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### Kinesiophobia and its Impairment of Successful Return to Sport After Anterior Cruciate Ligament Injury and Reconstruction

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**Kinesiophobia and its Impairment of Successful Return to Sport After  
Anterior Cruciate Ligament Injury and Reconstruction**

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## **Abstract:**

**Introduction:** The rehabilitation of an athlete after an anterior cruciate ligament (ACL) injury includes both physical and psychological barriers. One such psychological barrier is kinesiophobia, more commonly referred to as the fear of reinjury. All individuals experience some level of kinesiophobia, or fear of reinjury, related to the return to sport after ACL injury and reconstruction. Kinesiophobia can have a negative impact on an athlete's short-term rehabilitation and long-term goals of return to sport. In many cases the fear of reinjury has been found to be one of the key reasons that an athlete does not return to sport or to their previous level of activity at all. Despite the advancements in graft technology for ACL reconstruction and the development of advanced return to sport protocols after surgery, successful return to sport rates are still considerably low. Many individuals do not return to their pre-injury level of activity despite regaining full physical knee function without any instability

**Purpose:** The aim of this review is to expand on the effects of kinesiophobia on the successful return to sport following a reconstruction of the anterior cruciate ligament and to help determine risk factors, causes, and possible treatments to better the chance for successful return to sport after ACL injury. Although there has been significant research connecting the fear of reinjury (kinesiophobia) to negative rehabilitation outcomes following anterior cruciate ligament reconstruction, there has been very little research into the appropriate treatment of kinesiophobia and how to improve the low rates of successful return to sport.

**Conclusions:** Rehabilitation and return to sport are both negatively impacted by psychological factors such as the fear of reinjury. Kinesiophobia has been found to increase with lengthened total time out of sport, increased time before surgery, and proximity in time to return to sport. Evidence has been found to support the use of psychological interventions/treatments targeting kinesiophobia and the fear of reinjury in the improvement of rehabilitation outcomes after ACL reconstruction. Further research should focus on the psychological aspect of rehabilitation after anterior cruciate ligament injury, and its impact on return to play as well as the inclusion of psychological intervention strategies in ACLR post-operative rehabilitation protocols.

## **1.0 Introduction**

Anterior cruciate ligament (ACL) injury is one of the most common traumatic injuries in sport today. Though not considered to be career ending, due to the ability to undergo ACL reconstruction, return to sport rates are significantly low (even in individuals with good post-operative physical knee function). The low rate of return to sport suggests that psychological factors such as kinesiophobia play a large role in the determination of an athlete's return to sport, as athletes who do not return to their preinjury level of activity have been found to report greater feelings of fear of reinjury related to returning to sport/activity. Several factors contribute to the development of kinesiophobia after ACL injury, both before and after surgical repair. Although previous research has shown negative impacts of kinesiophobia on rehabilitation and return to sport outcomes, very few ACL reconstruction protocols include any form of psychological treatment or intervention. The purpose of this review is to determine the negative effects of kinesiophobia on successful return to sport after ACL injury and to focus on possible strategies to minimize these effects and increase the rate of successful return to sport.

## **Literature Review**

### **2.0 Kinesiophobia**

#### **2.1 Defining Kinesiophobia**

Kinesiophobia is defined as a debilitating and irrational fear of activity and physical movement as a result of a feeling of vulnerability to painful injury and/or reinjury after recovery.<sup>1,2</sup> Kinesiophobia is a psychosocial factor affecting all thoughts, feelings, moods, and emotions that an individual may experience post injury.<sup>3</sup> It is an extreme level of the fear of reinjury, negatively affecting an individual's quality of life, psychological and physical health.

##### **2.1.1 Fear Response**

Fear is generally a normal and healthy reaction people experience in their everyday lives. When an individual is presented with a stress or challenge in their environment, fear helps the body to signal an appropriate response based on both physical and psychological well-being.<sup>1</sup> In such situations fear may be both beneficial and detrimental. In the case of kinesiophobia, fear takes over to the point where it is no longer signalling appropriate reactions to stress, but instead causing an inappropriate stress response impairing both natural physiological and psychological functions and abilities.

