

Quadriceps tendon autograft for primary ACL reconstruction may result in weakness of knee extensor strength compared to hamstring tendon autograft in the early post-operative period

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INTRODUCTION:

The quadriceps tendon (QT) autograft has been increasingly utilized for anterior cruciate ligament (ACL) reconstruction in recent years. ACL reconstruction using a QT autograft has been reported to show no difference in patient-perceived outcome or graft failure rates compared to hamstring tendon (HT) autograft¹. Additionally, the QT autograft offers the advantage of harvest tendons of consistent quality². However, concerns have been raised about postoperative weakness, particularly in knee extensor muscles. Therefore, this study aims to compare the postoperative recovery of muscle strength and clinical outcomes between patients with ACL injuries treated with QT autografts and those treated with HT autografts.

METHODS:

This study included 15 patients (QT group: 9 males and 6 females) treated with QT autograft, and 18 patients (HT group: 10 males and 8 females) treated with HT autograft for primary ACL injury at our institution between April 2021 and August 2022. Informed consent was obtained from all patients and the ethical approval for this study was obtained from the institutional review board (IRB #2302). Knee flexion and extension strength and International knee documentation committee (IKDC) score were analyzed preoperatively and at postoperative 3, 6, 9, and 12 months. The Tegner activity scale (TAS) and knee stability measured by manual pivot shift test and KT-2000 were evaluated preoperatively and postoperative 12 months. Isokinetic movement (60°/sec) was used to measure knee extension and flexion strength for both the injured and non-injured limbs (genuPLUS, Easytech, Bologna, Italy). The limb symmetry index (LSI) was used to evaluate knee strength. Knee stability was assessed through the manual pivot shift test, and patients were categorized into four groups based on the IKDC criterion (0: equal, 1: glide, 2: clunk, 3: gross). Furthermore, knee anterior instability was assessed by KT-2000 (Knee Ligament ARTHROMETER, MEDmetric Corp, San Diego, CA, USA) measuring the amount of the forward knee drawer and the side-to-side difference between injured and non-injured side was evaluated.

Statistical analysis

Student's t-test, one-way Analysis of variance, and Pearson's chi-square test were used for statistical examination, and the significance rate was set at 5 %. A priori power analysis based on preliminary experiments with a statistical power of 80 % and significance set at 0.05, indicated a required sample size of at least 12 per group.

RESULTS:

Compared to the HT group, the QT group exhibited significantly lower knee extension strength at 3 months postoperatively (HT group: $60.0 \pm 19.4\%$, QT group: $44.3 \pm 18.3\%$, $p < 0.05$), with no significant difference between the two groups at 6, 9, and 12 months postoperatively (Figure 1). No significant differences were observed in knee flexion strength or IKDC scores between the two groups (not significant) (Table 1), and The TAS returned to the same level as preoperatively in both groups (preoperatively / PO12M: HT group: $6.7 \pm 2.0 / 6.3 \pm 1.8$ (not significant), QT group: $6.0 \pm 0.9 / 5.8 \pm 1.0$ (not significant)). Knee joint stability significantly improved in both groups (KT-2000 preoperatively / PO12M: HT group: $4.2 \pm 1.5 / 0.8 \pm 2.0$ ($p < 0.05$), QT group: $4.0 \pm 1.4 / 1.0 \pm 1.3$ ($p < 0.05$)) and there was no significant difference in postoperative negative pivot shift rate between HT and QT group (89 % vs 93 %, not significant).

DISCUSSION:

The most important finding of this study is that while the QT group demonstrated a reduction in extensor strength in the early postoperative period, it was not inferior to the HT group after 6 months postoperatively. This finding aligns with previous literatures³⁻⁵, which reported no difference in clinical outcome or knee stability between QT and HT groups. The results suggest that QT may be a viable option as a tendon graft for ACL reconstruction. As this study followed patients for up to 1 year postoperatively, long-term outcomes cannot be discussed.

SIGNIFICANCE/CLINICAL RELEVANCE:

Surgeons should be attentive to knee extension weakness, particularly in the early postoperative period, following primary ACL reconstruction using a quadriceps tendon autograft compared to a hamstring tendon autograft. This knowledge should also be conveyed to patients before surgery to establish appropriate expectations.

REFERENCES:

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IMAGES AND TABLES:

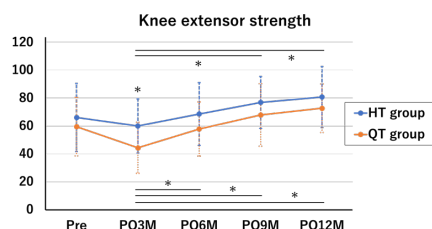


Figure 1. Significant difference in extensor strength between two groups can be seen at 3 months postoperatively. Both groups showed significant improvement in extensor strength after 3 months postoperatively. HT: hamstring tendon, QT: quadriceps tendon, M: months, Pre: pre-operative. * Statistical significance is set at $P < 0.05$.

	knee flexor strength			IKDC score		
	HT group	QT group	P value	HT group	QT group	P value
Pre	76.5 ± 26.1%	69.7 ± 13.2%	0.22	56.5 ± 12.0%	56.4 ± 10.4%	0.22
PO3M	73.4 ± 16.4%	74.7 ± 18.0%	0.42	57.8 ± 11.6%	52.4 ± 13.3%	0.13
PO6M	80.1 ± 14.8%	83.8 ± 15.7%	0.25	64.6 ± 9.1%	59.3 ± 13.3%	0.11
PO9M	85.9 ± 9.7%	89.4 ± 20.7%	0.28	72.6 ± 9.1%	69.9 ± 14.8%	0.27
PO12M	95.5 ± 24.1%	91.5 ± 14.3%	0.3	74.8 ± 10.3%	75.7 ± 9.4%	0.41

Table 1. There is no significant difference at knee flexor strength and IKDC score in both groups at any period. Values are expressed as mean±standard deviation. HT: hamstring tendon, QT: quadriceps tendon, M: months, Pre: pre-operative. Statistical significance is set at $P < 0.05$.