Anterior Cruciate Ligament Revision — Posterolateral Bundle Augmentation of Vertical Graft: A Case Report

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Introduction

Anterior cruciate ligament (ACL) reconstruction is among the most commonly performed orthopaedic procedures in the United States, with more than 100,000 done each year.[1] Results are generally good; however, failures can occur at a rate of 10% to 20%.[2] The cause of failed ACL reconstruction varies, with technical error resulting in bone tunnel malposition being the most common cause.[3] Working through a tibial tunnel can make it more difficult to recognize the correct starting position on the femur, and the surgeon may be more likely to start the femoral tunnel in a central 12 o'clock position. The combination of subtle posterior placement of the tibial tunnel and central placement of the femoral tunnel results in a graft that is malpositioned in both the sagittal and coronal planes—a "vertical graft," [4] which can result in rotational instability on clinical exam. The number of potential ACL revisions in the United States is estimated at 3,000 to 10,000 per year.[5] In a revision case, typically the primary graft has ruptured and thus revision of the entire graft is necessary. However, as seen in a vertically placed reconstruction, the graft remains intact. In these particular cases, the option of selective single- or double-bundle augmentation of a primary vertical graft is available.

We report the case of a professional skier who presented with persistent rotational instability and an intact graft ten years after an ACL reconstruction performed at an outside hospital. The patient discussed in this report was informed that data concerning his case was to be submitted for publication, and he consented. The patient's confidentiality was protected in compliance with the Health Insurance Portability and Accountability Act.

Case Report

A thirty-four-year-old male who was a former professional skier presented to our clinic with right knee swelling and instability. He had undergone a right knee ACL reconstruction using bone-patellar tendon-bone (BTB) autograft, ten years prior, at an outside institution. His primary concerns were increasing episodes of "giving way", particularly during activities such as hiking or fly fishing. On physical examination of the right knee, there was a mild joint effusion noted. Range of motion was from 0-130 degrees. He had a 2A Lachman (increased laxity with a good endpoint) and a positive pivot shift. Posterior drawer was negative, and he was stable to varus and valgus stress at 0 and 30 degrees of flexion. In the prone position, the dial test was normal with no excess external rotation at 30 or 90 degrees of flexion. Radiographs (Figure 1) demonstrated vertical graft positioning that was more anterior on the femur and posterior on the tibia. MRI of the right knee (Figure 2) demonstrated an intact ACL graft.

We offered the patient the options of a complete ACL graft revision versus revision with posterolateral bundle augmentation. The patient requested to proceed with augmentation. Right knee arthroscopy confirmed an intact ACL graft that was vertical and allowed increased translation. A semitendinosus autograft was then harvested, leaving the gracilis intact. The graft was sized at 6mm. Drill holes were placed in the femur and tibia independent of one another. The hamstring graft was then passed posterior to the BTB graft and secured on the femoral side using an Endobutton®. The graft was then fixed in 15 degrees of flexion on the tibial side using a BioSure® screw.

The patient had an uneventful postoperative course. At subsequent visits he had regained full range of motion, strength, and denied any feelings of instability. He had resumed an active lifestyle including return to skiing. At his most recent visit, he was more than two years out from surgery. He had no knee effusion. At this time, he had a normal hop test compared to the contralateral side and Lachman symmetrical to the other side. There was no pivot shift and quadriceps strength and circumference was equal to the other side. Radiographs (Figure 3) and repeat MRI (Figure 4) are shown. MRI demonstrates an intact posterolateral bundle augmentation with some scar tissue formation.

Figure 1: AP and lateral radiographs of right knee demonstrating previous autograft bone-patellar tendon-bone (BTB) ACL reconstruction with vertical graft placement.

Figure 3: AP and lateral radiographs of right knee showing ACL revision with posterolateral bundle augmentation.

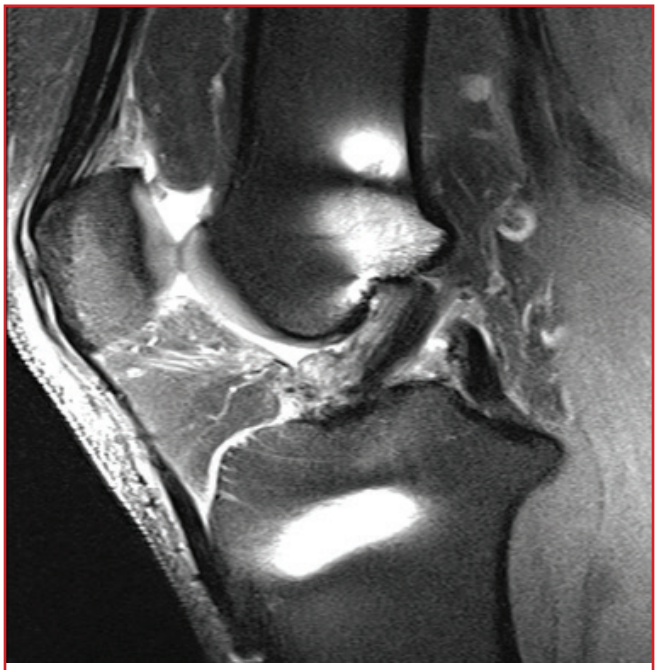

Figure 2.: Right knee MRI showing intact ACL BTB graft.

