Psychological Impact and Posttraumatic Stress Disorder Symptomatology After Ulnar Collateral Ligament Injuries in Baseball Players

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Background: Significant psychological impact and prevalence of posttraumatic stress disorder (PTSD) have been well documented in patients sustaining anterior cruciate ligament injury.

Purpose: To examine PTSD symptomatology in baseball players after sustaining elbow ulnar collateral ligament (UCL) injury.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: Male baseball players of various competition levels (high school through Minor League Baseball [MiLB]) who underwent surgery for a UCL injury between April 2019 and June 2022 participated in the study. Before surgery, patients completed the Impact of Event Scale–Revised (IES-R) to assess PTSD symptomatology. Subgroup analysis was conducted according to level of play and player position.

Results: A total of 104 male baseball players with a mean age of 19.4 years (range, 15-29 years) were included in the study; 32 players (30.8%) were in high school, 65 (62.5%) were in college, and 7 (6.7%) were in MiLB. There were 64 (61.5%) pitchers, 18 (17.3%) position players, and 22 (21.2%) 2-way players (both pitching and playing on the field). A total of 30 (28.8%) patients scored high enough on the IES-R to support PTSD as a probable diagnosis, and another 22 patients (21.2%) scored high enough to support PTSD as a clinical concern. Nineteen patients (18.3%) had potentially severe PTSD. Only 4 players (3.8%) were completely asymptomatic. Subgroup analysis revealed college players as significantly more symptomatic than high school players (P = .02), and 2-way players were found to be significantly less susceptible to developing symptoms of PTSD compared with pitchers (P = .04).

Conclusion: Nearly 30% of baseball players who sustained a UCL injury qualified for a probable diagnosis of PTSD based on the IES-R. Pitchers and college athletes were at increased risk for PTSD after UCL injury compared with 2-way players and high school athletes, respectively.

Keywords: ulnar collateral ligament injury; medial ulnar collateral ligament injury; thrower's elbow; Tommy John surgery; posttraumatic stress disorder; rehabilitation

Ulnar collateral ligament (UCL) injuries have been studied extensively. Surgical outcomes, technical variations, cost analyses, rehabilitation protocols, and player metrics after surgery have all been investigated.[7,14,15,21,25,27] To date, however, the psychological impact of an athlete's UCL injury has not been well studied. More recently, the mental health of athletes who sustain injury has been gaining more attention.[22,23,31]

Significant psychological impact and prevalence of posttraumatic stress disorder (PTSD) have been documented in patients after anterior cruciate ligament (ACL) injury.[‡] In 1 study, 42% of patients were found to meet the criteria for

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[‡]References 1, 3, 5, 8, 16, 23, 24, 28, 30, 33.

major depressive disorder after ACL reconstruction.[33] Additionally, improved mental health and psychosocial factors lead to improved outcomes after ACL reconstruction.[32]

The recovery from UCL surgery can range from 6 months for repair to >18 months for reconstruction, with about 67% to 87% returning to the same level of play by 15 months.[9,10,26] Previous studies have indicated that athletes, particularly amateur athletes with professional aspirations, lose their self-identify while recovering from injury and possibly may exhibit some symptoms of PTSD.[6,22] However, the psychological impact of UCL injury has not been fully assessed, despite the significant and potentially career-altering ramifications for baseball players at all levels.

The purpose of this study was to examine the psychological impact, including potential PTSD symptoms, of elbow UCL injuries in baseball players. We used the Impact of Events Scale–Revised (IES-R), a validated tool that measures subjective distress caused by dramatic events according to Diagnostic and Statistical Manual of Mental Disorders (DSM)–4 criteria.[31]

METHODS

Study Design

The protocol for this study received institutional review board approval. We prospectively collected data from our single-center experience on 104 baseball players who injured their UCL and consecutively underwent surgery (UCL reconstruction or repair) by the senior attending surgeon (C.S.A.) between April 2019 and June 2022. Patients consented for the study in the senior author's office or on video visit, and surveys including the IES-R scale were administered by a qualified athletic trainer (F.J.A.) on an encrypted iPad (Apple Inc.; Version 10) on the date of surgery prior to the procedure. The exact date of injury was not recorded; however, typically our patients undergo surgery within 1 to 2 weeks of injury. Inclusion criteria included being a high school, collegiate, or professional baseball player who sustained a UCL injury and underwent surgery. Excluded were those who did not wish to participate in the study.

