

Displaced Nonunion Patellar Fracture Following Use of a Patellar Tendon Autograft for ACL Reconstruction

Case Report

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INTRODUCTION

Although a variety of graft sources are available for anterior cruciate ligament (ACL) reconstructive surgery, the patellar tendon autograft remains the most commonly used autograft. A recognized but unusual complication of patellar tendon autograft includes patellar fracture, patellar tendon rupture, or both.⁶ This article reports a displaced nonunion patellar fracture following patellar tendon autograft reconstructive surgery.

CASE REPORT

A 22-year-old recreational athlete presented for a second opinion and transfer of care 3 years following an endoscopic ACL reconstruction using a mid-third patellar tendon autograft. She had sustained a workers' compensation related injury to her left knee while playing basketball at a sports camp in July 1998 and underwent ACL reconstruction in November 1998 with patellar tendon autograft. Review of the operative report indicated no intraoperative complications. A standard 10×25-mm bone patellar bone plug had been harvested, and bone reamings were used to primarily graft the defect.

During the rehabilitation process, the patient complained of persistent knee soreness, weakness, stiffness, and catching and clunking. Seven months postoperatively, radiographs (Figure 1) were demonstrated a three-part comminuted patellar fracture with an established nonunion. According to the patient, and corroborated by review her medical records, there was no specific macrotraumatic event.

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In November 2001, the patient presented to our office for a second opinion and transfer of care. She had persistent knee soreness, weakness, and stiffness as well as difficulties squatting, kneeling, and ascending and descending stairs. In addition, she was unable to return to sports. She also described a loud crepitation and a sense of locking in the peripatellar region.

Physical examination revealed symmetric range of motion with matched hyperextension and flexion (2/0/135). Her extensor mechanism was intact without evidence of a lag by straight leg raising and active quadriceps extension maneuvers. The Lachman test was normal with a firm endpoint. She had negative anterior drawer and pivot shift tests. Marked patellofemoral crepitation on active flexion and extension was observed. Although she demonstrated her extensor mechanism was intact without a lag, her muscle strength was graded as 4/5. She had a freely palpable mobile proximal component of her patella, and the patellar width was markedly widened by approximately 2 cm. No effusion was noted.

KT-1000 arthrometer measurements revealed the contralateral normal knee was 4, 5, and 7 mm at 15 and 20 lb, and maximum manual testing of the involved reconstructed knee was 8, 9, and 9.5 mm, consistent with a stable ACL graft.

Radiographs revealed a comminuted displaced patellar fracture (Figure 1) with an established nonunion. This was confirmed by magnetic resonance imaging (Figure 2).

In January 2002, the patient underwent surgery. An established nonunion was noted under direct vision (Figure 3) demonstrating gross motion of the multiple fragments. The fibrous tissue was excised between these three major fragments. The fracture interfaces were decorticated and burred, and then underwent operative fixation. The larger more proximal fragment was secured initially to the distal medial fragment using two cannulated 4-mm AO screws. This provided solid fixation as the bone quality was determined to be excellent. The distal inferolateral fragment

