

## ATTACKING ACL INJURY PREVENTION

By Jessica Heath and Neal Goulet

Robert Griffin III arrived in the National Football League in 2012 with lots of hype and great expectations. Before ever playing a regular-season game, he reportedly had earned more money (from endorsements) than any other rookie in NFL history.

The Washington Redskins, last-place finishers the previous four seasons, selected “RG3” second overall in the NFL draft. Blessed with a powerful right arm and the legs of a track star, which he was in high school, Griffin carried the Redskins to a division title.

But in the first round of the playoffs, he tore two ligaments in his right knee. One of them, his anterior cruciate ligament (ACL), already had been repaired when he was in college.

Griffin is an elite athlete, but he is in abundant company in one respect: football, basketball, soccer and skiing often are associated with ACL injuries, which are almost solely connected with sports.

The knee joint is where the thigh bone (femur) meets the shin bone (tibia). These bones are connected by four main ligaments: anterior cruciate, medial collateral, lateral collateral, and posterior collateral (see image on page 2).

ACL injuries can occur for a number of reasons but most often are of a non-contact vari-



**Most ACL injuries are non-contact in nature, such as by stopping quickly and changing direction.**

ety: by overextending the knee joint; by stopping quickly and changing direction, such as while running, landing from a jump, turning; by getting hit on the side of the knee as during a football tackle.

And ACL injuries often occur with other injuries: The Redskins’ Griffin simultaneously tore his lateral collateral ligament and meniscus (shock-absorbing cartilage).

### **SURGERY AND OSTEOARTHRITIS**

In the United States, there are approximately 250,000 ACL injuries each year – or 1 in every 3,000 people. Women are four to eight times more likely than men to suffer an ACL injury: anatomical, biomechanical and neuromuscular differences are believed

to be behind the gender disparity.

Assuming that one-third of those injured require surgery at a cost of \$17,000 per ACL reconstruction, one study estimated that the annual cost is \$1.5 billion. Another estimate put the tab at \$5 billion.

Whether surgically repaired or not, ACL injuries are a “well-recognized risk factor for the development of knee osteoarthritis,” according to the Arthritis Foundation. A torn ACL leads to osteoarthritis in more than half of affected knees five to 15 years after injury.

Sometimes referred to as “wear-and-tear arthritis,” osteoarthritis results from a wearing down over time of the protective cartilage on the ends of bones.

Osteoarthritis may necessitate surgery, perhaps an osteotomy, which cuts the shinbone (tibia) or the thigh-bone (femur) to improve the alignment of the knee joint, or total or partial knee arthroplasty, more commonly known as knee replacement.

Given the potential for surgery, the financial cost, the recovery time and the emotional duress associated with ACL injuries, preventing them has gained greater currency.

### **INJURY PREVENTION**

The majority of research into ACL injuries and injury prevention has focused on female soccer players. ACL injury-prevention programs have existed for more than 15 years and typically include:

- Warm-ups to increase body temperature and blood flow to muscles; these may consist of jogging (forward and backward), arm swings and dynamic flexibility.
- Stretching to improve lower extremity flexibility; muscle groups include hamstrings, hip flexors, calves and quadriceps.
- Strengthening of abdominal and gluteal muscles.
- Plyometrics: jump-training exercises focused on improving motor control and increasing speed and power while emphasizing correct landing.
- Agility drills: sport-specific training focused on improving coordination, speed and balance.

However, a 2011 review

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noted that few of these programs had been assessed both for their effect on ACL injury rates and for athlete performance. The review determined that only two programs “had a positive influence” on both injury reduction and athletic performance among female athletes:

#### Sportsmetrics

Under the direction of Dr. Frank Noyes (co-author of the 2011 review), Sportsmetrics describes itself as the first ACL injury-prevention program scientifically proven to decrease serious knee ligament injuries in female athletes. Sportsmetrics uses drills to encourage proper form for jumping and landing during athletic participation.

