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Paper #3

Effects of Remnant Ligament Tissue Preservation on The Clinical Outcome after Anatomic Double-bundle Anterior Cruciate Ligament Reconstruction: One-year Follow-up and Second-look Arthroscopic Evaluations

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Summary:

The present study demonstrated that sufficient intra-operative graft coverage by the remnant tissue in anatomic double-bundle ACL reconstruction significantly enhanced synovial coverage of each graft at 1 year postoperatively, and significantly improved the 1-year clinical outcome, specifically concerning the knee stability.

Abstract:

[INTRODUCTION]

It is known that the remnant ACL tissue has good subsynovial and intrafascicular vascularity [1]. Therefore, there is a strong possibility that preservation of the remnant tissue enhances the revascularization and cellular proliferation of the graft after ACL reconstruction. Several investigators have developed single-bundle ACL reconstruction techniques with preservation of the remnant tissue [2,3]. On the other hand, only a remnant-preserving technique has been reported for double-bundle ACL reconstruction using a split quadriceps tendon graft [4]. Anatomic double bundle ACL reconstruction using the hamstring grafts has attracted great attention because of biomechanical advantages in laboratory studies. Recently, we reported a novel procedure for anatomic double-bundle ACL reconstruction with remnant tissue preservation [5]. However, no studies have shown any clinical evidence about the utility of the remnant ACL tissue preservation in anatomic double-bundle ACL reconstruction as of yet. Therefore, we have conducted a prospective comparative cohort study with 67 patients to clarify the clinical effect of the remnant tissue preservation in anatomic double-bundle ACL reconstruction. We have hypothesized that sufficient intraoperative graft coverage by the remnant tissue in anatomic double-bundle ACL reconstruction may significantly enhance synovial coverage of each graft at 1 year postoperatively, and may significantly improve the 1-year clinical outcome, specifically concerning the knee stability. The purpose of this study was to test this hypothesis.

[METHODS]

A prospective, comparative cohort study was conducted with 67 patients (36 men and 31 women) who underwent ACL reconstruction for unilateral ACL insufficiency between 2010 and 2011. The mean age was 29 years (range, 13 to 57 years). The following study design had been accepted by the institutional review board clearance committee before commencement. All patients consented to take part in this follow-up study after explanation with the document.

During surgery, we arthroscopically evaluated the status of the remnant ACL tissue. In 28 of the 67 patients, we could not find sufficient remnant ACL tissue, and we performed anatomic double-bundle ACL reconstruction without remnant preservation, using our original procedure [5]. In the remaining 39 patients who had the remnant ACL tissue (Crain's Type 1, 2, or 3 [6]), we performed the same double-bundle ACL reconstruction with our original remnant



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tissue preservation technique [7]. Then, because the quality and the quantity of the remnant tissue varied, we evaluated the degree of coverage of each graft by the remnant tissue at the end of surgery, using the following scoring system: Each graft mid-substance was divided into three parts; the tibial one-third, the middle one-third, and the femoral one-third. In each part, we provided 3 points when 75% or more of the part was covered by the remnant tissue; when 50-75%, 25-50%, and 0-25% of the part was covered, we gave 2, 1, and 0 points, respectively. Then, we defined the degree of coverage of each graft as "Excellent" when a total score of the 3 parts was 5 points or more, and as "Poor" when a total score was 4 points or less. To test the study hypothesis, the 67 patients who had anatomic double-bundle ACL reconstruction were divided into 3 groups, based on the degree of coverage of the AM bundle by the preserved remnant tissue, because the degree of the AM graft coverage is more sufficient than that of the PL graft: In Group I (26 patients), AM graft coverage was evaluated as "Excellent"; in Group II (13 patients), AM graft coverage was evaluated as "Excellent"; in Group II (13 patients), AM graft coverage was evaluated as "Poor" so the age, the gender, and the sports level among the 3 groups.

The 67 patients were followed up at 1 year or more after surgery, and we evaluated the clinical outcome using the side-to-side anterior laxity measured with KT-2000 arthrometer at 20 degrees of flexion, the pivot-shift test, the range of knee motion, the quadriceps and hamstring muscle torque, the Lysholm knee score, and the IKDC evaluation. Then, we performed second-look arthroscopic examination in all the patients. The reconstructed AM and PL grafts were evaluated using the previously reported criteria [8]: Namely, the synovium-coverage of each bundle was evaluated as "A" (completely covered), "B" (partially covered), or "C" (almost not covered). In addition, the laceration and tension of each bundle was evaluated as "A" (no laceration or elongation), "B" (partial laceration), or "C" (complete tear or obvious elongation). Statistical analysis to test the hypothesis was made using the Spearman's rank correlation analysis, the Student t test, and the chi-square test. The significance level was set at p=0.05.

