

Primary Repair of Proximal Ulnar Collateral Ligament Ruptures in Pediatric Overhead Athletes



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Abstract: Ulnar collateral ligament (UCL) injury is commonly seen in overhead throwing athletes resulting from the repetitive valgus stress placed on the medial elbow. UCL injuries (attenuation, insufficiency, or rupture) can result in medial elbow pain, a loss of pitch velocity and accuracy, and increased fatigue. Diagnosis can be made by performing a thorough physical examination along with imaging if indicated, such as ultrasound or magnetic resonance imaging. Treatment options include nonoperative in recreational athletes or those whose primary positions in sport are not high-volume throwing, such as position players in baseball. If nonoperative treatment fails, or the patient has potential for future high-level overhead activity such as a baseball pitcher, surgical repair or reconstruction may be indicated. This article describes our surgical technique for UCL repair in pediatric baseball pitchers.

Throughout the course of a season, pitchers face demanding loads and repetitive stresses in their throwing arm, which places them at risk for ulnar collateral ligament (UCL) injury.¹ The UCL consists of anterior, oblique, and posterior bundles, with the majority of valgus force resistance provided by the anterior bundle during the throwing motion.² Biomechanical studies have demonstrated that the UCL is most prone to injury during the late cocking and early acceleration phases of the throwing motion, which may produce a torque and valgus load on the medial elbow that exceed the natural capacity of the UCL.³ Injury to the UCL can be an acute event, with the patient reporting hearing an audible “pop” while throwing overhead. Chronic UCL injury can present as vague medial elbow pain, edema, and

decreased pitching performance (velocity and accuracy).⁴

The increasing incidence of UCL injury has been well-documented in the literature.⁵ Since the initial description by Dr. Frank Jobe in 1986,⁶ there have been several operative techniques for UCL repair that have been developed.^{7,8} A review of the literature has shown favorable outcomes in “adolescents” (aged 13-19 years) who underwent UCL reconstruction.⁹ However, published surgical technique for athletes younger than this age group is currently lacking. Recent trends in adolescent and youth pitchers demonstrate greater sport specialization and year-round pitching, with several studies warning of the potential risk of increased injury rates associated with this phenomenon.^{10,11} As youth pitchers become increasingly at risk of UCL injury, orthopaedic surgeons are faced with treating these injuries in a younger patient population.¹² The purpose of this work is to describe the technique of a primary open UCL repair in a pediatric baseball pitcher. It is our hope that this technique can aid in the treatment of a pathology seen in younger age groups than was historically reported.

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Surgical Technique

A detailed description of the procedure is provided in [Video 1](#).

Diagnosis, Evaluation, and Imaging

Upon presentation to clinic, a patient with a history of repetitive overhead activities presenting with elbow

pain should raise suspicion for UCL injury. Most pitchers will not recall a specific pitch that caused injury; however, it is typical for pitchers to complain of medial elbow pain exacerbated by the throwing motion and alleviated with rest. Often times, pitchers will state that they are unable to throw as fast or as accurately, with progression of worsening symptoms. After a full history is elicited, a complete physical examination should be conducted. This includes observation for visible lesions, swelling or ecchymosis about the elbow, or palpable defects such as at the triceps tendon insertion. Palpation should include all bony prominences, noting any tenderness at the medial epicondyle. Sensory and motor testing, grip strength testing, and range of motion of the extremity should be compared to the contralateral side. Next, elbow stability may be evaluated with varus and valgus stress examinations. Frank elbow instability secondary to UCL disruption is often not present, but stress testing may reproduce symptoms at the medial elbow. Obtaining supporting radiographic studies that correlate with history and physical examination findings is confirmatory in making the diagnosis. In skeletally immature patients, plain film radiographs may occasionally show a fleck avulsion of the UCL either proximally or distally, indicating deficiency. Magnetic resonance imaging (MRI) may confirm injury to the UCL or detect early edema or partial-thickness injury. In young athletes who may not tolerate MRI, ultrasound is a quick and effective alternative. Apart from assessing UCL injury, dynamic ultrasound imaging also has a role in assessing medial ulnohumeral joint space widening under valgus loads in pitchers.

