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Psychological Treatments and Results in the Recovery After the Rupture of the Anterior Cruciate Ligament in Sports

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Abstract

Anterior cruciate ligament (ACL) rupture is a major sports injury with consequences that extend beyond the restoration of knee stability and strength. Athletes may achieve satisfactory physical rehabilitation yet remain unable or unwilling to return to sport because of the fear of reinjury, kinesiophobia, reduced self-efficacy, altered athletic identity, depressive symptoms, unrealistic expectations, or social pressure. This narrative review examines psychological determinants of recovery after anterior cruciate ligament rupture, methods used to assess psychological readiness, and interventions that can be incorporated into rehabilitation. The Anterior Cruciate Ligament-Return to Sport after Injury (ACL-RSI) scale, measures of kinesiophobia, and self-efficacy instruments provide clinically useful information that is not captured by strength or functional testing alone. Interventions described in the literature include realistic education and expectation setting, graded rehabilitation goals, imagery, cognitive-behavioral strategies, pain education, relaxation techniques, and structured communication within the rehabilitation team. Recent systematic-review evidence also links poor psychological readiness with delayed return to sport, altered biomechanics, and possibly subsequent injury while emphasizing that intervention studies remain comparatively limited and heterogeneous. Psychological assessment should therefore be integrated longitudinally with physical rehabilitation rather than reserved for athletes who have already failed to return to sport. Individualized treatment is most appropriate when fear, low confidence, catastrophizing, or poor readiness persists despite satisfactory physical progress.

Categories: Sports Medicine, Orthopedics
Keywords: anterior cruciate ligament (acl), athletes, kinesiophobia, psychological readiness, rehabilitation, return to sport

Introduction And Background

Sports injuries can have consequences extending beyond immediate physical impairment. In competitive and professional athletes, anterior cruciate ligament (ACL) rupture may affect return to play, subsequent performance, and career continuity, with outcomes varying across sports and competitive settings [1-4]. Contemporary reconstruction and rehabilitation permit many athletes to resume sport; however, return to participation does not necessarily mean the restoration of the preinjury competitive level or performance [5,6].

The rupture of the anterior cruciate ligament (ACL) provides a useful model for examining this broader concept of recovery. Rehabilitation is prolonged and requires progressive re-exposure to movements such as pivoting, cutting, jumping, and rapid deceleration that may have become associated with the original injury. Even when physical recovery is satisfactory, a substantial proportion of athletes do not regain their previous level of sporting participation [6]. This discrepancy between physical recovery and actual return to sport supports the consideration of psychological responses, alongside conventional functional measures during rehabilitation.

This narrative review examines the psychological factors associated with recovery and return to sport after ACL rupture, the tools available to identify athletes in whom these factors are clinically important, and the psychological treatments or rehabilitation strategies that may reduce their negative effects. As most of the available evidence concerns athletes undergoing ACL reconstruction, the review focuses predominantly on postoperative rehabilitation, while evidence relating to ACL injury more broadly is included where relevant. The emphasis is on the practical integration of psychological assessment and treatment within multidisciplinary sports rehabilitation.

Review

Literature identification

This narrative review was informed by targeted PubMed searches (conducted from database inception to 2026) using combinations of the terms “anterior cruciate ligament,” “ACL reconstruction,” “psychological readiness,” “fear of reinjury,” “kinesiophobia,” “self-efficacy,” “return to sport,” and “psychological intervention.” Reference lists of relevant reviews and included articles were hand-searched for additional eligible literature. English-language studies addressing psychological factors, psychological readiness, assessment instruments, or behavioral interventions relevant to ACL injury or reconstruction were considered. Priority was given to systematic reviews, meta-analyses, prospective studies, randomized controlled trials, and psychometric validation studies, while older literature was retained when representing foundational work or the original development of key assessment instruments.

Clinical outcomes after ACL rupture and reconstruction

For the purposes of this review, return to participation, return to sport, and return to preinjury performance are considered distinct outcomes. The resumption of training or modified sporting participation should not be equated with return to the same sport at the previous competitive or performance level.

Return to sport after ACL reconstruction is common but should not be equated with return to preinjury performance. In professional athletes from major North American sports, Mai et al. reported an overall return-to-sport rate of 86.6%, although both return rates and subsequent performance differed by sport [1]. Professional American football players have also demonstrated reduced postreconstruction performance in some position-specific analyses [1,2].

