



Prevalence and Treatment Outcomes of Hand and Wrist Injuries in Professional Athletes: A Systematic Review

Jason D. Lehman, MD · Karthik R. Krishnan, MS · Jeffrey G. Stepan, MD, MSc · Benedict U. Nwachukwu, MD, MBA

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Abstract *Background:* Injuries to the hand and wrist constitute up to 25% of all athletic injuries, yet not much information is available on the effects of such injuries on the careers of professional athletes. Understanding whether elite athletes can return to sport and at what level has value for athletes, coaches, managers, and others, including athletes at other levels of play. *Questions/Purposes:* The purpose of this study was to systematically review the literature on injuries of the hand and wrist in professional athletes to determine the prevalence and types of injuries sustained in professional sports, the management and clinical outcomes of such injuries, and the statistics regarding return to play. *Methods:* A systematic review was conducted of PubMed/MEDLINE and the Cochrane Central Register of Controlled Trials to identify all studies reporting on hand and wrist injuries in professional athletes that were published between January 1970 and April 2019. Inclusion criteria were injuries of the upper extremity distal to the elbow that occurred in professional athletes during athletic competition, English language, and a study cohort consisting of four or more subjects. Details of injury sustained, sport, treatment, clinical outcome, and return to sport were extracted. *Results:* We

identified 32 nonoverlapping studies involving a total of 4299 hand and wrist injuries. The most common sport studied was baseball (eight studies), followed by football (seven), boxing (six), and basketball (five). Specific injury type was included in 29 of 32 studies and totaled 792 injuries. Metacarpal fractures were the most common injuries ($n = 273$; 34.5%), followed by thumb collateral ligament injuries ($n = 110$; 13.9%), phalangeal fractures ($n = 87$; 11.0%), and scaphoid fractures ($n = 56$; 7.1%). The overall operative rate was 18.3% ($n = 708$ of 3867). One-half of the studies reported the return to play (average, 2.8 months; range, 0.5 to 9 months). Seven studies reported sport-specific objective performance measures, with six describing consistent return to preinjury levels of performance among athletes. *Conclusions:* Based on the available evidence, a large majority of hand and wrist injuries in professional athletes are treated conservatively. Athletes frequently return to preinjury levels of performance after surgery. Additionally, return to play after a hand injury appears to be faster than that after other bony injuries. Further research is needed into the impact of these injuries on athletic performance, as well as how surgical intervention affects validated patient-reported outcome measures in professional athletes.

Level of Evidence Level IV: Systematic Review of Level III and IV studies

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J. D. Lehman, MD · J. G. Stepan, MD, MSc (✉) ·
B. U. Nwachukwu, MD, MBA
Hospital for Special Surgery,
535 East 70th Street,
New York, NY, USA
e-mail: jeffstepan@gmail.com

K. R. Krishnan, MS
Weill Cornell Medicine,
New York, NY, USA

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Introduction

Injuries to the hand and wrist are common during sports participation and constitute up to 25% of all athletic injuries [31]. Given the variance in performance demands of different sports, the location, mechanism, and severity of these injuries may vary substantially. Understanding the factors related to morbidity and management after hand and wrist injuries is important for both players and their physicians. From the perspective of players and coaches, knowing how

long a recovery process they can expect, as well as how the athletes' performance may be affected on their return to play, is crucial.

Patient-reported outcomes (PROs) have become increasingly important in the evaluation of outcomes of surgery in orthopedics [2]. However, little is known about how PROs reflect the success of a procedure in athletes with high-performance demands, including those playing at the professional level. To date, no systematic review has analyzed these injuries among professional athletes. Understanding whether elite athletes are able to return to their preinjury level of performance also has value for athletes at other levels of play and may help predict outcomes in athletes with lower performance demands [12].

The purpose of this study was to systematically review the literature on injuries of the hand and wrist in professional athletes. We sought to determine (1) the prevalence and types of injuries sustained in professional sports, (2) the management and clinical outcomes of these injuries, and (3) statistics regarding return to play. We hypothesized that a large percentage of hand and wrist injuries are treated conservatively, with a relatively short time to return to play.

