Distal Fibula Fractures in National Football League Athletes

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Background: Despite the frequency of distal fibula fractures in elite athletes and the significant potential impact on the athletes' season and future careers, little data exist characterizing the epidemiology of these injuries or, more importantly, return to competition.

Purpose: To (1) evaluate the incidence of acute distal fibula fractures in National Football League (NFL) athletes, including isolated distal fibula and combined ankle fracture patterns; (2) analyze distal fibula fracture rates in NFL athletes by position, type of play, and contact type; (3) determine the rates of distal fibula fracture surgery in NFL athletes; and (4) report the days missed due to distal fibula fractures in NFL athletes.

Study Design: Descriptive epidemiology study.

Methods: A retrospective review of distal fibula fractures reported to the NFL from 2000 to 2014 was performed using the NFL Injury Surveillance System. All distal fibula fractures were included, along with isolated and combined fracture patterns. Stress fractures and proximal fibula fractures were excluded. Epidemiological data and rates of surgery were determined. Return to sport was calculated and stratified by injury pattern and management.

Results: Overall, 237 distal fibula fractures in NFL athletes from 2000 to 2014 were included; 197 (83%) were isolated distal fibula fractures. A mean of 16 distal fibula fractures occurred each year (median, 16 per year). Fractures occurred most frequently on running (38%) and passing (24%) plays, but the frequency was next highest on kickoffs (16%), despite the relative infrequency of kickoffs during the average game compared with other play types. Surgery was reported for more than half of all distal fibula fractures (n = 128, 54%). Overall, patients who underwent surgery missed significantly more days (mean, 123.8 days) than players who did not undergo surgery (mean, 75.3 days) (*P* < .001). Players with isolated distal fibula fractures had significantly fewer days missed (mean, 93.6 days) compared with those with combined patterns (mean, 132.3 days) (*P* = .0004).

Conclusion: Fibula fractures affect a number of NFL athletes and result in significant time missed from competition. Further research is required to determine the optimal management of fibula fractures in NFL athletes. In this study, time to return to play depended on both the fracture pattern and whether surgery was required and ranged from 72 to 145 days.

Keywords: National Football League; fibula fracture; return to sport; ankle fracture; surgery; kickoff; American football

Foot and ankle injuries are common among competitive athletes.[1] Ankle fractures comprise 7% of all sport-related fractures,[6] and ankle fracture surgery is one of the most common surgical procedures reported among participants at the National Football League (NFL) Scouting Combine.[3] In NFL athletes, ankle injuries represent the second most common injury.[11] Most existing studies of ankle injuries in active NFL athletes combine fractures with ankle sprains and other ankle injuries, making it difficult to specifically evaluate ankle fractures in this population.[10,11] Return to sport (RTS) after an ankle fracture has been described in smaller studies for numerous sports and depends on

several factors, including whether surgical fixation is required.[7,16] A recent study utilizing public data to determine RTS rates after common surgical procedures in NFL athletes reported that 78.6% of players who underwent surgical fixation of ankle fractures eventually returned to play.[15] This study was limited in its scope and applicability because of its use of publicly available data rather than NFL data, inclusion of only operative ankle fractures, and combination of varying fracture patterns.

There is a lack of literature specifically evaluating distal fibula fractures, which are among the most common ankle fractures encountered, in athletes. Distal fibula fractures were chosen to evaluate because they are the most frequently encountered fractures of all ankle fractures and are specifically coded in the NFL injury database. Given the intensity of professional football, these fractures may be

more common in the NFL but are also likely problematic across all levels of football and other sports. Additionally, distal fibula fractures may be treated differently in NFL athletes, and there are no studies characterizing treatment trends in this population. Finally, elite athletes could have a different recovery pattern after these injuries.

