

## [ Orthopaedic Surgery ]

# Anterior Cruciate Ligament Reconstruction—Not Exactly a One-Way Ticket Back to the Preinjury Level: A Review of Contextual Factors Affecting Return to Sport After Surgery

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**Context:** A recently updated meta-analysis of return-to-sport rates after anterior cruciate ligament (ACL) reconstruction demonstrated that 65% of athletes returned to their preinjury level of sport after surgery. The aim of this clinical review was to explore contextual factors associated with returning or not returning to the preinjury level after ACL reconstruction.

**Evidence Acquisition:** Data were obtained from peer-reviewed literature via a search of the electronic databases Medline, Embase, CINAHL, and SPORTDiscus from database inception to January 2015. The keywords *anterior cruciate ligament* and *return to sport* were used. Additional literature was identified via hand-searching of the reference lists of relevant articles and the ePublication lists of key scientific journals. Random effects meta-analyses were used to pool the results of modifiable contextual factors and to examine their association with returning or not returning to the preinjury level of sport after surgery.

**Study Design:** Clinical review.

**Level of Evidence:** Level 2.

**Results:** Lower fear of reinjury (standardized mean difference, 0.7), greater psychological readiness to return to sport (standardized mean difference, 1.0), and a more positive subjective assessment of knee function (standardized mean difference, 0.9) favored return to the preinjury level after surgery.

**Conclusion:** Returning or not returning to the preinjury level after ACL reconstruction is complex and multifactorial. Screening for potentially modifiable contextual factors, particularly psychological factors, early after ACL injury may help clinicians identify athletes who could be at risk of not returning to the preinjury level of sport and institute interventions that could improve returning to sport.

**Keywords:** knee; ligament; sport psychology; sport reentry; anterior cruciate ligament

Anterior cruciate ligament (ACL) rupture is one of the most common sports-related injuries to the knee.<sup>39</sup> Patients are typically young, active, and otherwise healthy individuals who are often devastated to receive their diagnosis. Before the adoption of modern surgical and rehabilitation techniques, ACL rupture was often considered a career-ending injury for athletes.<sup>22,46,62</sup> Surgery was performed to stabilize the injured and dysfunctional knee joint to eliminate giving way episodes in patients with recurrent instability. With the shift to less invasive

surgical techniques and accelerated rehabilitation protocols<sup>55</sup> in the late 1980s, surgical and functional outcomes steadily improved, and ACL reconstruction was increasingly performed to restore stability and facilitate return to sport. At the same time, it was hoped that early intervention could reduce the individual's risk of developing posttraumatic osteoarthritis. In contemporary orthopaedics, the desire to return to the preinjury level of sports participation is one of the main reasons athletes choose surgical treatment,<sup>20,26</sup> and a key indication for clinicians to advise ACL

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reconstruction, particularly if the individual wishes to return to pivoting sports.<sup>41,50</sup>

While returning to participation in sport is often the most important outcome for patients after ACL reconstruction, research has been primarily focused on evaluating impairment-based outcomes as a measure of the success of surgery. Postoperative impairment-based outcomes such as knee laxity and muscle strength have been excellent,<sup>9</sup> but in a previous systematic review, participation—particularly in competitive sport—was disappointingly low.<sup>6</sup> The ability to return to participation at the preinjury level was recently considered by experts as a key milestone in successful outcome after ACL reconstruction.<sup>38</sup>

Evaluating impairment-based outcomes after ACL reconstruction is justified. Recovery of physical impairments after surgery is important because the individual requires the physical capabilities, such as sufficient muscle strength about the knee, and neuromuscular control to safely cope with the physical requirements of playing sport.<sup>1,60</sup> However, the recovery of physical capabilities alone is not enough to ensure a return to sport.<sup>9</sup> It is acknowledged that both physical and psychological readiness is important for successful return to sport, but these states do not always coincide.<sup>5,7,48</sup> In support of this, in a previous meta-analysis, a range of physical and contextual factors were found to be associated with returning to the preinjury level of sport after surgery.<sup>6</sup>

