

# Early Complications of Ulnar Collateral Ligament Repair With Collagen-Coated Suture Tape Augmentation

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**Background:** Recent innovative techniques have led to renewed interest in ulnar collateral ligament (UCL) repair. Although early outcome data regarding the clinical outcome of overhead athletes undergoing UCL repair with augmentation have been encouraging, long-term data are still needed to evaluate both the appropriate indications and success rate for this procedure.

**Purpose:** To describe and evaluate the acute complications seen in a large cohort of patients who underwent UCL repair with internal brace augmentation at a single institution.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** We performed a retrospective chart review of a prospectively collected database, consisting of all patients who underwent UCL repair with internal brace augmentation utilizing a collagen-dipped FiberTape at our institution from August 2013 to January 2020. Patient characteristics, injury setting, side of surgery, and concomitant ulnar nerve transposition procedures were recorded. Early complications of UCL repair (within 6 months of the procedure) were evaluated and characterized as either minor or major, depending on whether the patient required a return to the operating room.

**Results:** Of the 353 patients who underwent UCL repair at our institution with a minimum of 6-month follow-up, 84.7% (299/353) reported no complications, 11.9% (42/353) reported minor complications—including ulnar nerve paresthesia, postoperative medial elbow pain, and postoperative superficial wound complications—and 3.4% (12/353) required a return to the operating room because of a major complication requiring ulnar nerve exploration/debridement, primary ulnar nerve transposition, or heterotopic ossification excision.

**Conclusion:** The low major complication rate identified in this study further validates the efficacy of the UCL repair with the internal bracing augmentation technique. Longer term follow-up data are needed to more adequately assess the outcomes and durability of this procedure.

**Keywords:** elbow; overhead athlete; sports medicine; Tommy John surgery

In recent decades, there has been a well-documented increase in the incidence of elbow ulnar collateral ligament (UCL) injuries in overhead athletes requiring surgical intervention.<sup>2-4,7,10-12,14-17,20-23</sup> Baseball at all levels of competition has significantly contributed to this increase in surgical injuries. After the original UCL reconstruction technique described by Dr Frank Jobe, surgical modifications have led to up to 83% of overhead athletes returning to play at the same level or a higher level.<sup>2-4,14,16,18</sup> Complications from UCL surgery, most often involving the ulnar nerve, have continued to decline.<sup>7,19,20</sup> With these successful outcomes in UCL reconstruction in baseball and other overhead sports, the focus began to shift to minimizing the rehabilitation time for these athletes to return to

play. The largest reported case series of overhead athletes showed the mean time for a player to return to full competition after UCL reconstruction was 11.6 months, but Major League Baseball (MLB) pitchers took even longer (range, 16.8-18.5 months).<sup>14,18</sup>

Extensive rehabilitation times for patients undergoing UCL reconstruction have led to an emerging interest in UCL repair with internal brace augmentation as a novel alternative for patients with failed attempts at conservative treatment.<sup>3,4,25</sup> Historically, patients with UCL injuries were treated with UCL reconstruction regardless of extent of tear, quality of ligament tissues, or location of a ligamentous avulsion.<sup>3,4,14-16</sup> Early attempts at UCL repair provided suboptimal results with an unacceptable overall return to sport rate (50%), while MLB players returned at an even lower rate (29%).<sup>5,6</sup> Despite modifications to the surgical technique, the return-to-play rate peaked at 63% in 2000.<sup>3</sup>

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In recent decades, advances in suture and suture-anchor technology provided an opportunity to update the UCL repair technique as a method of treating UCL tears that were amenable to repair. One technique uses a collagen-coated FiberTape (Arthrex) to reduce valgus stress and augment the biologic healing of the repaired native ligament onto the collagen substrate of the FiberTape.<sup>7-9,19</sup> The UCL repair with internal brace technique demonstrated dramatically superior results than previous efforts at native ligamentous repair, with 92% (102/111 eligible overhead athletes) returning to the same or higher level of competition at a mean of 6.7 months after surgical repair.<sup>7</sup>

