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ORIGINAL RESEARCH



Defining the contemporary epidemiology and return to play for high ankle sprains in the National Football League

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ABSTRACT

Background:

High ankle sprains and syndesmotic injuries are commonly sustained by National Football League players, yet there is a paucity of literature reporting the incidence, risk factors and return to play (RTP) rates for these injuries. The purpose of this study is to examine the epidemiology and trends in incidence of high ankle sprains across 11 NFL seasons.

Methods:

Publicly available data from the 2009–2010 through 2019–20 seasons were reviewed to identify injuries and collect player characteristics and return to play. Incidence of high ankle injuries was calculated per 10,000 athlete-exposures. Linear regression was performed for incidence of injuries. Risk factors for failure to RTP were identified through multivariate logistic regression, controlling for year of injury, player position, body mass index (BMI), age at injury, and years of experience before injury.

Results:

A total of 533 high ankle sprains were identified in 498 players at an average age of 25.8 ± 3.1 and average BMI of 31.8 ± 4.6 . The annual incidence of high ankle sprains in the NFL increased at a linear rate of 0.067 per 10,000 player exposures ($R^2 = 0.3357$) in 2009, to 1.75 per 10,000 player exposures to 2.49 in 2019–20. Most injuries were in offensive players (304/533 injuries, 57.0%). Overall, 89.7% (478/533) of players returned to play; average RTP time was 80.5 ± 132.9 days. Defensive players had a faster RTP (68.1 ± 114.6 days) compared to offensive players (90.1 ± 144.8 days) ($p = 0.084$). Higher age at injury was found to increase the risk of failure to RTP ($p = 0.0088$).

Conclusion:

RTP rate was high following high ankle sprain among NFL players at 90%, with an average recovery period of 11 weeks. Defensive players experience RTP faster than offensive players. Future studies are needed to determine performance outcomes following RTP, along with which patients might benefit from surgery.

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Ankle; high ankle sprain; NFL; ankle RTP

Introduction

Ankle sprains are one of the most prevalent injuries in the National Football League (NFL), second only to knee injuries [1]. High ankle sprains, or syndesmotic injuries, are notorious in professional football players. They take longer to heal than low ankle sprains, leading to prolonged disability and missed playing time [2]. These injuries affect the distal tibiofibular syndesmosis, which is comprised of the anterior-inferior tibiofibular ligament (AITFL), interosseus ligament (IOL), posterior-inferior tibiofibular ligament (PITFL), and inferior transverse ligament [2]. The deltoid ligament confers stability by restricting lateral talar translation, which is often an accompanying injury to syndesmotic injuries [3]. High ankle sprains are more common in high-impact sports, such as football, rugby, or hockey, and remain a persistent source of missed playing time amongst elite athletes [4]. The injury typically results

from forced dorsiflexion and external rotation of the foot relative to the ankle and tibia.

Previous epidemiological investigation into high ankle injuries in football players have primarily investigated incidence at the college level. Hunt et al. examined trends in syndesmotic injuries across 5 seasons (2004–2005 to 2008–2009) of National Collegiate Athletic Association (NCAA) men's football and identified an incidence of 0.24 high ankle injuries per 1,000 athlete exposures, compared to the rate of 0.1 per 1000 athlete exposures seen across 25 NCAA sports [5]. Football represented the highest rate of syndesmotic injuries across NCAA sports, occurring primarily during gameplay due to contact with another player [4]. Kaplan et al. found that of 320 elite college football players taking part in the 2006 NFL Combine, 24.7% of players had a history of a syndesmotic sprain, with offensive lineman the most likely of the position

groups to have suffered a high ankle injury during their football career [6].

Although high ankle sprains have been investigated in collegiate athletes, there is a paucity of recent literature examining the incidence and return to play (RTP) rate following high ankle sprains across the NFL player population. Previous studies have focused on either a single team or a small group of players in college football and the NFL. To date, there has not been a large-scale study examining syndesmotic injuries in the NFL over multiple seasons. The purpose of this study is to examine the epidemiology and trends in incidence of high ankle sprains across 11 seasons of the NFL. We hypothesized that the incidence of injuries has increased over the past 11 seasons, and that average time to return is a substantial portion of the season.

