National Football League Skilled and Unskilled Positions Vary in Opportunity and Yield in Return to Play After an Anterior Cruciate Ligament Injury

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Background: Anterior cruciate ligament (ACL) injuries pose a significant risk to the careers of players in the National Football League (NFL). The relationships between draft round and position on return to play (RTP) among NFL players are not well understood, and the ability to return to preinjury performance levels remains unknown for most positions.

Purpose: To test for differences in RTP rates and changes in performance after an ACL injury by position and draft round. We hypothesized that skilled positions would return at a lower rate compared to unskilled positions. We further hypothesized that early draft-round status would relate to a greater rate of RTP and that skilled positions and a lower draft round would correlate with decreased performance for players who return to sport.

Study Design: Case-control study; Level of evidence, 3.

Methods: Utilizing a previously established database of publicly available information regarding ACL tears among NFL players, athletes with ACL tears occurring between the 2010 and 2013 seasons were identified. Generalized linear models and Kaplan-Meier time-to-event models were used to test the study hypotheses.

Results: The overall RTP rate was 61.7%, with skilled players and unskilled players returning at rates of 64.1% and 60.4%, respectively ($P = .74$). Early draft-round players and unskilled late draft-round players had greater rates of RTP compared to skilled late draft-round players and both unskilled and skilled undrafted free agents (UDFAs). Skilled early draft-round players constituted the only cohort that played significantly fewer games after an injury. Unskilled UDFAs constituted the only cohort to show a significant increase in the number of games started and ratio of games started to games played, starting more games in which they played, after an injury.

Conclusion: Early draft-round and unskilled players were more likely to return compared to their later draft-round and skilled peers. Skilled early draft-round players, who displayed relatively high rates of RTP, constituted the only cohort to show a decline in performance. Unskilled UDFAs, who exhibited relatively low rates of RTP, constituted the only cohort to show an increase in performance. The significant effect of draft round and position type on RTP may be caused by a combination of differences in talent levels and in opportunities given to returning to play.

Keywords: knee; ligaments; ACL; football (American); physical therapy/rehabilitation

Anterior cruciate ligament (ACL) tears are devastating and potentially career-ending injuries to professional athletes.[1,10,12,24] For athletes in the National Football League (NFL), return to play (RTP) often requires surgical reconstruction, recovery, and extensive rehabilitation, all of which are complicated by financial, professional, and social stresses. For those elite athletes who recover to near-preinjury levels of performance, RTP is still dependent on a limited number of roster positions in a league where each year brings a new class of recruits via an annual draft. Given the 6 to 9 months required for rehabilitation in a field where the average length of career is only 3.3 years and declining, ACL injuries pose a significant risk to players' careers.[2]

Previous researchers have demonstrated that many factors affect an NFL player's ability to return after ACL reconstruction. Differences in RTP depending on player

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position have been observed, both in smaller position-specific studies and larger all-inclusive studies.[11,15,16,24] The risk of ACL injuries and reinjuries has also been shown to differ by position, with a notably higher risk in running backs, tight ends, and wide receivers, who are more frequently involved in tackles and perform more change-of-direction movements than their peers.[14]

Draft round has also been shown to significantly affect RTP rates.[15,24] Being selected earlier in the NFL draft (rounds 1-3) has been demonstrated to increase the likelihood of RTP after an ACL injury compared to being selected later in the NFL draft (rounds 4-7) or not being drafted.[15,24] Despite multiple studies demonstrating significant relationships between position type, draft round, and RTP rates, no study to date has examined the interplay between draft round and position type broadly across the NFL. In addition, whether players are able to return to preinjury levels of performance after RTP remains unknown, with information available only for running backs, wide receivers, quarterbacks, and kickers.[9,11,16]

The purpose of this study was to evaluate RTP after primary ACL injuries, evaluate covariates that affect RTP, and assess preinjury and postinjury levels of performance for all positions. We hypothesized that RTP for skilled positions and that an early draft round would correlate to a higher probability and rate of RTP. We further hypothesized that a skilled position and later draft round selection would correlate with decreased performance for players who return to active NFL rosters.

METHODS

Utilizing a previously established database of publicly available information regarding ACL tears among NFL players,[14] we identified NFL players with publicly disclosed ACL tears occurring between the start of the 2010 season and the end of the 2013 season. To develop this database, an anonymized list of ACL injuries from the NFL Injury Surveillance System for the 2004 to 2013 NFL seasons was provided by Edgeworth Economics. Searches for "anterior cruciate ligament" and "ACL" were conducted within NFL.com, ESPN.com, Rotoworld.com, each team's published media guide, newspapers covering each team, and websites for each team hosted on SBNation.com. Searches for each year and the words "NFL" and "ACL" or "anterior cruciate ligament" were also conducted via Google. Only players for whom news reports could be obtained confirming the injury were included. News reports describing the individual ACL injuries were combined with player-specific searches to determine injury dates and previous ACL injuries.

