



Review Article

Psychological Factors Affecting Recovery After Rupture of the Anterior Cruciate Ligament in Sports: A Review of definitions, Impact, Risks and Treatments

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Abstract

Introduction: Sport injuries in athletes can have serious implications. When severe, they will require physical therapies and lengthy rehabilitation. Alongside these physical factors, psychological factors can affect the recovery. We aimed to identify and define these factors, assess their perceived importance and evaluate specific treatments to overcome their possible negative effects. We elected to concentrate in injuries to the Anterior Cruciate Ligament of the knee (ACL) as it is a high-profile injury in athletes that requires a prolonged recovery and has been extensively studied.

Outcomes after ACL injuries in athletes: Once considered a career-ending injury in elite athletes, current surgical and rehabilitation techniques have changed the perception. In recent times around 80% of athletes will return to pre-injury activities with similar performance after rupture of the ACL. The rehabilitation period remains long, with an average of 6 to 10 months in those who managed to perform at same level prior to their injury.

Psychological factors: Many psychological factors have been identified that can affect recovery after ACL injuries in athletes: Fear of re-injury, feeling unable to perform at same level as prior to injury, financial concerns or fear of pain to name a few. The perceived importance of these factors has been studied within trainers and therapists and assessment tools have been developed to evaluate their influence to interfere with the recovery. Specific treatments have been used both by trainers and psychologists to prevent negative effects of these factors during the recovery period: Counter conditioning, goal settings and positive thinking, mental imagery, positive self-talk and the creation of a team approach environment with open communication.

Conclusion: Psychological factors can affect recovery after ACL injury in athletes. They have been identified and defined; tools have been designed to predict their effects on the recovery; and interventions can be implemented either by therapists with the skills or by specific

professionals. These treatments are now being more regarded both by the therapists and the athletes that result in earlier and more common interventions.

Keywords: Sport Injuries; Anterior Cruciate Ligament; Rehabilitation; Athletes

Introduction

Injuries suffered during sporting activities are common. They affect individuals in different ways according to the level of activities performed. When suffered by elite athletes they can carry a high profile due to the implications in term of achievements, future careers and even financially.

With contemporary medical and rehabilitation standards of care, physical recovery from these injuries have improved

significantly, however there are psychological factors that can influence their recovery, the return of activities and even return to pre-injury performance levels. These factors have been described and in cases they have shown to be crucial to the full recovery of athletes. For these reasons, intended to define and evaluate them, including an attempt to identify tools designed to prevent and treat these psychological hurdles.

In order to be more concise, we focused on a common and dreaded injury for athletes, the rupture of the Anterior Cruciate Ligament (ACL) of the knee. This once feared career-ending injury has seen extensive improvements and refinements in physical and surgical therapies in recent decades. Nowadays, still qualified as a complex injury, return to activities and performance levels can be achieved. These outcomes have been extensively studied in the literature so current outcomes are available both for the regular and also the elite athletes understood as sport professionals. Because of the severity, complexity and fear of this particular injury and the extensive research associated to them it does make the ideal topic in which to assess what is known about psychological factors that can affect the recovery. Additionally, it is an injury with a lengthy time of recovery, between 6 to 10 months, making the sufferers more vulnerable to be affected by psychological factors in their recovery. The feelings of isolation, fears of re-injury and failure to achieve the same level of performance can augment the natural effects of the injury such as pain, lack of strength or restriction in movements.

As part of this review we will describe known outcomes following rupture of ACL in several cohorts of patients practising different sports, a description of psychological factors that can affect the recovery, the perceived importance of these factors and the tools that can be used predict and to overcome them by therapists.

Outcomes After ACL Injury in Athletes

Once considered a career-ending injury for athletes, the progress in surgical techniques and advances in physiotherapy and rehabilitation have improved outcomes after rupture of the ACL. The estimated recovery following injury ranges between 6 and 10 months and although there are still controversies between surgical and non-surgical treatments in partial tears of the ACL, when rupture occurs athletes will universally undergo surgery as part of their recovery. Due to the poor blood supply to the ACL, simple repair will have poor outcomes as the healing process is very limited, so surgical techniques have evolved to reinforce or substitute the ruptured ligament by the use of other allograft tissues. Adjunct to surgical intervention, specific rehabilitation processes are fundamental to the recovery. They include analgesia for pain, therapies to improve range of movements and strength, as well as general maintenance of required fitness over a prolonged recovery period away from the sport to facilitate the return.

