

**INVESTIGATING PARTICIPATION IN LEVEL I/II ACTIVITIES OF  
POTENTIAL COPERS AND NON-COPERS TWELVE MONTHS AFTER  
ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION**

by

Victoria E. Allen

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment  
of the requirements for the degree of Bachelor of Science in Nursing with Distinction.

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## **ABSTRACT**

A common success measure for athletes sustaining an anterior cruciate ligament (ACL) injury is their ability to return to sport (RTS) activity. The University of Delaware uses a functional test battery to determine a minimum state of readiness for RTS, utilizing hop tests, objective strength measures and self-reported knee function. Patients complete questionnaires about their perceived knee function, current activity, and what limits their ability to return to their previous level of athletic activity. Hartigan and colleagues found that 78% of non-copers passed the University of Delaware's RTS criteria 12 months after surgery; the rate of these individuals returning to their previous activity level is still unknown. There is a need to learn how many of these athletes actually return to previous levels of activity and investigate reasons that may prevent return to pre-injury sports or recreational activities.

This study examined athletes 12 months after ACL reconstruction. The purpose of the study was to (1) evaluate the rate of athletes returning to activity; (2) evaluate activity level based on the Marx Activity Rating Scale (MARS) and (3) investigate reasons for not returning to the same level of activity, despite meeting clinical RTS criteria.

Data were collected twelve months after reconstruction from a total of 88 non-copers (N=52) and potential copers (N=36), with an average age of 29 years. The



athletes in this study were high-level athletes involved in Level I/II activities, which include cutting, pivoting, and jumping. The MARS asks questions specific to the frequency with which these athletes are running, cutting, jumping and pivoting. Two supplemental questions from the information packet were used that asked the patients to describe 1) reasons why they have not returned to all pre-injury sports, and 2) why they have not returned to the same level of competition within the sport.

The pass rate for of RTS criteria was 92.0%. However, the overall return to activity rate was only 60.2% with 80.6% of potential copers and 46.2% of non-copers returning to previous activity levels. The study also found the MARS scores were inconsistent with patient reported level of activity. The MARS scores frequently indicated an activity level higher than the self-reported level, creating an inconsistency between the activity score and the athletes' self-reported RTS. Patients listed "fear of re-injury", "too little time to participate" and "not yet cleared from doctor", as the predominant reasons for not returning to the same level of activity, despite their clinical clearance for RTS.

Results indicate the longer it takes for an athlete to pass RTS criteria, the less likely they are to return to their previous level of activity. Although patients may pass RTS criteria, they may not return to same level of activity potentially due to fear or lifestyle limitations. Non-copers demonstrate the need for additional evaluation and education to increase their likelihood of participating in higher level activities. The outcomes here reveal the need to intervene with athletes' activity level after ACLR, to

increase the percentage of individuals who pass the clearance functional tests and who engage in fifty hours or more of level I/II sports a year.

## **Chapter 1**

### **INTRODUCTION**

#### **1.1 Anterior Cruciate Ligament Injury**

Among the estimated 7 million sport and recreational related injuries occurring annually<sup>19</sup>, anterior cruciate ligament (ACL) injuries remain the single largest problem in the field of orthopaedic sports medicine<sup>16</sup>. The majority of these injuries occur in athletes who participate in high-level activities involving jumping, cutting, twisting or sudden deceleration<sup>1,19</sup>. Athletes involved in these activities are at increased risk for ACL injuries as they frequently place high loads across their knees<sup>14</sup>. Rupture of the ACL typically leads to instability and loss of function, especially in those who regularly participate in strenuous physical activity<sup>5</sup>. For individuals who sustain an ACL injury, several treatment options exist. For those participating in high-level sports, however, operative management in the form of ACL reconstruction is often the preferred treatment<sup>1,15</sup>.

A primary goal of ACL reconstruction is to restore knee stability, allowing athletes to return to their previous activity level<sup>1,2,15</sup>. An estimated 50% of ACL injuries are treated via operative management in the United States<sup>15</sup>, followed by an extensive recovery period and rigorous regimen of physical rehabilitation<sup>18</sup>. Evaluating outcomes of operative management and rehabilitation for ACL-injured

individuals has become a necessity, as approximately 125,000 to 200,000 reconstructions are performed annually<sup>2</sup>.

