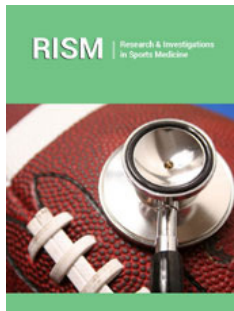


The Impact of Ulnar Collateral Ligament Injuries on Professional Pitchers and Baseball Organizations

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Abstract

In recent years, mainstream media has increasingly reported concern over the amount of arm injuries among baseball pitchers. Current literature validates this concern with regard to injury rates at the elbow in baseball players. In collegiate baseball, elbow injuries account for 15.5% of musculoskeletal injuries. Previous research has suggested that professional pitchers are disproportionately affected by upper extremity injuries when compared to professional position players. Therefore, the purpose of this study was to describe and analyze injury rates in Major League Baseball from 2020 to April 23, 2024. A secondary purpose of this study was to describe and analyze the economic impact of UCL reconstruction among MLB pitchers from 2020 to April 23, 2024. Data on MLB players being assigned to the Injured List (IL) was collected from a publicly accessible website that housed all MLB IL reports from 2020 to present. This information is publicly available due to provisions within the MLB Collective Bargaining Agreement that allow for the public disclosure of sports-related health information. Data on MLB salaries were collected from a publicly accessible website that housed information on professional athletes' contracts with professional organizations. Frequencies, means, and standard deviations were calculated where appropriate. Independent samples t-tests were performed to assess differences between pitchers and position players related to days into the season before injury, number of days on the IL, incidence of UCL related surgery, incidence of all elbow surgeries, and incidence of shoulder surgeries. Across all four full seasons, pitchers accounted for no less than 55.3% of all injuries reported on MLB IL reports. On average, pitchers spent more on the IL (Pitchers=49.6±51.2, Position Players=33.4±35.1, $t(2812)=9.792$, $p<.001$). From the 2022 season to the 2023 season, there was a 126.1% increase in total salary dollars paid to pitchers who underwent UCL reconstruction surgery. When looking at the last three full previous seasons and the 2024 season through April 23, the upward trend was still present. While this study captured a relatively small sample of data, the increased incidence of UCL reconstruction surgeries early in the season is concerning. Future studies should the impact new MLB pitching rules has on forces at the elbow and forearm muscle fatigue during pitching.

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Introduction

Baseball pitching produces large forces on the humeroulnar joint due to the biomechanics of overhead throwing [1]. When pitching with maximum effort, these forces can be in excess of 150% of the body weight of the pitcher [2]. Due to the aggressive nature of throwing, shoulder, elbow, and forearm muscle activity often surpasses maximum voluntary isometric contraction abilities at the competitive and elite levels [3]. Given the high volume of throwing in baseball, these forces have led to elbow injuries becoming a concern for competitive baseball pitchers. Current literature validates this concern regarding injury rates at the elbow in baseball players [4]. In collegiate baseball, elbow injuries account for 15.5% of musculoskeletal injuries [5]. This percentage increases at the professional baseball level, with elbow injuries accounting for 27.8% of all days spent on the injured/disabled list from 1990 to 2001 [6]. While this information is dated, it is some of the only data on the topic in the literature. Previous research has suggested that professional pitchers are disproportionately affected by upper extremity

injuries when compared to professional position players [7]. In recent years, mainstream media has increasingly reported on concern over the amount of arm injuries among baseball pitchers [8-10].

