

## [ Orthopaedic Surgery ]

# Return to Play and Performance After Jones Fracture in National Basketball Association Athletes

John P. Begly, MD,\*† Michael Guss, MD,† Austin J. Ramme, MD, PhD,† Raj Karia, MPH,† and Robert J. Meislin, MD†

**Background:** Basketball players are at risk for foot injuries, including Jones fractures. It is unknown how this injury affects the future play and performance of athletes.

**Hypothesis:** National Basketball Association (NBA) players who sustain Jones fractures of the base of the fifth metatarsal have high rates of return to play and do not experience a decrease in performance on return to competition when compared with preinjury and with control-matched peers.

**Study Design:** Retrospective cohort study.

**Level of Evidence:** Level 5.

**Methods:** Data on 26 elite basketball players with Jones fractures over 19 NBA seasons (1994-1995 to 2012-2013) were obtained from injury reports, press releases, player profiles, and online public databases. Variables included age, body mass index (BMI), player position, experience, and surgical treatment. Individual season statistics pre- and postinjury were collected. Twenty-six controls were identified by matched player position, age, and performance statistics.

**Results:** The mean age at the time of injury was 24.8 years, mean BMI was 24.7 kg/m<sup>2</sup>, and the mean experience prior to injury was 4.1 NBA seasons. Return to previous level of competition was achieved by 85% of athletes. There was no change in player efficiency rating (PER) when pre- and postinjury performance was compared. When compared with controls, no decline in PER measured performance was identified.

**Conclusion:** The majority of NBA players sustaining a Jones fracture return to their preinjury level of competition. These elite athletes demonstrate no decrease in performance on their return to play.

**Clinical Relevance:** Jones fractures are well-studied injuries in terms of etiology, diagnosis, and management. However, the effect of these injuries on future performance of athletes is unknown. Using the findings of our study, orthopaedic surgeons may be better prepared to counsel and educate elite athletes who sustain a Jones fracture.

**Keywords:** Jones fracture; performance; National Basketball Association; metatarsal; foot injury

Basketball is an intensely physical sport, and athletes are at risk for injury, including foot injuries.<sup>15</sup> This is particularly true in elite athletes, whose bodies must endure high stresses inherent in strenuous repetitive jumping and pivoting.<sup>18</sup> Defined as a transverse diaphyseal fracture of the proximal fifth metatarsal, Jones fractures rely on a tenuous vascular supply and are notoriously difficult to heal.<sup>4,11-13,17,19</sup> Although based largely in anecdotal evidence, members of the National Basketball Association (NBA) community, including

management, players, and the media, often express great concern over the diagnosis of a Jones fracture and the repercussions these injuries may have on future return to play and performance. It is currently unknown how this injury affects return to play and future performance of athletes.

Several authors have published data on timing of return to athletic performance after a Jones fracture.<sup>12,13,17,18,21</sup> However, no studies have assessed the effect of a Jones fracture on future athletic performance. The purpose of this study was to examine

From the †Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, New York

\*Address correspondence to John P. Begly, MD, NYU Hospital for Joint Diseases, 301 East 17th Street, New York, NY 10003 (email: john.begly@nyumc.org).

DOI: 10.1177/1941738115621011

© 2015 The Author(s)

performance and return to play in elite NBA athletes who sustained acute Jones fractures. Additionally, this study aimed to identify variables associated with an athlete's return to play and performance. We hypothesize that NBA players will not return to preinjury performance levels after Jones fracture.

## METHODS

Given the public nature of these data, no institutional review board approval was necessary for this study. The study group was composed of all NBA athletes who had sustained an acute Jones fracture during competition in an NBA game over a time period between the 1994-1995 and 2012-2013 seasons. Subjects were identified using a comprehensive online injury database (<http://www.prosportstransactions.com>). Results were cross-referenced with team press releases, online injury reports, and player profiles to confirm diagnosis. This method has been validated in multiple studies.<sup>2,3,7,8,14,16</sup> Effort was made to differentiate between stress fractures of the fifth metatarsal and acute Jones fractures. Access to an official NBA-controlled injury database was not available.

