Case Report

Anatomic Double-Bundle Anterior Cruciate Ligament Reconstruction Revision Surgery

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Abstract: With the increasing number of double-bundle anterior cruciate ligament (ACL) reconstructions being performed, revision cases are expected. This report describes the first 3 cases of revision double-bundle ACL surgeries performed at our institution. In 3 athletes in whom the ACL was previously reconstructed with an anatomic double-bundle technique, new traumatic events occurred and an ACL retear was diagnosed. In cases 1 and 2 the anteromedial (AM) bundle was completely torn and the posterolateral (PL) bundle was stretched and nonfunctional. In case 1 both bundles were reconstructed via the previous tunnels, and the AM and PL grafts were tensioned at 60° of flexion and full extension, respectively. In case 2 the PL femoral tunnel was posterosuperior to the PL anatomic position. Therefore we drilled a third femoral tunnel and used the previous PL tunnel as our new AM tunnel. In case 3 the rupture pattern presented an intact and functional PL bundle and a midsubstance AM tear. We decided to revise only the AM bundle using the previous AM tunnels, which were anatomically positioned. This report shows that revision of anatomic double-bundle ACL reconstruction is reasonable to accomplish and that the principles of anatomy are essential as a guide to approaching each case. **Key Words:** Anterior cruciate ligament—Double bundle—Revision.

Anterior cruciate ligament (ACL) reconstruction is the sixth most common orthopaedic procedure performed in the United States, with approximately 75,000 cases per year.[1] Anatomic studies reveal that the normal ACL consists of 2 functional bundles of ligament, the anteromedial (AM) and posterolateral (PL) bundles. Traditional ACL reconstruction has focused on reconstructing the AM bundle. Although this approach has effectively controlled anteroposterior stability, KT-1000 (MEDmetric, San Diego, CA) and Lachman examinations do not correlate this in functional outcomes.[2] The absence of pivot shift, by comparison, has been shown to correlate with subjective outcomes.[3] Therefore some surgeons have recently advocated a double-bundle approach to reconstruct both the AM and PL bundles.[4,5] Because the PL bundle has a role in rotational stability, its reconstruction may lead to improvements in functional outcomes.

With the increasing number of double-bundle ACL reconstructions being performed, revision cases are expected. Clinical experience with double-bundle ACL revision is limited, and potential technical concerns in completing revision cases have been raised.[6] This report describes the first 3 cases of revision double-bundle ACL surgeries performed at our institution.

CASE 1

A 19-year-old man sustained an acute ACL tear while playing football. Double-bundle reconstruction

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The authors report no conflict of interest.

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was performed in November 2003, via 2 femoral and tibial tunnels drilled to 7 mm in diameter and hamstring autografts tensioned at 70° and 30° of flexion for the AM bundle and PL bundle, respectively. In August 2005 he had an acute reinjury of the knee while playing football. Examination and magnetic resonance imaging (MRI) findings were consistent with ACL rerupture, and the patient proceeded to undergo ACL double-bundle revision surgery in August 2005. Arthroscopic evaluation revealed a ruptured AM bundle from the femoral side, as well as a grossly stretched PL bundle (Fig 1A). The tunnel position was anatomically correct; therefore we redrilled the original tunnels and passed two 7-mm tibialis anterior allografts (Fig 1B). The PL bundle was tensioned in full extension and the AM bundle in 60° of flexion. At 6 months postoperatively, examination revealed negative Lachman and pivot-shift test, a KT-1000 side-to-side difference of 0 mm, and full restoration of range of motion.

CASE 2

A 22-year-old man sustained an acute complete ACL tear while playing football and underwent anatomic double-bundle reconstruction in October 2004. The PL graft was tensioned in 10° of flexion and the AM graft in 45°. In November 2005 the patient had a reinjury of the knee while playing football. Examination and MRI findings were consistent with ACL rerupture. In January 2006 the patient underwent revision double-bundle ACL surgery. Arthroscopic evaluation showed the original grafts to be attached but nonfunctional. The AM bundle was partially torn from the femoral side, and the PL bundle was elongated. The PL femoral tunnel was noted to be posterosuperior to the true anatomic position of the PL bundle. Therefore a new PL femoral tunnel was drilled, and the existing PL femoral tunnel was used for the new AM graft (Fig 2A and B); 7- and 8-mm diameter tibialis anterior allografts were used for the PL bundle and AM bundle, respectively. The PL graft was tensioned in full extension and the AM graft in 60° of flexion. One month postoperatively, the patient had a negative Lachman test. The pivot-shift evaluation has not yet been attempted.