Comparable findings have been reported in association football. In a 15-year prospective study of professional players, most athletes returned to play, but only 65% were still competing at the highest level three years after ACL rupture [3]. A study across the five largest European football nations similarly demonstrated a distinction between return to professional participation and sustained return to the previous competitive level [4]. Systematic-review evidence across elite sports further demonstrates the distinction between return to sporting participation and the restoration of the preinjury level. Lai et al. reported that 83% (95% CI: 77%-88%) of 1,272 elite athletes returned to their preinjury level of sport after ACL reconstruction, with mean time to return ranging from six to 13 months [5]. The included populations represented several sports, including soccer, American football, basketball, ice hockey, rugby, baseball, handball, and snow sports; these elite-athlete estimates should therefore not be assumed to represent recreational or non-elite populations. Rates of return to competitive or preinjury levels remain lower in broader athletic populations [6].

Revision reconstruction creates an additional challenge. A systematic review by Grassi et al. found that return to the same level of sport after revision ACL reconstruction occurred in only about half of athletes, reinforcing that structural reconstruction and the completion of rehabilitation do not necessarily restore previous sporting participation [7]. These observations provide the clinical context for examining psychological readiness as an outcome in its own right.

Psychological determinants of recovery

Psychological responses change throughout rehabilitation. Early fear avoidance and low self-efficacy have been associated with the slower resolution of impairment and reduced readiness to progress, while longitudinal studies show that psychosocial responses generally improve as recovery advances [8-10]. The trajectory is nevertheless individual, and persistent fear or poor confidence may remain clinically important after objective measures of knee function have improved.

The fear of reinjury and kinesiophobia are among the most consistently described barriers to return to sport. Prospective and systematic studies have linked greater fear, lower psychological readiness, and related psychosocial factors with failure to return to previous activity levels [11-15]. In the Multicenter Orthopaedic Outcomes Network cohort of football players, the fear of reinjury was a prominent reason for not returning to play despite reconstruction [16]. Fear is also relevant because it may influence movement strategies rather than representing a purely subjective symptom. Reviews of fear after ACL reconstruction describe associations with altered behavior and function, while reinjury anxiety and coping strategies can influence return-to-sport decisions [17,18]. Overall, the fear of reinjury and kinesiophobia appear to be among the most consistently reported psychological barriers to return to sport; however, no single psychological factor explains recovery or return-to-sport outcomes in all athletes.

Concern about reinjury is not wholly irrational. Athletes who undergo ACL reconstruction remain at risk of graft rupture or contralateral ACL injury, and prospective work has explored whether fear and knee laxity may identify individuals who later sustain a second injury [19]. The clinical objective is therefore not to eliminate appropriate caution but to distinguish proportionate risk awareness from fear that unnecessarily restricts rehabilitation or sporting participation.

Mood, identity, and perceived control also affect recovery. Depressive symptoms have been documented after ACL injury and may be associated with poorer functional outcomes [20]. Qualitative research in high-level athletes has described postinjury trauma-related symptoms and reduced self-efficacy, emphasizing

that the loss of normal training and competition can alter an athlete's sense of self and future expectations [21]. Athletic identity may change protectively after reconstruction, and broader systematic-review evidence associates motivation, confidence, optimism, self-efficacy, and social support with recovery and return to sport [22,23]. These factors are interrelated: Fear may reduce participation, reduced participation may undermine confidence and identity, and external pressure from coaches, family, or teammates may further complicate decision-making.

Assessing psychological readiness

Psychological assessment is most useful when it complements rather than replaces physical evaluation. Systematic-review evidence has identified preoperative and postoperative psychological variables that predict patient-reported outcomes and return to sport after ACL reconstruction [24]. Repeated assessment can therefore help clinicians identify athletes whose physical recovery and psychological readiness are progressing at different rates.

The ACL-Return to Sport after Injury (ACL-RSI) scale was developed specifically to measure emotions, confidence in performance, and risk appraisal related to returning to sport [25]. It has subsequently been translated and validated in several populations [26-28]. A shortened six-item version retains useful measurement properties and may be easier to incorporate into routine clinical practice [29]. The clinical value of the ACL-RSI lies less in a single universal threshold than in identifying low readiness and monitoring change over time in the context of the athlete's sport, rehabilitation stage, and physical testing.

The ACL-RSI and Knee Self-Efficacy Scale assess psychological constructs relevant to sporting or knee-related confidence, whereas the Knee Injury and Osteoarthritis Outcome Score (KOOS) and International Knee Documentation Committee Subjective Knee Form (IKDC) primarily assess symptoms and knee function and should be regarded as complementary rather than psychological screening instruments. These patient-reported measures are not diagnostic tests; reported sensitivity and specificity depend on the threshold selected, timing of assessment, study population, and definition of return to sport. Consequently, a universal diagnostic cutoff or accuracy estimate should not be assumed.