Multiple studies have reported outcomes following ACL rupture both in elite athletes and in the general active population that enjoy practising sports. The former group becomes increasingly interesting due to the high profile and even media attention that these injuries can carry when professional sportsmen suffer them.

In a review of professional athletes in the major North-American professional leagues (baseball, basketball, ice hockey and American football) Mai, et al., reported that 298 of the 344 athletes returned to their sport (86.6%) although it did find differences between sports and also the performance level achieved. In the review, professional ice-hockey athletes fared better with a return to same activity of up to 96%. The worst results were reported in American football professionals, but it has to be taken into account that these professionals have normally much shorter professional careers than the other three major sports [1]. It is possible therefore that the natural competition for roster spaces and increased physical demands of American football might influence these results [2].

Traditional football or soccer is a worldwide high-profile sport where injuries to the ACL have been extensively studied at professional level over the years. Walden, et al., observed the recovery of 138 professional footballers who sustained ACL rupture finding that 134 of them returned to their previous rosters. At 3 years, 86% were still playing and 65% were doing so at similar level as before their injury [3].

These results were corroborated in an observational study of two divisions of the top 5 football leagues in Europe over 5 years. The return to professional activities was 98.2% and 59% of them did so at the same estimated level than before their injuries; with results at 5 years of 70% still performing the sports and 41% at the same level as pre-injury [4].

In a systematic review and using meta-analysis techniques, Lai, et al., reviewed publications describing outcomes of a total of 1272 of elite athletes participating in 18 professional sports who suffered rupture of ACL. The overall return to professional performance was 83% (85% in soccer, 82% in basketball and 78% in American football). Other sports including in this literature review included ice hockey, handball, baseball and rugby; all showing similar outcomes [5]. The authors acknowledged that the facilities and access to rehabilitation available to these athletes implied a better recovery than in the non-professional population with the same injuries, which is estimated at around 60% [6].

Even after a feared second injury of the ACL, athletes have returned to same level of activities including high-level ones. Grassi, et al., produced a review that included 15 published articles with a total report of 790 athletes of which 52% reported returning to the same level of activities. In the same review, four articles including 186 athletes reported that 51% returned to high-level activities [7].

Psychological Factors

Psychological Factors Affecting Recovery

Psychological factors affecting recovery of severe sports injuries including ACL rupture have been widely researched and debated by many authors and groups alike. It is now evident that during the lengthy recovery of ACL injuries, sufferers are susceptible of mental difficulties during the process. There is no model for what effects each patient is going to feel due to the individuality of people, their background and their weaknesses and strengths. Different patients will respond differently to the same stigma (in this case a ruptured ACL) due to circumstances which can lead one or more of the psychological impacts outlined below. In the context of ACL injuries, longitudinal studies have reported that the psychological responses to the injury are greater shortly after the trauma and gradually reduced as recovery takes place [8-10]. The factor that has been shown to have a greater negative impact in the recovery is the fear of re-injury or kinesiophobia. Other factors described are depression, loss of control, post-traumatic stress disorder, fear of not achieving a full recovery or isolation.

Fear of re-injury in athletes has often been confused with re-injury anxiety and the distinctive factor between the two is that fear refers to the worry or doubt that the same injury will happen again; whereas anxiety is a more negatively associated factor that relates to the patients concern about future surgeries and extended periods of time in rehabilitation for example. Several studies estimated that of the athletes that did not return to their full capacities after ACL rupture, 52% expressed fear of re-injury as a reason for their failure making it the most common concern by athletes [11-13]. The importance was also highlighted by Ardern, et al., using a metanalysis methodology in a review of patients that failed to fully recover being the most important factor affecting it.[14] These findings were even more clear at the MOON Cohort Study where 222 competitive football players were followed after ACL rupture. Over 50% of those who did not return to play described fear of re-injury as the main factor while symptoms only accounted for 15% and loss of speed or strength 12% [15].

