

## Anatomic Single-Bundle Anterior Cruciate Ligament Reconstruction

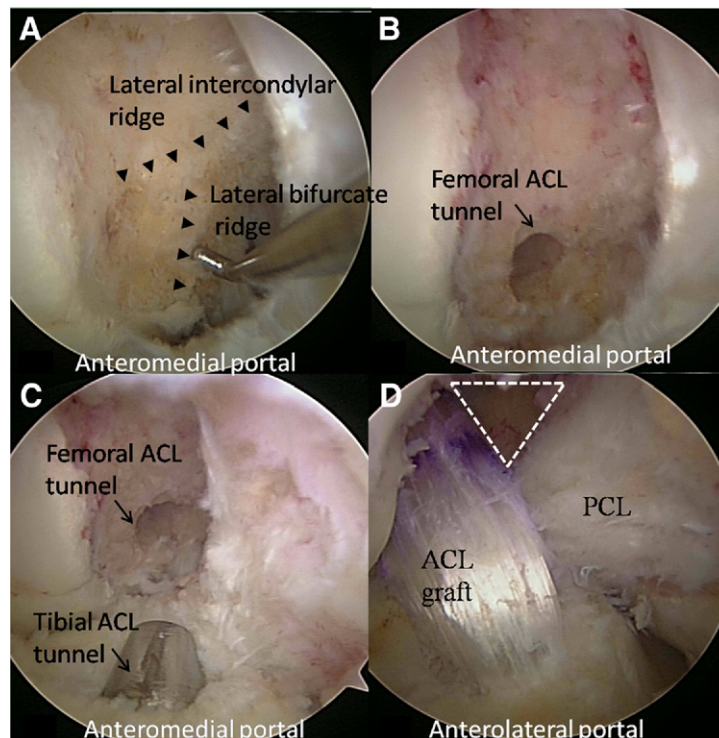
To the Editor:

In the February 2009 *Arthroscopy* “Cover Image” by Rene J. Abdalla and Andrea Forgas,<sup>1</sup> the authors present a single-bundle anterior cruciate ligament (ACL) reconstruction case with “ideal” femoral tunnel placement. Their description of the performed procedure is very concise with limited information on the technical details of the surgery—the cover shows the end result. The information provided by the authors is insufficient to determine whether tunnel placement was “ideal” or anatomic.

The advancing knowledge of ACL anatomy has allowed for improved modern reconstruction techniques that approach the anatomy of the native ACL.<sup>2</sup> For the audience to interpret and evaluate the results critically, the surgical procedure should be described in detail and accompanied by multiple informative surgical pictures (Fig 1) as well as postoperative imaging such as a radiograph, magnetic resonance image, or computed tomography scan (Fig 2). We

recommend that simple statements such as “we placed the tunnels in an ideal position,” “we performed anatomic ACL reconstruction,” or “we performed surgery in a routine fashion” should no longer be used in modern literature. Of course, we understand that a cover photograph is not a formal case report, and that this format may not allow the authors to describe their case in detail and provide multiple pictures.

