

Tibial Tubercle Fracture After Bone–Patellar Tendon–Bone Autograft

Matthew J. Brown, MD, Leslie J. Bisson, MD, and Mark J. Anders, MD

Abstract

Fractures occurring with anterior cruciate ligament (ACL) reconstruction are rare and those that do occur take place on the patellar side of a bone–patellar tendon–bone (BPTB) autograft. Here we discuss a far more infrequent occurrence, fracture of the tibial tubercle aspect of the BPTB autograft. This fracture type occurs even more infrequently than tibial plateau fractures after ACL reconstruction based on the published literature. In this article we discuss the third published episode of a tibial tubercle fracture after BPTB allograft. We also discuss the fracture types seen with this method of ACL reconstruction and provide insights into prevention of this occurrence.

A fracture occurring after anterior cruciate ligament (ACL) reconstruction is rare, and rarer still when it involves the harvest site of a bone–patellar tendon–bone (BPTB) autograft. The vast majority of fractures described in the literature are patellar, with the weak point along the patellar bone cut. A number of fractures generally also occur through the bone tunnels in both hamstring and BPTB grafts. However, only 2 cases of tibial tubercle fracture after BPTB graft have been published, and we expound on them in this case report.^{1,2} The patient provided written informed consent for print and electronic publication of this case report.

Case Report

Eight years after undergoing successful left ACL reconstruction with ipsilateral BPTB graft, a 45-year-

old man developed a graft rupture and demonstrated recurrent instability. He requested revision reconstruction, again with a BPTB construct. In the operating room, he was prepared and draped in the usual sterile fashion, and left ACL reconstruction was performed with right-knee central-third BPTB graft.

During surgery, the left knee was arthroscopically examined, and residual ACL graft from the initial reconstruction was removed. Notchplasty was performed, and the residual femoral interference screw was removed from the 12:30 position. A transtibial approach was used, with a 10-mm reamer brought through the proximal tibia, the posterior tibial ACL footprint, and the 2:00 distal femoral position, with 30 mm of femoral condyle drilled, leaving 1 mm of posterior femoral cortex.

After the right leg was exsanguinated, a central-third patellar tendon graft was harvested through a longitudinal incision with a 22-mm × 10-mm patellar plug, a 10-mm patellar graft, and a 22-mm × 11-mm tibial plug. The graft was prepared, the left tibia was overreamed, and the graft was passed. The graft was fixed with a 7-mm × 23-mm biointerference screw in the femur, trialed,



Figure 1. (A) Anteroposterior and (B) lateral radiographs of the right knee after injury.

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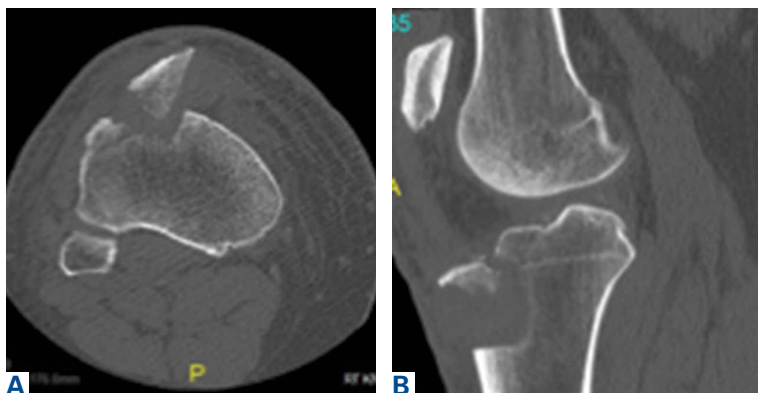


Figure 2. (A) Axial and (B) sagittal computed tomography scan of the right knee after injury.

