



# Players' perspectives on successfully returning to professional baseball after medial ulnar collateral ligament reconstruction

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**Background:** As the incidence of ulnar collateral ligament reconstruction (UCLR) surgery continues to rise, an improved understanding of baseball pitchers' perspectives on the postoperative recovery process and return to pitching is needed. The purpose of this study was to analyze pitchers' perspectives on recovery after UCLR.

**Methods:** <sup>a</sup>During the 2018 baseball season, an online questionnaire was distributed to the certified athletic trainers of all 30 Major League Baseball (MLB) organizations. These athletic trainers then administered the survey to all players within their organization including MLB and 6 levels of Minor League Baseball. MLB or Minor League Baseball pitchers who had previously undergone UCLR and participated in a rehabilitation program (or were currently participating in one at time of the survey) were included in the study.

**Results:** There were 530 professional pitchers who met inclusion criteria. The majority (81%) of pitchers began rehabilitation within 2 weeks of surgery, with 51% beginning within 1 week. The majority of pitchers began a long-toss throwing program at 5 and 6 months after surgery (27% and 21%), with 52% making their first throw off a mound between 7 and 9 months. The number of pitchers who participated in a weighted ball throwing program decreased significantly after surgery (20%-11%,  $P < .001$ ). After UCLR, 56% of pitchers reported no changes regarding pitching mechanics or types of pitches thrown, 42% reported changed mechanics, and only 3% either decreased or stopped throwing a certain pitch type. Overall, 54% believed that their current throwing velocity was faster than their velocity before ulnar collateral ligament injury. Twenty percent of pitchers reported experiencing a setback that resulted in temporary stoppage of their rehabilitation program, the most common reason being flexor tightness or tendonitis (53%). Seventy-six percent reported that they were not concerned about sustaining another elbow injury; however, significantly less (61%;  $P < .001$ ) stated that they would have UCLR again if necessary.

**Conclusions:** Although UCLR is generally reported to have excellent clinical outcomes, 20% of pitchers experienced a significant setback during their rehabilitation and only 61% of pitchers, having gone through UCLR and the subsequent recovery, would be willing to undergo revision surgery and repeat the rehabilitation process if it were to become necessary. In addition, 42% of pitchers felt that they had to alter their throwing mechanics to return to pitching. Surgeons and athletic trainers should aim to understand the UCLR recovery process from the pitchers' perspective to better counsel future patients recovering from UCLR.

**Level of evidence:** Survey Study; Patients

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Ulnar collateral ligament (UCL) injuries are increasingly common in professional baseball players, and the prevalence of UCL reconstruction (UCLR) surgery continues to increase over time.<sup>4,5,7</sup> For players requiring UCLR, the postoperative rehabilitation is a long and demanding process, with multiple phases and milestones that could result in potential setbacks.<sup>2</sup> This is particularly true for pitchers who require longer recoveries than positional players.<sup>5</sup> The average recovery time (from surgery to playing at the Major League Baseball [MLB] level) after UCLR for MLB pitchers has been reported to be 17.1 months,<sup>7</sup> whereas the rate of return to the same level of pitching after UCLR has been reported at just 72.8%.<sup>4</sup>

Given the significant burden of UCL injuries, many studies have been conducted to better understand a myriad of factors relevant to UCLR such as injury prevalence and risk factors, UCLR surgical technique optimization, postoperative recovery protocols, and return to play rates.<sup>1,4-9,12</sup> However, nearly all of these studies have evaluated these factors through the lens of the health care team, and relatively few studies have addressed these questions from the patients' perspectives.<sup>11</sup>

Players going through UCLR surgery and the subsequent recovery have a fundamentally different relationship to the recovery process than their health care providers. These players may have to make changes to their recovery and eventual athletic performance that their physicians and athletic trainers are unaware of. It is critical for health care providers to understand what pitchers experience to return to play after UCLR in order to guide them and to set appropriate expectations for future patients. These unique patient insights would also be an important addition to the body of knowledge regarding UCL injuries, particularly for furthering our understanding the UCLR recovery process. No study to date has evaluated players' perspectives on the postoperative recovery process and return to play after UCLR.