Materials and Methods

We conducted a systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (www.prisma-statement.org/PRISMAStatement). We conducted a search in April 2019 of MEDLINE and the Cochrane Central Register of Controlled Trials to identify all studies reporting on hand and wrist injuries in professional athletes published between January 1970 and April 2019. The following simple search term was used: hockey wrist OR hockey hand OR hockey thumb OR hockey radius OR hockey ulna OR hockey finger OR hockey digit OR hockey phalanx OR hockey carpal OR basketball wrist OR basketball hand OR basketball thumb OR basketball radius OR basketball ulna OR basketball finger OR basketball digit OR basketball phalanx OR basketball carpal OR football wrist OR football hand OR football thumb OR football radius OR football ulna OR football finger OR football digit OR football phalanx OR football carpal OR baseball wrist OR baseball hand OR baseball thumb OR baseball radius OR baseball ulna OR baseball finger OR baseball digit OR baseball phalanx OR baseball carpal OR tennis wrist OR tennis hand OR tennis thumb OR tennis radius OR tennis ulna OR tennis finger OR tennis digit OR tennis phalanx OR tennis carpal OR boxing wrist OR boxing hand OR boxing thumb OR boxing radius OR boxing ulna OR boxing finger OR boxing digit OR boxing phalanx OR boxing carpal OR skiing wrist OR skiing hand OR skiing thumb OR skiing radius OR skiing ulna OR skiing finger OR skiing digit OR skiing phalanx OR skiing carpal.

Inclusion criteria were as follows: injuries of the upper extremity distal to the elbow that occurred in professional athletes during athletic competition, English language, and a study cohort consisting of four or more subjects. We

considered a professional athlete as one participating in a professional league or otherwise identified as a nonamateur athlete. We excluded editorials and commentaries, case reports, review articles, descriptions of surgical techniques, studies not reporting treatment or treatment outcomes, and studies that failed to identify specific injuries of the distal upper extremity (incomplete data).

After the initial search, a total of 2880 articles were identified. The abstract of each was reviewed to determine whether it met the four above mentioned inclusion criteria. This initial screening yielded 170 studies for review. Of these, 138 were excluded. Reasons for exclusion include the following: incomplete data ($n = 34$ studies), review article ($n = 60$ studies), and case reports of fewer than four subjects ($n = 44$ studies). After application of the aforementioned inclusion or exclusion criteria, a total of 32 studies were identified for analysis in the review (Fig. 1). To ensure that all available studies were identified, we searched the references of the included studies for studies that were not captured in the initial search.

The following data were extracted from the included studies: (1) journal of publication, (2) level of evidence, (3) source of records, (4) geographical region, (5) sport, (6) specifics of injury, (7) treatment type, (8) follow-up, (9) return to play, and (10) measures of player performance and outcomes. All data were compiled and analyzed using Microsoft Excel version 15.41.0 (Microsoft, Redmond, WA, USA).

Results

The 32 studies that met the inclusion criteria described 4299 injuries in professional athletes (Table 1). The most common journal of publication was the *American Journal of Sports Medicine* (nine studies), followed by the *British Journal of Sports Medicine* and *Hand* (four studies each) and the *Journal of Hand Surgery* (three studies). Twenty-five studies (78%) were published in the 8 years before this writing. The level of evidence in 24 (75%) of the 32 studies was IV and in the remaining eight (25%) was III. The majority of articles (18 studies) used league databases as the source of records; 12 used hospital records, seven used public records, and one used insurance claims (some studies used more than one source). Twenty-two studies were from North America, five were from Europe, four were from Australia, and three were from Asia. Twenty-eight studies (88%) used return to play as an outcome measure, and 12 (38%) used objective performance metrics, and five (16%) used patient-reported outcomes (some studies used more than one outcome measure).

The mean age of professional athletes was 25.7 years (range, 22 to 32 years). The time of follow-up was poorly recorded and incalculable. The most commonly studied sport was baseball (eight studies), followed by football (seven), boxing (six), basketball (five), rugby (three, one of which was underwater rugby), Australian rules football (two), tennis (one), golf (one), and telemark skiing (one). Seven hundred ninety-two specific injuries were identified.

