

Return to Work After Anterior Cruciate Ligament Reconstruction

A Systematic Review

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Background: The timing of return to work (RTW) after anterior cruciate ligament (ACL) reconstruction (ACLR) is a less studied milestone compared with return to sports.

Purpose: To systematically review the rate and postoperative timing of RTW after ACLR.

Study Design: Systematic review; Level of evidence, 4.

Methods: This study was conducted in accordance with the 2020 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. A literature search was performed in PubMed, Embase, Cochrane, and Ovid databases for clinical studies reporting RTW after ACLR, and 806 studies were identified in August 2022. A quality assessment was performed using the Methodological Index of Nonrandomized Studies (MINORS) grading system. The following data were extracted from studies: study characteristics, cohort demographics, ACLR technique, concomitant meniscal and/or cartilage procedures, preoperative patient-reported outcomes, rates of RTW, and days required for RTW after ACLR.

Results: A total of 13 studies met inclusion criteria, totaling 1791 patients (86.4% male). Wide variability was observed in the methodological quality of the assessed studies (MINORS score range, 8-17). Hamstring tendon (HT) autograft was used in 76.8% (n = 1377; mean age, 30.5 years old), allograft in 17.1% (n = 308; mean age, 33.1 years old), the ligament advanced reinforcement system in 2.5% (n = 46; mean age, 33.2 years old), bone-patellar tendon-bone autograft in 2% (n = 36; mean age, 28.5 years old), and quadriceps tendon autograft in 1.3% (n = 24; mean age, 24.1 years old). Among the included patients, 99.1% (n = 1781) reported successful RTW after surgery. The mean time to RTW was 84.2 days (range, 31.4-107.1 days) for HT and 69.5 days (range, 49-56.6 days) for allograft.

Conclusion: While data regarding work intensity before and after ACL injury were absent, our study results suggested that patients most often RTW within 90 days of surgery. Patients with allograft ACLR may RTW earlier than patients undergoing ACLR with HT autograft.

Keywords: ACL; ACL reconstruction; allograft; autograft; graft; return to work

Anterior cruciate ligament (ACL) rupture is one of the most common injuries to the knee, and the number of ACL reconstructions (ACLRs) performed in patients ages 20 to 29 years old continues to increase.²² This population also encompasses a significant proportion of the global workforce.^{8,9,28} Whereas adequate outcomes are reported after nonoperative treatment of ACL injury, surgical

treatment is generally preferred for young, active patients.^{9,24} The main goal of surgical treatment and rehabilitation is to aid patients in their return to their daily activities and recreational or professional sports. While the timing of return to work (RTW) after ACL surgery is a relevant variable, it is a less studied milestone compared with return to sports in patients undergoing ACLR.^{9,32}

Studies have shown that ACLR successfully restores knee function,^{6,15,31} with 70% to 90% return-to-sports rate reported in the literature at 9 to 12 months postoperatively.^{13,17,32} However, research evaluating the impact of ACLR on the ability of patients to RTW after surgery is

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currently limited.²⁷ Recent studies assessing RTW after ACLR have been conducted in small sample sizes with heterogeneous patient populations and considerable variability in surgical technique; this may limit the accuracy and generalizability of available data.^{1,9,30} Despite limited evidence, knowledge of the timing and rate of RTW after ACLR is valuable information for patients with occupations involving manual labor and physical activity.²⁰

The purpose of this study was to systematically review the timing and rate of RTW after ACLR. We hypothesized that patients undergoing ACLR demonstrate a high RTW rate, with RTW achieved within 90 days after ACLR in most patients.

METHODS

Search Strategy and Study Selection

This study was conducted in accordance with the 2020 PRISMA statement,²¹ and it was registered on the PROSPERO International Prospective Register of Systematic Reviews (CRD42022321849). The Boolean search phrase (“anterior cruciate ligament reconstruction” OR “ACL reconstruction” OR “anterior cruciate ligament” OR “ACL”) AND (return to work” OR “RTW”) AND (“outcome”) was used to search the PubMed, Embase, Cochrane, and Ovid databases in April 2022. The studies which were found from databases via the Boolean search phrase were imported to Covidence (<https://www.covidence.org>) for article selection.

