

ACL reconstruction technique improves outcomes in pediatric patients

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A new study demonstrates the superiority of a specific technique to perform anterior cruciate ligament (ACL) reconstruction in children. In recent years, the number of ACL surgeries in pediatric athletes has skyrocketed.

The study, conducted by researchers at Hospital for Special Surgery (HSS) in New York City, shows that a technique called the All-Inside, All-Epiphyseal ACL Reconstruction (AE) provides great knee stability and effectively controls joint stress. "The AE technique is not available except in a few select centers around the country including HSS," said Frank Cordasco, M.D., surgical director of the [Ambulatory Surgery Center](#) and member of the Sports Medicine and Shoulder Service at HSS. "We believe the AE should be the preferred procedure for ACL reconstruction in the skeletally immature." The study will be presented on July 13 at the annual meeting of the American Orthopaedic Society for [Sports Medicine](#) (AOSSM), held in Baltimore.

Twenty years ago, very few children or adolescents presented at doctors' offices with ACL injuries. Today, these injuries are common because children and [young adolescents](#) are participating in sports earlier in life and at a higher level of competition. [Young athletes](#) are also increasingly specializing in one sport, putting them at risk for [overuse injuries](#) once only seen in professional athletes. In addition, since the Title IX ban on sex discrimination in school sports, the number of [female athletes](#) has increased and females are more prone to ACL injury.

Performing ACL reconstruction in patients who are still growing is difficult. The ACL can be thought of as a rope that connects the thighbone to the shinbone. The rounded ends of the thighbone and shinbone are called epiphyses and the ACL dangles between them. Open growth plates are located directly behind the epiphyses in children and adolescents, but not in adults.

In an adult ACL reconstruction, the torn ligament is removed from the knee, holes are drilled through the ends of the thighbone and shinbone, and a tissue graft is inserted in place of the removed ligament. In this way, the reconstruction mimics the natural ACL footprint. ACL reconstruction is difficult in children because if an adult-type reconstruction were performed, the graft would cross the growth plates, potentially causing damage that can result in uneven limb lengths or angular deformities. Thus, for many years, [ACL injuries](#) in children were managed with benign neglect, or surgical procedures that were not anatomic and required large incisions to avoid injuring the growth plate. In recent years, however, clinicians realized that non-operative treatment resulted in damage to menisci and articular cartilage thereby leading to early arthritis. Advances in technology, instrumentation and techniques are now available which allow surgeons to perform the AE reconstruction without risk of injury to the growth plate. These procedures are more technically demanding and are available at only a few centers around the country including HSS.

In the study, researchers, including Dr. Cordasco and HSS pediatric orthopedic surgeon Daniel Green, M.D., compared two ACL reconstruction techniques for children that minimize contact with the growth plate: the AE technique and the over-the-top reconstruction (OT). In the OT, surgeons slide a graft through a hole drilled into the shinbone, similar to an adult ACL surgery, but the graft is then attached to the back of the thighbone. The OT requires an open incision and does not mimic the natural ACL footprint. In the AE, surgeons mimic the

adult surgery, but the ligament is only attached to the epiphysis and does not cross into the growth plate. The AE is performed arthroscopically and mimics the natural ACL footprint. While the AE has been around for ten years, it has been drastically refined in the last few years, due to advances in arthroscopic technologies.

The researchers obtained ten human cadaver legs that had their ACLs intact. They fixed the legs firmly in cement and, using a robot, they put each of the legs through a series of motions to test knee stress and strain. They tested stability when the knee was pivoting, for example, and they measured contact stresses by delivering pressure to the leg and evaluating the stress experienced at different areas of the joint.

The investigators then removed the ACLs and performed the same set of experiments, to replicate an ACL insufficient patient. They then performed all-epiphyseal procedures in five of the legs and over-the-top reconstructions in the other five, performed the same stress and stability experiments, and then reversed the order, so that each leg underwent both procedures.

The goal of [ACL reconstruction](#) is to stabilize a joint enough so that an individual can participate in sport without damaging other knee structures, but not to stabilize the knee so much that it overconstrains the knee. "If we overconstrain a joint, whether it is a knee or shoulder, you lose motion, but more importantly, you can develop an arthritic condition," said Dr. Cordasco. "Obviously in a ten year old, if you have an overconstrained joint, that is going to mean that by the time they are 30 or 40, they might need a joint replacement."

The researchers found that the AE and OT performed similarly, but the AE performed better when the knee was at 15 degrees, which is commonly experienced by individuals who are running down a field. In the experiments, the investigators actually used a thicker graft in the OT

surgeries than would be used in actual patients, because they wanted to use the same size grafts in both AE and OT surgeries. Thus, in actual patients, OT surgeries would likely have resulted in worse outcomes.

While other studies have compared joint stability (kinematics) of the two procedures, this is the first to study contact stresses. "Both reconstructions improved the kinematics and contact stresses compared to the deficient state, but neither reconstruction completely restored normal kinematics and contact stresses," said Dr. Cordasco. "The OT had significantly higher contact stresses at 15% of flexion compared to the AE. This is important because most field and court sports involve knee function close to this position. The OT requires an arthrotomy, meaning an open incision, and therefore has increased morbidity with associated soft tissue trauma. We believe the AE is preferable in the pediatric and young adolescent population."

Provided by Hospital for Special Surgery

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