[RESULTS]

1)The degree of intra-operative graft coverage of the AM bundle (5.9 +/- 2.8 points) was significantly greater (p< 0.0001) than that of the PL bundle (3.1 +/- 1.8 points). There was a significant correlation between the 2 graft coverage scores (p<0.05).

2)The post-operative anterior laxity was 0.8 +/- 1.8 mm in Group I, 1.6 +/- 1.2 mm in Group II, and 1.8 +/- 1.3 mm in Group III. The Spearman's rank correlation analysis showed a significant correlation among the 3 groups (p=0.0421). The laxity of Group I was significantly less than that of Group III (p=0.0263). Concerning the Lysholm knee score, the IKDC evaluation, and the peak muscle torque of quadriceps and hamstrings, there were no significant differences among the 3 groups.

3)In second-look arthroscopy, the cyclops lesion without disturbance in the knee motion was observed in 4 patients (15%), 1 patient (8%), and 4 patients (13%) in Groups I, II, and III, respectively. There were no significant differences in the occurrence rate among the 3 groups. Concerning the synovium-coverage in Groups I and II, the AM graft showed Grade A in 95% of the patients and Grade B in 5%, while the PL graft revealed Grade A in 72% of the patients, Grade B in 25%, and Grade C in 3%. In Group III, the AM graft showed Grade B in 25%, while the PL graft revealed Grade A in 71% of the patients and Grade B in 29%, while the PL graft revealed Grade A in 65%, and Grade B in 35%. Concerning the synovium-coverage of the AM graft, Groups I and II were significantly better than Group III (p=0.0115). Specifically, in Group I, the AM and PL grafts were enveloped by thick fibrous tissues with a thin synovial membrane.

[DISCUSSION]

The present study demonstrated that sufficient intra-operative graft coverage by the remnant tissue in anatomic double-bundle ACL reconstruction significantly enhanced synovial coverage of each graft at 1 year postoperatively, and significantly improved the knee stability in the 1-year clinical outcome. In this study, we could sufficiently cover the AM and PL grafts with the preserved remnant tissue in Group I, and the grafts



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were enveloped by thick fibrous tissues with a thin synovial membrane at 1 year postoperatively. We consider that the sufficient fibrous tissue coverage of the grafts may reduce elongation or failure of the grafts in the graft-remodeling phase of each patient, resulting in better knee stability in the 1-year examination. On the other hand, there was no obvious difference in the knee stability between the Groups II and III. This fact suggested that, in remnant tissue preserving ACL reconstruction, the quality and the quantity of the graft coverage by the preserved remnant tissueare essential factors which significantly affect the clinical outcome. The quality and the quantity of the graft coverage during surgery are strongly affected by those of the remnant ACL tissue and surgical techniques. This information is important to determine the indication of ACL reconstruction procedures with remnant tissue preservation in the near future.

Georgoulis et al. [9] pointed out that the preservation of the ACL remnant tissue may become a source of the cyclops lesion. However, the second-look observations in the present study demonstrated the remnant tissue preservation does not significantly increase the occurrence rate of the cyclops lesion after double-bundle ACL reconstruction. Recently, Ahn et al. [10] and Cha et al. [11] reported similar results after single-bundle ACL reconstruction. More importantly, the present study demonstrated that the remnant tissue preservation did not have any adverse effects on the other clinical measures, such as the postoperative range of motion. These facts have provided us important information to conduct a prospective randomized study in the near future in order to evaluate the clinical utility of the anatomic double-bundle ACL reconstruction with remnant tissue preservation.

In conclusion, the present study demonstrated that sufficient intra-operative graft coverage by the remnant tissue in anatomic double-bundle ACL reconstruction significantly enhanced synovial coverage of each graft at 1 year postoperatively, and significantly improved the 1-year clinical outcome, specifically concerning the knee stability.

[REFERENCES]

[1] Dhillon et al. Int Orthop 2010 [2] Adachi et al. Arch Orthop Trauma Surg 2000 [3] Ochi et al.
Arthroscopy 2006 [4] Kim et al. Arch Orthop Trauma Surg 2009 [5] Yasuda et al. Arthroscopy 2004 [6]
Crain et al. Arthroscopy 2005 [7] Yasuda et al. Arthroscopy 2012 [8] Kondo et al. Arthroscopy 2007
[9] Georgoulis et al. Knee Surg Sports Traumatol Arthrosc 2001 [10] Ahn et al. Am J Sports Med 2010
[11] Cha et al. Skeletal Radiol 2012