29 Management of UCL Injuries in Non-throwing Athletes

James B. Carr II

Introduction

Injury to the ulnar collateral ligament (UCL) was initially described in javelin throwers by Waris in 1946 [1]. Nearly three decades later, Frank Jobe introduced ulnar collateral ligament reconstruction using a free tendon graft in professional pitcher Tommy John [2]. His subsequent case series of UCL reconstruction in 16 athletes revolutionized the treatment of what was once considered a career ending injury in overhead throwers. The introduction of UCL reconstruction by Jobe sparked a newfound interest in UCL injuries and UCL reconstruction techniques. This led to an abundance of literature focused on UCL injuries, including epidemiology, mechanism of injury, modifications to the UCL reconstruction technique, and outcomes following various treatment strategies.

The overwhelming majority of UCL injuries occur in overhead throwing athletes, especially baseball pitchers, due to the extreme, repetitive valgus force placed on the elbow during the pitching motion. Other overhead throwing athletes, including softball players and javelin throwers, are at a high risk for UCL injury. Furthermore, throwing athletes often require surgical reconstruction in order to return to previous level of competition. As a result, the vast majority of available literature on UCL injuries focuses on results in this specific demographic.

However, UCL injuries are not unique to overhead throwing athletes. A variety of sports other than baseball can place the UCL at risk for injury, either from repetitive valgus stress or more likely from episodic traumatic forces to the elbow. Combat sports (i.e., wrestling, mixed martial arts, jiu-jitsu), contact sports (football, hockey, rugby), and tumbling sports (gymnastics and cheerleading) often expose the elbow to forceful valgus loads and/or frequent weight bearing through the elbow joint, potentially creating a UCL injury.

Given the paucity of literature examining UCL injuries in the non-throwing athlete, management of these types of injuries can present a conundrum for the treating physician. Very few studies include non-throwing athletes in the analysis, and even fewer studies are solely dedicated to UCL injuries in non-throwing athletes. Though supporting literature is scarce, decision making is often based on a variety of factors, including age of the patient, level of competition, sport-specific demands, and timing within the sport season. This chapter presents a summary of the available literature of UCL injuries in non-throwing athletes as well as the author's preferred algorithm for management.

J. B. Carr II (✉)
Sports Medicine Institute, Hospital for Special Surgery, West Palm Beach, FL, USA
e-mail: carrja@hss.edu

J. S. Dines et al. (eds.), *Elbow Ulnar Collateral Ligament Injury*,
https://doi.org/10.1007/978-3-030-69567-5_29

Epidemiology

Like most aspects of UCL injury research, the epidemiology of such injuries is well described in throwing athletes but less so in the non-throwing athlete population [3–7]. This is likely attributable to its presumed lower incidence in non-throwing athletes. One of the first epidemiology studies for UCL injuries in non-throwing professional athletes was performed by Kenter et al. [8] They analyzed acute elbow injuries between 1991 and 1996 in the National Football League (NFL) and found that 19 of 91 (21%) elbow injuries were ulnar collateral ligament tears. The vast majority of these injuries (17 of 19) occurred in players other than quarterback. All players with UCL injuries were treated non-operatively, and all players were able to return to competition with an average time loss of less than one game.

Combat athletes have one of the highest rates of UCL injuries among non-throwing athletes. Frey et al. reviewed injury rates during 21 seasons of judo competitions in France and reported that UCL injuries accounted for 17% of all injuries [9]. Competing at a more elite level was a risk factor for sustaining a UCL injury, likely because of the increased forces transmitted during competition at higher levels of combat. Similarly, another epidemiology study of Brazilian jiu-jitsu athletes found the elbow joint to be the most commonly injured joint with UCL sprains occurring 6 times out of 5022 athlete exposures [10]. Interestingly, the Brazilian jiu-jitsu arm bar was the most commonly implicated mechanism of UCL injury, likely due to the possibility for a forceful valgus load.

One of the most robust epidemiological studies for UCL injuries in non-throwing athletes was performed by Li et al. [11] They analyzed the National Collegiate Athletic Association (NCAA) Injury Surveillance Program for UCL injuries between the academic years of 2009 and 2013 across 25 varsity NCAA sports. During the five seasons surveyed, there were a total of 109 UCL injuries reported, accounting for an overall UCL injury rate of 0.29 per 10,000 athlete exposures. Surprisingly, the majority of UCL injuries (83 out of 109, 76.1%) occurred in non-throwing athletes. The other 26 UCL injuries (23.9%) occurred in a throwing athlete, including baseball, softball, and javelin throwers. Wrestling and football were the most commonly played non-throwing sports for UCL injuries. However, UCL injuries in throwing athletes accounted for more time missed with a greater proportion of athletes missing more than 3 weeks of competition (36.4% vs 9.1% in throwing and non-throwing athletes, respectively). UCL injuries in throwing athletes also more commonly resulted in surgical intervention (11.1%) compared to non-throwing athletes (1.3%).

