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#### Recommended Citation

Okoroha KR, Kadri O, Keller RA, Marshall N, Cizmic Z, and Moutzouros V. Return to play after revision anterior cruciate ligament reconstruction in national football league players. *Orthop J Sports Med* 2017; 5(4):2325967117698788

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# Return to Play After Revision Anterior Cruciate Ligament Reconstruction in National Football League Players

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*Investigation performed at Henry Ford Hospital, Detroit, Michigan, USA*

**Background:** National Football League (NFL) players who undergo anterior cruciate ligament (ACL) reconstruction have been shown to have a lower return to play (RTP) than previously expected. However, RTP in the NFL after revision ACL reconstruction (RACLR) is not well defined.

**Purpose/Hypothesis:** The purpose of this study is to determine the RTP of NFL players after RACLR and evaluate factors that predict RTP. Our hypothesis was that more experienced and established players would be more likely to RTP after RACLR.

**Study Design:** Cohort study; Level of evidence, 3.

**Methods:** A total of 24 NFL players who underwent RACLR between 2007 and 2014 were reviewed and evaluated. Return to NFL play, time to return, seasons and games played prior to and after revision surgery, draft status, and demographic data were collected. Overall RTP was determined, and players who did RTP were compared with those unable to RTP. Data were also compared with control players matched for age, position, size, and experience.

**Results:** After RACLR, 79% (19/24) of NFL players returned to NFL regular-season play at an average of 12.6 months. All players who were drafted in the first 4 rounds, played in at least 55 games, or played 4 seasons of NFL play prior to injury were able to RTP. Players drafted in the first 4 rounds of the NFL draft were more likely to RTP than those who were not (odds ratio, 0.1; 95% CI, 0.01-1.00;  $P = .05$ ). Those who returned to NFL play played in significantly less games and seasons after their injury than before ( $P = .01$  and  $P = .01$ , respectively). However, these values did not differ when compared with matched controls ( $P = .67$  and  $P = .33$ ).

**Conclusion:** NFL players who RTP after RACLR do so at a similar rate but prolonged time period compared with after primary ACL reconstruction. Athletes who were drafted in earlier rounds were more likely to RTP than those who were not. Additionally, player experience prior to injury is an important factor when predicting RTP after RACLR.

**Keywords:** revision anterior cruciate ligament reconstruction; NFL; return to play; professional athletes; knee injury

Anterior cruciate ligament (ACL) tears are common sports injuries and may affect the longevity of an athlete's career. Players in the National Football League (NFL) have high athletic demand of their knees, placing the athlete at an increased risk for ACL rupture.<sup>1</sup>

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The authors declared that they have no conflicts of interest in the authorship and publication of this contribution.

Ethical approval for this study was obtained from Henry Ford Hospital Investigation Review Board.

The Orthopaedic Journal of Sports Medicine, 5(4), 2325967117698788

DOI: 10.1177/2325967117698788

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Various studies have evaluated return to play (RTP) and statistical performance after primary anterior cruciate ligament reconstruction (ACLR) in NFL athletes.<sup>1,3,5,9,11,17,18,20</sup> The results of Mai et al<sup>14</sup> suggest an up to 82% RTP rate, with most players returning to previous functional and statistical in-game performance levels.

Only recently have studies begun to evaluate rates of recurrent ACL injury in professional athletes.<sup>17</sup> Among the general population, the rate of revision ACLR (RACLR) after primary ACLR is 4.9% within 5 years.<sup>16</sup> Borchers et al<sup>2</sup> identified higher demand as a risk factor for ACL rerupture, and Brophy et al<sup>4</sup> found that 18.3% of ACL injuries in the NFL between 2010 and 2013 were ipsilateral retears.<sup>7</sup> While these studies have helped expand knowledge in terms of RTP after primary ACLR and rates of recurrent ACL tears, there remains a paucity of data regarding RTP after RACLR.

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The purpose of this study was to determine the rate of return to regular-season game play in NFL athletes who have undergone RACLR. The hypothesis was that more experienced and established players would be more likely to RTP after RACLR. Additionally, this study attempted to identify factors that predicted the likelihood of successful RTP.

## METHODS

We conducted a retrospective case-control study. NFL players with a history of ACLR while playing professionally and subsequent RACLR between 2007 and 2014 were evaluated. These players were identified with methods similar to those in previous studies that used publicly available Internet-based reports, thus precluding a formal institutional review board approval.<sup>8-10,12,13,15,16,20</sup> Sources for injury reports included team injury reports, team websites, press releases, personal websites, and professional and college football statistical websites. A player was deemed to have an RACLR if they were drafted to the NFL and participated in at least 1 NFL game before sustaining a recurrent tear requiring RACLR. Documentation from the above sources of 2 separate ACLRs on the ipsilateral knee was considered an acceptable reference. Any documentation of a third ACL tear of the same knee was also recorded.

