

ACL Tears in the Female Athlete: Train It or Sprain It

By John O'Kane, MD and Jordyn Eisenhard, ATC

Anterior cruciate ligament (ACL) tears occur in both genders, but female athletes are at higher risk with college basketball and soccer female athletes having a threefold higher risk than their male counterparts. The effect of this discrepancy has been amplified in the past few decades as a result of the passage of Title IX in 1972 resulting in large increases in female athletes participation and participation at higher levels of competition. In 1972 there were 300,000 female high school athletes and in 2007 that number grew to three million. It is currently estimated that one in 100 female high school athletes and one in 10 female college athletes will sustain a serious knee injury each year.

ACL tears occur most frequently in the act of landing or planting and cutting. They can occur with or without contact from an opposing player and female athletes are at higher risk of noncontact injury. Notoriously high risk sports include football, soccer, basketball, team handball and alpine ski racing. In females, the peak injury incidence occurs between ages 15 and 19. ACL tears do not heal but the ligament can be surgically reconstructed using harvested tendon or ligament from the patient or a deceased donor, although this has fallen out of favor in young athletes because of higher risk of re-rupture in donated tissue. Most medical experts recommend an ACL reconstruction for young athletes to restore knee stability allowing return to sport. The surgery is far from a perfect solution though, with athletes unable to return to sport for a minimum of 6-9 months while full recovery can take up to two years. For a young athlete



whose social identity is tightly linked to their sport, the loss of their sport for this length of time can be devastating. In addition, about half of all ACL tears have associated cartilage injuries that are more challenging or impossible to fix. Lastly even with surgery, there is evidence that over half of athletes sustaining an ACL tear will have evidence of knee arthritis starting within 12 years of injury. As a result there is great interest in preventing these injuries.

Anatomy

The anterior cruciate ligament (ACL) is located in the middle of the knee starting on the posterior aspect of the distal femur (thigh bone) and attaching to the anterior aspect of the proximal tibia (leg bone). It prevents the tibia from moving forward and also helps prevent rotation of the tibia. Because the quadriceps muscle also pulls the tibia forward, strong quadriceps activation is associated with ACL injury. The hamstrings attach behind the tibia and help prevent the tibia from going forward. As a result strong hamstrings and specifically hamstrings that are strong relative to the quadriceps are associated with lowering the risk of ACL injury. Because body position is associated with ACL injuries, strong hip and trunk muscles and good control over those muscles in athletic situations is also associated with lowering the risk of injury.

Causes of Injury

There are a range of theories to explain the higher risk of injury in females. The effect of hormones, specifically estrogen, has been studied.

There is evidence that high levels of estrogen can increase ligament laxity, and that increased laxity is associated with ACL tears. However, there is not consistent evidence that ACL tears occur at a specific time in the menstrual cycle. There is variability in joint laxity from person to person and those with loose knee ligaments are at higher risk for knee ligament injury. There is also evidence that those with smaller ACL's and those with a tibia that slopes downward posteriorly are at higher risk but these anatomic variables are not easily modified, so these factors could identify somebody who is at higher risk, but fixing these issues is impossible or impractical.

Fortunately there are muscle strength and biomechanical factors associated with ACL injury that are modifiable. One interesting finding is that before puberty, an ACL tear is rare and not more frequent in girls, but after puberty the girls' risk increases significantly. Through puberty boys naturally increase their hamstring strength more than their quadriceps strength while girls develop stronger quadriceps and their hamstring strength changes very little. This creates a muscle imbalance in young women and "quadriceps dominance" places

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the ACL at higher risk. A number of biomechanical differences also increase the risk for females. Females are more likely to land with a knee that turns and bends inward, known as valgus alignment. This alignment is associated with increased risk. Females also tend to land from a jump with a more upright posture and less knee bend. This position facilitates quadriceps activation and inhibits hamstrings increasing ACL risk. These muscle imbalance and biomechanical issues are modifiable and are the primary target of ACL injury prevention programs.

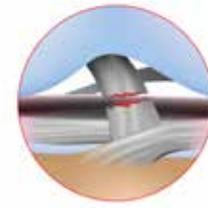
Preventing Injury

A number of injury prevention (or more appropriated injury reduction) programs targeting proposed ACL risk factors have been developed including the FIFA 11+, PEP program, Sports Metrics and PEAKC. A number of features are common to each program including a dynamic warm up (actively moving through a set of stretches), a plyometrics section (jumping), an agility section (emphasizing balance with hopping and change of direction) and a strengthening section. Each program teaches lower risk movement patterns emphasizing proper (less valgus) alignment of the knee and hip specifically with landing and cutting, the activities most associated with ACL injury. Specific instructions for each program are accessible on-line.