Other instruments provide complementary information. The Knee Injury and Osteoarthritis Outcome Score (KOOS) measures pain, symptoms, activities of daily living, sport and recreation, and knee-related quality of life and has been validated in competitive athletes after ACL reconstruction [30,31]. Supervised physiotherapy has been associated with better return to physical activity and patient-reported outcomes, illustrating the value of following both function and activity during recovery [32]. The International Knee Documentation Committee Subjective Knee Form (IKDC) is another validated measure of symptoms, function, and sports activity; low self-reported function can identify athletes who fail return-to-activity criteria even when other recovery measures appear favorable [33,34].

Assessment remains relevant after revision surgery, where return-to-sport outcomes can be poorer [35]. Self-efficacy can be measured more directly using the Knee Self-Efficacy Scale, which was designed for ACL-injured patients and has been associated with later participation in knee-strenuous sport [36,37]. In the prospective FAST cohort, ACL-RSI scores changed during recovery and were associated with return to sport, supporting longitudinal rather than one-time assessment of psychological readiness [38].

Psychological treatments and rehabilitation strategies

Psychological care should be embedded within rehabilitation rather than offered only after a failed return to sport. Clinicians do not need to provide formal psychotherapy themselves, but they should be able to recognize disproportionate fear, persistent catastrophizing, low confidence, mood disturbance, or unrealistic expectations and refer appropriately. Exposure to sport-injury psychology education has been associated with more favorable attitudes and behaviors among rehabilitation professionals, supporting basic psychological literacy within the multidisciplinary team [39]. No standardized frequency, intensity, time, and type (FITT) protocol was identified among the psychological interventions included in this review, and treatment delivery varied according to the intervention, rehabilitation stage, and individual clinical requirements.

A practical first step is to provide realistic education about the expected course of recovery and to develop graded, observable goals. Reinjury anxiety can fluctuate as the athlete progresses from controlled rehabilitation to sport-specific tasks, making the repeated discussion of feared activities clinically useful [40]. Goal-setting interventions can improve focus and provide measurable markers of progress when targets are realistic and jointly agreed between the athlete and rehabilitation team [41]. Reviews of psychological rehabilitation similarly emphasize combining goal setting with coping strategies and individualized progression rather than treating psychological recovery as a single late-stage decision [42].

Imagery and cognitive strategies may be particularly relevant during the transition back to demanding sport-specific movements. Resilience-related factors have been described during the rehabilitation of female football players after first-time ACL injury [43]. Sport-specific imagery has been associated with anxiety during injury rehabilitation and can be structured around the successful execution of movements, coping

with discomfort, and maintaining relaxation [44]. Evidence from athletic populations outside ACL rehabilitation has also suggested that cognitive-behavioral stress-management strategies may influence injury-related behavior and psychological well-being [45]. This represents indirect rather than ACL-specific evidence and should therefore be interpreted as supportive context rather than proof of treatment effectiveness after ACL reconstruction. Pain education is also important because expected rehabilitation discomfort may otherwise be interpreted as evidence of structural damage and reinforce avoidance [46].

Communication can strengthen these interventions. Professional athletes and physiotherapists have identified psychological skills and clear communication as relevant components of rehabilitation [47]. Broader sports-rehabilitation literature has described the use of relaxation and guided imagery, alongside physical treatment, when anxiety is prominent [48], while clinical reviews support a biopsychosocial approach that includes the athlete, rehabilitation professionals, coaches, family, and, when indicated, sports psychology or mental health specialists [49]. The purpose of this team approach is not to pressure an athlete to return sooner but to create consistent expectations and allow physical and psychological readiness to progress together.

Contemporary evidence and clinical integration

Contemporary evidence increasingly supports treating psychological readiness as a parallel domain of recovery rather than as a secondary consideration after physical rehabilitation. Nedder et al. synthesized 38 studies and confirmed that the fear of reinjury and kinesiophobia are common after ACL reconstruction and are associated with return-to-sport outcomes, self-reported knee function, biomechanics, and, in some studies, subsequent injury risk [50]. A systematic review and meta-analysis of 3,744 patients by Xiao et al. similarly found that athletes who returned to sport had substantially higher ACL-RSI scores, greater knee self-efficacy, and lower kinesiophobia than non-returners, despite clinically similar IKDC scores [51]. Psychological readiness also evolves nonlinearly: a 2024 systematic review of 83 studies found that ACL-RSI scores improve during the first three to six months after reconstruction but may then change little until later follow-up, although the certainty of evidence was limited and heterogeneity was high [52]. Together, these findings support serial psychological assessment rather than relying on a single late-stage return-to-sport measurement.