Given the limitations of the current literature regarding ankle fractures in professional and NFL athletes, the goals of the present study were to utilize data from the NFL Injury Surveillance System (NFL ISS) to (1) evaluate the incidence of acute distal fibula fractures, including isolated distal fibula and combined ankle fracture patterns, from 2000 to 2014; (2) analyze distal fibula fracture rates by player position, type of play, and contact type; (3) determine the rates of distal fibula fracture surgery; and (4) report the days missed due to distal fibula fractures in NFL athletes.

METHODS

Database

A retrospective review of all distal fibula fractures reported to the NFL from 2000 to 2014 was performed using the NFL ISS. This surveillance system has been in place since 1980 with the goal of monitoring injuries sustained by players in the NFL on a consistent basis. Data are collected prospectively by the team's athletic training staff if (1) the injury resulted in time lost from game or practice, including being unavailable for the remainder of the session during which the injury was sustained or (2) the injury was classified as reportable regardless of time loss (concussion, fracture, dental injury, heat-related illness, injury required medical intervention or special equipment).[14] Data collection and analytics of all NFL-wide data are led by the QuintilesIMS Injury Surveillance and Analytics Team and used by the NFL, its medical committees, and individual teams to provide aggregate information about injury occurrence and patterns. Express written consent to use data from the NFL ISS for this study was obtained from the NFL Injury and Safety Panel, the NFL Players Association, and the Hospital for Special Surgery Institutional Review Board.

Injuries

The present analysis included all reportable sport-related distal fibula fractures that occurred in NFL players during preseason, regular-season, and postseason practices and games from 2000 to 2014. Injuries that occurred during the offseason or during conditioning activities (eg, weight lifting) were not included, as surveillance reporting of these injuries was not mandatory before 2014. Injuries with unknown fracture types and stress fractures were also excluded.

For the purposes of this study, distal fibula fractures were defined as any acute fibula shaft fracture or distal fibula fracture. Distal fibula fractures were grouped and presented as (1) isolated fibula fractures (those without an ankle dislocation or associated medial malleolus fracture, posterior malleolus fracture, or tibia fracture) or (2) combined fibula fractures (those reported with an ankle dislocation, medial malleolus fracture, or distal tibia fracture). Distal fibula fractures with associated ligamentous abnormalities (eg, ankle sprain) or other nonfracture abnormalities were categorized as "isolated." All fractures are considered reportable to the NFL within surveillance efforts. It is important to note that the classification as "isolated" or "combined" was made based on what the athletic trainer reported to the surveillance system and that no imaging was reviewed for this classification.

There were a total of 355 potential fibula fractures identified. Forty-six patients were excluded for having proximal fibula fractures, 42 patients were excluded for having non–lateral malleolus fractures, 24 patients were excluded for having an unknown fracture pattern, and 6 patients were excluded for having a distal fibula stress fracture.

Data

The number of fibula fractures, including isolated and combined injury patterns, was first determined for each year, stratified by the time in the season (preseason, regular season, postseason) and then subcategorized by the session in which the injury occurred (practice or game setting). The incidence for those injuries that occurred during games was then further analyzed according to player position at the time of injury, type of play, and type of contact, where available.

The rates of surgery for all injuries were determined and categorized by the time during the season (preseason, regular season, postseason) as well as the injury pattern (all fibula fractures, isolated fibula fractures, combined fibula fractures).

Days missed due to injury were expressed as the number of days missed until the player returned to full participation from the injury. Full participation was defined as the player's being able to return to his normal repetitions without restriction, independent of the season or session. Days missed were calculated using the date of the removal from

participation due to the injury and the date of return to full participation. In the NFL ISS, team athletic trainers can either enter the actual return-to-play date or an estimated return-to-play date in cases where the actual return date is unknown (eg, player moved to another team while injured, or player returned during the offseason). Injuries with an unknown or estimated return-to-play date were excluded from this calculation.

Statistical Analysis

Epidemiological data are provided as the actual number of injuries for each category as entered into the NFL ISS monitored by QuintilesIMS. Comparisons of categorical variables were performed using a chi-square test. Continuous variables (eg, days missed due to injury) were reported as the mean, SD, and range, with comparisons performed using the Student t test. For all statistical tests, $P < .05$ was considered statistically significant.