Perhaps the most worrying of these elbow injuries are Ulnar Collateral Ligament (UCL) sprains [8-10]. The UCL serves as the primary ligamentous restraint for valgus stress at the humeroulnar joint [11]. In baseball, as with other sports, injuries to the UCL can occur as a result of cumulative degradation of ligamentous tissue over time, or from acute ruptures [11]. When a patient suffers a UCL injury, they are subject to a significant loss of time from participation in sport [11]. If a UCL sprain is appropriate for conservative management, patients undergo an average for three to four months of rest and therapeutic exercise before returning to sport [11]. If the severity and location of a UCL sprain warrants surgical reconstruction, commonly known as Tommy John surgery, the length of time for returning to sport extends to an average of 12 to 15 months [11]. Despite surgical intervention and subsequent rehabilitation, patients often require an additional three to six months before being able to play at their previous level of competition [11]. While loss of time participating in sports is a concern for patients, coaches, and healthcare providers, there are other implications to UCL surgical reconstruction. When looking at the collegiate and professional levels, baseball pitchers who undergo UCL reconstruction may suffer immediate and future financial implications as a result of this lost time [12]. In Major League Baseball (MLB), the economic impact of UCL reconstruction extends beyond the pitcher. By current MLB policies, an injured player is paid per the terms of their contract even when injured and unable to participate in practices and competitions. A previous study found that between 2004 and 2014, the cost of recovery from UCL reconstruction for an MLB pitcher was \$1.9 million based of 2017 United State currency exchange rates [13].

While 97% of pitchers have been reported to return to MLB or Minor League Baseball, this percentage decreases to 75%-87% when looking at the MLB level alone [14-17]. Given the nature of fully guaranteed contracts at the MLB level, this creates a potential economic loss for MLB organizations across multiple seasons if a pitcher gets injured before the end of their contract terms [18]. The economic impact of UCL reconstruction on MLB organizations is further compounded when considering the current value of the United States dollar. The previously mentioned study found the average cost of UCL reconstruction to the MLB organization was \$1.9 million in 2017 [13]. Using 2024 inflation rates, this equates to over \$2.4 million [19]. With the rise in UCL injuries, individuals and organizations are also having to deal with the increase in healthcare cost for surgical reconstruction. If this is indeed the case, there may be a need for baseball organizations and the MLB as a whole to implement changes to curtail the potential increase in UCL reconstruction surgeries. Therefore, the purpose of this study was to describe and analyze injury rates in Major League Baseball from 2020 to April 23, 2024. A secondary purpose of this study was to describe and analyze the economic impact of UCL reconstruction among MLB pitchers from 2020 to April 23, 2024.

Methods

Design

This study was conducted using a retrospective analysis of data collected from a review of publicly available injury lists and player contracts from MLB organizations.

Data collection

Data on MLB players being assigned to the Injured List (IL) was collected from a publicly accessible website that housed all MLB IL reports from 2020 to present [20]. This information is publicly available due to provisions within the MLB Collective Bargaining Agreement that allow for the public disclosure of sport related health information [21]. Injury information was transferred from the website to an Excel spreadsheet (Microsoft Corporation, Redmond, WA). Injury information was categorized by injury date, return to activity date, body part, type of injury, and whether or not the injury resulted in surgery. Injuries were excluded if they had occurred prior to the MLB season the IL report was generated during, or if information on the injury was too vague in the report to be categorized. Data on MLB salaries were collected from a publicly accessible website that housed information on professional athletes' contracts with professional organizations [22]. Salary information was transferred from the website to an Excel spreadsheet (Microsoft Corporation, Redmond, WA). Salary information was only collected for pitchers who underwent UCL reconstruction surgery. The included annual salary information was based off the season during which the player sustained the injury necessitating assignment to the IL. Given the anticipated 12-to-15-month recovery timeframe for UCL reconstruction, the entire annual salary was included for data analysis.

Statistical analysis

Relevant data from the Excel spreadsheets was transferred to, and analyzed using, a commercially available statistics software package (SPSS Version 28, IBM, Armonk, NY). A total of 3,488 injury records were included in data analysis on prevalence of injuries. A total of 124 player salaries were included for analysis on the economic impact of UCL reconstruction surgery for MLB pitchers. Data assessed included position of the player sustaining injury, body part injured, type of injury, whether or not the injury required surgical intervention, number of days into the season the injury occurred and number of days the patient was inactive during the season due to the injury. Frequencies, means, and standard deviations were calculated where appropriate. Independent samples t-tests were performed to assess differences between pitchers and position players related to days into the season before injury, number of days on the IL, incidence of UCL related surgery, incidence of all elbow surgeries, and incidence of shoulder surgeries. Significance was set at $p < 0.05$ a priori.

