



Knee Injury Prevention and Female Athlete Health Program

ACL/Knee

Special Section on the Female Athlete

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Anatomy

Open vs Closed Chain

Strength

1. Eccentric versus concentric

Research Says....

There were around 3 million ACL injuries in females in the year 2003. At an average cost of \$20-25,000 per injury in the all aspects of the health care industry, ACL's are a big business. This is why there is so much research guided toward physicians, therapists, and athletes as to how best surgically repair and rehabilitation the patients. It has also been said that the likelihood of injuring the non-injured ACL can be up to 50% greater than in those without ACL injuries.

Prevention

Physical therapists, athletic trainers, and certified strength trainers (Personal Trainers, Certified Strength and Conditioning Specialists) can help you to prevent injury in your knee, and lower the rate of injury for the future after surgery. There are 5 things to think about in regards to the ACL, that can help prevent injury.

1. Muscle structure. When speaking of the thigh/upper leg muscles, we have inner, middle, and outer quadriceps, all placing different forces on the kneecap. When all in harmony, pulling equally, the knee cap should, essentially, stay aligned, as well as provide balanced forces to straighten the knee. However, when the forces are unequal, the result is a biomechanical imbalance. In order to keep this potential low, strength training for all quadriceps muscles is essential. Vastus Medialis Obliquus (VMO) is the inner muscle, which is most times the weakest of the quads. Essential training needs to take place specifically for this. Biofeedback, a method of muscle

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contraction with coordinated feedback to the patient on strength of contraction through lights, sounds, or other methods, is a great way to train patients. It is a way, as well, to teach the patient where the muscle is and how to isolate the muscle (still under debate with scholars as to whether semi-isolation is neuro-muscularly possible).

2. Hamstring/quad ratio. The hamstrings bend the knee, and the quadriceps straighten the leg. They are opposite muscles that often time are very imbalanced. Because of biomechanics, muscle attachments, ligament structure, and bony alignment, if one is stronger than the other, the result can be uneven forces within the knee joint itself, placing forces on the structures within the knee, and then possible injury. The other reason that muscle balance is so important is so that when the knee/lower leg, is placed in a precarious situation, the muscles need to either co-contract to stabilize, or use one of the pair more than the other to pull out of a bad posture in a controlled manner. When either of these cannot be accomplished, there is disharmony, and potential for injury by overcorrection of body postures.

In strength testing, you want as close to a 1:1 ratio as possible. Many gymnasts, for example, are often seen with 3:1 quad/ham ratio because of the dominant demand for the quadriceps in sport. This is why sport specific training is good *in addition to* balanced muscle training outside of sport for injury prevention.

3. Proprioception. This is a term that is frequently used in rehabilitation of everyone from a stroke patient, to an elite athlete. Proprioception training makes one more aware of where their muscles and bone structure is in space. It will make a person able to be stable, while outside perturbations are enforced (i.e. standing on a pillow or Airex pad while the therapist tries to knock the patient over. Another example is standing eyes closed and doing ½ squats without falling over). Strength has many attributes, and two of those are amount and availability. If the body is strong, but does not know how or when to use it, there is a problem.

Proprioception is important in individual sports as well as contact sports. For example, figure skaters need to have proprioceptive and kinesthetic awareness in order to know where the body weight falls in relation to the weight bearing aspect of the foot upon landing a triple jump. If the skater can “feel or sense” where the body weight is, immediate corrections can be made with weight transfer, activation of muscle groups, etc. Football players need to be aware of this for when they are tackled, blindsighted, from any direction. The quicker the reaction time of the muscles to stabilize the disharmony caused by the outside force, the more likely the player to stay standing, or prevent injury.

4. Plyometric training.

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Plyometrics involves a pre-stretch of the muscle fibers, and then subsequent use of that “stored kinetic energy” to produce a higher force than the muscle can produce without pre-stretch. It, for the lower body, can involve jumping from a higher surface to the floor, and performing a height jump. Variations of this training can be done to help prepare the body for injury prevention and/or return to sport. One of the most simple aspects of training is often the most overlooked. Plyometrics should be incorporated in the ACL rehab when appropriate, and should be in most sport-specific training programs and/or conditioning regimens.

5. Body structure.

Well, as we all know, you cannot choose your parental genes that you are born with. Body structures are given to you, bones, some muscle alignments, etc. Now, that does not mean that things cannot change, or that we cannot biomechanically adapt your body to prevent injury.