After the publication of early successful outcomes of overhead athletes treated with UCL repair and brace augmentation at our institution, the popularity of this procedure began to increase at both high-volume academic centers and community orthopedic practices. A recent study of National Collegiate Athletic Association Division I collegiate baseball programs over 3 years demonstrated that the percentage of UCL repair procedures for players with surgical UCL injuries increased from 9.5% in 2017 to 19.9% in 2018 and finally to 25.1% of UCL surgeries in 2019.<sup>22</sup>

With this growth in popularity of the UCL repair technique, we sought to identify early complications in our large cohort of patients as an educational tool for other surgeons considering the adoption of this technique into their surgical armamentarium. As the technique continues to expand from high-volume academic centers to community practices, the appreciation of its benefits as well as its most common complications is crucial in appropriately treating young overhead athletes. Therefore, the aim of this study was to evaluate and report the early complications seen in patients who underwent UCL repair with an internal brace augmentation at a single institution.

## METHODS

After receiving institutional review board approval, we performed a retrospective chart review of a prospectively collected database of all patients who underwent UCL repair with internal brace augmentation at our institution. Each procedure was performed by 1 of the 3 surgeons (J.R.D., E.L.C., B.A.E.). Patients included in this study underwent UCL repair with internal bracing augmentation performed at our institution to treat either a partial or a complete UCL injury. The procedures were performed between August 2013 and January 2020, and participants were identified through the research databases at our institution. Patients

who experienced UCL injuries and were cared for with treatment options other than UCL repair with internal bracing augmentation were excluded from the study. The decision to reconstruct or repair the UCL was made intraoperatively in each case, with the repair technique only selected if the tear was at the proximal or distal end of the native ligament, with a high-quality native ligament tissue present. For injury patterns that involved midsubstance tears or bony ossicles with poor native tissue, traditional UCL reconstruction was performed. Patient characteristics were reviewed, and patient information gathered from our research databases included age, sex, affected side, sport, and whether the patient underwent ulnar nerve transposition at time of surgery.

The surgical technique to repair the UCL as described by Dugas<sup>6</sup> uses a medial incision centered posterior to the medial epicondyle and extending distally and proximally. The ulnar nerve is mobilized to properly visualize the entire extent of the UCL and tear. The deep heads of the flexor carpi ulnaris are elevated off the UCL, exposing the entire ligament. The native ligament is repaired to its origin, and the internal brace is then incorporated into the native ligament using 3 simple stitches. For all patients, a collagen-coated FiberTape (Arthrex) is secured using two, 3.5-mm polyethyl ether ketone SwiveLock anchors (Arthrex), which are inserted into at the UCL footprints in the medial epicondyle and sublime tubercle, respectively. During each procedure, the decision to perform a subcutaneous ulnar nerve transposition was left to the discretion of the operating surgeon. All subcutaneous ulnar nerve transpositions were performed using a small portion of the intermuscular septum as a fascial sling to hold the nerve in place anterior to the medial epicondyle. Initially, the decision to transpose was made if ulnar nerve symptoms were present on physical examination before the surgical intervention.

We reviewed the clinical follow-up notes for all patients included in this cohort and identified any acute complications identified within 6 months of surgery. Patients were typically seen postoperatively at 2 weeks, 6 weeks, 3 months, and 6 months. Complications varied and included paresthesia in either the medial antebrachial cutaneous nerve or in ulnar nerve distribution, postoperative medial elbow pain, superficial wound complications, and heterotopic ossification formation presenting as elbow stiffness. These different complications were recorded and divided into 2 primary categories: minor and major. Minor complications consisted of complications treated nonoperatively that were observed in the clinic and resolved over time

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Ethical approval for this study was obtained from Sterling IRB (ID: 6269-001).

