

Failed Exploration of Rotational Instability in Single- and Double-Bundle ACL Reconstruction

To the Editor:

We read with interest the article by Ho et al.¹ entitled "Equal Kinematics Between Central Anatomic Single-Bundle and Double-Bundle Anterior Cruciate Ligament Reconstructions." This article, which compared translational and rotational stability in single- and double-bundle anterior cruciate ligament (ACL) reconstruction using a navigation system, attempted to find objective differences between the 2 reconstruction techniques.

We were surprised that the study was unable to detect significant differences in rotational laxity between ACL-deficient and ACL-intact knees. These findings are in contrast to several recent in vivo studies that showed a difference in rotational stability between the 2 states^{2,3} and suggest that the joint positioning and loading used for this study may be unsuitable for comprehensive evaluation of ACL (or graft) function. Given that improvement in rotational control is reported to be one of the major advantages of the double-bundle reconstruction,⁴ the inability to detect any rotational abnormalities in the ACL-deficient state makes the results of this study difficult to interpret. Most cadaveric studies have used a simulated pivot-shift test for assessing rotational stability⁵; this test routinely distinguishes between ACL-intact and ACL-deficient joints and has been used previously to identify differences between double- and single-bundle reconstructions.⁴ Given that the simulated pivot-shift test can be performed with a navigation system,^{6,7} it is unfortunate that it was not included in this study.

We do appreciate the authors' approach of putting the single-bundle graft in an anatomically centered position. Furthermore, drilling of the femoral tunnel, for the single-bundle reconstruction, through the anteromedial portal ensures better femoral tunnel positioning. Surprisingly, the same technique was not used for the double-bundle reconstruction. Most investigators would agree that anatomic positioning of the tunnels is essential for superior clinical outcome and that transtibial tunnel drilling may lead to nonanatomic, high anteromedial bundle positions.^{8,9}

We look forward to the authors' response in hopes of improving our level of knowledge of the ACL.

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References

1. Ho JY, Gardiner A, Shah V, Steiner ME. Equal kinematics between central anatomic single-bundle and double-bundle anterior cruciate ligament reconstructions. *Arthroscopy* 2009;25:464-472.
2. Van de Velde SK, Gill TJ, Li G. Evaluation of kinematics of anterior cruciate ligament-deficient knees with use of advanced imaging techniques, three-dimensional modeling techniques, and robotics. *J Bone Joint Surg Am* 2009;91:108-114 (Suppl 1).
3. Tashman S, Collon D, Anderson K, Kolowich P, Anderst W. Abnormal rotational knee motion during running after anterior cruciate ligament reconstruction. *Am J Sports Med* 2004;32:975-983.
4. Yagi M, Kuroda R, Nagamune K, Yoshiya S, Kurosaka M. Double-bundle ACL reconstruction can improve rotational stability. *Clin Orthop Relat Res* 2007;454:100-107.
5. Yagi M, Wong EK, Kanamori A, Debski RE, Fu FH, Woo SLY. Biomechanical analysis of an anatomic anterior cruciate ligament reconstruction. *Am J Sports Med* 2002;30:660-666.
6. Robinson J, Carrat L, Granchi C, Colombet P. Influence of anterior cruciate ligament bundles on knee kinematics: Clinical assessment using computer-assisted navigation. *Am J Sports Med* 2007;35:2006-2013.
7. Zaffagnini S, Bignozzi S, Martelli S, Imakiire N, Lopomo N, Marcacci M. New intraoperative protocol for kinematic evaluation of ACL reconstruction: Preliminary results. *Knee Surg Sports Traumatol Arthrosc* 2006;14:811-816.
8. Colvin AC, Shen W, Musahl V, Fu FH. Avoiding pitfalls in anatomic ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc* 2009;17:956-963.
9. Zantop T, Diermann N, Schumacher T, Schanz S, Fu FH, Petersen W. Anatomical and nonanatomical double-bundle anterior cruciate ligament reconstruction: Importance of femoral tunnel location on knee kinematics. *Am J Sports Med* 2008;36:678-685.

Author's Reply

We appreciate the letter from Drs. Lorenz, Tashman, and Fu about our article. They raise some important issues related to rotational laxity in the ACL-injured and ACL-reconstructed knee.

We agree with the authors of the letter, and it is well documented, that the ACL-deficient knee does have a rotational abnormality—increased internal rotation under internal

torque.¹⁻³ This increase in internal rotation occurs near extension but is relatively small—up to 4°. We documented a 2.4° increase ($P = .06$) in internal rotation with internal torque at 30° of flexion, and using the same testing system, we have reported a 3.5° increase ($P < .001$).³

The major change in knee kinematics that occurs with ACL injury is not the small increase in internal rotation but rather a