The ABC's of ACL's for Gymnasts

Gina Pongetti, MPT, MA, CSCS, ART-Cert
medgyminfo@gmail.com
www.medgym.com
Shannon Miller Lifestyle Contributor/Blogger
www.shannonmillerlifestyle.com

Knee injuries can be fierce for a gymnast, and take a long time to recover. So many great gymnasts, men and women, have been effected by knee injuries that have caused them to lose parts or all of their season, such as Shawn Johnson, who tore hers while skiing in 2008, and Jason Gatson, who has had 2 ACL surgeries and was an icon in the sport for over 10 years. And then there is Justin Spring, who tore his while vaulting at Nationals in 2007, and then went on to have a wonderful showing at the Beijing 2008 Olympics. On our way not to London in 2012, we have seen many of our national team members sustain knee injuries, and fight back from them… but not without incredible amounts of hard work and multi-disciplinary treatment. Because gymnastics is a weight bearing sport, it is really hard to "stay off" of your knee. With ligament injuries in the knee (most commonly either the MCL or ACL in gymnasts), if they tear, it is a 4-6 month surgical/recovery process. There is not a large amount of information on ACL injuries specifically for gymnasts in the research and media, and even less on the return-to-sport advice-giving side. So, here is a great summary and start to your knee education- a link to the entire article can be found at www.medgym.net/

What is the ACL and what does it do?

The Anterior Cruciate Ligament is a connection between the femur (thigh bone) and the tibia (shin bone). It is one of two ligaments (the other being the PCL or posterior cruciate ligament). The ACL prevents excessive or out of the normal range of motion of the knee, specifically the translation or forward slide of the tibia on the femur. Research states that women are more likely to injure theirs, and studies have looked into and cited many reason, among which are estrogen levels, wide hips or Q angle, and lower extremity muscle underdevelopment.

How is it especially important in gymnastics?

The ACL provides stability to the knee in a very unstable environment. A gymnast needs to land in so many different ways: two footed, one footed, soft surfaces, hard surfaces, various manufacturers of equipment, trampolines, landing mats, spring floors, plyometric conditioning and more. The body, because of all of these different reaction surfaces, needs to get used to so many different situations, that Muscle Memory, or the body getting used to combinations of timing, muscle use, joint position on impact, ground reaction forces and more, can be lower because of so many situation options.

As well, skills are learned when they are transitioned from lead-ups, or drills, to various matting, to actual hard surface completion. Throughout this process, "short" landings, or over-rotations, or under-rotations exist within the

learning process, until the athlete perfects timing, air sense, and more. Gymnastics is unique in that the risk often to completion of skills is not in the performance upon attainment, but in the learning process itself.

Lastly, the velocity, torque, and ground reaction forces are high. The sport often requires high speed flipping or rotation that is not slowed down in the air prior to impact with the ground, but instead, at the time of impact with the ground or matting. Therefore, if the alignment is not perfect, joints take forces that the ligaments are not intended to withstand.

How does it get injured?

Most of the time, the ACL injury is done with hyperextension of the knee or excessive torsion of the knee joint. In the sport of gymnastics, mechanisms of injury include but are not limited to:

- Landing flipping or twisting skills with *legs straight* because of a lack of air awareness, location of the floor when in the skill
- *Landing short* in piked or lay out based skills, such as vaults and skills like double back pikes on floor. The legs are straight in the air, and the ground is not properly anticipated.
- Twisting skills that are landed with the shoulders, hips, knees and toes *not "squared"* or in alignment with one another. The knee then gets torqued, taking most of the stress when the femur and tibia rotate in opposite directions, or one rotates on the other one. Rotational injuries are often accompanied by meniscus tears, and sometimes by a medial collateral ligament (MCL tear). This is known as the Terrible Triad.
- Lastly, it can be injured with the *knees flexed and rotated* at the same time. Most of the time, and rarely, this happens in high velocity situations like Arabian double front half outs, or handspring double front halves on vault, or toe front twisting dismounts off of bars.

What are some risk factors?

There are also some risk factors that people may have (*human*), that the gym may provide (*environmental),* and that the athlete/coach relationship may provide (*communicative/coaching*). Those are:

Human:

- **Weak hip rotators**. These are the muscles that turn your leg (femur) in and out in the socket of your hip. These are important for preventing your knee from "caving in" when you land.

- **Poor ability to co-contract muscles** - your glutes, quads, hamstrings, and spine extensors together.

- **Poor core muscle strength, activation, or control**. Your core muscles include your abs, rib muscles, hips, some shoulder and glutes, as they all work together to stabilize your midsection, and allow your arms and legs to move with more efficiency and stability. In the sport of gymnastics, core tightness allows for better blocking on tumbling takeoffs, and vault, allows maintenance of better positioning on bars, and is necessary for many skills especially on rings, on pommel horse and more. Core strength relates to the knee with regards to stability, balance, landing control, and more.