While data is still limited, a non-throwing, contact trauma to the elbow is the most likely mechanism for a UCL injury in a non-throwing athlete. UCL injuries in non-throwing athletes likely do not garner as much attention as their throwing athlete counterparts due to the less morbidity and decreased incidence of surgery often seen in non-throwing athletes.

Mechanism of Injury

The UCL originates from the humeral medial epicondyle and has a broad insertion onto the sublime tubercle [12]. It is composed of the anterior bundle, the posterior bundle, and the transverse ligament. The UCL is the primary soft tissue restraint to valgus load of the elbow, with the anterior bundle being the most important stabilizer. Therefore, recreation of the anterior bundle is the primary goal of UCL reconstruction surgery.

In the throwing athlete, the UCL is often injured from repetitive valgus stress incurred during the late cocking and early acceleration phases of the throwing motion. This can result in microtrauma to the ligament and eventual attritional failure. In the non-throwing athlete, there are a variety of potential mechanisms of injury to the UCL with acute trauma being the most common denominator. For example, in combat sports, a single, forceful valgus stress can be applied to the arm during a combat maneuver, most frequently an arm bar. A sudden external rotation force during an arm bar can especially result in a large valgus force to the elbow, which can result in a

traumatic UCL injury [10]. Bracing the body from a fall can also result in a sudden valgus force that can lead to UCL injury. Similarly, UCL injuries occur in contact sports, such as football or rugby, most commonly from engaging the arm in extension during a block or from a sudden traumatic collision or fall [8].

Gymnastics and cheerleading place unique forces across the athlete's elbow because it becomes a weight bearing joint during many of the tumbling techniques. Koh et al. analyzed the weight bearing forces through the elbow joint in gymnasts performing a back handspring [13]. They found that ground reactive forces at the hand during upper extremity loading created a compressive force on the elbow that averages 2.37 times bodyweight and a valgus force that averages 0.03 × body weight × body height. As a result of frequent upper extremity weight bearing with associated valgus loads, gymnasts can develop both attritional and traumatic injuries to the UCL. Therefore, gymnasts are a unique subset of athletes with specialized demands on the elbow that must be considered when developing a treatment plan.

Understanding the mechanism of UCL injury in a non-throwing athlete is critical for developing a successful treatment plan. Because non-throwing athletes often sustain traumatic UCL injuries without chronic, attritional changes, they may be more amenable to non-operative management than their throwing athlete counterparts. The following section will discuss treatment options with respective results in the non-throwing athlete as well as the author's preferred algorithm.

Treatment Outcomes

Treatment options for a UCL injury include non-operative versus operative management. There are different surgical options, including ligament reconstruction or ligament repair with or without augmentation. Determining the appropriate treatment option depends on a variety of factors, including the type of sport played, level of competition, timing within the season, and shared decision making with the athlete. Unlike throwing athletes, some non-throwing athletes have a better likelihood of succeeding with non-operative management since they do not place repetitive valgus stress on the elbow. Gymnasts are a unique subgroup of non-throwing athletes that do place repetitive valgus stress on the elbow, so decision making can be more difficult in this population.

UCL injuries occur on a spectrum based on degree (partial, complete, or avulsion) and location (proximal, midsubstance, or distal). These factors often have prognostic implications and can influence treatment decisions. While there is extensive literature investigating treatment outcomes in throwing athletes, the available literature for non-throwing athletes is relatively sparse. The current section reviews outcome literature for various treatment options in non-throwing athletes.

Non-operative Management

While non-operative management tends to be unsuccessful in certain patterns of UCL injuries in throwing athletes, it is more successful in non-throwing athletes. Early studies reported poor return to sport rates in throwing athletes following non-operative management. Rettig et al. reported results in 31 overhead throwing athletes with UCL injury treated non-operatively with 2–3 months of bracing and progressive rehabilitation [14]. Only 13 patients (42%) were able to return to sport at an average of 24.5 weeks. Subsequent studies have highlighted the possibility of return to sports following a partial UCL injury, even in throwing athletes depending on tear pattern with partial proximal grade 1 or 2 UCL injuries having the best chance of full recovery [15].

