Subjective Causes for Failure to Return to Sport After Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis

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Context: While current literature has explored the outcomes of athletes who return to sport (RTS) after anterior cruciate ligament (ACL) injuries, less is known about the outcomes of those who are unsuccessful in returning to sport.

Objective: To determine the rate of athletes who did not RTS after primary ACL reconstruction (ACLR) and to identify the specific subjective reasons for failure to RTS.

Data Sources: A comprehensive search of the PubMed/MEDLINE, Scopus, and Web of Science databases was conducted through April 2021.

Study Selection: Eligible studies included those explicitly reporting the rate of failure for RTS after ACLR as well as providing details on reasons for athletes' inability to return; 31 studies met the inclusion criteria.

Study Design: Systematic review and meta-analysis.

Level of Evidence: Level 2 to 4.

Data Extraction: The reasons for failure to RTS referred to in our study are derived from those established previously in the studies included. Data were collected on the number of athletes, mean age, mean follow-up time, type of sport played, failure to RTS rate, and specific reasons for failure to return.

Results: The weighted rate of failure to RTS after ACLR was 25.5% (95% CI, 19.88-31.66). The estimated proportion of psychosocial-related reasons cited for failure to RTS was significantly greater than knee-related reasons for failure RTS (55.4% vs 44.6%, $P < 0.01$). The most cited reason for failure to RTS was fear of reinjury (33.0%).

Conclusion: This study estimates the rate of failure to RTS after ACLR to be 25.5%, with the majority of athletes citing fear of reinjury as the major deterrent for returning to sports. We highlight how factors independent of surgical outcomes may impact an athlete's ability to return to play given that the predominant reason for no RTS after ACLR was unrelated to the knee.

Keywords: ACL reconstruction; ACL tear; no return to sport; return to sport

Anterior cruciate ligament (ACL) injuries are a common orthopaedic injury with an estimated incidence rate of 1 in 3000; however, this number is believed to be much higher in the young athletic population.[1,19,43,52] These injuries occur most often in sports requiring frequent pivoting and rotational movements such as soccer, basketball, football, and gymnastics.[1,20,26] There are an estimated 200,000 patients who have sustained an ACL tear in the United States annually, and

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Table 1. Inclusion-exclusion criteria[a]

Inclusion	Exclusion
(1) Athletes who had undergone ACLR, regardless of age or level of competition	(1) Studies reporting solely on nonathletes.
(2) Reported rate of failure to RTS, or identifiable from provided data (3) Provided reasons for why athletes were unable to RTS after ACLR (4) Articles in the English language (5) Articles published in peer-reviewed journals	(2) Non-ACLR surgery (3) Missing or unidentifiable number/rate of athletes not returning to sports (4) Comments on nonreturning athletes are not provided (5) Studies with RTS rates of 100%

ACL, anterior cruciate ligament; ACLR, anterior cruciate ligament reconstruction; RTS, return to sport.
[a]Studies that met all the inclusion criteria were included in the meta-analysis. Studies that met at least 1 of the exclusion criteria were excluded from the meta-analysis.

the gold standard treatment remains ACL reconstruction (ACLR), with the primary goal of restoring knee stability and function.[9,12,16,29,41]

Previous studies have reported the rate of return to sport (RTS) after primary ACLR as 83% to 91%, albeit with lower rates for return to preinjury level of play and return to competitive sports.[4,6,7,32,36,51,57] Previously cited factors that influence an athlete's ability to RTS have included knee-related factors such as knee function, pain, and limb symmetry, as well as psychosocial-related factors including psychological readiness, fear of reinjury, and lack of time.[8,49,52,57] While current literature has explored to a great degree the outcomes of athletes who RTS after ACL injuries, less is known about the outcomes of those who are unsuccessful in returning to sports, especially the specific reasons that underlie an athlete's inability to return.

