Posterior Cruciate Ligament Injuries in Children and Adolescents – Treatment and Long-Term Outcomes

Morgan Batley, Katherine Ashe, Kathleen Maguire, Brendan Alexander Williams

INTRODUCTION: Evidence regarding treatment, rehabilitation guidelines, and outcomes of posterior cruciate ligament (PCL) injuries in the pediatric population is limited. Treatment for these injuries has historically leaned toward initial conservative management in the setting of isolated PCL tear. For cases of residual instability or concomitant injury, treatment strategies are traditionally derived from the adult population with surgical treatment more commonly considered. The present study aims to identify pediatric patients with MRI-confirmed PCL injuries without other cruciate or collateral ligament injury treated at a single center to evaluate injury characteristics, treatment, and outcomes.

METHODS: A retrospective review and cross-sectional outcomes assessment was performed identifying patients ≤18 years old with PCL injuries from a single treatment center between 2015 to 2021 using ICD-10 coding. Patients with concomitant collateral or cruciate ligament injury were excluded. Studied variables included patient demographics, injury characteristics, treatment strategies, prescribed bracing and rehabilitation guidelines, and patient outcomes. A cross-sectional survey was then distributed to all patients in March and April of 2023 that included patient-reported outcome measures and evaluated for subsequent knee injury. Descriptive statistics and bivariate testing were used to summarize these variables and compare surgical and nonsurgical cohorts.

RESULTS: Twenty-four patients meeting inclusion criteria were identified. Injured patients had a mean age of 13.17 years old and were predominantly male (67%, Table 1). Injuries most occurred during sport participation (75%) with a contact mechanism (67%). Most patients were managed nonsurgically (67%), with all patients undergoing formal physical therapy. Full thickness tears were more commonly treated surgically (p<0.01). Overall, there were no differences between treatment groups regarding complications or return to sport. Activity progression was noted to be slower in the surgical cohort and a longer period of recommended hinged knee brace wear. Seven (29%) completed the cross-sectional outcomes assessment at an average of 4.45 years from injury. All patients had successfully returned to sport without suffering an ipsilateral knee injury (Table 2). Patient-reported outcome scores fell within normative ranges.

DISCUSSION AND CONCLUSION: The present study expands upon the limited literature base regarding isolated PCL injuries in pediatric patients. Complete tears were more commonly treated surgically. Other patient and injury characteristics did not appear to guide management. Both treatment groups achieved successful return to sport in a similar timeframe with low rates of complication or early treatment failure. Variation in rehabilitation guidelines across both treatment strategies were noted. Within a limited subcohort with long-term follow up, we identified no PCL retreats and normative patient-reported and knee functional outcomes. These results suggest that both surgical and nonsurgical treatment strategies are reasonable in the management of pediatric PCL injuries. Further work is necessary to evaluate longer term clinical and patient-reported outcomes following these two treatment strategies in larger patient cohorts.

Variable[a]	Total (N = 24)	Non-Operative (N = 16)	Operative (N = 8)	p-value
Demographic Characteristics				
Age at Date of Injury (years)	13.17 ± 3.36	13.31 ± 3.20	12.88 ± 3.87	0.79
Male Sex (vs. Female)	16 (67%)	10 (63%)	6 (75%)	0.67
Race				
Black	4 (17%)	2 (13%)	2 (25%)	
White	18 (75%)	13 (81%)	5 (63%)	0.28
Other	2 (8%)	1 (6%)	1 (12%)	
Hispanic/Latinx (vs. Non-Hispanic/Latinx)	2 (8%)	2 (13%)	0	0.54
BMI	23.53 ± 4.89	23.85 ± 5.33	22.87 ± 4.52	0.64
Injury Characteristics				
Mechanism of Injury				
Sport (vs. Non-Sport)	18 (75%)	13 (81%)	5 (63%)	0.36
Contact (vs. Non-Contact)	16 (67%)	10 (63%)	6 (75%)	0.57
Physeal Status				
Open	12 (50%)	9 (56%)	3 (37%)	
Closing	10 (42%)	6 (38%)	4 (50%)	0.66
Closed	2 (8%)	1 (6%)	1 (12%)	
Right Knee (vs. Left)	11 (46%)	8 (50%)	3 (37%)	0.68
Location of Tear				
Proximal	7 (29%)	3 (19%)	4 (40%)	
Mid	11 (46%)	8 (50%)	3 (37%)	0.26
Distal	6 (25%)	5 (31%)	1 (12%)	
Ligamentous Tear (vs. Avulsion)	21 (88%)	15 (94%)	6 (75%)	0.25
Concurrent Injury (vs. None)	12 (50%)	7 (44%)	5 (63%)	0.67
Partial Tear (vs. Full)	12 (54%)	12 (75%)	1 (12%)	< 0.01
Time from Injury to OR (months)	-	-	14.53 ± 28.46	-
Treatment & Outcome Characteristics				
Functional Bracing Prescribed	19 (79%)	12 (75%)	7 (88%)	0.63
Complications During Treatment Course				
Continued Instability	0	0	0	
Re-tear/Re-injury	1 (4%)	0	1 (12%)	0.33
Return to OR	0	0	0	
Surgical Management				
Arthroscopic (vs. Open)	-	-	7 (88%)	-
Reconstruction (vs. Repair)	-	-	6 (75%)	-
Autograft (vs. Allograft)	-	-	5 (62%)	-
Concurrent Procedures (vs. None)	-	-	3 (37%)	-
Weeks to Full Weight-bearing	1.96 ± 2.35	1.00 ± 1.93	3.88 ± 1.96	< 0.01
Weeks to Full Range of Motion	2.17 ± 2.50	1.56 ± 2.50	3.38 ± 2.13	0.08
Weeks to Isolated Hamstring Strengthening	5.39 ± 4.83	3.27 ± 13.42	9.38 ± 5.26	0.01
Months to Impact Activities	3.52 ± 1.35	3.12 ± 1.14	4.28 ± 1.47	0.08
Months to Return to Sport	7.05 ± 4.08	6.14 ± 2.71	8.86 ± 0.38	0.06
Months of Follow-up	15.04 ± 17.77	8.81 ± 9.77	27.50 ± 23.82	0.07

Variable	Total (N=7)	Non-Operative (N=4)	Operative (N=3)
Age at Survey Response (years)	17.02 ± 5.50	15.74 ± 2.87	18.74 ± 8.40
Time from Injury to Survey Response (years)	4.45 ± 3.03	3.52 ± 2.61	5.69 ± 3.65
Successful Return to Sport After Injury	7 (100.0)	4 (100.0)	3 (100.0)
Subsequent Ipsilateral Knee Injury	0	0	0
Subsequent Contralateral Knee Injury	1 (14.3)	1 (25.0)	0
PROMIS t-Score	54.21 ± 6.41	51.80 ± 7.96	57.43 ± 0.92
IKDC Score	85.14 ± 8.21	86.25 ± 10.53	83.67 ± 5.51
Lysholm Score	76.0 ± 11.33	74.0 ± 12.27	78.67 ± 11.85