


# Is There a Relationship Between Grip Strength and Injuries in Professional Baseball Players?

Brandon J. Erickson,<sup>\*†‡</sup> MD , Paul Buchheit,<sup>§</sup> ATC, Joseph Rauch,<sup>§</sup> DPT, ATC, Michael G. Ciccotti,<sup>†</sup> MD, Ryan W. Paul,<sup>†</sup> BS, and Steven B. Cohen,<sup>†</sup> MD  
Investigation performed at Rothman Orthopaedic Institute, New York, New York, USA

**Background:** Injuries in professional baseball players have become exceedingly common. Efforts to mitigate injury risk have focused on the kinetic chain, shoulder motion, and so forth. It is unclear whether grip strength is related to injury risk in professional baseball pitchers.

**Purpose/Hypothesis:** The purpose of this study was to determine if grip strength was a risk factor for injury. It was hypothesized that pitchers with weaker grip strength would have a higher likelihood of sustaining a shoulder or elbow injury compared with pitchers with stronger grip strength.

**Study Design:** Case-control study; Level of evidence, 3.

**Methods:** All professional pitchers from a single Major League Baseball organization were included. Dominant and nondominant grip strength were measured after each pitching outing throughout the 2022 season. Injuries over the course of the season were recorded, and data were compared between pitchers who sustained a shoulder or elbow injury and those who did not.

**Results:** Overall, 213 pitchers were included, of whom 53 (24.9%) sustained a shoulder or elbow injury during the season. The mean grip strength for all pitchers was  $144.0 \pm 20.8$  lb ( $65.3 \pm 9.4$  kg). The mean dominant-arm grip strength was  $142.6 \pm 20.8$  lb ( $64.7 \pm 9.4$  kg) for pitchers who did not sustain a shoulder or elbow injury and  $148.2 \pm 20.9$  lb ( $67.2 \pm 9.5$  kg) for pitchers who did sustain an injury, with no significant group difference in grip strength ( $P > .05$ ). Furthermore, there were no significant differences in change in grip strength over the course of the season between the groups.

**Conclusion:** There was no significant difference in mean grip strength or change in grip strength over the course of a single season between professional baseball pitchers who sustained a shoulder or elbow injury and those who did not.

**Keywords:** baseball; pitcher; grip strength; injury; ulnar collateral ligament (UCL); elbow

Injury rates at all levels of baseball have been on the rise in recent years.<sup>1,2,5,6,8,10,19,20</sup> As a result, significant time and research have been dedicated toward understanding potential risk factors for injury, including a focus on pitch count limits, the number of days of rest needed between appearances, inning limits, and many other variables.<sup>9,13</sup> One area of focus that may play a role in injury, but has not garnered significant attention, is grip strength. Throwing a baseball requires gripping the seams using different fingers and locations, depending on the pitch, and as pitchers progress through a game, their grip strength may weaken.

Grip strength has previously been demonstrated to be a marker for an individual's overall muscular strength and functional status.<sup>3,21</sup> It is currently used as an assessment tool during the National Hockey League Entry Draft Combine.<sup>16</sup> Prior studies have demonstrated that age, sex, and body composition influence grip strength performance in youth athletes.<sup>4,11,18</sup> Hughes et al<sup>12</sup> investigated the impact of grip strength on instantaneous bat velocity of 23 collegiate baseball players; however, they found that that grip strength and bat velocity were not significantly related.

The role of grip strength fatigue in baseball pitchers over the course of a season remains unclear. As the flexor-pronator mass acts as a secondary stabilizer at the elbow, if this muscle mass becomes fatigued, it may cause an increase in stress on the ulnar collateral ligament (UCL), which could lead to injury. Hence, if a pitcher's

The Orthopaedic Journal of Sports Medicine, 12(7), 23259671241257622  
DOI: 10.1177/23259671241257622  
© The Author(s) 2024

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

grip strength decreased to a certain threshold during the season, that pitcher could be rested in an effort to prevent an injury.