Physiologically, fear causes an arousal response in the body leading to increased muscle tension, fatigue, increased muscle guarding, decreased coordination, and decreased

biomechanical symmetry – in turn further increasing the risk of potential injury/reinjury.<sup>4,5</sup> Fear, anxiety, and stress have also been shown to elevate neurobiological factors within the body (noradrenaline and dopamine), delaying the overall healing process after injury due to their proinflammatory cytokine activity.<sup>6</sup>

### 2.1.2 Behavioural Manifestations

Kinesiophobia is displayed in different individuals through a variety of behavioural manifestations. Symptoms may include (but are not limited to) hesitation, anxiety, depression, holding back or not giving maximal effort, avoidance of injury provoking situations/activity avoidance, strapping or bracing of the injured body part for participation in activity/sport, increased pain intensity, and an increased perception of disability.<sup>7-9</sup> Not every individual will present with the same set of signs and symptoms and there is no specific criteria of symptoms that must be present in all patients experiencing kinesiophobia.

### 2.2 Kinesiophobia Scales and Measurement

Many of the above described behaviours and symptoms are subjective and therefore difficult to qualify. The Tampa Scale of Kinesiophobia (TSK) was developed by Miller and colleagues in 1991 to

**Figure 1:** The Tampa Scale for Kinesiophobia

| Tampa Scale for Kinesiophobia<br>(Miller, Kori and Todd 1991)  |   |   |   |   |
|--|---|---|---|---|
| 1 = strongly disagree<br>2 = disagree<br>3 = agree<br>4 = strongly agree   |   |   |   |   |
| 1. I'm afraid that I might injure myself if I exercise   | 1 | 2 | 3 | 4 |
| 2. If I were to try to overcome it, my pain would increase   | 1 | 2 | 3 | 4 |
| 3. My body is telling me I have something dangerously wrong  | 1 | 2 | 3 | 4 |
| 4. My pain would probably be relieved if I were to exercise  | 1 | 2 | 3 | 4 |
| 5. People aren't taking my medical condition seriously enough  | 1 | 2 | 3 | 4 |
| 6. My accident has put my body at risk for the rest of my life   | 1 | 2 | 3 | 4 |
| 7. Pain always means I have injured my body  | 1 | 2 | 3 | 4 |
| 8. Just because something aggravates my pain does not mean it is dangerous   | 1 | 2 | 3 | 4 |
| 9. I am afraid that I might injure myself accidentally   | 1 | 2 | 3 | 4 |
| 10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening | 1 | 2 | 3 | 4 |
| 11. I wouldn't have this much pain if there weren't something potentially dangerous going on in my body                              | 1 | 2 | 3 | 4 |
| 12. Although my condition is painful, I would be better off if I were physically active  | 1 | 2 | 3 | 4 |
| 13. Pain lets me know when to stop exercising so that I don't injure myself  | 1 | 2 | 3 | 4 |
| 14. It's really not safe for a person with a condition like mine to be physically active   | 1 | 2 | 3 | 4 |
| 15. I can't do all the things normal people do because it's too easy for me to get injured   | 1 | 2 | 3 | 4 |
| 16. Even though something is causing me a lot of pain, I don't think it's actually dangerous   | 1 | 2 | 3 | 4 |
| 17. No one should have to exercise when he/she is in pain  | 1 | 2 | 3 | 4 |

The 17 item kinesiophobia scale. Total score calculated after inversion of individual scores of items 4,8,12,16.<sup>10</sup>

assist in the identification and measurement of kinesiophobia in individuals with chronic low back pain. The TSK is now widely used in relation to a variety of musculoskeletal injuries and pain (both chronic and acute).<sup>1,10</sup> It is currently the most commonly used tool in the assessment of pain and pain related fear of movement.<sup>1</sup> The TSK (17 items), or its modified version the TSK-13 (13 items), is a self-rated questionnaire that provides a score based upon an individual's responses to questions regarding specific situations, performance, the fear of reinjury and activity avoidance.<sup>1,7,10,11</sup> The TSK assists in the identification of kinesiophobia by providing an objective measurement to subjective responses and behaviours.

