureTape suture (0.9 mm) is then passed through the already-incised native UCL tissue from distal to proximal in locking Krakow fashion. One limb of the SutureTape (that was passed through the native UCL) and one limb of the FiberTape (from the 3.5-mm SwiveLock anchor in the sublime tubercle) are passed through one of the tunnels with one set of the shuttle sutures (VICRYL). The other remaining SutureTape limb and FiberTape limb are passed through the other tunnel with the other shuttle suture. The elbow is held in 50° of flexion with a varus force with the forearm supinated. The limbs of the FiberTape are first tied together with alternating half-hitch knots over the bone bridge over the medial epicondyle. The elbow is ranged to ensure adequate isometry and that full flexion is achieved. The SutureTape limbs are then also tied together. The native UCL is oversewn using 3-0 VICRYL for additional tensioning. The 0 FiberWire (Arthrex) from the 3.5-mm SwiveLock anchor (Arthrex) in the sublime tubercle is then used to repair the distal end of the native UCL (Fig 5).

Wound Closure

The FCU fascia is repaired with 3-0 VICRYL in running or interrupted sutures. The wound is then closed in layers per surgeon preference and the elbow is splinted at approximately 80° of elbow flexion.

Rehabilitation

Patients are immobilized for 7 to 10 days and then converted to a hinged elbow brace. Active range of motion is initiated at 2 weeks with 15° of locked extension and full range of motion and strengthening is initiated at 4 weeks. An interval throwing program is started at 3-4 months with a goal of return to play at 6-7 months.

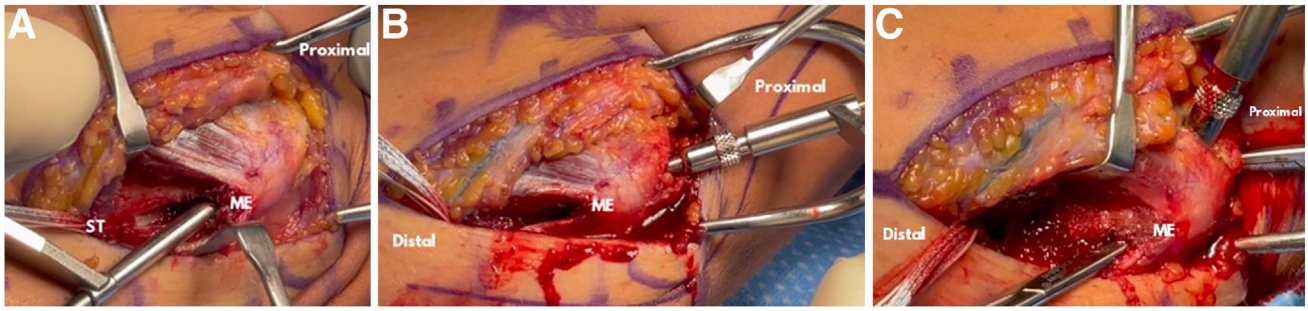

Fig 4. Right medial elbow. A 3.5-mm drill hole is then made in the distal ME (A) directed towards the proximal ME. A 2.5-mm drill hole is then made directly posterior to meet the distal 3.5-mm tunnel (B). The flexor fascia is split anteriorly and another 3.5-mm tunnel is made, communicating with the 2 previously drilled tunnels (C). (ME, medial epicondyle; ST, sublime tubercle.)

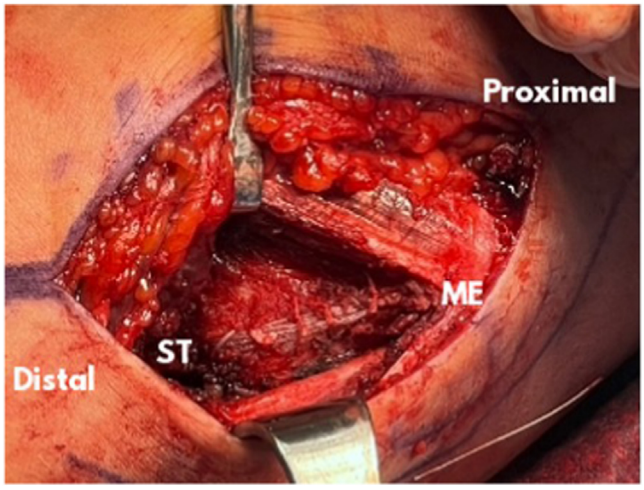

Fig 5. Right medial elbow. Final appearance of the ulnar collateral ligament repair. (ME, medial epicondyle; ST, sublime tubercle.)

