Intrasubstance Stretch Tear of a Preadolescent Patellar Tendon With Reconstruction Using Autogenous Hamstrings

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Patellar tendon ruptures have been reported after steroid use,[3] trauma,[7,10,14] and central-third patellar tendon removal for anterior cruciate ligament (ACL) reconstruction[12]; in patients with collagen-vascular disease[4]; and spontaneously.[18] However, ruptures of the patellar tendon are uncommon in patients with open physes. We report the case and treatment of a preadolescent female patient who had a traumatic intrasubstance stretch tear of the patellar tendon. To our knowledge, this is the first such report of this type of injury.

CASE REPORT

In November 1997, a 12-year-old Tanner stage I white girl was chasing her dog in the backyard when she tripped and her flexed left knee landed on cement blocks. She noted immediately that she could not ambulate because of lower extremity weakness. Before the injury, the patient was a high-level youth soccer player with no history of injury to her left knee. She also had no family history of connective tissue diseases or history of ciprofloxacin use.

Physical examination of her left knee revealed that the patella was high-riding and could be superiorly translated approximately 4 to 5 cm, consistent with a distal extensor mechanism injury. The rest of her knee examination was normal, with a negative Lachman test, posterior drawer test, and pivot shift test with no increased joint line opening to varus or valgus stress at 30°. Radiographs of her left knee revealed open physes with no evidence of any avulsion fractures of her extensor mechanism and were otherwise normal. The Insall-Salvati[9] and Blackburne-Peel[2] ratios were measured at 1.6 and 1.24, respectively, which indicated that patella alta was present.

An MRI of her left knee revealed an obliquely oriented mid- to distal intrasubstance stretch injury to her patellar tendon and significant patella alta (Figure 1). The distal half of the patellar tendon displayed an intrasubstance stretch injury with no evidence on MRI of a complete disruption.

At surgery, it was noted immediately that the peritenon layer anterior to the distal aspect of the patellar tendon had been torn and the patient had an intrasubstance stretch injury of the distal half of her patellar tendon (Figure 2). It was obliquely oriented with significant shredding of the tendon fibers but with no obvious complete tendon disruption. Proximally, the patellar tendon attachment to the patella was intact. The patellar tendon appeared to be approximately 1.5 times its normal length, consistent with the MRI findings. At that point, it was thought that a primary repair alone was not possible because of the significant tissue fraying and a patellar tendon reconstruction would be necessary.

A patellar tendon reconstruction with autogenous hamstring grafts circumferentially along the margins of the native patellar tendon with drill holes placed to avoid her open physes was believed to offer the best chances of success for early motion and a safe return to function in light of her young age. The gracilis and semitendinosus tendons were left intact on the tibia and harvested proximally with an open hamstring tendon stripper. The ends of each tendon were tubularized with No. 2 nonabsorbable sutures to facilitate

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Figure 1. Magnetic resonance imaging scans of the left knee demonstrating an intrasubstance stretch injury of the distal half patellar tendon (arrows) (sagittal view, left knee).

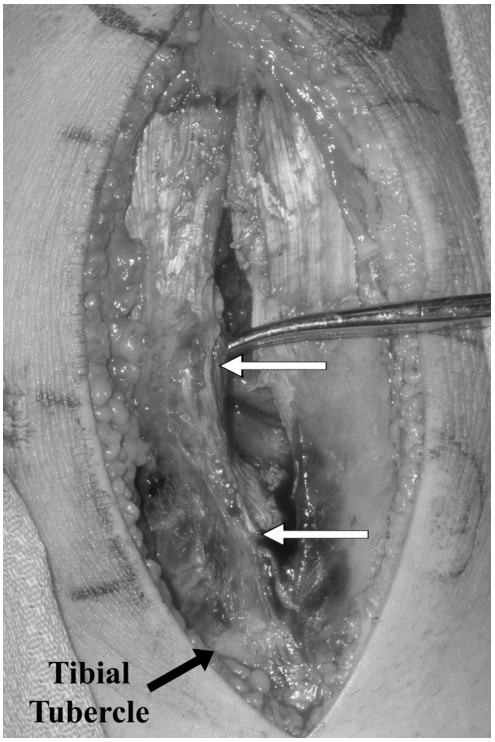

Figure 2. Photograph from surgery with incision through injured portion of patellar tendon demonstrating an intrasubstance stretch injury (between arrows) of the distal half of the patellar tendon.

graft passage. Transverse 4.5-mm holes were then drilled through the distal half of the patella and through the tibia, just distal to the open physes of the tibial tubercle, using fluoroscopic guidance. The gracilis was passed through the drill hole in the patella from medial to lateral. The semitendinosus, because of its more posterior and distal insertion on the tibia, was passed through the tibial drill hole from medial to lateral. These grafts were then tightened by proximal traction on the semitendinosus graft and distal traction on the gracilis graft until the distal pole of the patella was at the roof of the intercondylar notch and symmetric on fluoroscopic examination to her contralateral normal right knee patellar position, at the same degree of knee flexion, on the AP radiograph. The grafts were then sutured to each other using 0 Ethibond (Johnson & Johnson, Somerville, NJ) sutures with the gracilis graft lateral to the semitendinosus graft. The stretched portion of the patellar tendon was repaired primarily by overlapping the stretched fibers with 2-0 Vicryl sutures (Johnson & Johnson, Somerville, NJ). The hamstrings tendons, both medially and laterally, were then sutured to the native patellar tendon borders using Vicryl (Figure 3). At this point, the patella appeared to track normally and there was no increased medial or lateral patellar tracking at 45° of knee flexion. Knee flexion past 90° was noted to put obvious increased tension on the reconstructed patellar tendon, but it was believed this amount of tension was necessary to achieve the correct position of the patella.