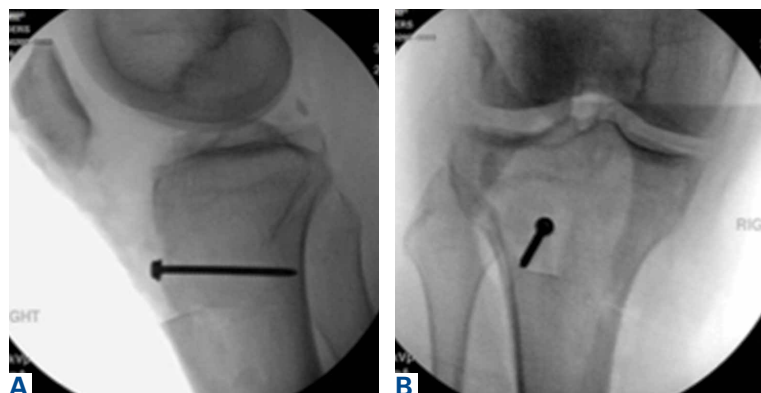


Figure 3. (A) Lateral and (B) anteroposterior radiographs of the right knee after operative fixation.

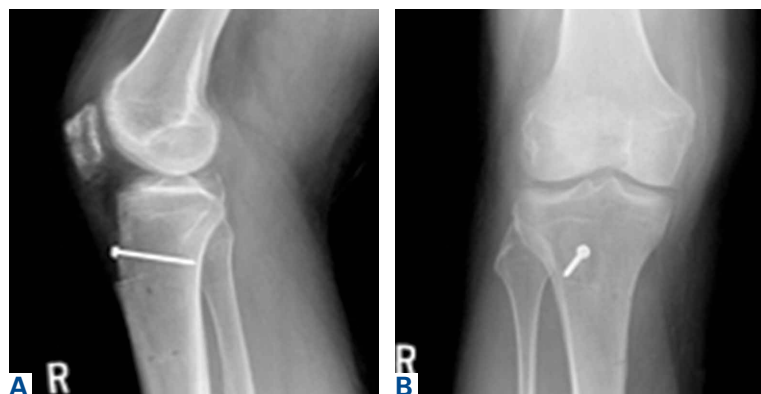


Figure 4. (A) Anteroposterior and (B) lateral radiographs of the right knee at 6-month follow-up.

and fixed with an 8-mm × 23-mm interference screw in the tibia. Excess bone graft was packed in the patellar defect in the right knee. The rent in the patellar tendon was closed. The rest of the incision was closed, and the patient was placed in an immobilizer and a cold therapy device (Polar Care; Breg, Inc).

At 2-week follow-up, the patient reported having slipped on ice and flexed the right knee, causing a pop, pain, and limitation in range of motion (ROM;

0°–70°). The left knee was doing well; straight-leg raise was possible, ROM ranged from 0° to 120°, and the Lachman test revealed a firm endpoint. Radiographs (**Figures 1A, 1B**) and computed tomography (**Figures 2A, 2B**) showed a right tibial tubercle avulsion fracture.

The patient returned to the operating room 5 days later and underwent open reduction and internal fixation (ORIF) of the tibial tubercle avulsion. After sterile preparation and draping, the previous incision was used. The bony fragment was isolated and the hematoma débrided. Repair was performed with two No. 2 running locked FiberWire sutures (Arthrex) placed through bony drill holes in the fragment (1 medial, 1 lateral). The fragment was reduced and the sutures tied, with further fixation provided with a DePuy Synthes small-fragment 3.5-mm cortical screw with washer. A No. 5 Ethibond suture (Ethicon) was then placed as a secondary cerclage figure-of-8 stitch to protect the repair. Postreduction radiographs were obtained (**Figures 3A, 3B**). The wound was closed in sequential fashion, and dressing was applied. A ROM brace locked in extension was then placed.

