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# Performance Outcomes After Metacarpal Fractures in National Basketball Association Players

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**Abstract**

**Background:** The aim was to determine whether players in the National Basketball Association (NBA) who sustain metacarpal fractures demonstrate decreased performance upon return to competition when compared with their performance before injury and that of their control-matched peers. **Methods:** Data for 32 NBA players with metacarpal fractures incurred over 11 seasons (2002-2003 to 2012-2013) were obtained from injury reports, press releases, and player profiles (www.nba.com and www.basketballreference.com). Player age, body mass index (BMI), position, shooting hand, number of years in the league, and treatment (surgical vs nonsurgical) were recorded. Individual season statistics for the 2 seasons immediately prior to injury and the 2 seasons after injury, including player efficiency rating (PER), were obtained. Thirty-two controls matched by player position, age, and performance statistics were identified. A performance comparison of the cohorts was performed. **Results:** Mean age at the time of injury was 27 years with an average player BMI of 24. Players had a mean 5.6 seasons of NBA experience prior to injury. There was no significant change in PER when preinjury and postinjury performances were compared. Neither injury to their shooting hand nor operative management of the fracture led to a decrease in performance during the 2 seasons after injury. When compared with matched controls, no significant decline in performance in PER the first season and second season after injury was found. **Conclusion:** NBA players sustaining metacarpal fractures can reasonably expect to return to their preinjury performance levels following appropriate treatment.

**Keywords:** metacarpal fracture, hand fracture, National Basketball Association, NBA players, athletes

## Introduction

Metacarpal fractures often occur during athletic competition and contact sports, such as basketball, especially during ball handling.[4,5,7,8,12] Professional basketball players are at risk of sustaining such injuries as they participate in a fast-paced, high-contact sport.[6,15] Players in the National Basketball Association (NBA) are highly skilled athletes who rely on full, unhindered function of their hands to perform at the highest level. Metacarpal fractures in this subset of high-level athletes may be potentially debilitating in terms of athletic performance.

Although few studies have published data on time to return to athletic performance following a metacarpal fracture,[11,14] there is a paucity of data assessing the effect of a metacarpal fracture on future athletic performance. The purpose of this study was to examine performance before and after injury, in elite NBA athletes who sustained a metacarpal fracture. In addition, our study attempted to identify variables associated with an athlete's return to performance. We hypothesized that a metacarpal fracture would lead to a decrease in performance when compared with the player's preinjury performance and control-matched peers. Furthermore, we hypothesized that injury to the shooting hand and fractures undergoing operative fixation would be variables associated with a decrease in performance.

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## Materials and Methods

The study group contained NBA players who sustained an acute metacarpal fracture during an 11-year time period between the 2002-2003 and 2012-2013 seasons. Subjects were identified using a comprehensive online injury database (www.prosportstransactions.com) cross-referenced with team press releases, online injury reports, and player profiles (www.nba.com and www.basketballreference.com). This methodology has been validated in multiple studies.[1-3,9,13]

Forty-two players with acute metacarpal fractures were initially identified. Players were included for analysis if they had played in at least 2 NBA seasons before and 2 NBA seasons after the index injury season. Of the 42 players, 8 were either in their first or second year in the league and were excluded due to lack of performance data for 2 years prior to the metacarpal fracture. Two players did not play for 2 full seasons after the fracture and were excluded; one player retired due to an unrelated injury and the other player changed leagues to play in Europe. The remaining 32 players had complete statistical performance data and were included in the study in the fracture cohort. A one-to-one matched control group was selected based on similarity scores provided by a comprehensive online database (www.basketballreference.com). These scores identify players whose careers are most similar according to performance data and seasons of play. Players in the control cohort were additionally matched according to position (guard, forward, or center), and all efforts were made to select controls without a significant injury history. A cohort group was utilized for comparison to minimize potential confounding variables inherent in the career path of NBA players as their performance may be affected by increasing age and experience.