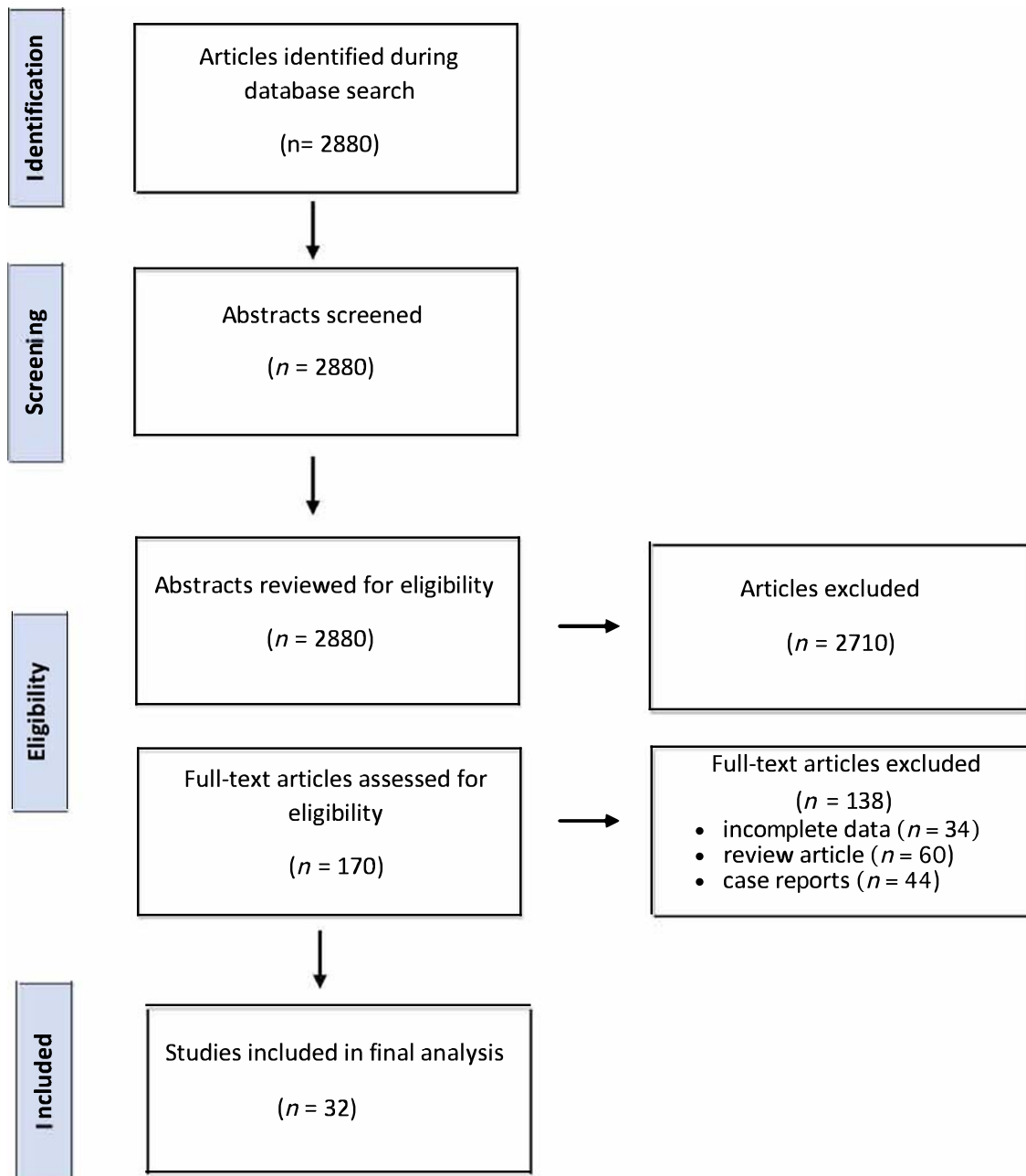


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram for study selection.

Of these, metacarpal fractures were the most common ($n = 273$; 34.5%), followed by thumb collateral ligament injuries ($n = 110$; 13.9%), phalangeal fractures ($n = 87$; 11.0%), scaphoid fractures ($n = 56$; 7.1%), and wrist fractures or carpometacarpal instability ($n = 54$; 6.8%) (Table 2). Of the 3867 injuries for which treatment was specified, 18.3% (708) were treated surgically.