The underlying issue with fear of re-injury is that (like many other psychological factors) it can also cause physiological damage in addition to the cognitive damage. A natural human response to injury and pain is to adjust postures or movements. 'Muscle bracing' isolates and decreases mobility in the injured area and increases the chance of re-injury or the development of other injuries delaying the recovery [16]. Re-injury anxiety have indicated a positive relation with return to sport concerns, exposing the importance of coping mechanisms that might have to be evaluated and treated [17].

One of the main reasons the fear of re-injury is so high could be due to the fact that surgery on the anterior cruciate ligament may not repair it to its full strength and patients who have suffered a ruptured ACL are more vulnerable to another ACL injury compared to those who have never experienced one. According to a pilot study published by Tagesson, et al., 4 to 8% of patients will sustain a graft rupture on the index knee within five years after an ACL reconstruction. During the same period, approximately 5-6% will sustain a contralateral ACL rupture. These facts are of course much higher than the incidence of first-time injury causing a possible fear in the injured athlete [18].

Depression can be a consequence to any stress of injury suffered and a severe injury such as ACL rupture is not exempt of it. Depression can be defined as 'feelings of severe despondency and dejection' and these feelings interrupt and slow down the recovery process. One of the principal reason's athletes become depressed is that they lose their 'athletic identity'. Elite athletes have spent most of their lives training and battling adversity to reach where they are; and when faced with a potential career-

threatening injury, it is difficult, near enough impossible to comprehend this sudden termination of lifestyle and loss of unique identity of being an athlete; that they are forced into this depressive state [19]. Due to the detrimental possible effects of depression, it has been shown beneficial to the patients to try and be as open and as honest about their mental well-being and any bouts of depression they are experiencing [20].

Another psychological factor that affects patients is locus of control. If a person has a higher locus of control, it signifies that they believe they have more control over what happens in their life. Whereas, on the contrary, a person with a low locus of control believes what happens in their life is primarily dictated by external forces. Typically speaking, religious people tend to have a lower locus of control due to the belief of a greater being or a god has an influence over their life [21]. The effect of a lower locus of control is that the athlete might lose the focus on the effect that his active physical efforts will have an effect in the outcomes leading to decreased or less effective rehabilitation. The decrease physical activity during the recovery phase has been shown to have a detrimental effect on ACL injuries [9].

Post-traumatic stress disorder regards the 'irrational fear of suffering from the same injury in an even more painful manner' and is a major deciding factor if an athlete is to recover from their injury. This trauma is so prevalent and active inside the mind of the athlete that often they give up and reverse all of the psychological training and rehabilitation given to them post-injury. This constant fear leads to a lack of focus during recovery and towards the sport and can eventually lead to the patient never wanting to return to that sport [20].

Family, friends, teammates and coaches all apply pressure and stress to the athlete's recovery be it intentional or unintentional. However well-intended these behaviours are, they can have a detrimental impact on the patient as they feel under pressure to return as quickly as possible. This could mean skipping therapy or physio sessions which in the future could cause a higher chance of re-injury or more severe psychological impacts if another injury were to occur. This constant feeling of having to live up to unrealistic expectations often leads to frustration towards the injury and can reduce self-esteem as athletes are left feeling isolated due to the fact no person around them seems to understand what they are enduring.

Another major psychological effect that athletes often suffer is fear of not returning to the previous level they were at within their sport. A sportsperson, especially one at a high level, can be said to be addicted to their sport, constantly training and trying to improve. According to many studies the average time to recover from a ruptured ACL in order to be able to perform is 6 to 10 months after surgery. In reality, including the time to get a surgery window, many athletes have to wait at least 12 months before they are back fully performing again. An entire year away from a sport one has played their entire life means they are probably not going to return at the same level as they have missed out on a year's worth of enhancing their ability in their sport. For many people, this significant amount of time on the side-lines is bound to cause doubt whether they ever will be able to return to the level they were previously at. This is especially true in professional sports where athletes are at the peak of their sporting lives playing or competing to their highest possible standard. In this environment, financial pressures over elite or aspiring high-level athletes multiply the importance. An injury as severe as a ruptured ACL is undoubtedly going to affect how confident a sportsperson is in regard to returning to their pre-injury level. Brewer, et al., studied the recovery in 108 patients with ruptured ACL for up to two years after surgery and identified that the athletes that were making a slower recovery at 6 and 12 months has a lower self-image than the ones making a faster recovery [22].