Result

Injury prevalence

A total of 3,488 injury records were included for the purposes of this study. Positions of players listed on the IL are detailed in Table

1. Across all four full seasons, and overall, pitchers accounted for no less than 55.3% of all injuries reported on MLB IL reports. Through April 23, 67.5% of injuries reported on the IL were accounted for by pitchers in the 2024 season. This is a higher percentage through April 23 when compared to previous years as outlined in Table 2. Across the data collection timeframe, 42 distinct body parts were listed on the IL. The 10 most common body parts are detailed in Table 3. These body parts accounted for 72.8% of all injuries reported on MLB organizations' IL from 2020 to April 23, 2024. Shoulder and elbow injuries accounted for 25.8% of all injuries

reported on organizations' IL. Specific annual data regarding shoulder and elbow injuries reported on organizations' IL by April 23 are detailed in Table 4 and Figure 1. When looking specifically at elbow injuries that required surgery within pitchers, UCL repair and reconstruction surgeries accounted for 6.0% to 8.7% of pitcher injuries reported on organizations' IL reports. Data on frequencies of UCL related surgeries and overall elbow surgeries from 2020 to 2023 is reported in Table 5. Data on frequencies of UCL related surgeries and overall elbow surgeries by April 23 are reported in Table 6 and Figure 2.

Table 1: Positions injured from 2020 to April 23, 2024.

Position	Frequency Overall	Frequency 2020	Frequency 2021	Frequency 2022	Frequency 2023	Frequency 2024
Pitcher	1989, 57.0%	277, 57.9%	650, 55.3%	465, 56.4%	456, 57.0%	141, 67.5%
Catcher	202, 5.8%	29, 6.1%	68, 5.8%	49, 5.9%	46, 5.8%	10, 4.8%
Infielder	501, 14.4%	73, 15.3%	165, 14.0%	123, 14.9%	115, 14.4%	25, 12.0%
Outfielder	529, 15.2%	63, 13.2%	182, 15.5%	130, 15.8%	131, 16.4%	23, 11.0%
Utility	252, 7.2%	34, 7.1%	104, 8.8%	57, 6.9%	47, 5.9%	10, 4.8%
Designated Hitter	15, 0.4%	2, 0.4%	7, 0.6%	1, 0.1%	5, 0.6%	0, 0.0%

Table 2: Positions injured by April 23.

Position	Frequency 2021	Frequency 2022	Frequency 2023	Frequency 2024
Pitcher	121, 57.3%	90, 64.7%	111, 60%	141, 67.5%
Catcher	8, 3.8%	6, 4.3%	15, 8.1%	10, 4.8%
Infielder	30, 14.2%	17, 12.2%	21, 11.4%	25, 12.0%
Outfielder	33, 15.6%	18, 12.9%	29, 15.7%	23, 11.0%
Utility	16, 7.6%	8, 5.8%	8, 4.3%	10, 4.8%
Designated Hitter	3, 1.4%	0, 0.0%	1, 0.5%	0, 0.0%

Table 3: Ten most commonly injured body parts from 2020 to April 23, 2024.

Body Part	Frequency
Shoulder	488, 14.0%
Elbow	411, 11.8%
General Medical Condition	383, 11.0%
Hamstrings	278, 8.0%
Back	227, 6.5%
Obliques	199, 5.7%
Knee	171, 4.9%
Forearm	159, 4.6%
Hip Adductor	115, 3.3%
Finger	104, 3.0%

Table 4: Percent of total injuries accounted for by shoulder and elbow injuries by April 23.