In the non-throwing athletes, there is limited data on return to sport following non-operative management of a UCL injury. Nicolette et al. reported on five collegiate division I female gymnasts who sustained a UCL injury [16]. Every patient experienced a traumatic mechanism with a sudden valgus load applied to the elbow during a back handspring or fall from an elevated competition surface. Each patient had a magnetic

resonance imaging (MRI) confirming a high grade partial or complete tear of the UCL without significant ligament attenuation. Following a structured rehabilitation protocol, 4 out of 5 gymnasts returned to sport an average of 3.98 weeks following the injury. Similarly, McCrum et al. presented a case series of 3 professional hockey players who sustained an acute, traumatic UCL injury from a collision or fall onto the ice [17]. MRI evaluation discovered two partial ligament tears and 1 complete proximal avulsion. All athletes returned to competition at an average of 36 days post-operatively following structured rehabilitation and a series of two leukocyte poor platelet rich plasma (PRP) injection (one injection 2 days and 1 week following the injury).

Platelet-rich plasma is an emerging biologic agent for the treatment of partial UCL tears. There are no studies evaluating the use of PRP for partial UCL tears in non-throwing athletes as all studies evaluate PRP in throwing athletes [18–20]. These results have been encouraging with similar return to sport rates as non-operative management of low-grade UCL injuries. However, it should be noted that these studies are often limited by a lack of control group.

Operative Management with UCL Reconstruction

While dedicated case series of UCL injuries in non-throwing athletes are rare, some larger studies have included non-throwing athletes with throwing athletes. These provide the majority of available evidence for the role of UCL reconstruction in the non-throwing athlete. Unfortunately, this does limit the generalizability of these studies to non-throwing athletes since the overall amount of such patients remains limited.

One study reports outcomes of UCL reconstruction specifically in non-throwing athletes. Fuller et al. reported results in 66 United States military members with 86.4% of patients reporting no significant disability in their elbow at final follow-up [21]. A total of 83.3% of patients reported a good or excellent outcome. Interestingly, 47% of patients had a previous history of playing a throwing sport, most commonly being a baseball pitcher.

Multiple studies have reported outcomes following UCL reconstruction with a mixed cohort of throwing and non-throwing athletes. Jones et al. reported 55 adolescent athletes status post UCL reconstruction using the docking technique [22]. There were three gymnasts in the group. While 87% of patients in the overall cohort reported an excellent Conway score, only one out of three had an excellent Conway score at final follow-up with only one patient returning to gymnastics. However, it should be noted that the two gymnasts who did not return to competition had advanced osteochondral capitellar injuries that underwent microfracture at the time of surgery.

Similarly, Erickson et al. reported on 187 patients after UCL reconstruction at a single institution [23]. The cohort was largely baseball players except for two gymnasts and one cheerleader. One gymnast (50%) and the cheerleader were able to return to the previous level of competition.

Operative Management with UCL Repair

UCL repair has historically had poor results with return to sport rates typically around 50–63% in overhead athletes [24, 25]. However, with the knowledge of the spectrum of UCL injuries (i.e., partial vs complete tears and distal vs proximal tears) as well as different athletic demands based on the sport, UCL repair has gained renewed interest. The use of collagen dipped suture augmentation for UCL repair has also contributed to renewed interest as results have been more promising with newer techniques [26–28].

Savoie et al. reported a series of 60 patients with UCL insufficiency treated with primary repair [28]. All patients failed a 3 month trial of rehabilitation and had injury to the UCL at a single site within the ligament. Most patients were overhead athletes, but there were nine non-overhead athletes (two basketball players, two cheerleaders, and five gymnasts). Nearly 93% of

patients returned to the same level of sport at mean 6 months postoperatively, including every non-throwing athlete.

Richard et al. analyzed UCL repair following acute traumatic injury [29]. Seven out of ten athletes were non-throwing athletes (football, golf, swimming, wrestling, and volleyball) and underwent repair with non-absorbable suture and a humeral tunnel. Nine out of ten athletes returned to the same level of sport between 4 and 6 months. The only athlete who did not return to sport was a senior football player who did not play professionally.

Preferred Algorithm

Acute traumatic UCL injuries in the non-throwing athlete can often be treated non-operatively due to the different mechanism of injury and different athletic demands compared to UCL insufficiency in the throwing athlete. For throwing athletes, UCL reconstruction remains the gold standard for UCL insufficiency that does not respond to rest and conservative management. Most non-throwing athletes can successfully be treated non-operatively. Collision athletes who do not throw are especially amenable to non-operative management, and this is the preferred first-line treatment for this subset of athletes. For tumbling and gymnastic athletes, treatment varies and is based on individual scenarios and shared decision making. Many gymnasts can be treated non-operatively, but if they do not respond after a 4–6 week trial of conservative management, then operative management should be recommended. When surgery is chosen, then reconstruction remains the gold standard though new techniques with UCL repair are promising, yet with insufficient data to support its regular use currently.