Many studies have also reflected positive psychological responses by the injured athlete (motivation, optimism, low fear, confidence or self-efficacy) increase the likelihood to return to pre-injury level in general sports injuries and specifically after ACL rupture [6,11,23,24].

Tools

Several tools have been designed and used for the assessment of the impact of psychological factors in the recovery following ACL rupture and other sports injuries.

The ACL-RSI (Appendix 1) explores the athlete's own understanding of their knee function. It consists of 12 questions with a score ranging from 1 to 10 each. A normal healthy knee would score between 80-90%; hence a full recovery 6 months after injury is considered when scores are over 80%. This questionnaire has been validated extensively such as the work by Webster, et al., in

220 patients 8 to 22 months following reconstruction of ACL, validating better scores in athletes returning to same performance as pre-injury. They included three categories: emotions, confidence in performance and risk appraisal [25]. Similar results and validation of the scores has been applied to different languages in other countries [26-28].

Langford, et al., included this ACL-RSI and added a ERAIQ in 87 athletes at 3, 6 and 12 months following reconstruction of ACL. ERAIQ is an Emotional Response of Athletes to Injury questionnaire, not specific to any particular injury, but useful to identify traits in recovery processes after sport traumas. In their study, 51% of the athletes returned to their professional or competitive sports and 49% did not. Interestingly the ACL-RSI scores were better at 6 and 12 months in the returners than in the non-returners group; but the ERAIQ scores were similar [29].

In a more recent publication, a cohort of 535 patients undergoing ACL reconstruction were studied with a shorter version (6 items) of the ACL-RSI. The study concluded that the reliability of this modified shorter version was as good as the original score in predicting return to sport outcomes. Both versions, the full and the short one were similarly valid to predict non-returners to sport thus validating the short version in identifying athletes that will fail in their full recovery in order to be investigated for psychological factors affecting their recovery. The authors concluded that the short-version can be used more universally on busy clinical settings and potentially increasing its reproducibility [30].

Roos, et al., described the Knee Injury and Osteoarthritic Outcomes Score (KOOS) (Appendix 2), that included 42 items within 5 subscales: pain, symptoms, functions of daily living, sports and knee related quality of life. The score ranges from 0 to 100 points. It was developed as the first score to evaluate outcomes following knee injuries in young and sports-active patients as previous tools were only available to evaluate effects of knee injuries in older patients with osteoarthritis. It was first used in 21 young patients undergoing ACL reconstruction and it was concluded its efficiency to assess outcomes with this self-responding questionnaire, recommending it as a complement for other scores [31]. This was validated in a cohort of 57 high-level athletes and confirmed this tool as useful and well designed in their subscales to be used in professional athletes after ACL reconstruction [32]. The use of KOOS has become widely used over the years and is now a valid tool as outcomes measure after interventions in ACL reconstructions. It has been recently used, for example, to predict the beneficial effect of supervised physiotherapy following ACL rupture that ultimately lead to better activity levels at 12 months [33].

The International Knee Documentation Committee 2000 (IKDC2000) (Appendix 3) is a subjective knee assessment form consisting of 18 questions evaluating function, activity and symptoms. It was validated in a study associated with physical tests of activity in 151 patients prospectively [34]. Below normal scores on IKDC2000 correlated with failure to return to same level activities, however normal results did not guarantee full return to activities. Shortly after its development, it was applied to 553 patients with different knee injuries, where this tool was validated as a reliable and valid knee-specific measure of symptoms, function and sports activity [35]. Both KOOS and IKDC have also been validated in cohorts of athletes undergoing revision surgery for ACL rupture [36].

