

# Cost analysis of Anterior Cruciate Ligament Reconstruction with Lateral Extra-Articular Tenodesis

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**INTRODUCTION:** Anterior Cruciate Ligament Reconstruction (ACLR) is effective but has high failure rates in at-risk patients. Lateral Extra-Articular Tenodesis (LET) improves stability and reduces failure, especially in high-risk or active individuals. While its use is growing, cost data for ACLR with LET are lacking. This study applies time-driven activity-based costing (TDABC) to determine its true cost and support value-based care.

**METHODS:** The retrospective study was performed at an ambulatory surgery center between 2020 and 2024. Patients undergoing primary or revision ACLR with LET were included, while those with additional major procedures such as medial collateral ligament (MCL), lateral collateral ligament (LCL), posterior cruciate ligament (PCL), posterolateral corner (PLC) reconstruction, osteotomy, or osteochondral allograft—were excluded. Patient and surgical data were collected from electronic medical records. The total cost of care was determined using TDABC. Multivariate regression analysis was conducted between ACLR cost and group characteristics.

## RESULTS:

The study included 134 patients with a mean age of 22.9±9.6 years and BMI of 25.7±4.7. Revision procedures accounted for 45(33.6%) of cases. Concomitant procedures included meniscectomy in 18(13.4%), meniscal repair in 48(35.8%), and root repair in 16(11.9%) cases. Bone–patellar tendon–bone (BTB) was the most common graft type 100(74.6%), followed by hamstring tendon (HT) 27(20.1%) and quadriceps tendon (QUAD) 7(5.2%). The average implant cost was \$1,065.9±963.8, while the total average cost per surgery was \$3,240.9 ±1,287.7. QUAD grafts were associated with significantly higher total (p=0.0037) and implant costs(p=0.0081) compared to BTB and HT grafts, but these cost differences were not statistically significant on analysis. In the multivariate regression analysis, higher age (p=0.006), revision surgery(p=0.0013), meniscal repair(p=0.002), root repair(p=0.035), and operating surgeon(p = 0.0061 and p < 0.000001) were all independently associated with significantly increased total cost. Graft choice (HT or QUAD vs. BTB), BMI, sex, and ASA classification were not significantly associated with cost.

**DISCUSSION AND CONCLUSION:** ACLR with LET incurs moderate costs, with higher age, revision surgery, meniscal/root repair, and surgeon variability significantly increasing total cost. Graft type, BMI, sex, and ASA classification did not independently affect cost. These findings support cost-aware, value-based care in high-risk ACL cases.

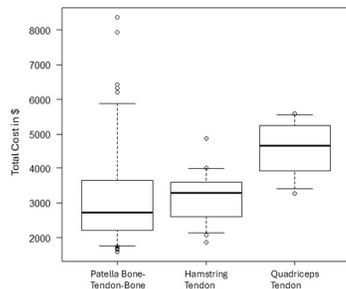


Figure 1: Box plot demonstrating TDABC derived cost of ACLR with LET according to graft type.

Table 1. Cohort demographic information, surgical characteristics, and day-of-surgery cost components.

Variable	n= 134
Age (Years)	23.0 ± 9.6
BMI	25.7 ± 4.7
Sex	
Female	62 (46.3)
Male	72 (53.7)
ASA	
1	81 (60.4)
2	45 (33.6)
3	4 (3.0)
Smoking	
Former	8 (6.0)
Never	123 (91.8)
Current	3 (2.2)
Sport Injury	100 (74.6)
Contact Injury	26 (19.4)
Graft Type	
BTB	100 (74.6)
HT	27 (20.1)
Quad	7 (5.2)
Index Revision Procedure	45 (33.6)
Meniscectomy	18 (13.4)
Meniscal Repair	48 (35.8)
Root Repair	16 (11.9)
Implant Cost*	1065.85 ± 963.79
Direct Cost*	2746.55 ± 1091.23
Indirect Cost*	494.38 ± 196.42
Total Cost*	3240.93 ± 1287.65

Scale variables are represented as mean ± standard deviation. Categorical variables are represented as counts (percentage).

\*All costs were adjusted for inflation and reflect 2024 United States Dollars.

BMI= Body Mass Index; ASA= American Society of Anesthesiologists; BTB= Bone-Tendon-Bone; HT= Hamstring Tendon; Quad = Quadriceps tendon.

Table 2: Multivariate linear regression model evaluating the association of the TDABC-derived cost\* of ACLR with LET with potential procedural covariates and patient comorbidities.

Factor	Estimate	TValue	PValue
Age	28.71	2.8	0.006
Sex[Male Vs. Female]	158.02	0.89	0.38
BMI	-1.2	-0.05	0.96
ASA(ASA 2 Vs. 1)	-261	-1.21	0.23
ASA (ASA 3 Vs. 1)	103.06	0.17	0.86
Revision	688.62	3.3	0.001
Meniscal Repair	640.97	3.14	0.002
Meniscectomy	112.73	0.4	0.69
Root Repair	627.6	2.13	0.035
Graft[HT VS. BTB]	-13.92	-0.06	0.95
Graft[QUAD VS. BTB]	169.12	0.38	0.71
Surgeon[2 VS 1]	-864.38	-0.84	0.4
Surgeon[3 VS 1]	-1033.45	-2.8	0.006
Surgeon[4 VS 1]	-1856.01	-6.36	<0.001
Surgeon[5 VS 1]	-369.18	-1.02	0.31

\*All costs were adjusted for inflation and reflect 2024 United States Dollars.

BMI= Body Mass Index; ASA= American Society of Anesthesiologists; BTB= Bone-Tendon-Bone; HT= Hamstring Tendon; Quad = Quadriceps tendon.