Higher scores on the TSK are related to a greater fear of reinjury or overall movement associated with fear avoidance, with a score of 37 or higher indicating kinesiophobia (scores ranging from 17-68).<sup>1,7,10,11</sup>

### **2.3 Kinesiophobia Relationship to Rehabilitation and Return to Sport**

Kinesiophobia or the fear of reinjury is one of the most commonly reported reasons for an athlete not returning to sport, or to their pre-injury level of activity/competition.<sup>3,12,13</sup> Fear is a common experience for athletes when approaching the time of return to sport. Heijne et al. reported that all athletes reported some level of fear and uncertainty when faced with the situation of returning to the same sport in which they had been previously injured.<sup>14</sup>

Previous research has demonstrated that the fear of reinjury is related to poor rehabilitation outcomes, thus a decreased likelihood of returning to preinjury activity level.<sup>3,8,15,16</sup> The psychological construct of fear of injury is closely associated to self-efficacy (belief or confidence in one's own ability to be successful), which can be mediated through 4 main sources: vicarious experience, performance accomplishment, verbal persuasion, and physiological arousal/emotion.<sup>17</sup>

## **3.0 Anterior Cruciate Ligament (ACL) Injury**

### **3.1 Anterior Cruciate Ligament (ACL) Injury Rates/Statistics**

In the United States alone there are 250-300 thousand anterior cruciate ligament (ACL) injuries annually. This number has seen a drastic spike in recent years with an increase in sport participation in general and an increased participation in high-risk sports.<sup>18</sup> High risk sports include those with high repetitions of the common mechanisms of injury – landing from a jump, change in direction, sudden deceleration, eccentric loading, and overextension of the leg.<sup>19</sup> Contrary to popular belief, ACL injuries occur twice as frequently due to non-contact mechanisms than contact mechanisms.<sup>19</sup> These mechanisms are most commonly seen in basketball, soccer, volleyball, handball, gymnastics, skiing, and martial arts – considering them high-risk sports.<sup>19</sup>

Damage or injury to the ACL increases joint laxity, reducing the overall stability of the knee joint. Individuals who injure the ACL may experience instability and sensations of 'giving way' both in sport and during activities of daily living.<sup>20-22</sup> ACL deficiency also increases the risk of other injuries including meniscus damage and degenerative changes within the knee joint.<sup>20-22</sup>

### **3.2 Anterior Cruciate Ligament Reconstruction (ACLR)**

Approximately 200,000 anterior cruciate ligament reconstructions (ACLR) are performed within the US each year.<sup>23</sup> Reconstruction of the ACL is generally completed using one of 4 graft types: the patellar tendon, gracilis tendon, semitendinosus tendon, or a combination of both hamstring tendons.<sup>24</sup> These grafts may be either autografts (one's own tissue) or allograft (from a donor tissue).<sup>25</sup> There are a

number of different techniques and procedures available, though the common thread is the use of a graft to recreate the connection between the tibia and the femur that is lost in ACL deficient patients.<sup>20</sup>

The ultimate goal of anterior cruciate ligament reconstruction is to restore full knee stability and function by effectively limiting the anterior-posterior laxity within the joint by means of surgical repair. Ideally, this also decreases the risk of further or subsequent knee injury.<sup>20,23</sup> Surgical success is determined by the ability of the graft to restore normal knee function and kinematics by restricting anterior translation of the tibia.<sup>20,26,27</sup> A successful ACLR relies on the connection of biological, mechanical and rehabilitation factors to help return an athlete to their preinjury level of activity.<sup>20</sup>

### **3.3 ACL Reconstruction Post-Op/Return to Play Protocol**

The primary focus of rehabilitation after ACLR is to regain full stability and functional performance at the affected knee joint by working to increase full lower quadrant strength and range of motion.<sup>14</sup> Although detailed protocols for rehabilitation and return to sport after anterior cruciate ligament injury are readily available to trainers and therapists, there is a lack of both information and focus on the psychological component of ACL injury and subsequent rehabilitation.<sup>28</sup>

