INTRODUCTION
Anatomic anterior cruciate ligament (ACL) reconstruction, either single- or double-bundle, has been advocated for better rotational instability. Although rotational instability, which is clinically evaluated by the pivot shift test, contains a dynamic property, most studies evaluated the effect of the anatomic ACL reconstruction by static measurement, such as translational or angular displacement. Dynamic measurement by velocity or acceleration of the knee instability has recently been introduced for more clinically relevant assessment.

Most previous studies attempting to measure rotational instability have been conducted for double-bundle ACL reconstruction, but rarely for the anatomic single-bundle (SB) ACL reconstruction in spite of its wider popularity. In addition, the single over-the-top (OTT) ACL reconstruction has not been investigated despite the fact that it is commonly used as a salvage option for revision cases and in skeletally immature patients. In the OTT procedure, the graft is passed over the superomedial border of the lateral femoral condyle and fixed on the lateral femoral shaft over the condyle.

Therefore, the purpose of this study was to investigate dynamic rotational instability of the anatomic SB and the OTT ACL reconstruction during pivot shift test with use of triaxial accelerometer. It was hypothesized that the anatomic SB reconstruction would provide better dynamic instability than the OTT procedure.

MATERIALS AND METHODS
Eight fresh frozen human cadaveric knees were used. The dynamic rotational instability was measured by the triaxial accelerometer (Kistler, Winterthur, Switzerland) during pivot shift test, which can reproduce the dislocation phase of the pivot shift phenomenon from flexion to extension. The same examiner manually performed the tests. The sensor was attached to the tibial tuberosity with a screw (Fig. 1).

The acceleration was monitored throughout the test at a sampling rate of 10 kHz. The maximum acceleration values among three repeated tests were used for comparison between ACL intact, resected and reconstructed states with two procedures (anatomic SB and OTT) in the same knees (Fig. 2).

RESULTS
The ACL deficient knees (1.680 ± 0.228 m/s²) had greater acceleration compared to the ACL intact knees (0.963 ± 0.138 m/s²). Both anatomic SB (1.329 ± 0.107 m/s²) and OTT (1.299 ± 0.107 m/s²) ACL reconstructions significantly reduced the acceleration compared to the ACL deficient knees, but still had larger accelerations compared to the ACL intact knees (Fig. 4). There were no significant differences between anatomic SB and OTT reconstruction procedures (p=0.92).

DISCUSSION
A triaxial accelerometer was used to evaluate the dynamic instability represented by the pivot shift phenomenon after anatomic SB and OTT ACL reconstructions. Both procedures could reduce the dynamic instability similarly from ACL deficient knees, but failed to restore the intact level. Although OTT reconstruction is used for limited cases, which cannot use the standard anatomic procedures, it provides comparable result to anatomic SB reconstruction in terms of controlling the dynamic rotational instability. Further study is warranted for assessing rotational stability after anatomic double bundle ACL reconstruction.

REFERENCES