The index injury season was defined as the season in which the player sustained the metacarpal fracture. 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 2 seasons after injury. Demographic data, including player height, weight, and body mass index (BMI), as well as player shooting hand and whether the player underwent surgical treatment of his or her metacarpal fracture, were noted. Performance data were recorded before and after injury and included minutes played per game (MPG), points per game (PPG), points per 36 minutes played, assists per 36 minutes played, rebounds per 36 minutes played, steals per 36 minutes played, and blocks per 36 minutes played. Statistics per 36 minutes played were used to allow for comparison between seasons while controlling for changes in playing time and team dynamics.

In addition, NBA player efficiency rating (PER) data were collected for both cohorts. PER is a novel statistical method, which involves the summation of a player's positive statistical contributions minus negative measures.[10] PER is a comprehensive statistic that accounts for variables such as a player's playing time, as well as his or her team's pace and style, and allows for standardized comparisons between players. It has been previously utilized as a standardized outcome metric in similar studies.[1,3,16]

As the variability in PER with regard to metacarpal fractures has not been investigated, we also reviewed the collected data to establish the PER means and variance for this injury as a reference for future studies. Descriptive statistics were performed to describe the 2 cohorts and their demographics. Univariate analysis was performed to compare the effects of whether the injury was incurred in the shooting hand, the type of treatment (operative vs nonoperative), and 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, with a subcomparison of operatively treated fracture patients versus the control cohort. Multivariate regression analysis was performed to identify factors associated with performance (as measured by PER) after the injury while controlling for age, height, BMI, seasons in the NBA, MPG prior to the injury, and PER 1 year prior to the injury as predictor variables. Continuous variables were evaluated using Student $t$ test, and categorical data were evaluated using Fisher exact test. The significance level was set at $P < .05$.

## Results

Among the fracture cohort, the average age at the time of injury was 27 years (range, 20-34). The average BMI was 24 and the mean experience prior to injury was 5.6 NBA seasons. Fourteen of the 32 (44%) players were treated with operative fixation. Refracture occurred in 2 (6%) players, with one player refracturing 3 months and one 5 months after nonoperative treatment. Metacarpal fractures of the shooting hand did not show a statistically significant difference in performance when compared with players with fractures of their nonshooting hand (Table 1). No significant differences were found between players treated operatively and those treated nonoperatively regarding MPG, PER, PPG, and performance variables per 36 minutes (Table 2). When comparing players before and after the index injury year, MPG as well as PER 1 and 2 seasons postinjury showed a modest decline. However, neither of these differences achieved statistical significance (Table 3).

Comparison of the fracture cohort with the control cohort revealed that the controls were well matched as there was no significant difference in demographic data, preindex season performance, or MPG (Table 4). There were no statistical differences between the fracture and control cohorts in

**Table 1.** Performance Parameter Comparison Between NBA Players Who Sustained Metacarpal Fractures of Their Shooting Hand Versus Those Who Fractured Their Nonshooting Hand.

| Parameter | Metacarpal fracture of the shooting hand (n = 15) | Metacarpal fracture of the nonshooting hand (n = 17) | *P* value |
|---|---|---|---|
| Minutes played per game | 1.19 (8.15) | 1.72 (8.34) | .862 |
| PER ± 1 season | −0.88 (3.54) | 0.65 (3.11) | .231 |
| PER ± 2 seasons | −0.65 (4.33) | 2.18 (3.01) | .089 |
| Points per game | −0.80 (1.93) | 0.27 (2.66) | .202 |
| Steals per 36 min played | −0.18 (0.33) | 0.07 (0.40) | .072 |
| Rebounds per 36 min played | −0.47 (1.50) | −0.08 (1.44) | .480 |
| Assists per 36 min played | 0.57 (1.17) | 0.07 (1.00) | .233 |
| Blocks per 36 min played | 0.12 (0.33) | 0.01 (0.57) | .508 |

*Note.* Values are expressed as mean difference between the preinjury and postinjury metrics (standard deviation). Preinjury refers to the season immediately prior to injury, and postinjury refers to the season immediately after injury. NBA, National Basketball Association; PER, player efficiency rating.