The purpose of this systematic review and meta-analysis is to determine the rate of athletes who did not RTS after ACLR for acute, primary ACL tears as well as to identify the specific reasons for failure to RTS in nonreturning athletes. We hypothesized that a lower than previously reported percentage of athletes would fail to RTS after ACLR and that the number of reasons cited for failure to return due to knee-related reasons would be comparable with numbers that are psychosocial-related.

METHODS

This systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[55]

Search Strategy

A comprehensive search was conducted from the following databases: United States National Library of Medicine PubMed/MEDLINE, Scopus, and Web of Science using various combinations of the following search terms: "athletes," "knee," "anterior cruciate ligament," "surgery," "anterior cruciate ligament reconstruction," "ACL," "ACLR," "reconstruction," "return to sport," "outcome," "outcomes," "sport," "reasons," and "failure to return to sport." The search was conducted from database inception through April 30, 2021.

Study Selection and Definition

All articles were screened by title and abstract by 2 authors independently based on our inclusion-exclusion criteria specified in Table 1. Any discrepancies were resolved by a third senior author. Any included articles then underwent a full-text screening by 2 authors, with discrepancies resolved by the same third author. Studies were included only if the rate of failure to RTS was clearly identified and additional commentary was provided specifying reasons for why athletes failed to RTS after ACLR. RTS was defined as returning to any intensity of play in the previous sport and competed (same level or reduced). Failure to RTS was defined as the inability to play at any level. Studies were included only if the article was available in the English language and had undergone peer review. Studies involving exclusively nonathletes and those reporting solely on ACL repair were excluded.

Data Extraction and Outcomes

Data were extracted using Microsoft Excel 2017 (Microsoft Corp) to collect the following variables from each included study: number of athletes who underwent ACLR for acute ACL tear, number or rate of patients who did not RTS, sex of patients who did not RTS, level of competition (high level, recreational, or mixed), type of sport, comments on patients who did not RTS, time between injury and surgery, reason for not returning to sports, number or rate of patients who did not RTS because of a knee issue, and number or rate of patients who did not RTS for reasons unrelated to the knee. Mixed level of competition was defined as studies including both recreational and competitive athletes.

Quality Assessment and Statistical Analysis

Included studies were assessed individually using the MINORS (Methodological Index for Non-Randomized Studies) criteria to