RESULTS

Overall Epidemiological Findings

There were 237 reported distal fibula fractures in NFL athletes that met inclusion criteria from 2000 to 2014. Of these, 197 (83%) were isolated fractures; the remaining 40 (17%) were combined fractures. The number of fractures ranged from 10 to 24 per year, with a mean of 16 per year (median, 16 per year) (Figure 1A). The majority of distal fibula fractures occurred during game play (n = 204, 86%) as opposed to practice (n = 33, 14%). The majority of distal fibula fractures occurred during the regular season (n = 167, 70%) compared to the preseason (n = 62, 26%) or postseason (n = 8, 3%), which makes sense given the number of practices and games in each of these time periods. As the majority of fractures were isolated, these trends were similar when examining the results of isolated distal fibula fractures (Figure 1B).

Stratified by Player Position at Time of Injury

The majority of fibula fractures that occurred during games (n = 204) were in offensive players (n = 99, 49%) compared to defensive players (n = 60, 29%; $P < .001$) or special teams (n = 42, 21%; $P < .001$) (Table 1). Player position was unknown for 3 fractures. The number of isolated distal fibula fractures (n = 167) was significantly higher in offensive players (n = 83, 50%) compared to defensive players (n = 47, 28%; $P < .001$) or special teams (n = 36, 22%; $P < .001$). The incidence of combined fractures was ≤6 for each position over the 15-year period.

Stratified by Team Activity

The majority of fibula fractures that were sustained in a game, including isolated and combined patterns, occurred on running plays (n = 77, 38%) (Table 2). A total of 32 fractures (16%) occurred on kickoffs. Very few fractures
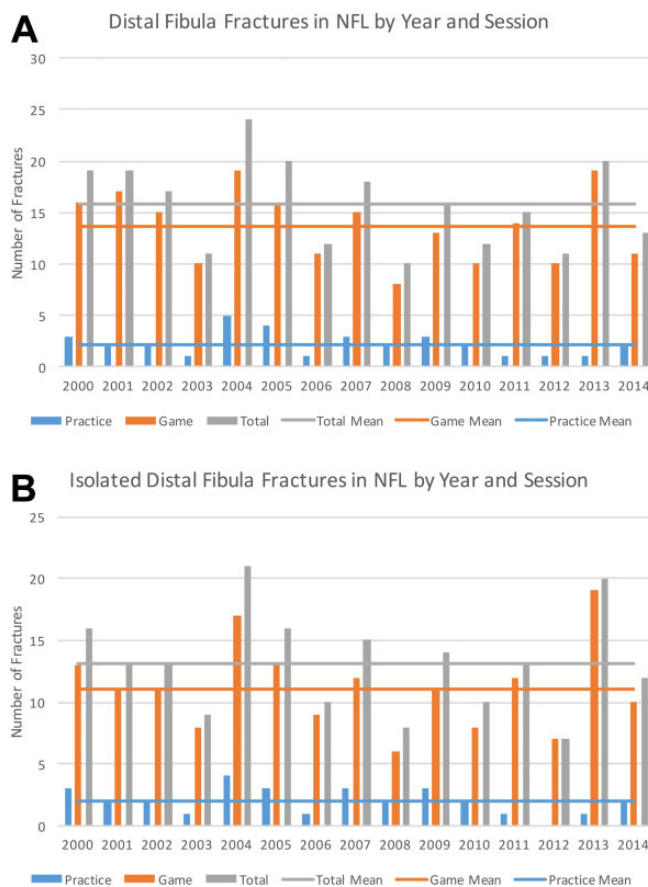
Figure 1. (A) Number of distal fibula fractures in the National Football League (NFL) by year from 2000 to 2014, including isolated fractures and those with combined ankle fracture or dislocation patterns. (B) Number of isolated distal fibula fractures in the NFL from 2000 to 2014, which represent the majority of fibula fractures compared to combined injury patterns.