Body Part	2021	2022	2023	2024
Shoulder	10.40%	19.40%	21.60%	19.10%
Elbow	12.80%	12.90%	10.80%	17.70%

Table 5: Frequency of UCL related surgeries and overall elbow surgeries in pitchers (% of total pitcher injuries).

Surgery	2020	2021	2022	2023
UCL Related Surgeries	24(8.7%)	39(6.0%)	33(7.1%)	32(7.0%)
All Elbow Surgeries	30(10.8%)	39(6.0%)	41(8.8%)	42(9.2%)

Table 6: Frequency of UCL related surgeries and overall elbow surgeries in pitchers by April 23 (% of total pitcher injuries).

Surgery	2021	2022	2023	2024
UCL Related Surgeries	15 (2.3%)	6 (1.3%)	5 (1.1%)	15 (10.6%)
All Elbow Surgeries	16 (2.5%)	6 (1.3%)	6 (1.3%)	20 (14.2%)

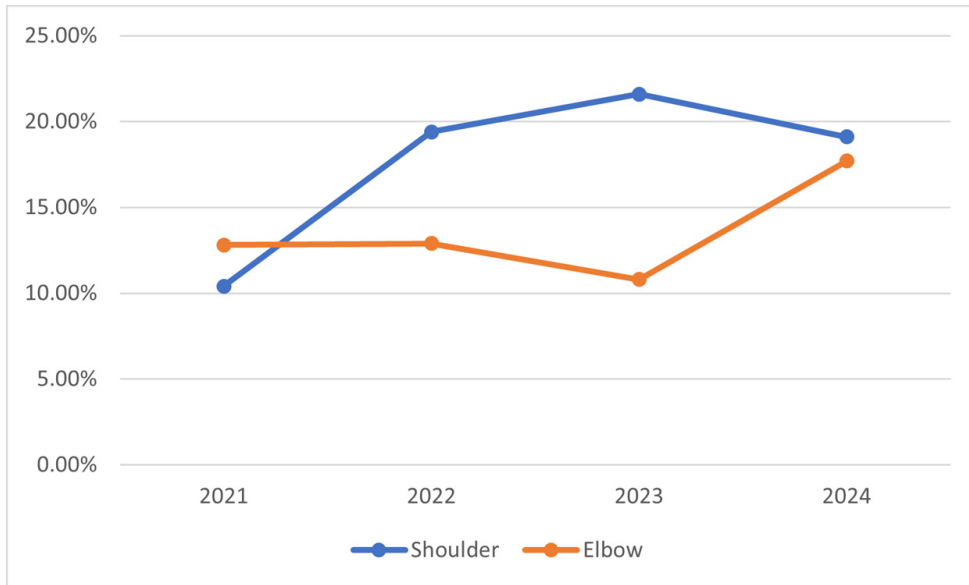


Figure 1: Percent of total injuries accounted for by shoulder and elbow injuries by April 23.

