Comparison of Rates of Growth Disturbance in Extraphyseal, Transphyseal and Partial Epiphyseal Anterior Cruciate Ligament Reconstruction in Skeletally Immature Patients

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The incidence of pediatric anterior cruciate ligament (ACL) ruptures has shown an upward trajectory, necessitating heightened vigilance in preserving the integrity of the growth plate within the skeletally immature demographic. Given the escalating incidence of such injuries, there is an imperative need for comprehensive investigation into the optimal reconstruction methodology applicable to children and adolescents. The objective of the present study is to evaluate the occurrence of growth plate disruption, graft failure rates, rates of reoperation, and the functional outcomes subsequent to anterior cruciate ligament reconstruction (ACLR) within the skeletally immature population.

Following local Institutional Review Board (IRB) approval, skeletally immature patients who underwent ACL reconstruction from June 26, 2018 to April 30, 2023 at a single tertiary pediatric hospital were identified. Exclusion criteria included any patients with partial ACL tears, skeletally mature patients, those lost to follow-up within 4 months post-surgery, and those with more than half of the data variables not reported. Data variables, including patient demographics, injury data, surgical techniques, clinical outcomes, and complications, were collected retrospectively. Pre- and postoperative clinical outcomes, including knee range of motion, Lachman grade, and stability to anterior, posterior, varus, or valgus forces, were also recorded. A p-value of less than 0.05 was considered statistically significant. RESULTS:

A total of 264 patients were initially identified, with 60 patients meeting inclusion and exclusion criteria. The mean age of the skeletally immature patients was 12.7 + 1.7 years. Forty-three (71.7%) patients were male. Predominantly, injuries were sports-related (88%). Twelve (20.0%) patients underwent transphyseal reconstruction, 32 (53.3%) underwent extraphyseal reconstruction, and 16 (26.7%) had partial epiphyseal reconstruction. The partial epiphyseal technique had higher rates of anterior pain postoperatively with 12.5% reporting it versus 0% for transphyseal and 0% for extraphyseal techniques (p < 0.05). Conversely, the transphyseal technique had a significantly higher rate of postoperative knee flexion weakness (33.3%) compared to the extraphyseal (3.13%) and partial epiphyseal techniques (12.5%) (p < 0.05). And while differences in reinjury and recovery times were noted between surgical approaches, no statistical significance was achieved.

DISCUSSION AND CONCLUSION:

In the study's pediatric cohort, there was no significant difference in growth arrest, graft rupture, or reoperation between transphyseal, extraphyseal, and partial epiphyseal reconstruction techniques, indicating that each of these techniques may be relatively safe in the skeletally immature. Notably, among skeletally immature patients, only the extraphyseal technique resulted in some cases of growth disturbance, although this was not determined to be statistically significant. Future studies should prioritize the inclusion of a more extensive skeletally immature cohort to advance the comprehension of optimal surgical treatment strategies.

Characteristics	Level	Surgical Techniques			
		Transphyseal (N= 12)	Extraphyseal (N= 32)	Partial Epiphyseal (N= 16)	P Value
Age in years	Mean (SD)	14.1 (1.0)	11.7 (1.5)	13.7 (1.1)	<0.001
Sex, n (%)	Male	8 (66.7)	27 (84.4)	8 (50.0)	0.041
	Female	4 (33.3)	5 (15.6)	8 (50.0)	
Sports-related injury, n (%)	No	0 (0.0)	7 (21.9)	1 (6.2)	0.102
	Yes	12 (100.0)	25 (78.1)	15 (93.8)	
Repair of concomitant injury, n (%)	No	4 (33.3)	7 (21.9)	9 (56.2)	0.059
	Yes	8 (66.7)	25 (78.1)	7 (43.8)	
Growth arrest, n (%)	No	10 (100.0)	22 (88.0)	10 (100.0)	0.276
	Yes	0 (0.0)	3 (12.0)	0 (0.0)	
Postop ROM Flexion, n (%)	≤ 120 degree	0 (0.0)	3 (9.4)	0 (0.0)	0.251
	> 120 degree	12 (100.0)	29 (90.6)	16 (100.0)	
Anterior pain, n (%)	No	12 (100.0)	27 (100.0)	11 (84.6)	0.044
	Yes	0 (0.0)	0 (0.0)	2 (15.4)	
Knee flexion strength, n (%)	Not full strength	4 (33.3)	1 (3.6)	2 (16.7)	0.038
	Full strength	8 (66.7)	27 (96.4)	10 (83.3)	
Reinjury, n (%)	No	7 (100.0)	28 (100.0)	14 (87.5)	0.103
	Yes	0 (0.0)	0 (0.0)	2 (12.5)	
Recovery time (months)	Mean (SD)	10.0 (1.8)	10.1 (2.2)	11.3 (2.9)	0.33

binary data ** If values do not add to correct group total, it is due to variables being not reported for certain patients leading to their exclusion for particular characteristics