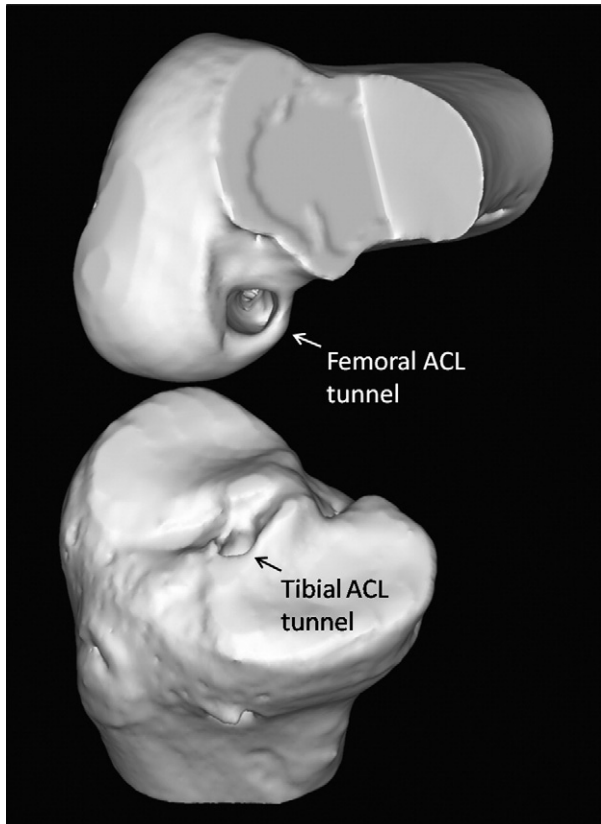
A surgical guideline has been published recently that can help orthopaedic surgeons perform anatomic ACL reconstruction,<sup>3</sup> which includes inspection of rupture pattern, use of soft-tissue and bony landmarks,<sup>4</sup> identification of anatomic insertion sites, and decision making based on the unique anatomy of each individual. The flowchart that accompanies the guidelines emphasizes the principles of anatomic ACL reconstruction. It is a dynamic document that is modified continuously as more information about the ACL anatomy and how to more closely restore it becomes avail-



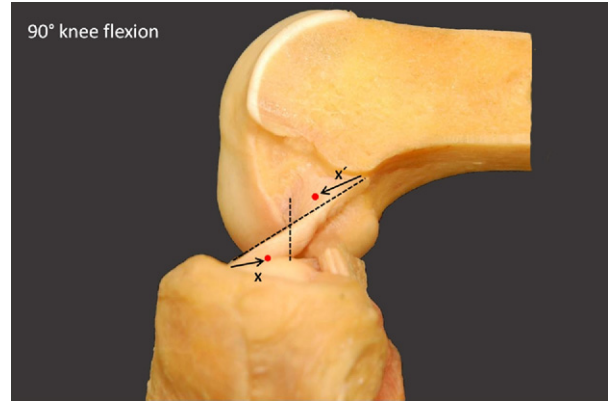
**FIGURE 1.** Documentation of an anatomic single-bundle ACL reconstruction case. (A) The bony ridges delineate the native ACL insertion site. With the knee in 90° of flexion, the lateral intercondylar ridge forms the superior border of the ACL insertion site and the lateral bifurcate ridge separates the anteromedial and posterolateral bundle. (B, C) Anatomic single-bundle ACL placement. The femoral tunnel is placed in the center of the ACL insertion site, below the lateral intercondylar ridge. (D) Anterolateral portal view after the ACL graft was passed. The triangle between the ACL and posterior cruciate ligament (PCL) was restored.

able (Appendix Fig 1). The flowchart can be applied to both single- and double-bundle reconstructions. Anatomic single-bundle reconstruction can be achieved by placing the tunnels in the center of the femoral and tibial ACL insertion sites or in a matched fashion with double-bundle techniques<sup>3</sup> (Fig 3).

In their case presentation, the authors support their choice for single-bundle ACL reconstruction by stating that “. . . the double-bundle [reconstruction] was unnecessary.”<sup>1</sup> However, they do not provide any arguments for that conclusion. The goal of anatomic ACL reconstruction should be to restore 80% to 90% of the native ACL anatomy. Theoretically, double-bundle reconstruction covers more of the native ACL insertion site area than single-bundle reconstruction, provided that both surgeries are done in an anatomic fashion. Therefore we prefer anatomic double-bundle reconstruction unless the patient has a tibial insertion site smaller than 14 mm in length or other specific criteria such as a narrow notch, multiple ligamentous injuries, and open physes.<sup>2</sup>



**FIGURE 2.** Three-dimensional reconstructed computed tomography scan of a right knee after anatomic single-bundle reconstruction. The medial femoral condyle is removed to show the whole lateral wall of the femoral intercondylar notch with the femoral tunnel.



