our new client, 16-year-old Alexis, is a competitive athlete who wants you to design a fitness program that will help her prevent a second anterior cruciate ligament (ACL) tear. She partially tore her ACL while playing soccer and rehabbed it with a physical therapist, who cleared her to play again. Alexis returned to spring softball without an issue, but she would like to be as fully prepared as possible for the upcoming fall soccer season. She hopes to be recruited to play in college, but her parents are concerned she will sustain another ACL injury, perhaps a more severe one.
ACL tears are among the most common orthopedic injuries in the United States (Silvers & Mandelbaum 2007). More than 100,000 ACL reconstructions are performed annually with the purpose of re-establishing knee stability and kinematics following an injury. The mechanism of injury can be either contact or noncontact, with approximately 70% of ACL tears secondary to noncontact injuries (Hewett, Myer & Ford 2006). Much of modern-day ACL injury research focuses on ACL prevention, or how best to reduce the frequency of this serious knee injury.

Fitness professionals are uniquely positioned to assist clients like Alexis who may be at risk for, or are recovering from, ACL injury, as many fit pros are already engaged with at-risk populations at their studios, health clubs or training centers. This article reviews details about ACL injury prevention and diagnosis, risk factors, injury management, and personal training program design.

**PREVENTION AND DIAGNOSIS**

The ACL provides the knee joint with stability and rotational control during movement. The ligament is located on the lateral femoral condyle (on the femur) and runs anteriorly to its insertion site on the tibia. It provides the primary restraint against anterior tibial translation, in addition to the rotational stability important in pivoting and cutting. ACL injury often results from noncontact pivoting, twisting or cutting or from a jump landing, for example, while rebounding (Bronstein & Schaffer 2017). Individuals commonly report hearing or feeling a “pop” at the time of injury, followed by localized swelling at the knee joint.

Preventing an ACL injury, in addition to staving off recurrence, is important to the knee joint’s long-standing health. If an athlete sustains a second ACL injury and must undergo a revised reconstruction, there is significantly more chondral (cartilage) damage (Mitchell et al. 2017). To add insult to injury, the prevalence of osteoarthritis (OA) after ACL reconstruction significantly increases over time (Cinque 2017).

Physicians diagnose an ACL injury by historical fact-finding and physical examination (increased anterior tibial translation...
via the Lachman test). Doctors may also order X-rays and an MRI, which will reveal disruption to ACL fibers. Concomitant injuries—to the meniscus and/or other ligaments and bones, for example—are also assessed. It’s not out of the ordinary for an MRI to show a very characteristic “bone bruise” pattern. During the injury itself, a “pivot shift” occurs in which the lateral tibial plateau makes contact with the lateral femoral condyle, resulting in edema in these areas (the typical bone bruise) (Milewski, Sanders & Miller 2011).

ACL INJURIES AND GENDER
Prevention isn’t always possible. Certain sports, such as soccer and basketball, have higher incidences of ACL injury owing to the frequent cutting, pivoting and decelerations required to play competitively (Boden et al. 2010).

Gender is also believed to play a large role in ACL injury risk, especially in the athletic, adolescent population. Female athletes experience a higher incidence of ACL rupture than their male peers across multiple sports (Boden et al. 2010).

Many modifiable and nonmodifiable risk factors influence this higher incidence. Nonmodifiable factors include anatomy (smaller intercondylar notch width, for instance). Additionally, it’s been hypothesized that reproductive hormones play a role, with some research suggesting that a shift in estrogen and progesterone levels may increase ACL injury susceptibility (Hewett, Myer & Ford 2006). However, consensus is lacking on the relationship between the menstrual cycle and ACL injuries.

Modifiable risk factors include neuromuscular control, strength and landing mechanics (Boden et al. 2010). Specifically, there are gender differences found in motion patterns and the forces generated from the hip and trunk to the knee. Females may have weaker hip extensors, which necessitates using hip flexor muscles for trunk control over the hips during jump landing. This posture results in a more upright hip position and an altered knee angle upon landing (Hewett et al. 2005). To combat this difference, strengthening programs that emphasize hip control—closed-chain gluteal and hamstring activation—have proved to be beneficial in ACL injury prevention (Hewett et al. 1999).

INJURY MANAGEMENT
A subset of individuals manage their ACL tears without surgery. In general, these people tend to be older and are less likely to have participated in high-level sports. The majority of people with an ACL tear will undergo reconstruction owing to persistent instability and reduced functional abilities. A desire to return to sports and recreational activities that involve pivoting or cutting is a driving factor for reconstruction. Age is not a limitation; the individual is evaluated, and treatment is determined based on specific needs and goals.

