The Bridge Enhanced ACL Repair (BEAR) Surgical Technique: A Modern Approach to ACL Repair

Chris Canu, PA-S; Jay Determan, PA-S, ATC; Aaron Bosch, PA-S, ATC; Rick Loutsch, DAT, ATC
Northwestern College Physician Assistant Program

Introduction

Anterior Cruciate Ligament (ACL) tears have a prevalence of 68.6 out of 1000 individuals every year in the United States.[1] As a result, roughly 400,000 ACL reconstruction surgeries are performed each year.[2] In December of 2020, the Food and Drug Administration (FDA) approved a new surgical technique for treating ACL tears that relies on bridging the torn ends of the native ACL as opposed to using traditional reconstruction techniques. The Bridge Enhanced ACL Repair (BEAR) technique uses a "resorbable protein-based implant that is combined with autologous blood to bridge the edges of a mid-substance ACL tear".[1] The BEAR technique was designed to be less invasive and minimize patient morbidities such as cartilage damage and earlier onset of osteoarthritis.[2] The purpose of this review is to review the current status of the literature and clinical implications of the BEAR technique as it compares to traditional ACL reconstruction techniques.

Procedure

<u>BEAR Procedure (Figure 1)</u>

The BEAR procedure involves placing an absorbable protein-based scaffold between the 2 torn ends of a mid-substance ACL tear.[3] This scaffold is then soaked with autologous blood to aid in the healing process of the torn ligament, in combination with the approximation of the two ends using sutures.[3] The scaffold is used as a bridge to allow approximation of the torn ligament ends which is required for healing.[3]

<u>ACL Reconstruction Procedure</u>

In contrast, traditional ACL reconstruction is a more invasive procedure that involves harvesting a tendon graft from the body.[3] The graft is then prepped and secured in bone tunnels using screws along the same path as the native ACL.[3]

BEAR Studies I and II

<u>BEAR I</u>

Published in 2016, the purpose of the study was to determine the safety of implanting the BEAR scaffolding on human patients. The trial consisted of 20 patients divided into a BEAR group and a traditional ACL Reconstruction. From this study, it was found that the BEAR implant group did not develop any additional adverse events, and had similar surgical outcomes[3]

<u>BEAR II</u>

After favorable results from the BEAR I trial, the BEAR II trial began with 100 patients randomly assigned, in a blinded manner, between the BEAR group and ACL Reconstruction group in a 2:1 ratio. The patients were followed for 2 years after surgery and data was collected on Patient-Reported Outcomes, Pain, ROM, and Strength in order to compare the BEAR to ACL Reconstruction. [3-8]
(Table 1, 2, 3)

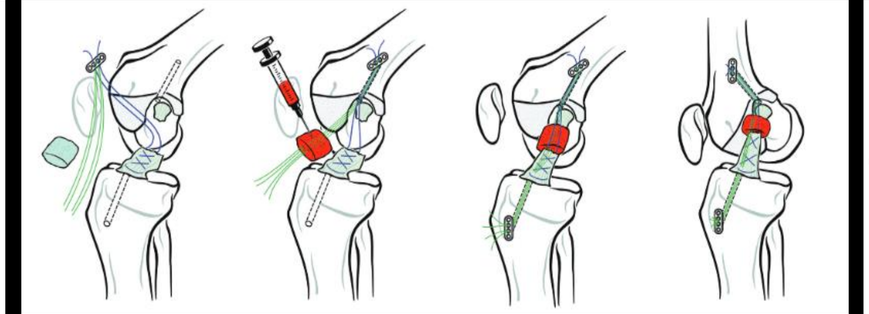

Figure 1: Diagram depicting the BEAR technique using protein-based scaffold being soaked with autologous blood and attached to previous track of native ACL.[4]