The patient was seen in follow-up 6 weeks after right ACL reconstruction and 4 weeks after left tibial tubercle ORIF. He continued with right knee restrictions, with the weight-bearing brace locked in extension. Left knee ROM was more than 0° to 90° even before any formal physical therapy. At this point, the patient began physical therapy on both knees with ROM limited to 0° to 30° and weight-bearing as tolerated on the right knee (no restrictions on the left knee). He progressed well, and, by 6 months after the right-knee ORIF, he was back to full ROM and full weight-bearing on both knees (**Figures 4A, 4B**).

Discussion

Cases of tibial tubercle fracture after BPTB autograft harvest are extremely rare in the published literature. PubMed and Cochrane Review searches revealed only 2—1 in the ipsilateral knee as ACL fixation¹ and 1 in the contralateral knee.² The middle third of the patellar tendon has been used for ACL reconstruction for more than 50 years, which supports the extreme rarity of this complication.³ Tibial tubercle fractures are so rare that they are not even mentioned in reviews of ACL complications.⁴ These fractures are universally treated with ORIF.^{1,2}

Far more common but still rare, fracture-type complications involve the extensor mechanism and the tibial plateau. Patellar fractures have been doc-

umented as occurring in 0.2% to 2.3% of cases.⁵⁻⁷ One paper reported a fracture in 1.3% of cases at a mean of 57 days, with roughly half caused by trauma and the other half having atraumatic causes.⁸ Lee and colleagues⁹ found a 0.2% complication rate for all BPTB grafts in 1725 consecutive patients. Although some patients were treated nonoperatively, others underwent operative fixation. Time to clinical and radiographic healing was 7 and 10 weeks, respectively.

Tibial plateau fracture after BPTB harvest is a rare complication, with 11 cases reported in the literature.¹⁰ In 4 of those cases, the proposed mechanism of fracture was a stress riser resulting from the synergistic weakness of the tibial harvest site combined with the tibial tunnel reducing proximal tibial bone strength.¹¹⁻¹⁴ The mechanism of injury varied from traumatic to insufficiency fracture, with fixation varying with fracture displacement.

Tibial tubercle fracture after BPTB harvest is extremely rare, with the present case being only the third published in the literature. Like most reported post-ACL reconstruction extensor mechanism disruptions, our case resulted from a traumatic event at an interval after surgery. All other tibial tubercle fracture post-ACL reconstruction disruptions occurred within 2 weeks after surgery.^{1,2} Sudden tension on the extensor mechanism secondary to hyperflexion caused a fracture through a weakened tibial tubercle with avulsion of the remaining tendon in 2 of the 3 cases, with the third being a lower stress popping noise that occurred during a pivot to stand.¹

The residual defect after tibial bone block harvest could represent a weakening of the tubercle by loss of structural bone and by development of stress risers. The previous reports of tibial tubercle fracture after BPTB harvest documented a similar methodology: Use a bone saw and osteotomes to harvest a trapezoidal tibial bone plug 10 mm to 11 mm wide and 22 cm to 35 cm long. As previously documented, we suggest taking care with saw cuts and osteotomes so as not to weaken the proximal tibia or distal patella more than is necessary.^{1,2} Before surgery, patients should be warned about the possibility of extensor mechanism injuries with use of BPTB grafts.

Conclusion

Tibial tubercle fracture after BPTB harvest for ACL reconstruction is an extremely rare complication.

Treatment is ORIF of the tubercle fragment, with a delay in ACL rehabilitation in cases involving the ipsilateral knee.

Dr. Brown is an Orthopaedic Resident, and Dr. Bisson and Dr. Anders are Orthopaedic Attending Surgeons, Department of Orthopaedic Surgery, University at Buffalo, State University of New York, Buffalo, New York.

Address correspondence to: Matthew J. Brown, MD, Department of Orthopaedic Surgery, University at Buffalo, State University of New York, 462 Grider St, Buffalo, NY 14215 (tel, 314-541-4144; fax, 716-898-3323; email, mjb9rc@mail.missouri.edu).

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This paper will be judged for the Resident Writer's Award.