Snap counts from ProFootballFocus.com and position listings on team websites were used to determine the primary position of each player at the time of injury. Information regarding the age of the player at the time of injury, draft position, height, weight, All-Pro and Pro-Bowl selections, Super Bowl victories, and playing history before and after the injury were gathered from NFL.com, ESPN.com, Rotoworld.com, Pro-Football-Reference.com, and each team's website. All data were inclusive through the conclusion of the 2015-2016 NFL season.

For inclusion into this study, the player must have been on the 53-person active roster for an NFL franchise if the injury occurred during the regular season or postseason or been on the 90-person roster if the injury occurred during the preseason from the 2010 to 2013 seasons. Exclusion criteria included players with a previously documented ipsilateral or contralateral ACL tear or players who developed a retear or contralateral tear after recovery during or after the study period. Any player who continued to play after an ACL tear without undergoing reconstruction was also excluded.

For the purposes of this study, "skilled" positions were defined as running backs, fullbacks, wide receivers, quarterbacks, tight ends, cornerbacks, linebackers, and safeties. "Unskilled" positions included offensive tackles, guards, centers, defensive tackles, and defensive ends. The remaining players were considered "special teams" position players. The preseason was defined as the period from the day after the Super Bowl of the previous season to the day preceding the first regular-season game of the index season. The regular season was defined as the period from the day of the first regular-season game to the day of the last regular-season game. The postseason was defined as the period between the day after the last regular-season game and the day of the Super Bowl. RTP was defined as participating in at least 1 play (1 down) in a regular-season or postseason game after the injury. The date of RTP was the first regular-season or postseason game in which the athlete played after the injury. Play in a formal preseason game was used as the date of RTP if the athlete subsequently played in a regular-season game that same season. Play in non-NFL franchises was not deemed to be a successful RTP.

In calculating regular-season games played and regular-season games started before the injury season, the season in which the injury occurred was excluded. Average regular-season games played and average regular-season games started before the injury season were calculated by respectively dividing regular-season games played before

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Ethical approval was not sought for the present study.

or started before by the number of seasons before the injury in which the athlete was on an active roster for at least 1 week. Average regular-season games played and average regular-season games started after the injury season were calculated by respectively dividing regular-season games played after or started after by the number of seasons after the injury in which the athlete was on an active roster for at least 1 week. If a player injured his ACL in his rookie season or had never been on an active roster preceding the injury season, average regular-season games played and average regular-season games started before the injury season were each recorded as null (no observation) rather than zero. If a player did not return after an ACL injury, average regular-season games played and average regular-season games started after the injury season were each recorded as null.

Statistical analysis was performed using SAS version 9.4 (SAS Institute). Players who were observed to return within 18 months after an injury were compared to those who had not returned to play. For baseline and demographic variables, players were compared using generalized linear models with the distribution and link function selected based on the type of dependent variable. Age at injury and body mass index were modeled as Gaussian, whereas counts (games, seasons) were modeled as negative binomial, and ratios (games started per played) were modeled as binomial. Because of their small sample size ($n < 5$), special teams players were excluded from statistical analyses. Players who had no prior active roster experience before the injury season were counted as "rookies" and excluded from analyses involving the number of games played and started before the injury, number of regular-season games played and started before the injury, number of regular-season games played and started per season before and after the injury, and ratio of regular-season games started to regular-season games played before and after the injury.

Kaplan-Meier estimation was used to model the probability of RTP as a function of time since the injury, and Wilcoxon weighting was used when comparing these failure functions. Because the effective sample sizes became small, functions were right-censored at 18 months after the injury. Where necessary, family-wise alpha was maintained at .05 across all comparisons using the Tukey-Kramer method. Both raw and adjusted *P* values are presented where available.

RESULTS

A total of 218 NFL players were identified as having torn their ACL between the start of the 2010 season and the end of the 2013 season. Of those 218 players, 41 had previously suffered a tear in either their contralateral or ipsilateral knee and were excluded from the study. Of the remaining 177 players who suffered primary ACL tears, 23 suffered a subsequent tear during the study period or in the 2 years after the study period and were excluded, leaving 154 players who suffered a primary ACL tear without a subsequent tear during or after the study period for analysis.

Players who returned to play within 18 months after an injury and those who did not were compared (Table 1).