- **Flat feet.** A risk factor because when the arches cave in, it allows the knees to cave in (genu valgum) and the tibia to rotate on the femur as well.

- **Hyperextended knees.** This is an issues because it stretches out the ligaments that control knee extension, makes the joint "sloppy," and means that athletes stand with the knees "locked out" instead of using muscles to maintain knee position and stability.

- **Improper landing technique.** Positioning of the hips, knees, and feet are important. Core muscle activation is necessary to make sure that the body is stable.

- **Anatomical predisposition**. This includes wider Q angle (hip- knee alignment and angle), and other bony and ligament tension/length issues that can be determined by tests done by your MD and some by your PT, including Anterior Drawer Test, X-Ray, MRI, and more.

Environmental:

- **Improper matting.** Mats that are old, worn down, have parts that are cratered, or worn through, or that are not level need to be replaced. In addition, matting needs to be flush, meaning that the mats cannot be various heights throughout the landing surface, or it will allow for the foot to land crooked, de-stabilizing the ankle and the whole kinetic chain of the hip-knee-toe alignment. The USA Gymnastics Safety Certification Manual and Course should be referenced for wonderful advice regarding matting, requirements, and suggestions for injury avoidance as well.

- **Bad floor** – most of the time the foam. Divots, bad springs, or worn-down foam can cause improper footing, wobbles, and body positions that are not proper due to how the foot impacts the floor.

Communicative/Coaching:

- **Skill readiness**. If the athlete is not ready to do the skill, they can get hurt. They need to understand that in order to do a back double full, the hips, shoulders, knees and toes ALL have to make it 2 revolutions around. If the feet land too soon (not enough height, or not a fast enough rotation) and the body keeps twisting, the knees will be "torqued" and injury may result.

- **Improper landing surface suggestion**. If the athlete is barely landing a back double full on a soft surface, possibly below ground level (pit or resi) and is forced/suggested/convinced to perform this skill on a hard surface, the ground may come a bit sooner that the athlete had projected. This is often because of poor technique, of setting, twisting, body shaping, and more. The issue is that the coach needs to provide unbiased, without ulterior motive, advice, objectively, that allows the athlete to trust him/her in guiding the gymnast to when he/she is ready to perform the skill properly. Too many times, a coach will place an athlete in a situation where she/he is not prepared, meaning that it is a recipe for disaster.

- **Fatigue.** Similar to the improper landing surface, if an athlete is tired, no amount of yelling (or form of motivation) will make muscles function! It makes common sense that as repetitions get higher, muscles get tired. As repetitions get higher and the day gets later, the athlete is fatigued – mentally and physically. And, the adage of "one more" is always "one too many." Sometimes coaches use this as motivation, because the coach is frustrated that the athlete is not performing the skill properly. However, at that point in time, there is a large possibility that the athlete needs to be taken to do lead-up drills, or simply leave the skill for the day, move on, and come back. Using this time to mentally coach (imagery and other techniques) is also a good idea. Whether the athlete is truly "giving it their all" and may be acting lazy, or they are actually fatigued,

matters for the future. But at the present time, either will result in potential injury and matter-of-factly, increase injury risk.

- **Pulling the plug.** The athlete always needs to understand that there is a way out of a skill. This comes with actually making the athlete "fail" or pull out (safely) before it happens acutely, to teach him/her how to be safe. Involved in this is the art of safe falling, recognizing poor takeoff, being aware of surroundings, and knowing how to stop the flip or rotation halfway through without "freaking out" or "balking." Examples of this that effect the knee are:

    - **Bars-** whether men's or women's, the bar is high. Athletes need to know that if they do not make their giant over, of a blind goes wrong, or if the grip is not right on a front giant, that they can safely land on the mat, absorb gravity, sit, roll back, etc. If they have never "fallen" because they are used to doing the skills over the pit (where they fell numerous times in the learning process but did not have to worry about injury) then they are predestined to be scared to fall, and not know how.
    - **Floor tumbling-** the athletes need to know that in double flipping skills, a really high-set single is always an option. They need to know that in a twisting skill, if they do not want to do the double or two and a half, and want to pull back to a single, they can, but they will have to slow rotation, know where they are, and stop the "dig" or angle at takeoff if they know that early.
    - **Beam –** if landing a layout step out on one foot is going to be too far off to the side, and the torque on the knee too much, the athlete should know this upon take off, or at least upon first glance at the beam. She, therefore, should know to touch her foot to the beam and push off to the side, or simply to land on her feet on the ground, prepared, versus trying to save it and twist her knee.