**Table 2.** Performance Parameter Comparison Between NBA Players Who Underwent Operative Treatment for Metacarpal Fractures and Those Treated Nonoperatively.

| Parameter | Operative treatment (n = 14) | Nonoperative treatment (n = 18) | *P* value |
|---|---|---|---|
| Minutes played per game | 3.42 (7.97) | 0.39 (8.23) | .314 |
| PER ± 1 season | 0.01 (2.56) | 0.12 (3.75) | .921 |
| PER ± 2 seasons | 2.53 (3.58) | 1.60 (3.09) | .518 |
| Points per game | −0.03 (2.23) | −0.20 (2.61) | .854 |
| Steals per 36 min played | −0.06 (0.34) | 0.00 (0.42) | .671 |
| Rebounds per 36 min played | −0.56 (1.47) | −0.03 (1.44) | .326 |
| Assists per 36 min played | 0.50 (1.55) | 0.11 (0.67) | .422 |
| Blocks per 36 min played | 0.02 (0.23) | 0.07 (0.60) | .726 |

*Note.* Values are expressed as mean difference between the preinjury and postinjury metrics (standard deviation). Preinjury refers to the season immediately prior to injury, and postinjury refers to the season immediately after injury. NBA, National Basketball Association; PER, player efficiency rating.

**Table 3.** Difference in Performance Variables for NBA Players With Metacarpal Fractures Based on Preinjury and Postinjury Seasons.

| Parameter | Fracture cohort (n = 32) | *P* value |
|---|---|---|
| Minutes played per game | 1.52 (8.14) | .526 |
| PER (based on ±1 season) | 0.08 (3.31) | .949 |
| PER (based on ±2 seasons) | 1.66 (2.98) | .295 |

*Note.* Values are expressed as mean difference between the preinjury and postinjury metrics (standard deviation). Preinjury refers to the season immediately prior to injury, and postinjury refers to the season immediately after injury. NBA, National Basketball Association; PER, player efficiency rating.

MPG, PPG, PER 1 and 2 seasons postinjury, or performance variables per 36 minutes played (Table 5). NBA players who underwent surgery for metacarpal fractures did not have a statistically significant decrease in performance outcomes when compared with controls (Table 6).

Multivariate regression analysis demonstrated that only PER prior to the injury was associated with a statistically significant increase in PER 1 year ($\beta = 0.74$, 95% confidence interval [CI], 0.517-0.970, $P < .001$) and 2 years ($\beta = 0.61$, 95% CI, 0.33-0.89, $P < .001$) postoperatively while controlling for other variables.

## Discussion

NBA players rely on full function of their hands to perform at the highest level of competition. Metacarpal fractures are one of the most common fractures of the upper extremity and commonly occur during athletic competition. Anecdotally, some authors have suggested that metacarpal fractures can significantly affect an athlete's career; however, there is a paucity of data reporting on performance outcomes after metacarpal fracture.[4,7,11,14]

Most metacarpal fractures in athletes are minimally displaced and can be treated nonoperatively with casting and rehabilitation.[11,14] Within our fracture cohort, we found a

**Table 4.** Demographic and Preindex Season Performance Comparison Between NBA Players With Metacarpal Fractures and Matched Controls.

| Parameter | Fracture cohort ($n$ = 32) | Control cohort ($n$ = 32) | $P$ value |
|---|---|---|---|
| Age, y | 27.31 (3.72) | 27.31 (3.72) | 1.000 |
| Height, in | 78.91 (4.55) | 78.25 (3.85) | .541 |
| BMI, kg/m$^2$ | 24.53 (1.74) | 24.25 (1.60) | .501 |
| No. of preindex seasons | 5.63 (3.15) | 5.75 (3.76) | .886 |
| PER 1 season prior to index season | 14.68 (4.93) | 14.93 (3.10) | .812 |
| PER 2 seasons prior to index season | 15.36 (3.84) | 14.59 (3.04) | .414 |
| Minutes played per game season prior to index season | 25.24 (9.22) | 25.89 (8.99) | .775 |
| Position played | | | |
| Forward | 13 | 13 | 1.000 |
| Guard | 13 | 13 | |
| Center | 6 | 6 | |