#### The PEP Program: Prevent Injury and Enhance Performance

Created by the Santa Monica Sports Medicine Research Foundation, a California nonprofit dedicated to sports medicine research, education and community service, the program addresses “potential deficits in the strength and coordination of the stabilizing muscles around the knee joint.”

This study notwithstanding, there are many other programs that apply similar principles and have successful outcomes.

One of those programs is SKIP – short for Successful Knee Injury Prevention. Developed by physical therapist Bill Johnson (DPT, OCS), SKIP provides physical therapists, physical therapy assistants and certified athletic trainers with the ability to identify faulty jumping and landing biomechanics and to establish a lower extremity injury-prevention program in their respective communities.

A belief exists that the implementation of injury-

prevention programs is tied to improved athletic performance. That is, coaches will be more inclined to implement the programs if they can see a tangible performance benefit on the court or field of play. This suggests that more research is needed in order to make these dual benefits more apparent.

#### HOW PHYSICAL THERAPY CAN HELP

Injury prevention should be taught by physical therapists and athletic trainers trained in each of the program components. Each professional should be able to recognize important factors in athletes that may put them at risk for injury; these may include strength or coordination deficits and body alignment.

A physical therapist also can play an important role in return to sport. After an injury such as an ACL tear, it is important for your therapist to incorporate prevention training once it has been established that you are able to return to sport training.

This training should include a graded progression of the components of the prevention program. This will assist in preventing future injury. ▀

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## Q&A

# ACL INJURIES

By Jeremy Ansbach

#### WHAT IS THE ANTERIOR CRUCIATE LIGAMENT (ACL)?

The ACL (image) is a knee joint ligament that attaches from the back of the femur (thigh) and the front of the tibia (lower leg). It is an important stabilizer of the knee joint. It resists forward motion of the tibia on the femur and inward rotation of the tibia.

#### HOW CAN THE ACL BE INJURED?

The ACL is injured when the force to the knee exceeds the stretch capacity of the fibers. While an ACL injury can occur from a direct blow to the knee, it is more commonly injured through non-contact mechanisms. These include hyperextension of the knee, an abrupt forward movement of the tibia, excessive twisting or a valgus (knock-kneed) force, or some combination of these movements. As a result, activities that often lead to a non-contact injury include an uncontrolled landing from a jump, an open cut move or a deceleration maneuver. Hamstring and quadriceps strength in knee control is important, as is hip musculature in controlling the position of the knee in space.

#### HOW CAN THE RISK OF ACL INJURIES BE DECREASED?

It is not possible to improve the strength of the ligaments in the knee so we must strengthen the muscles. But this is only half of the battle: It also is necessary

to address the strength of the muscles surrounding the hip and ankle, providing control throughout the chain, and allowing maintenance of the normal knee mechanics while preventing abnormal loads to occur.

#### HOW CAN PHYSICAL THERAPISTS PLAY A ROLE IN ACL INJURY PREVENTION?

By properly screening an individual’s predisposition to poor knee mechanics, PTs can help to prevent the likelihood of ACL injuries. This requires proprioceptive training of the hip, knee and ankle, which improves the body’s awareness of where it is in space. In doing so, the body can build a greater defense system to react to abnormal stresses placed on it. This should include promoting core strengthening, which helps to prevent uncontrolled movements of an individual’s center of mass. ▀



## CASE STUDY

## ACL: REHAB AND PREVENTION

By Alicia Bettis

**PATIENT HISTORY**

A 17-year-old male injured his right knee while playing as a tight end in a football game. As he was blocking an opponent, the patient reported, he stepped wrong, turned, and immediately felt intense pain and a pop. He was diagnosed with an anterior cruciate ligament (ACL) tear.

