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Period – 2

Commonality of ACL Injuries and Prevention Methods in Women

Anterior cruciate ligament or ACL injuries have become more common in the past decade than at any other time in our history. This could be based upon the fact that research on this specific topic has increased and improved. Doctors can now diagnose the injury consistently due to technological advancements in the field of medicine. Other factors could also be contributing to the growing amount of ACL injures. ACL tears are becoming more common in females than males, especially in young adults, because of the pressure being put on present day athletes' physical and mental well being, as well as four other components: hormonal, anatomic, environmental, and neuromuscular theories, therefore ACL tear prevention needs to be emphasized significantly more in all sports programs world wide.

ACL injuries are documented at significantly higher rates in females then males in all sports and are more commonly seen in soccer, softball, basketball, and football, with noncontact ACL injuries being the most common form. Women sustain two to eight times more ACL injuries for the same sport than men (Boden, Griffin, Garrett Jr., p. 2). So why is this the case?

One theory is hormones more prominent in the female body, like estrogen, may make women more receptive to ACL tears in athletics. Estrogen has receptors

on the human ACL, which makes it easier for the hormones to affect the ligament. Estrogen can relax the soft tissue of the knee. So when a woman is producing an increased amount of the hormone, which would be during the mid-cycle of a menstrual period, it would reduce the ligament's capability of being stretched, or the ligament's tensile strength, making it weaker then normal, therefore more prone to injury. Estrogen has also been reported to decline fine motor skills through both the central nervous system, which controls the spinal cord and brain, and the peripheral nervous system, which connects the central nervous system to the rest of the body using sensory and motor neurons. Deficiencies in motor skill could decrease neuromuscular protective systems in the knee. If the knee's protective system is down, the ACL could be at higher risk of being damaged.

> Estrogen's effect was analyzed in a retrospective study of 28 athletes who sustained noncontact ACL tears. All athletes reported a regular menstrual cycle. They found an increased incidence of ACL injury in women during the ovulatory phase (days 10 to 14) of the menstrual cycle, when a surge in estrogen production occurs, (Boden, Griffin, Garrett Jr., p. 2).

This theory further suggests that hormonal factors come into play when discovering a specific cause for the increased amount of female athletes ACL injuries.

An ACL's laxity could also be affected by estrogen. ACL laxity is assessed by using the KT2000 (MEDmetric Corp, San Diego) arthrometer, which is a device

that measures posterior and anterior tibial displacement. In a study, doctors evaluated more than 9,000 KT2000 results and they found a trend in increased knee laxity during the middle third part of a women's menstrual cycle. This shows that the hormone estrogen does effect the laxity of a female's knee during her mid-cycle which could be contributing to ACL injuries in women.

Another hypothesis is that a female athlete body's anatomy is why we see ACL tears more prevalent in girls than boys. A woman has a wider pelvis and greater average Q-angle, which place the knee in a more unstable position than men, which could contribute to ACL ruptures. Based on differences in extensor mechanism anatomy between the sexes, scientist Nisell found that at knee flexion angles less than 60 degrees quadriceps contractions of equal magnitude place an increased strain on the ACL in women (Boden Griffin, Garrett Jr., p. 3). So what may be responsible for the higher rate of ACL disruption could be this increased anterior vector.

Since women have displayed more muscle and knee laxity than men, they have more flexible hamstrings. The protective capability of this muscle group, including the hamstring, may be diminished and the pressures required of the muscle group to stabilize the knee would be put upon the knee's ligaments instead. Therefore, this could be a primary factor in determining the cause of ACL injuries in women.

Environmental contributors could also be causing anterior cruciate ligament destruction. The first contributor could simply be how an athlete's

footwear is constructed. A higher rate of ACL injuries has been reported in athletes who wear cleats that are placed at the peripheral margin of the sole with a number of smaller pointed cleats positioned interiorly (Boden Griffin, Garrett Jr., p. 4). This cleat design results in higher torsional, or twisting resistance, than other cleat arrangements. So when an athlete tries to pivot or change direction in this shoes, the foot cannot twist along with the athlete's movement causing an ACL rupture.

Uneven playing surfaces could be at fault as well. A multitude of patients who had ACL injuries occur documented landing or stepping on an uneven surface, like a bumpy grass field for instance, during the time of the incident. An unexpected foot position could disrupt usual knee movement patterns during physical exercise, increasing the athlete's likelihood of experiencing an ACL disruption.