The IES-R scale consists of 22 items, in which participants are asked to score how distressing each item had been during the past 7 days on a scale of 0 to 4, where 0 indicates "not at all," 1 indicates "a little bit," 2 indicates "moderately," 3 indicates "quite a bit," and 4 indicates "extremely." The anchor for each question is the injury itself. The IES-R scale was developed to closely match DSM-4 diagnostic criteria for PTSD, and it has been shown to be a highly sensitive and specific measure for current and lifetime diagnosis of PTSD, with a cutoff point of 24.[31] A score between 24 and 32 indicates PTSD as a potential clinical concern warranting further diagnostic testing,[3] a score between 33 and 38 indicates PTSD as a likely diagnosis,[12] and a score of ≥39 indicates potentially severe PTSD.[17] All patients who voiced their desire to see a sport psychologist or other mental health expert were referred to a mental health specialist for formal workup and care.

Statistical Analysis

Categorical variables were reported as counts, and continuous variables were reported as mean with standard deviation. Subgroup analysis was conducted to see if there was a difference in IES-R scores between levels of play (high school, college, or Minor League Baseball [MiLB] player) or player position (pitcher, position player, or 2-way player [one who both regularly pitched and played on the field]). The Student t test was used to compare means of continuous data between each subgroup, and the Kruskal-Wallis test was used to evaluate differences in categorical variables between each subgroup. Statistical significance was defined as a P value <.05, and analysis was conducted using Microsoft Excel.

RESULTS

A total of 104 male baseball players with a mean age at surgery of 19.4 years (range, 15-29 years) were included in the study. Of the total, 32 patients (30.8%) were in high school, 65 patients (62.5%) were in college, and 7 patients (6.7%) were MiLB players. There were 64 (61.5%) pitchers, 18 (17.3%) position players, and 22 (21.2%) 2-way players. A total of 99 (95.2%) baseball players underwent a UCL reconstruction, while the remainder underwent a UCL repair.

The mean IES-R score in our cohort was 24.5 ± 15.4. Table 1 shows the mean IES-R scores by item. A total of 30 (28.8%) patients scored high enough to indicate PTSD as a probable diagnosis, and another 22 patients (21.2%) scored high enough to support PTSD as a clinical concern (ie, a score of 24-32). Nineteen patients (18.3%) had potentially severe PTSD (a score of ≥39). Only 4 players (3.8%) exhibited no symptoms of PTSD (a score of 0), while the

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Ethical approval for this study was obtained from Columbia University Medical Center (ref No. IRB-AAAS3704).

TABLE 1
Results of the IES-R in the Study Cohort (N = 104)[a]

IES-R Survey Item[b]	Mean ± SD
Intrusion symptoms	
1. Any reminder brought back feelings about it	1.3 ± 1.0
2. I had trouble staying asleep	0.8 ± 1.0
3. Other things kept making me think about it	1.5 ± 1.0
4. I thought about it when I didn't mean to	1.5 ± 1.1
5. Pictures about it popped into my mind	1.1 ± 1.2
6. I found myself acting or feeling like I was back at that time	0.8 ± 1.0
7. I had waves of strong feelings about it	1.6 ± 1.2
8. I had dreams about it	0.8 ± 1.2
Avoidance symptoms	
1. I avoided letting myself get upset when I thought about it or was reminded of it	1.7 ± 1.1
2. I felt as if it hadn't happened or wasn't real	1.3 ± 1.4
3. I stayed away from reminders of it	1.0 ± 1.0
4. I tried to remove it from my memory	0.9 ± 1.1
5. I tried not to talk about it	1.2 ± 1.3
6. I tried not to think about it	1.8 ± 1.2
7. I was aware that I still had a lot of feelings about it, but I didn't deal with them	1.2 ± 1.1
8. My feelings about it were kind of numb	1.3 ± 1.2
Hyperarousal symptoms	
1. I had trouble falling asleep	0.9 ± 1.1
2. I had trouble concentrating	1.0 ± 1.1
3. Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	0.5 ± 0.9
4. I felt irritable and angry	1.3 ± 1.1
5. I felt watchful and on-guard	0.7 ± 1.0
6. I was jumpy and easily startled	0.4 ± 0.7
Total IES-R score[c]	24.5 ± 15.4