Discussion

Recent literature has highlighted UCL repair with suture augmentation as a reliable and effective treatment option for UCL injury in the appropriately selected patient. Several methods of UCL repair have been established in more recent years.[7-11] This Technical Note shows our preferred technique for UCL repair with suture augmentation that utilizes a combination of suture anchor fixation and transosseous tunnels to achieve an isometric repair.

The posterior band of the anterior bundle of the UCL is the primary restraint to valgus stress,[16,17] experiencing the greatest amount of stress during late cocking and early acceleration phase of the throwing cycle.[18] Failure rates of UCL repair were as high as 50% before the introduction of suture augmentation[2], likely because of inadequate protection of the repair during maximal valgus stress throughout late cocking and early acceleration. Failure rates decreased significantly after the introduction of new techniques including suture augmentation with internal bracing.[9] However, a recent review by Anvari et al.[12] notes failure to RTS in as many as 13% of patients. Although multifactorial, the authors believe that inability to achieve an isometric repair plays a large role in the failure of these constructs by lacking adequate protection of the native UCL during the throwing cycle.

Other UCL repair techniques involve anchors both at the sublime tubercle and the medial epicondyle, with the proximal medial epicondyle anchor tensioning the suture that is serving as the "internal brace."[8-11] The technique introduced allows for precise, controlled tensioning of both the FiberTape and SutureTape sutures. The FiberTape serves as the "internal brace" and the SutureTape acts to repair and tension the native UCL tissue. This contrasts with the original UCL repair with Internal Brace technique described where the fixation is tensioned with a suture anchor in the medial epicondyle, therefore, the surgeon is unable to modify or "dial in" the tension. In addition, this technique enables the surgeon to independently tension the "internal brace" sutures (FiberTape; Arthrex) and the sutures tensioning the native UCL (SutureTape; Arthrex). Pearls and pitfalls of this technique are shown in Table 1. The advantages and disadvantages of this technique are shown in Table 2.

In conclusion, we have demonstrated an additional method for performing UCL repair using suture augmentation, anchors, and bone tunnels for treatment of acute and subacute UCL injury. It is of the authors' experience that this technique has produced a high rate of return to play with few complications; however,

Table 1. Pearls and Pitfalls

Pearls
• Use a sterile tourniquet to allow for access to the surgical site
• The ulnar nerve is in close proximity and can be at risk with placement of the anchor in the sublime tubercle. Ensure an assistant is retracting the nerve and use a soft-tissue guide when drilling to avoid wrapping up soft tissue in the drill bit
• A clamp or curette placed in the central "docking" tunnel may be used to assist in converging the smaller 2.5-mm tunnels during drilling
• Suture limbs are tied with the elbow in 50° of flexion with the forearm supinated with a gentle varus load
• Reconstruction is favored over repair if the substance of the UCL is found to be of poor quality
• If transposing the ulnar nerve, then cheat the 2.5-mm tunnels more posteriorly to avoid having the knot stacks rest by the anteriorly transposed nerve.
• Tension the limbs of the FiberTape and SutureTape with elbow range of motion to test tension of the ligament and isometry prior to tying knots.
• Ensure full passive range of motion of the elbow is attainable after repair, otherwise the repair may be too tight or not isometric

UCL, ulnar collateral ligament.

Table 2. Advantages and Disadvantages Compared With Other Techniques

Advantages	Disadvantages
• Less costly due to fewer implants • Faster operative time compared with reconstruction and no need for graft and graft harvest • FiberTape sutures acting as the "internal brace" and SutureTape (Arthrex) sutures tensioning the native UCL can be independently tensioned • Tension can by modified as the sutures are tied compared to tensioning with a suture anchor	• Can be more time-consuming than placing one anchor in the medial epicondyle • Risk of perforating humeral cortex during tunnel drilling • Risk of tunnel malpositioning

UCL, ulnar collateral ligament.

further biomechanical and clinical studies are needed to validate this method.

