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Paper #39

Second-Look Arthroscopy After Anatomic Anterior Cruciate Ligament Reconstruction: A Bone-Patellar Tendon –Bone vs Hamstring Tendon Graft

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Summary:
Bone-tendon-bone grafts after anatomic rectangular-tunnel ACL reconstruction were morphologically better than hamstring tendon grafts after anatomic triple-bundle technique in synovial coverage or no graft damage at second-look arthroscopy approximately 11 months after primary ACL reconstruction.

Abstract:
Purpose
Anatomic double-bundle (ADB) ACL reconstruction has been widely performed because of its good outcomes.1-5 In order to mimic anatomy of the native ACL, Shino et al developed the following two novel anatomic ACL reconstruction techniques6-8: (1) the triple-bundle ACL reconstruction with two double-looped hamstring tendon (HST) grafts to simulate fan-like shape of the native ACL toward the tibial attachment by creating three tibial tunnels (ATB technique); (2) the rectangular tunnel ACL reconstruction with a single bone-tendon-bone (BTB) graft to mimic the natural fiber arrangement inside the native ACL based on the ADB concept (ART technique).

The purpose of this study was to compare the morphology between the two types of transplanted ACL grafts by second-look arthroscopic evaluation.

Materials & Methods
The anatomic ACL reconstructions were performed with BTB or HST grafts on 419 knees from January 2007 to December 2010. Of those knees, ART ACL reconstruction was performed on 188 knees, while 231 knees underwent ATB procedure. ART technique was predominantly indicated to athletes with higher motivation to return to sports and aggressiveness for muscle training.

As the two operative procedures were previously reported, here are brief descriptions on them.6-8 In ATB procedure, two femoral tunnels were created behind the resident's ridge and just anterior to the cartilage margin after cleaning up the ACL remnant, while three tibial tunnels were made in each footprint of the three ACL bundles.9-10 In ART technique, a femoral tunnel with a 5x10mm rectangular aperture was created behind the ridge and just anterior to the cartilage margin, while a parallelepiped tibial tunnel with a 5x10mm aperture was made in the ACL attachment. After graft fixation at femur with Endobutton-CL® (Smith & Nephew, MA, USA) for ATB technique or an interference screw for ART procedure, a total of initial tension of 15-20N was given at 15 degree of flexion with a tensioning boot, followed by the final graft fixation with pullout suture using DSP® (Meira Co., Nagoya, Japan) and screw.

After brace immobilization for 1 to 2 week, range of motion exercise was started. Partial weight bearing was allowed at two weeks and full weight bearing was started at four weeks. Jogging was then allowed at three months and return to sports activities was permitted at 7-9 months, depending on the recovery of muscle power.

Of the patients, 103 patients had consented to undergo second-look arthroscopy at the time of fixation hardware removal. There were 50 males and 53 females with a mean age of 22.7 years. The average time from ACL reconstruction to the second-look arthroscopy was 11.3 months. Exclusion criteria were the knees with re-injuries, those combined with the other ligamentous injuries, or severe osteoarthritic knees at the time of ACL reconstruction. Thus this second-look arthroscopic study included 44 patients who had undergone ART technique and 59 patients who had been treated with ATB procedure. None of them experienced giving way or complained of instability postoperatively.

At second-look arthroscopy, the grafts were evaluated, based on synovial coverage, tension, and damage/ tear of the grafts.11 Synovial coverage over the grafts was classified into the following 3 categories: good, synovial coverage more than 80% around graft; fair, more than 50%; poor, less than 50%. The tension and the tear/damage of the grafts were evaluated by probing from 20°to 90°of knee flexion. Then, the tension of the grafts was classified as taut, mildly lax, and lax. The tear of the grafts was classified into the following three categories: no tear, superficial tear, and substantial/complete tear. The femoral tunnel aperture was also observed in detail to assess the interface between the femoral tunnel aperture and the graft. We defined as positive space sign when probing found a space there. Clinical outcomes were also evaluated with physical examination including Lachman test and side-to-side difference by KT-2000 Knee Arthrometer. For statistical analyses, Chi-square and Mann-Whitney's U tests were used, and less than 0.05 of p-value was defined significant.

Results:
Good synovial coverage over the graft was found in 43 cases (98%) in ART technique and 46 cases (78%) in ATB technique, showing a significant difference in incidence of good synovial coverage. As to graft tension, 39 knees (89%) in ART technique, and 52 (88%) of anteromedial(AM)/intermediate(IM) graft and 46 (78%) of posterolateral(PL) graft in ATB technique were evaluated as taut, while 1 of AM/IM graft (2%) and 5 of PL graft (8%) in ATB technique were evaluated as lax. As to graft damage, there was no apparent rupture in ART technique, while substantial or complete rupture was observed in AM/IM graft of the one knee (2%) and in PL graft of the 3 knees (5%) in ATB technique. While no statistical difference was found in tension, substantial/complete graft rupture was found only in ATB technique. At femoral tunnel aperture, there was no cases with positive space sign in ART technique, while AM/IM graft (8%) in 5 cases and PL graft in 13 (22%) showed a space in ATB technique. With regard to clinical outcome, there were no significant differences between the two techniques, as shown that KT side-to-side difference with manual maximum load was 0.5+/- 0.8mm in ART and 0.2+/- 1.1mm in ATB technique.

Discussion
This second-look arthroscopic study has revealed that BTB grafts after ART ACL reconstruction were morphologically better than HST grafts after ATB technique in synovial coverage or no graft damage. As BTB grafts were firmly fixed at femur using an interference screw with bone-tendon junction adjusted to the femoral tunnel aperture, the bone plug–femoral tunnel integration in BTB graft was almost completed by 8 weeks postoperatively in ART procedure.12 On the contrary, HST graft might show some motion due to "bungee-cord effect" and/or "wind-shield wiper effect" at the femoral tunnel aperture even at several months after ATB ACL reconstruction, causing space between the graft and the femoral tunnel aperture.

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According to the previous reports of us about second-look arthroscopy after anatomic ACL reconstruction using HST graft, substantial/complete tear was observed in approximately 10%.13-14 In those reports, one of the potential reasons for graft tear was assumed excessive initial tension at the time of graft fixation. Therefore, we reduced the graft initial tension to half since 2007, based on our previous study about the laxity match pretension in ACL reconstruction.15 Then, in this study, no graft tear was found in ART technique, while it was observed in 5% of PL graft in ATB procedure. Thus, the reduced initial tension may have had a role to better mimic the biomechanical behavior of the normal ACL.

Surprisingly, there was no significant difference in clinical outcomes between the two techniques despite of some differences in second-look arthroscopic findings, as shown in the previous reports.13-14 Thus we could extrapolate more information from the second-look findings than the clinical outcomes.

Conclusions

1. 98% of BTB or 78 % of HST grafts in the anatomic ACL reconstructions showed good synovial coverage over the graft, showing a significant difference between the two graft sources.
2. None of the transplanted BTB grafts showed graft rupture, while 5% of hamstring grafts showed substantial/complete rupture around the femoral tunnel aperture.

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