Title: The Andrews Return to Sport ACL Score: A Developmental Study

Principal Investigator: Adam Anz, M.D.

Co-Investigators: James Andrews, M.D.

Steve Jordan, M.D.

Roger Ostrander, M.D.

Tyler Opitz, DPT, SCS, CSCS

Albi Gilmer, MSPT, OCS

Ron Courson, ATC, PT, NRAEMT, CSCS

Jessi Truett, MA, BCBA

Joshua Cook, B.S.

Chandler Bridges, M.S.

Thomas Denney Jr., Ph.D.

Funding Mechanism: Florida State Grant

Institution: Andrews Institute

1020 Gulf Breeze Pkwy.

Gulf Breeze, FL 32561

(850) 916- 8590

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Abbreviations and Definitions

ACL Anterior cruciate ligament

AE Adverse Event

AREF Andrews Research and Education Foundation

CRF Case Report Form

DHHS Department of Health and Human Services

EDC Electronic Data Capture

FMS Functional Movement Screening

GCP Good Clinical Practice

HIPAA Health Insurance Portability and Accountability Act

H_0 Null Hypothesis

H_1 Alternative Hypothesis

IRB Institutional Review Board

JHFT Jump Height by Flight Time

MRI Magnetic resonance imaging

OKC Open Kinetic Chain

PI Principal Investigator

PRO Patient Reported Outcomes

RTP Return to Play

RTS Return to Sport

QA Quality Assurance

SAE Severe Adverse Event

SOC Standard of Care

SOP Standard Operating Procedure

TSK Tampa Scale for Kinesiophobia

YBT Y Balance Test

Background / Scientific Rationale

It is estimated that 250,000 anterior cruciate ligament (ACL) injuries occur in the United States per year (Griffin et al., 2000, Gianotti et al., 2009). With ACL injuries being one of the most frequent injuries in both contact and noncontact sports, medical professionals need reliable tools to treat injured athletes and return them to sport in a safe/timely fashion (Harris et al., 2013). Along with the prevalence of initial injury, reinjury rates may be up to 30% in young active patients who undergo ACL surgical interventions. With the rate of return to competitive play post-ACL injury being 55%, it is imperative to create a systematic quantitative algorithm to safely return athletes to competitive play after ACL injury (Ardner et al.,2014). In addition to the primary injury often there is additional concern for instability of the knee, increased joint laxity, reduced activity and participation, as well as an increased risk of knee osteoarthritis in the future for the athlete (Lohmandeder et al., 2004). Along with the play time missed for the athletes, ACL injuries are associated with significant physical and mental harm as well as a lower health-related quality of life which supports the need for effective Return to Sport assessments. However, the current literature is limited regarding the standardization and data-driven decision in regards to return-to-sport algorithms (Creighton et al., 2010). Return-to-sport algorithms require further development.

Regenerative medicine technologies have the potential to expedite return to sport times after injury and surgery. However, to objectively study the application of regenerative medicine technologies to ACL injury and surgery, the development of an objective measurement system for the safe and appropriate return of patients to sport is required. Ensuring patients are being safely returned to their sports after treatments for ACL injuries is important to decrease the risk of reinjury. As noted in Grindem et al. (2016), athletes returning to sport with asymmetrical

quadricep strength have a significant risk increase for reinjury. After sustaining injury and operative intervention, a systematic evaluation process is needed to evaluate athletes' progress towards returning to sport. To safely return to sport, an athlete must restore range of motion, strength, and stability and control across the affected and unaffected knee (Wilk et al., 2012; Bodor, 2001). With current advancements in technology, an up-to-date quantitative return to sport algorithm is presented. Multiple measures are required to capture the risk factors for reinjury such as imbalances and weaknesses that are not always evident in observation. The purpose of this study is to develop the Andrews ACL S.C.O.R.E (Subjective Clinical Outcome Return to Play Evaluation.) Development will begin with baseline measures and re-evaluation during the rehabilitation progression to address asymmetries and movement inefficiencies in a data driven manner with the ultimate goal of returning to play safely, without reinjury. A modern return to sport algorithm will include patient reported outcome measures, objective/modern strength and ability testing, and MRI evaluation of the reconstructed ACL tissue. Ardern et al. (2014) report the importance of assessing the psychological factors that impede athletes from returning to sport after ACL reconstruction. To address these individualized factors, patient reported outcomes are used to quantify these measures.