The aim of the current clinical review was to explore the contextual factors associated with returning or not returning to sport after ACL reconstruction by synthesizing additional data not included in the previous meta-analysis. Studies were identified via a search of the electronic databases Medline, Embase, CINAHL, and SPORTDiscus from inception to January 31, 2015, and hand-searching of the reference lists and ePublication lists of relevant articles and scientific journals. Empirical data from studies comparing modifiable contextual factors between people who had and had not returned to their preinjury level of sport after primary ACL reconstruction (or where at least 80% of participants had primary surgery) were extracted. RevMan 5.1 (The Cochrane Collaboration) was used to calculate pooled standardized mean differences (also known as effect sizes) using a random-effects model where clinically homogenous data were available. The random effects model was chosen based on anticipated statistical heterogeneity. Cohen guidelines<sup>14</sup> were used when interpreting the pooled standardized mean differences. Heterogeneity was assessed statistically using Higgins  $I^2$ ,<sup>27</sup> which measures the amount of inconsistency in effects across studies included in a meta-analysis, and Cochran  $Q$ .

## WHEN IS IT SAFE TO RETURN TO SPORT?

Athletes are typically permitted to return to sport between 6 and 12 months after ACL reconstruction,<sup>44,46</sup> with the clinical assumption that return to sport will be achieved by 1 year after surgery.<sup>7</sup> Before clearance to return to sport, it is recommended that athletes have no knee effusion, symmetrical muscle strength, and adequate neuromuscular control to manage the

specific physical demands of their sport,<sup>11,60</sup> although it has yet to be determined whether these factors are predictive of returning to sport.<sup>19</sup> Nevertheless, important considerations for clinicians when preparing an athlete to return to sport are to ensure adequate graft healing, minimize the risk for subsequent injury, and prevent the development of osteoarthritis<sup>19,60</sup>; and evidence-based rehabilitation guidelines are broadly structured around these considerations.<sup>2,33</sup>

## HOW MANY PEOPLE RETURN TO SPORT AFTER ACL RECONSTRUCTION?

When reviewing the literature regarding return-to-sport outcomes, wide variation in return-to-sport rates can be seen—from 100% in some studies<sup>12,18,40,42</sup> to as low as 20% in others.<sup>7,52,54,56</sup> The results of the most recent meta-analysis of return-to-sport rates (based on data from 69 articles and 7556 participants) illustrated the importance of reporting the level of participation when evaluating returning to sport.<sup>6</sup> The analysis demonstrated that 81% of individuals returned to some form of sport after ACL reconstruction<sup>6</sup>—an acceptable result, one might contend. However, when the level of participation was taken into account, it was found that only 65% returned to their preinjury level of sport and 55% returned to competitive sport. This means that 1 in 3 individuals did not return to his or her previous level of sports participation, and 1 in 2 did not return to competitive sport after surgery.<sup>6</sup>

## PHYSICAL RECOVERY ALONE IS NOT ENOUGH TO ENSURE A RETURN TO SPORT

A central tenant of postoperative rehabilitation is to assist athletes to regain physical capacity so that they may participate safely and at their desired performance level. The results of impairment-based studies demonstrate that most athletes recover knee function to a level that contemporary clinical guidelines would contend is sufficient to cope with the demands of sport.<sup>9,31</sup> This suggests that surgery and postoperative rehabilitation programs do address knee function impairments, but it is also possible that current outcome measures may lack sensitivity to detect impairments that could impact function.<sup>35,60</sup> Many athletes with apparently good knee function do not return to their preinjury level of sport,<sup>9</sup> and the discrepancy between recovery of impairments and returning to sport is in agreement with other studies demonstrating a lack of association between impairments and participation in patients with musculoskeletal disorders.<sup>23,49</sup> Clearly, there are factors in addition to physical function that are important. Some of the factors that impact returning may be modifiable with appropriate intervention, while others may be nonmodifiable.