TABLE 1
Patient Demographics[a]

	Return to Play Within 18 mo After Injury	No Return to Play Within 18 mo After Injury	*P* Value
Age at injury,[b] y	25.2 (24.6-25.8)	25.4 (24.8-26.1)	.56
Body mass index,[b] kg/m^2	31.4 (30.4-32.5)	31.3 (30.2-32.4)	.87
Active roster seasons before injury[b]	2.81 (2.29-3.45)	2.36 (0.62-1.09)	.27
Games played before injury[c]	54.2 (3.8-4.2)	35.8 (27.0-47.5)	.018
Games started before injury[c]	34.0 (25.8-44.9)	16.3 (9.5-27.9)	.017
Regular-season games played before injury[d]	46.1 (37.8-56.2)	30.3 (22.3-41.2)	.025
Regular-season games played per season before injury[d]	13.1 (12.2-13.8)	10.3 (8.9-11.7)	.0006
Regular-season games started before injury[d]	26.7 (19.6-36.4)	13.2 (7.4-23.7)	.037
Regular-season games started per season before injury[d]	7.56 (6.02-9.13)	4.51 (2.84-6.68)	.025

[a]Values are shown as mean (95% CI).
[b]Includes all unskilled and skilled players (n = 150).
[c]Includes injury season and excludes 30 rookies (n = 120).
[d]Excludes injury season and excludes 30 rookies (n = 120).

There were no significant differences between the 2 groups with respect to age, body mass index, or number of active roster seasons before the injury. On average, players who returned to play had played more games than those who did not (54.2 vs 35.8 games, respectively; $P = .018$). Those who returned to play, on average, had also started more games than those who did not (34.0 vs 16.3 games, respectively; $P = .017$). The number of regular-season games played and started per season before the injury also significantly differed between the 2 groups. Players who returned to play, on average, played 13.1 regular-season games per season before the injury, while those who did not return, on average, played 10.3 regular-season games per season ($P = .0006$). Those who returned to play, on average, started 7.56 regular-season games per season before the injury, while those players who did not return started 4.51 regular-season games per season ($P = .025$).

Of the 154 players included in this study, 39 were skilled, 111 were unskilled, and 4 were special teams players (Table 2). The overall percentage of players who were able to return within 18 months after the injury was 55.8%. The percentage of unskilled and skilled players who were able to return was 58.9% and 54.1%, respectively ($P = .61$). When increasing the postinjury RTP window to greater than 18 months, the overall percentage of players who were able to return was 61.7%, and the percentage of unskilled and skilled players who were able to return was 64.1% and

TABLE 2
Return to Play and Draft Round by Position[a]

	Return <18 mo After Injury	Return >18 mo After Injury	Early Draft Round (Rounds 1-3)	Late Draft Round (Rounds 4-7)	Undrafted Free Agent
Unskilled (n = 39), n (%)	23/39 (58.9)	25/39 (64.1)	12/39 (30.7)	15/39 (38.5)	12/39 (30.8)
Center	3/6	4/6	2/6	3/6	1/6
Guard	6/8	6/8	0/8	4/8	4/8
Offensive tackle	3/7	3/7	4/7	1/7	2/7
Defensive tackle	6/11	7/11	2/11	5/11	4/11
Defensive end	5/7	5/7	4/7	2/7	1/7
Skilled (n = 111), n (%)	60/111 (54.1)	67/111 (60.4)	37/111 (33.3)	39/111 (35.1)	35/111 (31.5)
Quarterback	1/1	1/1	0/1	0/1	1/1
Running back	7/16	8/16	5/16	6/16	5/16
Fullback	1/4	1/4	0/4	1/4	3/4
Wide receiver	15/25	15/25	7/25	8/25	10/25
Tight end	8/14	11/14	5/14	5/14	4/14
Linebacker	12/26	14/26	10/26	11/26	5/26
Cornerback	9/13	9/13	4/13	5/13	4/13
Safety	7/12	8/12	6/12	3/12	3/12
Special teams (n = 4), n (%)	3/4 (75.0)	3/4 (75.0)	1/4 (25.0)	2/4 (50.0)	1/4 (25.0)
Long snapper	1/1	1/1	0/1	1/1	0/1
Punter	0/1	0/1	0/1	0/1	1/1
Kicker	2/2	2/2	1/2	1/2	0/2
Total (n = 154), n (%)	86/154 (55.8)	95/154 (61.7)	50/154 (32.5)	56/154 (36.4)	48/154 (31.2)

[a]Values are shown as n/total unless otherwise indicated.

60.4%, respectively ($P = .68$). RTP rates for positions with greater than 5 players were compared, and tight ends had the greatest percentage of RTP, with 78.6%. The lowest rate of RTP was offensive tackles, with 42.9%.

