

Performance Outcomes After Hook of Hamate Fractures in Major League Baseball Players

Michael S. Guss, John P. Begly, Austin J. Ramme, David P. Taormina, Michael E. Rettig, and John T. Capo

Context: Major League Baseball (MLB) players are at risk of hook of hamate fractures. There is a paucity of data assessing the effect of a hook of hamate fracture on MLB players' future athletic performance. **Objective:** To determine if MLB players who sustain hook of hamate fractures demonstrate decreased performance upon return to competition when compared with their performance before injury and that of their control-matched peers. **Design:** Retrospective case-control design. **Setting:** Retrospective database study. **Participants:** 18 MLB players who sustained hook of hamate fractures. **Methods:** Data for 18 MLB players with hook of hamate fractures incurred over 26 seasons (1989–2014) were obtained from injury reports, press releases, and player profiles (www.mlb.com and www.baseballreference.com). Player age, position, number of years in the league, mechanism of injury, and treatment were recorded. Individual season statistics for the 2 seasons immediately prior to injury and the 2 seasons after injury for the main performance variable—Wins Above Replacement—were obtained. Eighteen controls matched by player position, age, and performance statistics were identified. A performance comparison of the cohorts was performed. **Main Outcome Measures:** Postinjury performance compared with preinjury performance and matched-controls. **Results:** Mean age at the time of injury was 25.1 years with a mean of 4.4 seasons of MLB experience prior to injury. All injuries were sustained to their nondominant batting hand. All players underwent operative intervention. There was no significant change in Wins Above Replacement or isolated power when preinjury and postinjury performance were compared. When compared with matched-controls, no significant decline in performance in Wins Above Replacement the first season and second season after injury was found. **Conclusion:** MLB players sustaining hook of hamate fractures can reasonably expect to return to their preinjury performance levels following operative treatment.

Keywords: injury management, musculoskeletal system, orthopedics, return to play, sport medicine

Major League Baseball (MLB) players are highly skilled athletes that require full function of their hands to perform at the highest level, and are at risk for hook of hamate fractures while swinging the bat, or from direct blunt trauma, such as a fall on an outstretched hand or an errant pitch.^{1–3} Stark et al³ have shown that when the bat is gripped, the handle lies over the distal and ulnar surfaces of the hook of hamate of the nonbatting hand. Fracture can occur if the player relaxes the grip, or if the force of the swinging bat becomes greater than the grip strength, allowing the butt of the bat to impact the hook, leading to fracture. In this subset of elite athletes, hook of hamate fractures may negatively affect a player's return to previous athletic performance.

There is a paucity of data assessing the effect of a hook of hamate fracture on future athletic performance. Previous studies are mostly historical, small case series, lacking performance outcome data or control groups.^{4–6} The purpose of this study was to evaluate performance before and after injury in MLB players who sustained a hook of hamate fracture, and to compare them with their control-matched peers. In addition, we attempted to identify variables associated with an athlete's return to performance using regression analysis. We hypothesized that a hook of hamate fracture would lead to a decrease in performance when compared with the player's preinjury performance and control-matched peers.

Methods

The study group contained MLB players who sustained an acute hook of hamate fracture during a 26-year time period between the 1989 and 2014 seasons. The fracture cohort was identified using a comprehensive online injury database (www.prosportstransactions.com) cross-referenced with team press releases, online injury reports, and player profiles (www.mlb.com and www.baseballreference.com). The methodology used in this study has been previously published.^{7–9}

The data in this study are public in nature, making them exempt from institutional review board approval and informed consent.

Thirty-two players with hook of hamate fractures were identified. Based upon available information, these 32 players represented all MLB players who sustained a hamate hook fracture during our study period. Players were included for analysis if they had played in at least 2 MLB seasons before and 2 MLB seasons after the index injury season, and had at least 100 plate appearances in each season. Of the 32 players, 8 were injured during their first or second year of major league competition and were excluded due to a lack of preinjury performance data. An additional player was injured during the 2014 season and was excluded due to a lack of postinjury data. Four players had less than 100 plate appearances either in their preinjury season (3) or their postinjury season (1) and were excluded from analysis. The small sample size was not felt to be a reliable measure of performance because a small selection of plate appearances could result in type I or type II error. The one player that was excluded because of insufficient postinjury plate