## WHY DON'T ATHLETES RETURN TO SPORT AFTER ACL RECONSTRUCTION?

The World Health Organization's International Classification of Functioning, Disability, and Health<sup>65</sup> (ICF; Figure 1) has been

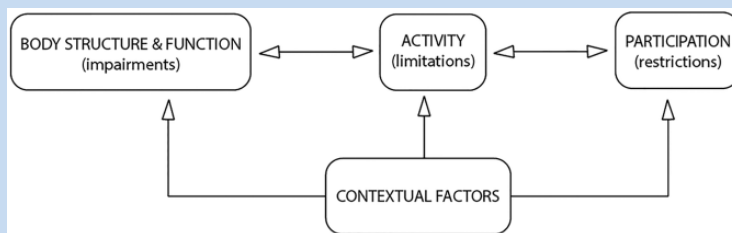


Figure 1. Conceptual model of the International Classification of Functioning, Disability, and Health (ICF).<sup>65</sup>

used as a framework for evaluating outcomes after ACL reconstruction.<sup>6,9,38</sup> The ICF considers impairments of body structure and function, activity limitations, and participation restrictions arising from a particular health state. It also views all aspects of an individual's functioning as occurring within a context and emphasizes that the impact of contextual factors must be considered when evaluating health-related outcomes. When applied to participation in sport after ACL reconstruction, the reasons for not returning to sport could be related to physical factors (body structure and function impairments and activity limitations) and to modifiable and nonmodifiable contextual factors (including surgical, personal, environmental, social, and psychological factors). It is possible that poor or inadequate recovery and rehabilitation may impact an athlete's physical capabilities to participate in sport, yet as previously discussed, there is a discrepancy between physical recovery and returning to sport. On the other hand, it is possible that subtle impairments in physical function, not adequately measured with existing outcome measures, may impact the high-level functional demands of sports participation. Evaluating impairment-based outcomes has been a focus of previous research,<sup>9</sup> so the current review focused on the current evidence for modifiable contextual factors given the potential relevance of such factors to sports medicine clinicians.

## THE INFLUENCE OF CONTEXTUAL FACTORS ON RETURN TO SPORT

### Nonmodifiable Factors

There are a number of nonmodifiable contextual factors that may influence whether an athlete returns to sport after ACL reconstruction. These factors include the graft type, age, sex, and level of sport the athlete participated in before their injury.<sup>6</sup> There are significantly greater odds (odds ratio [OR], 1.2; 95% CI, 1.1-1.5) of returning to the preinjury level for athletes who receive patellar tendon autografts, and greater odds of returning to competitive level for athletes who receive hamstrings tendon autografts (OR, 2.4; 95% CI, 1.9-3.1).<sup>6</sup> Being younger has a small effect, favoring returning to the preinjury level sport (effect size, 0.3).<sup>6</sup> Those older than 25 years are 50% less likely to be playing their preinjury level sport at an average of 39 months after surgery than their younger counterparts (OR, 0.5; 95% CI, 0.3-0.8),<sup>4</sup> and of those athletes older than 32 years, 2 of every 3

are not playing at their preinjury level.<sup>4</sup> Men are approximately 1.5 times more likely than women to return to the preinjury level of sport (OR, 1.4; 95% CI, 1.2-1.7) and competitive sport (OR, 1.7; 95% CI, 1.2-2.3).<sup>6</sup> Elite athletes have 2.5 times greater odds of returning to the preinjury level (OR, 2.5; 95% CI, 2.0-3.1) and 6 times greater odds of returning to their competitive level (OR, 5.9; 95% CI, 4.6-7.5) than nonelite athletes.<sup>6</sup>

### Modifiable Factors

There is growing evidence to suggest that psychological factors matter when it comes to returning to the preinjury level after ACL reconstruction; and this may have important implications for clinical practice. Recent systematic reviews have shown that positive psychological responses, including motivation, confidence, self-efficacy, optimism, and low fear, are associated with a greater likelihood of returning to the preinjury level after athletic injury<sup>5</sup> and ACL reconstruction.<sup>15,17,57</sup> In their meta-analysis, Ardern et al<sup>6</sup> found large effect sizes ( $d = 0.9-1.0$ ) based on the results of 4 studies, indicating that lower fear of reinjury<sup>32,37</sup> and greater psychological readiness to return to sport<sup>34,63</sup> favored returning to the preinjury level after surgery. There are additional empirical data that have been published since the previous meta-analysis, and the current review presents a new synthesis of the most recent findings regarding psychological factors and appraisals of knee function and returning to sport after ACL reconstruction.