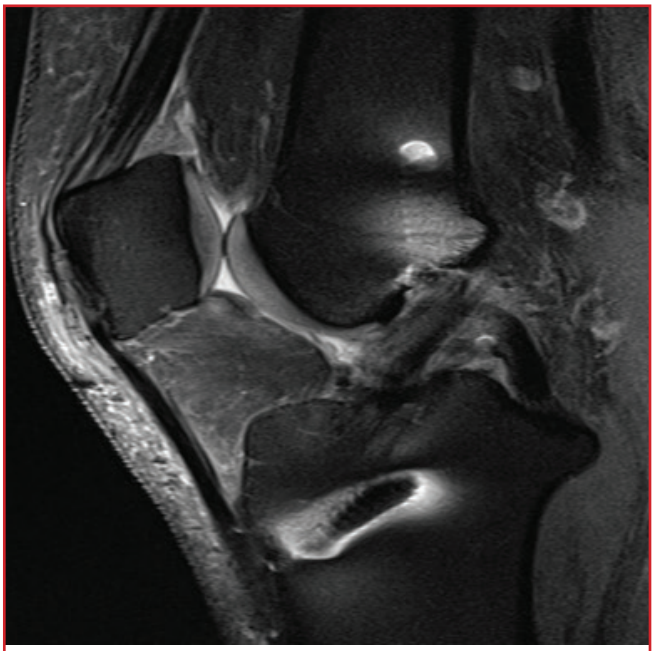

Figure 4: Right knee MRI showing intact PL bundle augmentation at 2 years postop.

Discussion

Traditional single-bundle anterior cruciate ligament reconstruction has been shown to achieve good to excellent results in about 60% of patients.[6] Fu, et al., have done extensive studies on the concept of anatomic double-bundle anterior cruciate ligament reconstruction.[7] The anteromedial bundle (AM) is the main contributor to anterior-posterior stability, while the posterolateral bundle (PL) mainly controls rotational stability, especially in deep knee flexion.

In rare instances, partial ligamentous disruption of one anterior cruciate ligament bundle in the native ligament may occur. Clinical exam may show a low grade pivot shift or glide but few other findings. A high index of suspicion

is necessary as oftentimes the diagnosis can only be made arthroscopically. MRI is accurate for differentiating the normal from the abnormal ACL. However, it is less reliable in diagnosing partial ACL tears.[8] Ochi, et al., describe a cohort of 45 patients over a ten-year period with partial ACL tears who were treated with either anteromedial or posterolateral bundle augmentation.[9] At a minimum 2-year follow-up, patients showed improved joint stability with a KT-1000 mean side-to-side difference of 0.5 ± 2.7 mm (preoperatively 3.3 ± 2.4 mm). The median Lysholm knee score significantly improved from 74 (range, 44 to 95) to 100 points (range, 81 to 100) after surgery. Abat, et al., reported on a series of 147 consecutive ACL reconstructions.[10] Twenty-eight patients (19%) had partial ACL tears. The minimum follow-up period was 30 months. Eighteen had anteromedial bundle augmentation and 10 had posterolateral bundle augmentation. Only 19% of their MRI's were categorized as partial ACL tears. The Lysholm score improved from 65.5 to 95.2 in the PL bundle augmentation group. The same or no more than one level lower Tegner score was restored. The pivot-shift, Lachman and anterior-drawer tests were negative in all cases.

More commonly, a patient will present after an ACL reconstruction with persistent instability, a Grade 1A or 2A Lachman, and a pivot glide or pivot shift. For this type of patient, a posterolateral bundle augmentation can be performed. Shen, et al., reported on nine posterolateral bundle augmentations performed for revision ACL surgery at their institution over a five-year period. Eight of the nine patients had normal results on both the Lachman and pivot shift tests. The mean KT-1000 side-to-side difference was 0.37 mm. Range-of-motion measurement showed an average side-to-side difference of 0° with the knee in extension and 0.75° with the knee in flexion. The mean score on the IKDC subjective knee form was 95.4.[11]

Our case illustrates a solution for one of the most common causes of failure of ACL reconstruction–malposition of bone tunnels. This technical error results in a vertical graft that can cause knee rotational instability due to failure to recreate the posterolateral bundle of the ACL. By performing a PL bundle augmentation of an intact vertical graft, our patient was able to return to competitive sports without instability and have excellent function of his knee. This concept can also be applied to partial tears of the native ACL ligament.

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