The 3 position groupings (unskilled, skilled, and special teams) were each further divided into 3 groups by draft round (Table 2). The 3 position groupings were subdivided into early draft round (rounds 1-3), late draft round (rounds 4-7), and undrafted free agents (UDFAs). The cumulative percentage of players who would return as a function of the time since injury was evaluated for 6 player groupings: unskilled early draft, unskilled late draft, unskilled UDFA, skilled early draft, skilled late draft, and skilled UDFA (Figure 1). The time from injury was right-censored at 18 months, as effective sample sizes became too small after that time period, and special teams players were excluded because of their sample size (n = 4).

The rate of RTP was statistically significantly greater for (1) unskilled late draft-round players compared to skilled UDFAs (Tukey-Kramer adjusted, $P = .0288$), (2) skilled early draft-round players compared to unskilled UDFAs ($P = .0420$), (3) skilled early draft-round players compared to skilled late draft-round players ($P = .0379$), and (4) skilled early draft-round players compared to skilled UDFAs ($P = .0068$) (Table 3). Based on unadjusted P values, additional significant differences were noted, demonstrating greater rates of return for (1) unskilled early draft-round players compared to skilled late draft-round players (raw, $P = .0215$; Tukey-Kramer adjusted, $P = .194$), (2) unskilled late draft-round players compared to unskilled UDFAs (raw, $P = .0357$; Tukey-Kramer adjusted, $P = .2868$), and (3) unskilled late draft-round players compared to skilled late draft-round players (raw, $P = .0155$; Tukey-Kramer adjusted, $P = .1488$).

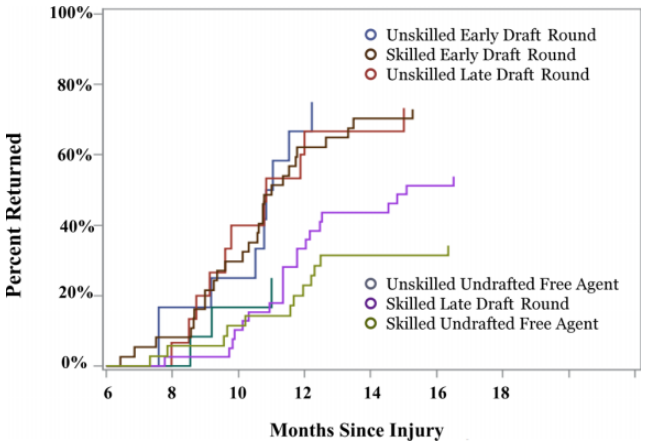

Figure 1. Kaplan-Meier estimated failure function describing return to play as a function of months since injury.

When evaluating the ratio of regular-season games played per games eligible before and after the injury for players who successfully returned to play, skilled early draft-round players displayed a significant decrease (Figure 2A), playing in an average of 86.8% of eligible games before the injury but in only 76.8% of eligible games after the injury ($P < .0001$). No statistically significant changes were found in any of the other position/draft round categories. When evaluating the ratio of regular-season

TABLE 3
Comparison of Estimated Probability of Return to Play as a Function of Months Since Injury, Position Type, and Draft Round[a]

	Unskilled Late Draft Round	Skilled Early Draft Round	Skilled Late Draft Round	Unskilled Undrafted Free Agent	Skilled Undrafted Free Agent
Unskilled early draft round	.7651 (.9997)	.1211 (.6315)	**.0215 (.1940)**	.0558 (.3841)	*.0033 (.0392)*
Unskilled late draft round		.2040 (.8013)	**.0155 (.1488)**	**.0357 (.2868)**	*.0024 (.0288)*
Skilled early draft round			*.0032 (.0379)*	*.0036 (.0420)*	*.0005 (.0068)*
Skilled late draft round				.3604 (.9429)	.6798 (.9985)
Unskilled undrafted free agent					.1374 (.6737)

[a]Values are shown as raw *P* value (Tukey-Kramer *P* value). Bold: raw *P* value statistically significant. Italics: both raw and Tukey-Kramer *P* values statistically significant.

