

# Comparison of Muscle Strength Recovery and Clinical Outcomes After ACL Reconstruction Using Quadriceps Tendon Autograft Between Young and Middle-Aged Patients

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## INTRODUCTION:

In recent years, anterior cruciate ligament (ACL) reconstruction using the quadriceps tendon (QT) has been increasingly performed, owing to advantages such as a lower rerupture rate, reduced incidence of anterior knee pain, and less hamstring strength deficit. However, in middle-aged and older patients, postoperative muscle strength recovery and clinical outcomes remain a concern, and few studies have directly compared these outcomes with those in younger patients.

The purpose of this study was to compare younger and middle-aged patient groups undergoing QT ACL reconstruction and to evaluate postoperative muscle strength recovery and clinical outcomes.

## METHODS:

Patients who underwent anterior cruciate ligament (ACL) reconstruction using a quadriceps tendon (QT) autograft at our institution between January 2022 and June 2024 and were followed for up to 1 year postoperatively were included in this study. Among these, patients were divided into a younger group (<40 years; Y group, 82 knees) and a middle-aged group (≥40 years; M group, 31 knees). At 12 months postoperatively, the limb symmetry index (LSI) for isokinetic knee extension and flexion strength at an angular velocity of 60°/sec, the International Knee Documentation Committee subjective score (IKDC), the Tegner activity score, and anterior knee laxity measured with the KT-2000 arthrometer were compared between the two groups. All patients provided informed consent and the ethical approval was obtained from the institutional review board (IRB #2302). All statistical analyses were conducted using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan). According to the normality of the data, either a paired t-test or a Wilcoxon signed-rank test was used for within-group comparisons, and an independent t-test or a Mann-Whitney U test was used for between-group comparisons. A p-value of < 0.05 was considered statistically significant.

## RESULTS:

The limb symmetry index (LSI) of quadriceps strength was 59.4 ± 17.2% in the younger group (Y group) and 56.3 ± 15.1% in the middle-aged group (M group) at 6 months postoperatively (p = 0.17), and 71.8 ± 19.6% and 66.5 ± 18.4% at 12 months (p = 0.22), respectively. The LSI of hamstring strength was 85.2 ± 16.8% in the Y group and 86.6 ± 14.9% in the M group at 6 months (p = 0.69), and 90.8 ± 15.6% and 93.6 ± 11.2% at 12 months (p = 0.48), respectively. The IKDC subjective score was 72.8 ± 12.0 in the Y group and 66.7 ± 13.4 in the M group at 6 months (p = 0.02), and 84.9 ± 11.3 and 77.4 ± 10.4 at 12 months, respectively, with a significant difference favoring the Y group (p < 0.01) (Table 1). The Tegner activity score (TAS) in the Y group decreased significantly from 6.81 ± 1.78 preoperatively to 6.51 ± 1.79 postoperatively (p < 0.01), whereas in the M group it decreased from 5.47 ± 1.55 to 5.20 ± 1.56 without significance (p = 0.10). KT-2000 measurements improved significantly in the Y group, from 3.6 ± 1.9 mm preoperatively to 1.5 ± 2.3 mm postoperatively (p < 0.01), and in the M group from 3.3 ± 1.9 mm to 0.6 ± 2.0 mm, respectively (p < 0.01) (Table 2).

## DISCUSSION:

In the present study, middle-aged patients generally demonstrated favorable improvement after ACL reconstruction using the quadriceps tendon; however, the IKDC score at 6 months and 1 year postoperatively was significantly lower compared with the younger group. Previous literature addressing differences in muscle strength recovery and subjective outcomes between younger and middle-aged patients remains limited. Some reports have indicated that, when other grafts such as hamstrings or bone-patellar tendon-bone are used, muscle strength recovery tends to be delayed in older patients<sup>1</sup>. In our cohort, quadriceps strength recovery showed a slightly lower tendency in the middle-aged group, although no significant difference was detected. Regarding subjective outcomes, several studies have reported that IKDC scores improve satisfactorily even in patients over 50 years of age<sup>2,3,4</sup>. In our series, the middle-aged group exhibited a significant reduction in the IKDC score at 6 months and 1 year, but most previous studies have followed patients for at least 2 years, suggesting that improvement in subjective outcomes might be delayed in older populations. On the other hand, both activity level and objective stability improved significantly after surgery, with no significant differences between younger and middle-aged patients, as reported by previous studies<sup>5</sup>. Nevertheless, the sample size was slightly smaller than required to detect intergroup differences, which may have limited the statistical power. Thus, the findings should be interpreted with caution, and larger studies with longer follow-up are needed.

## SIGNIFICANCE/CLINICAL RELEVANCE:

The quadriceps tendon represents a viable graft choice even in middle-aged patients; however, surgeons should be aware of the potential for delayed recovery of subjective knee function in this population.

## REFERENCES:

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## IMAGES AND TABLES:

**Table 1.**

Quadriceps & Hamstring Strength LSI and IKDC (Y group vs M group)

Outcome measure	Time point	Y group	M group	p value
Quadriceps LSI (%)	6 months	59.4 ± 17.2	56.3 ± 15.1	0.17
	12 months	71.8 ± 19.6	66.5 ± 18.4	0.22
Hamstring LSI (%)	6 months	85.2 ± 16.8	86.6 ± 14.9	0.69
	12 months	90.8 ± 15.6	93.6 ± 11.2	0.48
KDC subjective score	6 months	72.8 ± 12.0	66.7 ± 13.4	<b>0.02</b>
	12 months	84.9 ± 11.3	77.4 ± 10.4	<b>&lt;0.01</b>

Statistical significance was set at p < 0.05.

**Table 2.**

Tegner Activity Score (TAS) & KT-2000 SSD Measurements (Y group vs M group)

Outcome measure	Group	Preoperative	Postoperative	p value
Tegner Activity Score	Younger (Y)	6.81 ± 1.78	6.51 ± 1.79	<0.01
	Middle-aged (M)	5.47 ± 1.55	5.20 ± 1.56	0.10
KT-2000 SSD (mm)	Younger (Y)	3.6 ± 1.9	1.5 ± 2.3	<0.01
	Middle-aged (M)	3.3 ± 1.9	0.6 ± 2.0	<0.01

Statistical significance was set at p < 0.05.