

The Influence of Psychosocial Factors on Patients Undergoing Anterior Cruciate Ligament Reconstruction

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Context: Anterior cruciate ligament (ACL) injuries greatly impact patients in terms of future performance, reduced physical activity and athletic participation, and overall economic burden. Decades of research have investigated how to improve ACL reconstruction (ACLR) outcomes. Recently, there has been growing interest to understand the effects of psychosocial factors on patient outcomes.

Study Design: Clinical review.

Evidence Acquisition: A search of the PubMed database was performed in March 2023. Articles were reviewed by at least 2 authors to determine relevance. We highlighted publications of the past 5 years while incorporating previous pertinent studies.

Level of Evidence: Level 5.

Results: There is no standardization of psychosocial factors regarding ACLR. As such, there is a lack of consensus regarding which psychosocial measures to use and when. There is a need for clarification of the complex relationship between psychosocial factors and physical function. Despite this, psychosocial factors have the potential to help predict patients who are more likely to return to sport: (1) desire/motivation to return; (2) lower levels of kinesiophobia; (3) higher levels of self-efficacy, confidence, and subjective knee function; (4) risk acceptance; and (5) social support. However, there are no standardized interventions to improve psychosocial factors after ACLR.

Conclusion: Psychosocial factors affect outcomes after ACLR. However, the interplay between psychosocial factors and physical function is complex. There is emerging evidence that testing and interventions may improve ACLR outcomes. There is a lack of standardized interventions to determine or improve psychosocial factors after ACLR. Further research is needed to identify psychosocial factors and to develop standardized interventions for clinicians to implement to improve clinical outcomes.

Keywords: anterior cruciate ligament reconstruction; kinesiophobia; psychosocial; return to sport

Despite a great deal of research regarding anterior cruciate ligament (ACL) injuries, the rate of return to sport (RTS) at the same level remains low, at approximately 61%.⁶⁰ Furthermore, there is a high rate of ACL re-rupture, ranging from 6.3% to 18%, as well as increased risk for secondary ACL injuries including contralateral ACL rupture, which occurs in 9.4% to 30% of patients.⁵⁹ There remains a lack

of standardization surrounding the recovery process after ACL reconstruction (ACLR).^{7,72} Both subjective and objective outcomes have been investigated after ACLR, including musculoskeletal, biomechanical, radiographic, functional, and patient-reported outcomes.⁵⁶ Many of these studies, including that of Webster and Feller,⁷¹ aim to identify variables that impact outcomes with the hope of addressing modifiable factors to

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The following authors declared potential conflicts of interest: A.M.M. has received consulting fees from Arthrex and Miach Ortho. A.L.K. has received speaking fees from Smith & Nephew and Zimmer Biomet.

DOI: 10.1177/19417381231223560

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improve results and decrease reinjury.⁷¹ Recently, there has been growing interest in studying the effect of psychosocial factors on patient outcomes after ACLR.

Patient-reported outcomes and RTS rates are suboptimal despite comparable objective outcomes.⁷⁴ Confronting this issue and improving ACLR outcomes requires addressing psychosocial factors. Psychosocial factors are the interplay of the components of one's social, emotional, and physical entities.¹¹ Identifying these psychosocial factors and their role during ACLR recovery has gained headway; however, there is a paucity of studies identifying the psychosocial constituents of ACLR recovery. Furthermore, there is variability among clinicians in measuring and addressing such factors.^{7,18,35} Whereas the use of these psychological readiness scales may be beneficial in directing the recovery process, identifying and addressing the underlying factors may lead to more personalized recommendations and improved outcomes. The current review article aims to evaluate the impact of psychosocial factors on patients undergoing ACLR.