Methods

Publicly available data were reviewed to record all reported ankle injuries occurring in NFL athletes between the 2009–2010 and 2019–2020 seasons [7,8], utilizing previously reported data collection methods [9–14]. Inclusion criteria consisted of NFL athletes identified as sustaining high ankle sprains, syndesmosis, or syndesmotic injuries through publicly available data, while athletes were excluded from statistical analysis if their injury could not be explicitly classified as a high ankle injury. Player injury history was not available and therefore could not be included as a variable. Initial data collection was independently performed by two authors [DAH and JDM] by querying publicly available data from online league and player databases for weekly regular season NFL injury reports and identifying injuries reported as ‘high ankle sprain,’ ‘syndesmosis,’ or ‘syndesmotic injury.’ [7,8] These NFL injury reports consist of practice reports documenting athlete availability during NFL practices, along with game status reports that captures athlete availability during games [15,16]. The league mandates all NFL teams publish injury reports after each regular season practice and prior to each regular season game. Pro-Football-Reference.com (Sports Reference LLC, Philadelphia, PA) was also utilized to identify all ‘high ankle sprain,’ ‘syndesmosis,’ or ‘syndesmotic injury’ that resulted in a player being designated as injured reserve (IR) or physically unable to perform (PUP) [16]. For each queried injury, the record was further verified by reviewing publicly available press releases. Following the two independent authors data collection, identified athletes were compared, and any disagreements in athlete inclusion were resolved through mutual discussion with the first author [SFD].

Player and injury characteristics

For athletes meeting inclusion criteria, athlete characteristics at the time of injury (age, body mass index [BMI], years of experience, and player position) were recorded. Injury characteristics, including injury setting (preseason/offseason, regular season, postseason), activity (practice/workout versus in-game injury) were recorded when available.

Return to play (RTP) was collected and defined as the first date that a player was activated and played either a preseason/training camp or regular season game. All RTP dates were identified via Pro-Football-Reference [7].

Incidence of high ankle sprains injuries was calculated per 10,000 athlete-exposures, which was defined as participation in a practice or game. Incidence of injuries per 10,000 athlete-exposures was calculated by assuming 53 players per team, 105 practices per season, 20 games per season, and 32 teams in the NFL, as per a previously established protocol [17]. Changes in league size were also accounted for, as there were 30 teams in the 1998–1999 season and 31 teams in the 1999–2000 and 2000–2001 seasons. An athlete-exposure was defined as previously described as a single participation in a single practice or game [13].

Statistical analysis

Player characteristics were expressed as mean and standard deviation. Incidence of injuries was computed as follows:

$$\frac{\#ofinjuries}{(total exposures) \times (\#ofplayers)}$$

Linear regression was performed to assess incidence of injuries across time. Risk factors for failure to RTP following high ankle injuries were identified through multivariate logistic regression, controlling for year of injury, player position, BMI, age at injury, and years of experience before injury. Odds ratios (OR) were expressed with 95% confidence intervals (CI). Kaplan-Meier survivorship plots were computed for RTP, and a log-rank test compared the difference in RTP between offensive and defensive players. Statistical analysis was performed using RStudio V1.1.442 (RStudio Inc. Boston, MA). An α value of .05 was used.

Results

A total of 533 high ankle sprains were identified in 498 players from the 2009–10 through 2019–20 NFL seasons. The annual incidence of high ankle sprains in the NFL increased with a linear trend rate of 0.067 per 10,000 player exposures ($R^2 = 0.3357$) in 2009, from 1.75 per 10,000 player exposures to 2.49 in 2019–20 (Figure 1).

Player demographics

Average player age and BMI were 25.8 ± 3.1 (20–37) years and 31.8 ± 4.6 (24–43.5), respectively. Injuries were most frequently observed in offensive players (304/533 injuries, 57.0%). These injuries occurred predominantly in offensive linemen (111/304 injuries, 36.5%) followed by wide receivers (73/304, 24.0%) (Table 1). Injuries to defensive players represented 42.8% (228/533) of high ankle injuries, with a majority occurring in defensive secondary players (86/228, 37.7%). Players had an average of 2.9 ± 2.8 (0–14) experience years prior to injury. Injuries occurred primarily during the regular season. Injuries occurred most frequently during the NFL regular season (422/533, 79.2%), with 17.3% occurring during the NFL preseason