## **1.2 Outcome Measures**

After ACL injury, successful outcome of reconstruction and rehabilitation are difficult to assess using a single measure, therefore, a variety of measures are utilized to determine success. With an increasing emphasis on evaluating subjective outcomes, in addition to functional measures after ACL reconstruction and rehabilitation, patient reported outcomes have gained popularity with clinicians. Recent work Lynch<sup>13</sup> revealed that return to sport and patient reported outcomes were rated by clinicians as highly important criteria, when identifying success for operative management at one year.

Return to sport is a set of functional criteria used to determine a minimum readiness for ACL-deficient individuals to safely resume unrestricted activities. Once athletes have met this criterion, clinicians expect they will return to their pre-injury activities and resume participating at their previous level of competition. Research advocates for a return to unrestricted sports at 6 months or later following ACL reconstruction<sup>16</sup>; however, full return to sport among ACL-deficient athletes can take between 6 and 12 months<sup>1,8,18</sup>. By 12 months following ACL reconstruction, clinicians anticipate athletes who have passed the functional return to sport criteria have returned to their pre-injury level of activity. In addition to using functional ability to return to sport being as an important outcome measure, patient reported outcomes must be included in the clinical picture for evaluating success post-operatively.

Patient reported outcomes are subjective data directly from the patient. These outcome measures are important to the clinical picture because they provide clinicians and researchers with the individuals' perceptions of their abilities following ACL reconstruction and rehabilitation. Patient reported outcomes allow for a comparison between objective, functional data of the athletes' abilities and subjective data, to provide a comprehensive impression of success after reconstruction.

### **1.3 Clinical Relevance**

Ultimately the goal of ACL reconstruction is to restore knee stability and functionality<sup>1,2,15</sup>, allowing athletes to return to their pre-injury, high-level activities. Within 12 months of reconstruction, athletes are expected to return to unrestricted activities<sup>1</sup>, but little information is known about the activity levels of athletes at this particular time point. Previous studies have evaluated activity levels of ACL-deficient individuals at later time points and there are varying reports about the rates of athletes returning to their pre-injury activity levels.

Reports of individuals returning to pre-injury levels after reconstruction vary from 53% at the 3-4 year time point<sup>10</sup> to 62.2% at 5 years<sup>11</sup>. Gobbi and Francisco<sup>7</sup> found 65% of individuals resumed pre-injury activities, when they evaluated activity level at a minimum of 24 months following reconstruction. Studies that have measured activity level 12 months post-operatively, report 70% of patients return to pre-injury levels<sup>15</sup> while a recent study measuring activity level in high-level athletes' reported only 33% have returned<sup>1</sup>. The inconsistencies indicate the need to evaluate activity levels at a time point when high-level athletes are expected to resume unrestricted activities, 12 months after reconstruction.

Once return to activity rates is determined it is important to determine

underlying factors that may prevent athletes from returning to pre-injury activities and competition level. Previous work by Kvist et al.<sup>10</sup> revealed, only 36% of their patients returned to activity based on function alone; therefore, psychological factors (such as fear of re-injury) and other factors must be influencing outcomes after ACL reconstruction. Investigating subjective reasons influencing outcomes after ACL reconstruction has become necessary, as there has been a shift from a biomedical model to a biopsychosocial model<sup>17</sup>, which could help to account for possible differences in functional abilities and actual return to activities.

#### **1.4 Objectives and Hypothesis**

This study had three objectives. The first was to evaluate the rate of athletes returning to their pre-injury activities. It was hypothesized that the majority of potential copers who pass return to sport criteria will return to their pre-injury level of activity, while the majority of non-copers who pass return to sport criteria will not return to their pre-injury level of activity. Additionally, it was hypothesized that athletes who pass return to sport criteria prior to 12 months following ACL reconstruction are more likely to return to their pre-injury activity level.

The second objective was to evaluate athletes' activity level based on the Marx Activity Rating Scale<sup>14</sup>, 12 months after ACL reconstruction. It was hypothesized that there would be a significant difference in activity level according to Marx Activity Rating Scale<sup>14</sup> scores between potential copers and non-copers. It was also hypothesized that athletes returning to a lower level of activity will have a lower Marx Activity Rating Scale<sup>14</sup> score, than those who did return to their pre-injury activity level.

The third objective was to investigate reasons that may prevent athletes from

returning to their pre-injury level of activity, despite meeting clinical return to sport criteria. It was hypothesized that athletes who do not return to their pre-injury activities or level of competition will report not returning due to “fear of re-injury”, “knee instability” or “too little time”. It was also hypothesized that Tampa Scale for Kinesiophobia<sup>17</sup> will identify high-level athletes with kinesiophobia.