METHODS

Articles that discussed psychosocial factors in relation to ACL injuries were collected from peer-reviewed sources on PubMed. The search was performed in March 2023. Four search strategies were utilized: (1) ("anterior cruciate ligament" [MeSH]) AND ("return-to-sport" [MeSH] OR return-to-activity) AND (psycholog* OR psychosoc* OR biopsychosocial* OR ("fear" [MeSH]) OR ("kinesiophobia" [MeSH]) OR ("self-efficacy" [MeSH])), (2) ([anterior cruciate ligament OR ACL] AND reconstruction) AND (psycho* OR psychosocial) AND psychological readiness AND (fear OR confidence OR kinesiophobia OR self efficacy OR anxiety OR depression), (3) ([anterior cruciate ligament OR ACL] AND reconstruction) AND biopsychosocial AND qualitative, and (4) ([anterior cruciate ligament OR ACL] AND reconstruction) AND (biopsychosocial OR psychosocial OR social OR psycholog*) AND qualitative. Exclusion criteria included duplicates and irrelevance. Articles were reviewed by at least 2 authors to determine relevance. We highlighted publications of the past 5 years while incorporating previous pertinent studies.

DISCUSSION

Measuring Psychosocial Factors

Psychological and social factors affecting ACL injury and recovery have garnered increased interest recently. Many speculate that these factors affect performance outcomes, but it is difficult to quantify the extent of this significance to an individual patient's experience. A majority of providers interviewed by Betsch et al⁷ in a qualitative study reported to not evaluate psychosocial status during the recovery process. Glatke et al¹⁸ published a survey study in which only 23.3% of surgeons reported utilizing a psychological measurement when evaluating for RTS after ACLR. There is no standardized protocol for RTS, allowing providers to choose when, whether, and how patients are evaluated.^{7,35,72}

There are a multitude of ways to evaluate patient psychological readiness (Appendix Table A1, available in the online version of this article) including the ACL-Return to Sport Injury (ACL-RSI) scale,⁶⁹ Tampa Scale of Kinesiophobia (TSK/TSK-11),^{41,73} the Knee Self-Efficacy Scale (K-SES),¹³ the Fear Avoidance Belief Questionnaire with physical activity or sport (FABQ-PA; FABQ-S),⁶⁷ the Injury-Psychological Readiness to Return to Sport (I-PRSS) scale,¹⁹ the International Knee Documentation Committee Subjective Knee Form (IKDC-SKF),^{21,22} the Knee Injury and Osteoarthritis Outcome Score (KOOS) with Quality of Life subset (KOOS-QOL),⁵⁷ and the Anterior Cruciate Ligament Quality of Life (ACL-QoL) Score.^{26,34,42} While ACL-RSI is a commonly utilized tool for evaluating psychosocial factors after an ACL injury, it lacks an all-encompassing solution to identifying and addressing underlying factors as discussed by Webster and Feller.⁷¹ The lack of consistency in evaluation selection delays and sometimes omits recognition of patients' needs for psychosocial support. Betsch et al⁷ reported that sports psychologists are inconsistently consulted. Instead, providers rely strongly on functional and patient reports to determine RTS.²⁰ Neither of these fully account for psychosocial data, especially in patients who have little experience with psychosocial techniques (ie, mindfulness, meditation, self-awareness practices).

More recently, TSK-11 or ACL-RSI surveys have been increasingly utilized for evaluation.^{27,77} These have shown promising improvements for psychosocial assessments, yet many argue that there are additional and underlying psychosocial factors at play, which we discuss further in the "Impact of Injury Experience" subsection.^{33,71} Newer studies have observed which psychological interventions have helped patients with RTS due to their ability to identify and address these underlying factors.^{33,51} Chmielewski and George⁹ concluded that psychosocial correlates that predict outcomes - such as the subfactors as well as larger themes of kinesiophobia, self-efficacy, and pain catastrophizing - can be detected as early as 4 weeks after ACLR. Erickson et al¹² observed correlates of psychosocial measures at 3 months post-ACLR to predict 6-month outcomes. Both suggested that earlier detection creates opportunities to intervene and improve outcomes. Further investigation is needed to identify the optimal timeframe for psychosocial testing, but current consensus supports earlier testing.¹² Earlier detection may help clinicians implement interventions; however, evidence-based research is still needed to determine standardized interventions. Ultimately, the inconsistencies and failure to evaluate the psychosocial profile of patients may impact outcomes negatively after ACLR.