TABLE 1  
Patient Characteristics (N = 353)<sup>a</sup>

Variable	Value
Age at surgery, mean ± SD	19.1 ± 4.9
Sex	
Male	309 (87.5)
Female	44 (12.5)
Affected elbow	
Right	281 (79.6)
Left	72 (20.4)
Sport	
Baseball	272 (77.1)
Football	22 (6.2)
Cheerleading/tumbling/gymnastics	18 (5.1)
Softball	14 (4.0)
Falling accident	6 (1.7)
Javelin	6 (1.7)
Wrestling	4 (1.1)
Weightlifting	3 (0.8)
Volleyball	2 (0.6)
Basketball	1 (0.3)
Horseback riding	1 (0.3)
Unknown	4 (1.1)
Ulnar nerve transposition performed at surgery	
Yes	198 (56.1)
No	148 (41.9)
Previous	7 (2.0)

<sup>a</sup>Data are reported as n (%) unless otherwise indicated.

(grades 1-2 of the Dindo-Clavien classification), whereas major complications included those requiring a return to the operating room (grade 3 of the Dindo-Clavien classification).<sup>24</sup>

Rates of complication were compared based on sex, type of athlete, and whether there was a concomitant ulnar nerve transposition. Chi-square analyses were used, with significance set at  $P < .05$ .

## RESULTS

Review of our institution database yielded 353 patients who met the inclusion criteria (Table 1). The mean age at the time of surgery was 19.1 years (range, 12-68 years). Patients were predominantly men and right-handed, and the majority of procedures were performed on the dominant elbow. In a small subset of this cohort, a traumatic fall during the sporting activity caused an injury to the non-dominant elbow. Baseball was the primary injury setting for the majority of patients, with most of these patients identified as pitchers. The patient population also included football players, softball players, patients injured from falling accidents, javelin throwers, wrestlers, basketball players, weightlifters, and volleyball players.

Table 2 illustrates the complications from the 353 patients who met the inclusion criteria. Of this cohort, 299 (84.7%) reported no complications in the postoperative period. There were 42 patients (11.9%) who developed minor complications after surgery. Ulnar nerve paresthesia that resolved with time was the most common minor

TABLE 2  
Early Complications After UCL Repair

	n (%)
No complications	299 (84.7)
Minor complications	42 (11.9)
Ulnar nerve paresthesia	29 (8.2)
Postoperative medial elbow pain	11 (3.1)
Postoperative superficial wound complications	2 (0.6)
Major complications	12 (3.4)
Ulnar nerve exploration/debridement	6 (1.7)
Primary ulnar nerve transposition	4 (1.1)
Heterotopic ossification excision	2 (0.6)

complication, occurring in 29 patients. Medial elbow pain was the second most common acute complication, with 11 of 42 patients with minor complications reporting significant pain. Last, there were 2 patients who developed superficial wound complications that were treated with antibiotics, observed with clinical follow-up, and whose complications resolved with time.

Major complications requiring a return to the operating room were identified in 12 of the 353 patients (3.4%). The mean time between the index procedure and the revision procedure was 11.6 months (range, 4.3 to 27.5 months). Six patients required a revision procedure after ulnar nerve transposition was performed during the initial procedure. These revisions included exploration of the ulnar nerve in its transposed position with scar tissue debridement. Four patients required a primary ulnar nerve transposition after no transposition was performed during the index procedure. These 4 patients all had unremitting ulnar nerve paresthesia after UCL repair and failed a 6-month trial of conservative management. Finally, 2 patients required operative excision of heterotopic ossification. This heterotopic ossification was noted in the postoperative clinical setting with radiographs and correlated with pain and poor motion.

Table 3 compares the early complication rates after UCL repair between different groups of patients, including differences based on sex, type of athlete, and whether a concomitant ulnar nerve transposition was performed. This comparison demonstrated that women had a significantly higher incidence of minor complications compared with men ( $P < .001$ ). There were no significant differences in rates of complication based on the type of athlete ( $P = .194$ ). Finally, patients who had undergone a concomitant ulnar nerve transposition experienced a significantly higher number of minor complications compared with patients who had not ( $P = .013$ ).