Conclusions

Unlike overhead throwing athletes who often experience attritional breakdown of the UCL, non-throwing athletes often experience UCL insufficiency after a single traumatic episode without chronic, attritional compromise of the ligament. Therefore, the mechanism of injury usually leads to damage at a single location of the ligament that is often amenable to non-operative management. Furthermore, the demands of the medial elbow differ significantly between throwing and non-throwing athletes because non-throwing athletes do not place repetitive valgus stress on the elbow. Therefore, non-operative management of UCL injury in non-throwing athletes can often result in appropriate healing with full return to sport. After failure of conservative management, surgical treatment is a reasonable option with generally good to excellent results. In the setting of a high grade partial or complete tear near one insertion site, UCL repair is a possibility though long-term outcome data is limited.

References

1. Waris W. Elbow injuries of javelin-throwers. Acta Chir Scand. 1946;93(6):563–75.
2. Jobe FW, Stark H, Lombardo SJ. Reconstruction of the ulnar collateral ligament in athletes. J Bone Jt Surg Ser A. 1986;68(8):1158–63.
3. Camp CL, Conte S, D'Angelo J, Fealy SA. Epidemiology of ulnar collateral ligament reconstruction in Major and Minor League Baseball pitchers: comprehensive report of 1429 cases. J Shoulder Elb Surg. 2018;27(5):871–8.
4. Erickson BJ, Nwachukwu BU, Rosas S, Schairer WW, McCormick FM, Bach BR, et al. Trends in medial ulnar collateral ligament reconstruction in the United States: a retrospective review of a large private-payer database from 2007 to 2011. Am J Sports Med. 2015;43:1770–4.
5. Mahure SA, Mollon B, Shamah SD, Kwon YW, Rokito AS. Disproportionate trends in ulnar collateral ligament reconstruction: projections through 2025 and a literature review. J Shoulder Elb Surg. 2016;25(6):1005–12.
6. Erickson BJ, Harris JD, Tetreault M, Bush-Joseph C, Cohen M, Romeo AA. Is Tommy John surgery performed more frequently in major league baseball pitchers from warm weather areas? Orthop J Sport Med. 2014;2(10):1–6.
7. Zaremski JL, Horodyski M, Donlan RM, Brisbane ST, Farmer KW. Does geographic location matter on the prevalence of ulnar collateral ligament reconstruction in collegiate baseball pitchers? Orthop J Sports Med. 2015;3(11):2325967115616582. https://doi.org/10.1177/2325967115616582. PMID: 26740953; PMCID: PMC4687835.