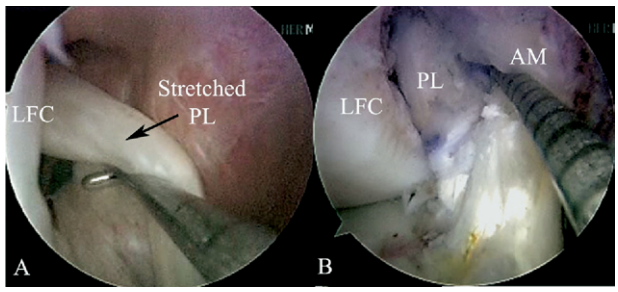

FIGURE 1. (A) Arthroscopic rupture pattern of original grafts, showing a stretched PL graft. (B) Revised double-bundle reconstruction, in which the original femoral and tibial tunnels were used. (LFC, lateral femoral condyle.)

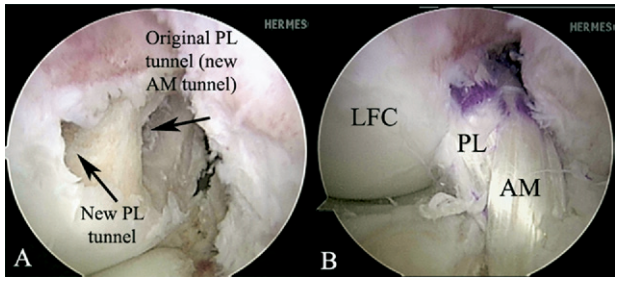

FIGURE 2. (A) Arthroscopic view of previous PL tunnel being used for new AM graft and new tunnel being created for PL graft. (B) New AM and PL grafts in place. (LFC, lateral femoral condyle.)

CASE 3

A 17-year-old male patient presented with an acute ACL tear and underwent reconstruction with the anatomic double-bundle technique in September 2005. The patient returned to playing sports before the recommendation of our rehabilitation protocol guidelines (6 months) and had an acute reinjury of his knee playing while basketball in February 2006. Examination revealed a 3-mm KT-1000 finding, 1+ pivot shift test, and 1+ Lachman test. MRI showed the graft to be partially ruptured. Under arthroscopic evaluation, the patient had a midsubstance tear of the AM bundle and an intact PL bundle (Fig 3A). Therefore we per-

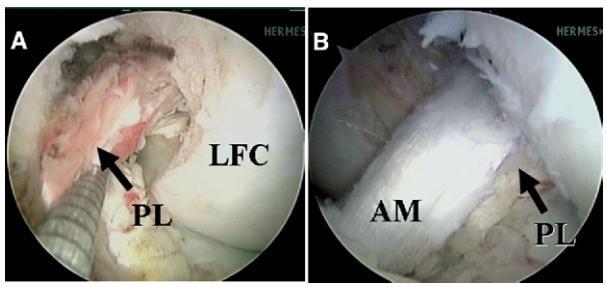

FIGURE 3. (A) Intact PL bundle, with AM bundle removed. (B) New AM bundle graft in place, with PL bundle partially hidden. (LFC, lateral femoral condyle.)

formed an isolated AM bundle repair via the previous AM tunnels (Fig 3B).

DISCUSSION

Failure of ACL reconstruction commonly results from any combination of 3 factors: biologic factors, surgical technique, and new traumatic events. In each case presented the subject had a new traumatic event while playing sports. However, we cannot be certain whether this factor was the only one involved.

In case 1 both tunnels were in the correct anatomic position and are unlikely to have been a factor in the eventual failure. However, the tensioning angles used for this case are a potential source of the failure: a recent study by Gabriel et al.[7] shows that the PL bundle is tightest in full extension, but the PL graft in this case was tensioned at 30°. Therefore the observed PL stretching was possibly a result of a chronic process related to tensioning at a suboptimal flexion angle. We currently tension each bundle in the angle where the highest in situ forces are present—that is, full extension for the PL bundle and in 60° of flexion for the AM bundle.

In case 2 the PL femoral tunnel was located posterosuperior to the true anatomic footprint of the PL bundle. Our current PL tunnel is centered approximately 5 mm posterior and 3 mm superior to the anterior articular cartilage border, with the knee in 90° of flexion. An accessory medial portal is used to facilitate correct tunnel placement. This case shows that if the original tunnels do not approximate the true anatomic position, it is possible to safely add a third femoral tunnel.

In case 3 the PL bundle was determined to be intact, and both tunnels were positioned anatomically. In the case of a primary intact PL bundle, anatomic reconstruction is accomplished with augmentation of the AM bundle alone. In this revision case we were able to use a similar approach, and the AM bundle was reconstructed via the original tunnels. For this case, it should be noted that, aside from the new traumatic event, incomplete "ligamentization" is also a possible source of the graft failure.

As clinical experience with anatomic double-bundle ACL reconstruction increases, it is likely that the need for revision surgeries will also increase. We have reported on the first 3 cases of revision surgery at our institution. We have shown that revision surgery after anatomic double-bundle ACL reconstruction is reasonable to accomplish, as well as that the principles of anatomy are essential as a guide to approaching each case.

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