## **Chapter 2**

### **METHODS**

Individuals with an isolated anterior cruciate ligament (ACL) tear were recruited by the University of Delaware Physical Therapy clinic. All subjects underwent unilateral ACL reconstruction by board-certified orthopaedic surgeons. After reconstruction, all subjects participated in the University of Delaware post-operative ACL protocol for rehabilitation. The sample consisted of 88 subjects (male,  $N=62$ ; female,  $N=26$ ; mean age-29 years), who participated in 50 hours or more per year of level I or II activities<sup>4,9</sup> prior to injury. Subjects in this study were either classified as potential copers ( $N=36$ ) or non-copers ( $N=52$ ) and were between the ages of 16 and 52. Subjects were part of larger clinical trials and data were collected using secondary analysis.

All subjects were provided informed consent prior to enrolling in the clinical trials, which was approved by the University of Delaware Institutional Human Subjects Review Board. Original informed consent documents are securely stored and can only be accessed by study investigators.

#### **2.1 Classification of Potential Copers and Non-copers**

The system to classify athletes following initial injury was developed to identify those ACL-deficient individuals who had a good probability of returning to a high level of functioning without surgical intervention in the short term<sup>6</sup>. Individuals



who demonstrated the specific criteria listed in Table 2.1<sup>5</sup> were classified as potential copers. Individuals who did not meet this criterion were classified as non-copers.

Table 2.1. Functional criteria for ACL-deficient individuals to be classified as potential copers

| Testing Criteria                                | Potential Coper |
|---|-----------------|
| Episodes of giving way since initial injury     | $\leq 1$        |
| Single limb 6-m time hop test for involved limb | $\geq 80\%$     |
| Knee Outcome Survey/ Activities of Daily Living | $\geq 80\%$     |
| Global Rating Score                             | $\geq 60\%$     |

## 2.2 Data Collection

Subjects participated in functional and clinical measures at a follow-up visit to the University of Delaware Physical Therapy clinic 12 months after ACL reconstruction. During this visit, subjects completed the University of Delaware's ACL Functional Test Packet. This study evaluated the subjects' report of their activity level before injury and their current level of activity (Appendix A). Additionally, subjects' responses to question 7 and question 8 were evaluated for reasons why they had not returned to all pre-injury sports (Appendix B) and/or not returned to the same level of competition within the sport (Appendix B).

To further assess subjects' participation in high-level activities, the Marx Activity Rating Scale<sup>14</sup> (Appendix C) was used because it measures the frequency

with which athletes are participating in movements specific to level I and II activities<sup>14</sup>. The item scores are summed to give a total score ranging on a 0-16 point scale, with higher scores indicating a high level of participation in activity<sup>14</sup>. For this study a score of 8 or greater was used to determine if athletes had returned to Level I or II activities 12 months after ACL reconstruction. A total score of 8 or greater was used because this score would indicate approximately 52 hours per year of participating in level I or II activities; thus the subject would be considered a level I or II athlete<sup>4</sup> if they scored 8 or greater.

To assess the extent to which fear of re-injury impacted the subjects ability to return to activity, The Tampa Scale for Kinesiophobia (TSK-11M)<sup>18</sup> questionnaire (Appendix D) was used. The item scores are summed to give a total score ranging from 11-44 points, with higher scores indicating greater fear or re-injury or pain-related fear. A total score of 37 or greater was used to classify athletes as having kinesiophobia<sup>12</sup>. Although Tampa Scale for Kinesiophobia (TSK-11M)<sup>17</sup> has been incorporated into the University of Delaware's ACL Functional Test Packet, the reliability and responsiveness of the questionnaire have not yet been assessed in patients with ACL reconstruction<sup>3</sup>.

### **2.3 Statistical Analysis**

Subjects' activity levels and scores on the Marx Activity Rating Scale<sup>14</sup> and the Tampa Scale for Kinesiophobia (TSK-11M)<sup>17</sup> were analyzed using chi-square tests, to compare categorical responses between groups. Comparisons were performed using a statistical analysis program (SPSS Statistics 19, Chicago, IL). Statistical significance was set at  $p < 0.05$ . Data were not included in comparisons when subjects did not provide responses to measures being evaluated.