Therefore, the following study was established to evaluate professional baseball pitchers' perspectives on rehabilitation and return to play process after UCLR. The primary aims of this study were to describe pitchers' perspectives on: (1) the postoperative rehabilitation process after UCLR, (2) the changes that were required for pitchers to successfully return to play, and (3) the setbacks during and athletic outcomes after the UCLR recovery process. We hypothesized that the perspectives of professional baseball pitchers on the UCLR recovery process would differ from those reported by health care providers.

## Materials and methods

This study was conducted by the administration of an online questionnaire during the 2018 professional baseball season (Supplementary Appendix S1). The survey was distributed to the head athletic trainers for each of the 30 MLB organizations. The

athletic trainers administered the survey in July of 2018 to all players within their organization at the following levels: MLB, AAA, AA, High A, High Rookie, Low Rookie, and the Dominican Summer League. All responses were collected by October 2018. The questionnaire was made available in English and Spanish, which allowed players to complete the survey in the language of their choice. The questionnaire consisted of a minimum of 8 and maximum of 108 questions, depending on the player's response. The survey contained response logic so that players with no history of UCLR were only required to complete the minimum number of questions, whereas those with a history of UCLR provided more information regarding their procedure and the rehabilitation process. To improve the accuracy of the collected data, players were allowed to skip questions if they could not confidently remember the answer.

The questionnaire gathered information regarding player demographics (such as age, position, level of play, and country of origin) and history of UCL surgery. Players with a history of UCL surgery were asked for surgical information and rehabilitation details, including rehabilitation timeline, participation in a long-toss or weighted ball program, time to first mound, setbacks, and changes in pitching mechanics. Inclusion criteria consisted of the following: (1) active MLB or Minor League Baseball (MiLB; inclusive of AAA, AA, High A, High Rookie, and Low Rookie leagues) pitchers, (2) history of prior UCLR, and (3) participation in (or were participating in at the time of survey) rehabilitation programs were included in the study. Pitchers who did not undergo UCLR underwent multiple UCL surgeries or did not participate in a rehabilitation program were excluded. Because only active players were surveyed, those with a history of prior UCL who did not make it back to an active professional baseball roster would not have been surveyed.

The collected data were stored in Microsoft Excel (2010; Microsoft Corp., Redmond, WA, USA) and analyzed with JMP Pro (v14.1.0; SAS Institute, Cary, NC, USA). Data were reported both collectively and separately for MLB and MiLB pitchers. Categorical variables were compared using  $\chi^2$  analysis or Fisher's exact tests after testing for assumption validity and evaluating for normality. For all analyses, a *P* value of <.05 was considered statistically significant.

## Results

Of the 9345 baseball players eligible to complete the survey, there were 6135 responses, and of these responses, 657 players indicated that they had undergone some form of UCL surgery in the past. In this UCL surgery group, there were 79 position players and 578 pitchers. Forty-eight pitcher responses were excluded because of undergoing UCL repair (7), more than 1 UCL surgery (25), or incomplete responses (16).

Ultimately, there were 530 professional baseball pitchers (MLB and MiLB) who met inclusion criteria. The mean current age was 24.7 years (95% confidence interval [CI], 24.4-25.0) with a mean of 4.7 years (95% CI, 4.4-5.1) of professional baseball experience. The mean age at the time of surgery was 20.8 years (95% CI, 20.6-21.2). The mean time from UCLR to survey completion was 3.3 years

(standard deviation, 3.0), and 56 pitchers (11%) were currently in their UCLR rehabilitation protocol during the survey. There were 102 (19%) MLB pitchers and 428 (81%) MiLB pitchers, and MiLB consisted of 88 AAA, 66 AA, 150 A, and 124 Rookie league pitchers. There were 270 (51%) relief and 260 (49%) starting pitchers.