The authors are with the Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, NY. Guss (gussmike@gmail.com) is corresponding author.

appearances did return to play, however, the following season, he had less than 100 plate appearances, unrelated to his hamate fracture the season prior. One player returned to competition at the minor league level, but did not return to the majors and was excluded. The remaining 18 players had complete statistical performance data and were included in the study as the fracture cohort. A one-to-one matched-control group was selected based upon patient age and similarity scores provided by a comprehensive online database (www.baseballreference.com), identifying which player's careers are most similar according to performance data and seasons of play. Players in the control cohort were additionally matched according to position (catcher, infield, or outfield), and all efforts were made to select controls without a significant injury history. A cohort group was utilized for comparison to mitigate potential confounding variables inherent in the career path of MLB players, as their performance may be affected by increasing age, changes in team compliment, and experience.

The year in which the player sustained the hook of hamate fracture was defined as the index season. The index season for controls was matched to the age of the matched-subject at the time of injury. Study parameters included the 2 seasons immediately before and the 2 seasons after injury for the main performance variable—Wins Above Replacement (WAR). Demographic data including age and player position were recorded. Performance data recorded for one season before and after injury included isolated power (ISO); on-base plus slugging (OPS); batting average; and rates for doubles, triples, homeruns, strike outs, base on balls, and runs batted in. Statistics measuring rates per at bat were used to allow for comparison between seasons while controlling for changes in plate appearances, playing time, and team dynamics.

MLB WAR data were collected for both cohorts. WAR is a statistical method, used by the MLB and baseball statisticians, to summarize a player's total contributions to their team in one statistic. WAR is a comprehensive statistic that allows for comparisons between players. In addition, ISO was collected for both cohorts. ISO is a statistic that measures a batter's raw power, measuring how many extra bases a player averages per at bat.

As no previous studies have investigated outcome measures with hook of hamate fractures, this pilot study used all available injuries to establish performance metric means and variances to allow for sample size estimates for future studies. Descriptive statistics were performed to describe the 2 cohorts and their

demographics. Univariate analysis was performed to determine whether there was a decline in athletic performance from preinjury to postinjury among players in the fracture cohort. Demographic and performance data were compared between the fracture and matched-control cohorts. The Student's *t* test was used to analyze continuous variables, and the Fisher's exact test was used to evaluate categorical data. The significance level was set at a *P* value of <.05 for all analyses.

Multivariate linear regression analyses were performed to look at the association between performance after injury (WAR a single season and 2 seasons after injury, as well as ISO and OPS a season after injury), with a variety of preinjury and demographic characteristics. The covariates included in the analysis were WAR (a season prior to injury) and WAR 2 seasons prior, ISO and OPS prior to injury, and demographic characteristics including height and age. For our analyses, we ran stepwise multivariate linear regression, including these predictors, together. We then reran the analyses looking at the demographic variables independent from preinjury performance predictors (WAR 1 season prior, WAR 2 seasons prior, preinjury ISO, preinjury OPS).

This article does not contain any studies with human or animal subjects. All data are public in nature and are exempt from Ethics Committee approval for human investigation.

Results

The average age at the time of injury in the fracture cohort was 25.1 years. The mean experience prior to injury was 4.4 MLB seasons (Table 1). All 32 players identified were treated with operative intervention. In addition, all players sustained an injury to their nondominant hand. All injuries occurred while the athlete was batting: 28 while swinging (4 of which were secondary to a foul tipped ball) and 4 after being hit by a pitch.

MLB players before and after the index injury year showed no significant differences in performance, including WAR at 1 and 2 seasons before and after injury (Table 2).

Comparison of the hook of hamate fracture cohort with the control cohort revealed that the controls were well matched, as there was no significant differences in demographic data or position (Table 1). There were no statistical differences between the fracture and control cohorts in WAR 1 and 2 seasons postinjury, ISO, OPS, or performance variables measured as rates per at bat (Table 3).