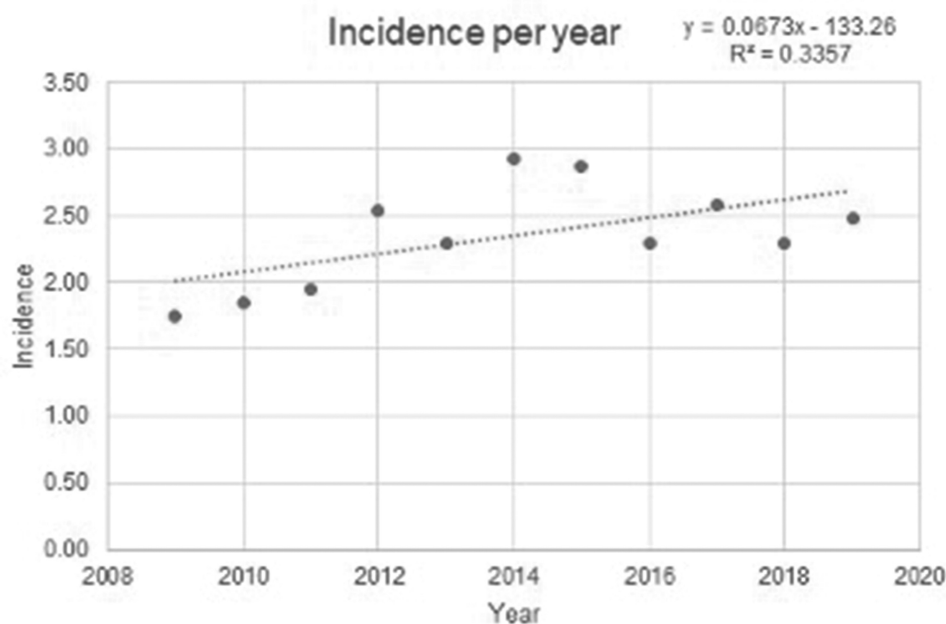


Figure 1. Incidence of high ankle sprain per year per 10,000 player exposures.

Table 1. Demographic data.

| | n | Mean BMI | Experience years (mean \pm SD) | RTP (mean days \pm SD) |
|----------------|-----|----------|----------------------------------|--------------------------|
| Total | 533 | 31.8 | 2.9 \pm 2.8 | 80.5 \pm 132.9 |
| Position | | | | |
| Defensive Line | 80 | 36.2 | 3.3 \pm 2.8 | 60.2 \pm 118.5 |
| Defensive Back | 86 | 27.5 | 2.3 \pm 3.2 | 73.1 \pm 115.7 |
| Linebacker | 62 | 31.1 | 2.0 \pm 1.9 | 71.4 \pm 109.8 |
| Offensive Line | 111 | 37.5 | 2.9 \pm 3.0 | 86.1 \pm 162.7 |
| Quarterback | 19 | 27.9 | 3.4 \pm 3.8 | 53.6 \pm 77.0 |
| Running Back | 65 | 29.9 | 2.9 \pm 2.4 | 99.4 \pm 150.4 |
| Special Teams | 1 | 29.9 | 1 | - |
| Tight End | 36 | 30.6 | 2.6 \pm 2.7 | 103.0 \pm 144.7 |
| Wide Receiver | 73 | 27.0 | 2.7 \pm 2.8 | 91.8 \pm 125.8 |
| Injury Timing | | | | |
| Preseason | 92 | - | - | 98.2 \pm 179.0 |
| Regular Season | 422 | - | - | 72.1 \pm 119.5 |
| Postseason | 19 | - | - | 198.3 \pm 98.5 |

^aBMI: body mass index. RTP: Return to play.
SD: Standard deviation

(92/533) and 3.6% occurring during the NFL postseason (19/533).

