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Case Report

Intra- and Extra-Articular IT Band ACL Reconstruction for a Pediatric Patient with Recurrent ACL Graft Failures

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Abstract

At the present time there is a lack of data on how to manage revision Anterior Cruciate Ligament (ACL) graft failures in the pediatric population. Decisions on management are reliant on surgeon's clinical experience. The current case review discusses the history and treatment of a 6-year-old patient followed over an 11-year period. The patient suffered an initial ACL tear and was treated operatively with an all-epiphyseal reconstruction. The patient then went on to suffer a graft failure requiring revision. Again, the patient suffered a subsequent graft failure. It was determined by the care team to treat the patient operatively with a Micheli technique. After two asymptomatic years the patient developed genu valgum requiring a guided growth procedure with implants. The implants were removed one year after implantation, and now four years later the patient has been managing well.

Keywords: Pediatric ACL; Recurrent ACL graft failure; Micheli Procedure; Intra- and Extra-Articular ACL Reconstruction

Introduction

ACL graft failures in the pediatric patient have had a rising incidence rate yearly and are only expected to continue. The current management of these patients is almost always through surgical intervention with the use of a graft (CITE). However, there remains debate as to which surgical intervention is best. In the setting of recurrent graft revision, as in the case we are presenting, there remains an even greater lack of evidence to support the best intervention.

Case Report

A 12-year-old male patient presented to our office with left knee effusion and feelings of instability after falling off his bike. Physical examination was significant for a positive Lachman, anterior drawer, and pivot tests. Radiographic imaging confirmed a tear of the patients left ACL graft. The patient had previously torn his ACL 6 years prior at the age of 6, after a sledding crash for which he received an all-epiphyseal ACL reconstruction with a semitendinosus and gracilis autograft. He managed surgery well, and it was not until 4 years after index surgery at 10 that he tore his graft while wrestling with his brother.

The patient, now 2 years later at the age of 12, has a subsequent left ACL graft failure. The orthopedic surgeon who was responsible for the patient's care up until this point had retired- which prompted the patient to seek out care at our clinic.

Due to the subsequent graft failures, the patient and mother agreed that a technique other than a subsequent graft revision should be performed. It was decided to proceed with a staged procedure including diagnostic arthroscopy, bone grafting tibial tunnel, and then perform a physeal-sparing Micheli approach using the Iliotibial band.

At the 2-week follow-up visit, he could flex the knee to 90 degrees without any pain. The patient was non-compliant with post-op protocol by not using his knee immobilizer and just using his crutches. At 6 weeks post-op the patient had been improving well meeting with a physical therapist, who was also pleased with his improvement. The patient's range of motion continued to increase over ensuing weeks, and at 6 months the patient was able to return to activity with the use of a brace. Two years post-Micheli, the patient presented with malalignment and required guided growth. The patient received an implant to arrest the physis. A year later the implants were removed due to restoration of the patient's anatomy and limited growth potential. Now, 6 years post-Micheli surgery, the patient continues to be asymptomatic with full range of motion, and participation in all activities.

Discussion

Anterior Cruciate Ligament (ACL) tears are common in chil-

dren and have become increasingly more prevalent every year due to early sport specialization, and participation in year-round sports [1]. A study done by Tepolt, et al. collected data from the Pediatric Health Information System (PHIS) database and found that there was a 2.8-fold increase in the number of pediatric ACL reconstruction surgeries over a 10-year time span, from 2004-2014 [2]. The mechanism of injury is typically non-contact and caused by a pivoting mechanism with the knee partially flexed and the foot planted [3]. The current treatment recommendation for these injuries is surgical intervention to prevent further knee degeneration and return functional anatomy to the knee [4]. With the growing rate of ACL surgery in the pediatric population, subsequent graft failure and the need for revision have also been on the rise [5,6].

