



Paper 64

Athletic Hip Injuries in Major League Baseball Pitchers Associated with UCL Pathology

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Objectives: Ulnar collateral ligament (UCL) reconstruction is a reliable treatment for elite overhand throwers with UCL pathology. In recent years, this operation has become increasingly common among Major League Baseball (MLB) pitchers. Predisposing factors and associated comorbidities, however, have not been well elucidated in the literature. The purpose of this investigation is to determine if professional baseball pitchers who underwent UCL reconstruction had an increased incidence of hip or groin injuries 4 years prior to or following their surgery. We hypothesized that MLB pitchers who sustained hip or groin injuries may have been more likely to develop UCL pathology due to kinetic chain alterations and overcompensation at the distal upper extremity during overhand throwing.

Methods: This case controlled study utilized a comprehensive list of all 247 MLB players who underwent UCL reconstruction between 2005 and 2017, through aggregation of online publicly accessible data. Application of inclusion criteria yielded a final sample size of 145. These athletes' injury histories were identified using systematic online searches and cross referenced with the official MLB disabled list. Age, playing time, and ERA-matched controls were generated for comparison of results.

Results: Of the 145 MLB pitchers who underwent UCL reconstruction between 2005 and 2017, 40 (27.6%) endured a proximal lower extremity injury within 4 years of their surgery. Specifically, 16 pitchers sustained hip injuries, 13 suffered hamstring injuries, and 14 experienced groin injuries. A significantly lower rate of hip and groin related injuries, 18%, was identified in matched controls during a similar timeframe ($p = 0.049$). This represents an odds ratio of 1.74, indicating that players who underwent a UCL reconstruction were 74% more likely to have sustained a hip, groin or hamstring injury within an eight-year timeframe compared to matched controls. Hip injuries, specifically, were independently associated with UCL reconstruction compared to matched controls ($p = 0.027$).

Conclusion: The results of this study demonstrate that MLB pitchers who required UCL reconstruction sustained a higher frequency of hip injuries both before and after surgery compared to matched controls. This association is significant as treatment of antecedent hip pathology, as well as emphasis on hip and core muscle mobility and strengthening, may help reduce the UCL injury burden in MLB pitchers.



Paper 65

Incidence Of Elbow Ulnar Collateral Ligament Surgery In Collegiate Baseball Players

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Objectives: Recent studies in the literature have highlighted the progressive increase in the incidence of ulnar collateral ligament (UCL) injuries to the elbow in baseball players of all levels. However, knowledge of the incidence and other epidemiological factors regarding UCL injuries, specifically in college baseball players, is currently lacking. In 2016, we launched a prospective, multi-year study to evaluate the incidence of UCL injuries requiring surgery in National Collegiate Athletic Association (NCAA) Division I baseball programs.

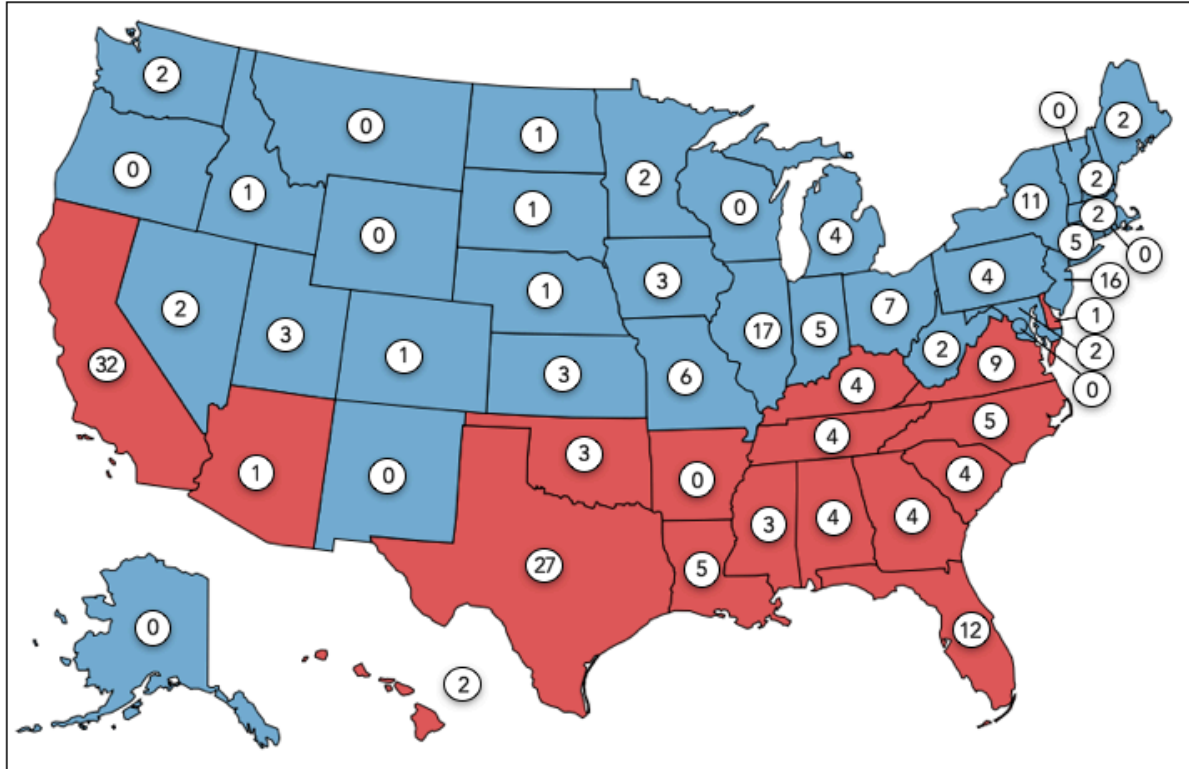
Methods: We invited 157 Division I collegiate baseball programs after the 2017 season, and 155 agreed to participate in the study. After the 2018 season, all 297 programs were invited and 294 participated. At the conclusion of the 2017 and 2018 collegiate baseball seasons, the athletic trainer for each program entered anonymous, detailed information on injured players through an electronic survey into a secured database.