A Knee Self Efficacy scale (K-SES) was described by Thomee, et al., as a measure of self-judgement potential ability to perform an activity following injury [37]. It is a 22-item questionnaire and was developed with data from 88 patients, later validated to a cohort of 122 patients and was correlated of satisfaction to the similar scales included in the KOOS have also shown to be better in returners to competitive sports after ACL injuries. A higher K-SES has been proven to correlate return to pre-injury levels of activity and to strenuous sport activities after ACL reconstruction in 157 patients [38].

In a very large recent FAST cohort study 681 patients of 30 +/- 9 years old of which 43.8% were either professional athletes or practised competitive sports were prospectively recruited. At 2 years 75% of the patients were active runners and 58% returned to the same sporting activities as prior to their injuries. Better scores in the ACL-RSI were consistently associated to return to the sport. They also correlated strongly the results of the ACL-RSI to the IKDC2000 and the KOOS (specially the pain, sports and knee-related quality of life components). They also correlated that sportsmen with a score over 60% 6 months after injury are very likely to return to the activities at the same level as before their injuries [39]. The same group had previously validated the ACL-RSI in a french population of 91 patients and 98 healthy controls, also comparing them to KOOS and IKDC200 scores with a complete correlation between the three tools [28].

Interventions

Without therapy or psychological rehabilitation, an athlete's mental well-being can spiral due to the aforementioned factors even though, physiologically their injury or ACL are healing as expected. The importance of assessing the need for psychological interventions after injuries in athletes at risk has been identified in surveys to trainers and therapists. A letter and email survey of 1000 members of the American National Athletic Trainers' Association and 1000 members of the American Physical Therapy Association yielded a response rate of 33%. The survey included 15 items trying to measure the trainers and therapists' attitudes about effectiveness of different interventions: mental imagery, self-talk, goal setting and pain affecting adherence to rehabilitation and speed of recovery. Both groups' replies showed a positive attitude towards the effectiveness of psychological skills to improve recovery after sport injuries, with a better one within trainers than within therapists and highlighting improved attitudes in the group of trainers or therapists that had undergone prior training in mental skills [40]. Interestingly, most of the studies reflect that knowledge in psychological recovery after injury by the therapist or trainers does improve outcomes, but more importantly prior training in these skills by physiotherapists and sports therapists increases the likelihood of involving professional psychologists and interventions in the process of athletes at risk rather than only counselling [41-43].

Unfortunately, it is assumed that the use by athletes of psychological or mental skills during recovery of spot injuries is not universal. In a very large study including 1283 athletes of different skill levels from different countries only 27% of the athletes responded that they had used mental skills during their rehabilitation. Of those who had used them, 72% reported self-perceived beneficial effects. The main skills or interventions used were goal setting, positive self-talk and imagery [44-47].

Several interventions used by therapists have been described to deal with career threatening and high trauma injuries such as a ruptured ACL: Counter conditioning, goal settings and positive thinking, mental imagery, positive self-talk and the creation of a team approach environment with open communication.

Counter conditioning is often used by psychologists. This intervention is particularly effective against re-injury anxiety and fear of re-injury. In order to achieve this the athlete must imagine fear or anxiety provoking situations to him/hers within their sport as detailed and as realistically as possible. The athlete and the therapist then place these situations in a hierarchy ranging from least anxiety provoking to most. To start with, the situation or event that triggers the least fear or anxiety should be imagined vividly. This image is then coupled with progressive muscular relaxation, so the athlete could remember what caused this anxiety or fear and be in a relaxed state whilst doing so [48]. Once achieving this, the athlete moves onto the next, least provoking scenario and so on. The sports-psychologist and patient pair these images with relaxation until the athlete overcomes their fear upon the presentation of images and scenarios deemed to be the root or origin of their anxiety and fears [49].

Another popular intervention used by psychologists and even physiotherapists alike is goal-setting, that comes close to positive thinking. For efficient and effective goal setting, the athlete, physio and psychologist must decide on realistic and achievable goals and the patient must learn how to monitor their recovery. Even though the goal setting is related to physiological achievements, the purpose and direction this intervention provides has been shown to reduce anxiety and improve self-confidence [50].

