Intra-operative Stability and Clinical Outcome Comparisons of ACL Reconstruction Using Double and Single Bundle Techniques

Introduction: Although the double bundle anterior cruciate ligament (ACL) reconstruction technique is capable of reproducing the two functional bundles at their anatomical insertion sites, there is no clear consensus among the studies in literature showing a significant advantage of this technique over the single bundle ACL reconstruction. Further, few studies have provided a quantitative comparison of rotational stabilities after single-bundle and double-bundle ACL reconstruction.1 In particular, no prospective study has been performed to compare intra-operative stability and short-term clinical outcome between double-bundle and single bundle ACL reconstructions. Our hypothesis was that double bundle ACL reconstruction provides better intra-operative stabilities and clinical outcomes than single bundle reconstruction. Thus, we undertook this prospective study to compare the intra-operative stabilities and short-term clinical outcomes achieved using these two techniques.

Methods: Patients who had received ACL reconstruction with a tibialis anterior allograft with a minimum follow-up of 1-year were included. Forty knees were equally allocated to the double bundle group (20 patients) and to the single-bundle group (20 patients) (Figure 1). This study was approved by the institutional review board, and written informed consent was obtained from all patients. Single and double bundle arthroscopic ACL reconstructions were performed by the same surgeon using EndoButton CL® (Smith & Nephew; Andover, MA) for femoral side fixation and a bio-absorbable interference screw® (Linvatec; Largo, FL) and a staple for tibial side fixation. We compared intra-operative stability including anteroposterior under anterior tibial load and rotational (sum of internal and external stabilities) stabilities under rotational tibial load at 30° of knee flexion using a navigation system before and after reconstruction. We also compared clinical outcomes including Lysholm knee score, Tegner activity scores, Lachman and pivot shift tests. Radiographic stability was evaluated using stress radiographs. The non-parametric Wilcoxon’s signed rank and the Mann-Whitney tests were used to compare the two methods. Significance was accepted at 95% level.

Results: Results: The anteroposterior stabilities under anterior tibial load were significantly improved in both groups after reconstruction (16.6 to 6.1 mm in single bundle and from 17.5 to 5.1 mm in the double bundle groups), showing significant inter-group difference (p=0.020) (Figure 2). After reconstructions, the tibial rotational stabilities under rotational load showed a significant improvement from 35.1° to 29.5° in the single bundle and from 33.2° to 23.3° in the double bundle groups. The tibial rotational stability after reconstruction also showed a significant inter-group difference (p<0.001) (Figure 3).

Average Lysholm knee scores at final follow-up were 92.0 (range, 75-100) in single bundle group and 94.1 (range, 79-100) in double bundle group, showing no inter-group difference (p=0.301).

Moreover, no significant inter-group difference was observed for activity levels (p=0.989) based on Tegner activity score at the final follow-up. The Lachman test showed that normal or grade I was observed in 18 patients of single bundle group and in 19 patients of double bundle group (p=0.832). In the pivot-shift tests at final follow-up, we could not find any inter-group difference (p=0.219). Average side to side difference by radiographic stability was improved to 2.7 ± 2.3 mm after single bundle reconstruction and to 2.4 ± 2.1 mm (range, 0-8 mm) after double bundle reconstruction. Thus, no significant difference was evident between the two groups with respect to side to side differences (p=0.862).

Discussion: Our intra-operative data demonstrate that anteroposterior and rotational stabilities were better restored using double bundle ACL reconstruction. These data confirmed the superiority of double bundle ACL reconstruction over single bundle ACL reconstruction as published by other authors using cadaveric knees.2 Several prospective comparative clinical studies sowed better clinical results in double bundle reconstruction than single bundle reconstruction.3 However, we were unable to find any differences between the two techniques in terms of functional outcomes and stabilities.

In conclusion, despite better anteroposterior and rotational stabilities during operations, double bundle ACL reconstruction technique does not demonstrate any advantages over single bundle reconstruction after a minimum follow-up of 1 year.

References
1. Ishibashi Y et al. *Orthopedics* 2005;28:s1277-1282
2. Yagi M et al. *CORR* 2007;454:100-107

Figure 1. Comparison of intra-operative stability under the anterior load at 30 degree of flexion. *, P<.05. Error bars represent SD

Figure 2. Comparison of intra-operative stability under the anterior load at 30 degree of flexion. *, P<.05. Error bars represent SD

Figure 3. Comparison of intra-operative stability under rotational load at 30 degree of flexion. *, P<.05. Error bars represent SD.