Thirty-seven players with acute Jones fractures were identified. Of these, 26 players with appropriate complete statistical performance data were included in the study. Return to play was defined as returning to at least 1 game of equal level of competition the year after injury. A 1-to-1 matched control group was selected based on "similarity scores" provided by a comprehensive online database (<http://www.basketballreference.com>). This score identifies players whose careers are most similar according to performance data and seasons of play. Regarding position, backcourt players were designated as "guards," while frontcourt players were classified as "forwards." Controls were additionally selected according to position, and all efforts were made to select controls without a significant injury history.

The index year was defined as the season in which the player sustained the Jones fracture. The index year for controls was matched to the age of the matched-subject at the time of injury. Study parameters included the season before and after injury, as well as averaged data over 3 seasons before and after injury, if available. Method of treatment and instances of recurrence and/or reoperation were recorded. Demographic data, including height, weight, and body mass index (BMI), were collected. Performance data were recorded before and after injury and included games missed, minutes per game, assists per 36 minutes played, rebounds per 36 minutes played, steals per 36 minutes played, blocks per 36 minutes played, and points per game. Statistics were evaluated on a per minute basis to help control for an athlete's playing time.

Additionally, NBA player efficiency rating (PER) data were collected on all subjects and controls. PER is a novel statistical method that involves the summation of a player's positive statistical contributions and then subtracting negative measures.<sup>9</sup> Yearly, a PER of 15 is designated to represent an average NBA player. PER is a comprehensive statistic that accounts for variables such as a player's playing time as well as their team's

pace and style and allows for standardized comparisons between players. It has been previously used as a variable in similar studies.<sup>1,2,20</sup>

As no previous studies have investigated the variability in PER with regard to Jones fractures, this pilot study used all available injuries to establish the PER means and variances for this injury to allow for future studies. Unfortunately, no sample size estimate was performed. Descriptive statistics were performed to describe the cohorts and their demographics. Univariate analysis was performed to compare the cohorts and the outcomes of the subjects (continuous variables were evaluated using Student *t* tests and categorical data were evaluated using the Fisher exact test). Additionally, multivariate regression analysis was performed to identify which factors were associated with performance (as measured by PER) after the injury while controlling for age, height, BMI, seasons in the NBA, minutes played per game prior to the injury, and PER 1 year prior to the injury as predictor variables. All statistical analyses were performed using SPSS version 19.0 software (IBM Corp), and significance level was set at  $P < 0.05$ .

## RESULTS

Four of the 26 (15%) players did not return to play in a subsequent NBA game after the season in which a Jones fracture was sustained. Twenty-four of 26 (92%) athletes were treated with operative fixation, and 3 players (12%) underwent secondary reoperation. Recurrence of the injury was experienced by 5 players (19%). The mean age at the time of injury was 24.8 years, with a standard deviation of 3.8 and a range of 21 to 38 years of age. The mean BMI of subjects was 24.7 kg/m<sup>2</sup>, and the mean experience prior to injury was 4.1 NBA seasons. Average PER for all players was 14.1. Average minutes played per game prior to injury was 21.5 for all athletes, and baseline PER did not differ significantly between athletes who returned to play after injury and those who did not (Tables 1 and 2).

Controls were matched according to position and performance, and the cohort consisted of 14 forwards and 12 guards. The 2 groups did not differ with respect to any demographic data; nor were there any significant differences in baseline minutes per game or performance.

NBA athletes who underwent surgery for a Jones fracture were examined based on pre- and postinjury performance variables (Table 3). In these athletes, minutes played per game decreased in postinjury seasons. PER values comparing 1 and 3 seasons before and after injury were not different in athletes who underwent operative treatment.

These performance variables were also examined in a comparison between athletes who underwent operative fixation and matched controls (Table 4). The 2 groups were not different with regard to minutes per game or PER before and after surgery.

In addition to PER, specific performance variables were also examined between the 2 groups (Table 5). Steals per

Table 1. Demographic and performance data for NBA players with Jones fractures<sup>a</sup>

Parameter	All Players	Returned to Play	Did Not Return
Age, y	24.8 (3.8)	25.2 (3.9)	22.8 (1.6)
Height, in	79.3 (3.7)	79.4 (3.7)	79.0 (4.4)
BMI, kg/m <sup>2</sup>	24.7 (2.1)	24.8 (2.3)	24.4 (1.4)
NBA seasons prior to injury	4.1 (3.5)	4.5 (3.5)	2.0 (2.3)
PER prior to injury	14.1 (4.0)	13.9 (4.1)	15.2 (5.5)
Minutes played per game prior to injury	21.5 (9.3)	21.9 (8.8)	19.0 (12.6)

BMI, body mass index; NBA, National Basketball Association; PER, player efficiency rating.  
<sup>a</sup>Values expressed as mean (SD).