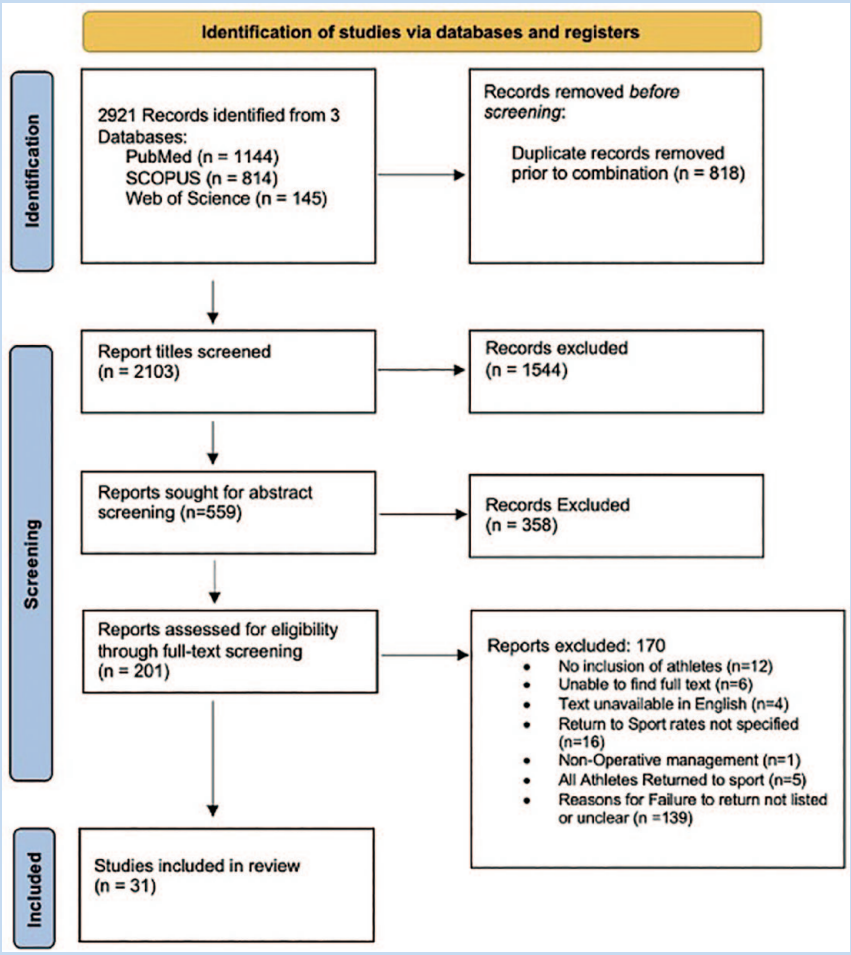


Figure 1. PRISMA flow chart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

ensure study quality before integration in the final quantitative analysis, with a maximum possible score of 24 for comparative studies and 16 for noncomparative studies.[52,53] The level of evidence was determined using established criteria from the American Academy of Orthopaedic Surgeons (AAOS).[52] The I^2 statistic was utilized to analyze the degree of study heterogeneity, and the random-effects model was used for analysis of the degree of heterogeneity between the articles included. A funnel plot was generated to assess publication bias, and a meta-analysis of pooled proportions with 95% CI was performed. All statistical analysis was conducted using the MedCalc software (Version 19.1.3; MedCalc Software Ltd).

RESULTS

Literature Search and Quality Assessment

A total of 31 studies were identified that met our inclusion criteria (Table 1) and reported both the number or rate of athletes failing to RTS and the reasons for failure to return after ACLR.[2,3,5,10,11,13,14,17,18,21,22,24,25,27,30,31,33-35,37-40,42,44,46,47,54,55,56,58] The results of the literature search and article exclusion is outlined in the PRISMA flow chart (Figure 1). A significant degree of study heterogeneity was observed (I^2 = 95.13%; 95% CI, 93.96-96.08; $P < 0.01$). In addition, publication bias was apparent, as exhibited by the asymmetry observed on the generated funnel plot (Figure 2). In regard to level of evidence, 7 of 31 (22.6%) studies were of Level 2 evidence,[10,11,13,31,40,42,44] 12 of 31 (38.7%) were of Level 3 evidence,[21,22,24,27,33,34,37-39,47,54,55] and 12 of 31 (38.7%) were of Level 4 evidence.[2,3,5,14,17,18,25,30,35,46,56,58] The mean MINORS score was 14.1 for noncomparative studies and 19.4 for comparative studies indicating relatively high study quality.

Study Population

Upon data extrapolation, a collective total of 4768 athletes or knees were included in the final analysis. Among the athletes included, 2929 of 4762 (61.4%) were male, and 1839 of 4762 (38.6%) were female (Table 2). The mean age of athletes was reported by 29 of 31 studies, with a calculated mean age of 24.3 ± 6.9 years, and the mean follow-up time was calculated to be

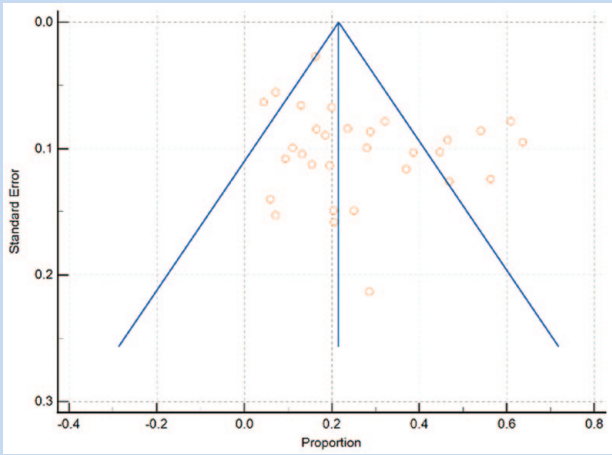


Figure 2. Funnel plot exhibiting a high degree of data asymmetry and potential for publication bias.