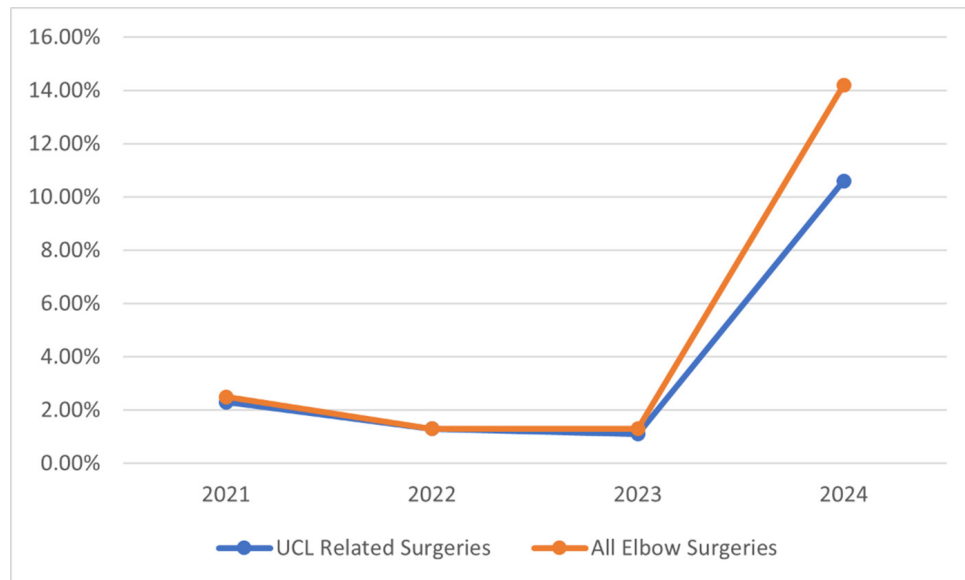


Figure 2: Percent of UCL related surgeries and overall elbow surgeries in pitchers relative to total number of pitcher injuries by April 23.

Significant differences were found between pitchers and position players for most variables that were analyzed. On average, pitchers were placed on the IL earlier in the season than position players (Pitchers=102.3±64.7 days, Position Players=108.1±60.8 days, $t(3021)=-2.569$, $p=.005$). Pitchers also spent more time on the IL (Pitchers=49.6±51.2, Position Players=33.4±35.1, $t(2812)=9.792$, $p<.001$). It should be noted that standard deviations for time spent on the IL were larger than the means. This was due to the fact that players were often put on the IL retroactively following their injury. Pitchers also underwent significantly more UCL related surgeries ($t(1692)=-9.497$, $p<.001$) and elbow surgeries in general ($t(2003)=-9.409$, $p<.001$). There was no significant difference between pitchers and position players for receiving shoulder surgery ($t(3201)=-.316$, $p=.752$).

Economic implications of UCL reconstruction surgery

Descriptive statistical analysis found that there is an upward trend in total salary dollars paid to MLB pitchers on the IL for UCL reconstruction surgery over the past four years. From the 2022 season to the 2023 season, there was a 126.1% increase in total salary dollars paid to pitchers who underwent UCL reconstruction surgery. Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery for the 2020 through 2023 seasons are presented in Table 7 and Figure 3. When looking at the last three full previous seasons and the 2024 season through April 23, the upward trend was still present. Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery by April 2023 are presented in Table 8 and Figure 4.

Table 7: Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery from 2020 to 2023.

Year	Total Salary in US Dollars
2020	\$35,362,242.00
2021	\$51,237,996.00
2022	\$60,688,220.00
2023	\$137,236,351.00

Table 8: Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery by April 23.

Year	Total Salary in US Dollars
2021	\$22,984,908.00
2022	\$6,567,000.00
2023	\$9,176,700.00
2024	\$36,365,700.00