## **Chapter 3**

### **RESULTS**

#### **3.1 Return to Pre-injury Activity Levels**

At 12 months after anterior cruciate ligament (ACL) reconstruction 81 (92.0%) patients passed the University of Delaware's strict return to sport criteria. There was a significant difference (Pearson Chi-Square,  $p = .022$ ) between potential copers and non-copers ability to pass return to sport criteria as 86.5% of non-copers ( $N=45$ ) passed return to sport criteria, while 100.0% of potential copers ( $N=34$ ) passed criteria (Table 3.1). When self-report return to activity rates was evaluated, 57 patients (64.8%) reported returning to activities 12 months after ACL reconstruction. There was no significant difference (Pearson Chi-Square,  $p = .491$ ) between non-copers (63.5%) and potential copers (66.7%) self-report of returning to activity (Table 3.1). Potential copers were more likely than non-copers (Pearson Chi-Square,  $p = .004$ ) to return to pre-injury activity levels at 12 months following ACL reconstruction (Table 3.1). Patients passing return to sport criteria before 12 months were more likely than those who did not pass (Pearson Chi-Square,  $p = .000$ ) within that time frame to return to pre-injury activity levels (Table 3.1).

#### **3.2 Activity Level Based on the Marx Activity Rating Scale**

At 12 months after ACL reconstruction, the average score on the Marx Activity Rating Scale (MARS)<sup>14</sup> was 11.17 when running was included in the total score, while the average was 8.11 when running was excluded (Figure 3.1). 88.9% of potential copers and 63.5% of non-copers scored an 8 or greater on the MARS<sup>14</sup> when running was incorporated into the total score (Table 3.2). However, when running was excluded from the total score, only 75% of potential copers and 34.6% of non-

copers scored an 8 or greater (Table 3.2). Potential copers were more likely than non-copers to score an 8 or greater on the MARS<sup>14</sup> when running was included (Pearson Chi-Square,  $p = .021$ ) as well as excluded (Pearson Chi-Square,  $p = .000$ ) from the total score (Table 3.2).

When the total score included running, 46 patients (86.8%) who returned to pre-injury activity level and 15 patients (75.0%) who returned to a lower activity level scored an 8 or greater on the MARS<sup>14</sup> (Table 3.2). Patients returning to pre-injury activity level were more likely to score an 8 or greater (Pearson Chi-Square,  $p = .000$ ). However, when the total score excluded running, 36 patients (73.6%) who returned to pre-injury activity level and 6 patients (30.0%) who returned to a lower activity level scored an 8 or greater on the MARS<sup>14</sup> (Table 3.2). Again, patients who returned to pre-injury activity level were more likely to score an 8 or greater (Pearson Chi-Square,  $p = .000$ ).

### **3.3 Subjective Reasons and Tampa Scale for Kinesiophobia (TSK-11M)**

At 12 months after ACL reconstruction, patients listed “fear of re-injury” as the most prominent reason for both not returning to all pre-injury activities and for not returning to the same level of competition within the sport (Table 3.3). The second and third most prominent reasons for not returning to pre-injury activities or level of competition were “too little time” and “not yet cleared from doctor”, respectively (Table 3.3). The Tampa Scale for Kinesiophobia (TSK-11M)<sup>17</sup> were calculated, the average score was 15 (range: 11-27) 12 months after ACL reconstruction. Because the highest TSK score reported 27, no patients were identified as having kinesiophobia within this population.

Table 3.1. Return to Activity Levels 12 Months after ACL Reconstruction

|   | Total<br>Population | Potential<br>Copers | Non-copers |
|---|---------------------|---------------------|------------|
| <i>Overall</i>                                      |                     |                     |            |
| Passed RTS Criteria<br>n (%)                        | 81 (92.0%)          | 36 (100.0%)         | 45 (86.5%) |
| Self-Report RTS<br>n (%)                            | 57 (64.8%)          | 24 (66.7%)          | 33 (63.5%) |
| Returned to Pre-injury Activity Level<br>n (%)      | 53 (60.2%)          | 29 (80.6%)          | 24 (46.2%) |
| Passed RTS Criteria before 12 Months<br>n (%)       | 59 (67.0%)          | 26 (72.2%)          | 33 (63.5%) |
| <i>Passed RTS<br/>Criteria Before<br/>12 Months</i> |                     |                     |            |
| Self-Report RTS<br>n (%)                            | 41 (69.5%)          |                     |            |
| Returned to Pre-injury Activity Level<br>n (%)      | 43 (72.9%)          |                     |            |

