Distal Rupture of the Infrapatellar Tendon After Use of Its Central Third for Anterior Cruciate Ligament Reconstruction

Case Report

Gregory T. Hardin, MD
Bernard R. Bach, Jr, MD

ABSTRACT: Extensor mechanism complications following use of the middle third patellar bone-tendon-bone autograft for ACL reconstruction are recognized but uncommon. A case report of a patellar tendon avulsion from the tibial tubercle is described, occurring 6 weeks postoperatively. The salient points regarding establishment of the diagnosis, operative treatment, and postoperative rehabilitation are discussed. Suggestions are made to minimize the chances of this complication.

Introduction

Previous reports of postoperative infrapatellar tendon rupture associated with its use in intra-articular anterior cruciate ligament (ACL) reconstruction have occurred proximally at its patellar origin.2,6 One case each of late patellar fracture and quadriceps tendon avulsion associated with cruciate surgery also have been reported.5,7 Recently, Bonatus and Alexander reported the complication of patellar fracture and distal patellar tendon avulsion following ACL reconstruction.3 This article reports the complication of distal rupture of the patellar tendon from the tibial tubercle after use of its central third to reconstruct the ACL.

Case Report

On January 5, 1991, a 42-year-old police officer underwent reconstructive surgery for a chronic symptomatic ACL-deficient knee. Examination under anesthesia yielded grade II Lachman, anterior drawer, and pivot shift test scores; there was no varus or valgus laxity, nor any posterolateral instability. A diagnostic arthroscopy and partial medial meniscectomy was performed. Standard principles of arthroscopic-assisted ACL reconstruction with patellar tendon substitution were employed including notch preparation, assessment of isometry, pretensioning the graft, and interference screw fixation of the graft.1

The patellar tendon measured 40 mm at its proximal insertion and 32 mm distally. The central third (11 mm) of the tendon was harvested along with 2.5-cm triangular-shaped bone plugs using an oscillating saw. The
Figure 1: T1-weighted sagittal MRI of the injured knee. The large effusion, soft tissue swelling, and increased signal at the distal patellar tendon insertion are indicative of total disruption.

Figure 2: Intraoperative photograph of the infrapatellar ruptured tendon. Note the increased width of remaining tendon, the extent of the disruption, and the retraction of tendon.

tendon defect was closed with interrupted no. 1 absorbable sutures. The knee was placed in a long leg brace with free knee motion. Complete knee extension, especially at night and while ambulating toe-touch weightbearing with crutches was encouraged during the first 4 postoperative weeks. Quadriceps and hamstring strengthening were begun immediately including 45° bent knee straight leg raises. Progressive active and assisted range-of-motion exercises, stationary bicycling, and electrical muscle stimulation were used.

Follow-up evaluation at 2 weeks showed -5° to 95° of motion, a benign wound, and a normal Lachman test. Standard AP and lateral radiographs obtained at the first postoperative visit were unremarkable. Formal physical therapy was initiated and crutch use was continued for 2 more weeks.

On February 5, 1991, the patient slipped on ice while on crutches, sustaining a hyperflexion injury resulting in acute onset of knee pain and swelling. The patient was seen in urgent evaluation on February 6, 1991 and demonstrated an inability to actively extend his knee or perform a bent knee leg raise. Local tenderness at the tibial tubercle and no palpable defect in the infrapatellar tendon were noted secondary to diffuse swelling. Comparison lateral knee radiographs demonstrated no difference in patellar height.

A presumptive clinical diagnosis of infrapatellar tendon rupture was made based on the local tenderness and inability to actively extend the knee, and a magnetic resonance imaging (MRI) scan was obtained. The scan demonstrated a large effusion, intact cruciate ligament reconstruction, soft tissue swelling, and high signal uptake at the distal patellar tendon insertion consistent with total disruption (Figure 1).

On February 12, 1991, the patient underwent operative repair. Examination under anesthesia revealed a stable knee with a negative Lachman score. A palpable defect in the infrapatellar tendon was noted distally near the tibial insertion. Intraoperatively, a 1½-in transverse defect with a ½-in retraction of the tendon was apparent at the tibial tubercle (Figure 2). It was interesting to note that the tendon width appeared to have hypertrophied distally measuring 30 mm. A double layer Bunnell suturing of the tendon ends was performed. The gracilis and semitendinosus tendons were harvested through the same incision using a tendon stripper (Concept Inc, Key Largo, Florida). Augmentation of the repair was performed via a double-loop of these tendons secured to the patella via drill holes over a screw and post distally (Figure 3). This was further reinforced with a figure-eight tension-band 18 ga wire loop. Intraoperative patellar height was confirmed via a lateral radiograph and compared with the opposite knee.

Postoperatively, the patient was placed in a continuous passive motion machine and a hinged knee brace allowing 0° to 30° of motion. He was allowed partial weightbearing in extension, was on crutches for 6 weeks, and wore the brace a total of 8 weeks. At 2 weeks postsurgery, radiographs were unchanged, motion was increased to 60° of total flexion, and quadriceps active and passive extension exercises were initiated. The patient continued strength and range-of-motion exercises, and on June 1, 1991 he underwent
Figure 3: Schematic diagram demonstrating the repair and augmentation of tendon rupture using looped semitendinosus gracilis tendons secured to the prior distal patellar defect and secured distally with an AO screw and spiked washer. The repair was augmented with a figure-eight tension-band loop to allow early range of motion.