This goal setting can also alleviate pressure applied from family, friends and coaches as they can see the targets set and work with the athlete rather than against them which consequently involves others with the recovery and can reduce the isolation felt by the athlete as they can see those around invested in the recovery process and ensuring everything possible is done to reach these goals set [51,52].

Goals should not create overambitious or unrealistic targets and should include the therapists and athletes alike. These interventions do reduce stress and anxiety as well as improve self-confidence, all factors that can prevent full recovery after ACL rupture. Effective and realistic goal setting does have an impact on the adherence to the process of recovery, which would influence positively in the recovery of ACL injuries in elite athletes [53].

Mental imagery has been extensively used in psychological evaluations. Santi, et al., differentiate the positive effects of imagery for performance (where athletes visualised themselves performing at their level) by athletes that are away from the competition not only in terms of self-confidence but even with physical effects from imagery for rehabilitation (where athletes anticipate pain

or anxiety sensations and can visualise relaxing strategies). This will visualise possible future events, including re-injuries, pains and other negative effects [49]. Exercises for self-relaxation imagery relating to their particular sport will help control anxiety and fears that could hamper recovery [54]. Mental imagery can even help athletes against negative thinking or events such as re-injury or pain, but has to be supported by efficient relaxation techniques before these interventions are used for negative situations.

Positive self-talk can affect cognitive behaviour managing stress by understanding and identifying negative thoughts in order to change them. Perna, et al., in a randomised trial showed that in competitive athletes these interventions reduced significantly injury days and visits to health services by half [55]. A pathway of these interventions has been described: express and reflect on feelings and thoughts, identify the negative thoughts, looking in a positive light to change negative to positive thoughts, find a positive reinforcing message or statement and repeating it to maintain it [56].

Open communication is important for some injured athletes. This is important not only for them to know the physical stages of their recovery including pain due to their rehabilitation but it is also important that they are aware of the process and timing of their recovery and rehabilitation process and this has been proven beneficial by the own athletes [57,58]. A team-approach in communication can be created not only between athletes and therapists or trainers but include feedback and information from peers that have suffered and recovered from the same injuries, friends and family to provide the emotional and psychological support and the own teammates. The effect of all of these interventions can vary from athlete to athlete at all levels [59]. Constructive communication and creation of a team environment with effective interactions has been shown to improve recovery after ACL injuries in qualitative studies. The team is in place not only to help in the physical recovery, but also to reinforce and highlight the goals achieved at the different stages of the recovery [53].

All these interventions should be used in an individualised manner according to the needs, progress and background of the injured athlete. Resilience and mental stamina can be very strong in some elite athletes and it could play a very important role in the recovery after severe injuries. A holistic view of each individual athlete will allow to choose any of these available interventions to aid the process of recovery [60,61].

Conclusion

Recovery after ACL injury in athletes can achieve excellent outcomes with contemporary physical tools for recovery including surgery and rehabilitation. Alongside these factors and probably highlighted by the lengthy process of recovery involved, psychological factors can influence the recovery. They have been identified and defined, tools have been designed to predict their effects on the recovery and interventions can be implemented either by therapists with the skills or by specific professional; and are now being more regarded both by the therapists and the athletes that result in earlier and more common interventions. Elite athletes might have a very strong self-believes and stamina, but their recovery after severe injuries can be hampered by non-physical factors. The impact of these factors can be crucial in elite athletes as they are more exposed to pressures and stress to achieve pre-injury levels of performance and not only a basic return to sporting activities. Fear of re-injury remains the most common factor affecting full return to pre-injury activities and might trigger other psychological negative responses during the recovery process as well as result in other “compensatory” injuries. Effective communication, prevention of isolation and positive imagery and goal setting are all important to deal with psychological factors during recovery after ACL rupture in athletes. All of them have shown to be effective during the recovery of severe sport injuries alongside the physical therapies.

Conflict of Interest

No conflict of interest from co-authors nor from any organization.

Availability of Data and Materials

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