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Comparison of second-look arthroscopic findings and clinical results according to the amount of preserved remnant in anterior cruciate ligament reconstruction

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ABSTRACT

Background: Although ACL reconstruction is prevalent, the most effective method for ACL reconstruction still remains controversial. The purpose of this study was to evaluate the effect of the preserved remnant in ACL reconstruction on graft morphology at second-look arthroscopy and clinical outcomes.
Methods: 66 consecutive patients who underwent a second-look arthroscopy after a remnant-preserving ACL reconstruction were enrolled. The patients were divided into two groups according to whether the remnant ACL fibers could be preserved by over 50% (Group I) or not (Group II). The Lysholm score, IKDC subjective score, Tegner activity score, pivot-shift test, and KT-2000 arthrometric findings were evaluated preoperatively and just prior to the second-look arthroscopy to assess clinical outcomes. At second-look arthroscopy, graft morphology was evaluated using hypertrophy rate and synovialization.
Results: At second-look arthroscopy, the hypertrophy rate of Group I (42.1%) was higher than Group II (25.1%), which was statistically significant ($p = 0.002$). In graft synovialization, there was a statistically significant difference between the two groups ($p < 0.001$). The IKDC subjective score improved from 42.9, 43.1 to 77.8, 75.0 for Group I and Group II, respectively ($p = 0.025$). For the Lysholm score, Group I and Group II improved from 55.4 and 55.7 to 87.8 and 84.9 ($p = 0.031$). There was also a significant difference between the pivot shift tests between the groups ($p = 0.039$). Other clinical tests showed no statistically significant differences.
Conclusion: Preserving the remnant ACL tissue during ACL reconstruction could have a positive effect on graft hypertrophy, synovialization and clinical outcomes.
Level of evidence: III, retrospective comparative study.

1. Introduction

The anterior cruciate ligament (ACL) is one of the commonly torn ligaments in the knee [1]. Although ACL reconstruction is prevalent, the most effective method for ACL reconstruction still remains controversial [2–4]. Recently several studies have shown that a successful ACL reconstruction may depend not only on the mechanical stability but also on the biological healing or recovery of proprioception [5,6]. Preservation of the remaining ACL (ACL remnant preserving method) may potentially be a possible source of revascularization, cell proliferation and promote the recovery of the proprioception as well as stability [7,8]. Indeed, some reports have shown that ACL reconstruction performed with the remnant preserving method had significantly better proprioceptive and functional outcomes [5,9].

Although some studies have reported second-look arthroscopic findings after ACL reconstruction [10–12], only a few of these have evaluated the differences in clinical outcomes and graft morphology according to the amount of preserved remnant in ACL reconstruction using a hamstring autograft.

The purpose of this study was to evaluate the effect of the preserved remnant in ACL reconstruction on graft morphology at second-look arthroscopy and clinical outcomes. We hypothesized that preservation of such remaining ACL tissue could lead to better graft morphology and clinical outcomes.

2. Materials and methods

This study, which began in June 2004 and continued up to July 2009, comprised of patients who underwent a second-look arthroscopy at the

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time of hardware removal after ACL reconstruction using a hamstring autograft with the remnant preserving method. Only 66 patients (48 men, 18 women) who were able to participate up to the two years follow-up were included in this study.

The most common reason for hardware removal was due to pain or discomfort from tendonitis or bursitis around the protruding staple or post-tie screw. Other reasons included the patients' request to confirm the reconstructed state of the graft. Exclusion criteria for this study were concomitant ligament injuries; ipsilateral long-bone injuries; any previous injury or operation on the same knee; and allograft, hybrid (mixed with autograft and allograft), double-bundle, and revision reconstructions. Patients who were re-injured after the primary ACL reconstruction were also excluded.

In terms of remnant preservation, we divided the group into two according to whether the remnant ACL fibers could be preserved by over 50% (Group I) at ACL reconstruction or not (Group II). Group I consisted of 30 males and 6 females whose average age was 28.9 years. The average period of follow-up second-look arthroscopy was 27.5 months after primary reconstruction. Group II was composed of 20 males and 10 females. Their average age was 32.0 years, and the average period of follow-ups was 26.6 months. In Group I, the mean interval between injury and operation was 10.2 weeks, and in Group II, the mean interval was 10.7 weeks. At primary ACL reconstruction, 13 patients had medial meniscus tears, 16 had lateral meniscus tears, and 5 patients had both medial and lateral meniscus tears. Of the total 18 patients with medial meniscus tears, 9 underwent meniscal repair, 7 had partial, and 2 had subtotal or total meniscectomy. Of the 21 cases with lateral meniscus tears, 7 had meniscal repairs, 7 had partial, 3 had subtotal meniscectomy, and 4 were left in situ. The demographics of the two groups are summarized in Table 1.

Table 1
Demographics of Groups I and II.

