Combined ACL and Anterolateral Ligament Reconstruction Improves Rotational Stability and May Enhance Meniscal Healing: A Second-Look Arthroscopic Evaluation

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INTRODUCTION: Meniscal healing following anterior cruciate ligament (ACL) reconstruction is critically influenced by postoperative knee stability. Residual knee laxity, particularly in the rotational direction, may adversely affect meniscal healing. Recent biomechanical studies have suggested that anterolateral ligament (ALL) reconstruction can enhance rotational control and potentially improve healing outcomes. However, clinical evidence based on objective measurement remains limited. This study aimed to evaluate whether combined ACL and ALL reconstruction (ACL+ALLR) improves postoperative rotational stability and meniscal healing, using second-look arthroscopy and quantitative pivot-shift assessment.

METHODS: This retrospective study analyzed data from 91 knees that underwent primary double-bundle ACL reconstruction with concomitant meniscal repair between 2016 and 2022. Based on the severity of preoperative pivot shift assessed under general anesthesia (IKDC grade), patients were categorized into two groups: the ALLR group (n = 27) received combined ACL and ALL reconstruction due to high-grade instability (IKDC grade ≥2), and the Isolated group (n = 64) underwent ACL reconstruction alone. Exclusion criteria included previous surgery on the affected knee, concomitant ligament injuries other than ACL, lack of second-look arthroscopy, and missing quantitative data at any time point. Second-look arthroscopy was performed at least 12 months postoperatively to evaluate meniscal healing, which was classified as completely healed, incompletely healed, or failed. In addition to arthroscopic assessment, quantitative knee laxity was evaluated using an inertial measurement unit under anesthesia at three time points (preoperative, intraoperative, and second-look). Measured parameters included anterior tibial translation (ATT) and side-to-side ratios of tibial acceleration and external rotational angular velocity (ERAV) during pivot-shift testing. Comparisons between groups were performed using the Mann-Whitney U test and Fisher's exact test. Effect sizes (Cohen's d) were calculated for preoperative and second-look parameters to assess the clinical relevance of differences.

RESULTS: A total of 124 menisci (88 in the Isolated group, 36 in the ALLR group) were assessed. The overall rate of complete meniscal healing was higher in the ALLR group compared to the Isolated group (72.2% vs. 61.0%), while failure was observed less frequently (11.1% vs. 27.3%), with a trend toward statistical significance (P = .087). Quantitative knee laxity measurements revealed that, preoperatively, the ALLR group demonstrated significantly greater ATT than the Isolated group (7.00 [6.00–8.00] mm vs. 6.00 [5.00–7.00] mm, P = .047), reflecting their higher baseline instability. Acceleration and ERAV also tended to be higher in the ALLR group preoperatively, although these differences did not reach statistical significance. At second-look evaluation, ATT values remained similar between the groups (1.00 [1.00–2.00] vs. 1.00 [0.00–2.00], P = .503). However, significant differences were observed in rotational stability measures: acceleration was lower in the ALLR group (1.20 [1.10–1.50] vs. 1.50 [1.17–2.00], P = .045), and ERAV was also reduced (1.20 [1.00–1.70] vs. 1.80 [1.05–2.20], P = .023). Effect size analysis demonstrated a Cohen's d of 0.75 for acceleration and 1.04 for ERAV, indicating moderate to large effects, whereas ATT showed only a small effect (d = 0.27). These findings suggest that while anterior stability was equally restored in both groups, rotational laxity was more effectively controlled in the ALLR group.

DISCUSSION AND CONCLUSION:

This study is among the first to quantitatively evaluate the relationship between residual rotational laxity and meniscal healing in a clinical setting using second-look arthroscopy and pivot-shift assessment. The results demonstrated that adding ALL reconstruction to ACL surgery significantly improves control of postoperative rotational instability, and this improvement may be associated with higher rates of meniscal healing. While the difference in healing rate did not reach conventional levels of statistical significance, the trend, combined with strong effect sizes in rotational parameters, underscores the potential clinical importance of rotational stabilization. These findings suggest that managing rotational instability through ALL augmentation may provide biomechanical conditions that support meniscal tissue healing, especially in patients with high-grade preoperative instability. Given the importance of successful meniscal repair for long-term knee health, integrating ALL reconstruction into the surgical strategy for selected high-risk patients could yield functional and structural benefits. Further prospective, randomized studies with larger sample sizes and long-term follow-up are warranted to confirm these results and to refine indications for ALL reconstruction in ACL-deficient knees.

Figure 1. Second-look arthroscopic evaluation for meniscus healing

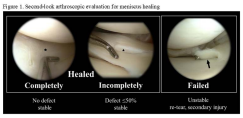

Table 1. Meniscal healing rate by second-look arthroscopy

	Isolated n = 77	ALLR n = 36	*P* value
Completely healed (%)	47 (61.0)	28 (72.2)	.087
Incompletely healed (%)	9 (11.7)	6 (16.7)	
Failed (%)	21 (27.3)	4 (11.1)	

ALLR, anterolateral ligament

Table 2. Quantitative data on knee laxity under anesthesia[a]

	Isolated n = 77	ALLR n = 36	*P* value	Cohen's d
ATT side-to-side distance, mm				
Pre-op	6.0 (5.0–7.0)	7.0 (6.0–8.0)	**.047**	-0.03
Second-look	1.0 (1.0–2.0)	1.0 (0.0–2.0)	.503	0.27
Acceleration side-to-side ratio				
Pre-op	5.4 (3.7–7.9)	5.5 (3.5–8.2)	.666	0.01
Second-look	1.5 (1.2–2.0)	1.2 (1.1–1.5)	**.045**	**0.78**
ERAV side-to-side ratio				
Pre-op	3.8 (2.5–5.2)	4.9 (3.2–7.1)	.079	-0.01
Second-look	1.8 (1.1–2.2)	1.2 (1.0–1.7)	**.023**	**1.04**

[a]Data are presented as median (interquartile range) unless otherwise indicated. Boldfaced *P* values indicate significant differences between groups ($P < .05$). Bolded effect size values (Cohen's d) indicate moderate to large effects. ALLR, anterolateral ligament; ATT, anterior tibial translation; ERAV, external rotational angular velocity