Table 2. Demographic information of all athletes included in final analysis of study

Total number of athletes (N)	4762
Sex	
Male	2929 (61.4)
Female	1839 (38.6)
Mean age, y	24.3 (± 6.9)
Mean follow-up, y	3.3 (± 2.3)
Sports (N = studies included)	31
Mixed sports	26 (85%)
Soccer only	4 (14%)
Unspecified	1 (<1%)
Level of competition	24
Competitive	4 (17%)
Recreational/practice	1 (<1%)
Mixed	19 (80%)

3.3 ± 2.3 years across the 24 of 31 studies reporting this variable. Regarding the types of sports included, 26 of 31 studies involved mixed sports,[2,3,5,13,14,17,18,21,22,24,25,30,31,33-35,37-40,42,44,46,47,54,55] 4 of 31 reported solely on soccer,[10,11,27,58] and type of sport was unspecified in 1 of the 31 studies.[56] Level of competition was reported for 24 studies, with 4 of 24 involving athletes at the competitive level,[2,27,33,34] 1 of 24 involving athletes at practice,63 and 19 of 24 including athletes from mixed levels of competition.[3,5,10,13,14,17,21,22,24,25,30,31,35,37,38,40,46,54,55]

Rate of Athletes Who Did Not RTS With Reasons

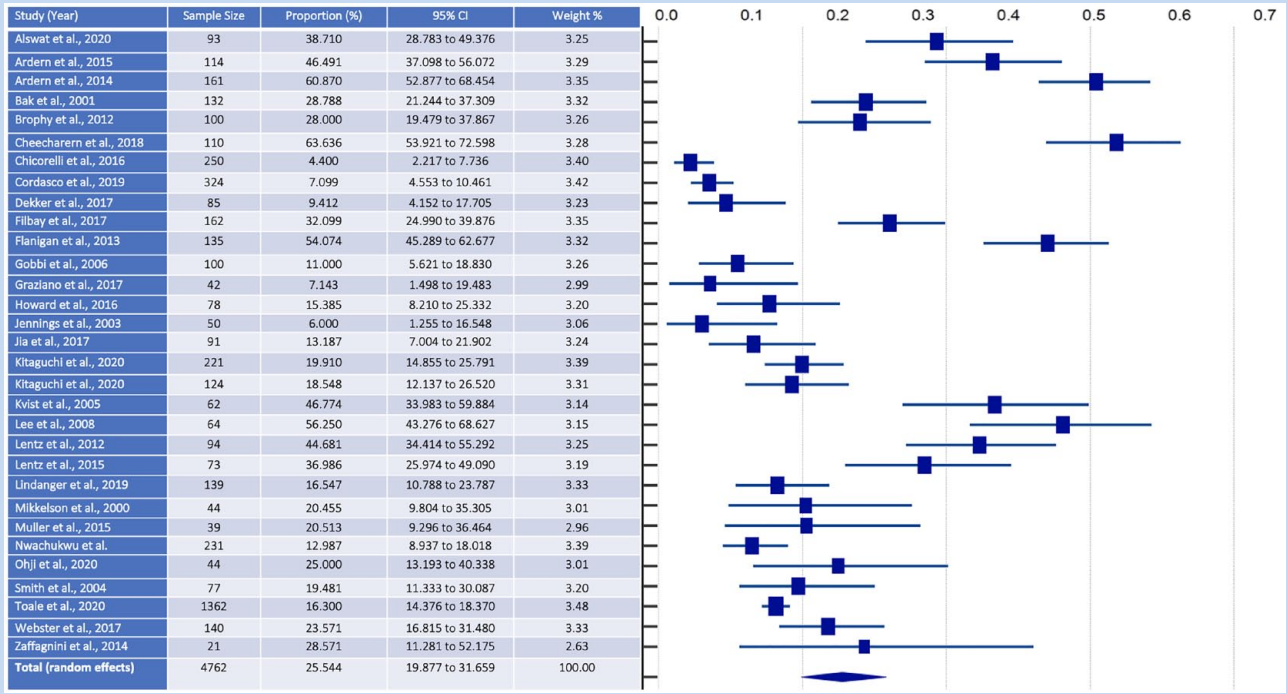
Of the patients included in the failure to RTS meta-analysis, a total of 1089 of 4762 (22.9%) of athletes were unable to return after ACLR. The pooled rate of failure to RTS was calculated to be 25.5% (95% CI, 19.88-31.66) using the random effects model (Figure 3).