Return to play

Players returned to play after 89.7% (478/533) of injuries, with an average RTP of 80.5 \pm 132.9 (3–1099) days post-injury (Figure 2A). There were two players in which RTP was the day the player returned to training camp, as they had another injury on the first day of training camp, and thus missed the rest of the season due to another injury. After

Table 2. Risk factors for failure to return to play following high ankle injury.

| Variables | OR | 95% CI | | p value |
|-----------------------------------|------|--------|------|---------------|
| Year of Injury | 1.12 | 1.01 | 1.24 | 0.0337 |
| Position (Ref: Defensive Line) | | | | |
| –Offensive Line | 1.31 | 0.49 | 3.78 | 0.6022 |
| –Defensive Back | 1.89 | 3.91 | 1.05 | 0.4462 |
| –Linebacker | 0.34 | 0.04 | 1.82 | 0.2304 |
| –Quarterback | 0.59 | 0.03 | 5.91 | 0.6842 |
| –Running Back | 1.19 | 0.25 | 5.65 | 0.8268 |
| –Special Teams | - | - | - | 0.985 |
| –Tight End | 2.26 | 0.56 | 9.80 | 0.2592 |
| –Wide Receiver | 1.27 | 0.23 | 7.79 | 0.7885 |
| BMI | 1.01 | 0.87 | 1.16 | 0.9459 |
| Age at Injury | 1.24 | 1.05 | 1.46 | 0.0088 |
| Years of Experience before Injury | 0.71 | 0.59 | 0.86 | 0.0004 |

stratifying players into offense and defense cohorts, Kaplan-Meier survivorship revealed that defensive players had a faster RTP (mean: 68.1 \pm 114.6 days) compared to offensive players (mean: 90.1 \pm 144.8 days) that approached significance ($p = 0.084$) (Figure 2B). Independently, higher age at injury was found to increase the risk of failing to RTP (OR = 1.24, 95%, CI 1.05–1.46, $p = 0.0088$), whereas number of years of experience before injury was found to decrease the risk of failing to RTP (OR = 0.71, 95%, CI 0.59–0.86, $p = 0.0004$) (Table 2).

Discussion

Our study demonstrates that the annual incidence of high ankle sprains over the past 11 NFL seasons has increased in a linear fashion from 1.75 per 10,000 player exposures in 2009 to 2.49 in the 2019–2020 season. RTP following high ankle sprain was 90%, with an average return at 80 days—approximately 11 weeks. Other studies have similarly reported increasing incidence of syndesmotom sprains. Hunt et al.

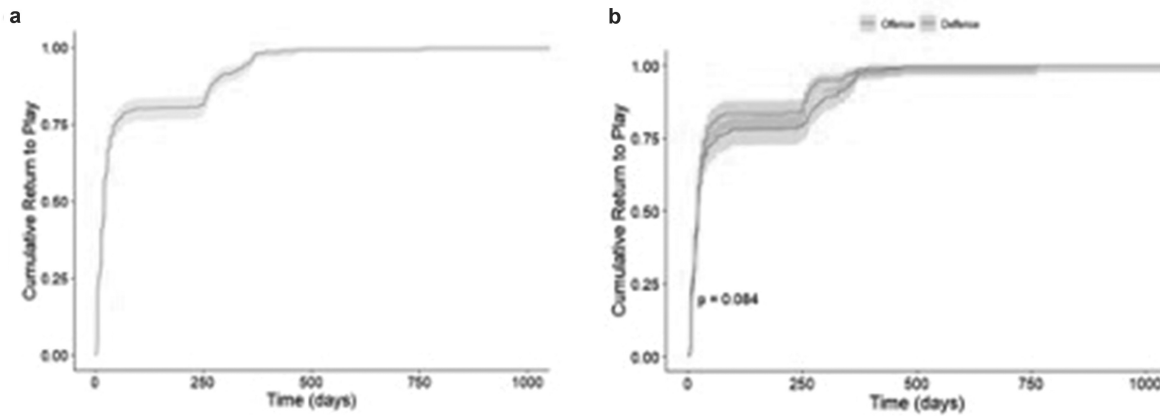


Figure 2. Kaplan-Meier survivorship curve for return to play following high ankle sprain.

demonstrated that syndesmotom injuries accounted for 24.6% of all ankle sprains in NCAA football players with an overall incidence of 0.24 per 1,000 athlete exposures [4]. Similarly, Kaplan et al. determined that 24.7% of players at the 2006 NFL Combine had a history of syndesmotom sprain [6]. The increasing incidence of this injury could be due to increasing athlete size, speed, and strength, or due to heightened awareness and improved diagnostic parameters. We postulate that the increased incidence is most likely due to a combination of these aforementioned factors. Players had an average of 2.9 ± 2.8 years of experience prior to injury with a mean age of 25.8 ± 3.1 . No previous study identified if players with more experience in the league tend have more syndesmotom injuries. The average age of an NFL player is 26.6, which indicates that players of all ages can suffer syndesmotom injuries [18].