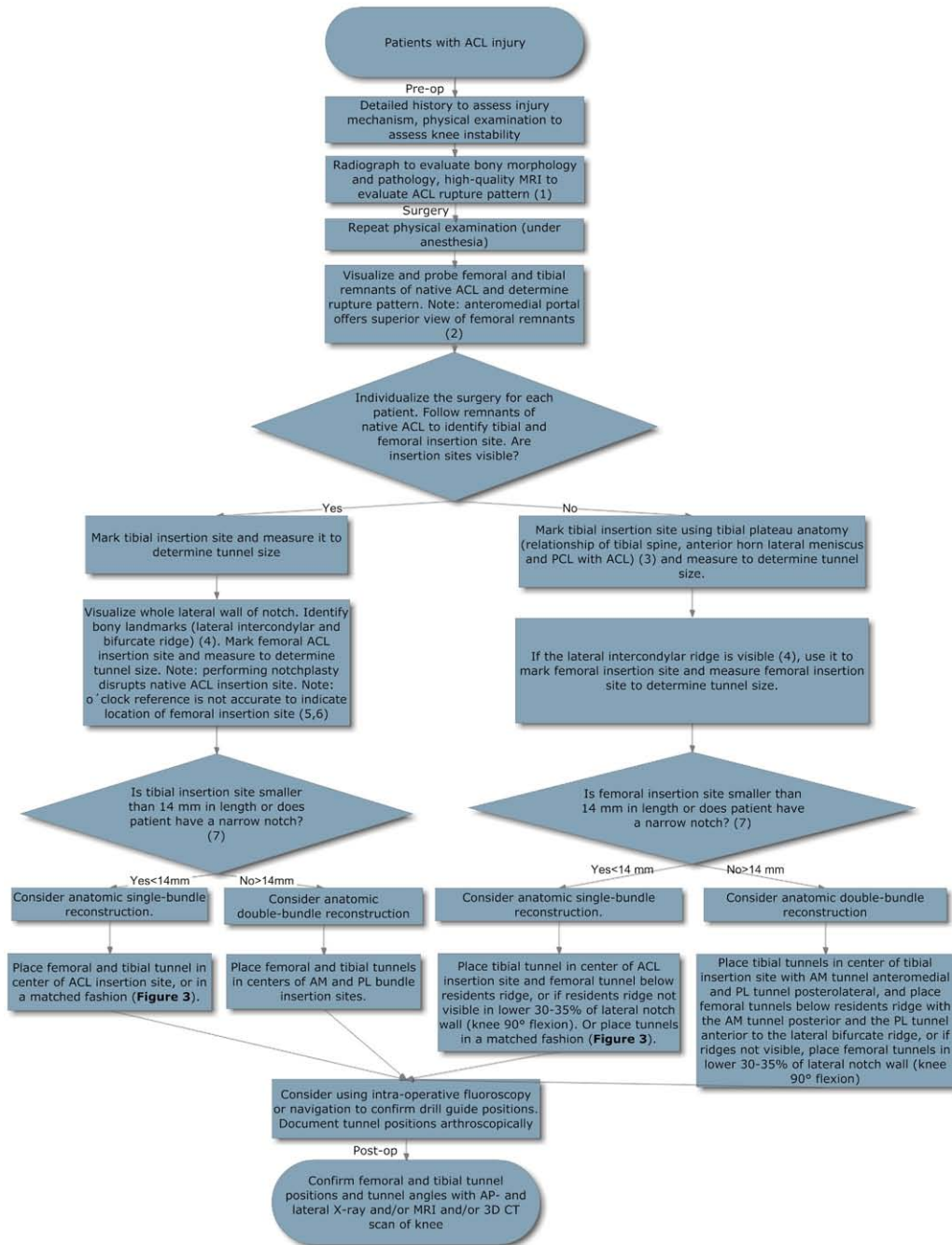
**FIGURE 3.** A medial view of a cadaveric knee with the medial condyle removed is shown to explain the matched single-bundle concept. The dashed lines indicate the borders of the ACL. The dots indicate the preferred tibial tunnel position (x) and femoral tunnel position (x') for anatomic single-bundle ACL reconstruction within this cadaveric specimen. Within the confines of a single-bundle reconstruction, this “matching” of the tibial and femoral tunnel positions maximizes the fill of the anatomic footprint and approximates the trajectory of the native ACL.