Fowler Kennedy's 'Physiotherapy Following ACL Reconstruction Protocol' is one of the most widely followed protocols currently used by therapists and athletes in the treatment and rehabilitation of ACL injuries after surgical repair. The protocol breaks down the full 6-month suggested rehab period into 7 smaller timelines, each with its own goals, focus, and suggested exercises including parameters.<sup>29</sup> The goals within the various protocol stages include increasing range of motion and flexibility, increasing strength and endurance, proprioception, gait, cardiovascular fitness.<sup>29</sup> It is important to note that nowhere within this well-known and commonly used protocol is there any mention of psychological readiness or treatment prior to returning to sport. Other rehabilitation protocols such as Herrington et al.'s task-based protocol<sup>30</sup>, The Stone Clinic's ACLR post-op protocol<sup>31</sup>, and Dr. Evans' ACL reconstruction rehabilitation protocol<sup>25</sup> all share similar issues. Each protocol details specific time frames, goals, and exercises appropriate to the stage of healing.<sup>25,29-31</sup> Evans' protocol is the only one found to consider any aspect of psychological rehabilitation, however, it is only mentioned in preparation for surgery and not after reconstruction or in relation to returning to sport.<sup>25</sup>

#### **3.3.1 Common Timeline of Return to Sport after ACL Injury**

The return to sport timeline after anterior cruciate ligament reconstruction is variable and dependent on surgeon and rehabilitation protocol followed. Most protocols follow a 6-month rehabilitation timeline, suggesting return to sport is possible after 24 weeks (6 months). Criteria for progression through independent protocol timelines is based on the completion of specific goals and tasks, not on time alone.<sup>25,29-31</sup> Unfortunately, although initially expecting a 6-month rehabilitation process, research has found that most patients still do not feel confident or ready to

return at 1-year post reconstruction; with no patients feeling ready at the 6-month mark.<sup>14</sup> Of those individual's that do return to activity or sport, 1 year is the frequently reported time frame from surgical reconstruction to the start of sport specific training and activity.<sup>14</sup>

### **3.3.2 Return to Sport Success Rates**

Successful return to sport (successful rehabilitation of initial injury) is defined by an individual's return to their pre-injury activity state.<sup>3</sup> Rates of successful return to sport are significantly low considering the high success rate of the physical reconstruction itself. Kvist and colleagues reported that only half of patients who receive an ACL reconstruction eventually return to their preinjury level of activity.<sup>16</sup> A meta-analysis conducted by Medvecky and Nelson in 2015 determined that after an anterior cruciate ligament reconstruction, although 82% of patients return to some kind of athletic activity, only 63% will reach their preinjury level of participation in sport, and an even lower 44% will return to competitive sport.<sup>12</sup> The most commonly reported factors for not returning to activity was fear of reinjury and pain.<sup>12</sup>

## **4.0 Kinesiophobia in Athletes Post Anterior Cruciate Ligament (ACL) Injury**

### **4.1 Causes of Kinesiophobia After ACL Reconstruction**

Kinesiophobia can be related to a number of factors. The most common causes/factors associated with kinesiophobia after ACL reconstruction are as follows:

- 1) Rates of reinjury after return to sport<sup>23,32</sup>
- 2) Physical knee joint instability/surgical complications<sup>8,14,33</sup>
- 3) Increased or prolonged time out of sport<sup>8,12</sup>
- 4) Increased time between injury and repair<sup>8</sup>
- 5) Sex (female)<sup>8</sup>
- 6) Predisposing risk factors (familial and pre-operative)<sup>34,35</sup>

#### **4.1.1 Rates of Reinjury after Return to Sport**

Graft failure is a potential risk of returning to sport after ACL reconstruction. Previous research has found that 17-20% of individuals experience graft failure and/or injury to the contralateral ACL.<sup>23,32</sup> The risk of reinjury due to graft failure is elevated by increased career length and early age of initial/primary injury. Elite-level adolescents who undergo ACL reconstruction prior to participation in collegiate level sport have an increased risk of graft failure and subsequent injury, including contralateral ACL injury.<sup>32</sup>



### **4.1.2 Physical Knee Joint Instability/Surgical Complications**

Return to sport success appears to be unrelated to actual physical post-operative knee function, but instead to the feeling or psychological concept of knee joint instability. Ardern et al. reported that patients with poor physical knee function and stability were found to be just as likely to return to sport as patients with good post-operative knee function and stability.<sup>8,33</sup> An individual's feelings or thoughts of knee joint instability have a negative impact on their confidence when returning to sport.<sup>14</sup>