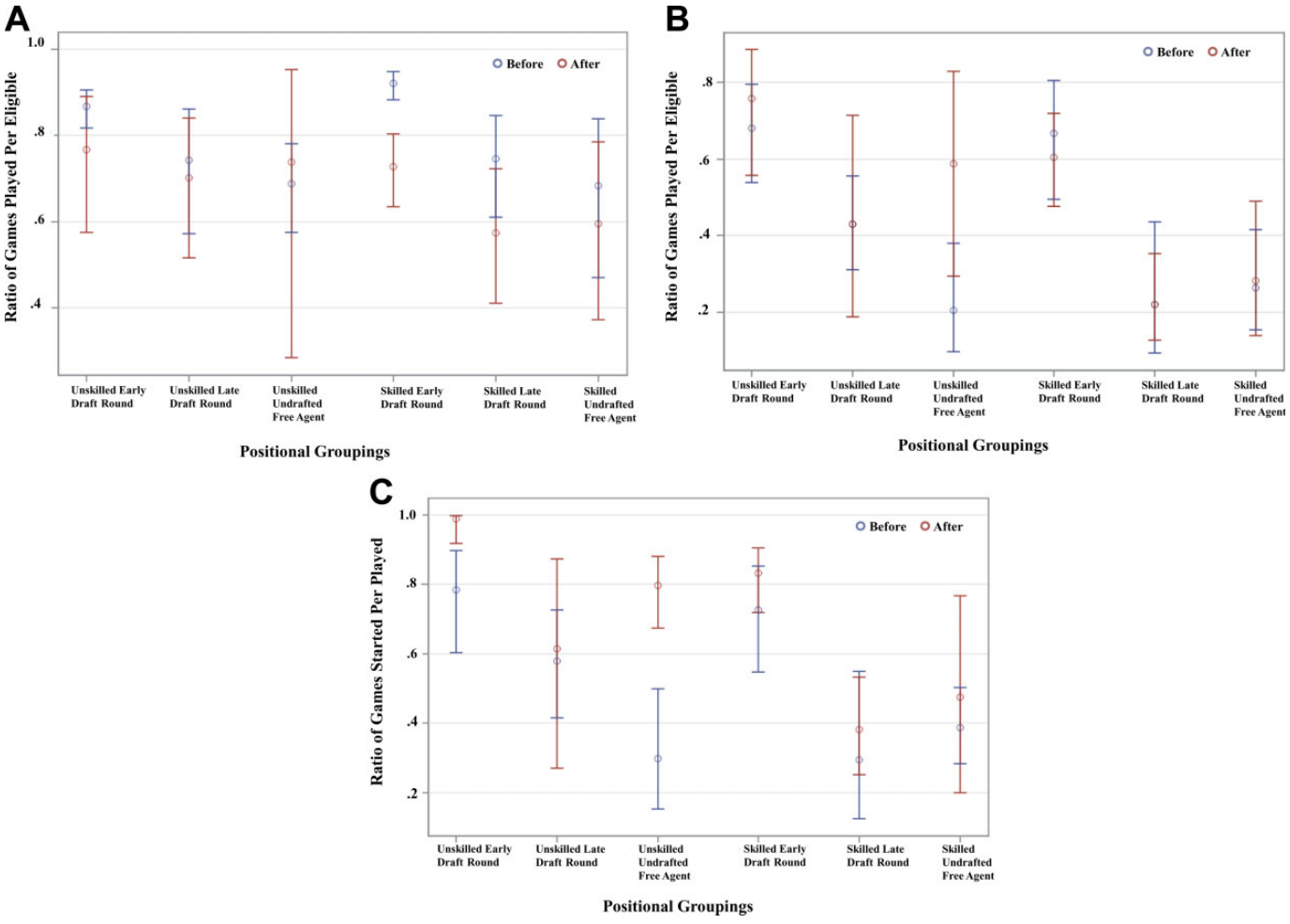

Figure 2. Regular-season games (A) played and (B) started per eligible before and after injury. (C) Regular-season games started per played before and after injury.

games started per eligible before and after the injury for players who successfully returned to play, unskilled UDFAs constituted the only cohort to show a significant change. Of those who successfully returned to play, unskilled UDFAs started an average of 20.5% of eligible games before the injury and 58.8% of eligible games after the injury ($P = .044$). No statistically significant changes were found in any of the position/draft-round categories with regard to games started per eligible before and after the injury (Figure 2B).

When evaluating the ratio of games started to games played before and after the injury, only unskilled UDFAs displayed a significant change (Figure 2C). Unskilled UDFAs started a greater percentage of games that they

played after RTP. For unskilled UDFAs, the ratio of games started to games played before and after the injury was 0.30 and 0.80, respectively ($P = .0037$). No statistically significant changes were found in any of the other position/draft-round categories.

DISCUSSION

Athletes often expect to return to all activities at a performance level equal to their preinjury level after an ACL tear.[22] Optimism about returning after an ACL tear is shared by NFL teams and physicians alike. In a 2007 study, Brophy et al[7] evaluated an NFL team's Combine sessions and found that the number of athletes that the team disqualified from possibly selecting in the draft because of previous ACL reconstruction dropped significantly over a 13-year span. Bradley et al[6] also surveyed all NFL team physicians and found that 90% of physicians expected 90% to 100% of players to return to the NFL after ACL reconstruction. These expectations may be warranted, as Keller et al[20] demonstrated in 2015 that NFL Combine athletes with a history of primary ACL reconstruction performed similarly to matched controls in the 40-yd dash, vertical leap, and other tests of agility and quickness.

