Approximately 70 percent of ACL injuries occur while playing agility sports. Girls are especially at risk.

In this Columbia Orthopedics interview, a pediatric ACL specialist explains how to protect our young athletes and get them back on the field following ACL injury.

**Q&A - PEDIATRIC ACL INJURIES**

**Ahmad:** Are ACL injuries in young athletes a problem?

**Popkin:** Absolutely. We are seeing a sharp increase in the number of pediatric and adolescent ACL injuries, especially in young, female athletes. On average, one girl on every high school varsity soccer team will tear an ACL during the upcoming season. Several factors are implicated in the increased incidence of ACL tears in the young athlete. First, there has been increased youth participation in cutting and pivoting sports, including soccer, football, hockey, and skiing. There are between 45 and 50 million children playing organized sports each year in this country and, with that many youngsters playing sports, injuries follow. Second, these athletes are playing with greater intensity at younger ages. The increased participation and intensity in cutting and contact sports, combined with increased physician awareness and improved diagnostic methods, are responsible for the heightened recognition and incidence of pediatric ACL injuries.

**Ahmad:** What work up do you recommend for a young athlete you suspect has an ACL tear?

**Popkin:** The first part of any workup is obtaining a good history. As with adult ACL injuries, ACL injuries in children most often result from non-contact mechanisms involved in cutting and pivoting. Patients often experience an audible pop followed by a rapid-onset knee swelling. Following the initial event, some young athletes resume full activity without seeking medical attention. Therefore, it is not unusual for patients to sustain repeated episodes of instability before finally seeking medical attention when a large meniscal tear causes acute loss of knee extension.
Dr. Popkin is currently conducting research on hockey injuries of the knee, ACL injury prevention, ACL reconstruction techniques in the pediatric athlete, the influence of parents on sport performance, and advanced arthroscopic techniques of the elbow. He has lectured nationally on overuse injuries to the pediatric and adolescent athlete, osteitis pubis and cartilage lesions of the knee.

Born and raised in Minneapolis, MN, Dr. Popkin attended Colgate University in upstate New York, where he played football as a defensive back for the Raiders. He is a life-long hockey fan and, during his training, has cared for college hockey teams in both Canada and Minnesota. Dr. Popkin resides in Manhattan with his wife and son.

Ahmad: Are you able to estimate a patient’s remaining growth?

Popkin: Yes we are. Treating an ACL injury in this population requires comfort in assessing the young athlete’s physical maturity, as the physician must determine how respectful to be of the growth plates around the knee when planning surgical reconstruction. Recognizing the common discordance between chronological age and skeletal age is the first step in surgical planning. Skeletal growth is usually complete by age 14 in girls and age 16 in boys, though significant variation does exist. The physiologic age of the patient can be assessed by a number of techniques. Commonly used methods in an orthopedic clinic are: bone age by left hand radiograph (Greulich and Pyle Atlas); knee radiographs; and menarchal status in female patients. Tanner staging is often cited as a predictive method, though this presents practical challenges in the typical environment of an orthopedic practice.

Ahmad: What is the natural history of non-operative treatment for complete ACL tears in children?

Popkin: The optimal treatment of ACL tears in the skeletally immature patient is still under debate. Supporters of non-operative management believe that surgical reconstruction should be delayed until the patient reaches skeletal maturity and that physical therapy, bracing, and activity modification should be instituted as temporizing measures. This may be a reasonable strategy for those with partial ACL tears, but the results of non-operative treatment are consistently suboptimal for complete tears. These patients tend to experience persistent events of instability, pain, and an inability to participate in sports. In turn, repeated episodes of instability lead to meniscal tears, cartilage injuries, stretching of other ligaments, and even arthritis. More importantly, delayed treatment increases the risk of developing an irreparable meniscal tear. I learned during my time training in Toronto at the Hospital for Sick Children that many skeletally immature athletes wait several months after their initial injuries to undergo surgical ACL reconstruction. I saw firsthand the startling number of large, irreparable meniscal tears in these patients.

There are a number of explanations to account for the high failure rate of non-operative management in these young athletes. First, noncompliance with activity modification is a difficult and often impossible recommendation. Young athletes are often reluctant to adjust their post-injury activity level due to constant exposure to sports and the importance that society and individuals place on athletics. Second, functional braces do not provide adequate stability for patients with ACL deficiency. The precise mechanism of brace efficacy is unknown and, in young patients, proper brace fit can be difficult because of variability in leg length and girth. Finally, children and adolescents may also fail to appreciate the long-term consequences of their knee injuries.