The literature search identified 10 studies that examined the effect of modifiable contextual factors on returning to the preinjury level after ACL reconstruction.<sup>7,8,10,13,32,34,36,37,45,63</sup> Data were combinable for 3 factors: fear of reinjury, psychological readiness to return to sport, and subjective assessment of knee function.

When data from 6 studies ( $n = 504$ ) were combined, a moderately large effect (pooled standardized mean difference, 0.7; 95% CI, 0.4-1.0) was found for lower fear of reinjury, favoring returning to the preinjury level of sport (Figure 2).

When data from 6 studies ( $n = 697$ ) were combined, a large effect (pooled standardized mean difference, 0.9; 95% CI, 0.6-1.1) for greater psychological readiness to return to sport favoring returning to the preinjury level of sport was found (Figure 3).

When data from 4 studies ( $n = 384$ ) were combined, a large effect (pooled standardized mean difference, 1.0; 95% CI, 0.5-1.6) for positive subjective rating of knee function (measured with the International Knee Documentation

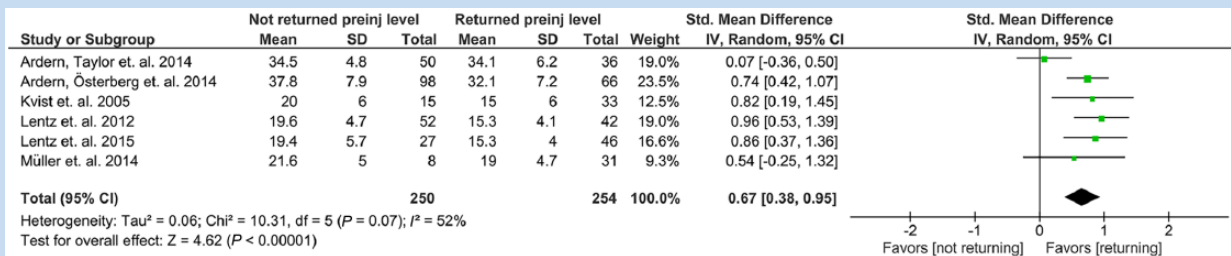


Figure 2. Forest plot showing comparison of fear of reinjury between people who had and had not returned to their preinjury level of sport after anterior cruciate ligament reconstruction.

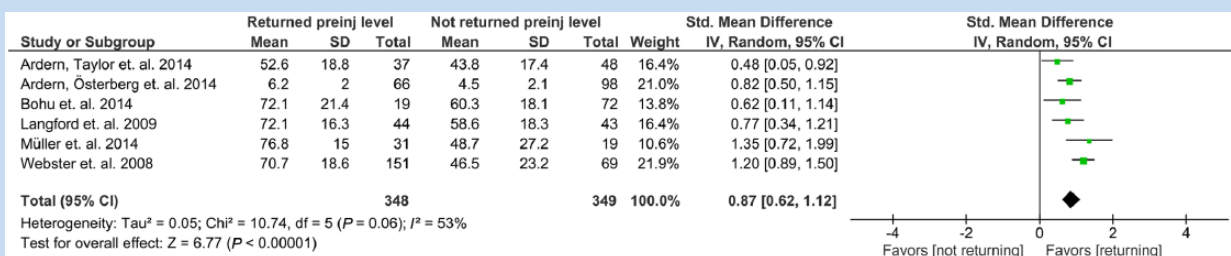


Figure 3. Forest plot showing comparison of psychological readiness to return to sport between people who had and had not returned to their preinjury level of sport after anterior cruciate ligament reconstruction.

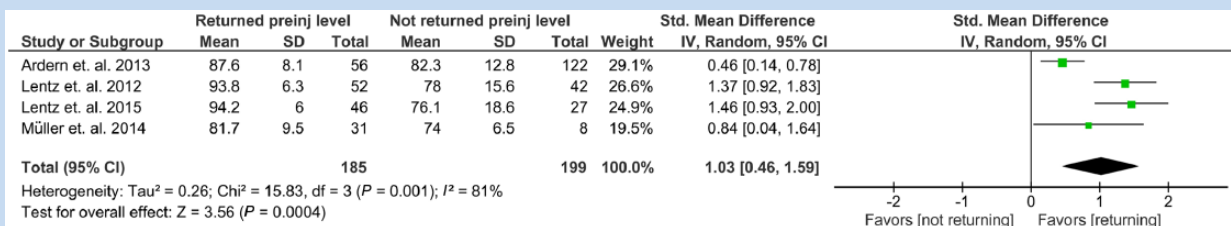


Figure 4. Forest plot showing comparison of subjective rating of knee function between people who had and had not returned to their preinjury level of sport after anterior cruciate ligament reconstruction.