With respect to return to play, only 16 (50%) of included studies reported on the time frame. Among those, the time to return to play averaged 2.8 months (range, 0.5 to 9 months). The longest times to return to play were seen in boxers, in whom the time averaged 6 months (range, 3 to 9 months), as

compared with baseball players (2.6 months), basketball players (1.4 months), and rugby or football players (2.0 months). Across the studies that reported outcomes of surgery, 305 of 311 athletes (98.1%) were able to return to play after surgery.

Measures of performance other than return to play were poorly recorded. Only two studies included validated upper extremity patient-reported outcome measures. Other reported measures of functional performance included grip strength ($n = 3$ studies), player efficiency rating ($n = 2$ studies), and games or minutes played ($n = 4$ studies). Seven studies reported sport-specific objective performance

Table 1 Summary of studies included in the review

Study: first author (year)	Region	Source(s) of records	Primary sport(s)	No. of injuries ^a	Most common injury	Return to sport (%)
Camp (2018) [8]	NA	League database	Baseball	843	Metacarpal fracture	NR
Sochacki (2018) [35]	NA	Public records	Football	23	Ulnar collateral ligament rupture	96
Jack (2018) [17]	NA	Public records	Baseball	21	Ulnar collateral ligament rupture	100
Moatshe (2017) [25]	NA	Hospital records, league database	Football	56	Scaphoid fracture	NR
Yalitzis (2017) [40]	Australia	Hospital records, league database	Australian rules Football	16	Metacarpal fracture	100
Beaulieu-Jones (2017) [4]	NA	Hospital records, league database	Football	739	Metacarpal/PIP dislocation	NR
Guss (2017) [15]	NA	Public records, league database	Baseball	18	Hook of hamate fracture	100
Camp (2017) [7]	NA	League database	Baseball	413	Unspecified hand/finger/thumb injury	NR
Loosemore (2017) [20]	Europe	League database	Boxing	172	CMC instability	100
Morse (2017) [26]	NA	Public records	Basketball	67	Phalangeal fracture	100
Guss (2016) [14]	NA	Public records, league database	Basketball	32	Metacarpal fracture	100
Fortington (2016) [13]	Australia	Hospital records, league database, insurance claims	Australian rules football	9	Unspecified hand/wrist/finger injury	NR
Werner (2016) [38]	NA	League database	Football	32	Thumb MCP collateral ligament	100
Minhas (2016) [24]	NA	Public records	Basketball	52	Hand/wrist fracture	98
Johansen (2015) [18]	NA, Europe, Asia	Public records, league database	Telemark skiing	30	Unspecified hand/finger/thumb injury	NR
Bachoura (2013) [3]	NA	Hospital records	Baseball	8	Hook of hamate fracture	100
Scheufler (2013) [32]	Europe	League database	Underwater rugby	17	Hook of hamate fracture	88
Williams (2013) [39]	Europe	NR	Rugby, boxing, golf	14	Scapholunate instability	73
Li (2013) [19]	NA	League database	Baseball	17	Unspecified wrist injury	100
Nazarian (2013) [28]	Europe, Australia	Hospital records	Boxing	13	Index/middle metacarpal joint instability	100
McCarthy (2013) [22]	NA	League database	Basketball	105	Hand/wrist injury (fracture/sprain)	100
Sell (2014) [33]	NA	League database	Tennis	95	Unspecified wrist injury	NR
Usman (2012) [37]	Australia	League database	Rugby	88	Unspecified hand/finger injury	NR
Melone (2012) [23]	NA	Hospital records	Basketball	25	SLIL disruption	100
Lourie (2011) [21]	NA	Hospital records	Baseball	4	Annular pulley rupture	NR
Brophy (2007) [5]	NA	League database	Football	1307	Unspecified nonfracture hand/wrist injury	NR
Nagaoka (2006) [27]	Asia	Hospital records	Boxing	5	MCP joint capsule tear	100
Arai (2002) [1]	Asia	Hospital records	Boxing	16	MCP joint injury	100
Hame (2000) [16]	NA	Hospital records	Boxing	8	MCP joint extensor mechanism injury	100
Raab (1994) [30]	NA	League database	Football	10	Lunate dislocation	90
Parker (1986) [29]	NA	Hospital records	Baseball	6	Hook of hamate fracture	100
Ellsasser (1979) [11]	NA	League database	Football	38	Phalangeal fracture	100