- **Basics.** Whether you are a parent, athlete, coach, gym owner or spectator, you have been to meets where you clearly see that gyms are "better" than others. An interesting scenario would be to take the gyms who's athletes are struggling, and move their kids back one level, to be able to perform skills that they can do properly, with good form. Yes, this would not allow that gym to have as high of level of athletes, but since when do we judge on numbers of kids at level 9 or 10 versus great looking 8's? This all comes down to basics, conditioning and body shaping, plain and simple. Athletes are all to often moved through levels too quickly because of many factors. Some of those are: 1) gym wants a better recognition of having higher level team kids. 2) Athletes are "Stuck: in a level, so instead of fixing issues, they just get moved up. 3) the basic requirement for USA Gymnastics to move levels is set at a very achievable level and does not mark perfection, just accomplishment. If the gym uses just this bar of measurement and not skill sets and other milestones, the athlete is set to be too challenged. 4) Parental pressure. Kids are moved up because parents think their athlete should be. I always say, unless as a parent you are a former gymnast and a coach at m gym, leave the level advancement to those that coach the kid! 5) Age. As athletes get older, the better kids get younger… no one wants to be a third year level 5 at the age of 16 with 8 year olds… and 6) Peers. Gymnasts who stay at the same gym for any amount of time are often in a group that competes, improves, travel and advances together. When you are left behind and the group moves up, you become sad, lonely, and socially unmotivated, which is a big part of this sport. So… in summary, basics are important. And you have to have core strength, stability, skill progressions, and understanding of the mechanics to move on… not just the 6 factors listed above!

What is the rehabilitation process?

The rehab process is varied, depending on 1) the severity of the injury, 2) if there are other ligaments, soft tissue, or bony surfaces that are injured, or 3) if the case is surgical or non-surgical, and 4) if surgical, what the procedure is. All of the options should include the following:

1. Initial focus on regaining proper *Range of Motion* (ROM) of the knee joint, patella (knee cap), and hip. Flexibility of the hamstrings, hip flexors, quads, and calves as well as gluteals is very important in rehab and prevention.
2. *Soft tissue work*, hands on certified techniques, such as Active Release Techniques (ART), Graston Technique (GT), Strain/ Counterstrain (S/CS), Myofascial Release (MFR) and more are crucial to making sure that scar tissue does not form, contractures of muscles are not allowed, and tension in muscle attachments is proper.
3. *Maintaining proper core muscle strength*. The gymnast can stay active in many aspects of conditioning so that when the knee is ready, that is the *only* thing holding the athlete back from progressing, instead of taking full time off and having to re-train muscles that have been dormant for no reason.
4. *Maintaining proper gait* – as much as possible. If the athlete is placed on crutches, making sure that the other leg is not overstressed and that the shoulders are not injured due to supporting body weight abnormally. If the athlete is to do partial weight bearing, or wear a knee brace (especially when locked in extension), that alters normal gait and will effect the hips, low back, SI joint, ankle, and more. The PT can give advice on how to help to prevent this during this time that is unavoidable.
5. *Balance* needs to be regained and maintained. Working the other side, and eventually both sides safely, will help the athlete feel like their equilibrium is present, and prepare for return to skills.
6. *Strengthening muscles in open chain* (meaning non weight bearing) at first. This includes the ankle, knee, and hip.
7. *Strengthening in weight bearing* as soon as possible or allowed.
8. *Bracing* the athlete properly so that they can start skills that are low risk, such as handstands, turn on the uninjured leg, and conditioning skills while keeping re-injury to the injured knee low.
9. *Introducing all aspects of the sport* including landing position, air sense, twisting, turning, and inverting (handstands) as soon as released to, so that proprioception (knowing where the body is in space) is maintained and/or regained.
10. *Gradually increasing touches/jumps, meaning "counting"* each jump from warm-up, to skills, to rehab exercises to conditioning, making sure that the total number in a day and a week does not increase too rapidly.
11. *Reintroducing skills* as the athlete feels comfortable, as the injured and uninjured leg are equal in strength, and as fatigue throughout practice and the week is monitored.
12. *Doing exercises* well after the athlete has returned to gymnastics, to maintain strength through the 9-12 month range, and even beyond.

When can someone return to sport?

Benchmarks have to be met in order to return completely. Athletes really should never be out of the gym at all with ACL injuries, except for the initial day or two after surgery. Otherwise, core exercises can be completed without risking injury to the leg. Arms and back can maintain strength, even when the athlete is on crutches if that is prescribed. As the athlete progresses, they will increase skills based on

1. *How easy the skills are for the athlete.* If it is a level 5, and a split leap is challenging, that is a last level addition. If it is a level 10, the split leap may be added sooner as it is considered a basic skill.

