


Clinical Outcomes of Ulnar Collateral Ligament Surgery in Nonthrowing Athletes

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Background: Ulnar collateral ligament (UCL) surgery continues to demonstrate excellent clinical outcomes and a high return-to-play (RTP) rate with a low complication rate. Recent studies have demonstrated similar clinical outcomes for baseball players who have undergone either UCL reconstruction or UCL repair. In comparison, few studies have assessed the clinical outcomes of UCL surgery for nonthrowing athletes.

Purpose/Hypothesis: The primary objective of this study is to provide clinical outcomes of UCL surgery performed in nonthrowing athletes at a single institution with a minimum 2-year follow-up. Our hypothesis was that these patients would have similar clinical outcomes, complication rates, and RTP rates when compared with throwing athletes.

Level of Evidence: Case series; Level of evidence, 4.

Methods: From our longitudinal elbow registry, 40 nonthrowing athletes were identified who underwent UCL surgery (repair or reconstruction) between 2011 and 2019. Participant characteristics were recorded: age, sex, laterality, arm dominance, sport, level of competition, and type of surgery (UCL repair or reconstruction). Outcomes included RTP rate and average time, American Shoulder and Elbow Surgeons (ASES) scores, and complications.

Results: From the 40 patients eligible for inclusion in this study with a minimum 2-year follow-up, 37 (93%) were successfully contacted: 16 male (43%) and 21 female (57%). Mean \pm standard deviation age at the time of surgery was 18.0 ± 3.7 years. From the 37 technical procedures, 28 (76%) were UCL repairs and 9 (24%) were UCL reconstructions. For these patients, 15 (41%) had partial tears, 20 (54%) had complete tears, 1 (3%) had a medial epicondyle avulsion, and 1 (3%) had an unspecified pathology. Sports included football ($n = 11$), gymnastics (11), cheerleading (7), wrestling (4), volleyball (2), basketball (1), and acrobatics (1). Quarterbacks were excluded from the football patients, as quarterbacks are throwing athletes. Level of competition included high school ($n = 26$), college (8), professional (2), and youth sports (1). The RTP rate was 93% (26/28) at a mean 7.4 months for UCL repair and 100% (9/9) at a mean 10.0 months for UCL reconstruction. Mean ASES scores were 94.4 and 98.7 for UCL repair and reconstruction, respectively. Complications were low, with 2 patients in the UCL repair group requiring ulnar nerve transposition for ulnar nerve paresthesia.

Conclusion: In nonthrowing athletes, patients undergoing UCL repair and UCL reconstruction show favorable outcomes at minimum 2-year follow-up. RTP and clinical outcomes are consistent with previous studies in baseball players as well as a parallel ongoing study conducted on non-baseball throwing athletes.

Keywords: elbow; ulnar collateral ligament (UCL); Tommy John; nonthrowing athletes

Surgery to restore function of an injured elbow ulnar collateral ligament (UCL) has been studied extensively since its original description by Frank Jobe in 1986.¹⁵ Recent literature has demonstrated improvements in the surgical technique and expected outcomes after UCL surgery.^{1-12,16-37} Most publications have involved baseball players, who perform repetitive overhead motions that create chronic valgus stress on

the UCL.[§] Repetitive high loads applied to the UCL during throwing may lead to serious injury, as described in previous biomechanical studies.^{5,13,14,23,25,35,36} This chronic valgus load can lead to attritional injury through partial or complete tearing of the ligament and can occur acutely during the throwing motion.

Surgical correction through UCL reconstruction and, more recently, UCL repair in appropriate candidates has shown excellent clinical outcomes in these athletes with a high rate of return to play (RTP).^{||} The investigation of

UCL injury in nonthrowing athletes has been limited, despite these athletes representing a large portion of patients who sustain surgical UCL injuries.^{21,24,28,33} In an epidemiological study by Zaremski et al,³⁷ nonthrowing athletes represented 27% of patients treated for UCL injury over a 16-year span. The injury pattern in these athletes was less often attritional and more commonly an acute traumatic event.²⁸ Kenter et al¹⁸ showed that most UCL injuries in the National Football League occurred while the player was blocking at the line of scrimmage with the arms extended in front of the body or by application of a valgus force at the elbow with the hand planted on the playing surface. In a case series of 5 patients, Nicolette and Gravelle²⁴ described the repetitive axial loading to the elbow seen in gymnasts.