Results: We obtained a 100% completion rate in the first two years of this ongoing study (155/155 respondents in the first year, 294/294 in the second year). Of the 5,364 collegiate baseball players tracked in Year 1 (2016-2017), 134 underwent surgery for an injured UCL, resulting in a team surgery rate of 0.86 per program. In Year 2 (2017-2018), there were 230 surgeries reported from 10,019 players tracked, resulting in a team surgery rate of 0.78 per program. A majority of schools experienced at least one surgery during both years (56.8% in Year 1, 50.7% in Year 2). Pitchers experience a vast majority of the surgical injuries (85.8% in Year 1, 84.3% in Year 2). Underclassmen made up 65.7% of surgeries in Year 1, which fell slightly to 56.1% in Year 2. Nearly half of the surgeries occurred during an ongoing baseball season in Year 1 (48.5%), but this fell in Year 2 to 41.3%. In both years, a non-significant majority of players were from warm-weather states (65.4% in Year 1, 52.9% in Year 2). Revision surgical rates remained nearly constant with 3.0% revision surgeries in Year 1 compared with 2.6% revisions in Year 2. Interestingly, the percentage of UCL repairs with internal brace augmentation rose from 9.5% in Year 1 to 19.9% of all procedures in Year 2.

Conclusion: The incidence of UCL surgeries in NCAA Division I collegiate baseball players represents substantial morbidity to this young athletic population. This multi-year prospective study has been established to assess the incidence of surgical UCL injuries in collegiate baseball. Also, importantly, with multiple years of data we will identify trends in the demographics of players undergoing surgery and in



surgical details over time. Awareness of these factors should be considered in injury prevention programs in the future.





Paper 66

Outcomes of Non-Operatively Treated Elbow Ulnar Collateral Ligament Injuries in Professional Baseball Players by Magnetic Resonance Imaging Tear Grade and Location

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Objectives: Evaluate the relationship of 1) MRI tear grade and 2) injury location with outcomes for non-operatively treated elbow ulnar collateral ligament (UCL) injuries in professional baseball players.

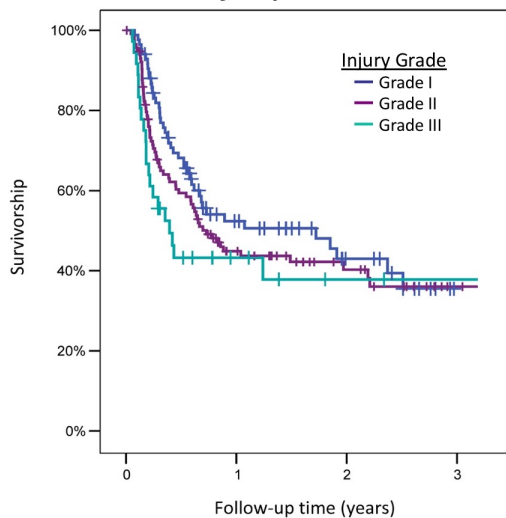
Methods: 544 professional baseball players were identified from the MLB Health and Injury Tracking System (HITS) that were treated non-operatively for their UCL injuries from 2011-2015. Of these players, 237 MRI's were directly available for review by an independent, expert musculoskeletal radiologist who evaluated the grade (Grade I -edema, II-partial tear, III-complete tear) and location of the tears (humeral, ulnar, both-sided). Player demographics and outcomes including return to throwing (RTT), return to play (RTP), failed non-operative treatment leading to UCL reconstruction (UCLR), and Kaplan-Meier survivorship analysis of the native UCL to re-injury or surgery based on MRI grade and tear location was measured. A multivariate analysis adjusting for age, MRI grade, tear location, and level of play (Major = MLB; Minor = MiLB) was also performed.