Demographic data, including age, NFL experience, height, weight, and position, for each player were recorded. RTP data, including date of injury, overall RTP rate, and RTP on the same team, were recorded. Also recorded were the number of regular-season games, play-off games, seasons played before and after injury, career length, draft round, and number of Pro Bowl appearances before and after injury. Return to the same team was based on the team for which the athlete appeared in their first regular-season game after injury. Athletes with a report of “undisclosed knee injury” or who were on the injured list at the time of data gathering were excluded. The percentage of the season lost was calculated by dividing the number of regular-season games lost due to injury by 16 (number of regular-season games in a standard NFL season).

A control group was then identified to compare the cohort with a representative group of NFL players with similar attributes who had not undergone RACLR. The control group was assembled via a blinded age-, size-, and position-matched cohort of NFL players who had not previously undergone RACLR. Our methods for selecting the control cohort were similar to those reported in previous literature.<sup>8-10,12,13,15-17,20</sup> Players with a known history of RACLR or “undisclosed knee injury” were excluded from the control cohort. We then compiled a deidentified database of all remaining players who participated in the NFL between 2007 and 2014. Players were then matched to the respective RACLR athletes based on the year of RACLR for the respective player in the original cohort, designated as the index year. The controls were then selected based on age during the index year, qualified as  $\pm 1$  year, listed position, age at index year, NFL experience, height, and weight.

TABLE 1  
Characteristics of Revision ACLR and Control Players

Variable	All Players (N = 24)	Controls (N = 24)	P Value
Body mass index, kg/m <sup>2</sup>	30.0 $\pm$ 4.9	30.1 $\pm$ 4.1	.66
Position, n (%)			N/A
QB	3 (12.5)	3 (12.5)	
WR	7 (29)	7 (29)	
OL	2 (8.3)	2 (8.3)	
NT	1 (4.2)	1 (4.2)	
LB	3 (12.5)	3 (12.5)	
OT	2 (8.3)	2 (8.3)	
CB	2 (8.3)	2 (8.3)	
DE	2 (8.3)	2 (8.3)	
TE	1 (4.2)	1 (4.2)	
RB	1 (4.2)	1 (4.2)	
Age, y	26.3 $\pm$ 3.9	25.1 $\pm$ 3.6	.41
Career length, seasons	6.5 $\pm$ 3.4	5.7 $\pm$ 3.0	.38
Draft round, n (%)			N/A
1	11 (46)	10 (42)	
2	3 (13)	3 (13)	
3	0 (0)	0 (0)	
4	1 (4)	1 (4)	
5	4 (17)	5 (21)	
6	1 (4)	1 (4)	
7	2 (8)	3 (13)	
Undrafted	2 (8)	1 (4)	
Draft round (continuous)	2.8 $\pm$ 2.2	3.1 $\pm$ 2.3	.62
Pro Bowls before, n	0.5 $\pm$ 1.3	0.3 $\pm$ 1.0	.41

<sup>a</sup>Data provided as mean  $\pm$  SD unless otherwise specified. ACLR, anterior cruciate ligament reconstruction; CB, cornerback; DE, defensive end; LB, linebacker; N/A, not applicable; NT, nose tackle; OL, offensive linemen; OT, offensive tackle; QB, quarterback; RB, running back; WR, wide receiver.

Beyond demographic data, career length, draft round, and number of Pro Bowl appearances before and after injury in the index year were evaluated for each control player.

All data were compared between players who RTP and those who did not using nonparametric univariate tests. The Wilcoxon signed rank test was used for continuous variables, and the Fisher exact test was used for categorical variables. Pre- and postsurgery data for those who did RTP were compared using the Wilcoxon signed rank-sum test. Demographic data between the study cohort and controls were compared using 2-sample *t* tests for continuous measures and chi-square tests for categorical measures. Pearson correlation coefficients were used to assess the relationship between age and the performance measures for all players separately. Statistical significance was set at  $P < .05$ . All analyses were performed using SAS 9.4 (SAS Institute).

## RESULTS

A total of 24 NFL players who underwent RACLR between 2007 and 2014 were included. Table 1 shows demographic characteristics of the study cohort and control players. There were no statistical differences between the 2 groups.