^a Only among professional athletes in study

NA North America, NR not reported, PIP proximal interphalangeal, CMC carpometacarpal, MCP metacarpophalangeal, SLIL scapholunate interosseous ligament

Table 2 Frequency of specific injuries reported across 792 cases

Injury	No. (%)
Metacarpal fracture	273 (34.5)
Thumb collateral ligament	110 (13.9)
Phalangeal fractures	87 (11.0)
Scaphoid injury	56 (7.1)
Wrist fracture/carpometacarpal instability	54 (6.8)
Metacarpophalangeal joint related	46 (5.8)
Hook of hamate fracture	43 (5.4)
Scapholunate instability	40 (5.1)
Wrist sprain	23 (2.9)
Lunate or perilunate dislocation	10 (1.3)
Miscellaneous hand injury	10 (1.3)
Miscellaneous wrist injury	10 (1.3)
Triangular fibrocartilage complex tear	8 (1.0)
Extensor expansion tendon tear/rupture	6 (0.8)
Annular pulley rupture	4 (0.5)
Intrinsic muscle strain	3 (0.4)
Wrist contusion	3 (0.4)
Wrist extensor tendinopathy	3 (0.4)
Finger distal interphalangeal joint sprain	2 (0.3)
Wrist capsulitis	1 (0.1)

measures (Table 3). Only one of the studies analyzing football player performance after hand or wrist surgery found a decrease in performance in players in certain positions.

Discussion

This systematic review of distal upper extremity injuries in professional athletes demonstrates that a high percentage (98.1%) of athletes sustaining hand and wrist injuries are able to return to their respective sports. Consistent with our hypothesis, we found a relatively short average time to return to play, 2.8 months, which varied substantially by sport. This review also highlighted the infrequency of the use of validated patient-reported outcome measures and performance metrics to assess outcomes after treatment (only seven of the studies in our review).

There are limitations to this study. Non-English language studies were not included, which limits the scope of our reporting. Similarly, studies that included professional and nonprofessional athletes but did not separate the respective data were also excluded. Most of the studies included in our study were retrospective in nature and were not designed to compare different treatment options; because of this, we are unable to comment on the effectiveness of different treatment regimens for hand and wrist injuries. We also cannot draw any broad conclusions regarding the ability of professional athletes to return to a preinjury level of play after the injuries described, given the low number of studies using performance metrics.

In the majority of cases and across multiple sports, professional athletes were able to return to a preinjury level of play. Both studies evaluating basketball players found no significant change in player efficiency rating or other performance metrics after surgery for hook of hamate fracture or other hand or wrist fractures [14, 24]. Baseball players in two studies undergoing thumb ulnar collateral ligament

repair or hook of hamate excision also exhibited similar performance, both in comparison with matched controls and relative to their preoperative performance [12, 17]. In addition, performance among football and Australian rules football players undergoing thumb ulnar collateral ligament repair and metacarpal fracture fixation returned to preoperative levels [25, 35]. However, one study of players in the National Football League (NFL) combine discovered a reduction in a few position-specific performance metrics among tight ends, running backs, and defensive backs after hand or wrist injury [4].

In comparison, only 30.6% of athletes across multiple leagues—the National Basketball Association (NBA), the NFL, the National Hockey League, and Major League Baseball (MLB)—were able to return to play after Achilles tendon rupture and repair [36]. One study of NBA athletes undergoing anterior cruciate ligament reconstruction found that 78% were able to return to play, with only 34% returning to their preinjury level of play [6]. Among 581 professional baseball players, shoulder surgery was associated with a 63% return rate, with an average time to return of 9 to 13 months, depending on player position [9]. Ulnar collateral ligament reconstruction in MLB pitchers was associated with a high rate of return (79 to 92%) but also a lengthy time to return to competition (17.3 months) [10].