It is well studied that surgical intervention provides the best long-term outcome for the pediatric ACL tear patient, but the type of surgical intervention remains controversial [3,4]. Current options for surgeons to consider include the transphyseal, partial transphysesal, all-epiphyseal, and the extra-articular and intra-articular iliotibial band reconstruction. The transphyseal and partial transphyseal approaches involve drilling across the physis, and in the skeletally immature patient with open physeal plates this option is typically avoided to prevent the theoretical increased risk of limb-length discrepancy [7]. The all-epiphyseal approach has been frequently utilized. Albeit this technique involves drilling into the bone however it avoids drilling across the physis. Of note, current literature does not offer a consensus on the actual increased rate in physeal disturbance in the skeletally immature patient when comparing the full and partial transphyseal approaches to the physeal sparring approach, but the theoretical component is evident. A study done by Wall et al., a retrospective review of 27 patients who underwent all-epiphyseal approach found bone overgrowths in 11% of patients requiring further surgical intervention. When providing the all-epiphyseal approach there remains a point of contention on graft selection for these young patients.

Multiple options exist when selecting a graft option and it is important for surgeons to consider many factors when choosing the best option for their patient. The Hamstrings (HS) grafts are commonly used as they provide good functional outcomes, have low harvest site morbidity, however they come with a higher incidence of graft rupture when compared to Bone Patellar Tendon Bone (BPTB) grafts. BPTB grafts provide excellent functional outcomes with low rates or graft failure, however they remain contraindicated in the skeletally immature patient as harvesting the graft involves violating the phsysis and increases the risk for limb length discrepancy [8]. Quad Tendon (QT) grafts are also used and provide the benefit of being able to be harvested minimally-invasively and pose less risk of infection compared to HS. However, they are shown to have prolonged quadricep tendon weakness and higher rates of graft failure compared to its autograft counterparts [9]. Lind et al., analyzed graft failure rates and found QT to be higher at 4.7%m compared to HS and BPTB (2.3% versus 1.5%. respectively) [10]. Allografts from cadaver are another option, but they come with significant risks including increased graft failure, disease transmission, immune responses, and delayed incorporation and healing [11].

Wasserstein et al., found that in patients under 25 there was a 9.6% graft rupture rate with autograft versus 25.0% with allograft [12]. Therefore, special consideration is needed to determine the activity level of the patient you are treating to assess for potential risk of re-rupture. Graft rupture remains high in this patient population as shown in a retrospective study done by nelson et al., which found that out of 534 skeletally immature patients that received an ACLR there was a total revision rate of 8.2%. However, there is currently a lack of consensus on the subsequent graft failure risk, and the best surgical management for those patients.

The surgical management of recurrent ACL graft tears remains unclear due to the lack of literature in the skeletally immature patient population. A newer surgical intervention being provided to skeletally immature patients that rupture their ACL is the extra-articular and intra-articular iliotibial band reconstruction [13]. This provides the theoretical benefit of avoiding the physeal plate and lacks any bone tunnel drilling entirely. A study done by Koher et al., followed 44 skeletally immature patients for 22 years, where they reported no angular deformities or growth discrepancies, as well as only 2 graft revision at 4.7 years, and 8.3 years postoperatively (Kocher et al., 2006). This newer approach provides an alternative in the subsequent revisional setting to provide excellent function outcomes and great short to long term outcomes [13,14].

One of the feared adverse effects of ACLR in the skeletally immature patient is limb length discrepancy due to disturbance of the physis. Current management for these patients includes conservative and surgical intervention options. Conservative management is typically provided for those that have under a 5cm limb length discrepancy and the options include insoles, shoe lifts, or an orthosis [15]. Surgical management is recommended for patients beyond those parameters and those that have growth potential by arresting the physeal plate either temporarily through the use of staples or more permanently through screws or plate-screw systems bridging the epiphyseal plate [15].

Conclusion

To conclude, ACL tears in the skeletally immature patient population have become more frequent year by year. Multiple surgical interventions and graft types exist, and each require special consideration of potential drawbacks when finding the best option to fit a patient's needs. In the setting of multiple graft failures, there remains a lack of consensus in the literature to determine the best course of management. In this case, the extra-articular and intra-articular iliotibial band reconstruction was able to restore functional outcomes without a subsequent failure. Finally, limb-length discrepancy remains a feared outcome when treating this patient population, and awareness and early intervention are vital to restore symmetric anatomy.

Author Contributions

Steven J Grampp - Concept and Design of study, drafting article, revising article.

Emily Ellison - Concept and Design of study, drafting article, revising article

Meagan Fernandez - Final Approval, Intellectual Content, revising article

Mark Seeley - Final Approval, Intellectual Content, revising article

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