Patient Positioning and Setup

The patient is met in the preoperative area, where the operative side and site is confirmed and marked. The patient is then taken into the operating room and placed supine on the operating table (Fig 1). General

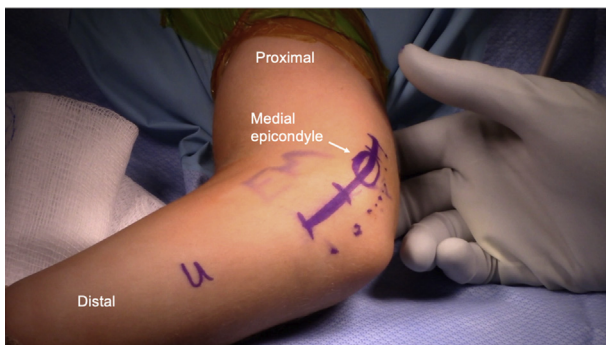


Fig 1. Right medial elbow. The patient is positioned supine on the operating table. A 6-cm incision is marked centered over the medial epicondyle (solid line). By palpation, the ulnar nerve is identified and marked (dashed line) posterior to the medial epicondyle.

anesthesia is administered along with preoperative antibiotics. Preoperative examination under anesthesia is notable for full range of motion. The operative side is prepped and draped in the standard fashion. A pre-operation pause is then performed according to the hospital protocol.

Exposure of the UCL

An 8–10 cm incision is marked and centered over the medial epicondyle. The ulnar nerve should be identified by palpation and marked just posterior to the medial epicondyle. The ulnar and radial borders of the forearm should be marked before draping the hand. After sterile prepping and draping of the upper extremity and the operative pause, the limb is exsanguinated and a tourniquet is inflated to 200 mm Hg. The incision is made using a No. 15 blade, followed by dissection through the subcutaneous tissue to the fascia using Metzenbaum scissors. Careful dissection should be attempted to identify the medial antebrachial cutaneous nerve to the forearm, which is protected away from the surgical field using a vessel loop or retractors. The raphe in the flexor pronator mass is incised and an elevator is used to expose the UCL (Fig 2). In this patient, a bony avulsion of the medial epicondyle consistent with the MRI findings is identified, with ligament distal to the avulsion fully intact (Fig 3A). Scar tissue that had formed between the avulsion and the proximal bony bed on the medial epicondyle origination footprint is identified and excised. The bony fragment was not initially reducible to the bony bed; however, splitting the native ligament lengthwise aided in its mobilization.

The proximal footprint is then prepared by performing light decortication using a curette. The entry hole for the anchor is drilled to the depth of the anchor, typically 18 mm, but in this situation, 12 mm of bone working length was available, taking care to avoid perforating the far cortex of the epicondyle. The pilot hole is then tapped

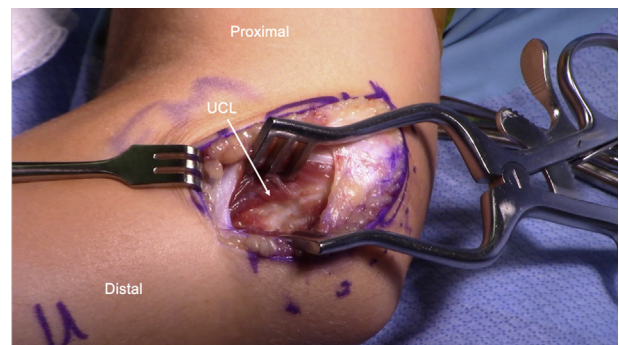


Fig 2. Right medial elbow. Superficial dissection is followed by a longitudinal incision of the flexor carpi ulnaris fascia from distal to proximal toward the medial epicondyle. Blunt dissection of the flexor carpi ulnaris muscle exposes the underlying UCL. UCL, ulnar collateral ligament.