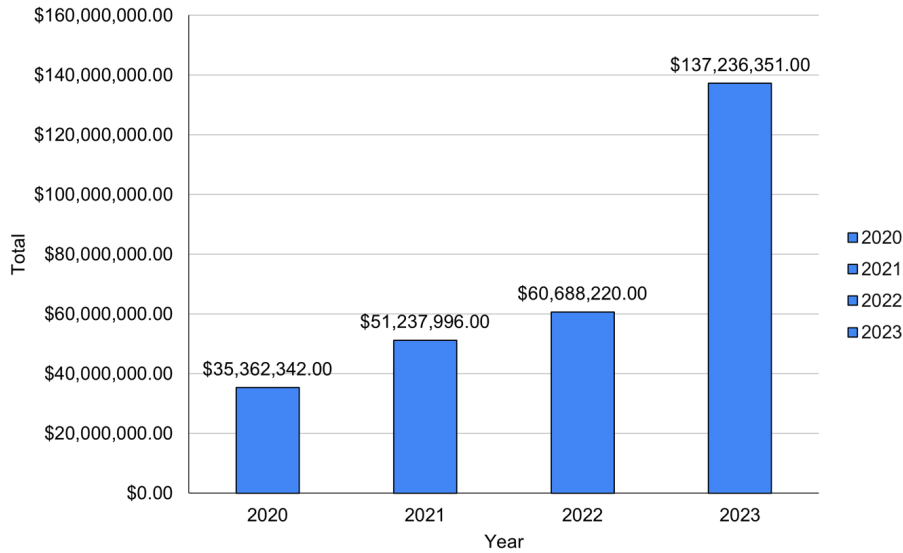


Figure 3: Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery from 2020 to 2023.

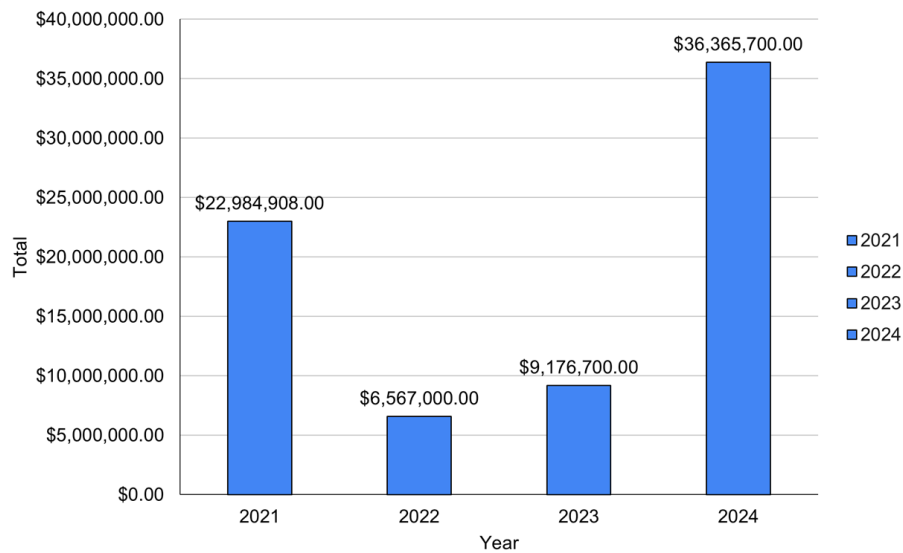


Figure 4: Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery through April 23.

Discussion

The purpose of this study was to describe and analyze injury rates in Major League Baseball from 2020 to April 23, 2024. A secondary purpose of this study was to describe and analyze the economic impact of UCL reconstruction among MLB pitchers from 2020 to April 23, 2024. Over the past three years, sports media

outlets have raised concerns over the number of elbow injuries that pitchers have been sustaining in the MLB [8-10]. This concern has been expressed publicly by both sports media pundits and MLB pitchers themselves [8,23]. Some of the concerns of the sports media and MLB pitchers may be based on anecdotal evidence. However, the findings of this study show that more pitchers have

sustained elbow injuries warranting surgery relative to total injuries to pitcher in the 2024 season through April 23 compared to the past three seasons. As of April 23, organizations had played 22 to 25 games. This may mean that the number of elbow injuries warranting surgeries will stabilize by the end of the 2024 season. That being said, there was a 296.3% increase in total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgeries by April 23 from 2023 to 2024. While some of this increase may be accounted for by the salaries of the specific pitchers being injured, the sharp increase in compensation for injured pitchers should spur future research to seek to determine methods of reducing the risk of elbow injuries in baseball pitchers. Additionally, over the last four full MLB seasons, pitchers have spent longer on the IL than position players. This would suggest that the injuries suffered by pitchers are often more debilitating than those suffered by position players. These findings may be cause for even more concern, given that media coverage of baseball has highlighted the financial and performance value of pitchers outpacing the value of position players [24-27].