**ASSESSMENT**

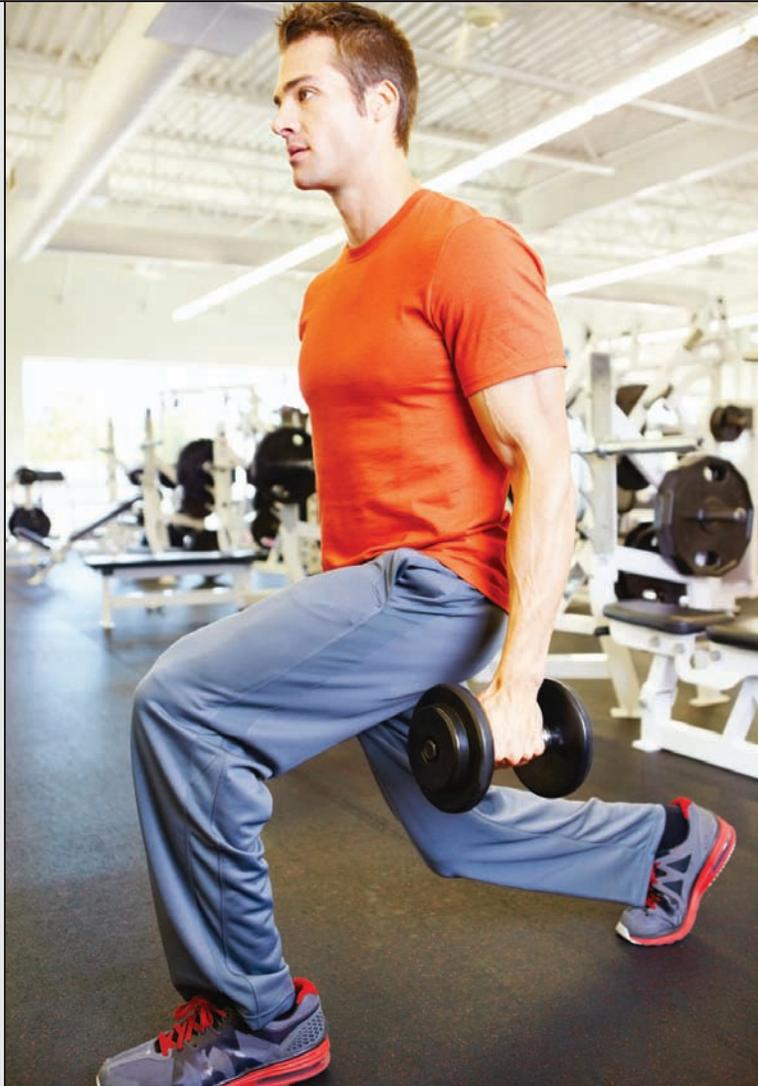
This patient is a well-rounded athlete who also plays goalie in lacrosse. Three weeks after his football injury, he underwent an ACL reconstruction with a patellar tendon graft. He was referred to physical therapy one week post-surgery for an extensive rehabilitation with a return-to-sport emphasis.

After surgery, the patient ambulated without crutches, but with some gait deviations. He exhibited unequal weight bearing and displayed moderate femoral internal rotation and genu valgus. He also presented with significant quadriceps atrophy, swelling, and limited active range of motion at the knee (minus-8 degrees of extension to 112 degrees of flexion). He was unable to perform a straight leg raise while maintaining full extension.

**TREATMENT**

The patient's plan of care consisted of therapeutic exercise for range of motion and flexibility; quadriceps, hamstring and hip strengthening; and gait and balance/proprioceptive training.

The patient worked to obtain full range of motion at the knee measuring 0 to 142 degrees and improved flexibility of the hip and calf musculature. Muscle strength of the knee and hip became strong



**A physical therapist monitored the exercises to ensure the patient's safety and appropriateness for each activity.**

and equal between sides. He was able to perform single-leg balance bilaterally for 15 seconds as well as a double leg squat with good motor control and no pain. He was able to ambulate with equal weight on both feet and without the medial collapse of his right knee.

At week 10, the patient was ready to begin a progressive running program. As with walking, he was able to run with a well-aligned right knee and equal stride length and push-off as compared with his left leg.