A comprehensive assessment is required to ensure an athlete's ability to safely return to sport is identified. This Return to Sport assessment must incorporate the overall health of the individual and assess specific measures of the affected ACL area. These qualities of assessment include the need for their strength to be at or near their preinjury level with symmetry to the non-injured leg, range of motion at or near their preinjury level with symmetry to the non-injured leg, joint stability at or near their preinjury level with symmetry to the non-injured level and confidence in movement comparable to the confidence in movement to the non-injured leg. As found by

Ardern et al. (2014) symmetry hopping in movement has positive predictive factors for returning to competitive sport levels after ACL reconstruction. The functional movement screening assessment, a low-cost assessment, is also widely used to assess current functioning level. This assessment includes seven movement patterns to ensure the whole-body biomechanics can be assessed. The FMS assessment will provide a quantitative assessment of functional movement

Objective:

This project will develop a data driven decision making model to assess a competitive athlete's readiness to return to sport after ACL injury and surgery safely. A specific audience and return to activity level specification is required for complete return to sport studies (Gokeler et al., 2017). This Return to Sport algorithm is targeting competitive pre-collegiate and collegiate athletes with a return to sport that is congruent with their pre-injury level of play.

Return to Sport- Obtaining medical clearance to participate in competitive sports at the athlete's pre-injury level

Safely- Returning to pre-injury competitive level without instances of reinjury of the same ACL

Protocol Design

This will be a prospective cohort study of 100 competitive level pre-collegiate and collegiate level athletes who have sustained an ACL injury requiring reconstruction with a length of enrollment of 36 months.

Hypotheses

Alternative Hypothesis:

The prospective capture of multimodal data will improve the safe return of athletes to sport after ACL surgery and allow for the evaluation of regenerative medicine technologies to improve this process.

Patient reported outcomes and return to sport times will correlate directly with MRI objective scores and biometric strength/movement scores.

Null Hypothesis:

The prospective capture of multimodal data will not show improvement in the rate of safe return of athletes to sport after ACL surgery.

Patient reported outcomes and return to sport times will not directly correlate with MRI objective scores and biometric strength/movement scores.

Treatment Plan

For the one hundred participants recruited for this study, the duration of the treatment plan will be 24 months. Each of the participants will be qualified for the study due to falling within all inclusion criterion and no exclusion criterion. The screening of the inclusion criterion will occur at visit one of the study. At this time, the AREF Research Team will review and collect informed consent from each participant. Visit two will occur three (3) months after each participant's ACL reconstruction surgery. At this time, an evaluation by the treating physician will occur along with functional movement assessment and MRI. Visit three will occur six (6) months after each participant's ACL reconstruction surgery. At this time, an evaluation by the treating physician

will occur along with functional movement assessment and MRI. Visit four will occur nine (9) months after each participant's ACL reconstruction surgery. At this time, an evaluation by the treating physician will occur along with functional movement assessment and MRI. Visit five will occur twelve (12) months after each participant's ACL reconstruction surgery. At this time, an evaluation by the treating physician will occur along with functional movement assessment and MRI. Visit six will occur eighteen (18) months after each participant's ACL reconstruction surgery. At this time, an evaluation by the treating physician will occur along with functional movement assessment and MRI. Visit seven will occur twenty-four (24) months after each participant's ACL reconstruction surgery. At this time, an evaluation by the treating physician will occur along with functional movement assessment and MRI. At each time point, the treating physician or the therapist performing the functional movement assessment can choose to limit the functional movement assessment if there are concerns that the patient may not be ready for the expected load of one or more elements of the functional movement assessment.