TABLE 1
Fibula Fractures in the NFL by Player Position
at the Time of Injury[a]

Position	Injury Type		
	Isolated	Combined	Total
Offense, n (%)	83 (50)	16 (43)	99 (49)
Offensive lineman	39	6	45
Running back	24	4	28
Tight end	9	3	12
Quarterback	2	0	2
Wide receiver	9	3	12
Defense, n (%)	47 (28)	13 (35)	60 (29)
Defensive secondary	19	6	25
Defensive lineman	18	4	22
Linebacker	10	3	13
Special teams, n (%)	36 (22)	6 (16)	42 (21)
Unknown, n (%)	1 (1)	2 (5)	3 (2)
Total	167	37	204

[a]Values are presented as No. unless otherwise indicated. NFL, National Football League.

TABLE 2
Fibula Fractures in the NFL
by Injury Type and Type of Play[a]

Team Activity	Injury Type		
	Isolated	Combined	Total, n (%)
Pass play	38	11	49 (24)
Run play	63	14	77 (38)
Interception	2	1	3 (1)
Kickoff	29	3	32 (16)
Punt	6	3	9 (4)
Unknown	29	5	34 (17)
Total	167	37	204 (100)

[a]Values are presented as No. unless otherwise indicated. NFL, National Football League.

TABLE 3
Fibula Fractures in the NFL by Contact Type[a]

Contact Type	Injury Type		
	Isolated	Combined	Total, n (%)
Contact with another player	126	30	156 (77)
Tackling	30	3	33
Being tackled	32	9	41
Blocking	42	10	52
Being blocked	22	8	30
Other contact[b]	26	3	29 (14)
No contact	5	3	8 (4)
Unknown	10	1	11 (5)
Total	167	37	204 (100)

[a]Values are presented as No. unless otherwise indicated. NFL, National Football League.
[b]Other includes contact with the playing surface, equipment, nonplayers (eg, referee), and unknown contact.

occurred on punts or interceptions, and 17% of fractures were not associated with a team activity.

Stratified by Contact Type

A significantly greater proportion of fibula fractures that were sustained in a game occurred during contact with another player (n = 156, 77%) compared to other types of contact (n = 29, 14%; $P < .001$) or noncontact (n = 8, 4%; $P < .001$). Fractures sustained during contact with another player occurred more frequently during blocking (n = 52, 33%) compared to tackling (n = 33, 21%; $P = .022$) or being blocked (n = 30, 19%; $P = .007$) (Table 3).

Surgical Intervention

Over half of the distal fibula fractures were treated with surgery (n = 128, 54%) (Table 4). There was no significant difference in the percentage of isolated fractures that underwent surgery and those that did not ($P = .382$). A

TABLE 4
Fibula Fractures in the NFL Requiring Surgery by Season[a]

Injury Type/ Surgery Status	NFL Season			
	Preseason	Regular Season	Postseason	Total, n (%)
All fibula fractures				
Surgery	35	90	3	128 (54)
Surgery not reported	27	77	5	109 (46)
Isolated fibula fractures				
Surgery	27	70	3	100 (51)
Surgery not reported	22	70	5	97 (49)
Combined fibula fractures				
Surgery	8	20	0	28 (70)
Surgery not reported	5	7	0	12 (30)

[a]Values are presented as No. unless otherwise indicated. NFL, National Football League.

TABLE 5
Days Missed Due to Fibula Fractures in the NFL[a]

Injury Type/ Surgery Status	Days Missed		Excluded From Calculation of Days Missed[b]
	n	Mean ± SD	
All fibula fractures			
Surgery	111	123.8 ± 61.4	17
Surgery not reported	103	75.3 ± 51.4	6
Total	214	100.5 ± 61.7	23
Isolated fibula fractures			
Surgery	84	117.1 ± 55.5	16
Surgery not reported	92	72.1 ± 50.8	5
Total	176	93.6 ± 57.5	21
Combined fibula fractures			
Surgery	27	144.7 ± 74.2	1
Surgery not reported	11	101.6 ± 51.8	1
Total	38	132.3 ± 70.6	2

[a]NFL, National Football League.
[b]Injuries with an unknown or estimated return-to-play date are excluded from the calculation of days missed.

significantly greater proportion of combined fibula fractures were treated with surgery ($P = .04$).