Weeks 12 to 20 focused on sport-specific activities based on the Sportsmetrics and PEP ACL injury-prevention programs. Exercises included:

- Cardiovascular warm-up to include jogging on a treadmill or elliptical machine, and ladder drills (forward, backward, laterally);
- Flexibility exercise to include dynamic flexibility; "Frankenstein Walk" or straight leg march; mountain climbers, both forward and with leg toward opposite shoulder;
- Core and hip strengthening such as plank on level and

uneven surfaces, glute medius and maximus strengthening;

- Agility and sport-specific drills focusing on performance and controlled landing to include an overhead lacrosse shot with a pivot; steamboats on even and uneven surfaces; box drills; squat jumps; up/downs; skipping and bounding exercises; small box jumps that progressed to large box jumps; small, quick taps that progressed to large box taps; 180-degree jumps; zig-zag line jumps; and running in place with quick lateral turns in both directions.

All of these exercises were monitored to ensure the patient's safety and appropriateness for the activity. For example, if the patient displayed an improper movement pattern, such as knee valgus collapse during an activity, the physical therapist would give verbal cues to him to help correct form. Any exercise that the patient was unable to complete with proper form was discontinued as it could predispose him to re-injury. Proper form was emphasized for both legs, which helps to reduce the risk of future injury to either extremity.

**OUTCOME**

The patient returned to lacrosse and anticipated playing football in the fall. He continued with a weightlifting regimen with guidance from a certified athletic trainer at high school. He also continued a home exercise program based on principles from the prevention program in an effort to maintain his status. He was to follow up with his physical therapist if he had any questions or concerns regarding his return to sport or the ACL injury-prevention concepts. ■

## RESEARCH ABSTRACT

## ACL INJURY-PREVENTION PROGRAMS IN SOCCER

By Dr. Irene Davis

### INTRODUCTION

Among the most common major injuries in soccer are those to the anterior cruciate ligament (ACL). This injury has one of the longest rehabilitation times and can have a significant impact on one's activity level. In addition, the associated secondary injuries and increased risk of knee osteoarthritis can negatively affect quality of life in a significant way. Therefore, the prevention of these devastating injuries can have a profound effect on an athlete's life. The purpose of this paper was to review ACL injury-prevention programs in soccer (between 1983-2008) and their effects on ACL injury rates.

### METHODS

The authors first focused on 10 prevention programs aimed at reducing risk factors previously identified for non-contact ACL injuries. Most interventions ranged between six and nine weeks in length; however, two were implemented throughout the season. The authors assessed these factors pre- and post-intervention to determine whether the risk factors had been reduced.

The types of neuromuscular risk factors addressed included hamstring-quadriceps ratios, muscle strength and activation times, and neuromuscular patterns during dynamic activities.

Biomechanical risk factors, such as hip and knee angles and torques during landing,



**The most successful programs were conducted on the field with supervision as part of pre-season or in-season training.**

jumping and cutting were addressed. While each study had its own focus, there was overlap among them. In general, these programs were successful in improving both neuromuscular and biomechanical patterns during dynamic activities. However, none of the programs addressed the effect of these changes on ACL injury rates.

### RESULTS

Therefore, the authors reviewed 10 papers that each

looked at an ACL injury-prevention program and assessed its effect on injury rates.

- These interventions focused on similar neuromuscular and biomechanical risk factors and included activities such as strengthening, jump landing technique, cutting, and deceleration training.
- All emphasized good body positioning (i.e. hips over knees over feet).
- Most of the programs ranged in length between six and 12 weeks; however, one was conducted across eight months.

• Injuries reportedly were reduced by 41 to 88 percent in some studies. However, only 50 percent of the programs reduced ACL injuries.

The most common observation for the lack of success was poor compliance. The most successful programs, in terms of injury reduction, were conducted on the field with supervision, as part of pre-season or in-season training.

### DISCUSSION

Prevention programs appear to be successful in altering risk factors associated with ACL injuries in soccer. However, not all programs result in an actual reduction of ACL injuries. As not all successful prevention programs were the same, the challenge is to understand which of the common elements lead to success. For example, improving neuromuscular control may have more of an influence on injury risk than improving beyond some baseline of strength. Future research is needed to determine the optimal intervention program in terms of activities involved and duration. ■

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