While the UCL is the primary restraint to valgus stress at the elbow, the flexor-pronator mass functions as a dynamic secondary stabilizer to the medial elbow during the baseball throw where it takes some of stress off of the UCL.<sup>7,14,15</sup> It would therefore seem that the stronger the flexor-pronator muscle mass is, the more it could protect the UCL during throwing and the less stress the UCL would see. This could, in theory, lead to fewer UCL injuries if the flexor-pronator mass were stronger and better able to protect the UCL. While direct measurement of the flexor-pronator muscle efficiency is difficult, one proxy measure of flexor-pronator strength is grip strength. Grip strength has been used as an assessment tool in the National Hockey League, and it has become a more common measurement used in professional baseball. Pexa et al<sup>17</sup> evaluated medial joint gapping and the effect of grip contraction on the amount of gapping. The authors found that the amount of medial joint line gapping caused by a valgus stress of the elbow is significantly reduced when patients maximally exert their grip strength. Hence, the flexor-pronator mass may provide some protection to the UCL.

The purpose of this study was to examine the grip strength in professional baseball pitchers over the course of a season to determine if strength changes, and if it does, when and by how much it changes, to determine if grip strength fatigue can be an indicator for potential injury. We hypothesized that pitchers with weaker grip strength would have a higher likelihood of sustaining a shoulder or elbow injury than pitchers with stronger grip strength.

## METHODS

Institutional review board approval was obtained for the study protocol. All professional pitchers who were members of a single Major League Baseball (MLB) team and pitching during the 2022 season were included. Grip strength was recorded by a team athletic trainer after each pitching outing in a game using the Jamar Smedley hand dynamometer (Sammons Preston). When the pitcher was removed from the game and went into the clubhouse, he went to the training room and took a single grip strength measurement on his dominant hand and nondominant hand.<sup>12</sup> All measurements were taken by members of

the training staff, with the pitcher positioned with his arm at the side, the elbow flexed to 90°, and the forearm in neutral rotation. All injuries for these pitchers were also recorded by the team over the course of the season.

The mean grip strength over the course of the season was then compared between pitchers who sustained a shoulder or elbow injury during the season and those who did not. Injuries were defined as any shoulder or elbow problem that caused the player to be evaluated by the medical staff and have a treatment regimen implemented. Placement on the injured list was not a requirement for a shoulder or elbow injury to be considered an injury. The change in grip strength from the beginning of the season to the end of the season was also calculated and compared between pitchers who sustained an injury and those who did not.

Continuous data were reported as means and standard deviations, and *t* tests were used to compare grip strength between the 2 study groups.

## RESULTS

Overall, 213 individual pitchers across the MLB team were included. Of these pitchers, 53 (24.9%) sustained a shoulder or elbow injury during the season. Some players sustained >1 injury over the course of the season. There were 39 injuries involving the elbow and forearm and 37 involving the shoulder. Four players sustained an injury to both the shoulder and elbow. Of the elbow injuries, 4 involved the UCL.

The mean grip strength for all pitchers was 144.0 ± 20.8 lb (65.3 ± 9.4 kg). There was no significant difference when comparing the mean grip strength for the dominant versus nondominant arm (Table 1). The mean dominant-arm grip strength was 148.2 ± 20.9 lb (67.2 ± 9.5 kg) for pitchers who sustained a shoulder or elbow injury and 142.6 ± 20.8 lb (64.7 ± 9.4 kg) for pitchers who did not. There was no significant difference in mean grip strength for pitchers who did and did not sustain a shoulder or elbow injury, but pitchers who sustained an injury had a significantly higher final-season grip strength measurement compared with those who did not sustain an injury (152.6 ± 25.3 lb [69.2 ± 11.5 kg] vs 142.0 ± 26.2 lb [64.4 ± 11.9 kg]; *P* = .012) (Table 2). There were no significant differences in change in grip strength over the course of the season between the groups (Table 2).

