

Predictors of Anterior Cruciate Ligament Reinjury and Return to Sport in Adolescent Athletes

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INTRODUCTION:

The incidence of anterior cruciate ligament (ACL) injuries is increasing among the adolescent population with a peak occurring in the high school age range. In young athletes who undergo ACL reconstruction (ACLR), the risk for secondary ACL injury is greatest in the early RTS period. The aim of this study was to characterize recent epidemiologic trends of ACL injuries and re-tear rates in high school adolescents and determine variables associated with sustaining secondary ACL injury.

METHODS:

A prospectively maintained institutional database was retrospectively reviewed for all patients 18 or younger who underwent primary ACL reconstruction between 2015 to 2020. Patients were eligible for inclusion in this study if they were between the ages of 13-18 years old, participated in sporting activity in high school, and underwent evaluation and primary ACLR at a single institution. Odds ratios were calculated for baseline patient characteristics and their association with risk of re-tear. Multivariate cox regression analysis was also performed to identify the relationship between re-tear and potential risk factors.

RESULTS:

A total of 431 patients were included, with median follow up of 64.9 months. Nine percent of patients experienced a primary graft failure, and 11.2% sustained a contralateral ACL tear (Table 1). Patients with a secondary ACL injury were older than those who did not sustain a subsequent ACL tear (mean age at surgery 16.2 ± 1.3 years versus 15.6 ± 1.5 years, respectively, p = 0.003). A significantly longer follow-up duration was appreciated in adolescents with a secondary ACL injury (65.3 ± 18.8 months versus 71.4 ± 21.2 months, p = 0.022). Multivariable cox regression analysis of secondary ACL injury and stepwise backward elimination analysis illustrated that younger age at primary ACL reconstruction (HR 0.71, 95% CI: 0.60, 0.85) and time to return to sport (HR 0.83, 95% CI: 0.74, 0.92) were significantly associated with an increased rate of secondary ACL injury (Table 2). As age at primary ACLR increases by 1 year, the rate of secondary ACL injury decreases by 29%. Similarly, a 1-month delay in return to sport decreases the rate of secondary ACL injury by 17%.

DISCUSSION AND CONCLUSION:

Younger age and decreased time to return to sport following ACL injury are significant variables associated with sustaining secondary ACL injury in the pediatric patient population. Counseling of young adolescent athletes should include adequate physical therapy compliance and allowing for adequate healing and time to return to sport.

Table 2. Multivariable Cox Regression Analysis of Secondary ACL Injury

Predictor	Hazards Ratio (95% CI)	p-value
Cox Regression Model		
Age at primary ACLR	0.71 (0.60, 0.85)	< 0.001
Time to Return to Sports	0.83 (0.74, 0.92)	0.004

Table 1: Major Demographic and Clinical Characteristics of Study Population Overall and by Secondary ACL Injury Type

Patient Characteristics	Control	Secondary ACL Injury		p-value
		Graft Failure	Contralateral ACL Injury	
N	344	39	48	
Sex				0.48
Male	183 (53.2%)	19 (46.2%)	22 (45.8%)	
Female	161 (46.8%)	21 (53.8%)	26 (54.2%)	
Age, mean years (SD)	16.2 ± 1.3	15.7 ± 1.8	15.5 ± 1.3	0.007
BMI, Median (IQR)	23.8 (21.7, 27.3)	24.4 (22.5, 26.5)	24.0 (22.1, 25.5)	0.78
Race (N=22)				0.40
Asian	2 (0.6%)	0 (0.0%)	1 (2.1%)	
Black	96 (28.4%)	7 (17.9%)	9 (20.0%)	
Other	5 (1.5%)	0 (0.0%)	0 (0.0%)	
White	235 (69.5%)	32 (82.1%)	35 (77.8%)	
Primary Sport prior to ACL Injury (N=383)				0.07
Basketball	87 (28.4%)	3 (8.8%)	12 (27.9%)	
Football	72 (23.5%)	12 (35.3%)	11 (25.6%)	
Soccer	58 (19.0%)	12 (35.3%)	11 (25.6%)	
Other	66 (21.6%)	7 (20.6%)	7 (16.3%)	
Volleyball	23 (7.5%)	0 (0.0%)	2 (4.7%)	
Graft Type (N=430)				0.08
BTB	175 (51.0%)	14 (35.9%)	30 (62.5%)	
Hamstring	87 (25.4%)	38 (46.2%)	12 (25.0%)	
Quad Tendon	79 (23.0%)	7 (17.9%)	6 (12.5%)	
Other	2 (0.6%)	0 (0.0%)	0 (0.0%)	
Use of Allograft (N=430)	5 (1.5%)	0 (0.0%)	1 (2.1%)	0.75
No. of PT Visits, Median (IQR) (N=279)	24.0 (17.0, 35.0)	20.0 (14.0, 30.0)	26.0 (16.0, 36.0)	0.22
Time to Return to Sport, Median mo (IQR) (N=311)	9.0 (7.0, 9.0)	8.0 (7.0, 9.0)	9.0 (7.0, 9.0)	0.19
Sport Clearance (N=362)	239 (83.0%)	22 (71.0%)	34 (79.1%)	0.24
Return to Competitive Play (N=354)	224 (80.9%)	27 (81.8%)	41 (93.2%)	0.14
Duration of Follow-up, Median mo (IQR) (N=428)	64.2 (48.1, 81.8)	77.2 (60.4, 90.7)	64.3 (52.1, 79.3)	0.006
Time to Re-tear, Median mo (IQR) (N=83)	—	14.0 (9.0, 41.5)	19.0 (12.0, 35.0)	0.72

* Postoperative complications other than graft failure
PT = physical therapy

Note: most patient charts did not contain complete information on all variables. As such, frequency and percentages for these variables are calculated using the total available patients rather than overall patients.