Of the included studies, 16 reported the sex breakdown of patients who failed to RTS. In total, these studies had 1784 male and 1071 female patients. Of these, 452 of 1784 (25.3%) male and 341 of 1071 (31.8%) female patients failed to RTS. In these studies, female patients were significantly more likely to fail to RTS than their male counterparts ($P < 0.01$).

As some studies allowed athletes to endorse multiple reasons for not returning to sports, a total of 1436 reasons were aggregated across all included studies. The most cited reason overall was fear of reinjury (33.0%), followed by other reasons unrelated to the knee (11.0%), unspecified or otherwise poor knee function (10.2%), knee pain (8.7%), and lack of interest or personal reasons (7.8%). The category "other reasons unrelated to the knee" encompasses all patients who failed to RTS for psychosocial reasons where the specific factor was not cited in the included publication. Stratification of reasons for failure to RTS by knee-related versus psychosocial-related reasons yielded 544 of 1436 (37.9%) instances of knee-related reasons, and 892 of 1436 (62.1%) psychosocial-related reasons for failure to return.

Of the 274 patients who did not RTS from 4 studies including only competitive athletes, 120 of 274 (43.8%) cited knee-related reasons and 154 of 274 (56.2%) cited psychosocial reasons. From the 19 studies that included both competitive and recreational athletes, 872 patients did not RTS. Of these 872 patients, 278 (31.9%) cited knee-related reasons compared with 594 (68.1%) who cited psychosocial factors.

A significantly higher weighted proportion of athletes cited psychosocial-related versus knee-related reasons for failure to RTS (55.4% vs 44.6%, $P < 0.01$). Knee-related reasons for failure to RTS were defined as follows: physician advice, ACL reinjury, surgery failure, and knee problems (weakness, poor function/unspecified, joint stiffness, joint swelling, joint instability, pain). Among knee-related reasons for failure to RTS, the most frequently cited included unspecified knee problems/poor function (28.4%), pain (24.3%), and weakness (11.9%) (Figure 4). Psychosocial reasons for failure to RTS were defined as follows: change in team or coach, lack of time, lack of activities, employment/education, lack of interest/personal reasons, fear of injury/psychological, and other (undefined). Although advanced age and heavy weight are not psychosocial factors, they are factors unrelated to the knee that have been found to impact RTS after ACLR. Fear of reinjury (51.6%) was the most frequently cited psychosocial-related reason followed by other