The highest number of injuries occurred in offensive linemen, with injuries in defensive backs and defensive linemen also being common. Offensive and defensive linemen often play within crowded spaces and can suffer high ankle sprains with excessive dorsiflexion and external rotation of the foot relative to the ankle, which is consistent with previous studies of NCAA football players [19]. Defensive backs, such as safeties and cornerbacks, generate tremendous speed when making tackles, potentially increasing their risk for syndesmotom injury. Previous studies echo our findings that offensive and defensive linemen are among the most affected positions, although Hunt et al. in their 2013 study of NCAA players found running backs to be the most affected [4,6,20]. Osbahr et al. found that linebackers were the most affected position, although only 36 players were identified in total of having syndesmotom injuries [20]. Regardless of the position, Boytim et al. compared the mechanism of injuries of players sustaining high ankle sprains, and of the 15 NFL players studied, 9 suffered an external rotation movement due to a contact or non-contact twisting mechanism [21]. Six of the 15 players suffered sprains after another player fell onto their lower legs. Hunt et al. found that 75.2% of the syndesmotom sprains seen in 573 NCAA football players from 2005 to 2009 occurred due to direct contact with another player [4]. The

authors also reported that 51.8% of injuries occurred on the offensive or defensive line side of a running play. Running plays might increasingly target linemen due to the tremendous force exerted onto them by another lineman coupled with their rapidly changing direction as they attempt to target the running back.

Understanding how long an injured NFL player may be sidelined can have implications on a team's success and an individual's player's longevity in the league. Our study found that players RTP at a rate of 89.7%, with an average 80.5 days \pm 132.9 days off the field, with injuries primarily occurring within the regular season (79.2%) rather than in the pre- or post-season. Regular season injuries were the most prevalent, as demonstrated in an earlier study of NCAA football players, where the regular season syndesmotom injury rate was reported at 0.28 per 1,000 athlete-exposures when compared with preseason (0.18) and post-season (0.15) [4].

Our results contradict previous studies, where RTP was found to be much shorter. Boytim et al. found that 15 NFL players missed an average of 1.4 games (estimated 17 days), while Osbahr et al. found that 36 NFL players, all treated with nonoperative management, returned after an average of 15.4 days \pm 11.1 days [20,21]. Amongst NCAA football players, Hunt et al. reported that the median RTP to be higher among complete syndesmosis injuries (31.3 days lost vs 15.8 days lost for partial injuries) [4]. Miller et al. found a similar timeframe of 15.5 \pm 9.5 days lost (2–30) in 21 Division I college football players [22]. It is possible that today's NFL players are experiencing more severe high ankle sprains as compared to these NCAA cohorts, which can prolong recovery, though it remains possible that very minor high ankle injuries with shorter recovery times are underreported and therefore underrepresented in the methodology of this study. This study was able to examine a substantially larger volume of NFL player injuries (533 vs 15–36) across 10 seasons (2009–2010 through 2019–20), compared to single season investigations, representing the first of its kind [20,21]. These findings underscore the importance of injury prevention and may be helpful for

counseling players on their risk of injury, as well as providing valuable information for estimating RTP.

Limitations

An inherent limitation of this type of study is the use of public databases to acquire information about syndesmotom injuries, although this method of data collection has been widely accepted in the literature [9–14]. This can lead to over or under reporting of injuries, as identifying high ankle injuries from ‘ankle’ injuries relies on press releases, which can lead to not all cases being captured and higher profile athletes being overrepresented. The overall incidence of high ankle sprains was likely underestimated, as injuries to practice squad or less commonly reported players may have not received the publicity required to differentiate a high ankle from low ankle sprain. Furthermore, we did not address the severity of injury in each case which would more directly guide treatment and have an impact on RTP time. Variables of interest such as playing surface material or type of contact leading to injury are not available through this method of data collection. Additionally, since player injury history was not available, this study was unable to analyze the role of previous injury on a player’s future risk of injury and RTP. Advanced imaging or team specific rehabilitation were likewise not obtainable, as both the severity of injury and the therapy undertaken may contribute to the RTP time. Additionally, other factors that may affect RTP such as team personnel decisions or personal decision by the athletes to remain out of play were not able to be considered. Despite these limitations, this is the largest, longest, and most comprehensive study examining the epidemiology and rates of RTP following high ankle sprains amongst NFL players to our knowledge.