Committee [IKDC] subjective evaluation form<sup>28</sup>) favoring returning to the preinjury level was found (Figure 4).

The results of the meta-analyses in the current review corroborate the findings of the meta-analysis by Ardern et al.<sup>6</sup> With the addition of empirical data from 6 studies<sup>8,10,13,32,36,45</sup> that were not included in the previous meta-analysis,<sup>6</sup> moderately large to large effect sizes were found favoring returning to the preinjury level of sport. The most noticeable difference between the results of the current analysis compared with the previous meta-analysis<sup>6</sup> was in the effect size for fear of reinjury. With the additional data, there was a 20% reduction in the effect size (from 0.9 to 0.7). This may be due to the nonsignificant results of 2 studies<sup>8,45</sup> published since the previous meta-analysis.<sup>6</sup> However, taken together, the results show a consistent and sizable effect, supporting the notion that fear of reinjury may be a hindrance to returning to the preinjury level after surgery.<sup>5</sup>

Fear of reinjury is one of the most frequently cited reasons by athletes for not returning to their preinjury level of sport after

ACL reconstruction, and the results of the current review provide empirical evidence of its impact. It is difficult to know the basis of the fear of reinjury. Perhaps it is not wanting to go through surgery and rehabilitation again? Perhaps it is because a new injury could have implications for participation in employment or school, or impact on family commitments? Fear is also a prominent emotion for many athletes around the time of their transition from rehabilitation to returning to sport.<sup>26,30,61</sup> Athletes who return to sport report using fear as a motivating factor for their return<sup>61</sup> and that testing their knee in sport helps to allay their fears, provided the return goes well.<sup>30</sup> On the other hand, when athletes perceive pressure to return to sport and a lack of control over their return, negative psychological responses may prevail.<sup>5</sup> These responses may in turn thwart self-motivation for returning to sport.<sup>5</sup> As many as 1 in 2 athletes who do not return to their preinjury level of sport report that the main reason is fear of sustaining a new injury.<sup>10,21</sup> Athletes who do not return may be fearful of pain or the

consequences of sustaining a new injury,<sup>61</sup> and some report being unwilling to risk being injured again, even though they know their knee has sufficient physical capacity to cope with the demands of sport.<sup>61</sup>

The evidence presented in the current review demonstrates the importance of athletes being psychologically ready to return to sport to making a successful transition back to the preinjury level. The scale used to evaluate psychological readiness to return to sport (the ACL–Return to Sport after Injury scale<sup>63</sup>) assesses emotions, confidence, and risk appraisals associated with returning to sport after ACL reconstruction. Psychological readiness to return to sport and knee self-efficacy (measured using the Knee Self-Efficacy scale<sup>59</sup>) are factors that have been found to predict returning to sport and physical activity after surgery.<sup>7,8,34,45,58</sup> Both of these psychological factors involve the injured athlete making a prospective appraisal of their capacity to return to sport before attempting to return and suggest that athletes who feel less confident about their knee function and their ability to participate may be less likely to return to sport after surgery.<sup>43,53</sup> Attitudes and motivation likely play an important role in determining self-efficacy and psychological readiness to return to sport,<sup>3,53</sup> and supporting this notion is the fact that people who place greater importance on exercising are more likely to return to their preinjury level of sport.<sup>24</sup>

The finding of a large effect for subjective assessment of knee function favoring return to the preinjury level of sport supports the fact that an individual athlete's appraisals about their ability to participate in sport may be an important determinant of returning. It may be a particularly important consideration for clinicians who must recognize that athletes' appraisals of knee function do not necessarily match the results of clinical assessments.<sup>51</sup> Psychological factors and appraisals of knee function may also be inextricably linked. For example, the experience of pain may influence returning to sport via an influence on an individual's prospective judgment of their readiness to return to sport.<sup>17</sup> Pain perceptions, including catastrophization of pain, can hinder wound healing, physical and psychological recovery, and ultimately return to sport after athletic injury.<sup>64</sup> Therefore, an athlete who perceives that pain is an alert that their knee lacks sufficient physical capacity to cope with the demands of returning to sport, or that pain indicates that there is something going wrong with their knee, may have reduced self-motivation to return to sport.

