Senior Honors Research Proposal

Name

Date

The anterior cruciate ligament is responsible for limiting the movement of the knee anteriorly. The tearing of this ligament is one of the most prevalent sports related knee injuries to occur in athletics, specifically female athletics. Athletes who have an increased risk of an ACL tear are females between the ages of fourteen and eighteen who engage in sports that involve sharp turns, quick accelerations, and any pivoting movements (Mayo Clinic, 2017). The sport with the highest risk is soccer, followed by basketball, skiing, football, and tennis. Even though it is not as likely, any sport could possibly lead to an ACL tear, whether it be from impact (football) or twisting the knee a little too far in a swing (Mayo Clinic, 2017). Coach Rick Canter, the head strength and conditioning coach at Longwood University, explained a common cause for ACL tears is that the training athletes participate in is not relevant to competition. Coach Canter basically explained that neurons that learn to fire together will fuse together. This means that training that is specific to competition will create neural pathways that will continue to strengthen. Only when an athlete trains the muscles used in competition will he or she decrease the risk of an ACL injury (personal communication, Nov. 10, 2017).

A study completed by Arendt, Agel, and Dick (1999) tested over 150 teams for men and women to see how many knee injuries were sustained in a specific timeframe. The men's basketball team had a surprisingly low amount of ACL injuries but the women's results follow along the same lines as Padua's findings where most of the knee injuries were ACL tears (Arendt, Agel, Dick 1999). The results were conclusive that women in collegiate sports are much more likely to have a knee injury, specifically an ACL injury than men (1999). The researchers also concluded that, like Padua and other researchers, no known physical or genetic cause can be attributed to the increased likelihood (1999).

The main problem associated with an ACL injury for a continuing athlete is the increased risk of a re-tear. Paterno, Rauh, Scmitt, Ford and Hewitt (2014) did a study to find the likelihood of a re-injury in the same limb or an injury in the collateral limb versus the likelihood of an athlete without any ACL injuries to have an injury. They found that athletes who have already torn their ACL once are six times more likely to re-injure their ACL than an athlete who has never had an ACL injury. They also found that athletes who were female were two times more likely to tear their ACL in the opposite limb than those without a previous injury. It was noted that females are at a higher risk for an injury in the opposite limb while men are at a higher risk of re-injuring the same limb (Paterno, 2014). In a study done by David Bell et al (2014), athletes who previously tore their ACL had worse landing mechanics on that leg and scored higher LESS scores because of the previous injury. This, along with Paterno's study, confirms that athletes who tore their ACL once have a very high risk for tearing it again.

Sport	Number of Injured
Women's Soccer	0
Men's Soccer	3
Women's Basketball	2
Men's Basketball	0
Golf	0
Cross Country	0
Softball	0
Baseball	0
Field Hockey	0
Lacrosse	1
Women's Tennis	0
Men's Tennis	0

Image (above) shows the number of athletes with a torn ACL this year (Fall 2017).

A study completed by Krosshaug et al (2007) identified the likelihood of front court versus back court athletes sustaining an ACL injury. They researched 39 participants via video and noted how the injury occurred, whether it be on one leg, two legs, or crossovers (2007). 29 of the 39 athletes were injured doing something called attacking, which is when the front court athletes drive towards the basket (2007). This supports the idea that the driving motion used by front court athletes will result in more knee injuries.

A system that helps find the increased risk for a specific athlete is the Landing Error Scoring System (LESS). The LESS is a screening tool commonly used to assess probability of lower extremity injuries. This system was developed by Padua and implemented in his JUMP ACL study with military subjects. The Joint Undertaking to Monitor and Prevent ACL injuries, or JUMP ACL, was performed using 2691 subjects. Padua completed this study to test the reliability of LESS screening compared to that of the Gold Standard. After completing his study, he concluded that LESS is a reliable and inexpensive way to test individuals for risk of ACL injuries (Padua, et al 2009).

LESS screening is a very inexpensive screening tool. The materials needed are a 30 centimeter plyometric-box, two cameras (one facing the frontal plane, one facing the sagittal), a tape measurer, and a marker for the horizontal distance of the jump. The only expensive part of a LESS screen would be the use of a force plate, which is not necessary for this screen. The procedure has multiple steps but is very simple to set-up. First, use the tape measurer to get the athlete's height and then divide that measurement in two. Use half of the height to measure out from the 30 centimeter plyometric-box and then mark that distance on the ground. Using the height as a measuring factor helps eliminate a few of the variables we cannot control. After that, the cameras need to be set up to look at the landing and torso of the athlete after the jump. This means the lateral camera should be in line with the marker on the ground and far enough back to see the whole body and the front camera should be directly in the middle of the box, far enough back to see the whole body. After set-up, we will make sure all of the equipment is safe and in the right areas before asking the athlete to complete their jumps. When instructing an athlete on how to do this screen, start off with a demonstration that does not focus on what they should specifically do when they land. While explaining something is beneficial, most athletes are

kinesthetic learners or visual learners meaning a demonstration would prove to be the most helpful. The easiest way to explain is to tell the athlete that they are completing three trials where they are to stand on the plyometric-box, take a horizontal broad jump out to where their heels are past the marker on the ground, and then immediately jump vertically as high as they can. The purpose of getting the athlete to complete a vertical jump is because without the end jump, the athlete will focus on their landing too much and possibly skew the data. While it is important to tell the athlete to land with two feet after the broad jump, no other information on landing techniques should be given because then the athlete will be focused on following the instructions instead of doing what comes naturally to them. After completion of the screen, it is alright to tell the athlete anything major they are doing wrong at that moment but remember a prevention program is on the way. One last thing to take into consideration when teaching an athlete to complete this screen is to allow them a few trial runs. Nobody is capable of doing something right the very first time and the athlete also might feel a little nervous, so it would be good to get the first few jumps out of the way without filming.