Although injury mechanisms have been explored in various nonthrowing athletes, outcomes of UCL surgery in this population are lacking. Therefore, the purpose of this study was to provide clinical outcomes for UCL surgery performed at a single institution in nonthrowing athletes with minimum 2-year follow-up. Our hypothesis was that these patients would have similar clinical outcomes, complication rates, and RTP rates when compared with throwing athletes.

METHODS

After approval by Sterling institutional review board, all consecutive patients who underwent UCL surgery between 2011 and 2019 were identified retrospectively and contacted, and participants provided informed consent over the telephone. Each surgical procedure had been performed by a fellowship-trained sports medicine surgeon (E.L.C., J.R.D., B.A.E.) at Andrews Sports Medicine & Orthopaedic Center in Birmingham, Alabama. Throwing athletes (baseball, softball, javelin, etc) and patients with <2-year follow-up were excluded. Patient demographics, level of sport, injury characteristics, and operative details were captured at the time of surgery. Outcome data were collected via telephone with an orally administered questionnaire. Participants were asked to answer questions from the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form and the American Sports Medicine Institute RTP questionnaire regarding the ability to RTP and the timeline of RTP. The Kerlan-Jobe Orthopaedic Clinic (KJOC) Shoulder and Elbow Score questionnaire was not utilized, as it is designed for throwing athletes. Any complications throughout their treatment course were also recorded.

Patient Selection

All patients had clinically confirmed UCL insufficiency and were unable to return to sport despite nonoperative management. This nonoperative treatment typically consisted of rest and rehabilitation but included bracing and platelet-rich plasma injections in selected cases. Sport-specific factors also played a role in surgical discussion, such as timing within the season, timing within the athlete's career, and overall career goals. On physical examination, UCL tear was suspected with a positive milking maneuver and/or moving valgus stress test result and medial-sided elbow tenderness to palpation. Magnetic resonance imaging (MRI) was used to confirm UCL injury and rule out additional pathology, such as osteophytes or loose bodies. MRI was performed at our institution with intra-articular contrast; however, in some cases, patients were referred to us with a nonarthrographic MRI. When patients fulfilled the inclusion criteria preoperatively, they were indicated for repair or reconstruction and informed that the final decision would be determined by the operating surgeon based on intraoperative examination of the functional integrity of the UCL. For patients with degenerative tissue not amenable to repair, a bony ossicle in the ligamentous tissue that would leave a defect upon extraction, or a complete midsubstance tear, the decision was to proceed with UCL reconstruction. For patients with partial-thickness tears or complete proximal or distal tears with adequate ligamentous quality, the decision was to proceed with UCL repair with internal brace augmentation.

Operative Technique

The operative technique for UCL repair and reconstruction was performed utilizing an Arthrex collagen-dipped internal brace (repair) or a modified Jobe technique (reconstruction) as described by Dugas et al¹⁰ and Azar et al,² respectively.

The surgical technique to repair the UCL by Dugas et al¹⁰ used a medial incision centered posterior to the medial epicondyle and extending distally and proximally for a total length of approximately 10 cm. The ulnar nerve was mobilized to properly visualize the entire extent of the UCL and tear. The deep heads of the flexor carpi ulnaris were elevated off the UCL, exposing the entire ligament. The native ligament was repaired to its origin, and the internal brace was then incorporated into the native ligament using 3 simple stitches. For all patients, a collagen-