Eligibility Criteria

Studies written in English or with English translation published after 1987 that contained RTW outcomes after primary ACLR in patients >18 years old were included in the analysis. Exclusion criteria were as follows: (1) studies that did not define successful RTW, (2) research on nonoperative management after ACL rupture, (3) literature with level 5 evidence, (4) revision ACLR, (5) ACL repair, (6) multiligamentous surgeries, (7) studies including professional athletes, and (8) studies published as abstracts only. Search results were assessed independently by 2 of the coauthors (M.D., C.B.) for inclusion and exclusion criteria. Any disagreements in the selection criteria were resolved by a third coauthor (E.A.O.).

Quality Assessment

All included studies were reviewed for methodological quality using the Methodological Index of Nonrandomized Studies (MINORS) checklist.²⁹ Any discrepancies in scoring were discussed initially between reviewers, and, when needed, the third author (E.A.O.) was consulted.

Data Extraction

Data were extracted from the included studies via Covidence (<https://www.covidence.org>) and recorded in an Excel spreadsheet (Version 2022; Microsoft). The following data were extracted from studies: study characteristics (author, year of publication, sample size, study design, level of evidence [LOE]), mean follow-up, cohort demographics (age, sex, body mass index), ACLR technique (single bundle, double bundle), graft source (allograft/autograft), autograft types (bone-patellar tendon-bone [BTB], hamstring tendon [HT], quadriceps tendon [QT]), concomitant meniscal and/or cartilage procedures performed at the time of ACLR, preoperative patient-reported outcome (PRO) measures including Lysholm, International Knee Documentation Committee (IKDC), and Tegner scores, and rates of RTW after ACLR. Days required for RTW after ACLR was also extracted from the individual studies. Data reported as months were converted to days, where 1 month was counted as 30 days. Data reported as weeks were converted to days, where 1 week corresponded to 7 days.

Statistical Analysis

Descriptive statistics were calculated using SPSS software (Version 24; IBM). Because of the selection criteria and biases inherent to combining studies with small sample sizes, failure to adjust for confounders, and heterogeneous reporting of results, it was decided not to perform a meta-analysis.¹⁰

RESULTS

Search Results

After initial search, 806 studies were detected, and 230 duplicate studies were removed (Figure 1). A total of 576

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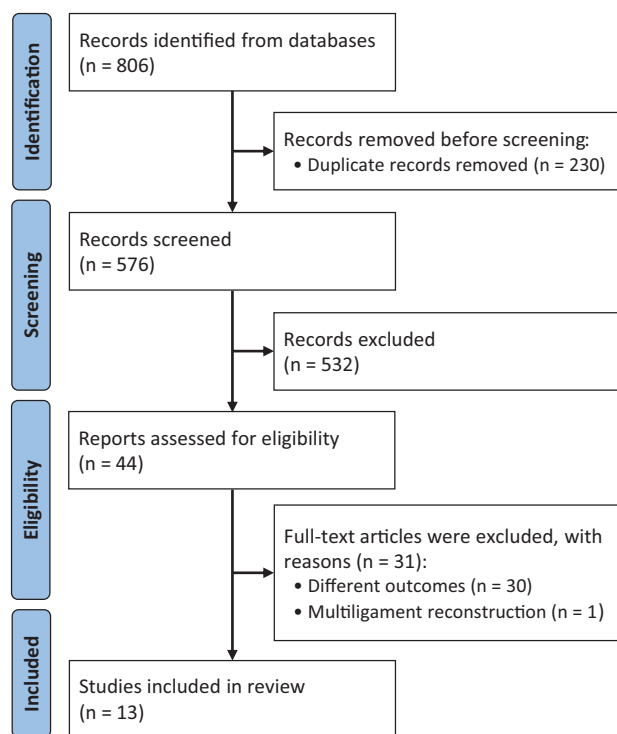


Figure 1. PRISMA flowchart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

studies were scanned for titles and abstracts, and 44 studies were included in the full-text review for further evaluation. A total of 13 studies with a total of 1791 patients met the inclusion criteria and were included in the final review.[¶]

Characteristics of Included Studies

A summary of the characteristics of each study is given in Table 1. Four of the studies had a LOE of 4,^{1,12,16,30} 2 studies were identified as LOE 2,^{11,19} and 7 studies as LOE 3.^{3,4,9,14,18,23,25} Wide variability was observed in the methodological quality of the assessed studies (MINORS score range, 8-17).

