Editorial Commentary: Anatomic Single-Bundle Anterior Cruciate Ligament Reconstruction Makes More Sense Than Triple-Bundle: Three's a Crowd

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Abstract: Recent research reports impressive patient-reported and objective stability outcomes after triple-bundle anterior cruciate ligament (ACL) reconstruction with hamstring autograft. However, the results are similar to those reported in the orthopaedic literature for single-bundle ACL reconstruction. If the triple-bundle technique does not reduce graft failure rates, and bearing in mind that it is more complex, more expensive, and more difficult to revise, then an anatomically-positioned single-bundle ACL reconstruction makes more sense. If the data supporting double-bundle ACL reconstruction is inconclusive, then why add a third bundle?

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There have been a number of biomechanical[1-5] and clinical studies[6-8] comparing single- and double-bundle anterior cruciate ligament (ACL) reconstruction. In theory, the double-bundle technique can reconstruct both the anteromedial and the posterolateral bundles and thus may reproduce knee stability and kinematics closer to the native knee than a single-bundle technique. In practice, the results have been inconsistent. While several studies reported that the double-bundle technique yields superior knee stability and clinical outcomes,[6] other investigators found that both knee stability and clinical function were not significantly different between the two techniques.[7] Moreover, a recent meta-analysis included 5 randomized controlled trials involving 294 patients with at least 5 years of follow-up. The results revealed that there was no significant difference in knee stability, clinical function, graft rupture, and osteoarthritis changes between the single- and double-bundle techniques in autologous ACL reconstruction.[9]

In their article titled "Anatomical Triple Bundle Anterior Cruciate Ligament Reconstructions With Hamstring Tendon Autografts: Tunnel Locations and 2-Year Clinical Outcomes," Uchida, Shino, Iuchi, Tachibana, Yokoi, Nakagawa, and Mae[10] note impressive patient-reported and objective stability outcomes after triple-bundle ACL reconstruction with hamstring autograft. Moreover, corresponding computed tomography scanning evaluations demonstrating that the entire femoral tunnel aperture and the majority of the tibial tunnel aperture were located within the anatomic attachment areas of the native ACL. Given that these results are similar to those after single-bundle ACL reconstruction, combined with the lack of comparative data, I still prefer single-bundle ACL reconstruction.

If the data supporting double-bundle ACL reconstruction are inconclusive, then why add a third bundle? The authors of this study state that the ACL can be divided into "three fiber bundles: the medial portion of the anteromedial (AMM), the lateral portion of the anteromedial (AML) and the posterolateral (PL) bundles." The same group of investigators have found that lower initial tension on the graft was needed in triple-bundle ACL reconstruction to restore stability compared to double- or single-bundle ACL reconstruction.[11] In addition, this group has published early clinical results showing favorable knee stability for the triple-bundle ACL reconstruction technique as compared to the double-bundle technique, although single-bundle ACL reconstructions were not included in this previous study.[12] Although the present study validates the anatomic triple-bundle ACL reconstruction technique using computed tomography scanning and short-term

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clinical results, a comparison study with a single-bundle reconstruction technique cohort is needed to prove non-inferiority. I, for one, would be very curious to see these results.

There are a number of limitations to this study. Most notably, the authors include a small sample size of patients, nearly all of whom are female. Longer follow-up on a larger cohort with more gender parity is needed. As cost-effective care becomes more important, I can't help but wonder how much longer the average operative time (with associated overhead) would be for a triple-bundle ACL reconstruction as compared to a single-bundle reconstruction. In addition, the femoral tunnel aperture area is more than double that of a single-bundle technique, whereas the tibial tunnel aperture area is triple that of a single-bundle technique. This has negative ramifications on potential revisions, because limited bone stock would necessitate a 2-stage revision much more often than after a single-bundle reconstruction.

Although I do not think there is a need for an anatomic triple-bundle ACLR, I cannot discredit the authors findings. The authors should be commended for drawing light to the feasibility of a triple-bundle reconstruction technique. I look forward to seeing more of the authors' work and a longer-term follow-up study from this patient cohort to elucidate the potential advantages and disadvantages of this technique over single-bundle ACL reconstructions. For now, if the triple-bundle technique does not reduce graft failure rates while being more complex, more expensive, and harder to revise, then I still prefer an anatomically-positioned single-bundle ACL reconstruction.

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