\*Address correspondence to Brandon J. Erickson, MD, Rothman Orthopaedic Institute, 645 Madison Avenue, New York, NY 10022, USA (email: brandon.erickson@rothmanortho.com).

<sup>†</sup>Rothman Orthopaedic Institute, New York, New York, USA.

<sup>‡</sup>Department of Orthopaedic Surgery, New York University, New York, New York, USA.

<sup>§</sup>Philadelphia Phillies, Philadelphia, Pennsylvania, USA.

Final revision submitted December 13, 2023; accepted January 1, 2024.

One or more of the authors has declared the following potential conflict of interest or source of funding: B.J.E. has received grant support from Arthrex, education payments from Arthrex and Smith+Nephew, consulting fees from Arthrex and DePuy Synthes, nonconsulting fees from Arthrex, and hospitality payments from Linvatec and Stryker. M.G.C. has received grant support from Arthrex and DJO. S.B.C. has received education payments from Liberty Surgical and consulting fees from Zimmer Biomet. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was obtained from Thomas Jefferson University (ref No. 22D.300).

TABLE 1  
Dominant Versus Nondominant-Arm Grip Strength in All Professional Baseball Pitchers (N = 213)<sup>a</sup>

	Dominant Arm	Nondominant Arm	P
Grip strength, lb (kg)	144.0 ± 20.8 (65.3 ± 9.4)	142.3 ± 21.5 (64.5 ± 9.8)	>.05

<sup>a</sup>Data are presented as mean ± SD.

TABLE 2  
Comparison of Grip Strength Between Professional Baseball Pitchers Who Did Versus Did Not Sustain a Shoulder or Elbow Injury<sup>a</sup>

	Injured (n = 53)	Not Injured (n = 160)	P
Mean grip strength for the season, lb (kg)	148.2 ± 20.9 (67.2 ± 9.5)	142.6 ± 20.8 (64.7 ± 9.4)	.092
Initial grip strength measurement of season, lb (kg)	145.9 ± 21.3 (66.2 ± 9.7)	139.5 ± 20.1 (63.3 ± 9.1)	.062
Final grip strength measurement of season, lb (kg)	152.6 ± 25.3 (69.2 ± 11.5)	142.0 ± 26.2 (64.4 ± 11.9)	<b>.012</b>
Change in grip strength over course of season, lb (kg)	6.6 ± 17.2 (3.0 ± 7.8)	2.5 ± 17.4 (1.1 ± 7.9)	.148

<sup>a</sup>Data are presented as mean ± SD. Boldface P value indicates a statistically significant difference between groups (P < .05).

TABLE 3  
Comparison of Grip Strength Between Professional Baseball Pitchers Who Did Versus Did Not Sustain an Elbow Injury<sup>a</sup>

	Injured (n = 29)	Not Injured (n = 184)	P
Mean grip strength for the season, lb (kg)	144.7 ± 21.8 (65.6 ± 9.9)	143.9 ± 20.8 (65.3 ± 9.4)	.853
Initial grip strength measurement of season, lb (kg)	144.8 ± 21.4 (65.7 ± 9.7)	140.6 ± 20.4 (63.8 ± 9.3)	.333
Final grip strength measurement of season, lb (kg)	150.1 ± 26.3 (68.1 ± 11.9)	143.9 ± 26.3 (65.3 ± 11.9)	.248
Change in grip strength over course of season, lb (kg)	5.3 ± 17.8 (2.4 ± 8.1)	3.3 ± 17.4 (1.5 ± 7.9)	.591

<sup>a</sup>Data are presented as mean ± SD.

When isolating pitchers who sustained only an elbow injury, there was no significant difference in mean grip strength over the course of the season compared with pitchers with no elbow injury. Similarly, there were no significant differences in change in grip strength over the course of the season for pitchers who sustained an elbow injury and those who did not (Table 3).