TABLE 2  
Return to Play (RTP) by Position

Position	Return/Total	RTP, %
Quarterback	1/1	100
Wide receiver	4/7	57
Offensive linemen	2/2	100
Nose tackle	1/1	100
Linebacker	2/3	67
Offensive tackle	2/2	100
Cornerback	2/2	100
Defensive end	2/2	100
Tight end	0/1	0
Running back	1/1	100

TABLE 3  
Likelihood of Returning to Play<sup>a</sup>

Variables	Odds Ratio (95% CI)	P Value
Age	1.11 (0.84-1.48)	.47
Body mass index	1.20 (0.85-1.68)	.30
Drafted $\leq 4$ vs $>4$ <sup>b</sup>	0.10 (0.01-1.00)	<b>.05</b>
Seasons prior	1.58 (0.77-3.23)	.21
Games preinjury	1.04 (0.98-1.09)	.21
Career length (seasons)	1.57 (0.91-2.70)	.10

<sup>a</sup>Boldface value indicates statistical significance.

<sup>b</sup>Drafted  $\leq 4$  = National Football League draft round 1-4.

The mean age at recurrent injury was 26.3 years (range, 21-34 years) in the reconstructed group versus 25.1 years (range, 21-33 years) in the control group ( $P = .41$ ). Mean body mass index was 30.0 kg/m<sup>2</sup> (range, 24.9-45.3 kg/m<sup>2</sup>) in the reconstructed group versus 30.1 kg/m<sup>2</sup> (range, 23.2-37.5 kg/m<sup>2</sup>) in the control group ( $P = .66$ ). Eighteen of the 24 (75%) injuries occurred during the spring, preseason, or regular-season weeks 1 to 4. The remaining 6 (25%) injuries occurred between week 5 and the end of the season.

Of the total 24 NFL players in the study, 19 (79%) returned to NFL competition after RACLR. The mean time to RTP in these players was 12.6 months. No athlete returned to play during the same season of competition in which he was injured. All players who returned to play (19/19) were drafted in the first round, played in at least 4 NFL seasons, and played in at least 55 NFL games. Fourteen of 19 players (74%) who returned to play did so with the same team they were playing for when they were injured. RTP by position is listed in Table 2.

Players who did and did not RTP are compared in Tables 3 and 4. Players who were drafted in the first 4 rounds were more likely to RTP than those who were not (odds ratio [95% CI], 0.1 [0.01-1.00];  $P = .05$ ). There was a nonsignificant trend showing longer career length in athletes who returned to play (6.5 seasons) compared with those who did not (4 seasons) ( $P = .08$ ). There were no other significant differences between those who returned to NFL competition and those who did not. Those who returned to NFL play played in significantly less games and seasons after their injury than before ( $P = .01$  and  $P = .01$ , respectively). However, these values did not differ when compared with

matched controls. All athletes with recurrent ACL tears who previously participated in a Pro Bowl game returned to play the subsequent season.

In evaluating performance after RACLR, there was no difference in games and seasons played between those who returned to play and matched controls (Table 5). No factors were predictive of RTP on the same team. Players who returned to the same team played in more games per season (12.5 games) than those who did not (8.4 games), but this did not reach significance ( $P = .16$ ).

## DISCUSSION

The current study findings suggest that players undergoing RACLR RTP at a similar rate and over a prolonged time period compared with those undergoing primary reconstruction. Our data also suggest that draft pick status and player experience are important factors when predicting RTP in players after RACLR. Athletes who are drafted in earlier rounds and play in more games/seasons before recurrent injury are more likely to RTP than those who do not.

Previous studies have evaluated RTP in non-NFL athletes after revision.<sup>1,6,19</sup> Anand et al<sup>1</sup> reported a 46% return to preinjury level of sport at a mean of 5 years for RACLR compared with a 50% return after primary reconstruction. However, Denti et al<sup>6</sup> suggested that limitation of a cohort to highly motivated patients led to return to the same level of competition in 78% of RACLR patients compared with 58% after primary ACLR. Similarly, Shelbourne et al<sup>19</sup> reported a 74% rate of return to sports at preinjury level in high school and collegiate athletes after RACLR. In the current study, we found an overall RTP rate of 79% in NFL athletes after RACLR. This RTP rate is higher than that reported in previous studies in the general population for revision surgery and similar to the 82% RTP rate in NFL athletes after primary ACLR reported by Mai et al.<sup>14</sup> This can be explained by the fact that professional athletes likely are more motivated to RTP, and this cohort had a past experience with the same injury, surgery, and recovery. The fact that the athlete has already returned after an ACLR may also place confidence in NFL teams that the athlete can return after RACLR.