Table 2. Comparison between NBA players with Jones fractures and control players<sup>a</sup>

Parameter	Subject	Control	P
Age, y	24.8 (3.8)	24.7 (3.8)	0.884
Height, in	79.3 (3.7)	77.7 (3.6)	0.124
BMI, kg/m <sup>2</sup>	24.7 (2.1)	23.7 (11.4)	0.055
Preinjury/preindex seasons	4.1 (3.5)	2.9 (3.0)	0.188
PER 1 season prior to injury	14.1 (4.0)	14.0 (3.5)	0.936
PER 3 seasons prior to injury	14.1 (3.5)	13.7 (3.1)	0.601
Minutes played per game prior to injury	21.4 (9.3)	24.1 (9.1)	0.313
Position played, n			
Forward	13	13	>0.999
Guard	13	13	

BMI, body mass index; NBA, National Basketball Association; PER, player efficiency rating.  
<sup>a</sup>Values expressed as mean (SD) unless indicated otherwise.

Table 3. Difference in performance variables for NBA players who underwent surgery for Jones fracture based on preinjury and postinjury seasons<sup>a</sup>

Parameter	Preinjury Value – Postinjury Value	P
Minutes played per game	-1.03 (8.37)	0.588
PER (based on ± 1 season)	0.99 (3.25)	0.191
PER (based on ± 3 seasons)	0.46 (2.53)	0.431

NBA, National Basketball Association; PER, player efficiency rating.  
<sup>a</sup>Values expressed as mean difference between the preinjury and postinjury metrics (SD).

Table 4. Performance comparison between NBA players who underwent surgery for Jones fracture and controls<sup>a</sup>

Parameter	Subjects (Preoperative – Postoperative)	Controls (Preindex – Postindex)	P
Minutes played per game	–1.03 (8.37)	–0.82 (10.48)	0.943
PER $\pm$ 1 season	0.98 (3.25)	–0.49 (2.65)	0.125
PER $\pm$ 3 seasons	0.46 (2.53)	–0.30 (2.38)	0.338

NBA, National Basketball Association; PER, player efficiency rating.

<sup>a</sup>Values expressed as mean difference between the preinjury and postinjury metrics (SD).

Table 5. Performance parameter comparison between NBA players who underwent surgery for Jones fractures and controls<sup>a</sup>

Parameter	Subjects (Preoperative – Postoperative)	Controls (Preindex – Postindex)	P
Points per game	0.77 (3.61)	–1.27 (2.22)	0.041
Steals per 36 min played	–0.08 (0.66)	0.06 (0.35)	0.446
Rebounds per 36 min played	0.26 (2.19)	0.11 (0.99)	0.790
Assists per 36 min played	0.75 (1.64)	–0.59 (1.31)	0.007
Blocks per 36 min played	0.24 (0.65)	0.06 (0.51)	0.361

NBA, National Basketball Association.

<sup>a</sup>Values expressed as mean difference between the preinjury and postinjury metrics (SD).

36 minutes, rebounds per 36 minutes, and blocks per 36 minutes were similar between subjects and controls. However, athletes who underwent operative fixation experienced a statistically significant decrease in postoperative season points per game and assists per 36 minutes when compared with matched controls ( $P = 0.041$  and  $P = 0.007$ , respectively).

The multivariate regression demonstrated that only PER prior to injury was associated with a statistically significant change to PER 1 year ( $\beta = 0.79$ ; 95% CI = 0.405-1.183;  $P < 0.001$ ) and 3 years ( $\beta = 0.69$ ; 95% CI = 0.372-1.015;  $P < 0.001$ ) postoperatively.