Despite optimistic expectations from NFL physicians and athletes, the rate of RTP in NFL athletes remains relatively low. Previous studies have demonstrated an RTP rate above 70% in collegiate soccer and football as well as a 78% RTP rate in the National Basketball Association and 89% in the National Hockey League.[10,13,18,25] RTP rates for NFL players have previously been reported at 62% and 63%.[15,24] This study reports a rate consistent with the literature, with players returning at a rate of 61.6%.

Lower rates of RTP in the NFL may be caused by the difference between being able to return and being given the opportunity to do so. In 2010, Shah et al[24] found that players selected in the first 4 rounds of the NFL draft were 12.2 times more likely to return after an ACL injury compared to those drafted later or undrafted. Eisenstein et al[15] found a similar correlation between draft round and RTP rates, with the odds ratio of 4.44 favoring RTP for players drafted in the first 3 rounds compared to those drafted in the fourth round or later. The positive association between earlier draft status and RTP rates has also been demonstrated in NFL players after partial meniscectomy, patellar tendon ruptures, and quadriceps tendon injuries.[3-5] In an analysis of 219 NFL players, Secrist et al[23] found that players earning less than $2 million per year before an ACL injury were less likely to remain in the league than uninjured controls, while those earning over $2 million were not negatively affected.

This study similarly found that both skilled and unskilled players drafted in early rounds exhibited higher rates of RTP compared to their later drafted or undrafted peers. Players who were selected earlier in the draft may warrant higher salaries. If so, these players may return more frequently, as they are more talented players who command earlier draft selections and higher salaries.[17] However, in a league where draft selections in the earlier rounds are coveted, the higher rates of RTP among early draft-round players compared to late draft-round players may reflect the higher investment that NFL teams placed in selecting those early draft-round players. Keefer[19] examined the "sunk-cost fallacy" in the NFL and found that first-round selections, despite being no more productive than their peers, started significantly more games because of their compensation premium. This sunk-cost concept may go beyond payment alone and may also apply to marketing, media, and other promotions. In examining the National Basketball Association, Staw and Hoang[26] also found that teams granted more playing time to their most highly drafted players and retained them longer, even after controlling for players' on-court performance, injuries, trade status, and position played. Thus, higher rates of RTP among players drafted earlier appear to be affected by both their intrinsic talents and extrinsic investment valuation, leading to better and more opportunities after an ACL injury.[19,26]

The effect of an ACL injury on career length remains largely unknown. Brophy et al[8] reported similar career lengths in NFL athletes with and without ACL reconstruction but shorter career lengths in players who underwent ACL reconstruction with associated meniscectomy. In contrast, Mai et al[21] reported that players who underwent ACL reconstruction had significantly shorter careers than those who underwent procedures for other injuries, such as Achilles tendon tears and cervical disc herniation. Because final analyses on the career longevity of our cohort cannot be studied until all of the players retire, no assumption can be made about career length in this population at this time.

Rates of injury and RTP have also been shown to differ by position. Dodson et al[14] discovered that certain skilled players, such as wide receivers and running backs, faced a significantly greater risk of ACL injuries than the rest of the NFL. Positional differences in the rates of RTP remain largely unknown. Eisenstein et al[15] found that quarterbacks and safeties exhibited the highest rate of RTP with 100%, while fullbacks exhibited the lowest rate of RTP with 0%. Shah et al[24] observed that wide receivers and quarterbacks exhibited the highest rate of RTP with 100%, while defensive line players and fullbacks exhibited the lower rate of RTP with 50%. However, both of these studies were limited by small sample sizes, with many positions comprising fewer than 5 players, and as a result, it is difficult to clearly define positional differences in RTP rates.

Although this study features the largest positional cohorts in this population, many positional subsets were composed of fewer than 10 players. When players were divided into skilled and unskilled positional groupings, a common method of differentiating between players, there were no statistical differences in the rates of RTP. After subdividing unskilled and skilled positions by their draft round, significant differences were observed in the rates of RTP, with early draft-round players and unskilled late draft-round players exhibiting the highest rates of RTP.

Of note, unskilled late draft-round players were more likely to return than their skilled late draft-round

counterparts. This may be because skilled positions tend to be involved more in tackles and require more lateral movement, and as a result, skilled positions may be thought to be more affected by a less than complete recovery than unskilled positions.[23] In a study of 33 running backs and wide receivers, Carey et al[11] found that player performance, measured by power ratings (total yards divided by 10, plus touchdowns multiplied by 6), declined by one-third after an ACL injury. In our study, skilled early draft-round players constituted the only group to exhibit a decline in performance, with early draft-round players displaying a significant decrease in the number of games played after the injury compared to before the injury. Thus, although they were one of the cohorts with the highest rates of RTP, skilled early draft-round players may be the players most negatively affected by an ACL injury.