### **4.1.3 Increased or Prolonged Time Out of Sport**

Previous research has demonstrated that the greater the period of time an athlete experiences out of their sport, the decreased likelihood that the individual will return to sport. This is most commonly related to competitive and professional athletes and may also be due to other factors in and individual's life.<sup>8,12</sup>

### **4.1.4 Increased Time Between Injury and Repair**

In 2012, Ardern and coworkers found that patients reported better subjective knee function and greater post-operative activity levels when reconstruction was performed within 3 months of the initial injury. It is suggested that patients who delay surgery, will experience more instability with an increased time attempting to function (possibly within sport) with an ACL deficient knee, leading to an increase in the fear of re-injury. Pre-operative experiences of instability have a detrimental effect on emotional responses, including the fear of reinjury, after ACL reconstruction.<sup>8</sup>

### **4.1.5 Sex**

Fear of reinjury/kinesiophobia is more common in females than males, as females have demonstrated increased feelings of concern with regards to return to play. Research from Ardern et al. reports emotional concern and worry was increased when paired with the concept of unpredictable events such as weather or environmental conditions while playing.<sup>8</sup>

### **4.1.6 Predisposing Risk Factors**

Genetics may play a role in the development of kinesiophobia. Familial and parental history of distress, anxiety, and depression may increase an individual's risk of developing distress or fear related disorders.<sup>34</sup> Pre-operative emotional responses and behaviours may lead to post-operative distress contributing to kinesiophobia. Emotional and motivational withdrawal prior to injury is related to an increased risk for the development of distress/fear disorders after experiencing injury.<sup>34</sup> In a 2012 study focusing on psychological risk factors of depression, anxiety, fear and activity avoidance, activity expectations, catastrophizing, worry about the operation, perceived pain, and pre-operative optimism levels, Powell et al. determined decreased pre-operative optimism and decreased

perceived pain control was related to a greater risk of experiencing chronic post-surgical pain (CPSP) and predict reported pain intensity at 4 months post-op after inguinal hernia repair.<sup>35</sup>

## **4.2 Kinesiophobia Relationship to Return to Sport**

Previous research has helped to demonstrate the negative effects of kinesiophobia on the overall rehabilitation process and thus the success of returning to activity after anterior cruciate ligament injury and reconstruction.<sup>3,8,11,13,16</sup> Fear of reinjury is a critical psychological factor reported by individuals who do not return to activity.<sup>3,12,13</sup> Individuals who do not return to sport or activity after undergoing ACL reconstruction have been found to exhibit a greater fear of reinjury and report a decreased quality of life related to knee function when compared to individuals who return to activity.<sup>16</sup> Kinesiophobia has long term effects on an athlete's rehabilitation and ongoing sport participation after surgery. Kinesiophobia after ACL reconstruction was found to be greatest in female athletes and individuals who had an increased time between injury and date of surgery/repair (>3 months).<sup>8</sup> The negative effects of kinesiophobia have the greatest impact on rehabilitation outcomes during the course of 6-12 months after reconstruction leading to return to sport.<sup>28</sup>

## **5.0 Psychological Treatment/Interventions for Kinesiophobia Related to Anterior Cruciate Ligament (ACL) Injury and Reconstruction**

### **5.1 Treatment/Intervention Options**

The key to treating kinesiophobia is the modulation of the 4 sources of self-efficacy (vicarious experience, performance accomplishment, verbal persuasion, and physiological arousal/emotion) to increase self-efficacy of skills required within the sport.<sup>17</sup> Previous and current research has considered a variety of different strategies to control the fear of reinjury and facilitate self-efficacy including imagery, relaxation, coping modeling, altered/modified training and technique, positive self-communication, routine of action, past successful performance outcomes, peer or coach support/influence, mental and physical preparation, and cognitive behavioural therapy.<sup>11,14,17,28,36,37</sup> The most common strategies include techniques of imagery, relaxation and cognitive behavioural therapy. It is important to note that the focus of these strategies is to positively manage or cope with fear, not eliminate it.<sup>37</sup>

#### **5.1.1 Imagery**

Imagery involves the performance of a skill by the use of the senses without any overt action. It is done within the mind and can be done at any stage within the rehabilitation process because it is not limited by the physical restrictions in range of motion and/or strength.<sup>28</sup>