Relationship Between Psychosocial Measures and Physical Function

As discussed previously, most clinicians focus on physical function measures when assessing the ACLR recovery process. There is significant discrepancy across the literature regarding whether and how psychosocial measures correlate with physical function (Table 1). In patients who RTS, psychological readiness has been correlated positively with individual test performances

Table 1. Psychosocial measurements and physical function correlates

Paper	Author (Year)	Conclusions
Psychosocial factors 3 months after anterior cruciate ligament reconstruction predict 6-month subjective and objective knee outcomes	Erickson et al ¹² (2022)	<ul style="list-style-type: none"> – Psychological readiness is a predictor of quad strength symmetry – Psychological readiness and knee self-efficacy are positively correlated to quad strength and all patient-reported functional outcomes – Knee flexion excursion at 3 months after ACLR does not correlate with ACL-RSI
Psychological patient-reported outcomes cannot predict a second anterior cruciate ligament injury in patients who return to sports after an anterior cruciate ligament reconstruction	Piussi et al ⁵⁴ (2022)	<ul style="list-style-type: none"> – ACL-RSI cannot predict secondary ACL injury
Isometric knee strength is greater in individuals who score higher on psychological readiness to return to sport after primary anterior cruciate ligament reconstruction	Sugarman et al ⁶² (2022)	<ul style="list-style-type: none"> – Higher ACL-RSI is associated with greater isometric knee flexion – ACL-RSI does not correlate with static or dynamic postural stability – ACL-RSI does not correlate with hop distance
The role of psychological readiness in return to sport assessment after anterior cruciate ligament reconstruction	Faleide et al ¹⁴ (2021)	<ul style="list-style-type: none"> – ACL-RSI is a predictor of RTS at 2 years, while functional tests were not predictive of RTS
Knee strength, hop performance and self-efficacy at 4 months are associated with symmetrical knee muscle function in young athletes 1 year after an anterior cruciate ligament reconstruction	Beischer et al ⁵ (2019)	<ul style="list-style-type: none"> – Knee self-efficacy associated with symmetric knee muscle function
Fear avoidance and self-efficacy at 4 weeks after ACL reconstruction are associated with early impairment resolution and readiness for advanced rehabilitation	Chmielewski et al ⁹ (2019)	<ul style="list-style-type: none"> – Higher kinesiophobia is associated with inability to reach advanced rehabilitation
The association of psychological readiness to return to sport after anterior cruciate ligament reconstruction and hip and knee landing kinematics	Nagelli et al ⁴⁵ (2019)	<ul style="list-style-type: none"> – Psychological readiness is positively associated with front plane knee range of motion during single-leg landing biomechanics – Psychological preparedness does not correlate with sagittal plane range of motion of hip and knee
Clinical outcome measures and return-to-sport timing in adolescent athletes after anterior cruciate ligament reconstruction	Burland et al ⁸ (2018)	<ul style="list-style-type: none"> – Greater readiness to return correlated with greater isometric extension strength
Quadriceps function, knee pain, and self-reported outcomes in patients with anterior cruciate ligament reconstruction	Lepley et al ²⁸ (2018)	<ul style="list-style-type: none"> – Greater readiness to return is correlated with greater increases in quad strength
Psychological and functional readiness for sport following advanced group training in patients with anterior cruciate ligament reconstruction	Meierbachtol et al ⁴⁰ (2018)	<ul style="list-style-type: none"> – ACL-RSI and single and triple limb symmetry hop scores are not significantly correlated

(continued)

Table 1. (continued)

Paper	Author (Year)	Conclusions
Self-reported fear predicts functional performance and second ACL injury after ACL reconstruction and return to sport: a pilot study	Paterno et al ⁴⁹ (2018)	– Increased self-reported fear was associated with lower single-leg hop performance and greater quadriceps strength asymmetry
Predictive parameters for return to pre-injury level of sport 6 months following anterior cruciate ligament reconstruction surgery	Müller et al ⁴⁴ (2015)	– Positive correlation between ACL-RSI and triple hop test for distance – ACL-RSI and TSK-11 were not correlated with muscle strength
Self-efficacy of knee function as a pre-operative predictor of outcome 1 year after anterior cruciate ligament reconstruction	Thomeé et al ⁶⁵ (2008)	– K-SES is predictive of 1-leg hop for distance – Self-efficacy predicts muscle function 1 year after ACLR

ACL, anterior cruciate ligament; ACLR, ACL reconstruction; ACL-RSI, ACL-Return to Sport Injury; K-SES, Knee Self-Efficacy Scale; TSK-11, Tampa Scale of Kinesiophobia-11; RTS, return to sport.