## DISCUSSION

During basketball, the fifth metatarsal is subject to significant forces both due to the sport-specific repetitious jumping and cutting<sup>6,18,21</sup> as well as the inherent structure of the ligamentous and capsular attachments.<sup>19</sup> There are relatively high rates of Jones fracture among basketball players<sup>10,22</sup> as well as significant risk with reinjury and chronic discomfort.<sup>11,22</sup> Because of these associations, the Jones fracture has developed a particularly infamous reputation within the NBA management and media community and carries an ominous connotation among the general public with regard to return to play and performance.

Of the 26 athletes in the study, 24 were treated operatively. There are improved rates of union and decreased complication rates and shorter time to return to play in athletes treated operatively compared with those treated nonoperatively.<sup>11,13,14,17-19</sup> Despite the success of operative management, elite athletes are at an increased risk of treatment failure,<sup>12,19</sup> likely because of the unique strenuous stresses placed on the metatarsal during sport and early return to play. Nineteen percent of the players in this study experienced a recurrence of their injury, and 12% underwent a second procedure. The use of larger 4.5-mm screws in patients with higher BMIs, screw exchange, functional bracing, shoe modifications, and use of alternative imaging in fracture follow-up have all been proposed as methods to help prevent and manage injury recurrence.<sup>5,19</sup>

Contrary to the common perspective regarding the prognosis of Jones fractures in NBA athletes—as well as our hypothesis—the overall results of our study were not consistent with an unrecoverable injury. Only 15% of players did not return to play in a postinjury NBA season, and 2 of these athletes were much older (30 and 38 years of age, respectively) than the average age of all players in the study (24.8 years). Athletes did not experience a significant decrease in minutes per game or PER on return from injury.

On closer examination of performance statistics between subjects and controls, the only variables found to be different between the 2 groups were points per game and assists per 36 minutes. Athletes who underwent operative fixation of a Jones fracture experienced slight postinjury decreases in these statistics compared with matched controls. These results suggest that contrary to its reputation, the Jones fracture is not a devastating injury. In the majority of cases, NBA athletes are able to return to an equivalent level of competition with little change in performance after sustaining a Jones fracture.

The multivariate regression analysis demonstrated that the only variable of those tested that was associated with a change to the PER after the injury was the PER before the injury. For every 1 point increase in PER before injury, the PER after injury would increase by 0.79 and 0.69 at 1 and 3 years, respectively. We are not suggesting that the players improved in performance based on this injury; however, players with higher PER before the injury also had a higher PER after the injury.

Our study has several limitations. Because of the inherently small sample size and use of a new outcome measure, no power analysis on sample size was performed. Because of the search method of the study, details such as past medical and surgical history, surgical technique, and rehabilitation protocols were not available for collection. Additionally, we cannot exclude concomitant injuries in athletes over the study period despite efforts to control for such potentially confounding associated injuries. However, controls were highly matched according to position, ability, and performance.

This study involves a relatively small number of athletes. However, the 26 players represent a comprehensive cohort of all players who have sustained a documented acute Jones fracture during NBA play since the 1994-1995 season. Because of this relatively small sample, the analysis presented may be subject to type II error, and larger studies are needed to confirm findings. Definitive conclusions in the study may be limited due to the inherently small sample size of subjects with Jones fractures in the database and potential confounding variables.

Last, it is possible that off-court confounding variables existed, such as players' personal lives and changes in team style of play and system. Additionally, access to details regarding operative intervention and surgical technique was unavailable and may vary from subject to subject. However, a strength of this study is the use of PER—a comprehensive performance statistic designed for maximal standardization—as the primary performance variable. The lack of change in PER both in athletes pre- and postinjury, as well as compared with controls, suggests that elite basketball players may fully recover from a Jones fracture.

## CONCLUSION

Despite the reputation surrounding Jones fractures in the basketball community, NBA athletes have consistently returned to play and performance after injury. Of 26 players who sustained a Jones fracture during play since the 1994-1995

season, only 4 did not return to play in a subsequent NBA season. Those players who did return to play did not experience a decrease in performance compared with their preinjury statistics nor compared with matched controls. Because of the nature of data collection and the cohort studied, these results are specific to NBA athletes. With appropriate management, these athletes may expect to make a full recovery regarding performance in sport after an acute Jones fracture.