Previous research studies have used imagery sessions averaging 10-15 minutes delivered over a 5 week – 6-month period (depending on the study) in combination with physical therapy, to treat the fear of reinjury.<sup>38-41</sup>

### **5.1.2 Cognitive Behavioural Therapy (CBT)**

Cognitive behavioural therapy (CBT) is based on the concept that maladaptive beliefs and cognitions lead to maladaptive behaviours and negative mood states.<sup>42</sup> CBT aims to break this cycle of maladaptive thought, behaviour, and emotions to effectively treat negative moods, anger, and the fear of reinjury.<sup>43-45</sup> Cognitive behavioural therapy is a combination of treatment strategies including:

- Disputing the reality of a negative thought/image/emotion<sup>37</sup>
- Emphasizing possibility of full recovery through interactions with and thoughts of athletes who previously returned to activity (modelling)<sup>46</sup>
- Systematic self-desensitization (progressive engagement in increasingly fearful situations)<sup>47</sup>
- Time projection (imagination of future progress and reflection on past growth/progress)<sup>48</sup>

## **5.2 Effects of Psychological Therapy for Kinesiophobia After ACLR**

Imagery and relaxation strategies have been found to have the greatest impact related to decreasing fear of reinjury and kinesiophobia in individuals after ACL reconstruction. The use of imagery as a psychological intervention following ACL reconstruction has been successful in the reduction of stress, anxiety, pain perception, effusion, swelling/inflammation and fear of reinjury.<sup>28,41,49</sup> Imagery in combination with common physical therapy tools exhibited increased quadriceps muscle activation and decreased ligamentous laxity, promoting greater overall knee function and stability.<sup>28,39,40</sup> In 2011, Lebon et al., determined that motor imagery training in conjunction with physical therapy, by means of instructing an individual to perceive joint tension and muscle activation while imagining a maximal contraction of full knee extension without overt movement, effectively increased muscle activation when compared to standard physical therapy alone.<sup>39</sup>

Imagery treatment has also been found to reduce the concentration of noradrenaline and dopamine (neurobiological pro-inflammatory factors), commonly associated with fear, stress, and anxiety.<sup>6,38</sup> Imagery effectively promotes the healing process, improves self-efficacy, increases confidence and decreases the fear of reinjury in individuals after ACLR.<sup>3,6,49,50</sup>

In a case study after anterior cruciate and medial collateral ligamentous injury, cognitive behavioural therapy (CBT) was found to effectively decrease flashbacks, increase self-awareness and positive coping skills, increase self-reported overall day-to-day mood, and decrease the fear of re-injury.<sup>37</sup>

## **6.0 Recommendations**

Physiological and psychological factors must both be considered in regards to anterior cruciate ligament injury and rehabilitation. ACL rehabilitation can be effectively facilitated through psychological interventions, as the appropriate treatment of kinesiophobia has demonstrated benefits to both the psychological and physiological components of ACLR rehabilitation. Psychological intervention should be recommended and/or provided by the therapist during ACLR rehabilitation.

Due to the significant impact of psychological factors (kinesiophobia) on the rehabilitation outcomes and success of return to sport after ACL injury, psychological treatment strategies such as imagery, relaxation, and cognitive behavioral therapy should be incorporated directly into anterior cruciate ligament reconstruction protocols, alongside physical exercise suggestions and manual therapy.

Future research should focus on the development of sport specific imagery techniques and the use of technology to provide treatment (virtual reality therapy as a possible delivery method for skill specific guided imagery). As well, future steps should be taken to encourage the implementation of psychological treatment into ACLR rehabilitation protocols including appropriate parameters for the use of such strategies.

## **7.0 Conclusions**

Injury to the anterior cruciate ligament (ACL) has both physiological and psychological effects on an individual. The fear of reinjury or kinesiophobia is a significant barrier to the successful return to sport after ACL reconstruction. Psychological interventions should be implemented into rehabilitation protocols to help prevent kinesiophobia and to help facilitate appropriate psychological responses to injury and emotions regarding return to activity. Appropriate recognition and treatment of kinesiophobia can promote healing after ACL reconstruction and increase the success rate of return to play after experiencing anterior cruciate ligament injury.

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