The majority (81%) of pitchers began formal rehabilitation within 2 weeks of surgery, with 51% ( $n = 269$ ) of all pitchers beginning during the first week of recovery (Table I). Roughly one-third (31%) of pitchers began an interval throwing program 4 months after surgery, with the majority of others beginning at 5 and 6 months (27% and 21%, respectively). During interval throwing programs, the most common maximum long-toss distance (55% of pitchers) was between 120 and 150 feet, with 25% throwing a maximum distance of 175-200 feet and only 18% throwing 250 feet or farther. Among pitchers who had completed rehabilitation and were able to recollect their timeline of returning to the pitching mound ( $n = 437$ ), 52% ( $n = 225$ ) made their first throw off a mound between 7 and 9 months after surgery. Thirty-three percent ( $n = 150$ ) made their first throw off a mound between 10 and 12 months, whereas only 7% ( $n = 31$ ) did so at 6 months or earlier.

Before UCL injury and subsequent reconstruction, 20% (95% CI, 16.9-23.7) of pitchers participated in a weighted ball throwing program (Table II). Of note, significantly more MiLB pitchers who had undergone UCLR had participated in a weighted ball program compared with MLB pitchers (23% vs. 10%,  $P = .004$ ). After surgery, the number of pitchers who participated in a weighted ball program dropped significantly to 11% (95% CI, 9.0-14.5;  $P < .001$ ). Only 18 of the 105 (17%) pitchers who used weighted balls before UCLR continued to use them after surgery. In those who participated in weighted ball throwing programs, the weight of the lightest and heaviest balls thrown varied widely. Significantly more pitchers used a 0.113 kg (4 oz) ball as their lightest ball ( $P = .017$ ) during rehabilitation, but there were no significant differences among the weights of the heaviest ball thrown.

After UCLR, 56% ( $n = 296$ ) of pitchers believed that they made no changes regarding pitching mechanics or types of pitches thrown (Table III). Forty percent ( $n = 213$ ) reported changes in their pitching mechanics, whereas only 3% ( $n = 18$ ) either decreased or stopped throwing a certain pitch type. Overall, 54% ( $n = 226$ ) of pitchers believed that their current throwing velocity to be faster than their velocity before UCL injury (Table IV). MiLB pitchers were much more likely than MLB pitchers to report an increase in pitch velocity (58% vs. 39%;  $P = .002$ ), whereas MLB pitchers were more likely than MiLB pitchers to report no velocity change (44% vs. 31%;  $P = .022$ ).

During rehabilitation, 20% ( $n = 107$ ) of pitchers reported experiencing a setback that resulted in a temporary stoppage of their program (Table V). The most common etiologies of these setbacks included flexor tightness or

**Table I** Time from surgery to rehabilitation, an interval throwing program, and first throw off a mound

Time from surgery to begin rehabilitation	
Within 1 week	51 (269)
Within 2 weeks	30 (158)
Within 3 weeks	9 (50)
More than 3 weeks	8 (42)
Don't know or haven't started	2 (11)
Time from surgery to begin an interval throwing program	
4 mo	31 (161)
5 mo	27 (141)
6 mo	21 (111)
More than 6 mo	7 (35)
Don't know or still in rehab	11 (55)
Max long-toss distance during an interval throwing program	
120-150 feet	55 (250)
175-200 feet	26 (116)
≥250 feet	18 (80)
Time from surgery to the first throw off a mound	
4-6 mo	6 (31)
7-9 mo	43 (225)
10-12 mo	29 (150)
Don't know or still in rehab	18 (93)

Values are presented as % (n).

tendonitis (53%), UCL inflammation or sprain (13%), and ulnar nerve issues (11%).

Twelve percent ( $n = 64$ ) of pitchers reported having another surgery on their throwing elbow after UCLR, whereas 5% ( $n = 26$ ) reported subsequent surgery on their throwing shoulder. Seventy-six percent ( $n = 398$ ) of pitchers reported that they were not concerned about sustaining another elbow injury; however, significantly less (61%;  $P < .001$ ) stated that they would have UCLR again if necessary. Eighteen percent (93) reported that they would not have UCLR again and 21% ( $n = 110$ ) stated that they were unsure. There was no difference in these rates between starters and relievers ( $P = .352$ ) or when pitchers were compared according to age ( $P = .832$ ) or time removed from UCLR ( $P = .302$ ).