The mean patient age was 30 years old (range, 18-51 years old), with male patients representing 86.4% of the study population. The minimum follow-up period for the combined study population was 4 months, with the maximum being 84 months. Concomitant surgical procedures to ACLR were reported in only 10 studies, with concomitant meniscal surgery performed in 554 patients, and concomitant cartilage surgery performed in 138 patients.[#] HT autograft was used in 76.8% of cases, QT autograft in 2%, BTB autograft in 1.3%, ligament augmentation and reconstruction system (LARS) in 2.5%, and allograft in 17.1%. Preoperative PRO scores were reported in 5 studies.^{11,12,18,19,30}

[¶]References 1, 3, 4, 9, 11, 12, 14, 16, 18, 19, 23, 25, 30.

[#]References 1, 3, 4, 11, 12, 18, 19, 23, 25, 30.

RTW Rates and Times

Each included study reported the RTW rate, which ranged from 75% to 100% (Table 2). The 75% RTW rate was reported in a study that included 470 patients who served in the military.¹ Groot et al⁹ reported a full RTW rate of 92%, with partial RTW of the remaining 8% of patients at final follow-up; no description of the occupations of the study population was provided. A study by Jenny and Clement¹² of 72 patients reported a full RTW rate of 96% (69/72); the remaining 3 patients did not return to their preoperative work for reasons not addressed in the study. All of the other studies reported a 100% RTW rate; however, no descriptions of the occupation of the study patients were reported in these studies either.

All but 1 study reported the timing of RTW.¹ The mean time to RTW ranged from 31.4 to 109.5 days, with 82.7% of patients returning to work earlier than 75 days postoperatively. A total of 90.2% of patients returned to work in the first 90 days postoperatively (Table 2). The mean time to RTW was >90 days in 3 studies^{3,4,30}; the patients in these studies comprised 9.8% of the overall study population. The mean time of RTW <75 days was reported in 4 of the included studies^{11,14,16,18}; the patients in these studies comprised 17.3% of the total study population.

Graft Source and RTW

While the mean RTW rate and timing with respect to specific ACLR graft types were reported in 12 of the 13 studies,^{**} this information was unavailable for BTB autograft from the relevant studies (Table 2). A 99% RTW rate was reported in studies with HT autograft (Table 2). The mean time to RTW was 84.2 days for patients with HT autograft, and RTW was reported earlier than the 90-day average in 88.5% of these patients. For patients with QT autograft, results pertinent to RTW were reported in a study by Horstmann et al¹¹ with 24 patients; an RTW rate of 100%, and mean time to RTW of 45.8 days were reported. With regard to allograft ACLR, the prevalence and timing of RTW were reported in 3 studies,^{4,16,18} with a 100% RTW rate. All patients returned to work before 90 days, and the mean RTW time for patients with allograft ACLR was 69.5 days. Information pertinent to LARS was reported in only 1 study,¹⁴ with an average RTW rate of 100% and a mean RTW timing of 49.2 days.

DISCUSSION

Despite the high prevalence of ACL injuries occurring in nonprofessional athletes, there is a scarcity of studies focusing on the impact of ACLR on RTW, which may be a relevant metric for a large proportion of the general patient population.³³ The key finding of this systematic review was that 99.4% of patients achieved RTW after

^{**}References 3, 4, 9, 11, 12, 14, 16, 18, 19, 23, 25, 30.