[a]IES-R, Impact of Events Scale–Revised; PTSD, posttraumatic stress disorder.
[b]For each item, participants rated how distressing each item had been during the past 7 days on a scale of 0 to 4, where 0 indicated "not at all," 1 indicated "a little bit," 2 indicated "moderately," 3 indicated "quite a bit," and 4 indicated "extremely."
[c]A score between 24 and 32 indicated PTSD as a potential clinical concern warranting further diagnostic testing.

remaining patients scored below the PTSD cutoff point of 24. Overall, 96 patients (92.3%) experienced symptoms of intrusion, 98 patients (94.2%) experienced symptoms of avoidance, and 92 patients (88.5%) experienced symptoms of hyperarousal. The survey items with the highest mean scores were "I tried not to think about it" (mean score, 1.78 ± 1.23) and "I avoided letting myself get upset when I thought about it or was reminded of it" (mean score, 1.65 ± 1.11), both of which are suggestive of avoidance.

A subgroup analysis showed that college players were significantly more symptomatic than high school players ($P = .02$) but not MiLB players ($P = .10$). There was no difference between high school and MiLB players ($P = .59$) (Table 2). There was a significant difference in response scores to the items "I thought about it when I didn't mean to," "I found myself acting or feeling like I was back at that time," and "I had dreams about it" ($P = .002$, .04, and .04, respectively), all intrusive symptoms that were more commonly experienced by college players compared with high school or MiLB players. There was also a significant difference in responses to the items "I had trouble concentrating" and "Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart," with MiLB and college players experiencing these hyperarousal symptoms more than high school players ($P = .01$ and .05, respectively).

Four (12.5%) high school players scored high enough to indicate PTSD as a probable diagnosis, and another 8 high school players (25%) scored high enough to indicate PTSD as a clinical concern. Of college players, 23 (35.4%) scored high enough to indicate PTSD as a probable diagnosis, and another 13 college players (20%) scored high enough to indicate PTSD as a clinical concern.

A subgroup analysis also showed that 2-way players were significantly less susceptible to developing symptoms of PTSD than pitchers ($P = .04$) but not compared with position players ($P = .20$) (Table 3). There were no significant differences in specific item responses between the subgroups according to position played. Among pitchers, 21 (32.8%) scored high enough to indicate PTSD as a probable diagnosis, and another 13 pitchers (20.3%) scored high enough to indicate PTSD as a clinical concern. Four (22.2%) position players scored high enough to indicate PTSD as a probable diagnosis, and another 5 players (27.8%) scored high enough to indicate PTSD as a clinical concern. Three (13.6%) 2-way players scored high enough to indicate PTSD as a probable diagnosis, and another

TABLE 2
Subgroup Analysis to Determine Differences in PTSD Symptoms After UCL Injury According to Level of Play[a]