## Discussion

UCLR is an increasingly common surgery performed on professional baseball pitchers with UCL injuries. Although much is known about UCLR and its postoperative rehabilitation from the surgeon and athletic trainers' perspectives, no study has previously evaluated the postoperative recovery process from the pitcher's perspective. In the current study, we assessed the perspectives of professional baseball pitchers who had undergone UCLR and a

**Table II** Participation in a weighted ball program before UCLR and during rehabilitation

	Before UCLR	After UCLR	P value
Participation in a weighted ball program			
Response			
Yes	20 (105)	11 (59)	<.001
No	79 (418)	87 (455)	<.001
Lightest ball used			
Weight of ball			
0.028 kg (1 oz)	19 (20)	24 (14)	.45
0.057 kg (2 oz)	25 (26)	19 (11)	.38
0.085 kg (3 oz)	32 (33)	15 (9)	.018
0.113 kg (4 oz)	24 (25)	42 (25)	.017
Heaviest ball used			
Weight of ball			
0.17-0.226 kg (6-8 oz)	29 (30)	31 (18)	.80
0.255-0.312 kg (9-11 oz)	13 (14)	22 (13)	.16
0.45 kg (1 lb)	12 (12)	8 (5)	.46
0.91 kg (2 lb)	38 (39)	24 (14)	.09

UCLR, ulnar collateral ligament reconstruction. Values are presented as % (n).

**Table III** Player perception of changes to pitching mechanics or pitch type after ulnar collateral ligament (UCL) reconstruction

Pitching changes since UCL reconstruction	
Changed pitching mechanics (A)	40 (213)
Not throwing/decreased % of a pitch type (B)	1 (7)
Both mechanics (A) and pitch type (B)	2 (11)
No changes	56 (296)

Values are presented as % (n).

subsequent rehabilitation. We found that these pitchers experienced large variability in the rehabilitation schedule and techniques used, changes to their pitching techniques, and not infrequent setbacks to their recovery that required temporary discontinuation of the rehabilitation program.

When assessing pitchers' perspectives on the post-operative rehabilitation process after UCLR, there was variability in when certain milestones were met during the recovery process (Table I). Despite this variability, all respondents to this survey did successfully return to a professional baseball team or were currently in the rehabilitation process given the design of the study (only players on an active roster or currently rehabilitating were surveyed). This awareness of the variability in pitchers' recovery process and schedule after UCLR is helpful in guiding and counseling pitchers in the future through the recovery process. Pitchers should not be encouraged to

**Table IV** Player perception of current velocity vs. that before primary ulnar collateral ligament reconstruction

2018 MLB vs. MiLB			
Response	2018 MLB	2018 MiLB	P value
Slower	17 (15)	11 (37)	.13
Same	44 (39)	31 (103)	.022
Faster	39 (34)	58 (192)	.002

MLB, Major League Baseball; MiLB, Minor League Baseball. Values are presented as % (n).

**Table V** Etiologies of rehabilitation setbacks resulting in temporary stoppage of the rehabilitation program

Rehabilitation setback (stoppage)	
due to a medical problem	
Yes	20 (107)
No	66 (351)
Still in rehabilitation	14 (72)
Etiology of setback (stoppage)	
Flexor tightness or tendonitis	53 (57)
UCL inflammation or sprain	13 (14)
Posterior impingement	6 (6)
Ulnar nerve issues	11 (12)
Shoulder problems	5 (5)
Other	22 (24)

UCL, ulnar collateral ligament. Values are presented as % (n).

“rush” their recovery as successful return to pitching can be achieved via a wide variety of timetables and methodologies.

The decreasing use of weighted baseballs after UCLR by pitchers points to an important potential divergence in opinion between what pitchers and health care providers believe is the injury risk associated with certain recovery and training tools. A recent systematic review found that weighted ball pitching exercise programs have been found to increase pitch velocity in the majority of studies.<sup>3</sup> When assessing injury risk, the authors of this review found that inadequate evidence exists in the literature to determine whether weighted ball training puts pitchers at increased risk of UCL injury.<sup>3</sup> Interestingly, we found that the rate of weighted ball training program participation significantly decreased for pitchers after undergoing UCLR from 20% to 11% and that only 17% of pitchers who had used weighted ball programs before UCLR continued to use them afterward. This may indicate a belief on the behalf of pitchers (or their medical providers/coaches) that weighted ball training programs increase the risk of UCL injury, which is currently unclear based on published literature.