Conclusion

RTP rate was high following high ankle sprain amongst NFL players at 90%, with an average recovery period of 11 weeks. Defensive players experience RTP faster than offensive players. Future studies are needed to determine performance outcomes following RTP, along with which patients might benefit from surgery.

Declaration of interest

No potential conflict of interest was reported by the author(s).

References

- Lawrence DW, Hutchison MG, Comper P. Descriptive National Football League, 2012-2014. *Orthop J Sport Med.* 2015;3(5):2325967115583653.
- Hunt KJ, Phisitkul P, Pirolo J, et al. High ankle sprains and syndesmotom injuries in athletes. *J Am Acad Orthop Surg.* 2015;23(11):661–673.
- Xenos JS, Hopkinson WJ, Mulligan ME, et al. The tibiofibular syndesmosis. Evaluation of the ligamentous structures, methods of fixation, and radiographic assessment. *J Bone Jt Surg - Ser A.* 1995;77(6):847–856.
- Hunt KJ, George E, Harris AHS, et al. Epidemiology of syndesmosis injuries in intercollegiate football. *Clin J Sport Med.* 2013;23(4):278–282.
- Mauntel TC, Wikstrom EA, Roos KG, et al. The epidemiology of high ankle sprains in National Collegiate Athletic Association Sports. *Am J Sports Med.* 2017;45(9):2156–2163.
- Kaplan LD, Jost PW, Honkamp N, et al. Incidence and variance of foot and ankle injuries in elite college football players. *Am J Orthop (Belle Mead NJ).* 2011 Accessed 2020 Oct 8. Published: <https://pubmed.ncbi.nlm.nih.gov/21720586/>
- Pro-Football-Reference.com. 2020.
- ESPN. 2020.
- Hsu WK. Outcomes following nonoperative and operative treatment for cervical disc herniations in national football league athletes. *Spine (Phila Pa 1976).* 2011;36(10):800–805.
- Hsu WK. Performance-based outcomes following lumbar discectomy in professional athletes in the national football league. *Spine (Phila Pa 1976).* 2010;35(12):1247–1251.
- Mai HT, Chun DS, Schneider AD, et al. Performance-based outcomes after anterior cruciate ligament reconstruction in professional athletes differ between sports. *Am J Sports Med.* 2017;45(10):2226–2232.
- Minhas SV, Kester BS, Larkin KE, et al. The effect of an orthopaedic surgical procedure in the National Basketball Association. *Am J Sports Med.* 2015;44(4):1056–1061.
- Nguyen MT, Hsu WK. Performance-based outcomes following patellar tendon repair in professional athletes. *Phys Sportsmed.* 2020;48(1):110–115.
- Wise P, Gallo RA. Increasing incidence of pectoralis major ruptures in NFL players. *Orthop J Sport Med.* 2019;7(7_suppl5):2325967119S0039.
- Health & Safety Rules Changes. NFL Football Operations.
- The National Football League: 2017 Personnel (injury) report policy. *Natl Footb Leag.* 2017.
- Sahota S, Gibbs DB, Lawton CD, et al. Pectoralis major injuries in the National Football League. *Sports Health.* 2020;12(2):116–123.
- The average age in esports vs. major sports. Published 2017. cited 2020 Dec 30. https://www.espn.com/esports/story/_id/20733853/the-average-age-esports-versus-nfl-nba-mlb-nhl
- Mulcahey MK, Bernhardtson AS, Murphy CP, et al. The epidemiology of ankle injuries identified at the National Football League combine, 2009-2015. *Orthop J Sport Med.* 2018;6(7):232596711878622.
- Osbahr DC, Drakos MC, O’Loughlin PF, et al. Syndesmosis and lateral ankle sprains in the National Football League. *Orthopedics.* 2013;36(11):e1378–e1384.
- Boytim MJ, Fischer DA, Neumann L. Syndesmotom ankle sprains. *Am J Sports Med.* 1991;19(3):294–298.
- Miller BS, Downie BK, Johnson PD, et al. Time to return to play after high ankle sprains in collegiate football players: a prediction model. *Sports Health.* 2012;4(6):504–509.