The Knee xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

The Knee

Double-bundle anterior cruciate ligament reconstruction with and without remnant preservation — Comparison of early postoperative outcomes and complications

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ARTICLE INFO

Article history:
Received 13 February 2017
Received in revised form 26 March 2017
Accepted 13 May 2017
Available online xxxx

Keywords:
Anterior cruciate ligament
Remnant
Double bundle reconstruction
Heel-height difference
Extension loss

ABSTRACT

Background: To compare the early postoperative outcomes and complications of double-bundle anterior cruciate ligament (ACL) reconstruction with and without remnant preservation.
Methods: The study population comprised 125 consecutive knees that underwent double-bundle ACL reconstruction using hamstring autograft. Among the 125 knees, remnant preservation was indicated for 50 knees, while standard double-bundle reconstruction was performed in the remaining 75 knees. Postoperative evaluations included heel-height difference (HHD) at periodical follow-ups, number of knees requiring arthroscopic debridement due to problematic extension loss within six months, re-injury within one year, graft status upon second-look arthroscopy, and clinical examinations by Lysholm score and KT measurement at one year.
Results: All patients could be followed up for a minimum of one year after surgery. When the results obtained from both groups were compared, HHD values were significantly larger in the preservation group at three and six months, and the rate of knees requiring arthroscopic debridement was also higher in this group (12% versus 4.0%). Graft status on second-look arthroscopy was considered to be good for 92% of the knees in the preservation group versus 59% in the non-preservation group. Re-injury rates within one year were 2.0% in the preservation group and 5.3% in the non-preservation group. No significant differences in clinical examinations were found between the groups at one year.
Conclusions: Remnant preservation in double-bundle hamstring autograft ACL reconstruction may enhance tissue healing; however, retention of the remnant with its full volume resulted in an increased incidence of postoperative problematic extension loss.

1. Introduction

Preservation of the remnant in anterior cruciate ligament (ACL) reconstruction has potential advantages of promoting faster graft revascularization and maturation by supplying new vessels and cells from the remnant tissue [1,2]. In addition, mechanoreceptors included in the remnant may contribute to better proprioceptive function after surgery [3]. There have been several clinical studies comparing the outcomes of ACL reconstruction with and without remnant preservation [1,2,4–10]; however, the results of those comparative studies are inconsistent, and the significance of remnant preservation in ACL reconstruction has

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http://dx.doi.org/10.1016/j.knee.2017.05.008
0968-0160/

not been clarified. Moreover, the majority of the comparative studies examined the effect of remnant preservation on the outcome of single-bundle reconstruction, whereas remnant preservation in anatomic double-bundle reconstruction has been subjected to analysis in only a small number of reports [1,5,12].

Among the factors potentially influencing the surgical results of remnant-preserving ACL reconstruction, the volume of the remnant has been reported to correlate with the outcome with a larger volume producing better stability [1,2]. In double-bundle reconstruction, however, preservation of a large remnant may result in excessive graft volume in comparison to the space of the intercondylar fossa. In this situation, postoperative notch impingement can be a problem leading to loss of knee extension [1].

In this series, the ACL remnant was preserved with its full volume and tensioned through the femoral drill hole using traction sutures following the technique described by Ahn et al. [13]. The purpose of this study was to examine the outcomes and complications of double-bundle hamstring ACL reconstruction with remnant preservation as compared to those of standard double-bundle reconstruction performed for knees without a usable remnant during the same period. We hypothesized that remnant preservation would accomplish improved graft healing but increase the rate of complications associated with excessive tissue proliferation.

2. Patients and methods

2.1. Study population

The study design was approved by the Review Board of Hyogo College of Medicine. The study population comprised 125 consecutive knees in 125 patients that underwent anatomic double-bundle ACL reconstruction using an autogenous semitendinosus tendon graft. Exclusion criteria were revision ACL reconstruction and other concomitant ligament and bony procedures. Remnant preservation was indicated for knees with a substantial remnant that retained a diameter of more than 50% of its original size (preservation group). In order to provide a secure suture application, remnant preservation was indicated for knees with a substantial remnant that retained a diameter of more than 50% of its original size (preservation group). The remnant types included groups 1 (ACL scarring to the posterior cruciate ligament), 2 (ACL healing to the roof of the notch), and 3 (attenuated ACL remnant healed to the lateral wall more anteriorly and distally than its anatomic origin) according to Crain's classification [14]. In the remaining knees, standard double-bundle reconstruction was performed after debridement of scar tissue in the intercondylar notch (non-preservation group). All patients could be tracked up to one year by one of the authors (HN).

2.2. Surgical procedure

The semitendinosus tendon was harvested and prepared into two double-stranded tendon grafts for each of the anteromedial (AM) and posterolateral (PL) bundle grafts. Both femoral and tibial bone tunnels were drilled using the outside-in technique with diameters corresponding to the graft sizes. The locations of the tibial AM/PL tunnels were determined using the remnant footprint as a landmark. Femoral AM/PL tunnels were located behind the resident's ridge under arthroscopic control. Remnant suture and tension technique followed the method described by Ahn et al. [13] (Figure 1). First, three No. 2-0 PDS sutures (Ethicon, Somerville, NJ) were placed in the proximal portion of the remnant and the free ends of the sutures were brought out of the AM portal. Application of traction to the suture helped visualize the ACL femoral attachment site in the notch (Figure 1A). Soft tissue on the inner wall of the lateral femoral condyle in the intercondylar notch was cleared out using a radiofrequency device (Figure 1B). During the passage of the graft, the PL bundle graft was first introduced from the tibial to the femoral PL tunnel (Figure 1D). Second, the traction sutures of the remnant were passed through the AM femoral tunnel followed by passage of the AM bundle graft (Figure 1E). Graft fixation on the femoral side was achieved by Endo-Button CL (Smith & Nephew, Andover, MA), while screw post-method fixation was employed on the tibial side. The traction suture of the remnant was pulled through the femoral bone tunnel and tied over the Endo-Button while tension was applied to the remnant. Consequently, the remnant tissue was placed between the AM and PL bundle grafts (Figure 1F). All surgeries were performed by one of the authors (HN).

2.3. Postoperative rehabilitation

The operated knee was immobilized in extension for one week after surgery. Range of motion exercise was started at one week. Partial weight-bearing was allowed at one week with progression to full weight-bearing at three weeks. Jogging was begun at four months, and full return to strenuous sports activity was permitted between nine and 12 months.

2.4. Evaluation methods

2.4.1. Extension loss (heel-height difference (HHD))

Extension loss was quantitatively assessed using HHD as a reference. Schlegel et al. reported that a one centimeter side-to-side difference in HHD would correspond to a 1.2° difference in knee extension [15]. HHD measurement was periodically performed at two, three, six, and 12 months after surgery.

Please cite this article as: Nakayama H, et al, Double-bundle anterior cruciate ligament reconstruction with and without remnant preservation — Comparison of early postoperative outcomes..., Knee (2017), http://dx.doi.org/10.1016/j.knee.2017.05.008