Table 1 Demographic and Preindex Season Performance Comparison Between MLB Players With Hook of Hamate Fractures and Matched-Controls

Parameter	Fracture cohort (n = 18)	Control cohort (n = 18)	<i>P</i> value
Age, y	25.1 (1.7)	25.1 (1.7)	>.99
WAR 1 season prior to index season	2.7 (2.4)	3.0 (2.2)	.75
WAR 2 seasons prior to index season	1.5 (1.9)	1.9 (2.38)	.60
Preindex season isolated power	0.14 (0.06)	0.16 (0.06)	.34
Preindex season on-base plus slugging	0.76 (0.15)	0.77 (0.11)	.45
Position played			
Catcher	1	1	.59
Infield	9	6	
Outfield	8	11	

Abbreviations: MLB, Major League Baseball; WAR, Wins Above Replacement. Note: Demographic data and performance values expressed as mean (SD). The index season refers to the season in which a fracture cohort player sustained a hook of hamate fracture and the representative season, a control cohort player was age-matched to their corresponding fracture cohort player.

Table 2 Difference in Performance Variables for Major League Baseball Players With Hook of Hamate Fractures Based on Preinjury and Postinjury Seasons

Parameter	Fracture cohort (n = 18) (preinjury value – postinjury value)	P value
Wins Above Replacement (based on ± 1 season)	0.199 (2.658)	.81
Wins Above Replacement (based on ± 2 seasons)	–0.769 (2.209)	.35
Isolated power	–0.020 (0.054)	.39
On-base plus slugging	0.064 (0.128)	.24
Hit—double rate	0.001 (0.020)	.85
Hit—triple rate	0.0002 (0.005)	.91
Hit—homerun rate	–0.001 (0.013)	.94
Runs batted in rate	0.002 (0.043)	.89
Strike out rate	–0.020 (0.064)	.39
Batting average rate	0.012 (0.046)	.28
Base on balls rate	0.018 (0.033)	.17

Note: Values expressed as mean difference between the preinjury and postinjury metrics (SD). Preinjury refers to the season immediately prior to injury and postinjury refers to the season immediately after injury.

Table 3 Performance Comparison Between Major League Baseball Players With Hook of Hamate Fractures and Matched-Controls

Parameter	Fracture cohort (preindex value – postindex value)	Control cohort (preindex value – postindex value)	P value
Wins Above Replacement (based on ± 1 season)	0.199 (2.658)	1.061 (2.302)	.31
Wins Above Replacement (based on ± 2 seasons)	–0.769 (2.209)	–0.894 (2.626)	.88
Isolated power	–0.020 (0.054)	–0.005 (0.055)	.40
On-base plus slugging	0.064 (0.128)	–0.001 (0.101)	.10
Hit—double rate	0.001 (0.020)	0.004 (0.017)	.70
Hit—triple rate	0.0002 (0.005)	0.002 (0.006)	.35
Hit—homerun rate	–0.001 (0.013)	–0.004 (0.015)	.46
Runs batted in rate	0.002 (0.043)	–0.009 (0.035)	.38
Strike out rate	–0.020 (0.064)	0.002 (0.034)	.21
Batting average rate	0.012 (0.046)	–0.001 (0.032)	.35
Base on balls rate	0.018 (0.033)	0.069 (0.024)	.25

Note: Performance values expressed as mean difference between the preindex and postindex metrics (SD). Preindex refers to the season immediately prior to injury and postindex refers to the season immediately after injury.

Due to a small sample size, multivariate analysis may not appropriately rule out associations with hook of hamate fractures. However, stepwise multivariate linear regression analysis demonstrated that WAR 2 seasons prior to injury was most frequently associated with postinjury performance metrics. In the 4 models that were run, preinjury ISO ($P = .02$) and WAR 2 seasons prior to injury ($P = .04$) were predictive of WAR after injury (when combined [$P = .01$]). For each 1-point increase in WAR 2 seasons prior to injury, there was an increase of 0.45 detected in WAR after injury (standardized $\beta = 0.446$; $P = .04$, 95% confidence interval [CI], 0.027–1.216). The same covariates (WAR 2 seasons prior [$P = .05$] and preinjury ISO [$P < .01$]) were also predictive of post injury ISO. For each increase in preinjury ISO of 0.100, there was a postinjury ISO increase of 0.075 (standardized $\beta = 0.752$; $P < .01$, 95% CI, 0.497–1.501). When looking at predictors of postinjury OPS, WAR 2 seasons prior ($P = .04$) and preinjury OPS ($P < .01$) were both associated. Each preinjury OPS increase of 0.100 was associated with postinjury OPS increase of 0.069 (standardized $\beta = 0.698$; $P < .01$, 95% CI, 0.347–1.334). The smaller subgroup

analyses separating demographic predictors from preinjury performance predictors isolated height as having a weak predictive association with postinjury ISO (standardized $\beta = 0.524$; $P = .03$, 95% CI, 0.003–0.038).