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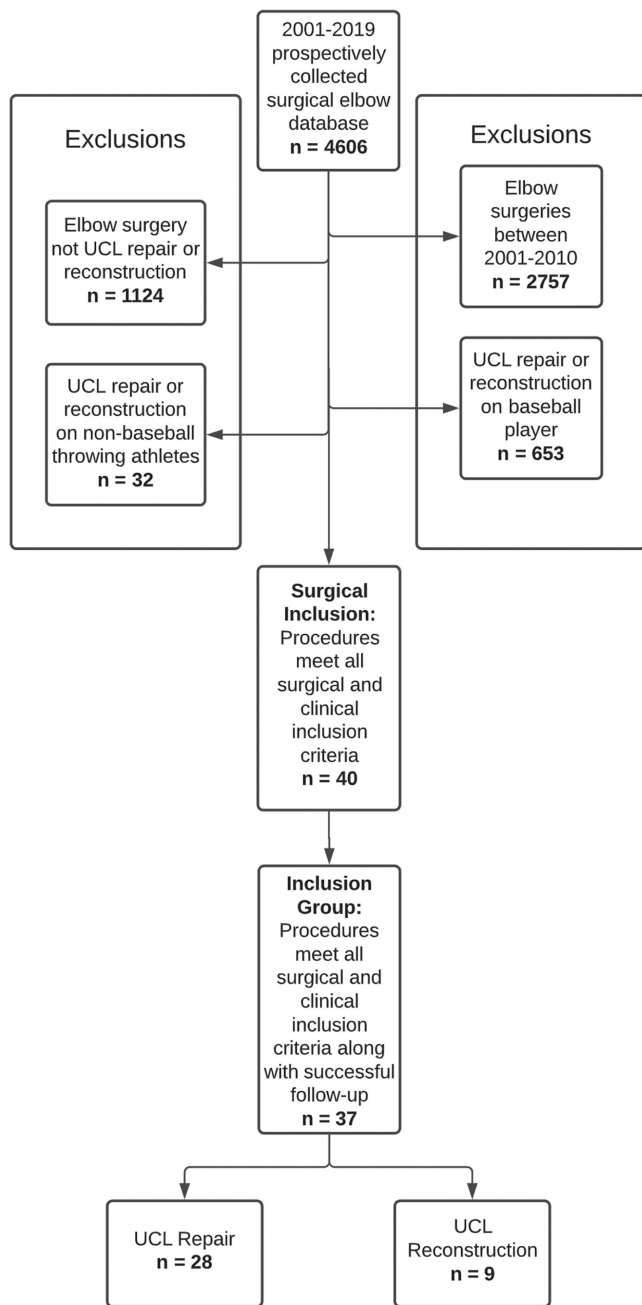


Figure 1. Flowchart of inclusion and exclusion criteria applied to our surgical elbow database to generate the cohort of patients for this study. UCL, ulnar collateral ligament.

coated FiberTape (Arthrex) was secured using two 3.5-mm polyether ether ketone SwiveLock anchors (PEEK; Arthrex), which were inserted into the UCL footprints in the medial epicondyle and sublime tubercle. During each procedure, the decision to perform a subcutaneous ulnar nerve transposition was left to 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.

TABLE 1
Participant Characteristics in the Data Analysis of Clinical Outcomes After UCL Surgery (37 Athletes)^a

Characteristic	UCL Repair (n = 28)	UCL Reconstruction (n = 9)
Sex		
Male	12 (43)	4 (44)
Female	16 (57)	5 (56)
Age at surgery, y	17.5 ± 3.7	19.6 ± 3.5
Laterality		
Right	15 (54)	4 (44)
Left	13 (46)	5 (56)
Dominant arm affected		
Yes	16 (57)	5 (56)
No	12 (43)	4 (44)
Sport		
Basketball	1 (4)	0
Cheerleading	7 (25)	0
Football	10 (36)	1 (11)
Gymnastics	8 (29)	3 (33)
Volleyball	1 (4)	1 (11)
Wrestling	1 (4)	3 (33)
Acrobatics	0 (0)	1 (11)
Level of competition		
Youth	1 (4)	0
High school	21 (75)	5 (56)
College	5 (18)	3 (33)
Professional	1 (4)	1 (11)

^aData are presented as No. (%) or mean ± SD. UCL, ulnar collateral ligament.