More recent intervention evidence strengthens the rationale for addressing psychological barriers during rehabilitation, although effects vary according to the outcome assessed. A 2026 systematic review and meta-analysis of 11 randomized trials involving 440 participants reported improvements in pain (six trials; standardized mean difference {SMD}, -0.96; 95% CI, -1.40 to -0.52; I^2=47%), kinesiophobia (five trials; SMD, -0.48; 95% CI, -0.74 to -0.22; I^2=0%), knee self-efficacy (three trials; SMD, 0.53; 95% CI, 0.19-0.86; I^2=0%), and patient-reported knee function measured using the IKDC (two trials; SMD, 0.58; 95% CI, 0.26-0.90; I^2=0%) compared with usual care [53]. No statistically significant pooled difference was demonstrated for ACL-RSI, objective knee strength, or several other outcomes, with substantial heterogeneity reported for ACL-RSI. These findings provide preliminary evidence of benefit in selected patient-reported domains but do not establish improved rates of sustained return to sport.

One of the randomized trials incorporated within this evidence base was reported by Sun et al. [54]. Seventy-two participants were randomized to cognitive-behavioral physical therapy or standard rehabilitation, with 61 included in the final analysis and assessments performed through 24 postoperative weeks. The intervention group demonstrated higher ACL-RSI, future knee self-efficacy, resilience, and selected Lysholm scores, whereas no statistically significant between-group difference was demonstrated for kinesiophobia. These findings concern short-term psychological and functional outcomes rather than confirmed return-to-sport rates; moreover, because this trial contributed to the subsequently published meta-analysis, it should not be regarded as independent confirmation of the pooled findings [53].

Clinical integration should therefore be multidimensional and longitudinal. In a 2025 network meta-analysis of 12 studies including 1,889 participants, the ACL-RSI showed the largest standardized difference between athletes who returned and did not return to sport among the psychological, subjective, and functional measures compared, but the authors emphasized combining psychological and physical assessment rather than using either domain in isolation [55]. Prospective cohort evidence is consistent with this approach: In 203 athletes followed for two years after ACL reconstruction, rehabilitation volume, psychological readiness, and functional hop/jump performance were among the most important modifiable factors associated with successful return to the preinjury level, and psychological readiness remained predictive at multiple rehabilitation time points [56].

A pragmatic approach is therefore to assess psychological readiness early and repeatedly and interpret it, alongside symptoms, strength, hop testing, movement quality, sport-specific demands, and clinical examination. Persistent pain, swelling, instability, weakness, the loss of motion, or deterioration in function should prompt appropriate reassessment for physical or structural causes before symptoms are attributed primarily to psychological barriers. Where physical recovery is satisfactory but psychological barriers remain prominent, clinicians may consider strategies such as graded exposure or imagery for fear-related presentations, mastery-based goals and feedback where confidence is low, and cognitive-behavioral or pain-education approaches where catastrophizing is prominent. These suggestions represent pragmatic clinical

considerations rather than a prospectively validated symptom-to-treatment algorithm. Clinically significant or persistent mood symptoms should prompt assessment by an appropriately trained professional.

Limitations of the current evidence

This is a narrative review and does not use a prospectively registered systematic-search methodology; consequently, it should not be interpreted as an exhaustive evidence synthesis. The literature is also heterogeneous in athlete level, age, sex, graft type, rehabilitation protocol, the timing of assessment, the definition of return to sport, and psychological instruments. Many studies are observational, making the direction of causation difficult to establish. Poor psychological readiness may limit physical recovery, but slower physical recovery may also worsen confidence and fear. Graft type was not consistently evaluated in relation to psychological outcomes across the studies included in this narrative review, and no graft-specific analysis was performed.

The evidence supporting psychological assessment is more extensive than the evidence defining the optimal psychological treatment after ACL reconstruction. Recent meta-analytic evidence now includes randomized trials, but total sample sizes remain modest, and interventions, timing, comparators, and outcome measures remain heterogeneous [53]. Some interventions also combine psychological and physical components, making the independent contribution of each element difficult to isolate. Future research should use standardized return-to-sport definitions, prespecified psychological outcomes, repeated measurements across rehabilitation, and adequately powered comparative trials of targeted interventions.

Conclusions

Recovery after ACL rupture is not exclusively a biomechanical process. The fear of reinjury, kinesiophobia, self-efficacy, expectations, mood, identity, and social context can influence whether an athlete progresses through rehabilitation and ultimately returns to sport. Psychological readiness may remain impaired even when conventional physical criteria have been met, making it an important parallel domain of recovery.

Psychological screening should therefore be incorporated longitudinally into ACL rehabilitation and linked to individualized treatment. Education, realistic goal setting, imagery, cognitive-behavioral strategies, pain education, and effective multidisciplinary communication are reasonable components of this approach, while referral for specialist psychological care should be considered when symptoms are persistent or clinically significant. Current evidence supports the integration of psychological care, but stronger comparative trials are still required to define the most effective intervention, timing, and patient-selection strategies.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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