Conversely, although unskilled UDFAs exhibited lower rates of RTP compared to the other cohorts in our study, the players who did return became bigger contributors to their team after returning, as measured by the games started. The number of games started and the ratio of games started to games played increased among unskilled UDFAs after an injury. Although the likelihood of RTP for an unskilled UDFA may be relatively low, those few who are given the opportunity and are able to return may return to a greater role on their team.

This study features the largest known cohort studied among the NFL population with regard to RTP after an ACL injury. The players studied were evaluated and treated at multiple institutions, limiting selection bias. All players in our study suffered a primary ACL tear, allowing us to evaluate recovery from an isolated incident without additional recovery from possible residual damage from past tears. Our study was the first to examine the interplay between position type and draft round, 2 variables that previous studies have shown to significantly affect RTP.[15,24] In addition, this is the largest study, to date, to evaluate preinjury and postinjury levels of performance for all positions.

This study has several limitations. First, we only evaluated RTP within 18 months after an injury. This is because effective sample sizes became too small to confidently assess with Kaplan-Meier failure functions when evaluating more than 18 months after an injury. We chose to evaluate RTP within this shorter time period and with greater accuracy rather than to examine RTP over a longer period and with limited statistical power. As a result, players who injured their ACL in the preseason were given less "available" time to RTP, as they had to return in the same season in which they were injured, a possible but uncommon occurrence. In addition, we assessed performance by evaluating the number of regular-season games played and started. We believe that a more comprehensive performance analysis is an area for future study and would require metrics specific for each position, such as yards per rush for running backs. However, many positions were limited by small sizes, prohibiting a robust analysis, and as a result we used regular-season games played and started as performance metrics, as these are ubiquitous measures across all positions. Further, this study is a retrospective cohort analysis, and thus, causation between an ACL injury and ability to return to NFL play cannot be proven.

The information used in this study was obtained from publicly available data. Although every effort was made to identify all players who had suffered an ACL injury, and the NFL requires all teams to report injuries occurring to their players, it is possible that our database did not include all of the players who suffered an ACL injury during this time period. The use of publicly available online data may also have introduced a bias toward more recent news stories, as they are featured most prominently in online searches. As a result, information regarding previous ACL injuries sustained in high school and college may not have been documented and reported. Concomitant and associated injuries, such as meniscal tears, were not evaluated in this study, given inconsistent reporting and documentation of treatment.

Despite having the largest cohort studied in this population, the number of quarterbacks, fullbacks, kickers, long snappers, and punters each had too small of a sample size ($n < 5$) for meaningful analysis. The positional definitions used in this study may have obscured the nuances of certain positional differences, such as defensive players who act as offensive blockers in goal-line situations and players who play predominantly on special teams, which do not fit cleanly into these categories. We attempted to match players in our dataset with controls based on position, draft round, playing history (number of years in league, average number of regular-season games played, and average number of games started), and major injury history to better assess the relative risk of ACL tears on RTP. However, we were unable to match many players based on those 6 criteria, all of which we thought were important for proper matching. Last, the players who contributed to our overall RTP rate in this study had a minimum of 2 full seasons to RTP. Although it is unlikely for a player to return after 2 full seasons, as evidenced by only 1 player of 95 taking longer than 2 years to return, it is possible that a player in our dataset who had not returned to play at the end of the 2015 season may still return.

CONCLUSION

Overall, 61.7% of NFL players were able to return after an ACL injury, with 55.8% of NFL players returning within 18 months of the injury. Early draft-round and unskilled players were more likely to return compared to their later draft-round and skilled peers. The ability to return in the NFL is complex and is contingent on recovery, being given the opportunity to return, and many other factors. Our findings suggest that players may be given different opportunities to return based on the round in which a player was drafted, his anticipated player performance, and position type.