Statistical Analysis

To determine whether the outcome variables differed between procedures, statistical analyses were performed using SPSS Version 27.0 (IBM Corporation). Mean ± standard deviation values were calculated for continuous variables (eg, age). Categorical variables (eg, laterality) were expressed as numbers and percentages. Comparisons for RTP and ASES values between the repair and reconstruction groups were assessed using independent samples *t* tests. Correlations between procedure type and sex, handedness, and whether the athletes successfully returned to play were examined using the Fisher exact test. Statistical significance level was set at $\alpha = .05$.

RESULTS

All patients from our institution who had undergone UCL surgery from 2011 to 2019 were reviewed for inclusion in this study. Figure 1 contains a flowchart with the inclusion and exclusion criteria used to determine our surgical inclusion group from the total patient database. From the elbow database consisting of 4606 patients, 1849 were treated surgically at our institution between 2011 and 2019. Of these patients, 725 underwent either UCL repair or reconstruction, 72 of whom were non-baseball athletes. From this group of 72 patients, 32 were non-baseball throwing sport athletes, leaving 40 in the surgical inclusion group

as nonthrowing sport athletes. From this group of 40 nonthrowing athletes, 37 were successfully contacted for a follow-up rate of 93%. Of these 37 patients, 28 (76%) had undergone UCL repair and 9 (24%) had undergone UCL reconstruction. For these patients, the preoperative imaging and intraoperative findings confirmed that 15 (41%) patients had partial tears, 20 (54%) had complete tears, 1 (3%) had a medial epicondyle avulsion, and 1 (3%) was unspecified. In terms of location of the tear, 21 (64%) were proximal tears and 12 (36%) were distal, with 4 unspecified. In this cohort, 20 patients (54%) had concomitant primary ulnar nerve transposition, whereas 17 (46%) did not. Participant data, including age, sex, dominant arm, sport played, and level of competition, are included in Table 1.

Patient outcomes are shown in Table 2. The average follow-up time was 3.71 years after surgery. In UCL repairs, 26 of 28 (93%) patients who attempted to return to the same or higher level of competition were able to do so. One of the patients who did not RTP was in her senior year of college cheerleading and chose to focus on school after recovery. The other patient who did not RTP was treated during his senior year of high school football and did not play competitively in college. The mean time to return to competition was 7.4 months, and the average ASES score was 94.4.

In UCL reconstructions, 9 of 9 patients (100%) returned to the same or higher level of competition. The mean time to return to competition was 10.0 months, and the average ASES score was 98.7. There were no significant differences with respect to RTP or ASES score between the UCL repair and UCL reconstruction surgical cohorts.

Complications

Two patients who underwent UCL repair required ulnar neurolysis and revision ulnar nerve transposition. In 1 of these patients, the fascial sling was torn with the nerve falling posteriorly over the medial epicondyle with symptomatic instability; the other had a significant amount of scar formation causing ulnar nerve compression. Each patient had full resolution of the symptoms after revision ulnar nerve neurolysis and ulnar nerve transposition.

DISCUSSION

In recent decades, there have been numerous studies reporting clinical outcomes for UCL surgery in baseball players and other non-baseball throwing athletes.⁸ The literature is surprisingly scarce on clinical outcomes after UCL surgery in nonthrowing athletes.^{21,24,28,33} These few studies often contain small numbers of nonthrowing athletes with variable outcomes. Jones et al¹⁷ included 3 gymnasts in their publication on UCL reconstruction using the docking technique; their study had a total of 55 athletes, with the remainder being baseball players ($n = 47$) and javelin throwers ($n = 5$). Only 1 of 3 gymnasts had an excellent Conway score at final follow-up, and just 1 of 3 returned to gymnastics. The 2 failed cases in the subgroup had advanced osteochondral lesions of the capitellum that