Table 1

RESULTS

Assessment	BEAR	ACLR
Strength	Increased Hamstring, Quadriceps, Hip Extensors [4-8]	Increased Hip Adductor [4-8]
Range of Motion	Improved Passive Knee Flexion Decreased Passive Knee Extension Loss [4-8]	
Patient-Reported	No significant differences[10,12]	
Retear/Revision Rate	Ipsilateral: 14% Contralateral: 8 patients Total: 25%[4]	Ipsilateral: 6% Contralateral: 4 patients Total: 14.3%[4]

Table 2

Functional Measures at 2 Years After Surgery[a]

	BEAR		ACLR			
	No.	Mean (SD)	No.	Mean (SD)	Mean Difference (95% CI)[b]	*P* Value
Index						
Hamstring	59	98.2 (26.5)	31	63.2 (15.5)	35.0 (26.1 to 43.8)	<.001
Quadriceps	59	100.1 (12.2)	31	101.5 (12.4)	–1.4 (–6.6 to 4.0)	.61
Hamstring:quadriceps ratio (surgical side)	59	0.43 (0.12)	32	0.27 (0.08)	0.16 (0.11 to 0.21)	<.001
Hip abductor index	56	105.3 (15.3)	31	107.9 (22.5)	–2.6 (–11.7 to 6.6)	.58
Hop						
Single-leg	42	94.4 (13.0)	23	96.9 (13.4)	–2.4 (–9.2 to 4.4)	.48
Triple	41	94.9 (9.7)	22	98.0 (6.9)	–3.0 (–7.7 to 1.6)	.20
6-m timed	40	103.9 (10.6)	22	98.0 (6.7)	5.9 (1.5 to 10.3)	.009
Crossover	39	96.6 (9.8)	22	96.0 (7.3)	0.6 (–4.2 to 5.4)	.81

[a]Values are presented as percentages, unless otherwise stated. ACLR, anterior cruciate ligament reconstruction; BEAR, bridge-enhanced anterior cruciate ligament repair.
[b]Positive difference favors BEAR, and negative difference favors ACLR for all outcomes except 6-m timed hop.

Table 3

Additional Ipsilateral and Contralateral Knee Surgical Procedures Within the First 2 Postoperative Years for the BEAR and ACLR Groups[a]

	BEAR (n = 64)	ACLR (n = 35)	*P* Value
Ipsilateral ACL surgery—all	9 (14.1)	2 (5.7)	.32
Isolated	1 (1.6)	1 (2.9)	≥.99
With meniscus	8 (12.5)	1 (2.9)	.15
Non-ACL ipsilateral knee surgery			
Arthrofibrosis	0 (0.0)	2 (5.7)	.12
Meniscus	7 (10.9)	2 (5.7)	.49
Removal of hardware	1 (1.6)	0 (0.0)	≥.99
Total patients with ipsilateral knee surgery[b]	16 (25.0)	5 (14.3)	.30
Contralateral ACL surgery	2 (3.1)	1 (2.9)	≥.99

[a]Values are presented as No. (%). ACL, anterior cruciate ligament; ACLR, ACL reconstruction; BEAR, bridge-enhanced ACL repair.
[b]Two patients (BEAR, n = 1; ALCR, n = 1) had both ACL and non-ACL ipsilateral knee surgery.

Conclusion/Discussion

Early trials of the BEAR technique have shown promising results as an alternative treatment option to treat ACL tears. Using qMRI measurements to confirm healing, the BEAR technique has been shown to facilitate complete ACL healing. The BEAR technique and ACLR are comparable when evaluating postoperative pain from surgery. However, when assessing patient-reported outcomes, the BEAR technique had more favorable outcomes within the first year after surgery; however, the difference became less significant later.[6] Regarding postoperative muscle strength, the BEAR technique showed superior postoperative strength compared to ACLR over two years.[4-8] This preliminary improvement from the BEAR group may be attributed to the lack of graft harvesting, leading to faster improvement of symptoms.[6] One area where traditional ACLR has shown to be superior to the BEAR technique is regarding re-tear and revision rates; however, these rates may improve as the technique continues to be refined and larger sample sizes are studied.

Sources

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