Efficacy and Implementation of Injury Prevention Programs

Across a range of studies, most injury prevention programs reduce the risk of serious knee injuries by 50% or more. While girls are often the primary target, boys can also significantly reduce their risk with these programs. Age 14 or puberty is often identified as the appropriate time to start these programs and results for teens as opposed to college age players are the most dramatic. Improved compliance does improve outcomes. One study showed that the most compliant players had an 88% reduction in risk while the least compliant did not benefit and while many of the programs recommend training twice a week, at least one program with weekly training over the course of a year was effective. It takes time, probably at least six weeks, to begin seeing a reduction in injury risk so programs should start pre-season and be



Anterior Cruciate Ligament (ACL) Injury

continued through the season to be most effective. Not only do injury prevention warm-ups reduce injury, but they also have been shown to increase balance, vertical jump and other measures of performance.

Despite proven benefits of injury prevention programs, U.S. youth sports clubs have been slow to incorporate them. Sports physicians, physical therapists and certified athletic trainers all have a role in encouraging youth organizations to adopt these programs and studies have shown that if a health professional teaches the coach and/or the athletes, the programs are completed more effectively. Education then “buy in” starting with the coaching directors and board members is an effective strategy to improve longer-term compliance and “marketing” these programs for both injury reduction and performance enhancement is both valid and proven to improve compliance.

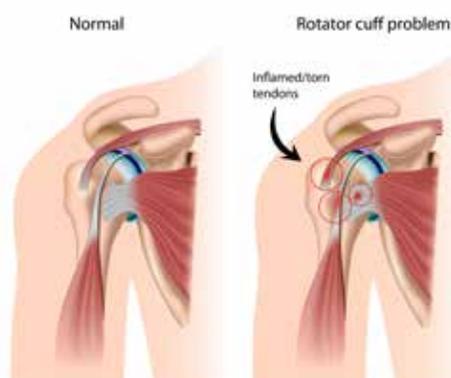
5 Questions to Ask Your Physician About Rotator Cuff Tears

By Jeremy Johnson, MD, MPH

The human shoulder allows for an incredible amount of motion. However, this also can put this joint at risk for injury. In order to perform movements like serving a tennis ball, combing your hair or reaching for something on the top shelf we have to coordinate muscles that stabilize and move the shoulder blade (scapula) and the arm (humerus). Injuries to these muscles and tendons can be bothersome and make daily activities difficult and painful. While there are many causes of shoulder pain, the following will review the symptoms, diagnosis and treatment of rotator cuff tears (RCTs).

Rotator cuff tears are rare prior to 40 years of age but then become increasingly common as we age. It is

important to note that not all RCT cause symptoms, but when you have shoulder pain that does not resolve or you have an injury it is important to seek medical attention.



1 What are the symptoms of a RCT?

- Pain is often described as “dull and aching and “located deep in the shoulder”.
- Symptoms are often made worse with overhead activities, such as combing hair.
- Full thickness tears are likely accompanied by weakness.
- Many experience night pain, that is worse with sleeping on the affected side.

2 How is a rotator cuff tear diagnosed?

Shoulder pain is common and can stem from issues other than a rotator cuff tear. After obtaining a history and performing a physical exam, your *continued on next page...*

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physician will decide if imaging is needed to help determine the type and severity of injury. MRI (Magnetic Resonance Imaging) and Ultrasound imaging are the primary imaging tools used to diagnose and characterize RCT's. Both have similar sensitivity in locating and describing RCTs. An MRI can show very detailed pictures of your entire shoulder joint, where as an ultrasound provides direct, real-time visualization of the muscles and tendons as they move. However, if shoulder instability is a concern, a MRI with contrast is a more appropriate test. X-rays are often obtained to assess if arthritis or bone spurs are contributing to the pain. While helpful, X-rays cannot diagnose RCT.

3 Does physical therapy help?

Physical therapy is the first step of treatment for most RCT's. However, in the case of large RCT or sudden injury leading to marked shoulder weakness, early surgical repair may be indicated. Physical therapy proceeds in phases, initially improving range of motion, then focusing on improving function through strength and coordination of the muscles around the shoulder. Physical therapy can be more effective among individuals who are less than 60 years old and in those with partial thickness tears.

4 Do injections help?

There is some evidence that sub-acromial steroid injections may provide short-term pain relief for those with partial rotator cuff tears and impingement symptoms. However, it is important to note that non-steroidal anti-inflammatory drugs (i.e. ibuprofen) may be equally effective. Repeat injections should be used with caution as there is an association with decreased durability of surgically repaired tendons. Also, injections do not "cure tears" and should generally be reserved for those with severe pain that limits participation in therapy or for those in whom surgery is not an option.

5 When should I get surgery?

For partial and chronic RCTs a 6-12 week trial of non-surgical management, as described above, is appropriate. In the case of acutely worsening symptoms or weakness one should be re-evaluated to determine the severity and type of tear. If there is an acute, full thickness tear or a large chronic tear, an early surgical referral should be considered.

Resource courtesy of SportsMedToday.com.