Return to Play

The mean days missed due to injury, stratified by injury pattern as well as surgical intervention, are presented in Table 5. Overall, players who underwent surgery missed significantly more days (mean, 123.8 days) than players who did not undergo surgery (mean, 75.3 days) ($P < .001$). For isolated distal fibula fractures, injuries that were treated with surgery resulted in significantly more days missed (117.1 days) compared to those without surgery (72.1 days) ($P < .001$). For combined fracture patterns, there was no significant difference in the mean days missed between patients who underwent surgery and those who did not

undergo surgery ($P = .08$). Irrespective of surgery, players with isolated distal fibula fractures had significantly fewer days missed (mean, 93.6 days) compared to those with combined fracture patterns (mean, 132.3 days) ($P = .0004$) (Table 5).

Overall, 214 of 237 (90%) players were reported as having returned to play after a distal fibula fracture. Moreover, 176 of 197 (89%) players returned to play after isolated distal fibula fractures, and 38 of 40 (95%) players returned to play after combined patterns ($P = .42$).

DISCUSSION

A mean of 16 fibula fractures occurred during each NFL season from 2000 to 2014, with the majority being isolated rather than combined injuries. Offensive players were most likely to sustain fibula fractures. Surgery was performed on more than half of the fibula fractures and much more frequently for combined fracture patterns. Time to return to play depended on both the fracture pattern and whether surgery was performed and ranged from 72 to 145 days.

Most previous studies of ankle injuries in NFL athletes have combined fractures with other ankle injuries, making it difficult to evaluate the impact of ankle fractures on NFL athletes.[10,11] Studies specific to fibula fractures in NFL athletes are limited to small case series; however, our results suggest that fibula fractures are affecting players each season.[9] A recent study of the National Collegiate Athletic Association ISS reported data for all foot and ankle injuries in football athletes, including fractures, from the 2004-2005 to 2008-2009 seasons.[13] During this 5-season period, 49 malleolus fractures occurred, including 28 lateral malleolus fractures. This equated to 0.22 lateral malleolus fractures per 10,000 athletic-exposures. The average days missed were 33.0; 41% of injuries required surgery, and 60% resulted in medical disqualification. Fracture dislocations resulted in a substantially greater number of missed days.[13] Ankle fractures have also been reported as common injuries in the adolescent and young adult population for other sports, most notably soccer and rugby.[4,12,16]

A key contribution of the present investigation is reporting the time to RTS after fibula fractures in NFL athletes. A recent study utilizing publicly available data to determine RTS rates after common surgical procedures in NFL athletes reported that 78.6% of players who underwent surgical fixation of ankle fractures eventually returned to play after an average of nearly 1 year.[15] That study was limited in its scope and applicability because of its use of publicly available data rather than NFL data, inclusion of only operative ankle fractures, and combination of varying fracture patterns. Often, players return during the offseason, a characteristic that would be difficult to capture from publicly available data and may artificially increase the time to RTS.

RTS after ankle fractures has been studied in other sports. In a mixed population of predominantly soccer and rugby athletes, the mean time for RTS after an ankle fracture was 140 days for injuries managed nonoperatively and 245 days for players requiring surgery.[16] A recent systematic review of 7 retrospective studies including a heterogeneous athlete population found inconsistent reporting of the time to RTS after an ankle fracture and could not reach any conclusions regarding time to RTS after the injury, although the rate of RTS seemed to be related to the athlete's skill level.[7] In a study of 243 recreational athletes, only 15% had returned to full participation within 6 months, and only 25% had returned within 1 year.[5]

