Functional Outcomes of Bridge-Enhanced ACL Repair (BEAR): A Retrospective Comparison to Autograft ACL Reconstruction

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INTRODUCTION: There is increasing interest in Bridge-Enhanced Anterior Cruciate Ligament Restoration (BEAR) procedure as a treatment for acute anterior cruciate ligament tears. However, there is limited understanding of how functional outcomes compare between BEAR and other established graft types such as autograft (bone-patellar-tendon-bone (BPTB), quadriceps, hamstring) or allograft. This study aims to describe and evaluate the functional outcomes of BEAR compared to autograft ACL reconstruction in clinical practice. The hypothesis was that BEAR patients would have improved functional outcomes at 6 and 9 months due to lower surgical burden.

METHODS: A retrospective chart review was conducted on 26 consecutive patients who received BEAR by a single surgeon and completed functional testing at 6 months. 14 patients returned for follow-up testing at 9 months. A comparison cohort of consecutive patients during the same time period from the same surgeon who underwent ACL reconstruction with quadriceps autograft (n=26) and BPTB (n=14) were included. At 6 and 9 months, patients underwent a standardized functional testing protocol that included isokinetic strength testing, Landing Error Scoring System (LESS), hop testing, and arthrometer testing. Patient-reported outcomes (PRO) included the Single Assessment Numerical Evaluation (SANE), Anterior Cruciate Ligament Return to Sport After Injury (ACL-RSI) and the International Knee Documentation Committee (IKDC). Student's t-tests and One-way ANOVA test were used for comparison between the BEAR, quadriceps, and BPTB groups.

RESULTS: In the BEAR group (n=26), 54% of the patients were male with an average age of 32.7±14.3 years. No significant differences were found in PROs when comparing the BEAR group to the quadriceps and BPTB groups (SANE: p = 0.89, IKDC: p = 0.78, ACL-RSI: p = 0.48). At 9 months, the BEAR group PROs were increased to a SANE of 85.7±12.5, IKDC of 80.3±14.6, and an ACL-RSI of 60.1±23.4. There were no significant differences found between groups in isokinetic strength evaluation, hop testing, or arthrometer testing. The mean LESS score for each group at 6 months was 5.1±2.7 for BEAR, 5.1±3.0 for quadriceps, and 5.0±2.8 for BPTB.

DISCUSSION AND CONCLUSION: This study is one of the first to report functional outcomes of BEAR patients in comparison to ACL reconstruction with BTB and Quadriceps. The major conclusion from this study was that no significant differences were found in functional outcomes between the BEAR and the Quadriceps and BTB types at 6 and 9-month time points. This study suggests that BEAR ACL has similar early functional outcomes with BTB and Quadricep autograft.

Table 1: 6-month functional outcomes of BEAR, quadriceps, and BPTB patients

	BEAR		Quad		BPTB		BEAR vs Quad	BEAR vs BPTB	ANOVA
	No.	Mean (SD)	No.	Mean (SD)	No.	Mean (SD)	p-value	p-value	p-value
Age	26	32.7 (14.3)	26	28.8 (13)	14	27.8 (11.3)	0.31	0.28	0.42
M (%)/F (%)	26	M(54%)/F(46%)	26	M (65%)/F(35%)	14	M (93%), F(7%)	0.54	**0.003**	**0.042**
SANE (0-100)	23	73.5 (13.8)	20	74.9 (12.8)	4	71.3 (10.3)	0.73	0.76	0.89
IKDC (0-100)	26	73.2 (16.3)	26	76.3 (17.6)	13	76.4 (10.9)	0.51	0.53	0.78
ACL-RSI (0-100)	26	54.6 (24.8)	26	60.7 (25)	13	64.6 (22)	0.38	0.24	0.48
KT1000 Knee Arthrometer (Limb Difference)									
Anterior 15 pounds	26	0.2 (1.4)	26	0.3 (1.3)	12	0.8 (0.6)			
Anterior 20 pounds	26	0.5 (1.9)	26	0.3 (1.4)	12	1.2 (1)			
Anterior 30 pounds	26	1.3 (1.8)	26	0.8 (1.7)	12	1.7 (1.8)	0.31	0.53	0.27
Isokinetic Force (Foot Pounds) - 60 degrees/sec Extension									
% BW inv	26	51.6 (22.4)	26	57 (25.5)	12	50.7 (19.2)			
% BW uni.	26	67 (19.3)	26	77.1 (28.9)	12	71.3 (30.5)			
LSI % (inv/uni)	26	78.7 (26.2)	26	71.9 (19.2)	13	67.6 (20.9)	0.29	0.19	0.29
Isokinetic Force (Foot Pounds) – 60 degrees/sec Flexion									
% BW inv	26	30.3 (12.8)	26	37.9 (20.8)	12	40.8 (17.7)			
% BW uni.	26	35.5 (11.1)	26	39.8 (19.7)	12	48.9 (22.4)			
LSI % (inv/uni)	26	84.7 (20.3)	26	92.2 (17.2)	13	87.6 (16.2)	0.16	0.66	0.32
Landing Error Scoring System (LESS) (0-10)	15	5.1 (2.7)	16	5.1 (3)	9	5 (2.8)	1.00	0.93	1.00
Hop Testing: LSI %									
Single Leg Hop for Distance	10	79.1 (31.8)	11	78.4 (14.2)	7	89.6 (7)	0.95	0.41	0.52
Triple Hop for Distance	8	84.4 (34.8)	6	86.2 (6.4)	5	88.4 (5.4)	0.90	0.80	0.96
Triple Crossover Hop for Distance	7	82.6 (38.2)	6	80.7 (11.7)	5	89.2 (8.6)	0.90	0.70	0.85
6 Meter Hop for Time	9	84 (32.9)	6	90.7 (8.8)	5	92.8 (2.8)	0.68	0.63	0.76