Study (Year)	Sample Size	Proportion (%)	95% CI	Weight %
Alswat et al., 2020	93	38.710	28.783 to 49.376	3.25
Ardern et al., 2015	114	46.491	37.098 to 56.072	3.29
Ardern et al., 2014	161	60.870	52.877 to 68.454	3.35
Bak et al., 2001	132	28.788	21.244 to 37.309	3.32
Brophy et al., 2012	100	28.000	19.479 to 37.867	3.26
Cheecharern et al., 2018	110	63.636	53.921 to 72.598	3.28
Chicorelli et al., 2016	250	4.400	2.217 to 7.736	3.40
Cordasco et al., 2019	324	7.099	4.553 to 10.461	3.42
Dekker et al., 2017	85	9.412	4.152 to 17.705	3.23
Filbay et al., 2017	162	32.099	24.990 to 39.876	3.35
Flanigan et al., 2013	135	54.074	45.289 to 62.677	3.32
Gobbi et al., 2006	100	11.000	5.621 to 18.830	3.26
Graziano et al., 2017	42	7.143	1.498 to 19.483	2.99
Howard et al., 2016	78	15.385	8.210 to 25.332	3.20
Jennings et al., 2003	50	6.000	1.255 to 16.548	3.06
Jia et al., 2017	91	13.187	7.004 to 21.902	3.24
Kitaguchi et al., 2020	221	19.910	14.855 to 25.791	3.39
Kitaguchi et al., 2020	124	18.548	12.137 to 26.520	3.31
Kvist et al., 2005	62	46.774	33.983 to 59.884	3.14
Lee et al., 2008	64	56.250	43.276 to 68.627	3.15
Lentz et al., 2012	94	44.681	34.414 to 55.292	3.25
Lentz et al., 2015	73	36.986	25.974 to 49.090	3.19
Lindanger et al., 2019	139	16.547	10.788 to 23.787	3.33
Mikkelson et al., 2000	44	20.455	9.804 to 35.305	3.01
Muller et al., 2015	39	20.513	9.296 to 36.464	2.96
Nwachukwu et al.	231	12.987	8.937 to 18.018	3.39
Ohji et al., 2020	44	25.000	13.193 to 40.338	3.01
Smith et al., 2004	77	19.481	11.333 to 30.087	3.20
Toale et al., 2020	1362	16.300	14.376 to 18.370	3.48
Webster et al., 2017	140	23.571	16.815 to 31.480	3.33
Zaffagnini et al., 2014	21	28.571	11.281 to 52.175	2.63
Total (random effects)	4762	25.544	19.877 to 31.659	100.00

Figure 3. Forest plot demonstrating the pooled rate of failure to RTS after ACLR, based on a random effects model. Respective study weights represented by the size of the square. ACLR, anterior cruciate ligament reconstruction; RTS, return to sport.

(undefined) reasons unrelated to the knee (17.2%) and lack of interest/personal reasons (12.3%) (Figure 5).

DISCUSSION

The goal of this study was to determine the rate of athletes who did not RTS after primary ACLR, and the specific reasons for failing to RTS. In the 31 studies reviewed, the overall pooled failure to RTS rate was calculated to be 25.5%. Further stratification of cited knee-related and psychosocial-related reasons for failure to RTS revealed a significantly higher proportion of cited psychosocial-related reasons (55.4% vs. 44.6%, $P < 0.01$). The most cited reason overall for failure to RTS after ACLR was fear of reinjury (33.0%).

Multiple systematic reviews and meta-analyses have reported in detail the rate of RTS after ACLR. However, data reported in these studies often fail to provide insight into the specific reasons why an athlete fails to RTS after this procedure. In a recent article by Randsborg et al[50] published in the *American Journal of Sports Medicine* in 2022, the authors cited a 70% RTS rate with 87% of patients reporting stable knee function at 9 years postoperatively. However, they found that 26% of patients required subsequent surgery during those 9 years, with the surgeries including revision ACLR, other surgery for knee pathology on the ipsilateral knee, and contralateral ACL tear.

One study published by Lai et al[36] in 2018 reported an 83% RTS rate in professional or Division I level college athletes who sustained an ACL tear and underwent ACLR. This rate of return is higher than the 74.5% of athletes in this study who did RTS. Furthermore, they reported that most of the elite athletes who did return had decreased athletic performance after their surgery, as determined by analyzing individual sport statistics, although this varied based on the sport played.

While the rate of RTS we calculated was significant, it is important to note that many of the studies included possessed a relatively wide range of RTS rates. This heterogeneity is likely due to potentially varying definitions for RTS, as well as the level of sport and type of sports reported. Furthermore, the non-RTS rate may also be influenced by various surgical techniques, differing skill levels across physicians, and rehabilitation methodologies. Certain studies also solely reported on athletes at the competitive level, which likely implicates higher barriers to RTS, potentially inflating our calculated failure to RTS rate. Furthermore, our primary goal was to determine the factors that contributed to the failure to RTS in athletes. Thus, our exclusion of studies reporting 100% RTS rates or not detailing the reasons for failure to RTS likely resulted in a higher-than-expected failure to RTS rate.