By July 29, 1991 his range of motion was 3° to 111°. KT-1000 measurement showed a maximum manual difference of 1 mm, and the knee was stable during Lachman and pivot shift testing. The patient noted minimal pain at the extremes of motion, had no effusion, and was able to return to work August 5, 1991. At the time of this writing, the patient has returned to work, runs 2.5 miles daily, is painfree, and has a normal straight leg raise. At his most recent follow-up examination, his range of motion was 3° to 126°.

Discussion

Rupture of the remaining patellar tendon from the tibial insertion after use of its central third for cruciate reconstruction is a concern for surgeons performing patellar tendon reconstruction of the ACL-deficient knee. While we could not find any case reports in the English literature on this, there are several anecdotal reports of infrapatellar tendon rupture. Bonamo et al documented two cases of rupture of the tendon from the distal pole of the patella associated with open ACL reconstruction using the middle third quadriceps patellar ligament without a patellar bone plug. Each case involved significant trauma, was associated with 6 weeks of postoperative long-leg casting, and occurred more than 3 months after surgery. One had an avulsion fracture of the distal pole of the patella while the other had a transverse tear. Both were associated with complete healing of the central longitudinal defect in the patellar tendon. They felt that the ruptures may have been related to the interruption of the normal vasculature, focal necrosis from tight closure of the defect, or from loss of tensile strength secondary to reduction in tendon mass. Calcification was noted within the proximal substance of the patellar tendon within one patient, possibly the result of impaired blood supply. No prodromal symptoms involving the extensor mechanism were observed in these cases. Langman and Fontanetta reported a single case also associated with proximal rupture of the tendon after open ACL reconstruction. Interestingly, no known trauma was associated with their case and diagnosis was delayed. DeLee and Cravito
recently reported a case of quadriceps tendon disruption associated with a proximal pole patellar avulsion fracture.\(^5\) It occurred within 6 weeks of an ACL reconstruction and was due to a hyperflexion valgus injury while wearing a brace.

Possible etiologies leading to infrapatellar tendon rupture include medial or lateral undermining of the residual patellar tendon distally at its tubercle insertion. This could lead to weakness or necrosis at the insertion site. Additionally, trapezoidal or rectangular bone plugs rather than the usual triangular configuration will decrease the cross-sectional areas of bone remaining, thereby theoretically increasing the potential of devascularizing portions of the tendon or placing the insertion site at risk for an avulsion fracture (Figure 4). The osteoperiosteal flap medial to the tibial tubercle created for tibial tunnel preparation is also a possible site of iatrogenic injury if the medial portion of remaining infrapatellar tendon is inadvertently violated or undermined.

In general, we have attempted to maintain at least 20 mm of remaining patellar tendon width as recommended by F.R. Noyes, MD (personal communication). In situations where this could not be achieved, we have used the hamstring tendons instead of a patellar tendon graft. Recently, Cooper and coworkers have repeated Noyes' classic biomechanical tensile strength study on the middle one-third grafts from “younger” cadavers that demonstrated that a 10-mm graft failed at an average of 2977 N (±516 N) and that a 7-mm graft failed at 2238 N (±316 N).\(^4\) A trend of using smaller width grafts based on these observations may soon evolve.

Accelerated motion and early full weightbearing is a currently accepted principle of ACL surgery rehabilitation.\(^8\) During the first 6 weeks postsurgery, protection of the graft to allow boneplug consolidation and protection of the donor site to minimize patellar tendon rupture or fracture are critical. At the time of our patient’s injury, weightbearing was allowed as tolerated by the patient; subsequently, we have braced our patients in full extension while weightbearing during the first 6 weeks.

This case involved arthroscopic reconstruction without associated arthrotomy or disruption of the fat pad. The middle third of the tendon width was used, and defect closure was performed. We do not believe that defect closure played a role in rupture of the patellar tendon. No calcification of the distal tendon mass was noted on radiographs. Physical examination combined with an MRI scan helped confirm the diagnosis. Comparison lateral radiographs were of little help in postinjury assessment. Although our current ACL rehabilitation protocol includes the use of a brace, more strict enforcement in wear, especially in the early peri- and postoperative period and at times of inclement weather, would likely be beneficial.

We also feel that it is important to document and record the dimensions of the graft widths and the patellar tendon width proximally and distally at the time of surgery should this unfortunate but rare complication occur. Infrapatellar tendon rupture after use of its central third in cruciate ligament surgery is a rare event but we continue to include this as a part of our preoperative counseling with regard to risks and possible complications of the ACL surgery using patellar tendon autograft. In this instance, the surgical technique described allowed us to continue a rehabilitation program for the ACL reconstructed knee that provided the patient with an excellent short-term result.

References