The authors’ statement “. . . ideal femoral placement at the 9:30 position and low . . .” provides a disservice to anatomic reconstruction methods because it provides a generic formula that cannot be applied universally. Anatomic ACL reconstruction is, by definition, a technique based on the individual’s anatomy. Furthermore, there is often failure in the literature to report on knee flexion angles as well as the viewing portal when using the “o’clock” reference that limits standardization among technical descriptions and research methods.<sup>5</sup>

Although there is still much to learn about anatomic ACL reconstruction methods, we should strive toward providing the best possible care for our patients. This starts with meticulous evaluation, appropriate examination documentation, and translation of these thought processes to accurate anatomic restoration. In our opinion the concise legend for the cover image fails to appreciate the complexity and advances in understanding of the native anatomy, and it reaches conclusions that are a disservice to modern ACL reconstruction techniques.

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## Anatomic single- and double-bundle ACL reconstruction flowchart



## References:

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2. Cohen, S.B. and F.H. Fu, Three-portal technique for anterior cruciate ligament reconstruction: use of a central medial portal. *Arthroscopy*, 2007. 23(3): p. 325 e1-5.
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This flowchart was created by Carola F. van Eck, MD, Bryson P. Lesniak, MD, and Freddie H. Fu, MD, University of Pittsburgh.

APPENDIX FIGURE 1. Anatomic single- and double-bundle ACL reconstruction flowchart. (Pre-op, preoperatively; MRI, magnetic resonance imaging; PCL, posterior cruciate ligament; Post-op, postoperatively; AP, anteroposterior; 3D, 3-dimensional; CT, computed tomography.)

### References

1. Abdalla RJ, Forgas A. Cover image. *Arthroscopy* 2009;25:A10.
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4. Ferretti M, Ekdahl M, Shen W, Fu FH. Osseous landmarks of the femoral attachment of the anterior cruciate ligament: An anatomic study. *Arthroscopy* 2007;23:1218-1225.
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### Author's Reply

When we submitted our cover photograph, taken in 2007, the concept was already out of date. The thought behind submitting this picture was just for it to be on the cover of *Arthroscopy*; however, obeying the "on the cover" instructions, we sent a summary of the patient history. We have to agree with the comments of Fu et al., especially when they say that phrases such as "we placed the tunnels in an ideal position," "we performed an anatomic anterior cruciate ligament (ACL) reconstruction," or "we performed surgery in a routine fashion" should no longer be used in the modern literature.

Another important point is the imprecise position of the femoral tunnel compared with a clock-face location; however, once again, because we only submitted one picture, this seemed to be the fastest and most practical way to define this position. To be honest, it is important to state that this patient had an intact meniscus and an intact secondary restraint, and for this reason, we did not see a need to perform a more complex procedure to correct the issue.

At the end of this athlete's rehabilitation process, he was given an International Knee Documentation Committee rating of "A", and he resumed his activities with the same intensity and frequency as before he was injured.<sup>1</sup> He also presented

FIGURE 2. Graft positioned.

with a 3-mm difference on KT-2000 evaluation (MEDmetric, San Diego, CA), which justifies his stability for anterior translation and external rotation.<sup>2</sup>

Once again, the idea was just to show this picture and not to compare techniques. At the time, we did not submit a description of our present anatomic and biomechanical approach. With the Editor's permission, we would like to make some important points. First, we would like to describe technically how we positioned the graft in the femur: we used a single-bundle graft and anatomic ACL placement. The guide pin was placed on the lateral notch at the midpoint of the proximal to distal length of the ACL attachment, just above this location (Fig 1) and about 7 to 8 mm from the posterior cortex. To achieve this, we have been using a special guide and flexible drill system through the anterior medial portal and with the knee in flexion.<sup>2</sup> After this standard selection, we inserted our graft (Fig 2).

With regard to the literature, it is also necessary to point out that when we talk about double-bundle reconstruction, we still lack conclusive data on where to place the tunnels during surgery, and we still cannot conclude that we have a better result when we compare both techniques. From the biomechanical point of view<sup>3-7</sup> and also from the clinical benefits,

FIGURE 1. Femoral pin.