across multiple studies; these tests include quadriceps strength, hamstring strength, symmetrical muscle function, and frontal plane knee and hip range of motion during single-leg biomechanics.^{5,12,17,45,61,63} Similarly, Sugarman et al⁶² evaluated functional performance and psychological readiness in patients who had undergone ACLR utilizing the ACL-RSI. Those scoring higher on ACL-RSI performed significantly better on isometric knee flexion. Peebles et al⁵⁰ found a positive correlation between psychological readiness and symmetric landing kinetics. Another study found a positive correlation between reduced kinesiophobia, the fear of movement due to previous experiences, and greater single-leg hop for distance performance.⁴

However, Meierbachtol et al³⁹ concluded improving psychological readiness and hop test performance does not show significant improvement of fear.

Piussi et al⁵⁴ also raised concerns about the use of psychological patient-reported outcomes based on the lack of meaningful cutoff scores. Utilizing demographics, quadriceps isokinetic strength, ACL-RSI scores, KOOS scores, Function in Sport and Recreation subscales, and K-SES, it was determined that there is no suitable cut off within these scores to accurately predict patients at risk for rerupture. The discrepancies between studies indicates that psychosocial factors alone are unable to guide the ACLR recovery process, but rather should be utilized in conjunction with other variables.

It is difficult to determine whether the improved psychological readiness profile is a product of improved performance and strength or whether the improved performance and strength is a product of higher psychological readiness. Due to the administration of psychological readiness scales being administered exclusively toward the middle and end of recovery (between 3 and 12 months after ACLR), it is difficult to discern the interplay between these variables. Further investigation

should be conducted measuring psychological factors preoperatively and earlier in recovery.

Psychological readiness has also been studied in relation to ACL graft rupture rate. Those with less progression in psychological readiness than their counterparts have increased risk for a secondary ACL injury compared with those with greater improvement of psychological readiness.³⁸ Conversely, Piussi et al⁵¹ evaluated this relationship in a matched cohort study design. A group of 36 patients who sustained a re-tear were matched to a group of 108 patients who did not sustain a re-tear. Those patients who had greater psychological readiness and knee related self-efficacy had greater ACL graft rupture rates within 2 years of ACLR, yet there were no differences in muscle function recovery^{51,70} However, the improved psychosocial profile for these patients may have led to earlier RTS and more frequent sporting activity, thus increasing the chance that the patient may suffer an ACL re-tear. The study was unable to control for such confounding factors. In another study by Zarzycki et al,⁷⁶ a secondary analysis of a randomized trial further evaluated psychological readiness and second ACL injury. Patients who sustained a second ACL tear reported a more positive psychological outlook, improved risk appraisal, and met RTS criteria sooner. In light of these findings, clinicians may need to emphasize a time component to address biologic healing of the graft among other factors when patients exhibit high psychological readiness and pass RTS criteria.

Patients' physical activity levels diminish over time beyond 2 years from injury despite higher psychological readiness promoting RTS.^{6,15} Of those who return to pre-injury sport level, only 68% remain active at this level 3 to 5 years after ACLR.⁶ While this could be explained by aging or shifting priorities, a study using a healthy matched control would help determine whether age phenomenon, other factors, or psychosocial factors are influencing the drop in physical activity. Kinesiophobia and

fear of reinjury has been shown to persist long after physical recovery and clearance from rehabilitation,³³ which can affect patients' physical activity participation even after returning to sport. Fear of pain and reinjury has persisted for as long as 20 years in some patients,¹⁵ supporting the view that psychosocial implications after ACLR do not dissipate with RTS. Furthermore, despite evidence of high rates of osteoarthritis after ACLR, the psychosocial impacts on the progression of health-related quality of life and osteoarthritis is under evaluation.^{64,72} It appears mental recovery takes several years, possibly decades, and further investigation is needed to fully understand the directionality of these relationships and long-term associations.