On the other hand, young athletes who undergo ACL reconstruction are more likely to return to sports, have great knee stability, and experience lower rates of secondary meniscal tears when compared to patients who initially undergo non-operative management. The trend in active young athletes with knee instability is to reconstruct the ACL.

Ahmad: Is there a risk of growth disturbance with ACL reconstruction?

Popkin: A major concern in managing a skeletally immature patient with an ACL injury is that the growth plate will be damaged during surgery. The more growth that remains, the greater the potential for an injury to the growth plate and the larger the magnitude of the growth disturbance- should one occur. Adult ACL reconstruction techniques violate the distal femoral and proximal tibial physis (growth plate) and have shown potential for significant growth arrest, angular deformity or leg-length discrepancy. Reports of post-operative growth disturbance in the skeletally immature patient are uncommon, but they do exist. Described growth disturbances are usually the result of hardware or large bone plugs placed across the growth plates.

Ahmad: Can surgical technique minimize the risk of growth problems?

Popkin: To minimize the risk of growth plate injury during surgery, research supports drilling small tunnels perpendicular to the growth plate and filling the tunnels with...
soft-tissue graft. In the prepubescent patient, physeal-sparing ACL reconstruction is recommended if there is a concomitant meniscal tear or cartilage injury or if the patient has failed non-operative management.

Treatment of an ACL tear in a skeletally immature athlete requires recognizing symptomatic instability and tailoring the surgical approach to the skeletal maturity of the patient. An ACL reconstruction in a child with more than 3 years of growth remaining requires special attention. This age group would include those that are pre-pubescent. With these patients, I prefer to avoid the growth plate completely when performing the ACL reconstruction.

At Columbia, we recently completed a study looking at computer navigation to help us place tunnels that will not compromise the growth plate. For patients with 1 to 3 years of growth remaining, we perform a growth plate respecting ACL reconstruction using the patient’s hamstrings. We drill small tunnels and place them in a more central position to cause a minimal amount of disruption to the growth plate. Furthermore, the growth plate is not spanned with metal or bone during fixation of the ACL graft. Our preference at Columbia for these patients is to use quadrupled autograft hamstring with suspensory fixation on the femur and to tie the graft over a post on the tibial side far away from the growth plate. The patient with less than 1 year of growth remaining can be treated as an adult without concern of significant injury to the growth plate. The graft and fixation selection for these patients can match the preferred technique of the operating surgeon and mirror best practice in a contemporary adult ACL reconstruction. Graft choices for these patients include autograft bone tendon bone (BTB), quadrupled hamstring or quadriceps tendon. The decision about which graft to use is made after discussions with the individual patient regarding his or her needs.

Ahmad: For those who undergo surgery, does postoperative rehabilitation affect outcome?

Popkin: Rehabilitation after surgery is as important as the surgery itself in returning the athlete safely back to sport. At Columbia, we are currently developing and researching return-to-sport testing after ACL surgery to ensure the young athlete is ready to get back in the game. Postoperatively, the athlete should be in a brace for six weeks to protect the reconstruction. In the more skeletally immature patient undergoing physeal-sparing iliotibial band reconstruction, six weeks of restricted weight bearing is recommended, whereas two weeks is recommended in the adolescent patient who undergoes a physeal-respecting hamstring reconstruction. Aggressive rehabilitation typically lasts three months and consists of leg strengthening, range-of-motion exercises, patellar mobilization, and proprioception training. This is often followed by three additional months of plyometrics, straight-line jogging and sport-specific exercises. Patients can expect to return to full activities approximately six to nine months after surgery. Typically, the use of a functional knee brace during athletics is recommended for one year following the surgery.
Ahmad: What can be done to prevent ACL injuries?

Popkin: Great question. Right now the biggest thing we are targeting is the athlete’s neuromuscular control, which has been shown to be a modifiable risk factor for developing an ACL tear. There are a couple prevention programs, the FIFA-11 and the PEP program from Santa Monica, which are designed to improve the athlete’s neuromuscular control and, in turn, prevent ACL injuries. In the office, we can use a simple drop vertical jump test to help us identify athletes at higher risk for ACL injury based on their landing mechanics and then send these individuals to designated therapists and training centers to work on their neuromuscular control.