Revision Anterior Cruciate Ligament Reconstruction Practice Patterns Vary by Surgeon Volume

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INTRODUCTION:

Lower rates of reoperation, readmission, infection, and decreased cost have been demonstrated when primary anterior cruciate ligament reconstruction (ACLR) is performed by high-volume surgeons.1-3 Knowledge of the effect of surgeon volume in the revision ACLR setting would be useful for targeted interventions to improve clinical outcomes, but this has not been well studied to date. The purpose of this study was to determine the percent of revision ACLR that comprise the practice of high-, medium-, and low-volume surgeons; additionally, this study aimed to assess referral, demographic, injury, and treatment variables among each group. It was hypothesized that high-volume surgeons would perform more revision ACLRs annually than medium- and low-volume surgeons; additionally, revision ACLRs for high-volume surgeons would be more complex referrals from other providers and healthcare systems.

METHODS:

A retrospective cohort study investigating all revision ACLR performed from 2015-2020 in a single healthcare system was performed. Surgeons were categorized as low- (≤17), medium- (18-34), or high-volume (≥35) based on the number of annual ACLRs performed.[4] Referral source, demographic, injury, and treatment variables were recorded and analyzed. Comparison among low-, medium-, and high-volume surgeons was performed by a Chi-square test for categorical variables and a one-way ANOVA with post-hoc Tukey analysis or a Kruskal-Wallis test was used, as appropriate, for continuous variables. Statistical analysis was performed with $p < 0.05$.

RESULTS:

Of 4,555 ACLR, 171 were revision ACLR (3.8%). The percentage of revision ACLRs was significantly higher for high- (4.9%) and medium- (3.9%) compared to low-volume surgeons (1.6%, $p = 0.00$). There were no significant differences in referral patterns by surgeon volume. High-volume surgeons more commonly performed revision ACLR on patients with a higher activity and competition level than medium- and low-volume surgeons ($p = 0.00$, Figure 1, Table 1). Allografts were used significantly more often by low- (70%) compared to medium- (35%) and high-volume surgeons (25%; $p = 0.00$, Figure 2). Bone-patellar tendon-bone (BPTB) and quadriceps tendon (QT) autografts were used significantly more often by high- (32% BPTB, 39% QT) and medium-volume (38% BPTB, 14% QT) surgeons compared to low-volume surgeons (15% BPTB, 10% QT; $p = 0.00$). Notably, in cases of revision ACLR for high-level athletes analyzed separately, there was no significant difference in autograft usage by surgeon volume. High-volume surgeons were more likely to perform revisions on patients with cartilage injuries ($p = 0.01$) and perform staged revision ACLR ($p = 0.01$). Finally, high-volume surgeons performed meniscus repair more frequently (54% high vs. 22% medium and 36% low, $p = 0.03$; between medium- and low-volume surgeons, $p = 0.78$), despite similar rates of concomitant meniscus tears, compared to low- and medium-volume surgeons.

DISCUSSION AND CONCLUSION:

In this registry study of an integrated healthcare system, practice patterns of revision ACLR were found to vary significantly by surgeon volume. High-volume surgeons are more likely to perform revision ACLR on patients with a higher activity and competition level. Additionally, high-volume surgeons more commonly choose meniscal-sparing surgery, favor the use of autograft, and perform staged revision ACLR when compared to low-volume surgeons. These findings are likely due to high-volume surgeons being more willing to perform revision ACLR and aggressively diagnose and treat concomitant injuries, based on appraisal of the literature. In value-based health care, this data may allow targeted interventions with the aim of improving clinical outcomes in patients with failed ACLR.

References:

[1]Leroux et al. AJSM. 2014. [2]Lyman et al. JBJS. 2009. [3]Scott et al. OJSM. 2015. [4]Schairer et al. OJSM. 2017.

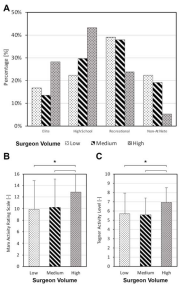

Figure 1. Competition level (A), Marx Activity Rating Scale (B), and Tegner Activity Level (C) of low- (≤17), medium- (18-34), and high-volume (≥35) surgeons. (*) Denotes statistically significant difference between groups ($p < 0.05$).

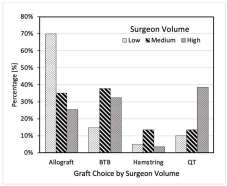

Figure 2. Graft choice among low- (≤17), medium- (18-34), and high-volume (≥35) surgeons. BPTB, bone-patellar tendon-bone autograft; QT, quadriceps tendon autograft.

Table 1: Statistically significant patient, injury, and treatment variables for revision anterior cruciate ligament reconstruction among surgeons of various levels of surgical volume. All data presented as n (%) or mean ± SD unless otherwise specified. BPTB, bone-patellar tendon-bone autograft; QT, quadriceps tendon autograft.

Surgeon Volume	Low (≤17 cases)	Medium (17-34 cases)	High (≥35 cases)	p-value
Activity level				
Elite	3 (17%)	5 (14%)	32 (28%)	
High School	4 (22%)	11 (30%)	49 (43%)	$p = 0.01$
Recreational	7 (39%)	14 (38%)	27 (24%)	
Non-Athlete	4 (22%)	7 (19%)	6 (5%)	
Marx Activity Rating Scale	9.9 ± 4.9	10.2 ± 4.9	12.9 ± 3.7	$p = 0.00$
Tegner Activity Level	5.7 ± 2.2	5.6 ± 1.8	6.9 ± 1.6	$p = 0.00$
Graft choice at Revision				
Allograft	14 (70%)	13 (35%)	29 (25%)	
BPTB Autograft	3 (15%)	14 (38%)	37 (32%)	
Hamstring Autograft	1 (5%)	5 (14%)	4 (4%)	$p = 0.00$
QT Autograft	2 (10%)	5 (14%)	44 (39%)	
Cartilaginous Injury	9 (45%)	13 (35%)	71 (62%)	$p = 0.01$
Staged Management	3 (15%)	3 (8%)	37 (33%)	$p = 0.01$
Meniscal Tear	14 (70%)	23 (62%)	67 (59%)	$p = 0.66$
Meniscal Tear Treatment				
Non-operative	2 (14%)	4 (17%)	10 (15%)	
Partial Meniscectomy	7 (50%)	13 (57%)	16 (23%)	
Meniscectomy	0 (0%)	1 (4%)	0 (0%)	$p = 0.03$
Repair	5 (36%)	5 (22%)	36 (54%)	
Allograft transplant	0 (0%)	0 (0%)	5 (7.5%)	