I, along with my sponsor Dr. Timothy Coffey, will perform a LESS screen on men and women's basketball during the fall semester. I will, after practice scoring LESS screens on Dartfish (a computer program) with Dr. Coffey, score each player's test to see the likelihood of an ACL tear or re-tear. Then, I will compare the LESS scores among the position players. Strength and conditioning programs are specifically created for a position. For example, front court athletes are required to drive forward toward the basket which involves sharp pivoting motions, an action that commonly causes knee injuries. A program designed for this athlete will consist of agility drills and hamstring strengthening lifts. An average score taken for the front court players will be compared to an average for the back court players to see which has the

increased likelihood for ACL injuries. Each gender will be compared within its own team, and then compared against the other gender to see whether women or men have the highest risk at Longwood University. I hypothesize that women's basketball will have the highest risk because of research already completed by Padua stating that females are at a higher risk and also that front court will have the highest risk because of the sharp turns performed with the ball. The purpose of this study is to decrease the likelihood of ACL injuries at Longwood University. By researching ACL injuries and scoring the basketball athletes based on a predetermined scoring sheet, we can decrease the amount of re-occurring injuries in Longwood athletics.

The executive committee for my research will be composed of my sponsor, Dr. Coffey, the head of the strength and conditioning program, Rick Canter, and Dr. Morrison, a kinesiology professor at Longwood University. I am a junior in the kinesiology department and have taken multiple classes with Dr. Morrison and Dr. Coffey. During the fall, I will complete the LESS screen and score them and then compare the results. The spring semester will be mostly composed of researching other articles supporting my findings to publish and analyzing the data. It is important to understand the LESS scoring because the strength and conditioning coach will need to adapt the program for the athletes with at risk scores. Even athletes who are not at risk might need to have a different program developed that will strengthen muscles and tendons around the knee to eliminate risks before they can occur.

LESS Scoring Sheet KINS 386

Athlete Number: Reviewer:

Testing Date Review Date:

Measure	Description	Camera View	Score		Score
Knee Flexion: Initial Contact	The knee is flexed less than 30 degrees at initial contact.	Sagittal	0= Absent	1= Present	
Hip Flexion: Initial Contact	The thigh is in line with the trunk at initial contact (sagittal plane).	Sagittal	0= Absent	1= Present	
Trunk Flexion: initial contact	The trunk is vertical or extended on the hips at initial contact (straight back)	Sagittal	0= Absent	1= Present	
Ankle-plantar flexion: initial contact	The foot lands heel to toe or with a flat foot at initial contact (0▪ toe to heel)	Sagittal	0= Absent	1= Present	
Medial knee position: initial contact	The center of the patella is medial to he midfoot at initial contact	Frontal	0= Absent	1= Present	
Lateral-trunk flexion: initial contact	The midline of the trunk is flexed to the left or the right side of the body at initial contact	Frontal	0= Absent	1= Present	
Stance width: Wide	The feet are positioned greater than a shoulder width apart (acromion processes) at initial contact	Frontal	0= Absent	1= Present	
Stance width: narrow	The feet are positioned less than a shoulder width apart (acromion processes) at initial contact	Frontal	0= Absent	1= Present	
Foot position: external rotation	The foot is internally rotated more than 30 degrees between initial contact and maximum knee flexion	Frontal	0= Absent	1= Present	
Foot postion: Internal rotation	The foot is externally rotated more than 30 degrees between initial contact and maximum knee flexion	Frontal	0= Absent	1= Present	
Symmetric initial foot contact: initial contact	One foot lands before the other foot or 1 foot lands heel to toe and the other foot lands toe to heel	Frontal	0= Absent	1= Present	
Knee-Flexion Displacement	The knee flexes less than 45 degrees between initial contact and maximum knee flexion	Sagittal	0= Absent	1= Present	
Hip-Flexion displacement	The thigh does not flex more on the trunk between initial contact and maximum knee flexion	Sagittal	0= Absent	1= Present	
Trunk -flexion displacement	The trunk does not flex more between initial contact and maximum knee flexion	Sagittal	0= Absent	1= Present	
Medial knee Displacement	At the point of maximum medial knee position, the center of the patella is medial to the midfoot.	Frontal	0= Absent	1= Present	
Joint Displacement	**Soft:** the participant demonstrates a large amount of trunk, hip, and knee displacement. **Average:** the participant has some, but not a large amount of trunk, hip, and knee displacement. **Stiff:** the participant goes through very little, if any, trunk, hip and knee displacement.	Sagittal	0 = Soft 1= Avg	2= Stiff	
Overall Impression	**Excellent**: the participant displays a soft landing with no frontal- plane or transverse-plane motion. **Poor**: the participant displays large frontal plane or transverse plane motion or the participant displays a stiff landing with some frontal plane or transverse plane motion. **AVG**: all others	Frontal	0=Excellent 1= Avg	2= Poor	
	Total Score				

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R. Canter, personal communication, November 10, 2017.