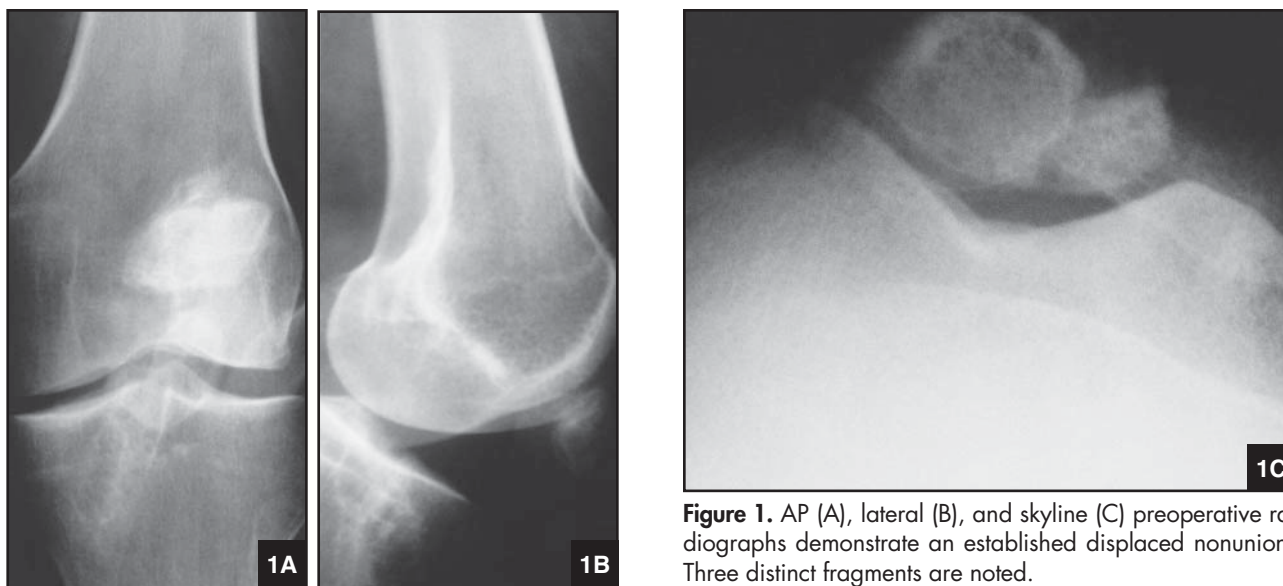


Figure 1. AP (A), lateral (B), and skyline (C) preoperative radiographs demonstrate an established displaced nonunion. Three distinct fragments are noted.

then was secured to the distal medial fragment with two additional transversely oriented 4-mm cancellous screws. An attempt to lag the proximal fragment to the inferomedial fragment in an oblique fashion proved unsuccessful; instead, additional fixation was achieved with a Kirschner wire. The knee was brought through a range of motion demonstrating excellent fixation and acceptable alignment, recognizing that perfect anatomical restoration was not possible 3 years after the initial surgery.

Postoperatively, the patient was maintained in a drop-lock postoperative brace. She was allowed to bear weight with the brace locked in extension. Immediate range of motion was allowed in the range of 0° to 30° for the first 2 weeks, 0° to 60° for weeks 3 to 4, and 0° to 90° for weeks 5 to 6. Quadriceps sets were allowed, but straight leg raising exercises were prohibited. She was seen at 2-week intervals with repeat radiographs, which demonstrated no interval change in hardware or fracture alignment. The patient could discern almost immediately a change in the character of her pain symptoms, with no clunking of the patella on range of motion. By 16 weeks postoperatively, the patient had achieved osseous union.

She was seen at regular intervals for the first year postoperatively. Thirteen months postoperatively, she reported no pain on ascending and descending stairs and did not have any stiffness with prolonged sitting. She noted the contour of her patella was smaller, but she reported no swelling or crepitation. She had no peripatellar complaints. Her physical examination revealed a normal ACL examination, symmetric motion (2/0/135), ¾-inch measured thigh girth atrophy, no patella femoral crepitation on active flexion and extension of the knee, no effusion, and an intact extensor mechanism without a lag on active straight leg raising and seated knee extension. Manual muscle strength grading was 5/5. Radiographs revealed no interval change in hardware position. The position of the fracture fragments was unchanged. There were no lucencies about the hardware to suggest frag-

ment micromotion. There was a persistent dorsal lucency along the cortex but osseous integration on the articular portion of the fracture (Figure 4).

DISCUSSION

Complications following ACL reconstruction using patellar tendon autograft include patellar fracture, patellar tendon rupture, quadriceps tendon rupture, patellar instability, patella baja, and anterior knee pain.⁶ The incidence of patella fracture using patellar tendon autograft is less than 1%.⁴ However, several authors believe this to be an under-reported complication.^{2,5,11} These fractures may occur intra- or postoperatively. An intraoperative patellar fracture usually is associated with excessive cutting depth or excessive force used to lever the bone plug from its osseous bed. The fracture pattern in this situation is generally sagittally oriented. Postoperative patellar fractures may be secondary to direct or indirect trauma. The time period when these fractures occur is variable.^{1,11} Direct blows generally result in stellate fractures while indirect trauma, such as a forceful quadriceps contraction, usually results in a transverse fracture. In more than 2000 patellar tendon autograft procedures performed by the senior author (B.R.B.) and one of his sports medicine associates, only one intraoperative sagittally oriented patellar fracture occurred, and no postoperative fractures were observed.

A literature review reveals Christen and Jakob⁵ reported seven fractures that were caused by direct trauma. Most of these fractures were longitudinal fractures occurring at the time of surgery. Five fractures, including two that involved patellar ligament rupture, were secondary to indirect forces. Three of these fractures occurred within 3 weeks postoperatively. Simonian et al¹² attributed two stellate fractures occurring at 3 and 5 weeks postoperatively to indirect forces.