REFERENCES

1. Ardern CL, Webster KE, Taylor NF, Feller JA. Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review

and meta-analysis of the state of play. *Br J Sports Med*. 2011;45(7): 596-606.
2. Arthur R. The shrinking shelf life of NFL players. *Wall Street Journal*. February 29, 2016. Available at: https://www.wsj.com/articles/the-shrinking-shelf-life-of-nfl-players-1456694959. Accessed January 3, 2017.
3. Aune KT, Andrews JR, Dugas JR, Cain EL Jr. Return to play after partial lateral meniscectomy in National Football League athletes. *Am J Sports Med*. 2014;42(8):1865-1872.
4. Boublik M, Schlegel T, Koonce R, Genuario J, Lind C, Hamming D. Patellar tendon ruptures in National Football League players. *Am J Sports Med*. 2011;39(11):2436-2440.
5. Boublik M, Schlegel TF, Koonce RC, Genuario JW, Kinkartz JD. Quadriceps tendon injuries in National Football League players. *Am J Sports Med*. 2013;41(8):1841-1846.
6. Bradley JP, Klimkiewicz JJ, Rytel MJ, Powell JW. Anterior cruciate ligament injuries in the National Football League: epidemiology and current treatment trends among team physicians. *Arthroscopy*. 2002; 18(5):502-509.
7. Brophy RH, Barnes R, Rodeo SA, Warren RF. Prevalence of musculoskeletal disorders at the NFL Combine: trends from 1987 to 2000. *Med Sci Sports Exerc*. 2007;39(1):22-27.
8. Brophy RH, Gill CS, Lyman S, Barnes RP, Rodeo SA, Warren RF. Effect of anterior cruciate ligament reconstruction and meniscectomy on length of career in National Football League athletes: a case control study. *Am J Sports Med*. 2009;37(11):2102-2107.
9. Brophy RH, Wright RW, Powell JW, Matava MJ. Injuries to kickers in American football: the National Football League experience. *Am J Sports Med*. 2010;38(6):1166-1173.
10. 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(8): 825-830.
11. Carey JL, Huffman GR, Parekh SG, Sennett BJ. Outcomes of anterior cruciate ligament injuries to running backs and wide receivers in the National Football League. *Am J Sports Med*. 2006;34(12):1911-1917.
12. Carmont MR, Ennis O, Rees D. "Return to play after anterior cruciate ligament reconstruction in National Football League athletes" by Shah et al [letter]. *Am J Sports Med*. 2011;39(2):NP3.
13. Daruwalla JH, Xerogeanes JW, Greis PE, et al. Rates and determinants of return to play after anterior cruciate ligament reconstruction in Division 1 college football athletes: a study of the ACC, SEC, and PAC-12 conferences. *Orthop J Sports Med*. 2014;2(8): 2325967114543901.
14. Dodson CC, Secrist ES, Bhat SB, Woods DP, Deluca PF. Anterior cruciate ligament injuries in National Football League athletes from 2010 to 2013: a descriptive epidemiology study. *Orthop J Sports Med*. 2016;4(3):2325967116631949.
15. Eisenstein ED, Rawicki NL, Rensing NJ, Kusnezov NA, Lanzi JT. Variables affecting return to play after anterior cruciate ligament injury in the National Football League. *Orthop J Sports Med*. 2016;4(10): 2325967116670117.
16. Erickson BJ, Harris JD, Heninger JR, et al. Performance and return-to-sport after ACL reconstruction in NFL quarterbacks. *Orthopedics*. 2014;37(8):e728-e734.
17. Hendricks W, DeBrock L, Koenker R. Uncertainty, hiring, and subsequent performance: the NFL draft. *J Labor Econ*. 2003;21(4):857-886.
18. Howard JS, Lembach ML, Metzler AV, Johnson DL. Rates and determinants of return to play after anterior cruciate ligament reconstruction in National Collegiate Athletic Association Division I soccer athletes: a study of the Southeastern Conference. *Am J Sports Med*. 2016;44(2):433-439.
19. Keefer QAW. The sunk-cost fallacy in the National Football League: salary cap value and playing time. *J Sports Econom*. 2017;18(3): 282-297.
20. Keller RA, Mehran N, Austin W, Marshall NE, Bastin K, Moutzouros V. Athletic performance at the NFL Scouting Combine after anterior cruciate ligament reconstruction. *Am J Sports Med*. 2015;43(12): 3022-3026.
21. Mai HT, Alvarez AP, Freshman RD, et al. The NFL Orthopaedic Surgery Outcomes Database (NO-SOD): the effect of common orthopaedic procedures on football careers. *Am J Sports Med*. 2016;44(9): 2255-2262.
22. Schoderbek RJ Jr, Treme GP, Miller MD. Bone-patella tendon-bone autograft anterior cruciate ligament reconstruction. *Clin Sports Med*. 2007;26(4):525-547.
23. Secrist ES, Bhat SB, Dodson CC. The financial and professional impact of anterior cruciate ligament injuries in National Football League athletes. *Orthop J Sports Med*. 2016;4(8):2325967116663921.
24. Shah VM, Andrews JR, Fleisig GS, McMichael CS, Lemak LJ. Return to play after anterior cruciate ligament reconstruction in National Football League athletes. *Am J Sports Med*. 2010; 38(11):2233-2239.
25. Sikka R, Kurtenbach C, Steubs JT, Boyd JL, Nelson BJ. Anterior cruciate ligament injuries in professional hockey players. *Am J Sports Med*. 2016;44(2):378-383.
26. Staw BM, Hoang H. Sunk costs in the NBA: why draft order affects playing time and survival in professional basketball. *Adm Sci Q*. 1995; 40(3):474-494.