Discussion

MLB players rely on their hands to help them perform at an elite level. Hook of hamate fractures are associated with baseball players, yet there is limited data on performance outcomes after injury. In 1986, Parker et al reported on 5 athletes with 6 hook of hamate fractures (4 professional).² Four injured while batting fractured their nondominant hand. All patients underwent hook of hamate excision and returned to competition. Bachoura et al⁴ reported on 8 hook of hamate fractures in 7 baseball players (1 high school, 3 college, and 3 professional). Six occurred during batting, and 2 occurred due to an errant pitch. Batting injuries were of the nondominant hand. Patients underwent hamate hook excision and ulnar tunnel

decompression. All athletes returned to competition. These studies did not report performance outcomes. Similar to these 2 smaller reports, 88% of our fracture cohort sustained injuries during batting, all injured their nondominant hand, and all players returned to competition, signifying that a hook of hamate fracture in the nondominant hand is not a career ending injury.

Most authors recommend early surgical intervention with excision of the hook, especially in high performance athletes, to restore function, allow early return to play, and prevent the chance of future missed games secondary to failure of nonoperative treatment, including nonunion, flexor tendon irritation, and ulnar nerve impingement.^{5,10,11} Within our fracture cohort, we found a 100% operation rate. However, due to the limited nature of our data, we are unable to differentiate the specific procedure performed, the timing of surgery, complications, or additional procedures, and cannot comment on preferred surgical intervention based upon our study cohort. MLB players represent a large investment for their teams, and require treatment that will return them to play as quickly as possible. Thus, the rate of surgical treatment in this patient population may be higher than in the general population.

We hypothesized that a hook of hamate fracture would lead to a decrease in performance in MLB players. However, our results demonstrated that players returned to their preinjury performance level. MLB players sustaining hook of hamate fractures did not show any decrease in performance when compared with matched-controls. Our findings suggest that MLB players are able to return to their prior performance level, and continue their careers unhindered after sustaining a hook of hamate fracture.

Interestingly, when controlling for all factors included in our multivariate regression model, WAR 2 seasons preinjury and ISO preinjury were predictive of performance after injury with a strong positive correlation. We believe that the players who were more productive preinjury, were more motivated to complete their rehabilitation and return to play at an elite level.

MLB players were able to return to a high level of play without a significant decrease in performance after injury. Therefore, it is reasonable to infer that the “everyday” baseball player may expect to return to play. However, it is unclear if the professional athletes’ motivation and access to trainers, therapists, and rehab can be matched by the “everyday” player in order to return to his or her preinjury performance level.

Our study has several limitations. Due to the retrospective nature of the study, our data contain a heterogeneous treatment population. Details including medical and surgical history, surgical technique, and rehab protocols were not available for collection; and, therefore, we are unable to comment on which surgical procedure was most commonly performed or most effective. In addition, we could not control for potential confounders, including simultaneous injuries, trades, personal player circumstances, changes in coaching, and playing time for both the fracture and control cohorts. We also could not control for compliance with treatment protocols. Additionally, matching the controls to patients based upon age means that not all players had the same level of playing experience, and is another limitation. Exclusion of 14 of the 32 players sustaining hook of hamate fractures from the fracture cohort may subject our study to selection bias. Finally, our analysis may be subject to type II error due a relatively small sample size of 18 MLB players included in this study. We recommend that future evaluations of hook of hamate fractures include larger cohorts as the data become available.

Conclusion

Hook of hamate fractures treated by operative means, in MLB players, did not impact postinjury performance. MLB players were able to return to play after their injury and perform at a similar level as their control-matched peers at 2 years postinjury. This study provides the treating physician with information to aid in guiding athlete expectations regarding return to baseball at his or her preinjury performance level following a hook of hamate fracture.

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