At each monthly time point after ACL reconstruction patient reported outcomes will be collected by the research team to assist in assessing the overall health and confidence in Return to Sport for each athlete. The following patient reported outcomes will be collected in written or electronic format after informed consent has been obtained from each participant: Sports Participation, Reinjury, Tampa Kinesiophobia Scale, IKDC, PROMIS, SANE.

Participation:

A total of 100 competitive pre-collegiate or collegiate athletes will be recruited for participation in the Andrews Return to Sport algorithm study. Participants in the study will be individuals who have provided informed consent to the research team to adhere to the provided research protocol.

Inclusion Criterion:

One hundred (100) pre-collegiate or collegiate level athletes will be included in this study. They will fall within the following inclusion criterion:

1. Age 14-24 years
2. Require ACL reconstruction surgery
3. No other ligament injury which would require repair or reconstruction to lower extremity is present as assessed by treating physician
4. Exhibits desire to return to pre-injury competitive level
5. Assessed to be in good physical health condition by the treating physician

Exclusion Criterion:

1. Requires more than one ACL reconstruction surgery at time of screening
2. Has comorbid lower extremity diagnoses which would impede return to sport as assessed by the treating physician
3. Does not desire to return to pre-injury competitive sport level

Benefits:

Each study participant will be provided with a total five hundred dollars ($500.00) for their participation in the study through the 24-month period. The $500.00 will be dispersed on the following predetermined schedule. $100.00 at Visit 2, $100.00 at Visit 3, $100.00 at Visit 5, $100.00 at Visit 6, and $100.00 at Visit 7. If a participant withdraws from the study the

monetary benefits will not be dispersed after the withdrawal date. However, there will be no effect on the medical care provided if a participant withdraws from the study.

Return To Sport Assessments:

Isokinetic Strength Testing:

Isokinetic strength testing is crucial to assess the muscular strength of the quadricep and hamstring after ACL reconstruction. Due to the high rate of reinjury with known predictive factors due to imbalance in strength, a quantitative measure of balance of strength is required to guide return to sport decision making. An isokinetic dynamometer will be used to assess knee extensor and flexor strength (Riesterer et al., 2020). Isokinetic strength testing will support the Andrews Return to Sport algorithm through multimodal functional assessments.

Magnetic Resonance Imaging

Magnetic Resonance Imaging (MRI) will be used as a noninvasive assessment tool to obtain quantitative measures to assess progress in graft maturity and rehabilitation towards safe return to sport. As the injured ACL undergoes ligamentization, MRI will be used to monitor the progress of each participant through T2* analysis and volume at the following time intervals: 3months, 6months, 9months, 12months, 18months, and 24months. MRIs will review the integrity of each graft, placement within the tunnel, and tunnel healing, and healing of the donor site (Grassi et al., 2016).

Functional Movement Assessments:

The functional movement screening assessment (FMS) is widely used to assess current functioning level and does not require significant monetary resources to provide this assessment. This assessment includes seven movement patterns to ensure the whole-body biomechanics can be assessed. The movements required are deep squat, hurdle step, inline lunge, shoulder mobility, active straight leg raise, trunk stability push up, and rotary stability assessment. FMS screening will be used to identify the precursor deficits which could lead to reinjury. These deficits include increased anterior tibial shear force, decrease knee flexion, decreased hip flexion, increased knee internal rotation, increased trunk flexion, and increased lumbar hyperextension. The FMS assessment will provide a quantitative assessment of functional movement on a 0-3 scale as follows (Hoogenboom, Voight, Cook, & Rose, 2013).

3- Individual can perform the movement without any compensation.

2- Individual can perform the movement but must utilize poor mechanics and compensatory patterns to accomplish the movement.

1- One is given if the individual cannot perform the movement pattern even with compensation.

0- Individual reports pain during activity.

Single Leg Squats:

The single leg squat assessment is commonly used to evaluate the eccentric and concentric contractions of the muscles in the upper leg, lower leg, and hip (Bailey et al., 2010). This test was first executed and defined the method for performing by Livengood (2004) to assess balance, strength, and the kinetic chain. To rate the single leg squat test, Livengood also assigned

a scale to the test (Figure 1). Each participant will be instructed to squat down to approximately 60 degrees with a time constraint of six seconds while holding one leg suspended in the air. When analyzing the movements within the single leg squat, researchers assess the functioning and symmetry of following muscles and the activity associated: vastus medialis obliquus, gluteus medius, hip flexion, hip abduction, and knee flexion (Table 1).