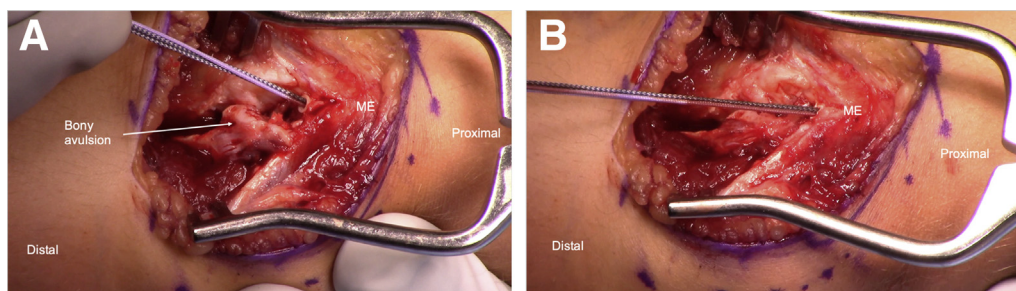


Fig 3. Right medial elbow. (A) A bony avulsion of the medial epicondyle consistent with magnetic resonance imaging findings can be seen. After the anchor was impacted, a portion remained proud and was subsequently removed using a rongeur. The anchor was firmly situated by stressing the suture. (B) Anchor after the proud portion was removed with a rongeur. ME, medial epicondyle.

to improve cortical integration of the anchor. The anchor is then impacted into the pilot hole at the base of the medial epicondyle. After impaction, stressing the sutures demonstrates solid fixation of the anchor into the bone, and 1-2 mm of proud anchor can be safely removed using a small rongeur (Fig 3B). The anchor of choice is a double-loaded (3.0-mm Healicoil; DePuy Mitek, Raynham, MA) Orthocord suture (2 pairs, 4 suture strands).

Ligament Repair

Using 1 pair of Orthocord from the anchor, a running whipstitch is performed with 1 limb and a simple pass with the other limb in preparation of a tension slide. A modified Mason-Allen stitch is placed with the second pair. The elbow is then placed under varus stress and flexion positioning to reduce the tension on the repair, and the ligament is reduced to the origination site with the bony avulsion approximated to the bony bed of the medial epicondyle. The repair is tied down sequentially, achieving adequate reapproximation and tension of the ligament (Fig 4). Manipulation intraoperatively demonstrated the repair to be stable under gentle varus and valgus stress.

The wound is then copiously irrigated with sterile saline and chlorhexidine gluconate 0.05% solution (Irrisept; Irrimax, Gainseville, FL), and the tourniquet is let down. The limb is placed into neutral position. The

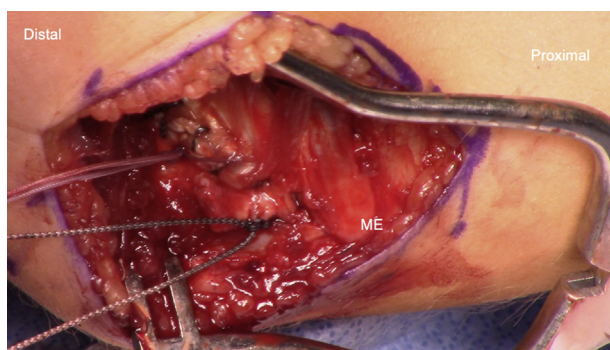


Fig 4. Right medial elbow in the supine position. Final appearance of the ulnar collateral ligament repair. ME, medial epicondyle.

flexor-pronator mass split is identified and closed anatomically with a running 2-0 Vicryl braided, absorbable suture (Ethicon, Somerville, NJ), followed by the deep layer. The subcuticular dermal layer is closed with a running 3-0 Monocryl absorbable suture (Ethicon) and a topical skin adhesive (Dermabond; Ethicon). Local anesthesia is injected subcutaneously to provide incisional analgesia postoperatively (14 mL used in this case). The incision is cleaned, dried and covered with a sterile adhesive dressing (Aquacel; ConvaTec, Princeton, NJ). A well-padded posterior mold splint with side hinges is then applied. The patient was then extubated without complication and transported to the postanesthesia care unit in stable condition. Pearls and pitfalls of the procedure can be seen in Table 1.