IES-R Survey Item	High School (n = 32)	College (n = 65)	MiLB (n = 7)	*P*
Intrusion symptoms				
1. Any reminder brought back feelings about it	1.3 ± 1.1	1.4 ± 1.0	0.5 ± 0.8	.10
2. I had trouble staying asleep	0.5 ± 0.8	0.9 ± 1.1	0.8 ± 1.2	.38
3. Other things kept making me think about it	1.2 ± 1.0	1.7 ± 1.0	1.3 ± 1.4	.16
4. I thought about it when I didn't mean to	1.1 ± 1.0	1.8 ± 1.1	0.5 ± 0.5	**.002**
5. Pictures about it popped into my mind	0.9 ± 1.1	1.3 ± 1.3	0.5 ± 0.8	.21
6. I found myself acting or feeling like I was back at that time	0.3 ± 0.8	1.0 ± 1.1	0.5 ± 0.8	**.04**
7. I had waves of strong feelings about it	1.3 ± 1.3	1.7 ± 1.1	0.8 ± 1.2	.11
8. I had dreams about it	0.4 ± 1.0	1.0 ± 1.3	0.7 ± 0.8	**.04**
Avoidance symptoms				
1. I avoided letting myself get upset when I thought about it or was reminded of it	1.4 ± 1.0	1.8 ± 1.1	1.0 ± 1.5	.08
2. I felt as if it hadn't happened or wasn't real	1.0 ± 1.2	1.4 ± 1.5	0.8 ± 1.6	.43
3. I stayed away from reminders of it	0.8 ± 0.9	1.1 ± 1.1	1.0 ± 0.9	.54
4. I tried to remove it from my memory	0.8 ± 1.1	0.9 ± 1.2	0.7 ± 0.8	.99
5. I tried not to talk about it	1.4 ± 1.4	1.2 ± 1.2	1.0 ± 1.5	.67
6. I tried not to think about it	1.5 ± 1.2	1.9 ± 1.2	0.8 ± 1.6	.35
7. I was aware that I still had a lot of feelings about it, but I didn't deal with them	0.9 ± 1.0	1.4 ± 1.2	1.0 ± 0.9	.05
8. My feelings about it were kind of numb	1.1 ± 1.3	1.4 ± 1.2	0.7 ± 0.8	.17
Hyperarousal symptoms				
1. I had trouble falling asleep	0.6 ± 0.9	1.0 ± 1.2	0.7 ± 0.5	.27
2. I had trouble concentrating	0.7 ± 1.1	1.2 ± 1.1	1.7 ± 1.0	**.01**
3. Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	0.2 ± 0.6	0.7 ± 1.0	0.7 ± 0.8	**.05**
4. I felt irritable and angry	1.5 ± 1.1	1.3 ± 1.1	0.8 ± 1.0	.42
5. I felt watchful and on-guard	0.5 ± 0.9	0.8 ± 1.0	0.3 ± 0.5	.27
6. I was jumpy and easily startled	0.3 ± 0.5	0.4 ± 0.7	0.5 ± 0.5	.50
Total IES-R score	19.7 ± 13.1	27.2 ± 15.8	16.3 ± 13.3	**.02**[b]

[a]Data are reported as mean ± SD. Boldface *P* values indicate statistically significant difference between levels of play ($P < .05$). IES-R, Impact of Events Scale–Revised; MiLB, Minor League Baseball; PTSD, posttraumatic stress disorder; UCL, ulnar collateral ligament.
[b]College players were found to be significantly more symptomatic than high school players ($P = .02$) but not MiLB players ($P = .10$). There was no difference between high school and MiLB players ($P = .59$).

four 2-way players (18.2%) scored high enough to indicate PTSD as a clinical concern.

DISCUSSION

The primary objective of this study was to investigate the prevalence and severity of PTSD symptomatology in baseball players after UCL injury for the first time. The study findings demonstrated that nearly 30% of players scored highly enough to warrant a probable PTSD diagnosis, and another 20% warranted further testing with more formal structured interviewing. A total of 96% of patients experienced at least one symptom of intrusion, avoidance, or hyperarousal. These findings highlight the importance of including mental health assessments when treating athletes recovering from a major injury.

