Hamstring Allograft Anterior Cruciate Ligament Reconstruction in the Skeletally Immature Patient

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Abstract: Reconstruction of the anterior cruciate ligament (ACL) remains the most appropriate treatment for adolescent patients who are ACL deficient. This article reviews the indications for adolescent ACL reconstruction, potential risks, and the technique for allograft reconstruction.

Key Words: anterior cruciate ligament, adolescent, allograft, knee ligament, over the top

(*Tech Knee Surg* 2009;8: 47–53)

HISTORICAL PERSPECTIVE

In the last 20 years, there has been an increase in the literature pertaining to the management of a skeletally immature patient with anterior cruciate ligament (ACL) injuries. With increasing involvement of children in sports, an increase in ACL injuries in this population has been reported.[1] In a survey of members of the Herodicus Society and the ACL Study Group, Kocher et al[2] reported that the members studied a mean of 5.8 pediatric patients with ACL injuries annually. In addition, 78% of those surveyed stated that they had performed an ACL reconstruction on a skeletally immature patient within the previous year.

Historically, ACL reconstruction in skeletally immature patients has been discouraged because of the theoretical risks of damage to the physes and the risk of growth disturbance. However, the case series data available in the literature have not supported a significant pattern of leg length discrepancy or angular deformity caused by ACL reconstruction in adolescent patients.[3–10]

Controversy still exists between nonoperative management and surgical reconstruction of these patients based on the potential risks of both treatment options. Nonsurgical treatment risks an unstable knee and further damages the meniscal structures and articular cartilage. Anterior cruciate ligament injuries in adolescents behave similarly to those injuries in adults; chondral and meniscal injuries are common. Operative reconstruction risks potential damage to the growth plate. Previous research has shown that 21% to 100% of pediatric patients with ACL injuries will have a concomitant meniscal injury.[1,4,5,10–14] In addition, there is a risk of exacerbating initial injury or new meniscal damage if the knee remains chronically unstable.[5,15,16] Growth plate arrest after ACL reconstruction, although a concern, has only been infrequently reported.[2,17,18] Furthermore, the treatment of physeal arrest is soft tissue interposition, and for this reason, hamstring tendon grafts have been recommended as the graft of choice in patients with open growth plates.[19]

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INDICATIONS/CONTRAINDICATIONS

Indications for ACL reconstruction in skeletally immature patients are similar to those in an adult. There is, however, more need for counseling and compliance, as the adolescent population places high demands on their knees with their daily activities. This can lead to further knee damage as previously mentioned. Anterior cruciate ligament reconstruction can be viewed as more urgent in an adolescent compared to that in an adult. Clinical ACL insufficiency is the main indication for ACL reconstruction. Other considerations include patient activity level, KT-1000 (MEDMetric, San Diego, Calif) maximum manual side-to-side differences of greater than 3 mm, associated repairable meniscal tears, and multiligament injury association.[1–3,5,17]

Contraindications to physeal-sparing ACL reconstruction include medical comorbidities precluding surgical intervention, a stiff knee that does not have normal motion, and closed growth plates. In adolescents who have finished growing earlier than their peers and have closed their growth plates, standard adult-type ACL reconstruction can be performed.

PREOPERATIVE PLANNING

In a skeletally immature patient, preoperative planning is important. An accurate assessment of bone age and remaining growth assists in the planning process and guides the decision making for graft choice. In a patient who is very close to skeletal maturity, using an adult reconstructive technique would be acceptable. In a patient who has significant remaining growth based on bone age, using a physeal sparing or adolescent ACL technique is more appropriate. Each child has a unique rate of growth, and especially in males, there can be significant variation of remaining growth among subjects of the same age. Therefore, numerical age alone cannot solely guide decision making regarding a skeletally immature patient who is ACL insufficient.

To assess bone age, we obtain anteroposterior hand radiographs from all adolescent patients and compare them with the Greulich and Pyle atlas.[20] Adolescent girls will usually stop growing at the skeletal age of 14, whereas adolescent boys will stop growing at 16.5 years. When appropriate, we also use patients' height compared with their parents', secondary sexual characteristics (Tanner level), and in adolescent girls, the onset of menarche. In adolescent girls, a growth spurt precedes the onset of menarche and, in general, they will grow for 2 years from the onset of menses. In addition, if a growth arrest would occur, it may take up to a year to manifest itself; hence, if there is less than 1 year of predicted remaining growth, we generally will perform our adult ACL reconstruction.

If we determine that a patient has significant remaining growth, we discuss the options that are available for reconstruction. Many of these adolescents are quite petite, and in those circumstances, we discuss and recommend allograft hamstring