TABLE 2
Clinical Outcome Data by Surgical
Technique (37 Patients)^a

Variable	UCL Repair (n = 28)	UCL Reconstruction (n = 9)	P Value
RTP competition			
Yes	26 (93)	9 (100)	>.99
No	2 (7)	0	.08
RTP time, mo	7.4 ± 3.8	10.0 ± 2.7	
ASES score	94.4	98.7	.10
Complications	2 (7)	0	
ulnar neuritis			

^aData are presented as No. (%) or mean ± SD, unless otherwise indicated. ASES, American Shoulder and Elbow Surgeons; RTP, return to play; UCL, ulnar collateral ligament.

were drilled arthroscopically at the time of UCL reconstruction. The authors cautioned that the presence of intra-articular lesions may confer a risk for poorer outcome. Erickson et al¹² reported on 3 tumbling athletes (2 gymnasts, 1 cheerleader) in their study of 187 UCL reconstructions. The cheerleader returned to sport with a final KJOC score of 94.7, but only 1 gymnast returned to competitive gymnastics with an average subgroup KJOC score of 76.3. In contrast to these previous reports of poor outcomes in nonthrowing athletes after UCL surgery, our study included 11 gymnasts (8 UCL repairs, 3 UCL reconstructions) with a 100% return to sport.

In addition to the limited number of publications for UCL outcomes in nonthrowing athletes, most studies report solely on UCL reconstruction, with few studies that include a high volume of UCL repairs.^{10,11,16,31,32} In our study, UCL repair was performed in 28 out of 37 nonthrowing athletes, with a 93% RTP rate at a mean time of 7.4 months and a mean ASES score of 94.4. These results are consistent with a previous publication from our institution reporting on UCL repair in 111 throwing athletes, which illustrated 92% RTP at a mean 6.7 months and a mean KJOC score of 88.2 at final follow-up.¹⁰ Furthermore, nonthrowing athletes who underwent UCL reconstruction had similar results to our institution's experience with throwing athletes. The nonthrowing athletes in this study who underwent UCL reconstruction had an RTP rate of 100% at a mean 10 months and a mean ASES score of 98.7; in comparison, Cain et al³ published outcomes for 743 athletes who underwent UCL reconstruction, reporting an RTP rate of 83% at a mean 11.6 months. Although the preference in our practice to perform UCL repair in the young athletic population with high-quality native ligamentous tissue is higher than average when compared with the sports medicine population as a whole, recent literature has demonstrated a sharp increase in the performance of the UCL repair procedure in young athletes.³⁰

Very few complications were seen in this study. Two patients had complications related to ulnar neuritis. Both underwent revision ulnar neurolysis with ulnar nerve transposition, and both patients had full resolution of their symptoms after the revision procedure.

This study has limitations. Despite being the largest cohort reported on nonthrowing athletes undergoing UCL surgery to our knowledge, this still represents a relatively small number of patients, and higher volumes will help confirm our results. Additionally, as with most questionnaires, recall bias is an inherent bias that is difficult to avoid. The decision to proceed with UCL repair or UCL reconstruction is based on intraoperative examination of the tissue quality and thus subjective, not objective and reproducible. However, despite these limitations, we believe that this is the highest-quality study to date that assesses patient-reported outcomes, complication rates, and RTP rates in nonthrowing athletes after UCL surgery.

CONCLUSION

Athletes undergoing UCL repair and reconstruction continue to display excellent clinical outcomes with a high RTP rate and a low complication rate. Although nonoperative treatment is the mainstay of treatment in nonthrowing athletes with UCL injuries, this study shows excellent results regarding RTP and ASES scores in this cohort whose nonoperative treatment failed. There were no significant differences between nonthrowing athletes undergoing UCL repair and reconstruction and no differences between these nonthrowing athletes and throwing athletes with regard to clinical outcomes, complication rates, and RTP rates. This study will serve as the foundation for future research, including a larger cohort of nonthrowing athletes with long-term follow-up, and it provides clinical outcome data in this specific patient population to help in the preoperative counseling of future nonthrowing athletes with surgical UCL injuries.

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