Prior studies have found that pitchers do not significantly change their pitching tendencies after UCLR. For instance,

Portney and et al<sup>10</sup> used publicly available pitch tracking data to compare the pitch-type selection, accuracy, and velocity for pitchers who had undergone UCLR before and after surgery. The authors found that there was no significant difference after UCLR in these 3 parameters.<sup>10</sup> Conversely, 44% of the pitchers in our study stated that they changed their pitching mechanics, their pitch-type frequency, or both after UCLR. It is unclear why this discrepancy exists between the scientific literature and pitchers' perspective on pitching changes after UCLR but, again, highlights the importance of evaluating the return to play process from the players' point of view to more completely understand UCLR recovery.

In our study, 20% of pitchers reported experiencing at least 1 setback during their recovery that required them to pause their rehabilitation. This is despite a strong financial and athletic incentive to return to play as quickly as possible. In greater than half of the cases of rehabilitation stoppage, this setback was due to flexor tendon tightness or tendonitis. This finding suggests that surgeons and training staff should consider focusing on the flexion-pronator musculature during rehabilitation and consider exercises and therapies that can mitigate strain on this at-risk muscle group.

Surprisingly, only 61% of these pitchers reported that they would undergo an additional UCLR and the rehabilitation process again if it were to become necessary for their careers. This may be due to the long recovery process after surgery. Perhaps this percentage would be greater in patients truly facing the prospect of not pitching again but, regardless, this finding demonstrates how significantly the surgery and recovery process impacts the lives of professional pitchers.

We are aware of just one other study in the literature that has assessed baseball players' perspectives on UCL injuries. Vance et al<sup>11</sup> used a survey to assess professional and amateur baseball players' perspectives on the risk and causes of UCL injuries and preventative measures. They too found that there were significant differences between players' beliefs and those reported in the literature, for example with regard to the injury risk of specific pitch types and the likelihood of UCL injury in pitchers.<sup>11</sup> Taken together, the findings of our study and those of Vance et al indicate that important and unique insights can be gained from analyzing players' perspectives on UCL injuries, UCLR surgery, and the postoperative recovery process. An appreciation for the player experience can help surgeons and health care staff better understand UCL injuries and provide better patient-informed recommendations for future patients recovering from UCLR surgery.

Although we believe that this study uniquely contributes to the UCL body of literature, several limitations do exist. This study's data were gathered from players answering a self-reporting questionnaire after the completion of their UCLR rehabilitation. This design may introduce a recall bias regarding postoperative recovery and return to play details. In addition, players who were actively participating in their

rehabilitation during the administration of this questionnaire may have had opinions regarding the recovery process that reflected their stage in the recovery rather than the totality of the recovery process, but this number of pitchers was too small to make meaningful conclusions from the data. Lastly, another limitation with this study is that we surveyed the opinions of only those players who were currently in professional baseball. Because of this survey design, the perspectives of players who were unable to return to professional baseball after UCLR would not have been included in this study's results. It is reasonable to hypothesize that players who were unable to return to professional play after UCLR may have different views on the rehabilitation process than their "successful" counterparts, and future studies should compare these players' perspectives with those in our study to further understand the patient-perceived barriers to an optimal UCLR recovery.

## Conclusion

Although UCLR is generally reported to have excellent clinical outcomes, 20% of pitchers experienced a significant setback during their rehabilitation and only 61% of pitchers, having gone through UCLR and the subsequent recovery, would be willing to undergo revision surgery and repeat the rehabilitation process if it were to become necessary. In addition, 42% of pitchers felt that they had to alter their throwing mechanics to return to pitching. Surgeons and athletic trainers should aim to understand the UCLR recovery process from the pitchers' perspective to better counsel future patients recovering from UCLR.

## Disclaimer

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## Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jse.2020.08.041>.

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