At the 1-week postoperative clinic visit, the splint is replaced in a long-arm cast at 45° of flexion. This is replaced at the 3-week postoperative clinic visit and replaced with a hinged brace, which is adjusted to allow an increasing range of motion from 1 to 6 weeks postoperatively. From 6 to 12 weeks postoperatively, the patient is removed from the brace and allowed to gradually achieve recovery to a full range of motion.

Table 1. Pearls and Pitfalls of Ulnar Collateral Ligament Repair

Pearls	Pitfalls
Identification and protection of the ulnar and medial antebrachial cutaneous nerves	Drilling too far laterally may cause physal growth arrest
Decorticate the footprint to allow improved osseous blood flow and ligament healing	Impaction of the anchor without tapping first may cause iatrogenic medial epicondyle fracture
The integrity of the proximal and distal ligament dictate the ability of primary repair versus necessity of reconstruction	Too proud of an anchor may indicate poor purchase; intraoperative stability testing is necessary

During this time, the patient was referred to physical therapy to assist with increasing range of motion only. After 12 weeks postoperatively, the patient performs exercises to improve power, strength and endurance. At 24 weeks postoperatively, the patient initiates the return to throwing program.

Discussion

Historically, treatment of UCL injuries was reserved for elite athletes and commonly involved reconstruction of the ligament.^{5,7} Recent literature has described several case series and reviews of the indications of UCL surgery in an adolescent population increasing in incidence.¹¹ UCL repair and reconstruction has demonstrated good outcomes and high return to sport rates in young adolescent and high school pitchers.^{4,13} Similar techniques in overhead athletic populations have shown similar improvements in function, pain, and sport performance.⁸ The literature is less robust regarding UCL technique in younger and less experienced athletes. Given the increasing incidence of UCL injury in players of younger ages, likely because of increasing rates of year-round sports and sport specialization, how to treat these patients is a topic of great interest.^{8,11,12}

Many UCL injuries occur in an acute manner in younger pitchers, often enabling direct end-to-end primary repair of the native ligament, given the lack of chronic attrition throughout the length of the ligament as seen in high-level mature athletes. The goal of this repair is to reconstitute anatomical position of the native ligament to provide stability against valgus stress of the medial elbow. We recommend this technique of repair in cases where the native ligament is structurally sound because it obviates any risk inherent to a reconstruction. Risks of reconstruction include donor site morbidity when using an autograft and the rare but inherent risks of using allograft specimens such as disease transmission and the possible preclusion of future tissue or blood donations by the patient.¹⁴

The procedure described in this technique does carry its own limitations. Patients are counseled on the risks of surgery including iatrogenic fracture of the medial epicondyle during anchor placement or injury to the cutaneous nerve or ulnar nerve. Furthermore, physal growth arrest is a rare but possible consequence of drilling too laterally when establishing the pilot hole. For these reasons, younger patients may elect to forgo surgery in favor of a reconstruction after growth is complete, especially in nonpitchers. Surgical risks of infection must be disclosed, particularly with the use of an implant. Patients should be counseled of the risks of reinjury, lack of improvement in pain and function, and potential not to return to sport at the same level of performance or to the same position. Clear and realistic expectations regarding postoperative rehabilitation,

recovery, and timelines should be established preoperatively. Finally, risks inherent to spinal or general anesthesia should be discussed with the patient and parental guardians.

In conclusion, UCL injuries are seen in younger patient populations and can cause pain and a decreased performance in youth throwing athletes. These injuries are seen at increasing rates and orthopaedic surgeons may effectively treat these conditions using primary repair of the native tendon as described in this technique. The technique described in this article is simple and effective in the treatment of UCL avulsion in an acute setting in young pitchers. Reconstruction should be reserved for chronic, attritional ligaments without the capacity for direct end-to-end repair.

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