NFL experience and draft round of an NFL athlete has been found to be predictive of RTP after primary ACLR. Shah et al<sup>18</sup> found that NFL players who were drafted in the first 4 rounds or played in 4 seasons prior to injury were 12.2 times and 5.5 times more likely to RTP after primary ACLR, respectively. Our study also found that those drafted in the first 4 rounds were more likely to RTP than those who were not. Although we did not find a significant difference between seasons played, we found that all players who RTP played in at least 4 NFL seasons and 55 games prior to injury. These results suggest that players drafted in early rounds or who are highly experienced are of higher value to their teams and have a proven career, which can predict return to NFL play.

The mean time to return to NFL season game play after RACLR has not been previously reported. Shah et al<sup>18</sup>

TABLE 4  
Comparison of RTP Group Versus Non-RTP Group<sup>a</sup>

Variable	Response	All (N = 24)	RTP (N = 19)	No RTP (N = 5)	P Value
Date of injury, n (%) <sup>b</sup>	Spring-week 4	18 (75)	13 (68%)	5 (100%)	.28
	Week 5-end	6 (25)	6 (32%)	0 (0%)	
Side, n (%)	Left	13 (54)	10 (53%)	3 (60%)	.99
	Right	11 (46)	9 (47%)	2 (40%)	
Age, y		26.3 ± 3.9	26.4 ± 4.4	25.0 ± 1.0	.67
Games before		55.4 ± 39.3	61.0 ± 42.6	33.9 ± 3.7	.19
Seasons before		4.3 ± 2.8	4.7 ± 3.0	2.8 ± 0.4	.16
Games per season before		12.7 ± 2.3	12.7 ± 2.1	12.5 ± 3.0	.44
Surgery—first game, mo		12.6 ± 4.3	12.6 ± 4.3		N/A
Career length, seasons		6.5 ± 3.4	7.2 ± 3.5	4.0 ± 1.2	.08
Draft round (continuous)		2.8 ± 2.2	2.4 ± 2.2	4.3 ± 1.5	.08
Pro Bowls before		0.5 ± 1.3	0.6 ± 1.5	0.0 ± 0.0	.31

<sup>a</sup>Data provided as mean ± SD unless otherwise specified. ACL, anterior cruciate ligament; N/A, not available; RTP, return to play.

<sup>b</sup>Date of injury listed as spring training through week 4 of regular season or week 5 through end of regular season.

TABLE 5  
Number of Games and Seasons Played Between Players  
Who Return to Play (RTP) and Controls<sup>a</sup>

Variable	Controls (N = 19)	RTP (N = 19)	P Value
Games after, n	28.4 ± 35.7	28.2 ± 31.9	.67
Seasons after, n	2.4 ± 2.9	2.3 ± 2.1	.41

<sup>a</sup>Data provided as mean ± SD.

reported that the mean RTP after primary ACLR is approximately 10.8 months. Our findings suggest a near 2-month increase in time to RTP. These findings are most likely multifactorial, encompassing both medical staff input and player bias/caution as well as a potential slower return of quadriceps function.

Previous studies, such as that by Shah et al,<sup>18</sup> have found that 78% of players who RTP returned to the same team. Our study similarly found that 74% of players returned to the same team. Unlike the previous study, our results found a nonsignificant trend in which players who returned to the same team played in more games per season than those who did not.

There are several limitations to this study. First, the data gathered with regard to RTP, games, and seasons played were collected from the NFL website. Although it is monitored regularly and is the official NFL website, it is difficult to ascertain the accuracy of all statistical and gameplay data. Additionally, concurrent meniscal or cartilage lesions are often not listed and could not be analyzed. Second, our cohort was limited in sample size due to the low prevalence of ACLR in the NFL. This may affect the ability to find significant differences as well as affect the accuracy of statistical comparisons between groups. Additionally, while studies have suggested the importance of mechanism of injury in RTP after ACLR, we did not examine its relationship to RTP. Finally, this study did not take into account that not all players who were studied are currently retired, which could lead to

bias when evaluating career length of players. NFL players represent a select patient population with multiple incentives to RTP. Our results are not likely generalizable to the general population.

## CONCLUSION

NFL players who RTP after ACLR do so at a similar rate and a prolonged time period compared with those undergoing primary ACLR. Athletes who were drafted in earlier rounds were more likely to RTP than those who were not. Additionally, player experience prior to injury is an important factor when predicting RTP after ACLR.

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