Comparative Outcomes at Minimum One-Year Follow-up Between ACL Reconstruction and Bridge-Enhanced ACL Repair (BEAR): A Propensity-Matched Cohort Study

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INTRODUCTION:

Anterior cruciate ligament (ACL) injuries are common and traditionally treated with ACL reconstruction (ACLR) using autograft or allograft tissue. The Bridge-Enhanced ACL Repair (BEAR) technique has emerged as a tissue-preserving alternative, employing a bioengineered, bovine-derived collagen scaffold to facilitate native ligament healing. While BEAR offers potential advantages such as reduced donor site morbidity and enhanced biological healing, concerns remain regarding re-tear and re-operation rates compared to standard reconstruction. This study aims to compare postoperative outcomes at a minimum one-year follow-up between patients undergoing ACLR and those treated with BEAR, using a propensity-matched cohort.

METHODS:

This retrospective cohort study evaluated patients who underwent either BEAR (n = 42) or ACLR (n = 64). Propensity score matching was performed based on age, sex, body mass index (BMI), smoking status, laterality, and follow-up duration to minimize confounding variables. Recorded data included demographic characteristics and concomitant procedures. Outcomes assessed were reoperation rates, re-tear incidence, range of motion (ROM), and postoperative complications. Statistical comparisons were performed using t-tests and chi-square analysis, with significance defined as $P < 0.05$.

RESULTS:

The BEAR (n = 42) and ACLR (n = 64) cohorts were well matched across all demographic variables including age (36.62 ± 1.26 vs. 34.54 ± 1.02 years; P = 0.201), sex (P = 0.267), BMI (25.82 ± 4.29 vs. 25.57 ± 4.28; P = 0.765), smoking status (P = 0.913), laterality (P = 0.875), and mean follow-up duration (1.65 ± 0.53 vs. 1.89 ± 0.76 years; P = 0.07). Concomitant procedures, including meniscus repair (BEAR: 38.1% vs. ACLR: 53.1%; P = 0.165) and meniscectomy (BEAR: 21.4% vs. ACLR: 14.1%; P = 0.429), were not significantly different between groups. In the ACLR cohort, the most commonly used graft was bone–patellar tendon–bone (BTB) autograft (65.6%), followed by BTB allograft (10.9%), quad autograft (6.3%), hamstring autograft (6.3%), hamstring allograft (6.3%), and other allografts (4.7%). Patients in the BEAR group had significantly reduced flexion ROM at final follow-up (126.8° ± 24.7° vs. 133.7° ± 2.7°; P = 0.04), while extension ROM was similar between groups (P = 0.384). The overall postoperative complication rate was significantly lower in the BEAR cohort (9.5% vs. 32.8%; P = 0.0038). All complications in the BEAR group were due to arthrofibrosis, whereas the ACLR group experienced a broader range of complications, including quadriceps weakness (33.3%), general knee pain (23.8%), anterior knee pain (19.1%), arthrofibrosis (9.5%), hamstring pain (4.8%), and swelling (4.8%). Reoperation rates were similar (BEAR: 11.9% vs. ACLR: 10.9%; P = 0.878), as were re-tear rates (BEAR: 2.4% vs. ACLR: 0%; P = 0.404). The incidence of manipulation under anesthesia (MUA) was also comparable between groups (BEAR: 9.5% vs. ACLR: 6.3%; P = 0.33).

DISCUSSION AND CONCLUSION:

At a minimum of one year postoperative follow up, BEAR and ACLR demonstrated comparable rates of reoperation and re-tear. BEAR was associated with significantly fewer overall complications but exhibited reduced knee flexion and a higher rate of postoperative stiffness necessitating MUA. These results suggest that BEAR can be a promising alternative to ACLR for select patients, with proximal tear patterns. However, vigilant postoperative management is crucial to address potential stiffness, and future studies are needed to confirm these findings long term.

Table 1: Patient Characteristics and Operative Details for BEAR and ACLR Cohorts Following Propensity Score Matching

Variable		BEAR (n=42)	ACLR (n=64)	P-Value
Age		36.62 ± 1.26	34.54 ± 1.02	0.201
Sex	Male	21 (50%)	25 (39.06%)	0.267
	Female	21 (50%)	39 (60.94%)	
BMI (kg/m²)		25.82 ± 4.29	25.57 ± 4.28	0.765
Smoking	Active Smokers	1 (2.38%)	1 (1.56%)	0.913
	Former Smokers	1 (2.38%)	1 (1.56%)	
	Nonsmokers	40 (95.24%)	62 (96.88%)	
Follow-up duration (Years)		1.65 ± 0.53	1.89 ± 0.76	0.07
Laterality (Right/Left)		21/42 = 0.5 / 21/42 = 0.5	31/64 = 0.4844 / 33/64 = 0.5156	0.875
Concomitant Procedure: Meniscus repair		16/42 = 0.381	34/64 = 0.5313	0.165
Concomitant Procedure: Meniscectomy		9/42 = 0.2143	9/64 = 0.1406	0.429

Table 2: Postoperative Outcomes Following BEAR ACL Repair and ACLR Procedures

Variable		BEAR (n=42)	ACLR (n=64)	P-Value
Reoperation		5 (11.9%)	7 (10.94%)	0.878
Reoperation Type	Meniscus Repair	1 (2.38%)	0	0.24
	Meniscectomy	1 (2.38%)	3 (4.69%)	
	Manipulation Under Anesthesia and Lysis of Adhesions	4 (9.52%)	4 (6.25%)	
Re-tear		1 (2.38%)	0	0.404
Flexion (degrees)		126.81 ± 24.66	133.65 ± 2.66	**0.04**
Extension (degrees)		-0.36 ± 3.27	0.04 ± 0.78	0.384
Post-operative complications		4/42 = 0.0952	21/64 = 0.3281	**0.0038**