*RTS, return to sport*

Table 3.2. Marx Activity Rating Scale<sup>14</sup> Total Scores

|  | Data with Running | Data without Running |
|--|-------------------|----------------------|
| <i>Total Score <math>\geq 8</math></i>         |                   |                      |
| Total Population<br>n (%)                      | 65 (73.9%)        | 45 (51.1%)           |
| Non-copers<br>n (%)                            | 33 (63.5%)        | 18 (34.6%)           |
| Potential Copers<br>n (%)                      | 32 (88.9%)        | 27 (75.0%)           |
| Returned to pre-injury activity level<br>n (%) | 46 (86.8%)        | 39 (73.6%)           |
| Returned to lower activity level<br>n (%)      | 15 (75.0%)        | 6 (30.0%)            |

Table 3.3. Subjective reasons listed by athletes, in order of priority for not returning to all pre-injury activity (Question 7) or not returning to the same level competition within the sport (Question 8)

| Ranking    | Question 7                                | Question 8                             |
|------------|---|--|
| #1 Reason  | "Fear of re-injury or lack of confidence" | "Fear of re-injury due to knee injury" |
| #2 Reason  | "Too little time or change in lifestyle"  | "Too little time to participate"       |
| # 3 Reason | "Not yet cleared from doctor"             | "Not yet cleared from doctor"          |

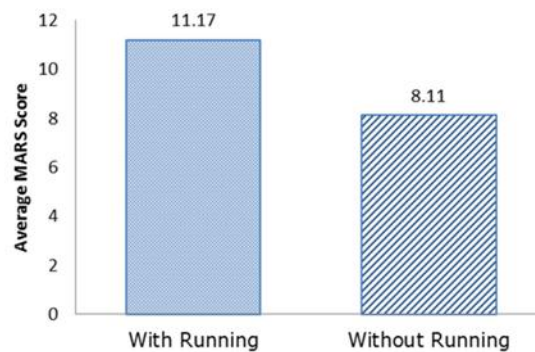


Figure 3.1. Average total score for the Marx Activity Rating Scale<sup>14</sup> (MARS).

## **Chapter 4**

### **DISCUSSION**

#### **4.1 Return to Pre-injury Activity Level**

The hypotheses regarding potential copers and non-coper participation in pre-injury level activities was supported by the results; the majority of potential copers (80.6%) did return to pre-injury activities and only 46.2% of non-copers returned to pre-injury activity levels (Table 3.1). Although 92.0% of the athletes in this study passed return to sport criteria, only 60.2% returned to their pre-injury level 12 months after anterior cruciate ligament (ACL) reconstruction (Table 3.1). The results indicate a notable difference between functional ability to pass return to sport criteria and patient reports of return to sport and participation in pre-injury level of activity. A recent study by Ardern et al.<sup>1</sup> found that only 33% of their participants attempted pre-injury competition level of sports at 12 months following reconstruction. The results for this current study show higher return to pre-injury activity level but still reveal “a discrepancy between physical rehabilitation outcomes and return to sport rates” (pg. 541) that was seen in the Ardern et al.<sup>1</sup> study. Results indicate that psychological factors may contribute to the discrepancy between functional and performance outcomes.

Because the vast majority of the athletes in the study passed return to sport criteria, the self-report return to sport outcomes were much lower than anticipated, with only 64.8% of the athletes reporting they had returned to activity (Table 3.1). Athletes may perceive themselves performing at a lower level within their pre-injury activity; therefore, they may be less likely to report themselves as fully returned to sport. Additionally, athletes may be experiencing a lack of confidence in their injured

knee. Previous work by Kvist and colleagues<sup>10</sup>, found that physicians and physical therapists observe patients displaying lack of confidence with injured knee, even with objective and subjective stability. A strength of this current study was the ability to assess the extent to which perceived decreased performance and lack of confidence contributed to returning to activity after ACL reconstruction (Appendix B). The results revealed that decreased functional performance due to knee injury or lack of confidence was not listed by patients as subjective reasons for not returning to sport (Table 3.3). The influence of these particular reasons on the discrepancy between passing clearance for returning to sport and self-report return to sport and activity level appears to be minimal. Results indicate there is a need to investigate reasons why athletes are not returning to activity despite functional ability.