NFL players and other elite athletes represent a unique population who have better access to therapy and rehabilitation and who also have a significant financial motivation to return, so it is not surprising that their time to RTS is much different than what has been previously reported for recreational athletes or for other sports. Additionally, the NFL game structure allows for periods of rest (offense vs defense) and free substitution that are not afforded in other professional sports, such as soccer or rugby. Also, some NFL positions, such as down lineman, involve much less running and agility maneuvers compared to other sports. In NFL athletes, days missed due to injury were related to the injury pattern (isolated fibula fracture vs combined pattern) and whether surgery was required for the injury. The mean days missed for all fibula fractures was 101 days, and there was a significantly quicker time to RTS (75 days) for players who did not undergo surgery compared to those who required surgery (123 days). This could be caused by many factors and should not be construed as a recommendation to manage fibula fractures in the NFL nonoperatively, as it is likely that fractures with less displacement were managed nonoperatively and those with higher energy or greater displacement or instability were managed operatively. This assertion was corroborated by the finding that combined patterns had significantly greater mean missed days compared to isolated fibula fracture patterns. Additionally, the majority of distal fibula fractures were isolated injuries, which suggests a lower energy injury mechanism than what is commonly seen in a trauma population.

Another interesting finding of the present study is the high frequency of fibula fractures during kickoffs given the infrequency of kickoffs compared to other play types during an average NFL game, in which there are an average of 81 passes, 53 runs, and 11 kickoffs.[8] The NFL has recently implemented rules to reduce the number of returns on kickoffs because of injury concerns.[2] The relatively high frequency of fibula fractures during kickoffs supports the notion that reducing kickoff returns may indeed be an effective way to reduce the occurrence of this injury.

Although this study provides a very comprehensive overview of the epidemiology, rates of surgery, and return to play after fibula fractures in the NFL, there are several limitations that must be acknowledged. First, the method of injury reporting to the NFL ISS changed throughout the study period, and in that time, greater emphasis was placed on injury reporting, which is largely done by NFL athletic trainers. This may have resulted in more complete ascertainment of fractures over time. A fracture, however, has always been considered a mandatory reportable injury, so this effect should be minimized for this particular injury. The data are based completely on what

athletic trainers report into the system and not imaging results, making it possible that isolated fractures may have had other associated injuries that would have changed their classification. Over the study period, there also have been significant changes in the NFL team structure, season, and games, including rule and roster size changes, variation in the number of practices, and variation in the total number of plays per game over time, all of which can affect the amount of on-field "exposure" and the chance of being injured. There have also been changes in injury reporting, including a greater emphasis on injury awareness and timely reporting and updates to injury codes, which could have resulted in the underreporting of injuries in earlier years.

There is also potential for underascertainment of surgery data, particularly before the 2012 NFL season, because of changes in the reporting system and processes. From 2000 to 2011, we only know if an injury required surgery; there are no data collected specifically on injuries that did not require surgery. For these reasons, this category of players was referred to as "surgery not reported" throughout the report. From 2012 forward, this process was improved, and surgery data during this period are known to be more reliable. Furthermore, we could not review radiographs, so we cannot comment on the need or indication for surgical treatment. We also did not have any specific data on the type of surgical treatment or fixation, length of postoperative immobilization, or details on the rehabilitation process. Dates of return to full participation do not always reflect the exact date of return, which may result in calculations of days missed being slightly lower or higher than the true number of days missed from injury. These dates can also be affected by the time during the season in which the injury occurred or the severity of injury. The database further does not include any measures of athletic-exposures or player hours, which limited our ability to compare our findings to other studies that reported injuries as the incidence per exposure. Last, for the majority of the study period, players were not distinguished by unique identifiers to allow tracking across multiple years in the database, so we were unable to quantify variables such as games played the following season or career longevity.

CONCLUSION

Fibula fractures affect a number of NFL athletes and influence their ability to return to play. Further research is required to determine the optimal management of fibula fractures in NFL athletes. In the current study, time to return to play depended on both the fracture pattern and whether surgery was required and ranged from 72 to 145 days.

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