*Note.* Demographic data and performance values are expressed as mean (standard deviation). The index season refers to the season in which a fracture cohort player sustained the metacarpal fracture and the representative season a control cohort player was age-matched to his or her corresponding fracture cohort player. NBA, National Basketball Association; BMI, body mass index; PER, player efficiency rating.

**Table 5.** Performance Comparison Between NBA Players With Metacarpal Fractures and Matched Controls.

| Parameter | Fracture cohort ($n$ = 32) | Control cohort ($n$ = 32) | $P$ value |
|---|---|---|---|
| Minutes played per game | 1.52 (8.13) | 0.15 (8.27) | .51 |
| PER ± 1 season | 0.08 (3.31) | 1.02 (3.41) | .267 |
| PER ± 2 seasons | 1.66 (2.98) | 0.91 (3.65) | .421 |
| Points per game | −0.13 (2.44) | 1.07 (3.46) | .115 |
| Steals per 36 min played | −0.02 (0.39) | 0.08 (0.34) | .310 |
| Rebounds per 36 min played | −0.225 (1.45) | 0.23 (1.28) | .190 |
| Assists per 36 min played | 0.26 (1.08) | −0.08 (1.17) | .234 |
| Blocks per 36 min played | 0.05 (0.49) | 0.15 (0.46) | .392 |

*Note.* Performance values expressed as mean difference between the preindex and postindex metrics (standard deviation). Preindex refers to the season immediately prior to injury, and postindex refers to the season immediately after injury. NBA, National Basketball Association; PER, player efficiency rating.

**Table 6.** Performance Comparison Between NBA Players Who Underwent Operative Treatment of Their Metacarpal Fractures and Matched Controls.

| Parameter | Operatively treated fracture cohort (n = 14) | Control cohort (n = 14) | $P$ value |
|---|---|---|---|
| Minutes played per game | 0.01 (2.56) | −0.99 (3.52) | .450 |
| PER ± 1 season | 1.89 (1.98) | 0.91 (3.05) | .409 |
| PER ± 2 seasons | 1.78 (2.96) | −0.84 (2.62) | .083 |
| Points per game | −0.06 (0.23) | −0.07 (0.23) | .944 |
| Steals per 36 min played | −0.56 (1.06) | 0.35 (1.06) | .097 |
| Rebounds per 36 min played | 0.50 (1.15) | −0.05 (1.15) | .334 |
| Assists per 36 min played | 0.02 (0.23) | −0.03 (0.25) | .679 |
| Blocks per 36 min played | −0.03 (4.06) | 0.28 (4.06) | .816 |

*Note.* Performance values are expressed as mean difference between the preindex and postindex metrics (standard deviation). Preindex refers to the season immediately prior to injury, and postindex refers to the season immediately after injury. Note that the control cohort presented in this table was matched to the operatively treated fracture cohort. NBA, National Basketball Association; PER, player efficiency rating.

44% rate of operative intervention. This is a higher rate than has previously been reported.[11,14] Rettig et al reported on 56 metacarpal fractures in 53 athletes participating in various sports.[14] Eight (14%) of the fractures in that study were treated operatively. The authors reported that the time lost from practice or competition in patients treated with casting was 12 days whereas the time lost after operative intervention was 14 days. In addition, the average time lost due to injuries from basketball was 20 days compared with 11 days for football injuries. This difference in time lost suggests the need for full hand function in basketball. Similarly, Kodama et al retrospectively reviewed 105 athletes with either metacarpal or phalangeal fractures.[11] Twenty of these patients underwent surgical treatment with open reduction and internal fixation "in an attempt to achieve an early return" to their sport. Of the 20 patients treated operatively, 8 underwent surgery for metacarpal fractures with all returning to activity within 4 weeks of surgery. No outcome data were reported.