Hand and wrist injuries among professional athletes have generally received little attention until recently, as is apparent in the low level of evidence (IV) of most of the studies included in this review. This is also reflected in the dates of publication: 25 of the 32 studies were published within the past 8 years.

Fewer than 20% of injuries across all studies analyzed were treated operatively. This may indicate that hand and wrist injuries sustained in the sports described are more amenable to nonoperative management than are injuries to other joints. The high rate of nonoperative management likely drives the relatively quick return to play we observed. The short time to return may also be unique to professional athletes, who have significant incentives to return to play sooner and may do so with protective equipment such as casts or braces before full healing is achieved [34]. Fractures of the metacarpals, wrist, and phalanges and carpometacarpal instability were among the most common injuries seen and were frequently managed conservatively [8]. We suspect that the mechanism of injury also influenced the low operative rate, given that the hand and wrist are likely to be subjected to less force than other joints in many of these sports. This appears to be consistent with the data; the three studies with the longest return to play reported (ranging from 5 to 9 months) described boxing injuries that consistently required operative management [16, 27, 28]. Those studies suggest a longer time to return to play for boxing in general, as compared with other sports.

We found that few studies used pre- and postinjury performance metrics or measured the impact of hand and wrist injuries on players' future earnings. Future research into the impact of hand or wrist injuries in professional athletes should also analyze the extent to which players across different sports are able to return to a preinjury level of performance. Said studies should also incorporate

Table 3 Sport-specific objective performance measures reported

Study: first author (year)	Sport	Measures	Conclusion
Sochacki (2018) [35]	Football	Games per season Career length Performance score	NSD between pre- and post-operative performance across any position NSD in career length NSD between post-operative performance, as compared with matched controls
Jack (2018) [17]	Baseball	Games per season WAR Plate appearances per season On-base percentage Slugging percentage On-base plus slugging percentage Batting average	NSD in games per season/career length NSD between post-operative performance measures, as compared with matched controls NSD between pre- and post-operative performance, except for a lower post-operative WAR for infielders
Yalizis (2017) [40]	Australian rules football	Kicks Marks Handballs Tackles	NSD between pre- and post-operative marks or handballs 1/11 players injured during season had a reduction in either tackles or kicks, no difference among the other 10 players
Beaulieu-Jones (2017) [4]	Football	Games played Games started Tackles reported Interceptions Passes defended Quarterback hits Sacks	Tight ends experienced reduction in games played, as compared with matched controls Running backs experienced reduction in carries and total yards Defensive backs played fewer games and recorded fewer tackles No other significant changes in performance in all positions analyzed
Guss (2018) [15]	Baseball	WAR ISO On-base plus slugging percentage Double/triple/home run rate Strike outs Batting average Base on balls Minutes played per game Points per game PER Steals/rebounds/assists/blocks per 36 min played Games played PER	NSD in post-operative WAR, ISO, or any other performance measure, as compared with matched controls or pre-operative performance NSD in PER observed either from pre- to post-op or when compared with matched controls
Minhas (2016) [24]	Basketball	Games played PER	No reduction in any performance measure when comparing pre- and post-operative performance after surgery for hand/wrist fracture

NSD no significant difference, WAR wins above replacement, ISO isolated power, PER player efficiency rating

validated patient-reported outcome measures to evaluate recovery, given the unique performance demands that are placed on professional athletes. To better guide efforts at injury prevention, another potential area for study is of the types of activities players are engaged in when acute injury occurs.

This systematic review demonstrates that distal upper extremity injuries in professional athletes are frequently managed nonoperatively and are associated with a high rate of return to play. We also found that athletes with these injuries return to play relatively quickly, as compared with athletes with injuries and interventions related to the ankle, shoulder, knee, or hip. Players were able to return to preinjury levels of performance in most cases reported. Further research is needed into the impact of these injuries on athletic performance, as well as how surgical intervention affects validated patient-reported outcome measures in professional athletes.

Compliance with Ethical Standards

Conflict of Interest: Jason D. Lehman, MD; Karthik R. Krishnan, MS; and Jeffrey G. Stepan, MD, MSc, declare that they have no conflict of interest. Benedict U. Nwachukwu, MD, MBA, declares educational support from Smith & Nephew, outside the submitted work.

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