		Group I	Group II	p value
Case number (M/F)		36 (28/8)	30 (20/10)	0.408
Mean age (years)		28.9 ± 8.8	32.0 ± 9.4	0.171
Mean period from injury to reconstruction (weeks)		10.2 ± 3.3	10.7 ± 6.4	0.494[a]
Mean period from reconstruction to second-look arthroscopy (months)		27.5 ± 3.1	26.6 ± 2.1	0.412
IKDC subjective score		42.9 ± 7.2	43.1 ± 5.0	0.877
Tegner score		5.1 ± 1.3	5.1 ± 1.0	0.954
Lysholm score		55.4 ± 8.1	55.7 ± 5.4	0.895
KT-2000 side-to-side differences (mm)		10.8 ± 1.6	10.5 ± 1.1	0.364
Pivot shift test	1	6 (16.7%)	3 (10.0%)	0.586
	2	17 (47.2%)	13 (43.3%)	
	3	13 (36.1%)	14 (46.7%)	
Concomitant injury				0.879
None		16 (44.4%)	16 (53.3%)	
Medial meniscus tear		7 (19.4%)	6 (20.0%)	
Lateral meniscus tear		10 (27.8%)	6 (20.0%)	
Medial & lateral		3 (8.3%)	2 (6.7%)	

Values are presented as mean ± standard deviation.
IKDC: international knee documentation committee.
[a] Mann–Whitney *U* test.

2.1. Operative technique & rehabilitation

All reconstructions were performed by one experienced surgeon using the same technique. The intra-articular exit point of the guide was placed at the center of the outlined tibial footprint. The external starting point was placed at the anterior border of the medial collateral ligament insertional fibers in all cases to allow for oblique orientation. The femoral tunnel was made in the femoral notch positioned at 10 o'clock (right knee) or 2 o'clock (left knee) through a transtibial technique, and the femoral tunnel was drilled partway between the anteromedial and posterolateral attachments. Notchplasty was not performed in all cases. The graft was passed through the remnant, which pushed the remnant ACL stump laterally. Then, the remnant ACL fiber was placed laterally to the graft, which directed the insertion of the PL bundle (Fig. 1). To fix the femoral tunnel, an Endobutton and Bio-Cross Pin (RIGIDFIX System; Mitek, Johnson & Johnson, Norwood, Massachusetts, USA) were used. The tibial tunnel was fixed first with bioabsorbable (polylactic acid) interference screws (BioRCI, Smith & Nephew, London, United Kingdom) and then the remaining tendon portion was additionally fixed with a staple or post tie for more tibial side fixation stability. Finally, we checked whether the remnant ligament impinged on the intercondylar notch or not.

All patients underwent the same standardized rehabilitation protocol as a home-based exercise. We regularly performed follow-ups of the patients in the out-patient clinic and set up a protocol for rehabilitation. The patients were allowed full weight bearing with an unlocked brace 2 weeks after surgery. Partial weight bearing with crutches for 6 weeks was mandated for patients who underwent meniscal repair. The goal for the patients was to gain a full range of motion at 2 to 6 weeks after surgery. A perturbation training program was started at 6 weeks after surgery. Running and side-cutting activities were allowed at 3 months, with a return to sports activities at 6 months after surgery.

2.2. Second-look arthroscopic findings

The hypertrophy rate was calculated by comparing the width of the graft at primary ACL reconstruction and second-look arthroscopy. At the primary ACL reconstruction, the width of the harvested hamstring tendon was measured with a ruler; at the second-look arthroscopy, this width was checked using a probe marked ruler (Fig. 2), placed perpendicular to the graft as a reference. Each measurement was made three times. The synovialization of the graft was classified into three grades at second-look arthroscopy: good, the entire graft is covered

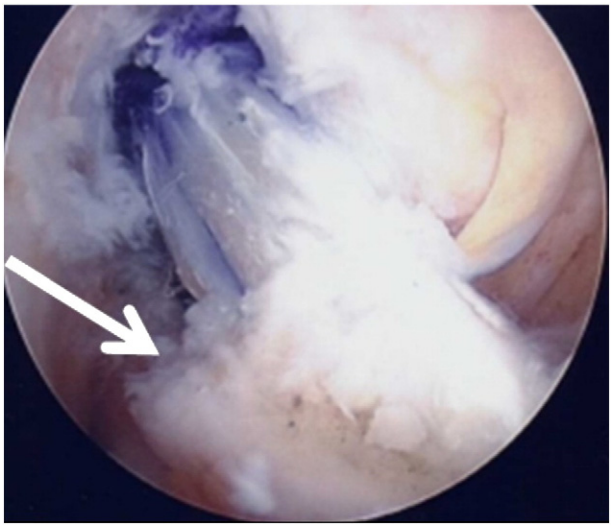

Fig. 1. About 50% of the remnant (white arrow) was preserved and positioned laterally in the femoral footprint.