Our secondary objective was to identify whether level of play or position affected rates of PTSD symptomatology. We found that college athletes were more likely to experience symptoms than high school athletes, but no difference was observed between college and MiLB players. College athletes may be at more risk of developing symptoms of PTSD after an injury, due to the potential impact on their draft status, while injured high school players may perceive less compromise to their overall playing future. Although underpowered, minor league players had the lowest IES-R scores, which may be a function of the additional security that comes with getting drafted and having more professional support available. Previous studies have shown that college athletes who sustain a career-ending injury have lower postcollegiate satisfaction compared with those who did not sustain career-ending sports injuries.[17] UCL injuries can thus cause substantial emotional distress for athletes, particularly in those who base their self-worth around their athletic performance.[6,21]

Pitchers were also more likely to experience PTSD symptoms than 2-way players ($P = .04$) but not compared with position players ($P = .58$). Although position players experienced more symptoms of PTSD than 2-way players, the results were not significantly different ($P = .20$). Nonetheless, these results are further support that diversifying athletic skill sets is a positive predictor for psychological recovery and return to play in baseball players, although larger studies are needed to confirm this dynamic.[11] In addition, an increasing emphasis has been placed on developing

TABLE 3
Subgroup Analysis to Determine Differences in PTSD Symptoms After UCL Injury According to Baseball Position[a]

IES-R Survey Item	Pitchers (n = 64)	Position Players (n = 18)	2-Way Players (n = 22)	*P*
Intrusion symptoms				
1. Any reminder brought back feelings about it	1.4 ± 1.0	1.2 ± 1.1	1.1 ± 0.9	.59
2. I had trouble staying asleep	0.8 ± 1.0	0.9 ± 1.1	0.6 ± 1.0	.50
3. Other things kept making me think about it	1.5 ± 1.0	1.6 ± 0.9	1.2 ± 1.1	.35
4. I thought about it when I didn't mean to	1.5 ± 1.1	1.4 ± 1.0	1.2 ± 0.9	.61
5. Pictures about it popped into my mind	1.1 ± 1.2	1.2 ± 1.2	0.9 ± 1.1	.70
6. I found myself acting or feeling like I was back at that time	0.8 ± 1.1	0.8 ± 1.1	0.6 ± 1.0	.71
7. I had waves of strong feelings about it	1.7 ± 1.1	1.4 ± 1.1	1.0 ± 1.0	.09
8. I had dreams about it	0.7 ± 1.1	0.9 ± 0.9	0.5 ± 0.9	.38
Avoidance symptoms				
1. I avoided letting myself get upset when I thought about it or was reminded of it	1.6 ± 1.0	1.5 ± 0.8	1.4 ± 1.0	.66
2. I felt as if it hadn't happened or wasn't real	1.2 ± 1.3	0.9 ± 1.0	0.9 ± 1.1	.63
3. I stayed away from reminders of it	1.0 ± 1.0	1.1 ± 0.8	0.7 ± 0.7	.33
4. I tried to remove it from my memory	0.9 ± 1.1	0.8 ± 1.0	0.5 ± 0.9	.28
5. I tried not to talk about it	1.2 ± 1.2	1.2 ± 1.2	1.0 ± 1.0	.83
6. I tried not to think about it	1.8 ± 1.1	1.6 ± 0.9	1.3 ± 1.2	.29
7. I was aware that I still had a lot of feelings about it, but I didn't deal with them	1.4 ± 1.2	0.9 ± 0.9	0.8 ± 1.0	.10
8. My feelings about it were kind of numb	1.4 ± 1.2	0.9 ± 1.0	0.9 ± 1.2	.14
Hyperarousal symptoms				
1. I had trouble falling asleep	0.9 ± 1.1	0.9 ± 1.2	0.9 ± 1.1	.94
2. I had trouble concentrating	1.0 ± 1.1	1.1 ± 1.2	0.7 ± 0.8	.53
3. Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	0.7 ± 1.0	0.2 ± 0.6	0.2 ± 0.6	.13
4. I felt irritable and angry	1.4 ± 1.1	1.2 ± 1.0	1.1 ± 0.9	.63
5. I felt watchful and on-guard	0.7 ± 0.9	0.8 ± 1.0	0.5 ± 0.9	.66
6. I was jumpy and easily startled	0.5 ± 0.8	0.6 ± 0.8	0.1 ± 0.3	.14
Total IES-R score	25.9 ± 15.7	23.9 ± 12.2	18.3 ± 14.2	**.04**[b]

[a]Data are reported as mean ± SD. Boldface *P* value indicates statistically significant difference between position groups ($P < .05$). IES-R, Impact of Events Scale–Revised; PTSD, posttraumatic stress disorder; UCL, ulnar collateral ligament.