Another consideration is the influence of motivation on the transition back to sport after an injury,<sup>5,48</sup> given the theorized impact of motivation on behavior.<sup>3,53</sup> It is reasonable to hypothesize that athletes with higher motivation to return to sport could be more likely to return after ACL reconstruction.<sup>24</sup> While there are few empirical studies investigating motivation to return to sport after surgery, the findings of 2 studies (which were not able to be synthesized using meta-analysis because of heterogeneity) support the hypothesis of a relationship between self-motivation and returning to sport after ACL reconstruction. In one study, motivation to return to sport measured preoperatively predicted returning to the preinjury level of sport at 2 years after surgery (effect size, 1.9).<sup>25</sup> In another study of

athletes who had not returned to their preinjury level of sport at 1 year after surgery, those who subsequently returned to their preinjury level rated their self-motivation to return to sport at 1 year significantly higher than those who were not playing sport at 2 years (effect sizes ranged from 0.2 to 0.9).<sup>8</sup>

Systematically addressing potentially modifiable contextual factors in postoperative rehabilitation programs may be warranted to improve return to sport rates after surgery, yet these factors are not addressed in current evidence-based clinical guidelines.<sup>2</sup> Interventions including motivational interviewing, imagery, and goal setting have shown promise in improving self-efficacy and reducing reinjury anxiety in athletes with sports injury.<sup>16,29</sup> There is also evidence of effectiveness in improving clinical and function outcomes in people with ACL reconstruction.<sup>47,66</sup> Given the overall good physical function outcomes achieved after surgery<sup>9</sup> and the fact that positive psychological responses have been shown to predict returning to the preinjury level of sport,<sup>5,7</sup> it may be hypothesized that adding psychological interventions to current physical rehabilitation interventions could be a way to help athletes make the transition back to sport. Although, randomized studies of new multifactorial rehabilitation paradigms are required to test this hypothesis. The results of the current review may also suggest that clinical screening for psychological responses that could hinder returning to sport might help clinicians to identify athletes who could be at risk of not returning to sport and target interventions at athletes who may need additional support to return to sport. Scores on the ACL–Return to Sport after Injury scale have been shown to predict athletes who return to their preinjury level of sport after surgery,<sup>7,34,45</sup> suggesting this scale may have clinical merit in identifying at-risk athletes.

## CONCLUSION

Returning to sport after ACL reconstruction is complex and multifactorial. One in 3 athletes does not return to his or her preinjury level of sport, and 1 in 2 does not return to competitive-level sport after surgery. There are modifiable and nonmodifiable factors that may influence returning to sport after surgery. The contextual factors of female sex, older age, and participating at a nonelite level prior to ACL injury are nonmodifiable factors that may increase the risk of not returning to the preinjury level of sport after surgery. Moderately large to large effects (standardized mean difference, 0.7-1.0) were found for lower fear of reinjury, greater psychological readiness to return to sport, and more positive subjective assessment of knee function favoring return to the preinjury level of sport after surgery. These potentially modifiable factors may be responsive to appropriate interventions during postoperative rehabilitation, and future research should investigate the efficacy of multifactorial rehabilitation paradigms for improving returning to sport. Early screening for maladaptive responses that could impact returning to the preinjury level of sport after surgery may also help athletes and clinicians maximize the chances of returning to sport.



# Clinical Recommendations

## **SORT: Strength of Recommendation Taxonomy**

**A:** consistent, good-quality patient-oriented evidence

**B:** inconsistent or limited-quality patient-oriented evidence

**C:** consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
A range of physical, surgical, environmental, personal, social, and psychological factors influence whether athletes return to their preinjury level of sport or not after anterior cruciate ligament reconstruction. There is a moderate to large effect for positive modifiable contextual factors favoring returning to sport	<b>A</b>

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