Jump Analysis:

The jump analysis highlights the importance of the monthly psychological data review completed by the Kinesiophobia Scale. In review of this data, the psychological apprehension will guide the functional jump analysis. The jump analysis will occur initially from both legs to address psychological apprehension (Davies et al., 2017). From this assessment, calculation is made based on the allometric scaling to each participant's height (Davies et al., 2017). Additionally, flight time will be measured as defined by the time (s) when the participant's feet leave the platform and subsequently contact the platform again (Jordan et al., 2020). Additionally, the jump height by flight time (JHFT) will be measured. JHFT is defined as the distance the marker on the malleolus moved from lowest point when in contact with the platform to the highest point during the jump.

A single leg hop assessment will also be performed across both the injured and non-injured legs. The score for this assessment is the distance travelled from the start to the location of the posterior heel of the landing leg (Manske & Reiman, 2013). The variability of scores across the injured and non-injured leg will be used as a measure of symmetry in function movement for each athlete.

Additionally, a double leg hop will be scored during the jump analysis. The score for this assessment is the distance travelled from the start to the location of the posterior heel of the landing leg (Manske & Reiman, 2013). Additionally the participant's jump will be assessment for symmetry in takeoff and landing across both the injured and uninjured leg.

Single Leg Press:

Additional readiness measures will be assessed through the single leg press motion. As the participants progress in rehabilitation a body weight single leg press will be completed across both the injured and non-injured leg until failure. Then a single leg press with 25% body weight will be completed until failure. This measure of repetitions until failure will be used to assess the current fatigue level of the injured leg regarding readiness to Return to Sport. This measure will also occur quantitative data as a measure of deficit which will align with future reinjury rates.

Back Squat

Each participant will undergo a back squat assessment as they progress in rehabilitation. Once the investigator deems the participant stable in the descending, stable hold position, and ascending motion. Each participant's movement pattern while completing a back squat will be assessed for stability and strength in maintaining position.

Y Balance Test (YBT)

The Y Balance Test is a reliable, yet simple assessment to measure the participant's strength, stability, balance, and confidence while moving in three different directions. The YBT requires the participant to balance on one leg at a time and to reach as far as possible with the suspended leg in three separate directions, anterior, posterolateral, and posteromedial. This assessment will

measure the level of rehabilitation by measuring the knee flexor and hip adductor strength after ACL injury (Walker, 2016).

The test will follow the procedural order of:

1. Right Anterior
2. Left Anterior
3. Right Posteromedial
4. Left Posteromedial
5. Right Posterolateral
6. Left Posterolateral

At the completion of the above sequence the following calculations will occur:

Absolute Reach Distance (cm)= (Reach 1 + Reach 2 + Reach 3)/3

Relative Reach Distance (%) = Absolute Reach Distance/Limb Length X 100

Composite Reach Distance (%) = Sum of the 3 Reach Directions/3 Times the Limb Length X 100

Patient Reported Outcomes

Monthly assessments of each participant's patient reported outcomes will be used to quantify physical and psychological aspects of rehabilitation after ACL reconstruction monthly after informed consent has been obtained and surgery has occurred.

Tampa Kinesiophobia Scale:

The fear of reinjury can be a barrier to the rehabilitation of competitive athletes after ACL reconstruction. To operationalize the fear associated with reinjury the Tampa Kinesiophobia (TSK) will be provided monthly to participants in the study to complete (Lundberg et al., 2009). Kinesiophobia is defined as the fear of movement (Lundberg et al., 2009). This measure will be collected to evaluate progression in rehabilitation to take into account not only the physical health of the injured athlete but also the psychological effects and rehabilitation.

