Anterolateral and Anterior Cruciate Ligament Reconstruction in the Young Athlete: When Should Both Be Considered?

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Introduction

Anterior cruciate ligament (ACL) ruptures have grown increasingly problematic in pediatric athletes, owing largely to an amplified competition level, increased single-sport specialization, and year-round play.[1–3] While reconstruction of the ACL generally offers excellent results[4], the re-rupture rate remains highest in young and active patients.[5] As surgeons strive to optimize the outcomes of ACL reconstruction in this high-risk population, the anterolateral ligament (ALL) has gained significant attention over the last decade as many hypothesize that residual rotational instability from unaddressed injuries to the supporting anterolateral structures may be contributing.[6]

The ligament's original description was in 1879 by Paul Segond, who hypothesized that the present-day "Segond fracture" was an avulsion fracture of the lateral tibia due to increased tension on a "pearly, resistant, fibrous band" now dubbed the ALL.[7] More recent anatomic studies have strengthened the idea that the ligament is a distinct entity deep to the iliotibial band, most often arising proximally from the lateral femoral epicondyle and inserting between the fibular head and the Gerdy tubercle.[8] Though the ligament has now been relatively well-described in the adult, less is known about the pediatric ALL, though two recent pediatric-specific cadaveric investigations have revealed an identification rate of 12.5% and 64% of specimens, respectively.[9,10] The objective of this article is to appraise and apply the existing literature on the ACL and ALL to provide our indications for performing a combined reconstruction procedure in the young athlete.

Question

When is it appropriate to consider performing a combined ACL and ALL reconstruction in young athletes as opposed to ACL reconstruction alone?

Discussion

Several recent biomechanical studies have demonstrated that the ALL appears to play an important role as a restraint against internal rotation of the tibia, especially at increased knee flexion angles.[11] However, data reporting long-term clinical outcomes is relatively lacking. Thus, in the absence of high-quality, prospective data to guide surgical decision-making, many surgeons elect to perform a combined ACL/ALL reconstruction in patients with the greatest risk of graft rupture, for which the specific indications vary widely from surgeon to surgeon. The following are scenarios in which we would consider augmenting an ACL reconstruction with a combined ALL reconstruction in the young athlete.

Revision ACL Reconstruction

The cause of ACL graft ruptures following initial reconstruction is often multifactorial. In fact, patients who suffer a first-time ACL rupture are actually at a greater risk of contralateral ACL tear compared to ipsilateral graft rupture.[12] Nonetheless, patients who suffer a re-tear with no readily apparent cause may have residual rotational laxity at the knee to blame. While ACL-only reconstruction provides outstanding correction against anterior tibial translation, a small percentage of patients can experience residual post-operative rotatory instability, ultimately leading to increased graft tension and possible failure.[13] Thus, we strongly consider performing a combined ACL/ALL reconstruction in revision cases where a cause of graft failure is not apparent.

Generalized ligamentous laxity

Patients with ligamentous laxity carry a heightened risk for several ligamentous injuries, especially of the ACL.[14] A prospective study in 2017 showed that patients with hypermobility—as determined by a modified Beighton score—who underwent ACL reconstruction suffered a graft failure rate of 24.4% compared to only 7.7% of those without hypermobility.[15] Furthermore, the hypermobile patients also reported inferior subjective and functional outcome scores following ACL reconstruction. Ultimately, we believe that patients with evidence of hyperlaxity with a Beighton score of > 6 or knee hyperextension of > 15 degrees may benefit from the additional stability afforded by an ALL reconstruction, especially for those involved in high-level pivoting sports.

High-Grade Pivot Shift

The goal of the pivot shift test is to reproduce the original mechanism of injury by simulating dynamic valgus and internal rotation, ultimately to assess the rotational stability of the knee.[16] The presence of a grade 2 or 3 pivot shift is suggestive

of significant rotational instability which may be insufficiently addressed with an ACL reconstruction alone, and has thus been shown to increase the risk of re-rupture.[13] Furthermore, in patients with a grade 3 pivot shift, up to 73% may have radiographic evidence of injury to the anterolateral structures, compared to only 20% of patients with a grade 1 pivot shift.[17] In these patients, an ALL reconstruction may provide an effective means to restore the apparent rotational stability of the knee.

Elite, Year-Round, Pivoting Sport Athlete

Athletes involved in sports which require constant pivoting and dynamic valgus are at the greatest risk for ACL ruptures and graft failure.[18,19] Accordingly, patients with high-level participation in soccer, football, basketball, or lacrosse may benefit greatly from a combined ACL/ALL reconstruction. In a recent large study of young athletes involved in pivoting sports, the addition of an ALL reconstruction was associated with a 2.5 – 3.1 times lower rate of graft failure compared to ACL reconstruction alone.[20] Thus, in the patient with a first-time ACL rupture who plans to return to a high level of competition in a high-risk sport, the addition of an ALL reconstruction may provide supplementary support against the dynamic valgus position.

Increased Posterior Tibial Slope

Radiographic parameters may also provide important information regarding re-rupture risk as well. Previous studies have demonstrated a direct correlation between increasing lateral posterior tibial slope and the magnitude of anterior translation of the tibia relative to the femur.[21] Consistent with this finding, an increased posterior tibial slope has been shown to increase both the risk of native-ACL rupture and also graft failure in ACL-reconstructed knees.[21,22] Specifically, the odds ratio for graft failure with 4 and 6 degree increases in tibial slope angle was 2.4 and 3.8, respectively.

Radiographic Evidence of ALL Disruption [Future]

The consistent and reliable identification of the intact ALL via MRI has been well demonstrated in adults and less so in skeletally immature patients.[23] However, the use of imaging modalities to reliably detect an ALL injury and subsequently guide clinical decision-making remains in its infancy. Nonetheless, we expect that future investigations will bolster the ability to accurately and reliably detect an ALL injury in the setting of an acute ACL rupture, which may provide more targeted indications for ALL reconstruction in the future.

Conclusions

The anterolateral ligament has garnered a substantial amount of interest within the sports medicine community as of late, though highest-level, evidence-based surgical literature in pediatric patients is currently lacking since descriptions of procedures for this structure remain in their infancy.At our high-volume center, we consider performing a combined anterior cruciate ligament and anterolateral ligament reconstruction in patients with the highest risk of graft rupture, namely those with a history of graft rupture, generalized ligamentous laxity or knee hyperextension, a high-grade pivot shift, increased posterior tibial slope, or the expectation of continued participation in high-level pivoting sports.

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