Impact of Injury Experience

Injuries are often described negatively, presenting a source of adversity that not every patient is able to overcome. Identifying patterns of shared experience will help predict recovery progression and guide future interventions. The original ACL-RSI framework was developed on the basis of the following emotional categories: fear of reinjury, frustration, nervousness, and tension.⁶⁹ More recent interviews have explored the effects behind these emotions and expanded on relationships of these themes. Burland et al⁸ interviewed participants (n = 12) and found 6 predominant themes: self-limitation due to hesitancy and low confidence, increased awareness, complex RTS decisions, acceptance and reprioritization, athletic identity, and a need for support systems. The same emotions underlying the ACL-RSI development were described throughout the interview process, contributing to each of the 6 themes. This pattern of emotions underlying reported themes are seen across several qualitative interviews and quantitative investigations. Fortunately, early mood disturbances do not correlate with 6 month recovery progression.⁴³ However, repeated emotions experienced throughout the entire recovery progression, such as in response to patient's performance (ie, personal records, relapse, plateaus), may positively or negatively impact the patient's appraisal of the situation. If this leads to changes in confidence, self-efficacy, goals, kinesiophobia, or mental status, it is likely to affect recovery progression.^{5,23,68,74} Numerous studies agree psychosocial factors such as emotion often intertwine with decision-making and influence future outcomes.

Psychosocial experiences are a product of the injury itself, the physical health progression, and the likely interplay between both. The initial injury invites senses of loss, fear, and challenges to identity. Patients report losing control, independence, daily routines, and trust in their own abilities.^{33,53} This creates fear of the patient's current situation and contributes to kinesiophobia - a problem that may exist throughout recovery and beyond.^{15,33} As the injury persists, emotional responses vary individually. Patients' descriptions of feelings include: burden, worry, frustration, hopelessness, devastation, and isolation.^{23,30,36,52,68} Mental health conditions, such as anxiety and depression, may increase in severity in response to injury and be detrimental to outcomes.⁴⁶ Schaffer et al⁵⁸ observed outcomes of patients stratified into 3 cohorts:

clinical diagnosis of depression, situational depression, and no depression. Clinically depressed patients undergoing ACLR reported a slower rate of progression and were more likely to have lower functional scores and forgo RTS. Another psychosocial experience that may contribute to poor outcomes and decreased functionality is kinesiophobia, which may result from the initial injury or pain that is experienced throughout the entirety of injury to recovery.¹⁶ These factors evolve throughout the injury experience.

After medical intervention, interactions throughout the rehabilitation and recovery phases with providers warrant attention. The interactions with the healthcare team can have a psychosocial impact on patients. Frustration and confusion arises from conflicting instructions and expectations between physicians, athletic trainers, physical therapists (PTs), and coaches; instructions undermining another erodes trust in providers and patient abilities.²⁵ This, and assumptions on both the provider and patient side, cause patients to create false expectations that undermine the recovery process (eg, duration, difficulty) and overestimate outcomes (eg, playing goals, physical ability).^{25,68} Patients are further dissatisfied when shown a lack of attention and/or generalized treatment.³⁶ Patients and their families report educational resources and consistent communication would better the experience, allowing collaborative decision-making and supportive care.^{25,33,53,68} The support system need not come only from rehabilitation care providers; larger support networks (eg, friends, family, teammates, care providers, coaches, fans, online support groups) promote positive recovery experiences.^{33,52} For example, fellow injured patients may serve as role models, evoking accountability, motivation, and connectedness during rehabilitation.^{55,66} However, on-field and competitive rehabilitation activities should be practiced with caution; some patients find the experience demotivating when unable to contribute or keep up.^{52,55} Interactions with coaches also contribute heavily. The authority and confidence they hold gives them the opportunity to encourage and motivate athletes, especially when they are involved in recovery and RTS decisions.^{7,33}

Patients may have different injury experiences based on patient gender or age. Lisee et al²⁹ goes into further detail of sex-specific perceptions of the injury experience: male patients reported that mood was influenced by physical and social limitations despite an internal locus of control compared with female patients, who were found to show more awareness of emotions that were influenced by rehabilitation fluctuations. Regarding age, younger (<21 years) patients show significantly lower psychological readiness when compared with noninjured counterparts, but no difference is seen when comparing older patients.³⁷ Vutescu et al⁶⁶ explains this difference as a result of differences in motivation: participants between 30 and 40 years of age had higher rates of completion of home rehabilitation exercise regimens for ACLR due to their reliance on self-motivation and social support, compared with younger patients who rely on their identification as an athlete.