Sports Participation Assessment:

A sports participation assessment will be completed monthly by the participants of the research project to quantify the participant's participation in sports activity during the rehabilitation period.

Reinjury Assessment:

A monthly injury questionnaire will be provided to each participant of the study to assess the rate of reinjury during the rehabilitation process. If reinjury is noted in the monthly questionnaire, the AREF research team will alert the principal investigator to ensure continuity of care is provided.

International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC):

The International Knee Documentation Committee Subjective Knee Evaluation (IKDC) form will contribute to the comprehensive data set to evaluate each participant's confidence in performance on a monthly schedule. IKDC has 19 questions that will take approximately 3-5 minutes for each participant to complete monthly. IKDC data will be collected by the AREF research team and reviewed with the primary investigator.

Patient Reported Outcomes Measurements Information Systems (PROMIS)

The patient reported outcomes measurement information system (PROMIS) is a measurement system used monthly in this project to assess monthly the overall health functioning and rehabilitation levels of each participant (Brodke, Saltzman, & Brodke, 2016). AREF will collect this data and alert the primary investigator if any adverse outcomes are found. The addition of the PROMIS data is required to ensure that a comprehensive assessment of overall functioning is reviewed in the determination of athlete readiness to return to sport.

Single Assessment Numeric Evaluation (SANE)

The SANE assessment is a single question patient reported outcome from a rating of 0-100 for each participant to score their current functioning in comparison to their pre-injury functioning level (O'Connor & Ring, 2019). This assessment will be collected monthly after ACL reconstruction by the AREF research team for each participant.

Review of Safety

Adverse Event (AE)

An adverse event is any untoward or unfavorable medical occurrence in the human subject, including any abnormal sign, symptom, or disease, temporally associated with the subject's participation in the research, whether considered related to the subject's participation in the research or not considered related to the subject's participation in the research.

Serious Adverse Event (SAE)

Serious adheres events are any events that:

- Result in death
- Is life threatening, or places the participant at immediate risk of death from the event as it occurred
- Requires or prolongs hospitalization
- Causes persistent or significant disability or incapacity
- Results in congenital anomalies or birth defects
- Is another condition which investigators just to represent significant hazards

Unanticipated Problem (UP):

Defined by DHHS 45 CFR part 46 as any incident, experience, or outcome that meets the following criteria.

- unexpected, in terms of nature, severity, or frequency, given (a) the research procedures that are described in the protocol-related documents, such as the IRB-approved research protocol and informed consent document; and (b) the characteristics of the study population.
- related or possibly related to participation in the research (in this guidance document, possibly related means there is a reasonable possibility that the incident, experience, or outcome may have been caused by the procedures involved in the research);
- suggests that the research places participants or others at a greater risk of harm (including physical, psychological, economic, or social harm) than was previously known or recognized.

AE & SAE Collection and Reporting

Throughout the study the research team will monitor the occurrence of AE and SAE. Data will be collected if an instance occurs, and the PI will be notified. All AE data, such as onset date, resolution date, outcome and treatments given will be documented in the source documents and will be recorded in the EDC and analyzed for severity to follow reporting protocol if severity level.

Follow-up will occur using the provided safety monitoring form if AE occurs. The follow up will end either when the symptoms resolve or up to 30 days past the end of the study participation.

Risks and Discomforts

As with any research involving participants, there is the inherent risk of a breach in patient confidentiality though this will be minimized using participant code numbers and adherence to all HIPAA guidelines.

Safety Monitoring Plan

The safety of each participant will be monitored through multiple channels as the primary focus on this project is to ensure the safe return to sport for each participant. Along with the medical evaluation performed at each of the seven study visits. Monthly patient reported outcomes will be collected and reviewed to ensure no additional injury or premature return to sport has occurred. Any deviation from protocol recommendations will be reported by the AREF research team to the principal investigator to assess and rectify participant actions if needed.

Quality Control and Assurance

All protocols will be monitored and analyzed data will be checked for accuracy by the principal investigator and /or a designated AREF research team member. All medical data will be kept in compliance with HIPAA guidelines.