ACL reconstruction involves utilizing a graft in place of the torn and nonviable ACL. Multiple graft choices are available,
each with advantages and disadvantages. Graft types are broadly divided into autograft (the patient’s own tissue) and allograft (cadaver tissue) options. Within those categories, further choices exist. Patella, hamstring and quadriceps tendon autografts are all well supported, with selection based on preference. Allograft tissue is used when autograft is not available (for example, in revision ACL procedures), or when the patient or surgeon prefers allograft tissue. Concomitant injuries and activity level are additional factors when determining graft selection.

REHABILITATION
After ACL reconstruction surgery, the client progresses systematically through rehabilitation phases. Early on, the focus is on restoring full range of motion, re-establishing normal gait, and reducing swelling or edema. Over time, the focus turns to strengthening the lower-extremity musculature, followed by facilitating a return to sport or other preferred recreational activities through thoughtful programming.

Historically, rehabilitation was time-based, meaning an athlete would move to the next phase once a certain number of weeks had passed; however, modern rehabilitation emphasizes criteria-based progression. In other words, the athlete must meet certain goals regarding ROM, strength, functional tests and clinical examination, for instance, prior to advancing to the next rehabilitation phase.

Please note that it is not within a personal trainer’s scope of practice to diagnose or treat an ACL injury. Always refer clients to the proper allied medical professional for treatment and clearance.

ACL PREVENTION PROGRAMMING: GOOD OUTCOMES
Fitness professionals are in an ideal position to help clients prevent an ACL injury. In fact, ACL injury prevention programs are becoming a preparatory mainstay for sports and recreation with today’s active adolescents and adults. As stated earlier, ACL injuries can lead to OA and injury in the knee cartilage. Timely referral and treatment are therefore critical. Given the potentially long-term, significant impact of an ACL injury, a proper program is vital.

Those who are already vulnerable to injury (females or those in high-risk sports) are particularly likely to see marked reduction in their risk when engaged in such programs. Since some risk factors are nonmodifiable (gender, for example), the focus has to be on those factors that can be modified, such as neuromuscular control. Maximizing strength, neuromuscular control and technique are the main goals of a program, and visual and verbal feedback are key to gauging a client’s success. Ideally, to prevent bad habits setting in early, ACL prevention programs are best initiated at or prior to the onset of puberty, and at least 6 weeks before the athletic season starts, with a maintenance program during the season.

Let’s circle back to Alexis, the 16-year-old client who’d like to prevent a second ACL injury. She has received full clearance by her orthopedic surgeon to participate in a sports conditioning program. When Alexis comes to you, she is pain-free and has good ROM and lower-extremity/core strength; however, she has poor neuromuscular control when asked to perform functional and single-leg exercises. You’ll create a multifaceted program that includes more than traditional strengthening exercises (see the sidebar “Prevention Exercises” for details). Alexis’s program will encompass dynamic strength exercises, plyometrics and sport-specific technique training 3–5 days per week, beginning several weeks ahead of the upcoming season. In season, she should perform a maintenance program as part of the team’s warmup routine and at home or in the gym.

Here’s a snapshot of her program (Sanders et al. 2017):
• Always begin with a dynamic warmup, followed by strength training, plyometrics, agility drills and technique training.
• Focus the resistance training portion on improving core, hip, and gluteal and thigh strength. (Strengthening programs in isolation do not reduce the number of ACL injuries, but when resistance training is combined with plyometric training, there is a significant reduction in ACL injuries, specifically in female athletes.)
• Focus plyometric training on improving landing biomechanics while also incorporating an element of balance. The goal is to eliminate or minimize limb asymmetries, a potential risk for ACL injury. >>

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RED FLAGS
If your client is having ACL injury symptoms, it is crucial that you refer him or her to a physician as soon as possible to reduce the chances of posttraumatic osteoarthritis. Watch for these signs:
• a history of knee injury (noncontact or contact)
• report of hearing a “pop” with subsequent swelling of the knee
• persistent knee pain during activity or at rest
• swelling or an effusion at the knee
• weakness or notable atrophy of the thigh
• complaints of knee instability (or “giving way”)
Focus agility training on maintaining joint mechanics and neuromuscular control. Design drills that simulate movements from the client's particular sport or activity.

Focus technique training on cutting and jumping drills.

In each of these segments, include frequent feedback cuing via video analysis, if possible.

Given the potentially long-term, significant impact of an ACL injury on the health of the knee, a proper prevention program is vital. As some risk factors cannot be modified, fitness professionals should focus on modifiable factors such as strength, neuromuscular control and technique, all of which can be maximized to help clients exceed expectations and continue with the sport or activity of their choice.

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