An athlete's playing style is also a large environmental contributor. Playing style may be influenced by genetics, but also dependent on environmental factors like training tactics and coaching techniques. ACL injuries could be caused by gender variations in movement patterns and athletic posture.

> Videotape analysis of male versus female athletes revealed that women tend to play sports in a more erect position. This was recently confirmed in a jumping study with the aid of a two-dimensional motion analysis. A more upright position amplifies ground reaction forces that increase the load transmitted to the knee and maximizes anterior shear forces from the

quadriceps, and ACL antagonist (Boden Griffin, Garrett Jr., p. 4).

So since women have a more erect position than men do, giving them a more upright position, scientists are seeing more knee injuries happening to females. The more erect position puts more pressure on the knee's ligaments, including the ACL, which results in severe tears to the ligaments of the knee.

Research on ACL tear causation has been more recently been focused on neuromuscular performance elements. Neuromuscular control of the knee involves a complex interplay between the neurosystem and the muscles that cross the knee joint (Boden Griffin, Garrett Jr., p. 4). In other words, the brain must send signals to the muscles located around the knee joint in order to make the knee move. If these knee joint movement patterns are altered in some way, this could lead to ACL rupture. For example, if a delayed or faulty brain signal is sent to the knee instead of a protective muscle response.

The relationship between movement pattern and muscle pattern of the quadriceps and the hamstring muscles needs to be balanced and is important to knee stability. The quadriceps, which are located at the front of the thigh, affect the ACL significantly. Scientists have found that quadriceps contraction increases ligament strain on the ACL between an interval of 10 degrees and 30 degrees of knee flexation. This is significant because more noncontact ACL injuries happen when the knee is almost fully extended. When a patient is trying to recover from this injury they should not participate in quadriceps extension to prevent ACL graft strain.

The hamstring muscles are more of a “stress shielder” in contrast to the quadriceps. This is dangerous because any increased flexibility, weakness, or delayed neuromuscular motor signal to this muscle group could increase the risk of a ligament tear. Huston and Wojtys, two scientists, compared neuromuscular response in male and female athletes and found that females had more laxity in their hamstrings as well as less muscle strength and endurance. Also, females relied more on their quadriceps muscle group than their hamstrings. Their hamstrings had much slower muscle torque after force was applied. Therefore, an alteration in neuromuscular signals could make a female's ACL more prone to injury than males.

Any athlete who has been coached by an individual has heard at least one if not all their coaches say that the athlete is out on the field or the court for two important reasons: to do their absolute best, giving 110%, and to have fun. However, because of the increasing competitive aspect of team sports, especially in younger athletics programs, and the colossal amounts of financial support that is put into sports programs, the pressure put on the youth has built up tremendously. The growing intensity of youth sports has been a significant element in the rise of knee injuries by putting s strain on adolescents’ young bodies. Over usage has made their bodies more susceptible to ligament damage. Most youth sports teams are adopting and developing a year-round model, where athletes constantly work their bodies without rest. If athletes do not take care of their bodies or properly execute their injury prevention techniques, they will

inevitably sustain a future sports related injury.

An ACL prevention program consists of three different components: stretching, plyometrics, and weight training. The program first focuses on teaching an athlete how to properly jump and land emphasizing posture, knee stability, and softer landings. Plyometrics training deals with jumping and landing techniques.

Athletes should avoid any excessive side-to-side movement and inward buckling of the knee when landing, which is more commonly seen in girls. They should try to land on the balls of their feet with their knees flexed chest over the knees. Weight training is used to strengthen the hamstring and quadriceps muscle groups, which will help prevent tear if both muscles have a more even strength ratio. Stretching the ACL before and after an athlete plays their sport helps the muscle be less prone to injury because it gets the muscles ready for exercise by making them more flexible and able to withstand more ground reaction force and doesn't allow the muscles to just tighten back up afterwards. With these ACL injury prevention techniques an athlete will drastically decrease their risk of injury.

Due to the four hormonal, anatomic, environmental, and neuromuscular theories and the differences between females and males in estrogen levels, playing style, body anatomy, and neuromuscular control of the hamstrings and quadriceps muscles a female athlete is more susceptible to ACL injury. By incorporating prevention programs that involve weight training, plyometrics, and

stretching into youth sports programs, I believe the amount of female athlete ACL injuries will decline significantly.

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