2. *Landing surface*. Believe it or not, the order in which an athlete is allowed to land on mats is different than you may think… Pits offer torqueing of the joints that cannot be controlled. Soft landing mats offer uneven surfaces for the ankle to struggle, therefore passing stability demands up the kinetic chain to the knee and hip, which are bad for initial stages of recovery. Trampolines offer varied demands for muscle co-contractions and can often lead to a loss of control.

3. *Time*. In some cases or rehab, time is the key. Research has proven that there is a certain amount of time needed for the wound to heal, the ligament to really attach to the bone, edema/swelling to go down (swelling can inhibit proper muscle activation), and that there are times that the ligament is more likely to re-tear.

4. *Strength*. There is a certain baseline strength that is necessary to be released to perform skills, even if the athlete thinks that they can return. For example, she may be able to *do* a standing back tuck, but are the muscles that should be working actually working, or is she compensating? Are the muscles supporting the joint or is there extra force on the joint? Is she doing it properly? All of these are concerns. Oft times, physicians will "release" the athlete to run or jump, when he/she has not (or does not have time in office) to "test" the athlete for required benchmarks. As well, if the Physical Therapist is not familiar with gymnastics, phrases like "just return slowly" or "do beam, but vault is too much" are wrong and not properly administered. Making sure that the PT was a gymnast, or is very familiar with the mechanics of the sport can make or break proper rehab, re-injury potential, and more. There are lead-up skills in running and jumping that need to be performed with proper position and weight, very similar to how a back tuck comes before a back full. These include squatting on two legs, squatting on one leg, leg pressing body weight percentages, progressing to jumping on two legs, jumping on one leg, and then starting to run. That is just one example (leaving out many other small steps before and within) and how complicated the rehab process can be.

5. *Edema*. Research studies over time have shown how swelling within and around the joint and the knee cap can be detrimental to the activation of the quad muscle, hamstrings, and other small muscles that control the rotation of the knee. Swelling is not something that should be pushed through. If skills are performed with the knee swollen, and the athlete performs skills that need muscle activation to pull her out of danger or compensation, muscles may not work as strongly or as quickly, therefore resulting in injury.

6. *Repetitions*. The athlete needs to prove to the therapist and coach that basics are re-mastered before higher level skills are added. This is important for performance, timing, body positioning and more.

7. *Proprioception*. When the athlete knows where their body is in space- has low reaction times to balance perturbations and understands how to correct them without actively thinking about it, they are ready. This is different for each person, and a product of early intervention with a great PT as well as working in all 3 planes of motion at all times.

8. *Gait and Biomechanics Evaluation*. One needs to go through evaluations such as FMS (Functional Movement Screening), using DorsaVi software, gait evaluation with sensors and motion/ground reaction force assessment. This is imperative for each sport, no matter the sport, because although the basics of strength may be pervasive through most sports, over 33% are sport specific.

How can we prevent ACL injuries?

1. Analyze risk factors for the athlete, as noted above.
2. Be vigilant about matting and proper environment for training.
3. Make sure the athlete is prepared for all situations of not performing the skill perfectly, and how to be aware of "pulling out" of the skill, or landing prepared.
4. Strength, of the lower extremity. Especially the balance between the quads, hamstrings, and gluteals.
5. Strength, of the core muscles.
6. Balance training and proprioception, as described above.

7. Making sure that the athlete is going through these prevention exercises as part of training multiple times per week, so that the neurological system does not forget its training.
8. Do not advance skills too quickly.
9. Recognize factors of fatigue in training within the day, within the practice, within the week, and within the season.
10. Make sure that the athlete's weight and strength are appropriate for the skills that he/she is performing.
11. Practice landing positions with basic skills, to over-emphasize co-contractions of muscles and absorption of force from multiple directions: flipping, twisting, various heights, and various speeds of landing.
12. Flexibility- of the hamstrings (both at the hip and knee) as well as the gluteals, and the thigh (quads and hip flexors). This is to make sure that the knee is not being pulled in any one direction, making the knee cap sit unevenly on the knee, etc.

This is, of course, not all-inclusive, or the only way to go about rehabilitating the knee. Factors will vary based on age, level in gymnastics, access to proper therapy (distance, time, location, etc.) as well as commitment to rehabilitation from the athlete, parent/family (transportation, support, etc.), coaches, and peer support from teammates. Best of luck with the rehabilitation process to you, your athlete, your family member or friend. And, if you are learning about prevention, kudos to you for giving your gymnasts a great head start on a healthy career!