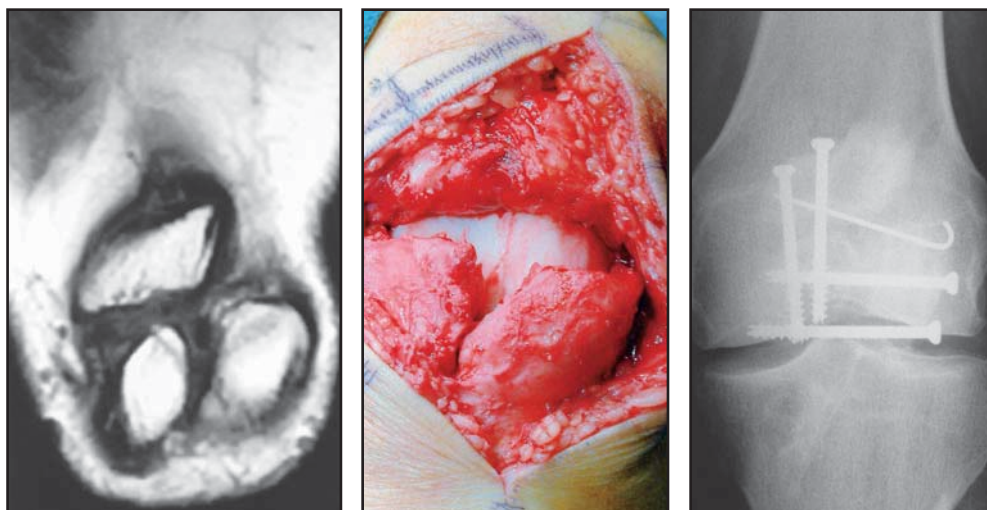


Figure 2. Coronal MRI further delineates the nonunion. **Figure 3.** Intraoperative photograph showing the nonunion. **Figure 4.** Postoperative radiograph obtained 13 months postoperatively demonstrates osseous healing on the articular side and a dorsal lucency. Comparison to interval radiographs revealed no changes in hardware position or lucencies suggestive of a “window wiper” effect.

Bonatus and Alexander² described the unusual complication of avulsion of the patellar fracture occurring with avulsion of a portion of the patellar tendon.

Ouweleen and McElroy¹⁰ described a fracture fragment consisting of the inferomedial quarter of the patella including the bone plug harvest trough that was associated with avulsion of the lateral third of the patellar tendon from the tibial tubercle. This fracture was repaired with the use of 4.5-mm cannulated screws and a tension-band wire. The avulsed patellar tendon was fixated into a bony trough with the use of two “super” Mitek anchors (Mitek Inc).

Miller et al⁹ reported a patellar fracture and patellar tendon rupture occurring 6 weeks postreconstruction. Bonomo et al³ described two fractures occurring after 24 weeks postoperative. The fracture pattern was an avulsion fracture of the inferior pole of the patella that occurred at 7.5 months postoperatively. McCarroll⁸ described a patellar displaced transverse fracture that occurred 6 months postoperatively and was related to a golf swing. Benson and Barnett¹ reported a nondisplaced transverse avulsion fracture of the superior pole of the patella occurring 1 year postoperatively.

The literature review did not yield any report of an established nonunion following graft harvesting. The authors believe once a fracture is recognized, definitive treatment is recommended if the fracture is displaced. If a patient has significant patellofemoral complaints or indirect patellar trauma, it may be advisable to obtain radiographs. The authors’ surgical technique protocol has included the use of a trapezoidal profile patellar graft to reduce the depth of bone harvest from the patella. Additionally, this defect is grafted with cancellous reamings obtained at the time of tibial tunnel reaming. Although no studies have reported bone grafting of the distal patellar defect clearly reduces the likelihood of a patellar fracture, intuitively, it makes sense that filling this defect with bone graft will be more protective of the patella. In addition, Gallaway and Karls-

son⁷ reported reduced incidence of patellar pain in patients who underwent grafting compared to those who did not undergo grafting for as long as 2 years postreconstruction.

Postoperatively, patellar fractures may occur at variable time periods. The authors’ protocol includes the use of a drop-lock postoperative motion brace to protect the donor site. This brace is used for the first 6 weeks postoperatively, allowing patients to bear weight in extension, with the brace removed for motion exercises.

The optimal surgical management of patients with established nonunion of the patella is unclear. One might argue patellectomy or partial patellectomy would have been preferable as a surgical option; this was considered preoperatively and was explained to the patient prior to surgery that this might be one of the surgical treatments performed. Second, one might be critical of the use of Alломatrix (Wright Medical Technology Inc) as a bone graft substitute rather than iliac crest bone graft. However, this patient was mildly obese, and the combination of fixation that was achieved and filling the interstices with the Alломatrix bone paste was preferable to accessing her iliac crest for autograft bone graft. An additional potential criticism of the surgical management in this case might be the lack of either the use of a cerclage wire or tension band. This was considered intraoperatively, but the fixation obtained with the cancellous screws provided excellent fixation intraoperatively and a cerclage wire was felt to be unnecessary. Finally, the long-term sequelae of this complication have not been determined.

This case consisted of a displaced nonunion of a patella fracture as a complication of patellar tendon autograft harvest for ACL reconstruction. Extensor mechanism disruption following patellar tendon autograft is a rare complication, but must be recognized and treated at the time of injury to optimize patient outcome. If patients experience significant patellofemoral pain or extensor mechanism

dysfunction following ACL reconstruction, it is advisable to obtain radiographs to rule out disruption to the extensor mechanism. However, if this complication is recognized as a late complication, good outcome and restoration of function can be obtained following surgical treatment.

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