Results: The average age of all players was 22.5 years, 90% played at the MiLB level, and 84% were pitchers. The radiologist's MRI injury grade was distributed as follows: Grade I (36%), Grade II (49%), and Grade III (15%) injuries. The tear locations were distributed as follows: humeral (65%), ulnar (13%), and both-sided (22%). There were no statistically significant differences in RTT, RTP, and UCLR by grade or tear location. However, objectively, ulnar-sided tears had the lowest RTT (81%) and RTP (42%). The ulnar (58%) and both-sided (60%) tears also had an objectively higher rate of UCLR compared to humeral sided tears (51%, $p=0.441$). The survivorship analysis showed a consistent decline over time with increasing MRI grade. By location, humeral tears had the highest survivorship (1 yr = 51%; 2 yr = 44%). However, there was no statistically significant differences in survivorship for either grade or location. Multivariate analysis measured the likelihood of not returning to play as 3 times higher [95% CI: 1-9.3; $p=0.044$] for older players (>25) compared to younger players. The likelihood of having re-injury or UCLR after non-operative treatment failed was almost 6 times higher [95% CI: 1.5-21.7; $p=0.012$] for MLB players as opposed to MiLB players. MRI grade and tear location were not significantly predictive of returning to play, re-injury, or surgery.

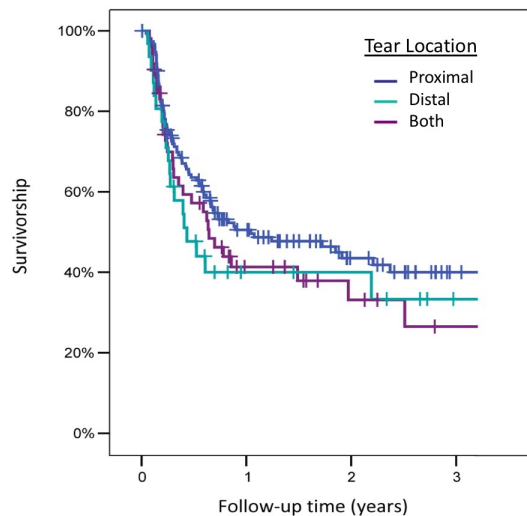


Conclusion: This is the largest study to evaluate the prognostic relationship of MRI injury grade and tear location with outcomes for non-operatively treated elbow UCL tears in professional baseball players. Lower MRI grade and humeral location were objectively associated with a higher RTT, higher RTP, lower UCLR, and higher survival compared to higher grade, and ulnar or both-sided tears. Older age (>25) had a significantly higher likelihood of not returning to play after non-operative treatment. Competing at the MLB level had a higher likelihood of re-injury or having UCLR. Based on this study, non-operative treatment of UCL injuries will likely be more successful in younger players, lower grade tears, and humeral-sided injuries.

Injury Grade



Tear Location





Player Outcomes by Grade and Location

Variable	RTT (% , N)	p-value	MLB (% , N)	MiLB (% , N)	p-value
MRI Grade					
Grade 1	92%, 78/85	0.216	100%, 5/5	91%, 73/80	0.215
Grade 2	87%, 101/116		93%, 14/15	85%, 87/101	
Grade 3	81%, 29/36		67%, 2/3	82%, 27/33	
Anatomic Location					
Humeral	90%, 137/153	0.375	94%, 17/18	89%, 120/135	0.406
Ulnar	81%, 25/31		80%, 4/5	88%, 42/48	
Both	87%, 46/53		-	81%, 25/31	

Variable	RTP (% , N)	p-value	MLB (% , N)	MiLB (% , N)	p-value
MRI Grade					
Grade 1	60%, 51/85	0.279	40%, 2/5	61%, 49/80	0.336
Grade 2	53%, 62/116		47%, 7/15	54%, 55/101	
Grade 3	44%, 16/36		33%, 1/3	45%, 15/33	
Anatomic Location					
Humeral	60%, 91/153	0.098	39%, 7/18	62%, 84/135	0.777
Ulnar	42%, 13/31		-	42%, 13/31	
Both	47%, 25/53		60%, 3/5	46%, 22/48	

RTT = Return to Throwing
RTP = Return to Play
UCLR = Ulnar Collateral Ligament
Reconstruction
MLB = major league
MiLB = minor league
p-value < 0.05 is statistically significant