They hypothesis regarding passing return to sport criteria within 12 months of ACL reconstruction increasing the likelihood of returning to pre-injury activity level was supported by the results (Table 3.1). 72.9% of patients who passed return to sport criteria before 12 months were more likely to return to their pre-injury level of activity (Table 3.1). While classification is not a significant predictor of functional ability to pass return to sport within 12 months of ACL reconstruction (Table 3.1), potential copers and non-copers appear to demonstrate performance differences post-operatively according to the results in Table 3.1. As a result of functional deficits, individuals may not be able to resume unrestricted activities 12 months post-reconstruction and may display more hesitancy in returning to pre-injury level activities when they eventually do pass the functional criteria.



## **4.2 Evaluating the Marx Activity Rating Scale<sup>14</sup>**

Results supported the hypothesis that there would be significant differences in Marx Activity Rating Scale<sup>14</sup> (MARS) scores between potential copers and non-copers (Table 3.2). In both inclusion and exclusion of running from the total MARS<sup>14</sup> score, potential copers were more likely to score an 8 or greater (Table 3.2). Interestingly, the hypothesis that patients who return to lower activity levels will have a lower MARS score was not supported by the results when running was included into the total score, as 75.0% of them scored an 8 or greater (Table 3.2). However, when running was excluded, only 30.0% of those who returned to lower activity levels scored an 8 or greater (Table 3.2). The results revealed a discrepancy between athletes' scores and their current activity level when running was included in the total score, which was unexpected because the scale is specifically designed to measure the frequency with which athletes are participating in high-level activities<sup>14</sup>.

Several factors may contribute to the variation between reported activity level and the activity level indicated by evaluating the MARS<sup>14</sup>. One likely possibility is inflated scores due to inclusion of running as a measure of level I and II activities as seen by the drop in average total MARS<sup>14</sup> score from 11.17 when running was included to 8.11 when running was excluded (Figure 3.1). Pivoting, decelerating, and jumping are considered level I and II activities whereas running is not. If the scale is designed to measure the specificity of which ACL-deficient athletes are participating in these high-level, high-risk for ACL injury movements, running should be excluded from these measurements. Additionally, athletes may be reporting they are cutting, pivoting and decelerating on a frequent basis, therefore still qualify as level I or II athletes, but may be participating at a lower level of competition. If they are participating at a lower level of competition, it could explain why there are higher

scores seen even in patients who self-reported they have not returned to sport.

While the MARS<sup>14</sup> is designed to measure specific ACL-straining movements, which also indicate high-level activity, it may not accurately reflect patient performance outcomes after ACL-reconstruction. If it is not an accurate reflection, it is not necessarily an extremely useful tool to use in determining successful outcome for athletes after ACL reconstruction. In regards to the MARS<sup>14</sup> and its usefulness in clinical and therapeutic application, future work should determine a total score using the scale that can be universally utilized as a measure of ‘returning to level I or II activities’. It is possible our variation in scores and activity levels were derived from using a score that was too low for qualification of return to activity. If there was a score that was universally used, the scale may have more application for outcome measures in the field of ACL reconstruction.

### **4.3 Investigating Subjective Reasons**

Results of this study provide evidence to support that psychological factors may influence outcomes after ACL reconstruction 12 months after ACL reconstruction. The results regarding subjective reasons for not returning to pre-injury activities and competition level supported the hypothesis that fear and too little time would be significant factors (Table 3.3). In order of importance, athletes listed the following as the most prominent factors: fear of re-injury, too little time to participate and not yet cleared from doctor (Table 3.3). Considering no functional reasons were listed by athletes for reasons why they did not return, psychological factors and lifestyle seem to be most influential. Results support the need of clinicians and researchers to consider that the anxiety over re-injury may be a psychological barrier to returning to a particular sport in which the ACL injury occurred<sup>18</sup>.

The impact of lifestyle seems to be a significant factor considering patients' listed a prominent reason for not returning to pre-injury activities as too little time to participate. There could be a multitude of reasons that account for too little time to participate, especially when lifestyle changes are considered. One example that could contribute to too little time to for athletes to participate is a change lifestyle after high school or college graduations. Change in lifestyle and time management for athletes was a hypothesized reason for not returning to pre-injury activities post-ACL reconstruction; however, not yet being cleared from the doctor was an unexpected result.

Patients reported they had not yet been cleared from the doctor as the third most significant reason for not returning to activities 12 months following reconstruction. As a significant percentage of patients have not passed return to sport criteria at 6 months and may not have had interim testing until 12 months, they would not have been cleared.