Ultimately, the injury experience may lead to an altered sense of self before resolution. Patients develop confidence,

self-efficacy, and trust throughout the process.^{33,52} Successful recoveries often have stronger social networks and psychosocial resources.³³ Some embrace an athletic identity as motivation to endure, whereas others favor nonathletic identities as they reprioritize their lives.⁵² Career setbacks, commitments, and time constraints alter behavior, affecting initial recovery and future risk appraisal. Further, diminished mobility often affects social interactions, shifting perception and expectations among friends and strangers.^{23,30} Patients may reevaluate their lives, choosing family, work, and education commitments as greater priorities.^{23,33}

Psychosocial Influences on RTS

It is understood that the criteria for RTS is inconsistent.^{7,35,72} Providers aim to assess a player's willingness, risk of injury, and probability of success before RTS clearance. At present, physical function tests dominate the RTS decision.^{7,35} Evaluations consist of objective, physical measures, and, recently, some psychological measures. Studies show patients with greater psychological readiness are more likely to RTS.⁷⁴ However, there is a complex - often variable - relationship between psychological readiness and physical function as discussed above.

Several factors other than physical function influence RTS. First, kinesiophobia has been found to be the leading reason for non-RTS (NRTS), accounting for as much as 50%.^{47,72} Furthermore, greater kinesiophobia at 4 weeks correlates to diminished achievement of advanced rehabilitation criteria at 12 weeks.⁹ This likely amplifies any negative psychosocial status since these patients would lack rehabilitation success that would normally evoke confidence and perceived progress. This relationship is supported by Chmielewski and George,⁹ who found that negative psychosocial factors (eg, low self-efficacy and high kinesiophobia) tend to correlate negatively with early rehabilitation outcomes. Some of these same factors can also serve as deterrents for patients to RTS. Paterno et al⁴⁹ reported patients that RTS with a TSK-11 of 19 or higher, indicating increased levels of kinesiophobia, were 13 times more likely to sustain an ipsilateral ACL tear within 2 years. These findings may explain how kinesiophobia creates preference to forgo RTS. However, there are still roughly 70% of ACLR cases that RTS.⁷² Despite no significant difference in IKDC, limb symmetry index, or knee laxity, patients who RTS had statistically significant higher psychological readiness, higher self-efficacy, and lower kinesiophobia.⁷⁴

Second, the presence and strength of motivation has been noted as a major driver in RTS decision-making.^{25,33,48,66,68} Motivational sources include, but are not limited to, commitment to the activity, personal goals, passion, strong athletic identity, and team interactions.^{33,48,66} Competitive athletes are theorized to possess greater investment and therefore greater motivation compared with recreational athletes.⁶⁶ Increases in motivation correlate with increased rate of return, possibly due to higher rehabilitation compliance.^{33,66} Strong athletic identities, where self-image and competitive

drives are foundational, keep the patient focused. Unfortunately, motivation and its sources may erode during the recovery process due to reasons described previously (eg, setbacks, reprioritizations, and lack of support).^{23,52,68}

Third, every patient and healthcare team must consider the risks: re-tear, contralateral injury, poor outcomes, and more. Patient's risk assessment is conditional on their awareness. Whether patients RTS or not, they experience increased bodily awareness surrounding the injury site; this can affect bracing choices and functional confidence during recovery and return.^{23,33} Situational awareness appraises the risk of each activity, determining whether a patient participates or avoids it. For example, a patient may be conscious of how they land, knowing that improper technique could be harmful.³³ Informational awareness, influenced largely by patient education, often dictates expectations and goals.³³ Ultimately, how aware a patient is of their circumstances and corresponding risks influences their decision-making. Risk acceptance is crucial to RTS; the lack thereof is a strong indicator of NRTS.^{33,52}

Last, external factors greatly affect the RTS decision. Joint decision-making between patient and provider is ideal; however, sometimes expectations are mismatched.^{52,68} Even more challenging is when decision-making is expanded to friends, family, and coaches.^{7,52} Betsch et al⁷ further recognize that financial status, stage of career, timing, and performance standings greatly affect the RTS decision. This may lead to situations for a patient to return when they are not ready, physically or psychosocially.