Regulatory Requirements

21 CFR 50- informed consent:

In adherence to the 21 CFR 50, Protection of Human Subjects Guidelines, the informed consent process will be performed by one of the study investigators or staff, in the research office on

paper or electronically via REDCap. REDCap is a secure web application for building and managing online surveys and databases. While REDCap can be used to collect virtually any type of data in any environment (including compliance with 21 CFR Part 11, FISMA, HIPAA, and GDPR), it is specifically geared to support online and offline data capture for research studies and operations. The REDCap Consortium, a vast support network of collaborators, is composed of thousands of active institutional partners in over one hundred countries who utilize and support their own individual REDCap systems. All participants will have the study described to them and will be given as much time as they require to read an approved, IRB stamped version of the informed consent document. The designee will review with each participant that they are free to refuse to participate in the study or to withdraw from it at any time.

After physical or electronic signing of the informed consent document, participants will be given a copy for their records. No aspects of the study will be conducted prior to obtaining informed consent from each participant.

Consent Withdrawal:

During the informed consent process, participants will be informed that if at any point during the study, consent may be withdrawn. To withdraw consent, participants can request in writing to withdraw HIPAA authorization and the research site will not use or provide any health information to researchers. At this time, the link between the participant's health information will be severed with the research team. This process for consent withdrawal will be reviewed with each participant and identified barriers will be addressed at the time of informed consent.

Participant Confidentiality

Signed consent forms for each subject will be de-identified by a coding system with the subject's unique study identification system. Authorization to use each subject's personal health information will be obtained during the informed consent procedure to adhere to the federal Health Insurance Portability and Accountability Act (HIPAA). The consent will specifically grant permission to use health information obtained as part of the presented study.

Data Analysis & Management Procedures

This study is anticipated to take 2 years to complete after informed consent is obtained for each participant. All data will be entered into REDCap. The investigators will meet at appropriate intervals to evaluate and analyze the data.

Data Collection

Data will be collected using the Electronic Data Capture (EDC) system. Reports of data will be used by internal site monitors to ensure accuracy of data elements. Data will be kept secure to reduce chances of breach of confidentiality. Data will also be de-identified as another confidentiality best practice measure.

Statistical Analysis

All patient data will be entered into EDC. The investigators will meet at appropriate intervals to evaluate and analyze the data. All compiled data will be de-identified.

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Appendix

Treatment Schedule:

1. Visit 1- Screening Visit (Informed Consent/Review Inclusion and Exclusion)

2. Visit 2- (3 mo after ACL Reconstruction)- $100.00 to participant

    a. Strength/Functional Testing with a Therapist, MRI

3. Visit 3- (6 mo after ACL Reconstruction)- $100.00 to participant

    a. Strength/Functional Testing with a Therapist, MRI

4. Visit 4- (9 mo after ACL Reconstruction)-

    a. Strength/Functional Testing with a Therapist, MRI

5. Visit 5- (12 mo after ACL Reconstruction)- $100.00 to participant

    a. Strength/Functional Testing with a Therapist, MRI

6. Visit 6- (18 mo after ACL Reconstruction)- $100.00 to participant

    a. Strength/Functional Testing with a Therapist, MRI

7. Visit 7- (24 mo after ACL Reconstruction)- $100.00 to participant

    a. Strength/Functional Testing with a Therapist, MRI

PRO: Monthly

1. Sports Participation (Monthly)

2. Reinjury (Monthly)
3. Tampa Kinesiophobia Scale (Monthly)
4. IKDC (Monthly)
5. PROMIS (Monthly)
6. SANE (Monthly)

MRI: 3mo, 6mo, 9mo, 12mo, 18mo, 24mo

1. Volume
2. Mean T2* Values

Strength/Functional Testing with a Therapist: 3mo, 6mo, 9mo, 12mo, 18mo, 24mo

1. Isokinetic Strength Testing
2. FMS- Functional Movement Screening
3. Y-Balance
4. Single Leg Hop
5. Single Leg Press with Body weight (number of reps), 25% body weight (number of reps)

Tampa Scale for Kinesiophobia

(Miller, Kori and Todd 1991)

1 = strongly disagree

2 = disagree

3 = agree

4 = strongly agree

1. I'm afraid that I might injury 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

Scoring Information Tampa Scale for Kinesiophobia **(Miller et al., 1991)**

A total score is calculated after inversion of the individual scores of items 4, 8, 12 and 16.