#### **4.4 Fear of Re-injury and the Tampa Scale for Kinesiophobia (TSK-11M)<sup>17</sup>**

Fear of re-injury was found to be a prominent reason for why athletes have not returned to pre-injury activity level and supported results from previous studies<sup>18</sup>. Results were consistent with the Tripp et al.<sup>18</sup> study that found a greater fear of re-injury could lead to decreased self-reports of return to pre-injury sport levels. Additionally, the results of this study supported previous findings indicating that in a group of ACL-deficient individuals who reported very little or close to no pain, fear of re-injury was a unique predictor of return to sport<sup>18</sup>.

The Tampa Scale for Kinesiophobia (TSK-11M) was incorporated because its aim is to quantify fear of re-injury due to movement and physical activity<sup>10</sup>, therefore

it would help identify the extent to which kinesiophobia influenced ACL-deficient athletes. Kinesiophobia is defined as an irrational and debilitating fear of physical movement resulting from a feeling of vulnerability to painful injury or re-injury<sup>10,17,18</sup>. This specific fear of movement and re-injury may be linked to decreased performance outcomes post-ACL reconstruction and a contributor to reluctance to engage in activities that may lead to re-injury<sup>18</sup>. Results revealed the highest TSK-11M score for participants 12 months after ACL reconstruction was 27, therefore no athletes in this study were classified as having kinesiophobia. Higher TSK-11M<sup>17</sup> scores were expected based on the results from the study conducted by Kvist et al.<sup>10</sup> which revealed that patients who did not return to pre-injury level scored higher on the TSK-11M<sup>17</sup>; therefore, were experiencing more fear of re-injury and/or fear of pain. Conversely, the results of this study showed despite returning to lower than pre-injury levels, higher TSK-11M<sup>17</sup> scores were not reported by the participants.

The fear of re-injury reported by the high-level athlete population in this study was not quantified by the TSK-11M<sup>17</sup> or measured as well as anticipated. Because the scale is mostly assessing fear of re-injury based on pain, and participants did not list pain as a top subjective reason, the TSK-11M<sup>17</sup> is not necessarily measuring fear of re-injury in the high-level athlete population. The TSK-11M<sup>17</sup> does not appear to give an accurate clinical picture due to the significant emphasis on pain when quantify fear of re-injury and a different questionnaire should be implemented to measure fear of re-injury in the high-level athlete population after ACL reconstruction.

A strength of this study was the ability to evaluate activity levels of high-level athletes 12 months after ACL reconstruction. A limitation of this study is that it was not a matched sample of non-copers and potential copers. An additional limitation is

that because not every patient completed the University of Delaware's ACL Functional Test Packet in its entirety.

## **Chapter 5**

### **CONCLUSIONS**

#### **5.1 Clinical Conclusions**

Despite passing functional criteria, athletes are reporting lower performance outcomes than expected. There is an influence of psychosocial factors that seem to be impacting ability of athletes to return to their pre-injury activities and level of competition, especially fear of re-injury which appears to be the most significant factor. The Marx Activity Rating Scale may not be accurately reflecting reality of individuals' activity levels and outcomes for clinicians. Additionally, the Tampa Scale for Kinesiophobia (TSK-11M) does not quantify fear of re-injury in the high-level athlete population after anterior cruciate ligament reconstruction. Outcomes reveal the need for clinicians to explore interventions to increase the percentage of individuals who engage in at least 50 hours per year of level I and II activities.

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## Appendix A

### UNIVERSITY OF DELAWARE'S ACL FUNCTIONAL TEST PACKET: LEVEL OF ACTIVITY

**LEVEL OF ACTIVITY** Please indicate in the spaces below the **HIGHEST** level of activity that you participated in **BEFORE YOUR INJURY** and the highest level you are able to participate in **CURRENTLY**.

BEFORE INJURY: Level\_\_\_\_\_ CURRENT: Level\_\_\_\_\_

|         |  |
|---------|--|
| Level 1 | Sports involving jumping, pivoting, cutting - e.g. soccer, football, rugby                       |
| Level 2 | Sports involving lateral movements with less jumping- e.g. ice hockey, wrestling, skiing, tennis |
| Level 3 | Light activities- e.g. running, low impact aerobics, weight lifting                              |
| Level 4 | Sedentary activities- e.g. housework, activities of daily living                                 |

## Appendix B

### UNIVERSITY OF DELAWARE'S ACL FUNCTIONAL TEST PACKET: QUESTIONS 7 AND 8

7. If you have not returned to ***all pre-injury sports***, mark an "X" next to the answer that best describes the reason. If you have more than one reason, please use "1", "2", "3", etc. to rank the order of importance.

