

Early Graft Failure in Children and Adolescents Following Anterior Cruciate Ligament Reconstruction

keinan agonias, Robert L Van Pelt, Jay C Albright, John Arvesen, Jennifer Beck, Richard E Bowen, Jennifer M Brey, Matthew Joel Brown, James Marc Cardelia, Charles M Chan, Christian Clark, Allison Elizabeth Crepeau, Aristides Ignacio Cruz, Eric William Edmonds, Matthew David Ellington, Peter D Fabricant, Jeremy Stephen Frank, Benton E Heyworth, Ryan Koehler, Kevin H Latz, John Todd Rutter Lawrence, Alfred A Mansour, Scott D McKay, Molly Claire Meadows, Heather Menzer, Matthew Milewski, Donna M Pacicca, Shital N. Parikh, Brian Piazza, Jason Troy Rhodes, John Schlechter, Gregory A Schmale, Stephen K Storer, Curtis D VandenBerg, Jeffrey M Vaughn, Drew Eugene Warnick, Margaret Wright, Yi-Meng Yen, Theodore J Ganley, Matthew R Schmitz, Michael G Saper, Emily Liyun Niu, Daniel William Green, Kevin G Shea, Philip L Wilson, Henry Bone Ellis

INTRODUCTION: Pediatric anterior cruciate ligament reconstruction (ACLR) rehabilitation routinely requires a minimum of 9-12 months before returning to sports. There is limited literature regarding early graft failures in this population. Therefore, the purpose of this study is to describe the incidence and characteristics of pediatric ACLR graft failure occurring \leq 8-month postoperatively utilizing a large, multi-center prospective quality improvement registry.

METHODS: A prospective, surgeon driven multi-center registry (27 institutions and 43 surgeons) was queried for consecutive ACLR between 2018-2025. All consecutive cases were entered into a HIPAA-compliant electronic platform. Patients who underwent isolated ACLR at \leq 19 years of age and had a minimum of 8 months follow-up were included. Graft failure was defined by requiring revision of ACLR or reinjury confirmed by advanced imaging. Demographics, graft type, drilling techniques, femoral and tibial fixation techniques and fixation devices, and postoperative rehabilitation data were analyzed. Descriptive statistics were utilized.

RESULTS: A total of 3337 ACLR with \geq 8-month follow-up were included for analysis. There were 35 graft failures which occurred \leq 8-month postoperatively, for an overall graft failure rate of 1.05%. The mean age of patients was 15.2 ± 1.6 years, 57.1% were male, and the mean BMI was 22.6 ± 4.1 . There were 15 (42.9%) closed physes, 10 (28.6%) closing physes, and 7 (20.0%) open physes. 33 (94.3%) were primary ACLR. Mean operative time was 102.2 \pm 32.9 minutes. The majority of autograft failures in this cohort included 11 hamstring autografts (30.5%), and 15 (41.7%) quadriceps tendon-soft tissue, which led to an early failure rate of 1.3% for hamstring autografts and 1.5% for quadriceps soft tissue autografts. The early failure rate for bone patellar bone autografts was 0.3% (2) and was 0.3% (1) for IT band autografts. Only 4 (11.4%) failures were seen with the addition of a lateral extra-articular tenodesis with any graft type. Early graft failures were observed in grafts with femoral fixation with adjustable loop in 24 patients (68.6%), interference screw in 5 patients (14.3%) and fixed loop in 4 patients (11.4%), while tibial fixation included 16 (45.7%) interference screws, 15 (42.9%) adjustable loops, 8 (22.9%) tibial anchors, 1 (2.9%) tibial screw and washer (Table 1). Variations were noted in post-operative restrictions (Table 2).

DISCUSSION AND CONCLUSION: In 3337 pediatric ACLR, the early (\leq 8-month) graft failure rate following ACLR reconstruction in pediatric patients was 1.05%. Higher Rates of early failures were identified in hamstring autograft and soft tissue quadriceps autografts. There were fewer early graft failures in grafts with the addition of a lateral extra-articular tenodesis.

Table 1. Patient Demographics and Surgical Data of Early ACLR Graft Failure (n=35)

Characteristic	n (%)
Age, years, range	15.2 ± 1.6 (10-19)
BMI, range	22.6 ± 4.1 (16.3-35.9)
Sexual Maturity	
Closed	15 (42.9%)
Closing	9 (28.6%)
Open	4 (11.4%)
Procedure type	
Primary	33 (94.3%)
Revision	2 (5.7%)
Graft Type	
Hamstring	11 (30.5%)
Quadriceps Tendon - Soft Tissue	15 (42.9%)
IT Band + Quadriceps Tendon - Soft Tissue	1 (2.9%)
Quadriceps Tendon - Bone Plug	2 (5.7%)
Allograft	1 (2.9%)
Bone Patellar Bone Plug	2 (5.7%)
IT Band	1 (2.9%)
Hybrid (Hamstring autograft and allograft)	1 (2.9%)
Femoral Diameter	
\leq 8 mm	13 (37.1%)
9 mm	10 (28.6%)
\geq 9.5 mm	10 (28.6%)
Femoral technique	
Transphyseal	10 (28.6%)
All-epiphyseal	4 (11.4%)
Over the top	1 (2.9%)
Standard Arthroscopic Single Incision	9 (25.7%)
Transphyseal + Standard Arthroscopic Single Incision	1 (2.9%)
Standard Arthroscopic Two Incision	9 (25.7%)
Transphyseal + Standard Arthroscopic Two Incision	1 (2.9%)
Femoral Fixation	
Femoral adjustable loop	24 (68.6%)
Femoral fixed loop	4 (11.4%)
Femoral interference screw	5 (14.3%)
Suture	1 (2.9%)
Tibial Diameter	
\leq 8 mm	13 (37.1%)
9 mm	10 (28.6%)
\geq 9.5 mm	10 (28.6%)
Tibial Fixation	
Tibial interference screw	16 (45.7%)
Tibial secondary supplement	5 (14.3%)
Tibial periosteum	1 (2.9%)
Tibial adjustable loop	15 (42.9%)
Tibial anchor	8 (22.9%)
Tibial concave screw and washers	1 (2.9%)

Table 2. Postoperative Rehabilitation of Early Graft Failure Cases (n=35)

Rehabilitation Protocol	n (%)
Physical therapy location	
Outpatient	2 (5.7%)
ICP	23 (65.4%)
CPM Use	4 (11.4%)
Goal Therapy Use	27 (77.1%)
Type of Range of Motion Restriction	
None	19 (57.1%)
Controlled (Fixed, Locked in Extension)	13 (37.1%)
0-90 degrees	9 (25.7%)
Average Duration Range of Motion Restriction, weeks (range)	3.9 (1-12)
Type of Weight Bearing Restriction	
Non-weight bearing	1 (2.9%)
Touch weight bearing	6 (17.1%)
Partial weight bearing	4 (11.4%)
Full weight bearing	24 (68.6%)
Average Duration Weight Bearing Restriction (range)	3.3 (2-8)

ICP = Continuous Passive Motion, ICP = Intensive Outpatient Therapy.