Variable	UCLR (% , N)	p-value	MLB (% , N)	MiLB (% , N)	p-value
MRI Grade					
Grade 1	48%, 41/85	0.270	80%, 4/5	46%, 37/80	0.558
Grade 2	55%, 64/116		73%, 11/15	52%, 53/101	
Grade 3	64%, 23/36		100%, 3/3	57%, 20/33	
Anatomic Location					
Humeral	51%, 78/153	0.441	78%, 14/18	47%, 64/135	0.391
Ulnar	58%, 18/31		-	58%, 18/31	
Both	60%, 32/53		100%, 5/5	56%, 27/48	



Paper 67

Major League Baseball Pitching Performance after Tommy John Surgery and the effect of Tear Characteristics, Technique, and Graft Type

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Objectives: Return to play and player satisfaction has been quite high after ulnar collateral ligament reconstruction (UCLR), however, there has been little reported on how outcomes are affected by surgical technique, graft type and tear characteristics. The purpose was to evaluate surgical techniques, graft type and tear characteristics on MLB performance after UCLR.

Methods: MLB pitchers that underwent primary UCLR at a single institution were included. Tear characteristics included tear location, tear grade and acuity. Surgical technique and graft type was also collected. Pitching performance statistics, including earned run average (ERA), Walks hits per innings pitched (WHIP), innings pitched, and fastball velocity were evaluated 3 years pre- and post-UCLR.

Results: 46 MLB pitchers were identified having primary UCLR. Return to play was 96%, with 82% returning to MLB play. Technique performed showed no difference in performance. Pitchers with palmaris grafts were younger ($p=0.043$), played longer after surgery ($p=0.007$), and returned to play at 100% (35/35) vs. 82% (9/11) of gracilis grafts ($p=0.011$). Pitchers with distal tears pitched at higher velocity (93.0 vs. 90.6 mph) ($p=0.023$) and had better performance (ERA, $p=0.003$; WHIP, $p=0.003$) prior to surgery, with proximal tears improving to match this performance and velocity after reconstruction higher. Pitchers with complete tears played longer after surgery (5.9 vs. 4.0 years) ($p=0.033$), had better ERA ($p=0.041$) prior to injury and better WHIP ($p=0.037$) and strikeouts/9 innings ($p=0.025$) after reconstruction vs. partial tears. Chronic tears had a significant improvement in ERA from 4.49 to 3.80 ($p=0.040$) postoperatively.

Conclusion: Technique performed and graft type used did not affect performance, however, palmaris grafts returned at a higher rate than gracilis grafts. Distal tears occurred in pitchers with greater velocity and better performance prior to injury with proximal tears matching this performance after reconstruction. Pitchers with complete tears played longer after reconstruction. Pitchers who had partial tears had worse performance prior to injury and after reconstruction and chronic tears saw a significant improvement in ERA with reconstruction.



Paper 68

Clinical Utility Of An MRI Based Classification For Operative Versus Non-operative Management Of UCL Tears: Two-year Follow Up

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Objectives: A recently introduced classification of medial ulnar collateral ligament (UCL) tears accounting for location and severity has demonstrated high interobserver and intraobserver reliability, but little is known about its clinical utility. The purpose of this study was to assess the relationship of the MRI-based classification system in predicting which athletes succeeded non-operative versus operative treatment after completing a standardized rehabilitative program. Secondary objectives included sub-analysis of baseball players, including return-to-play (RTP) and return-to-prior performance (RPP).

Methods: After *a priori* power analysis, 58 consecutive patients with UCL tears and a minimum of two-year follow-up were retrospectively classified into those succeeding operative versus non-operative treatments. The MRI-based classification system accounting for UCL tear location and severity were correlated with non-operative and operative cohorts. Sub-analyses for baseball players, including RTP and RPP, were performed.

Results: A total of 58 patients (40 baseball players, 34 pitchers) met inclusion criteria. A total of 35 patients (32 baseball players, 27 pitchers) underwent surgery, and 23 patients (8 baseball players, 7 pitchers) completed non-operative management. No patients in the non-operative arm crossed over to surgery after completing the rehabilitative program. Patients with distal (OR: 48.0, p=0.0004) and complete (OR: 5.4, p=0.004) tears were more likely to undergo surgery. Baseball players, regardless of position, were confounding determinants of operative management, although there was no difference in RTP and RPP between treatment arms.

Conclusion: A six-stage MRI-based classification addressing UCL tear grade and location may confer early decision-making as patients likely to fail non-operative treatment have complete, distal tears whereas those with proximal, partial tears may be more amenable to non-operative modalities.

Summary of eligible baseball players with UCL tears stratified by MRI-based classification

	Non-operative	Operative	Total
1A (Partial Proximal)	6	0	6
1B (Complete Proximal)	0	4	4
2A (Partial Midsubstance)	0	1	1



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2B (Complete Midsubstance)	2	5	7
3A (Partial Distal)	0	9	9
3B (Complete Distal)	0	13	13