8. Kenter K, Behr CT, Warren RF, O'Brien SJ, Barnes R. Acute elbow injuries in the National Football League. J Shoulder Elb Surg / Am Shoulder Elb Surg [et al]. 2000;9(1):1–5.
9. Frey A, Lambert C, Vesselle B, Rousseau R, Dor F, Marquet LA, Toussaint JF, Crema MD. Epidemiology of judo-related injuries in 21 seasons of competitions in France: A prospective study of relevant traumatic injuries. Orthop J Sports Med. 2019;7(5):2325967119847470. https://doi.org/10.1177/2325967119847470. PMID: 31211149; PMCID: PMC6545656.
10. Scoggin JF 3rd, Brusovanik G, Izuka BH, Zandee van Rilland E, Geling O, Tokumura S. Assessment of injuries during Brazilian Jiu-Jitsu Competition. Orthop J Sports Med. 2014;2(2):2325967114522184. https://doi.org/10.1177/2325967114522184. PMID: 26535299; PMCID: PMC4555620.
11. Li NY, Goodman AD, Lemme NJ, Owens BD. Epidemiology of elbow ulnar collateral ligament injuries in throwing versus contact athletes of the National Collegiate Athletic Association: Analysis of the 2009–2010 to 2013–2014 Seasons. Orthop J Sports Med. 2019;7(4):2325967119836428. https://doi.org/10.1177/2325967119836428. PMID: 31008136; PMCID: PMC6457031.
12. Erickson BJ, Fu M, Meyers K, Camp CL, Altchek DW, Coleman SH, Dines JS. The middle and distal aspects of the ulnar footprint of the medial ulnar collateral ligament of the elbow do not provide significant resistance to Valgus Stress: A Biomechanical Study. Orthop J Sports Med. 2019;7(2):2325967118825294. https://doi.org/10.1177/2325967118825294. PMID: 30800692; PMCID: PMC6378449.
13. Koh TJ, Grabiner MD, Weiker GG. Technique and ground reaction forces in the back handspring. Am J Sports Med. 1992;20(1):61–6.
14. Rettig AC, Sherrill C, Snead DS, Mendler JC, Mieling P. Nonoperative treatment of ulnar collateral ligament injuries in throwing athletes. Am J Sports Med. 2001;29(1):15–7.
15. Frangiamore SJ, Lynch TS, Vaughn MD, Soloff L, Forney M, Styron JF, Schickendantz MS. Magnetic resonance imaging predictors of failure in the nonoperative management of ulnar collateral ligament injuries in professional baseball pitchers. Am J Sports Med. 2017;45(8):1783–9. https://doi.org/10.1177/0363546517699832. Epub 2017 Apr 11. PMID: 28398820.
16. Nicolette GW, Gravlee JR. Ulnar collateral ligament injuries of the elbow in female division I collegiate gymnasts: a report of five cases. Open Access J Sport Med. 2018;9:83–9.
17. McCrum CL, Costello J, Onishi K, Stewart C, Vyas D. Return to play after PRP and Rehabilitation of 3 elite ice hockey players with ulnar collateral ligament injuries of the elbow. Orthop J Sports Med. 2018;6(8):2325967118790760. https://doi.org/10.1177/2325967118790760. PMID: 30148179; PMCID: PMC6100131.
18. Deal JB, Smith E, Heard W, O'Brien MJ, Savoie FH 3rd. Platelet-Rich plasma for primary treatment of partial ulnar collateral ligament tears: MRI correlation with results. Orthop J Sports Med. 2017;5(11):2325967117738238. https://doi.org/10.1177/2325967117738238. PMID: 29164165; PMCID: PMC5686880.
19. Podesta L, Crow SA, Volkmer D, Bert T, Yocum LA. Treatment of partial ulnar collateral ligament tears in the elbow with platelet-rich plasma. Am J Sports Med. 2013;41(7):1689–94.
20. Dines JS, Williams PN, ElAttrache N, Conte S, Tomczyk T, Osbahr DC, et al. Platelet-rich plasma can be used to successfully treat elbow ulnar collateral ligament insufficiency in high-level throwers. Am J Orthop (Belle Mead NJ). 2016;45(5):296–300.
21. Fuller JB, Dunn JC, Kusnezov NA, Nesti LJ, Kilcoyne KG. Outcome measures after medial ulnar collateral ligament reconstructions in a military population. J Shoulder Elb Surg. 2019;28(2):317–23.
22. Jones KJ, Dines JS, Rebolledo BJ, Weeks KD, Williams RJ, Dines DM, Altchek DW. Operative management of ulnar collateral ligament insufficiency in adolescent athletes. Am J Sports Med. 2014;42(1):117–21. https://doi.org/10.1177/0363546513507695. Epub 2013 Oct 21. PMID: 24145949.
23. Jones KJ, Dines JS, Rebolledo BJ, Weeks KD, Williams RJ, Dines DM, Altchek DW. Operative management of ulnar collateral ligament insufficiency in adolescent athletes. Am J Sports Med. 2014;42(1):117-21. https://doi.org/10.1177/0363546513507695. Epub 2013 Oct 21. PMID: 24145949.
24. Azar FM, Andrews JR, Wilk KE, Groh D. Operative treatment of ulnar collateral ligament injuries of the elbow in athletes. Am J Sports Med. 2000;28(1):16–23.
25. 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 Jt Surg Ser A. 1992;74(1):67–83.
26. Gilliam BD, Douglas L, Fleisig GS, Aune KT, Mason KA, Dugas JR, et al. Return to play and outcomes in baseball players after superior labral anterior-posterior repairs. Am J Sports Med. 2018;46(1):109–15.
27. Jones CM, Beason DP, Dugas JR. Ulnar collateral ligament reconstruction versus repair with internal bracing: Comparison of cyclic fatigue mechanics. Orthop J Sports Med. 2018;6(2):2325967118755991. https://doi.org/10.1177/2325967118755991. PMID: 29479544; PMCID: PMC5818096.
28. Savoie FH, Trenhaile SW, Roberts J, Field LD, Ramsey JR. Primary repair of ulnar collateral ligament injuries of the elbow in young athletes: a case series of injuries to the proximal and distal ends of the ligament. Am J Sports Med. 2008;36(6):1066–72.
29. Richard MJ, Aldridge JM, Wiesler ER, Ruch DS. Traumatic valgus instability of the elbow: Pathoanatomy and results of direct repair. J Bone Jt Surg Ser A. 2008;90(11):2416–22.