## DISCUSSION

Shoulder and elbow injuries are common among professional baseball pitchers. Our hypothesis was not supported, as there was no significant difference in grip strength between professional baseball pitchers who sustained a shoulder or elbow injury and those who did not. Furthermore, those players who sustained a shoulder or elbow injury had a significantly higher final-season grip strength measurement than those who did not sustain a shoulder or elbow injury (P = .012).

Throwing injuries in baseball pitchers of all levels of play have become increasingly common over the past 10 years. While these players can sustain various injuries, injuries to the shoulder and elbow are the most common. Camp et al<sup>1</sup> reported on the most common injuries in

professional baseball and found that of the nearly 50,000 injuries sustained between 2011 and 2016, 5 of the top 9 most common injuries involved the shoulder or elbow. UCL injuries of the elbow were the sixth most common injury (1175 injuries) between 2011 and 2016, the majority of which (82%) occurred in pitchers. This resulted in 323,033 days missed. Similarly, forearm flexor-pronator strains were the ninth most common injury (944 injuries), with 83,678 days missed because of these injuries. Again, 81% occurred in pitchers. As such, it is clear that the elbow is a significant cause of disability in professional baseball pitchers and has been the focus of injury mitigation efforts for the last several years.

One interesting finding for this study is that grip strength actually increased, albeit slightly, in both the injured and noninjured groups. It should be noted this was a very slight increase and could have been due to chance. There are several possible explanations for this, including success of in-season workouts and training, possible lack of effort at the beginning of the season, or increased comfort with the grip strength device with more frequent use toward the end of the season. Further study is needed to determine the significance and relevance of this potential increase.

The study findings indicated that overall mean grip strength was not different between pitchers who sustained

a shoulder or elbow injury and those who did not. Furthermore, change in grip strength over the course of a season was not significantly different between players who sustained a shoulder and elbow injury and those who did not. While this information provides an initial baseline, more research is required to fully evaluate any relationship. This was a preliminary study using the new grip strength data that one professional organization collected over the course of a season. Further work is needed to evaluate changes in grip strength in real time between innings while players are pitching to determine if acute changes in grip strength play a role in injury. If there is a threshold whereby injury risk increases as grip strength changes, players could be removed from games in an effort to mitigate injury risk.

### Limitations

This study was performed over a single season in a single MLB baseball organization. As such, the results may not be generalizable to other teams and athletes of various levels of play. This study did not evaluate change in grip strength over the course of a game, and as such, we cannot comment on whether grip strength decreases during a game and whether this can be a marker for injury. Further work is needed in this area to determine whether a threshold exists for when players should be removed from games to decrease injury risk based on their grip strength. This will require in-game measurements of grip strength in between innings.

### CONCLUSION

There was no significant difference in mean grip strength or change in grip strength over the course of the season between professional baseball pitchers who sustained a shoulder or elbow injury and those who did not.

### ACKNOWLEDGMENT

The authors acknowledge the training staff for the Philadelphia Phillies, who recorded and entered all these data over the past several years. It is because of their hard work, diligence, and attention to detail that this study was possible.

### ORCID iD

Brandon J. Erickson  <https://orcid.org/0000-0003-3238-7839>

### REFERENCES

1. Camp CL, Dines JS, van der List JP, et al. Summative report on time out of play for Major and Minor League Baseball: an analysis of