1. Females and the q-angle. The q-angle is the angle that the thigh bone (femur) makes in relation to the hips and the lower leg (tibia). If you take a look at someone standing, most likely their ASIS (the pointy bone of the front of the hip) is wider than the knees. This creates an angle, a *valgus* angle (away from midline) that predisposes a person to injury, muscle imbalance, etc. Strengthening can be done to help bring the body to balance. Ask your physical therapist about more specific, individualized analysis.
2. Arches. Most people know the arches in the feet as flat or high. Flat arches are called pes cavus, or navicular drop. They can be caused by a number of things, including lack of foot and ankle strength, former broken bones, loose ligament structures, or navicular structure problems. In addition, and most importantly, it can be an active, controlled, biomechanical/strength problem. This includes weak quadriceps, weak ankle controlling muscles, weak hip abductors (the ones that pull the leg out to the side) and/or weak hip external rotators (the ones that turn the femur outward, think ballet). With strengthening the foot, lower leg, ankle, thigh, and hips, we can structurally align a person for active motion in a more controlled and balanced manner. The last, and probably most important aspect of ankle and foot control is core stability. When the core is stable, including the abdominals, back extensors, back and abdominal rotators, hip rotators and the 4 directions of femur control (flexion, extension, abduction out, adduction in), co-contractions help to support the lower body. Think of it this way, it is much easier to stand and balance on a hard, steady surface than it is on an air-filled pillow. In this case, the support comes from up above, in the core, so that the muscles below have a steady beginning and end to focus on (core to ankle).

6. Balance

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This simple concept refers to left to right balance. This is especially important in the unilateral athlete (pitchers, ice skaters, gymnasts, dancers, baseball hitters, etc.) when one leg is asked to do the same repetitive motion, different from the other. Making sure that both legs have equal strength lowers the risk of dominance, or overuse syndromes in the strong leg. This can eventually lead to fatigue, breakdown, and an increase in potential injury.

Sport Specific Training

Not only does a person need to understand the sport that they are playing for strategy, game plays, etc. First, they also need to understand the biomechanics of the sport. For example, foot placement, knee bend, lower body alignment, all effect muscle tension and strength, potential strength production, and potential injury rate. Second, athletes need to participate in sport specific training *and* cross training. Humans need to work opposite muscle groups for stability and balance.

Fatigue

Fatigue, including overall sleep deprivation or muscle fatigue, can increase risk of injury. The hip, ankle, core *and* knee/leg muscles all have to be functioning at 100% to provide the joints and ligament with the best possibility of protection.

Overall Body Health for the Female

Most people have heard of the Female Athlete Triad, but few truly understand what it is, and most importantly, how to prevent symptoms and the triad itself. Knee injury often can coincide with amenorrhea and loss of bone density at a level higher than normal known as osteoporosis. There is a cycle of self-destruction that happens in the female body, being lower in weight, having this effect eating habits, losing more weight and eventually muscle mass, not getting proper nutrition, losing bone mass, becoming weaker, eventually dropping so low in body fat percentage that one become amenorrheic. The ligaments in the body need overall support to function: they need good tendon strength to attach onto the bone, they need good bone to anchor to, they need proper rest to function correctly, they need and are effected by hormones in the body produces with a properly functioning female, such as estrogen and testosterone. These effect the collagen strength and well as can effect the joint structure, increasing laxity. When these aspects, as well as many others are out of sync, there is a lack of homeostasis in the body, and a higher risk of overall body health depletion and injury.

ACL Injury Advice

In conclusion, there are many advanced ways that your physical therapist can help rehabilitate/prevent ACL injury . Here are just a few:

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- Make sure you are seeing a sport-specific physical therapist, if at all possible. They will guide you to rehabilitation in the beginning, but most importantly, directly guide you into a transition phase back to sport. Just being able to pass a jump test that basketball players perform does not mean a tennis player or gymnast can return to their sport.
- Make sure you are seeing an orthopedic educated physical therapist. They know about bones and joints, and most likely have continuing education courses in joint structure and biomechanics. You can always ask your potential therapist about the accreditations and background.
- Find someone certified in ACL protocols, like the *Frappier* Acceleration® method and their “ACL Bridbge Protocol.” There are only a handful of therapists in the USA that are certified, and actively practicing. This research-based program was developed to maximize the potential of the injured athlete, and return to sport as prepared, balanced, and strong as possible. See www.?????????.com for more information, or visit OccuSport.com for a therapist near you.
- Seeing your therapist as soon as possible after injury (even before surgery) can maximize your potential. Keeping all surrounding musculature strong is very important. Keeping the core strong, or increasing its base strength, is very key to rehab. The faster the swelling goes down, and the quicker Range Of Motion (ROM) is re-established, the sooner surgery can be performed.
- Hands-On. There are many Manual Therapy techniques that can be performed to prevent scarring. After surgery, make sure that your therapist puts their hands on your knee, to *feel* the structure, muscle tissue, fascial tissue, knee cap (patella), etc. A hands-off, exercise based, approach is *not* going to maximize your output. There are tendonitis issues to prevent, knee caps to align properly, muscles to train, and scar tissue to break up/prevent that are of utmost importance in the rehab process.
- Most importantly, listen to your doctor’s protocol. A speedy recovery is not necessarily a good one. Be patient, and you will be stronger than pre-injury. Take this injury opportunity to strengthen yourself, as a whole, and you will see the benefits!!!