Across the over four seasons' worth of data analyzed, the number of elbow related surgeries in MLB pitchers increased. When looking at both UCL related surgeries and all elbow surgeries by April 23, the percentage of total injuries these surgeries accounted for increased annually for the past three MLB seasons. If the current trend for the 2024 season were to continue, the number of injuries and total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgeries will again exceed the previous season. This provides further merit to the concerns brought forth by the media and MLB pitchers. A possible limitation of this study was that data was collected provides a relatively small sample size of the historical injury prevalence in the MLB. Future studies should examine a larger number of seasons to attempt to determine longer term trends in elbow injuries among MLB pitchers. Examining this data would also allow for a more holistic examination of the economic impact of UCL reconstruction surgeries among MLB pitchers. Another limitation of this study was that it did not examine the cause of the increase in UCL reconstruction surgeries among MLB pitchers before April 23 in the 2024 season. Previous research has suggested that increased pitch volume, and increased pitch velocity has led to an increase in injuries to the UCL [28-30]. Additionally, pitchers have anecdotally stated their belief that new rules such as the implementation of the pitch clock, and the increased emphasis on banning grip enhancing substances has increased the incidence of UCL injuries among pitchers [8,10].

Future research should be conducted to determine the impact of the pitch clock and grip enhancing substances on forces at the elbow, and forearm muscle fatigue during pitching. To the authors' knowledge, this is the first study assessing incidence of injury and economic impact of UCL reconstruction surgery in MLB pitchers from 2020 to April 23, 2024. While this study captured a relatively small sample of data, the increased incidence of UCL reconstruction surgeries early in the season is concerning. Future research should study the impact new MLB pitching rules has on forces at the elbow and forearm muscle fatigue during pitching. This research would

allow for deliberate and intentional conversations about whether or not these rules should be amended. In the interim, healthcare providers should be prepared to implement best practices for pitchers they are providing care for.

References

1. Fleisig GS, Andrews JR, Dillman CJ, Escamilla RF (1995) Kinetics of baseball pitching with implications about injury mechanisms. *Am J Sports Med* 23(2): 233-239.
2. Werner SL, Gill TJ, Murray TA, Cook TD, Hawkins RJ (2001) Relationships between throwing mechanics and shoulder distraction in professional baseball pitchers. *Am J Sports Med* 29(3): 354-358.
3. Di Giovine NM, Jobe FW, Pink M, Perry J (1992) An electromyographic analysis of the upper extremity in pitching. *J Shoulder Elbow Surg* 1(1): 15-25.
4. Wilk KE, Arrigo CA, Hooks TR, Andrews JR (2016) Rehabilitation of the overhead throwing athlete: There is more to it than just external rotation/internal rotation strengthening. *Physical Medicine & Rehabilitation* 8(3): S78-S90.
5. Wasserman EB, Sauers EL, Register-Mihalik JK, Pierpoint LA, Currie DW, et al. (2019) The first decade of web-based sports injury surveillance: Descriptive epidemiology of injuries in us high school boys' baseball (2005-2006 Through 2013-2014) and national collegiate athletic association men's baseball (2004-2005 Through 2013-2014). *J Athl Train* 54(2): 198-211.
6. Conte S, Requa RK, Garrick JG (2001) Disability days in major league baseball. *Am J Sports Med* 29(4): 431-436.
7. Posner M, Cameron K, Wolf JM, Belmont PL, Owens BD (2011) Epidemiology of major league baseball injuries. *Am J Sports Med* 39(8): 1678-1680.
8. James C (2021) Rays ace Tyler Glasnow says he tried to adjust for 'sticky stuff' rules. Now he's injured. *The Washington Post*, USA.
9. McCullough A (2024) MLB insiders "pretty worried" by rise in arm injuries to top young starting pitchers. *The Athletic*, New York, USA.
10. Snyder M (2024) Pitching injuries seem never-ending and experts see no easy answer to fix MLB's biggest on-field problem. *CBS Sports*, New York, USA.
11. Carr JB, Camp CL, Dines JS (2020) Elbow ulnar collateral ligament injuries: Indications, management and outcomes. *Arthroscopy* 36(5): 1221-1222.
12. Plummer HA, Plosser SM, Diaz PR, Lobb NJ, Michener LA (2022) Effectiveness of a shoulder exercise program in Division I collegiate baseball players during the fall season. *International Journal of Sports Physical Therapy* 17(2): 247-258.
13. Meldau JE, Srivastava K, Okoroha KR, Ahmad CS, Moutzouros V (2020) Cost analysis of tomy john surgery for major league baseball teams. *Journal of Shoulder and Elbow Surgery* 29(1): 121-125.
14. Cain EL, Andrews JR, Dugas JR, Wilk KE, McMichael CS, et al. (2010) Outcome of ulnar collateral ligament reconstruction of the elbow in 1281 athletes: Results in 743 athletes with minimum 2-year follow-up. *American Journal of Sports Medicine* 38(12): 2426-2434.
15. Conte SA, Fleisig GS, Dines JS, Wilk KE, Aune KT, et al. (2015) Prevalence of ulnar collateral ligament surgery in professional baseball players. *American Journal of Sports Medicine* 43(7): 1764-1769.
16. Keller RA, Steffes MJ, Zhuo D, Bey MJ, Moutzouros V (2014) The effects of medial ulnar collateral ligament reconstruction on major league pitching performance. *Journal of Shoulder and Elbow Surgery* 23(11): 1591-1598.
17. Makhni EC, Lee RW, Morrow ZS, Gualtieri AP, Gorroochurn P, et al. (2014) Performance, return to competition and reinjury after tomy