## DISCUSSION

Overall, in our cohort of patients, we observed an 11.9% minor complication rate and a 3.4% major complication rate. Ulnar nerve paresthesia was the most prevalent minor complication, and the most common ulnar nerve symptom observed was paresthesia in the ring and small

TABLE 3  
Comparison of Early Complication Rates Between Selected Groups<sup>a</sup>

	Complications		
	None	Minor	Major
Sex			
Male	270 (87)	28 (9) <sup>c</sup>	11 (4)
Female	29 (66)	14 (32) <sup>d</sup>	1 (2)
Type of athlete <sup>b</sup>			
Baseball pitcher	203 (87)	23 (10)	7 (3)
Baseball nonpitcher	27 (84)	3 (9)	2 (6)
Other throwing athlete (football quarterback, softball, javelin)	16 (70)	6 (26)	1 (4)
Other	45 (80)	10 (18)	1 (2)
Concomitant ulnar nerve transposition			
Yes	158 (80)	32 (16) <sup>d</sup>	8 (4)
No	141 (91)	10 (6) <sup>d</sup>	4 (3)

<sup>a</sup>Data are reported as n (% of row).

<sup>b</sup>A total of 9 patients (7 baseball and 2 football players) with unknown positions were omitted from the analysis for type of athlete.

<sup>c</sup>Statistically significant difference between sexes ( $P < .001$ ).

<sup>d</sup>Statistically significant difference between patients with versus without concomitant ulnar nerve transposition ( $P = .013$ ).

fingers on the surgical side. Most patients experiencing ulnar symptoms had resolution of the ulnar nerve paresthesia spontaneously, within a matter of months. This resolution was subjective, and all cases of ulnar nerve paresthesia that resolved were resolved by 12 months. In rare cases of ulnar nerve paresthesia, patients can develop decreased grip strength and possibly atrophy of the intrinsic muscles of the hand innervated by the ulnar nerve. None of the patients in our study developed these rare and more severe symptoms. Grip strength was assessed subjectively, and no patients reported a loss of strength in the operative upper extremity. Of the 29 patients who reported postoperative ulnar nerve paresthesia, 5 had not undergone transposition and represented patients with temporary ulnar nerve compression in its native location because of postoperative inflammation. The remaining 24 patients with postoperative ulnar nerve symptoms represented patients with paresthesia after transposition of the nerve to the anterior elbow that resolved with time.

Other minor complications that were seen included postoperative medial elbow pain and rare superficial wound complications. Patients in our cohort with medial elbow pain all reported improvement after the initial postoperative period and resolution of the pain with time. All patients had resolution of their pain by the 12-month follow-up visit. The 2 cases of superficial wound complications, including cellulitis and serous drainage, resolved after broad-spectrum oral antibiotics and close clinical observation. Culture of this serous drainage was not performed because of the high likelihood of skin contaminants in the drainage; in both cases, this drainage was resolved after 2 weeks of

antibiotics, and no long-term range of motion deficit was noted in these 2 patients.

Of the 12 patients requiring a return to the operating room after UCL repair, 10 exhibited symptoms of ulnar nerve paresthesia. The remaining 2 patients had pain with a limitation in range of motion related to heterotopic ossification formation and required open heterotopic ossification excision. For most of the UCL repairs performed at our institution during the collection period, the ulnar nerve was not transposed unless symptoms of ulnar nerve compression or instability were present. However, the decision for 1 surgeon (J.R.D.) at our institution to transpose in all cases developed as 4 cases of postoperative ulnar nerve paresthesia requiring a primary ulnar nerve transposition were identified. The remaining 6 cases of postoperative ulnar nerve paresthesia requiring a revision procedure all had compression of the ulnar nerve noted intraoperatively because of scar tissue formation. These patients all had resolution of their symptoms after scar tissue debridement of the ulnar nerve in its transposed position.