BEAR, Bridge-Enhanced Anterior Cruciate Ligament Repair; Quad, quadriceps autograft; BPTB, bone-patellar tendon-bone autograft; SANE, Single Assessment Numerical Evaluation; IKDC, International Knee Documentation Committee; ACL-RSI, Anterior Cruciate Ligament Return to Sport After Injury; LSI, Limb Symmetry Index; BW, Body weight

Table 2: 9-month functional outcomes of BEAR, quadriceps, and BPTB patients

	BEAR		Quad		BTB		BEAR vs Quad	BEAR vs BTB	ANOVA
	No.	Mean (SD)	No.	Mean (SD)	No.	Mean (SD)	p-value	p-value	p-value
Age	14	35.3 (12.8)	24	28.8 (12.9)	10	26.5 (12.3)	0.14	0.11	0.20
M (%)/F (%)	14	M(57%)/F(43%)	24	M(67.5%)/F32.5%)	10	M(90%)/F(10%)	0.76	0.07	0.21
SANE (0-100)	14	85.7 (12.5)	19	86.3 (10.2)	5	91 (5.8)	0.88	0.38	0.53
IKDC (0-100)	14	80.3 (14.6)	24	85.4 (10.4)	10	83.9 (14.6)	0.22	0.55	0.46
ACL-RSI (0-100)	14	60.1 (23.4)	24	73.1 (25.1)	10	71 (27.4)	0.12	0.31	0.31
KT1000 Knee Arthrometer (Limb Difference)									
Anterior 15 pounds	14	0.9 (1.9)	23	0.7 (0.9)	7	0.1 (0.7)			
Anterior 20 pounds	14	1.4 (2.4)	23	1 (1.3)	7	-0.5 (1.4)			
Anterior 30 pounds	14	2 (3.6)	23	1.3 (1.7)	7	-0.5 (1.7)	0.43	0.1	0.13
Isokinetic Force (Foot Pounds) - 60 degrees/sec Extension									
% BW inv	14	65 (35.6)	24	63.8 (22.1)	10	58 (21.2)			
% BW uni.	14	74.4 (27.4)	24	84.5 (34.1)	10	83.9 (21.5)			
LSI % (inv/uni)	14	83.5 (17.1)	24	76.5 (21.3)	10	69.5 (18.7)	0.3	0.07	0.28
Isokinetic Force (Foot Pounds) – 60 degrees/sec Flexion									
% BW inv	14	37 (17.2)	24	41 (17.8)	10	39.4 (14.5)			
% BW uni.	14	35.4 (13.8)	24	41.3 (19.4)	10	39.9 (12.6)			
LSI % (inv/uni)	14	99 (19.3)	24	100.2 (14.6)	10	96.1 (9.2)	0.83	0.67	0.79
Landing Error Scoring System (LESS) (0-10)	12	3.6 (2.2)	21	5.3 (2.9)	7	3.9 (3.7)	0.09	0.83	0.29
Hop Testing: LSI %									
Single Leg Hop for Distance	10	88.7 (11.5)	20	89.8 (11.9)	7	90.9 (11.6)	0.81	0.7	0.57
Triple Hop for Distance	10	89.3 (7.8)	17	92.3 (8.8)	7	94.3 (7.7)	0.38	0.21	0.41
Triple Crossover Hop for Distance	10	91.5 (9)	18	95.6 (7.6)	6	97.5 (2.7)	0.21	0.14	0.19
6 Meter Hop for Time	10	96.5 (9.2)	18	99.4 (8.5)	6	97.3 (4.1)	0.41	0.85	0.66

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