- john surgery in major league baseball pitchers: A review of 147 cases. *American Journal of Sports Medicine* 42(6): 1323-1332.
18. NBC Sports Staff (2023) MLB free agency 2023-24: Start date, largest contracts, history, team payrolls and more. NBC Sports, USA.
19. Webster I (2024) CPI inflation calculator, Alioth finance.
20. Fangraphs (2024) Roster resource injury report. Fangraphs.
21. McChrystal MK (2014) No hiding the ball: Medical privacy and pro sports. *Marquette Sports Law Review* 25(1): 163-180.
22. Salary Sport (2024) How much do teams pay their players? Salary Sport.
23. ESPN Writing Staff (2024) What MLB pitchers think of baseball's pitching injury rise. ESPN, USA.
24. Woodruff J (2018) How much money do baseball players make? Chron.
25. Lee G, Poindexter O (2024) Who are the highest-paid baseball players? Front Office Sports.
26. Brightman B (2024) Who are the highest-paid pitchers in MLB? Where Ohtani, Scherzer rank in 2024. NBC Philadelphia.
27. Olsen SJ, Fleisig GS, Dun S, Loftice J, Andrews JR (2006) Risk factors for shoulder and elbow injuries in adolescent baseball pitchers. *Am J Sports Med* 34(6): 905-912.
28. Petty DH, Andrews JR, Fleisig GS, Cain EL (2004) Ulnar collateral ligament reconstruction in high school baseball players: Clinical results and injury risk factors. *Am J Sports Med* 32(5): 1158-1164.
29. Yang J, Mann BJ, Guettler JH, Dugas JR, Irrgang JJ, et al. (2014) Risk-prone pitching activities and injuries in youth baseball: Findings from a national sample. *Am J Sports Med* 42(6): 1456-1463.
30. Dines JS, Frank JB, Akerman M, Yocum LA (2009) Glenohumeral internal rotation deficits in baseball players with ulnar collateral ligament insufficiency. *Am J Sports Med* 37(3): 566-570.