Heterotopic bone formation often involves abnormal bone growth in nonskeletal tissues and occurs uncommonly in patients recovering from UCL repair. This can be seen radiographically and often results in a limitation of range of motion as the ossification progresses. Two patients (0.6%) required an open excision to remove the heterotopic ossification because of recurrent pain noted during recovery at the 6-month follow-up visit. Both patients had sustained their initial injury in the dominant upper extremity during a sporting activity, and both underwent the appropriate rehabilitation process after surgery. This complication rate is identical to the 0.6% rate of symptomatic heterotopic ossification noted in a recent study looking at complications after 1420 UCL reconstructions at our institution.<sup>1</sup> These patients with heterotopic ossifications reported elbow pain, but the most common complaint was poor range of motion. This is consistent with the most common complaint in patients with heterotopic ossification after UCL reconstruction, and the majority of these patients returned to play without symptoms after heterotopic ossification excision in that long-term study.<sup>1</sup>

A slight majority of patients in this study underwent concomitant ulnar nerve transposition, and we found that a significantly higher percentage of these patients had minor complications that resolved with time. Most of these minor complications involved temporary ulnar nerve paresthesia, which is likely because of the necessary handling of the nerve during the transposition and subsequent small hematoma that commonly collects in the surgical field in the immediate postoperative period. Women had a significantly higher percentage of minor complications compared with men, but the time to return to play was no different between men and women.

A recent study quantified pitching biomechanics shortly after UCL repair.<sup>13</sup> In that study, 33 baseball pitchers were tested in a biomechanics laboratory as soon as they had returned to competition ( $10 \pm 3$  months after UCL repair). Compared with a control group (matched by age, height,

weight, and pitch velocity), the UCL repair group demonstrated no difference in passive range of motion and only 3 differences in pitching biomechanics. Specifically, the UCL group had less shoulder internal rotation velocity, elbow extension velocity, and elbow extension. All 33 UCL repair patients tested in that biomechanics study were patients in the current study. Of these 33, three had acute surgical complications (2 with ulnar nerve paresthesia and 1 with heterotopic ossification). Anecdotally, the patient with the history of heterotopic ossification had notably low internal rotation velocity, elbow extension velocity, and elbow extension, while the 2 patients with paresthesia had typical values for the UCL repair group. More data are needed to determine if postsurgical complications affect pitching biomechanics.

Future analysis of this cohort will investigate outcomes after UCL repair with collagen-coated suture tape augmentation in the longer term. There are possible late complications that have not yet been observed in this early cohort, including possible rerupture of the repaired UCL or theoretical stress-shielding or reaction to wear particles from the suture tape. This cohort will continue to provide valuable information regarding the outcomes and complications related to the novel UCL repair surgical technique.

A few limitations were noted while performing the study. Recall bias is common in retrospective studies, as the awareness of patient injury can alter the patient's own subjective recollection of symptoms. Also, the accuracy of the outcome data is dependent on the accuracy of past clinical notes. Although these clinical notes completed by the surgical fellows were reviewed and cosigned by the attending surgeons, there may have been an inconsistent level of accuracy because different surgical fellows dictated notes over several years of data collection. Also, the lack of consistent postoperative imaging may have led to an underestimation of heterotopic ossification formation, as not all patients had routine postoperative plain radiographs. It is also possible that patients had complications that were not addressed in our clinic, with this complication lost to follow-up. Finally, certain postoperative symptoms, such as ulnar nerve paresthesia, may not have been routinely or consistently assessed in this cohort of patients.

## CONCLUSION

The novel UCL repair with internal brace augmentation technique has demonstrated encouraging early outcomes and high return-to-play rates in properly selected patients. With increasing interest in the UCL repair, we analyzed our large cohort of patients to report on the early complications of this procedure at our institution. The understanding of proper indications and the most common early postsurgical complications can help optimize patient selection. We identified a low overall rate of complication, including an 11.9% minor complication rate and a 3.4%

major complication rate. Women and patients who had undergone an ulnar nerve transposition had a higher percentage of minor complications, but there was no significant difference in complication rates based on the type of athlete. The knowledge of these complication rates and careful consideration of the ulnar nerve intraoperatively can help minimize early postoperative complications in patients undergoing UCL repair with internal brace augmentation.

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