The concept of fear of reinjury, also referred to as kinesiophobia, has been explored previously in the literature for both ACLR and other sports-related injuries.[45,48] A systematic review by Nwachukwu et al[45] examining this variable as a potential reason for preventing an athlete from RTS noted a significant predominance of psychological reasons in precluding

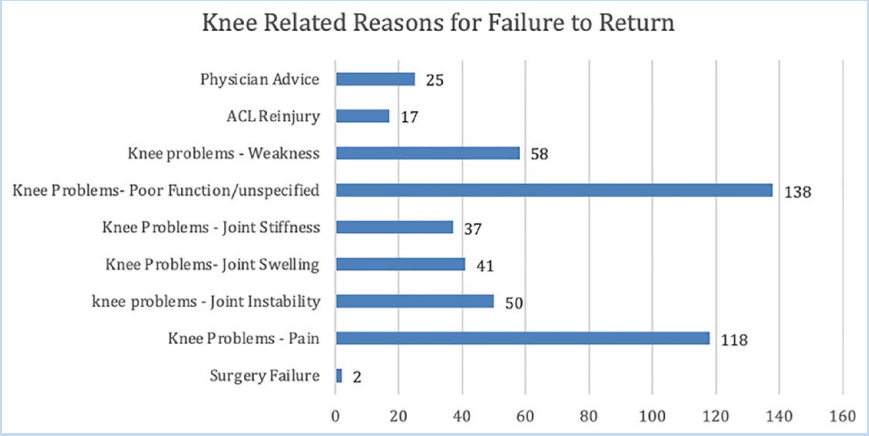


Figure 4. Reported knee-related reasons for failure to RTS after ACLR. ACL, anterior cruciate ligament; ACLR, anterior cruciate ligament reconstruction; RTS, return to sport.

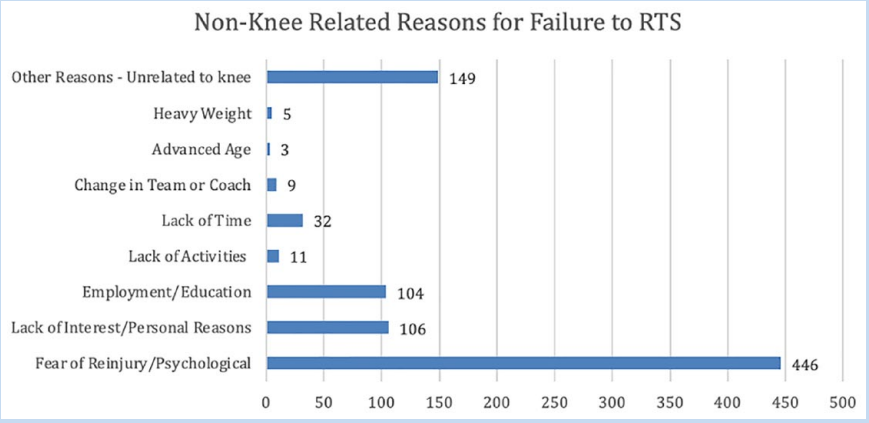


Figure 5. Reported psychosocial-related reasons for failure to RTS after ACLR. ACLR, anterior cruciate ligament reconstruction; RTS, return to sport.

RTS. Similar trends have been observed in other sports-related injuries. A cross-sectional study by Olds and Webster[48] analyzed psychological readiness in athletes who had ≥1 episode of shoulder dislocation using the "Shoulder Return to Sport After Injury" metric and noted that those who had undergone surgery and those who had returned to sports displayed a higher degree of intrinsic fear of shoulder reinjury. A different study on athletes undergoing arthroscopic Bankart repair found that those who did not RTS had lower psychological readiness and had a statistically significant increase in fear of reinjury compared with those who returned to play.[28] Whereas our study revealed this fear of reinjury to be the most predominantly cited reason for failure to RTS after ACLR, future studies are needed to better understand the role of psychological reasons and their impact on patient outcomes in regard to RTS in other orthopaedic injuries.