- 49,955 injuries from 2011 through 2016. *Am J Sports Med.* 2018;46(7):1727-1732.
2. Chalmers PN, Erickson BJ, Ball B, Romeo AA, Verma NN. Fastball pitch velocity helps predict ulnar collateral ligament reconstruction in Major League Baseball pitchers. *Am J Sports Med.* 2016;44(8):2130-2135.
3. De Smet L, Vercammen A. Grip strength in children. *J Pediatr Orthop B.* 2001;10(4):352-354.
4. de Souza MA, de Jesus Alves de Baptista CR, Baranauskas Benedicto MM, Pizzato TM, Mattiello-Sverzut AC. Normative data for hand grip strength in healthy children measured with a bulb dynamometer: a cross-sectional study. *Physiotherapy.* 2014;100(4):313-318.
5. Erickson BJ, Chalmers PN, Axe MJ, Romeo AA. Exceeding pitch count recommendations in Little League Baseball increases the chance of requiring Tommy John surgery as a professional baseball pitcher. *Orthop J Sports Med.* 2017;5(3):2325967117695085.
6. Erickson BJ, Cvetanovich GL, Bach BR Jr, Bush-Joseph CA, Verma NN, Romeo AA. Should we limit innings pitched after ulnar collateral ligament reconstruction in Major League Baseball pitchers? *Am J Sports Med.* 2016;44(9):2210-2213.
7. Erickson BJ, Romeo AA. The ulnar collateral ligament injury: evaluation and treatment. *J Bone Joint Surg Am.* 2017;99(1):76-86.
8. Erickson BJ, Sgori T, Chalmers PN, et al. The impact of fatigue on baseball pitching mechanics in adolescent male pitchers. *Arthroscopy.* 2016;32(5):762-771.
9. Fleisig GS, Andrews JR. Prevention of elbow injuries in youth baseball pitchers. *Sports Health.* 2012;4(5):419-424.
10. Fleisig GS, Andrews JR, Cutter GR, et al. Risk of serious injury for young baseball pitchers: a 10-year prospective study. *Am J Sports Med.* 2011;39(2):253-257.
11. Hager-Ross C, Rosblad B. Norms for grip strength in children aged 4-16 years. *Acta Paediatr.* 2002;91(6):617-625.
12. Hughes SS, Lyons BC, Mayo JJ. Effect of grip strength and grip strengthening exercises on instantaneous bat velocity of collegiate baseball players. *J Strength Cond Res.* 2004;18(2):298-301.
13. Marsh JA, Wagshol MI, Boddy KJ, et al. Effects of a six-week weighted-implementation throwing program on baseball pitching velocity, kinematics, arm stress, and arm range of motion. *PeerJ.* 2018;6:e6003.
14. Morrey BF. Applied anatomy and biomechanics of the elbow joint. *Instr Course Lect.* 1986;35:59-68.
15. Morrey BF, An KN. Articular and ligamentous contributions to the stability of the elbow joint. *Am J Sports Med.* 1983;11(5):315-319.
16. Nightingale SC, Miller S, Turner A. The usefulness and reliability of fitness testing protocols for ice hockey players: a literature review. *J Strength Cond Res.* 2013;27(6):1742-1748.
17. Pexa BS, Ryan ED, Myers JB. Medial elbow joint space increases with valgus stress and decreases when cued to perform a maximal grip contraction. *Am J Sports Med.* 2018;46(5):1114-1119.
18. Ploegmakers JJ, Hepping AM, Geertzen JH, Bulstra SK, Stevens M. Grip strength is strongly associated with height, weight and gender in childhood: a cross sectional study of 2241 children and adolescents providing reference values. *J Physiother.* 2013;59(4):255-261.
19. Wilk KE, Macrina LC, Fleisig GS, et al. Deficits in glenohumeral passive range of motion increase risk of elbow injury in professional baseball pitchers: a prospective study. *Am J Sports Med.* 2014;42(9):2075-2081.
20. Wilk KE, Macrina LC, Fleisig GS, et al. Deficits in glenohumeral passive range of motion increase risk of shoulder injury in professional baseball pitchers: a prospective study. *Am J Sports Med.* 2015;43(10):2379-2385.
21. Wind AE, Takken T, Helders PJ, Engelbert RH. Is grip strength a predictor for total muscle strength in healthy children, adolescents, and young adults? *Eur J Pediatr.* 2010;169(3):281-287.