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Single Bundle ACL Reconstruction Controls Both Anterior Translation and Internal Rotation During the Pivot Shift: Computer Navigation Study

Mark Darragh Porter, MD, DSc, FACSP, FRACS, FAOA, AUSTRALIA
Bruce Shadbolt, PhD, AUSTRALIA

Barton Private Hospital and Calvary John James Hospital
Canberra, ACT, AUSTRALIA

Summary:
In 20 patients undergoing an isolated ACL reconstruction, using computer navigation and the opposite knee as a control, single bundle ACL reconstruction was found to reduce both the anterior translation and the internal rotation of the tibia relative to the femur, to values similar to, or less than, those of the control knee, respectively.

Abstract:
BACKGROUND
The ability of single bundle ACL reconstruction to restore rotational control has been questioned by proponents of the double bundle technique. The term “anatomical positioning” has become popularized, in recognition of the incorrect positioning sometimes used in the past that may have contributed to the lack of rotation control. The pivot shift test remains the most clinically useful measure of ACL deficiency and it is now possible to measure it both accurately and objectively using computer navigation.

HYPOTHESIS
Single bundle (SB) ACL reconstruction will reduce anterior translation and internal rotation of the tibia during the pivot shift test to that of the contralateral uninjured knee.

Study design: Descriptive laboratory study.

METHODS
Twenty patients with an acute isolated ACL rupture underwent reconstruction using SB autologous hamstring graft. Computer navigation was used intra-operatively to plot the pivot shift both before, and after, reconstruction. The opposite normal knee was used as a control. Statistical analysis was used to compare the pivot shifts before and after surgery. For ethical reasons, intra-operative fixation could only be used on the operative side, while skin fixation was used on the control side. The authors used both skin fixation and then intra-osseous fixation on the operative side, before surgery, to calculate an intra-class correlation for skin fixation versus intra-osseous fixation.

RESULTS
Single bundle ACL reconstruction produced a significant reduction in the anterior translation, from 17.4mm (SD 3.80) to 6.4mm (SD 1.95), $p<0.001$, as well as the internal rotation, from 22.90 (SD 5.91) to 7.50 (SD 2.96), $p<0.001$. Relative to control knees, the anterior translation was similar, 6.4mm (SD 1.95) vs 5.6mm (SD 1.23), $p<0.148$, while the internal rotation was significantly less, 7.50 (SD 2.96) vs 11.90 (SD 3.36), $p<0.05$, in the reconstructed knees. The values for the coupled movements were used to calculate the length of the radius of curvature, about which the tibia rotates relative to the femur, during the pivot shift. In the control knees the mean value was 28.9mm (SD 8.21) while there was extreme variability in the operated knee both before and after surgery. The intra-class correlation coefficient between skin fixation and intra-osseous fixation was found to be 0.936 for internal rotation (95% confidence interval 0.84-0.974) and 0.89 for anterior translation (95% confidence interval 0.743-0.955).

A post-hoc power analysis found the observed power to be 1.0 for anterior translation, with an alpha value of 0.05 and a clinical tolerance of 2mm. For internal rotation the power was 0.96-1.0, with a clinical tolerance of 2 degrees and alpha equal to 0.05.

CONCLUSIONS
It is possible to reduce both the anterior translation and internal rotation, which occur during the pivot shift test in the ACL-deficient knee, using a single bundle ACL reconstruction, when measured at the time of surgery. However, normal motion is not fully restored.

Key terms: ACL, single bundle, computer navigation, pivot shift