- a. Pain \_\_\_\_\_
- b. Swelling \_\_\_\_\_
- c. Fear of re-injury or lack of confidence \_\_\_\_\_
- d. Knee instability \_\_\_\_\_
- e. Muscle weakness \_\_\_\_\_
- f. Not yet cleared from doctor to return to sports \_\_\_\_\_
- g. Too little time to participate or had a change in lifestyle \_\_\_\_\_
- h. Other \_\_\_\_\_

8. If you have not returned to ***the same level of competition within the sport***, mark an "X" next to the answer that best describes the reason. If you have more than one reason, please use "1" and "2" to rank the order of importance.

- a. Pain due to knee injury \_\_\_\_\_
- b. Swelling due to knee injury \_\_\_\_\_
- c. Fear of re-injury due to knee injury \_\_\_\_\_
- d. Lack of confidence due to knee injury \_\_\_\_\_
- e. Knee instability due to knee injury \_\_\_\_\_
- f. Muscle weakness due to knee injury \_\_\_\_\_
- g. Not yet cleared from the doctor \_\_\_\_\_
- h. Too little time to participate \_\_\_\_\_
- i. Lack of interest/motivation \_\_\_\_\_
- j. Decreased functional performance due to knee injury \_\_\_\_\_
- k. Change in lifestyle: Describe \_\_\_\_\_
- l. Other \_\_\_\_\_

## Appendix C

### MARX ACTIVITY RATING SCALE

**ONLY TO BE FILLED OUT AT 12 & 24 MONTH FOLLOW-UP TESTS**

#### Marx Activity Rating Scale

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Marx Activity Rating Scale (Marx et al., 2001)

Please indicate how often you performed each activity in your healthiest and most active state, in the past year.

|  | Less than one<br>time in a month | One time<br>in a month | One time<br>in a week | 2 or 3 times<br>in a week | 4 or more times<br>in a week |
|--|----------------------------------|------------------------|-----------------------|---------------------------|------------------------------|
| Running: running while<br>playing a sport or jogging   |                                  |                        |                       |                           |                              |
| Cutting: changing directions<br>while running  |                                  |                        |                       |                           |                              |
| Decelerating: coming to a<br>quick stop while running  |                                  |                        |                       |                           |                              |
| Pivoting: turning your body<br>with your foot planted while<br>playing a sport (skiing,<br>skating, kicking, throwing<br>hitting a ball (golf, tennis,<br>squash, etc. |                                  |                        |                       |                           |                              |

**Appendix D**

**TAMPA SCALE FOR KINESIOPHOBIA**

**TSK-11M**

Name \_\_\_\_\_

Date \_\_\_\_\_

|   | Strongly disagree | Somewhat disagree | Somewhat agree | 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 my pain, it would increase.....   | 1                 | 2                 | 3              | 4              |
| 3. My body is telling me that I have something dangerously wrong.....   | 1                 | 2                 | 3              | 4              |
| 4. People aren't taking my medical condition seriously enough.....  | 1                 | 2                 | 3              | 4              |
| 5. My accident has put my body at risk for the rest of my life.....   | 1                 | 2                 | 3              | 4              |
| 6. Pain always means that I injured my body.....  | 1                 | 2                 | 3              | 4              |
| 7. Simply being careful that I do not make any unnecessary movements is the<br>safest thing I can do to prevent my pain from worsening..... | 1                 | 2                 | 3              | 4              |
| 8. I wouldn't have this much pain if there weren't something potentially dangerous<br>going on in my body.....                              | 1                 | 2                 | 3              | 4              |
| 9. Pain lets me known when to stop exercising so that I don't injure myself.....  | 1                 | 2                 | 3              | 4              |
| 10. I can't do all the things normal people do because it's too easy for me to get<br>injured.....  | 1                 | 2                 | 3              | 4              |
| 11. No one should have to exercise when he/she is in pain.....  | 1                 | 2                 | 3              | 4              |

Please score by totaling the value of the responses. Score will range between 11 and 44 points.

**TSK-11M Score:** \_\_\_\_\_