[b]Pitchers were significantly more symptomatic than 2-way players ($P = .04$) but not position players ($P = .58$). There was no difference between position and 2-way players ($P = .20$).

positional versatility in both professional and amateur baseball players, which maximizes a player's role and value to the team while providing multiple playing options for the athlete's career. This may explain why 2-way players were not as affected psychologically in our cohort compared with pitchers, whose long-term playing options may ultimately fall entirely on their pitching arm. Thus, 2-way players may have higher levels of self-efficacy, or a belief in their athletic abilities, which has been shown to lead to more motivation, effort, and personal growth with quicker recovery from setbacks and better surgical outcomes.[4,29]

Previously, sports medicine specialists were troubled that as many as two-thirds of patients may not have returned to their preinjury level of sport by the expected 12 months after ACL reconstruction.[1,2,20,26] This failure to return to sports was despite satisfactory surgical and functional outcomes, with multiple studies showing recovery of performance-based measures by over 90% of their preinjury level.[2] This finding led to a number of studies investigating psychological factors that influenced return to sport.[1,5,19,28] Psychological responses—including readiness to return to sport, fear of reinjury, mood/emotions, locus of control, and recovery expectations—both before surgery and in early recovery were associated with returning to preinjury level of sport at 12 months. Some athletes have even struggled with PTSD-like symptoms after injuries.[22,23] In one study, 42% of patients with ACL reconstruction were found to meet the criteria for major depressive disorder.[33] A number of psychological interventions, ranging from self-talk to counseling and to modeling exercises have since been shown to improve the recovery period and outcomes after ACL reconstruction in these patients.[13,18,24] These studies emphasize why it is critically important to evaluate the psychological impact of UCL injuries in baseball players, in order to implement both preventative and therapeutic interventions that enhance their overall health.

Limitations

There are several limitations to our study. First, it was a single-center case series without a comparison or control group. Our subgroup analyses had different sample sizes among the subgroups; particularly, we had a small number of MiLB players when comparing level of play. Our analysis would have likely benefited from also including players from Major League Baseball. No patients had a reported

history of a mental health condition; however, baseline IES-R scores prior to the injury were not able to be collected. We do not know the degree of physical or mental preparation each athlete put into the sport, which may have affected one's symptomatology. Presurgical anxiety may have influenced the results of our study, but the patients consented prior to the day of surgery and surveys were administered in a consistent fashion to minimize any confounding. Furthermore, anxiety and PTSD are 2 distinct DSM-5 conditions with different symptomatology and screening/diagnostic questionnaires. Our patients demonstrated symptoms consistent with PTSD using the validated IES-R survey; however, we acknowledge that the chronicity of these symptoms would need to be further described to fulfill diagnostic criteria. It is thus also possible these patients had a diagnosis of other related DSM-5 mental health conditions such as acute stress disorder, which has similar symptoms to PTSD but is characterized by a shorter time frame from the traumatic event ($\leq$1 month). Similarly to PTSD, it is treated with formal psychiatric care, so we believe this to be a substantial finding that serves as a strong starting point to outline the psychological implications of UCL injuries and lead to the referral of at-risk players to mental health providers. Despite these limitations, we believe this study contributes substantially to the current understanding of UCL injuries and the accompanying psychological impact on patients.

CONCLUSION

Overall, we found that nearly 30% of baseball players warranted a probable PTSD diagnosis based on their IES-R score after UCL injury and another 20% warranted further diagnostic testing due to clinical concern for PTSD. All patients who agreed or expressed desire to see a mental health expert were referred to mental health providers postoperatively. Pitchers and college athletes were more likely to experience symptoms than 2-way players and high school athletes, respectively. Baseball players experience substantial psychological trauma after UCL injury. Future studies that longitudinally measure IES-R scores throughout the pre- and postoperative periods are warranted, and development of future multidisciplinary approaches for the treatment of players with UCL injuries is critical to the success of these young athletes.

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