2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

Name: **Date:** **Physician:**

Date of Injury:

SYMPTOMS*:

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain?

Very strenuous activities like jumping or pivoting as in basketball or soccer

Strenuous activities like heavy physical work, skiing or tennis

Moderate activities like moderate physical work, running or jogging

Light activities like walking, housework, or yard work

Unable to perform any of the above activities due to giving way of the knee

2. During the past 4 weeks, or since your injury, how often have you had pain?

0 1 2 3 4 5 6 7 8 9 10

Never Constant

3. If you have pain, how severe is it?

0 1 2 3 4 5 6 7 8 9 10

No pain Worse pain imaginable

4. During the past 4 weeks, or since your injury, how stiff or swollen was your knee

Not at all
Mildly
Moderately
Very
Extremely

5. What is the highest level of activity you can perform without significant swelling in your knee?

Very strenuous activities like jumping or pivoting as in basketball or soccer

Strenuous activities like heavy physical work, skiing or tennis

Moderate activities like moderate physical work, running or jogging

Light activities like walking, housework, or yard work

Unable to perform any of the above activities due to giving way of the knee

6. During the past 4 weeks, or since your injury, did your knee lock or catch?

Yes No

7. What is the highest level of activity you can perform without significant giving way in your knee?

Very strenuous activities like jumping or pivoting as in basketball or soccer

Strenuous activities like heavy physical work, skiing or tennis

Moderate activities like moderate physical work, running or jogging

Light activities like walking, housework, or yard work

Unable to perform any of the above activities due to giving way of the knee

SPORTS ACTIVITIES:

8. What is the highest level of activity you can participate in on a regular basis?

Very strenuous activities like jumping or pivoting as in basketball or soccer

Strenuous activities like heavy physical work, skiing or tennis

Moderate activities like moderate physical work, running or jogging

Light activities like walking, housework, or yard work

Unable to perform any of the above activities due to giving way of the knee

9. How does your knee affect your ability to:

		Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
A.	Go up stairs	○	○	○	○	○
B.	Go down stairs	○	○	○	○	○
C.	Kneel on the front of your knee	○	○	○	○	○
D.	Squat	○	○	○	○	○
E.	Sit with your knee bent	○	○	○	○	○
F.	Rise from a chair	○	○	○	○	○
G.	Run straight ahead	○	○	○	○	○

H.	Jump and land on your involved leg	○	○	○	○	○
I.	Stop and start quickly	○	○	○	○	○

FUNCTION:

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

FUNCTION PRIOR TO YOUR KNEE INJURY:

0 1 2 3 4 5 6 7 8 9 10

Couldn't perform daily activities — No limitations in daily activities

CURRENT FUNCTION OF YOUR KNEE:

0 1 2 3 4 5 6 7 8 9 10

Cannot perform daily activities — No limitation in daily activities

Single Leg Squat Scoring

Grade	Hip and Knee Criteria
Excellent	Hip flexion greater than 65°, hip abduction / adduction less than 10°, knee valgus / varus less than 10°
Good	Any of the above 2 criteria are met
Fair	Any 1 of the above criteria are met
Poor	None of the criteria are met or the athlete losses balance or falls

Figure 1. Single leg squat - Scoring Criteria for movements of closed chain limb

Single Leg Squat Assessment		Left	Right
Foot	Foot Flattens	yes/no	yes/no
Knee	Positioning/Valgus	Moves Inward Moves Outward	Moves Inward Moves Outward
Pelvic Plane	Excessive Tilt (Ant/Post)	yes/no	yes/no
Stance/Stability	Stability: Noticeable instability	yes/no	yes/no
Pain	Verbal report of pain	yes/no	yes/no

Table 1. Single leg squat assessment