TABLE 1
Characteristics of Included Studies^a

Study (Year)	Study Design (LOE)	MINORS Score, (%) ^b	Patients (n); % male	Mean Age, y	Preoperative PRO Scores, mean ± SD	Autograft (n, %)	Other Grafts (n, %)
Tiftikci (2015) ³⁰	Case series (4)	9 (56.2)	33; 100	27.8	Lysholm: 60.7 ± 12.5 Tegner: 3.5 ± 1.4	HT (33, 100)	
Krupa (2020) ¹⁶	Case control study (4)	8 (33.3)	61; -	-	-	HT (31, 50.8)	Allograft (30, 49.2)
Kentel (2021) ¹⁴	Case control study (3)	9 (37.5)	403; 100	31.3	-	HT (357, 88.5)	LARS (46, 11.5)
Horstmann (2022) ¹¹	RCT (2)		51; 64	28.4	IKDC: 62.9 ± 17.05 Lysholm: 66.3 ± 15.85	HT (27, 52.9), QT (24, 47.1)	
Biz (2019) ⁴	Case control study (3)	16 (66.6)	43; 95	31.5	-	HT (21, 48.8)	Allograft (22, 51.2)
Pförringer (2005) ²⁵	Randomized controlled trial (3)		46; -	-	-	HT (46, 100)	
Minzlaff (2018) ¹⁹	Nonrandomized experimental study (2)	10 (62.5)	60; 56	35	Lysholm: 66 Tegner: 4 ± 1.2	HT (60, 100)	
Jenny (2016) ¹²	Case series (4)	10 (62.5)	72; 79	31	IKDC: 36.8 ± 46.3 Lysholm: 59.6 ± 14.9 Tegner: 6.8 ± 1.9	HT (72, 100)	
Groot (2017) ⁹	Cohort study (3)	10 (62.5)	89; 52	27	-	HT (89, 100)	
Aydin (2016) ³	Case control study (3)	15 (62.5)	100; 95	29	-	HT (100, 100)	
Perelli (2020) ²³	Cohort study (3)	17 (70)	141; 57	31.4	-	HT (141, 100)	
Antosh (2018) ¹	Cohort study (4)	10 (62.5)	470; 91	28.5	-	HT (282, 60), BTB (36, 7)	Allograft (152, 32.3)
Mardani-Kivi (2016) ¹⁸	Cohort study (3)	17 (70)	222; 84	35.6	IKDC: 56.9 ± 16.9 Lysholm: 61.4 ± 13.2	HT (118, 53.1)	Allograft (104, 46.9)

^aDashes indicate data not available. BTB, bone-patellar tendon-bone; HT, hamstring tendon; IKDC, International Knee Documentation Committee; LARS, ligament augmentation and reconstruction system; LOE, level of evidence; PRO, patient-reported outcome; QT, quadriceps tendon; RCT, randomized controlled trial; RTW, return to work.

^bPercentage of highest possible MINORS score for noncomparative studies (16 points) or comparative studies (24 points).

TABLE 2
RTW Rates and Times by Study^a

Study (Year)	RTW Rate (%)	RTW Time, days ^b
Tiftikci (2015) ³⁰	100	HT 107.1 ± 28
Krupa (2020) ¹⁶	100	Overall, 56.8 ± 12.84 HT, 64.68 ± 11.27 Allograft, 49 ± 13.51
Kentel (2021) ¹⁴	100	Overall, 56.8 ± 16.31 HT, 64.47 ± 12.25 LARS, 49.28 ± 20.37
Horstmann (2022) ¹¹	100	Overall, 60.5 HT, 75.2 ± 41.9 QT, 45.8 ± 42.7
Biz (2019) ⁴	100	Overall, 109.5 HT, 129 ± 97 Allograft, 90 ± 75
Pförringer (2005) ²⁵	100	HT, 86.8
Minzlaff (2018) ¹⁹	100	HT, 49 ± 42
Jenny (2016) ¹²	96	HT, 69 ± 24
Groot (2017) ⁹	92	HT, 78 (48-112)
Aydin (2016) ³	100	HT, 96.0
Perelli (2020) ²³	100	HT, 31.4 (14-101)
Antosh (2018) ¹	75	-
Mardani-Kivi (2016) ¹⁸	100	Overall, 57.7 HT, 58.8 (55-61) Allograft, 56.63 (54-59)

^aDash indicates data not available. HT, hamstring tendon; LARS, ligament augmentation and reconstruction system; QT, quadriceps tendon; RTW, return to work.

^bData are presented as mean, mean ± SD, or mean (range).