## REFERENCES

- Amion NH, Old AB, Tabb LP, Garg R, Toosi N, Cerynik DL. Performance outcomes after repair of complete Achilles tendon ruptures in National Basketball Association players. *Am J Sports Med.* 2013;41:1864-1868.
- Busfield BT, Kharrazi FD, Starkey C, Lombardo SJ, Seegmiller J. Performance outcomes of anterior cruciate ligament reconstruction in the National Basketball Association. *Arthroscopy.* 2009;25:825-830.
- Erickson BJ, Harris JD, Cvetanovich GL, et al. Performance and return to sport after anterior cruciate ligament reconstruction in male Major League Soccer players. *Orthop J Sports Med.* 2013;1:2325967113497189.
- Fairen MF, Guillen J, Busto JM, Roura J. Fractures of the fifth metatarsal in basketball players. *Knee Surg Sports Traumatol Arthrosc.* 1999;7:373-377.
- Glasgow MT, Naranja RJ Jr, Glasgow SG, Torg JS. Analysis of failed surgical management of fractures of the base of the fifth metatarsal distal to the tuberosity: the Jones fracture. *Foot Ankle Int.* 1996;17:449-457.
- Gross TS, Bunch RP. A mechanical model of metatarsal stress fracture during distance running. *Am J Sports Med.* 1989;17:669-674.
- Harris JD, Erickson BJ, Bach BR, et al. Return to sport and performance after anterior cruciate ligament reconstruction in National Basketball Association players. *Sports Health.* 2013;5:562-568.
- Harris JD, Walton DM, Erickson BJ, et al. Return to sport and performance after microfracture in the knees of National Basketball Association players. *Orthop J Sports Med.* 2013;1:2325967113512759.
- Hollinger J. *Pro Basketball Forecast.* Dulles, VA: Potomac Books; 2005.
- Iwamoto J, Takeda T. Stress fractures in athletes: review of 196 cases. *J Orthop Sci.* 2003;8:273-278.
- Kavanaugh J, Brower T, Mann R. The Jones' fracture revisited. *J Bone Joint Surg Am.* 1978;60:776-782.
- Larson CM, Almekinders LC, Taft TN, Garrett WE. Intramedullary screw fixation of Jones fractures. *Am J Sports Med.* 2002;30:55-60.
- Mologne TS, Lundeen JM, Clapper MF, O'Brien TJ. Early screw fixation versus casting in the treatment of acute Jones fractures. *Am J Sports Med.* 2005;33:970-975.
- Namdari S, Baldwin K, Anakwenze O, Park MJ, Huffman R, Sennet BJ. Results and performance after microfracture in National Basketball Association athletes. *Am J Sports Med.* 2009;37:943-948.
- Newman JS, Newberg AH. Basketball injuries. *Radiol Clin North Am.* 2010;48:1095-1111.
- Anakwenze OA, Namdari S, Auerbach JD, et al. Athletic performance outcomes following lumbar discectomy in professional basketball players. *Spine (Phila Pa 1976).* 2010;35:825-828.
- Roche AJ, Calder JD. Treatment and return to sport following a Jones fracture of the fifth metatarsal: a systematic review. *Knee Surg Sports Traumatol Arthrosc.* 2013;21:1307-1315.
- Smith TO, Clark A, Hing CB. Interventions for treating proximal fifth metatarsal fractures in adults: a meta-analysis of the current evidence-base. *Foot Ankle Surg.* 2011;17:300-307.
- Wright RW, Fischer DA, Shively RA, Heidt RS Jr, Nuber GW. Refracture of proximal fifth metatarsal (Jones) fracture after intramedullary screw fixation in athletes. *Am J Sports Med.* 2000;28:732-736.
- Yeh PC, Starkey C, Lombardo S, Vitti G, Kharrazi FD. Epidemiology of isolated meniscal injury and its effect on performance in athletes from the National Basketball Association. *Am J Sports Med.* 2012;40:589-594.
- Yu B, Preston JJ, Queen RM, et al. Effects of wearing foot orthosis with medial arch support on the fifth metatarsal loading and ankle inversion angle in selected basketball tasks. *J Orthop Sports Phys Ther.* 2007;37:186-191.
- Zelco R, Torg J, Rachun A. Proximal diaphyseal fractures of the fifth metatarsal: treatment of the fractures and their complications in athletes. *Am J Sports Med.* 1979;7:95-101.