References

1. Fleisig GS, Escamilla RF. Biomechanics of the elbow in the throwing athlete. *Oper Tech Sports Med* 1996;4:62-68.
2. Erickson BJ, Bach BR Jr, Verma NN, Bush-Joseph CA, Romeo AA. Treatment of ulnar collateral ligament tears of the elbow: Is repair a viable option? *Orthop J Sports Med* 2017;5:1-6.
3. Erickson BJ, Harris JD, Chalmers PN, et al. Ulnar collateral ligament reconstruction: Anatomy, indications, techniques, and outcomes. *Sports Health* 2015;7:511-517.
4. Conte SA, Fleisig GS, Dines JS. Prevalence of ulnar collateral ligament surgery in professional baseball players. *Am J Sports Med* 2015;43:1764-1769.
5. Jobe FW, Stark H, Lombardo SJ. Reconstruction of the ulnar collateral ligament in athletes. *J Bone Joint Surg Am* 1986;68:1158-1163.
6. Conway JE, Jobe FW, Glousman RE, Pink M. Medial instability of the elbow in throwing athletes. Treatment by repair or reconstruction of the ulnar collateral ligament. *J Bone Joint Surg Am* 1992;74:67-83.
7. Dugas JR. Ulnar collateral ligament repair: An old idea with a new wrinkle. *Am J Orthop (Belle Mead NJ)* 2016;45:124-127.
8. O'Connell R, Hoof M, Heffernan J, O'Brien M, Savoie F. Medial ulnar collateral ligament repair with internal brace augmentation: Results in 40 consecutive patients. *Orthop J Sports Med* 2021;9:1-8.
9. Dugas JR, Looze CA, Capogna B, et al. Ulnar collateral ligament repair with collagen-dipped FiberTape augmentation in overhead-throwing athletes. *Am J Sports Med* 2019;47:1096-1102.
10. Trofa DP, Lombardi JM, Noticewala MS, Ahmad CS. Ulnar collateral ligament repair with suture augmentation. *Arthosc Tech* 2018;7:53-56.
11. Urch E, DeGiacomo A, Photopoulos CD, Limpisvasti O. Ulnar collateral ligament repair with suture bridge augmentation. *Arthrosc Tech* 2018;7:219-223.
12. Anvari A, Fathi A, Bolia IK, et al. Utilization of internal bracing in elbow medial UCL stabilization: From biomechanics to clinical application and patient outcomes. *Orthop Res Rev* 2021;13:201-208.
13. Rothermich MA, Fleisig GS, Lucas HE, et al. Early complications of ulnar collateral ligament repair with collagen-coated suture tape augmentation. *Orthop J Sports Med* 2021;9:1-6.
14. Spivey MG, Constantinescu DS, Costello II JP, Kao DS, O'Connell RS, Vap AR. The rate of medial ulnar collateral ligament repair is increasing while reconstruction remains the most common procedure overall among early-career orthopaedic surgeons [published online March 31, 2023]. *Arthrosc Sports Med Rehabil*. doi.org/10.1016/j.asmr.2023.02.007.
15. Camp CL, Dines JS, Voleti PB, James EW, Altchek DW. Ulnar collateral ligament reconstruction of the elbow: The docking technique. *Arthrosc Tech* 2016;5:519-523.
16. Callaway GH, Field LD, Deng XH, et al. Biomechanical evaluation of the medial collateral ligament of the elbow. *J Bone Joint Surg Am* 1997;79:1223-1231.
17. Cohen MS, Bruno RJ. The collateral ligaments of the elbow: anatomy and clinical correlation. *Clin Orthop Relat Res* 2001;383:123-130.
18. Cain EL, Dugas JR, Wolf RS, Andrews JR. Elbow injuries in throwing athletes: A current concepts review. *Am J Sports Med* 2003;31:621-635.