ACLR. Whereas many of these patients participate in sporting activities at various levels, almost all participants also contribute to the global workforce. Of the 13 studies included in the final synthesis, 10 reported a 100% RTW rate after ACLR.^{††} These studies did not make a clear distinction whether the patients involved partook in sedentary or strenuous work before injury. In contrast, 3 studies in the analysis reported RTW rates lower than 100%. In a study conducted by Antosh et al¹ on military personnel, the rate of full-duty RTW was just 75%. Whereas 25% of patients in the study reported that they received the medical evaluation board and permanent profile, these patients may go on to RTW with a reduced workload. However, this was not reported by the authors.¹ Two additional studies reported RTW rates of 92% (82/89 patients) and 96% (69/72 patients).^{9,12} That said, a possible reason these studies reported inferior RTW rates compared with others in the literature is the limited number of patients included compared with studies reporting similar outcomes.

Another important finding of this study is that 82.7% of patients who underwent ACLR were able to RTW within 75 days postoperatively and 90.2% within the first 90 days. The length of time before RTW is hypothesized to depend on the type of preoperative work a given patient participates in, the postoperative rehabilitation, and the surgical technique.⁵ The included study by Tiftikci et al³⁰

^{††}References 3, 4, 11, 14, 16, 18, 19, 23, 25, 30.

reported a mean RTW time of 107.1 days in coal workers. A longer duration to RTW may be expected in this patient population due to the nature of the occupation, characterized by knee-strenuous daily activity. The study by Aydin and Ozcan³ utilizing 3 different femoral fixation methods reported a mean RTW time of 96 days. RTW timing was not specified for each technique separately, but it was reported that patients working in the office were advised to return when walking without pain could be performed. Biz et al⁴ conducted a retrospective study of 43 patients undergoing ACLR with BTB allograft or HT autograft and reported a mean RTW time of 109.5 ± 9.0 days. All surgeries were performed with the transtibial technique. More research is needed to determine whether tunnel or fixation techniques play a role in postoperative RTW after ACLR.

The type of graft used during ACLR and the rate of return to sports have been the subject of several comparative studies and meta-analyses. Comparison of the 2 most commonly used autografts, HT and BTB, determined BTB to be superior in terms of return to preinjury activity level in some of the studies included in our analysis.^{2,7,26} However, the number of studies comparing RTW times by graft type is limited. In our systematic review, no studies reported RTW timing for ACLRs performed with BTB and all-soft tissue QT autografts. In contrast, the times to RTW for bone-block QT autograft (45.8 ± 42 days) and the LARS device (48.2 ± 20.3 days) were reported by Horstmann et al¹¹ and Kentel et al,¹⁴ respectively. The duration of RTW in patients using HT autograft was reported in all but 1 of the studies included in this review, and the mean RTW duration was determined as 84.2 days (range, 14-112 days). The mean RTW time of ACLR with allograft was reported as 69.5 days according to 3 of the studies.^{4,16,18} Due to the heterogeneous nature of the included studies, a meta-analysis could not be conducted to compare RTW times by graft type. However, regardless of graft type, the RTW rate was determined as 90.2% in the first 90 days.

Limitations

This study is not without limitations. A key limitation was our inability to perform a meta-analysis due to the lack of granularity in the data from the final synthesis. Thus, it was only possible to report what currently exists in the literature, without further statistical analysis. The second most important limitation of this study was that only 2 studies reported whether patients return to the same level of work as performed preoperatively.^{1,30} Furthermore, while surgery was performed arthroscopically in all included studies, differences in surgical techniques and fixation methods in the included studies may cause considerable heterogeneity in outcomes. Also, different rehabilitation programs and postoperative protocols among the individual study cohorts may potentially influence successful RTW and should be accounted for to prevent biased results. In addition, the different types of occupations of the patients before ACLR should be considered when examining RTW rates. Finally,

although the LOE of the included studies ranged between 2 and 4, only 2 studies with an LOE of 2 were included in our analysis.

CONCLUSION

The findings of this systematic review indicated that, despite unreported pre- and postoperative work intensity in the study population, most patients were able to RTW within 90 days of ACLR. The current findings suggest that ACLR performed with allograft result in an earlier RTW than that performed with HT. However, a statistically significant difference could not be assessed due to heterogeneous reporting in the individual studies. Knowledge obtained from the present study may assist surgeons in counseling young patients with active participation in the workforce and optimize RTW in the adult population.

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