The degree to which this fear improves with time is less certain. A previous study demonstrated an increased degree of pain-related fear of movement/reinjury, using the Tampa Scale of Kinesiophobia (TSK-17).[15,35] Although these results are promising through showing a lessening and, in some cases, resolution, of fear over time, it also presents a potential challenge in the case of high school and collegiate athletes who are limited in regard to the number of seasons of play time before graduation and desire to RTS at the preinjury level. That said, this emphasizes the need to develop more effective interventions aimed at better addressing these fears and concerns to promote faster and definitive RTS in this group of athletes.

While current research on potential psychosocial interventions is still developing, this presents an area where future studies can better guide sports medicine surgeons in treating athletes to

help them meet their goals. Gennarelli et al[23] examined the effectiveness of psychosocial interventions on athletes after any type of musculoskeletal injury. Common psychosocial interventions noted were goal setting, counseling, "positive self-talk," and "relaxation/guided imagery." While the authors noted that such interventions generally improved postinjury recovery, they acknowledged that no studies included in the analysis reported specifically on return-to-play outcomes after such interventions.

Regarding knee-related reasons for failure to return, unspecified knee problems/poor function, pain, weakness, and instability were all reported by athletes as reasons for not returning to sport after ACLR. A potential explanation for why knee-related reasons were reported at a lesser frequency than psychosocial related reasons may involve a greater ability by the athlete to directly control and manage factors such as pain, weakness, or otherwise poor function through either medication or engaging in aggressive physical rehabilitation and therapy that would then alleviate such symptoms to a degree to enable RTS. On the contrary, adequately addressing psychosocial reasons such as fear of reinjury, lack of interest, personal reasons, and education/employment is more a complex task and, in some cases, requires a decision based on the athlete's own personal priorities and career aspirations.

LIMITATIONS

We acknowledge numerous limitations in this study. Although we intended for our meta-analysis to be comprehensive, there is always a risk that relevant studies meeting the inclusion criteria are missed in either the search or screening process. As the literature review for this study was conducted in 2021, it is likely that relevant articles have been published since then. However, as our study included almost 5000 patients, we believe our conclusions remain valid and would be unlikely to be affected by the addition of studies published in the last 2 years. The majority of studies included in this meta-analysis consisted of observational studies (Levels 3 and 4 evidence). Our results may have also been affected by publication bias, a lack of risk of bias tool, and heterogeneity between studies.

The random-effects model was used for meta-analysis to improve the accuracy of the results, but we acknowledge that this does not eliminate the risk of error. A few studies included in this analysis allowed athletes to cite >1 reason for failure to RTS with no further specification as to the predominant reason influencing the decision to not RTS. Therefore, it is reasonable to surmise that there are overlapping reasons for failing to RTS, although our ability to account for such overlaps is beyond the scope of our study and, importantly, not indicated in the analyses of the included studies.

Our analysis strictly reported on the number of times a particular reason was cited for failure to RTS; however, this methodology potentially neglects the respective weight of a particular factor in an athlete's decision. In addition, the majority of studies included in this analysis reported on athletes involved in multiple different sports, and sufficient details were not provided to an extent to allow for subgroup analysis. Whether certain sports are more likely to exacerbate symptoms related to the knee than others is unknown and, as such, further investigations are needed to see whether our results hold true between different types of sports.

CONCLUSION

This study estimates the rate of failure to RTS after ACLR to be 25.5%, with the majority of athletes citing fear of reinjury (33.0%) as the major deterrent for returning to sports. We highlight how factors independent of surgical techniques or surgical decision-making may impact an athlete's ability to return to play. Although additional research is still indicated, this study showed that the predominant reason for not returning to sport after ACLR was unrelated to the knee and can encourage surgeons to effectively counsel athletes and understand reasons for hesitation in returning to sports, so that surgeons may better assist them in meeting their goals.

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