COACH'S CORNER

The 7-Minute Workout

By Jeffrey Bytowski, DO

High Intensity Interval Training (HIIT) has increased in popularity over the last few years. It is a great way to combine aerobic and resistance training. The 7-minute workout was developed by Brett Klika and Chris Jordan as a way for anyone to start this type of training with little experience or equipment. It encourages participants to start with minimal investment (only 7 minutes!) and progress as tolerated to three rounds (21 minutes). This is also a great way for coaches to introduce functional bodyweight training to their clients or teams. It is also a good starting point for athletes in their early teens for a way to start resistance training prior to weightlifting. The workout consists of 12 exercises done for 30 seconds with 10 second rest between each exercise:

1. Jumping jacks (Total body)
2. Wall sit (Lower body)
3. Push-up (Upper body)
4. Abdominal crunch (Core)
5. Step-up onto chair (Total body)
6. Squat (Lower body)
7. Triceps dip on chair (Upper body)
8. Plank (Core)
9. High knees/running in place (Total body)
10. Lunge (Lower body)
11. Push-up and rotation (Upper body)
12. Side plank (Core)



Caution should be taken when prescribing this protocol to individuals who are overweight/obese, detrained, previously injured or elderly or for individuals with comorbidities. For individuals with hypertension or heart disease, the isometric exercises (wall sit, plank and side plank) are not recommended.

An easy way to start using the 7-Minute workout is to download the official Johnson and Johnson 7-Minute Workout app on the App Store for iPhone and iPad and the Google Play Store for Android. It is free and gives more of the background of the workout, video demonstrations and audio cues and the ability to design custom workouts.

Reference: HIGH-INTENSITY CIRCUIT TRAINING USING BODY WEIGHT: Maximum Results with Minimal Investment: ACSM'S Health & Fitness Journal. 17(3):8-13, May/June 2013



Choosing Wisely: Imaging for Low Back Pain

By Aloiya Earl, MD

Choosing Wisely is an initiative of the American Board of Internal Medicine. It is supported by multiple medical societies, including the American Medical Society for Sports Medicine. Each supporting society was asked to contribute five diagnostic tests or treatments of which both physicians and patients should question the utility. The highlight for this quarter is AMSSM's fourth recommendation:

Don't order imaging for low back pain within the first six weeks of symptoms unless "red flags" are present. Examples of concerning red flags are severe or progressive neurological deficits or symptoms suspicious for serious underlying conditions like osteomyelitis (bone infection). For patients, this could mean new-onset numbness, tingling, weakness, bladder or bowel incontinence, unexplained weight loss or fever.

Red flags could also be found in patients' histories; patients with a history of cancer should be assessed for tumor metastases and patients with an identifiable trauma near the location of the current pain should be evaluated for fractures.

Low back pain is the fifth most common reason for all physician visits. Patients often request an X-ray or MRI of the lower back to identify the exact cause of the pain. It can feel frustrating and inconclusive for patients to leave their appointments without an imaging study. However, in typical cases of low back pain without red flags, imaging of the lower spine before six weeks does not improve outcomes, but it does increase costs.

The six-week cut-off is not an arbitrarily selected time frame; most cases of low back pain will improve in this amount of time regardless of whether targeted



therapy is employed. In other words, a precise diagnosis with a very specific corresponding treatment plan is not necessary for symptomatic improvement.

In fact, the initial conservative course of treatment prescribed will be the same, because these recommendations envelop the majority of the most common causes of low back pain in adults (like muscle strains, ligament injuries and inflammation around the joints or discs). For this reason, it makes the most sense for patients to save their money and forgo unwarranted early imaging studies (the cost of which can range between \$67 to \$1,019 depending on the test, according to [HealthcareBlueBook.com](https://www.healthcarebluebook.com)). Further, imaging can sometimes lead to expensive, potentially superfluous procedures that could be avoided with a proper trial of conservative treatment modalities.

Oftentimes, the best initial management approach for the most common causes of low back pain is early return to normal physical activity. Bed rest has not been proven to be

helpful and this inactivity can actually make the problem worse by leading to deconditioning (weakening) of the core muscles. The body responds with poor posture and compensated movements, which can make the initial injury worse and further exacerbate pain.

Other conservative treatments to try during the initial weeks of pain include stretching, application of heat (like heating pads or warm baths to ease tension in the lower back muscles) and anti-inflammatory medications (like ibuprofen or naproxen). Progressive muscle relaxation, adjustments in sleep posture (like sleeping with a pillow between the knees) and massage can also provide relief.

Click [here](#) for more information on this campaign.

Choosing Wisely[®]

An initiative of the ABIM Foundation

Editor-in-Chief: Jeffrey Bytowski, DO AMSSM is a multi-disciplinary organization of 2,800+ sports medicine physicians dedicated to education, research, advocacy and the care of athletes of all ages. The majority of AMSSM members are primary care physicians with fellowship training and added qualification in sports medicine who then combine their practice of sports medicine with their primary specialty. AMSSM includes members who specialize solely in non-surgical sports medicine and serve as team physicians at the youth level, NCAA, NFL, MLB, NBA, WNBA, MLS and NHL, as well as with Olympic teams. By nature of their training and experience, sports medicine physicians are ideally suited to provide comprehensive medical care for athletes, sports teams or active individuals who are simply looking to maintain a healthy lifestyle. Find a sports medicine physician in your area at www.amssm.org.