Athletes, especially NBA players, require optimal hand function and desire early return to play. Thus, the threshold for surgical treatment may be lower among elite athletes than in the general population.[11] In addition, metacarpal fractures sustained during basketball may be more amenable to surgical treatment and might explain the high rate of operative intervention in our fracture cohort. Furthermore, NBA players represent a large investment for NBA teams and therefore may be influenced to undergo operative fixation to allow for early return to play.

Basketball is a sport that requires a high amount of manual dexterity, and for this reason, we hypothesized that a metacarpal fracture would lead to a decrease in performance in NBA players. However, our results demonstrated that players returned to their preinjury performance level. When compared with matched controls, NBA players sustaining metacarpal fractures did not show any downtrend in performance. Our expectation was that injury to the shooting hand would result in a greater decrease in performance compared with the nonshooting hand given a NBA player's preferential use of the shooting hand for sports specific skills. However, no significant difference was found. We also expected a significant decrease in performance in players treated operatively, as these fractures are often more severe. However, no statistically significant difference was found between players treated operatively or nonoperatively. Based on our findings, it appears NBA players are able to return to their prior performance level and continue their careers largely unaffected by their metacarpal fracture.

Although our study focuses on high-level professional athletes, our results may be generalized to the "everyday" athlete. In our cohort, NBA 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 "weekend warrior" may expect to return to basketball at his or her preinjury performance level after appropriate treatment and dedicated rehabilitation.

Interestingly, multivariate regression analysis demonstrated that only PER before injury was predictive of a change to the PER after the injury. Players experienced an average increase in PER of 0.74 and 0.61 at 1 and 2 years post injury, respectively. Although unclear, the etiology of this finding is likely multifactorial. It may be that "better" players with a higher PER preinjury are more motivated to rehabilitate completely and improve quicker. The time lost for treatment and rehabilitation of their metacarpal fractures may also allow for maximum recuperation from other injuries. In addition, players may seek to use recovery time to improve their nonathletic basketball skills and mental conditioning by reviewing game footage and discussing strategy with the coaching staff.

Our study has several limitations. First, due to the retrospective nature of the study in the specific patient population of NBA players, our data contain a heterogeneous population of metacarpal fractures and management. Details such as past medical and surgical history, location and stability of the metacarpal fracture, nonoperative management strategy, surgical technique, and rehab protocols were not available for collection. Next, we could not control for potential confounders including concomitant injuries, trades, personal obligations, coaching changes, and changes in offensive and defensive systems for both the fracture and control cohorts. In addition, we could not control for compliance with treatment protocols. Last, exclusion of 10 of the 42 initially identified fracture cohort players may subject our study to selection bias. Similarly, the presented analysis may be subject to type II error due a relatively small sample size of NBA players included in this study.

Despite these limitations, this study provides hand surgeons with a report on athletic performance outcomes after metacarpal fractures in NBA players. Strengths of the study include the use of controls that were highly matched according to position, ability, and performance. In addition, the use of PER, a comprehensive performance statistic designed for maximal standardization, as the primary performance variable mitigates bias in objectively comparing performance among players of different positions and skill sets.

Metacarpal fractures, either treated by operative or nonoperative means, do not portend a significantly negative outcome in regard to an NBA player's postinjury performance. NBA players in the current study were able to return after recovery from their injury and perform at a similar level as their control-matched peers. In addition, injury to a player's shooting hand did not purport a significantly worse outcome. This study provides quantifiable evidence for the hand surgeon to assist in managing athlete expectations regarding return to basketball at his or her preinjury performance level.

## Ethical Approval

All data are public in nature and are exempt from institutional review board approval.

## Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

## Statement of Informed Consent

Given the public nature of the data, this study was exempt from institutional review board approval and did not require informed consent.

## Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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