Collectively, it would seem an athlete would choose to RTS if all the following criteria are met: they (1) wish to return; (2) have reached lower levels of kinesiophobia; (3) have developed higher levels of self-efficacy, confidence, and subjective knee function; (4) have accepted the risks of RTS, and (5) have social support conducive to RTS.

Proposed Interventions

With the growing interest in evaluating psychosocial factors affecting ACLR outcomes, there has been an initiative to address some of the underlying factors. Current guidelines after ACLR that address psychosocial factors are limited and underutilized.

Most of the research regarding interventions to address psychosocial factors is in the early phases of feasibility testing and data collection. Almuhaya et al¹ have published a feasibility study outlining the need for a randomized control trial to assess structured educational sessions built into ACLR recovery plans. This study showed the ability of these sessions, both as in person or recorded, to decrease the fear of reinjury in soccer athletes.¹ Another approach is in the form of eHealth, Back in the Game (BANG) - a recently developed internet delivered application designed to assist in the psychological recovery phase of ACLR.^{2,3} This application showed a favorable response in feasibility trials and is undergoing a randomized control trial to observe its effects on ACLR recovery. However, BANG has been designed with an athlete in mind and, while still

undergoing population-based studies, there is a need for resources that are applicable to the general population.

Although studied in a smaller cohort ($n = 7$), group exercise amongst patients undergoing ACLR demonstrated the ability to improve psychosocial outlook surrounding recovery.⁵⁵ This qualitative study identified the improvement of the following psychosocial factors: motivation to exercise, mental wellness and health, obligation to exercise, social interaction, reassurance, confidence, group cohesion, and fear of reinjury.⁵⁵ Other studies that have attempted to address psychosocial factors include intervention models that observed effects of guided imagery,³¹ vision of contemporary art videos via The Videoinsight method,⁷⁵ and modeling videos.³² Maddison et al³¹ reported an improvement of knee laxity as an indication for healing and decrease in neurobiologic stress levels (noradrenaline and dopamine) for participants randomized to standard rehabilitation with guided imagery compared with participants in the standardized rehabilitation-only cohort. However, the guided imagery intervention did not improve their primary outcome measure, knee strength. This is in contrast to a previous randomized control study that found patients undergoing guided imagery significantly improved strength after ACLR compared with a placebo group.¹⁰ There is a clear need for randomized control trials to continue to address psychosocial interventions that can benefit patients after ACLR.

PTs have been identified as a consistent factor in ACLR recovery as they work closely with patients throughout the ACL recovery process. Per qualitative interviews, sport PTs have suggested that overcoming psychosocial barriers may be more challenging than overcoming physical barriers after ACLR for some patients.⁵³ However, there has been concern raised that PTs lack appropriate education during their training in identifying these factors.^{24,53} PTs have also reported insufficient resources to address these factors even if they are identified.⁵³ Similar to their orthopaedic surgeon colleagues, PTs rely heavily on objective physical function measures when helping patients obtain clearance. In fact, the single-hop limb test is the most frequently used tool, with 89% of PTs utilizing this test as part of their assessment.²⁰ Further, <10% of PTs use fear or confidence scales in their protocol for ACLR recovery. Kaye et al²⁴ highlight the lack of biopsychosocial training among PTs and call for improved training to implement these approaches during ACLR rehabilitation.

Thus, there is a paucity of evidence-based interventions that would positively impact the psychosocial profile of a patient. There is a need for randomized studies that evaluate the proposed interventions to determine their usefulness in improving ACLR outcomes. Such interventions can then be incorporated into existing evaluation algorithms with strength and functional testing when helping patients RTS.

LIMITATIONS

This is a review article that is limited by its use of heterogenous articles. Current literature uses varying measurements of

psychosocial factors on ACLR outcomes. This includes the multitude of tools used to determine psychosocial factors as well as diversity among outcome measurements. This study is not an all-encompassing review of literature and was limited to articles in English and published, full-text articles.


CONCLUSION

Psychosocial factors affect outcomes after ACLR. However, the interplay between psychosocial factors and physical function is complex. There is emerging evidence that testing and interventions may improve ACLR outcomes. There is a lack of standardized interventions to determine or improve psychosocial factors after ACLR. Further research is needed to identify psychosocial factors and to develop standardized interventions for clinicians to implement to improve clinical outcomes.

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