After surgery, the patient's leg was placed in a continuous passive motion device for 4 hours daily with limits being set at 0° to 70° of knee flexion, and she was allowed partial weightbearing with the use of crutches and a knee immobilizer for 6 weeks. She was allowed to wean off crutches when she could walk without a limp. She was allowed to work on an exercise bike with low resistance at this point and was allowed to perform leg presses to a maximum of 70° of knee flexion, starting at one fourth body weight. She regained full motion by 3 months postoperatively and returned to playing soccer at 4 months after surgery.

A repeat MRI scan 63 months postoperatively, obtained for research purposes with all fees waived, revealed incorporation of the autogenous hamstring patellar tendon reconstruction, interval healing of her patellar tendon injury, and no evidence of any chondromalacia of her patellofemoral joint (Figure 4). The patient was seen back in clinic for a research-related follow-up 117 months after surgery. She was noted on examination of her left knee to have a range of motion of –4° to 140° (symmetric to her right knee), normal patellar tracking with no crepitation during translation of the patella in the trochlear groove, and no pain with deep squatting. Her thigh circumference 15 cm proximal to the joint line was 48 cm bilaterally. No significant leg-length discrepancy was noted, with a measured leg length from her anterior superior iliac spine to her medial malleolus of 86 and 85 cm in her left and right legs, respectively. Radiographs revealed no evidence of joint space narrowing, bony angulation, or osteophyte formation. Her Insall-Salvati[9] and Blackburne-Peel[2] ratios were 1.2 and 0.83 in the operative left knee, respectively. She has continued to function well through 9 years postoperatively with a Tegner score of 10, Lysholm score of 95, International Knee Documentation Committee (IKDC) subjective score of 97.7, and modified Cincinnati score of 96. She had an overall objective IKDC grade of A. Objectively, her single-legged hop was 96%, crossover triple hop was 95%, and single-legged timed hop was 96% of the contralateral side. In addition, isokinetic testing using a Biodex B-2000 Isokinetic Dynamometer

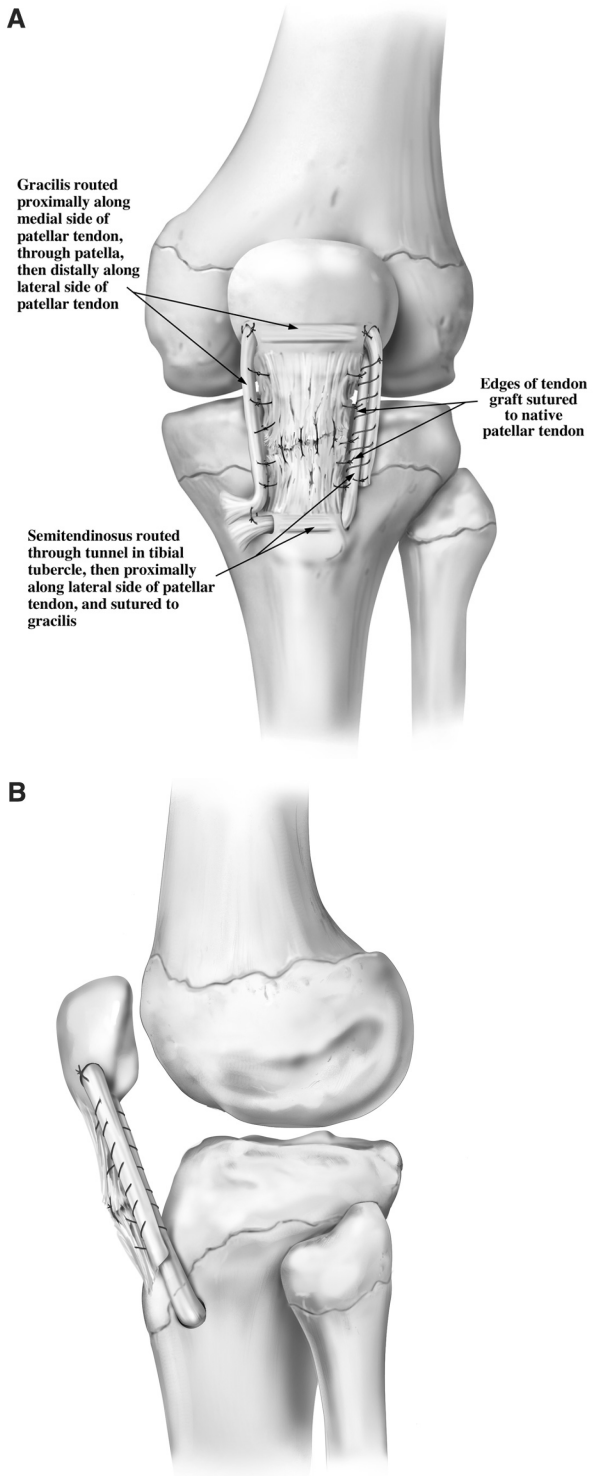

Figure 3. Operative technique for an autogenous hamstring graft to reconstruct the patellar tendon. A, AP view, left knee; B, lateral view, left knee.

(Biodex Medical Systems, Shirley, NY) revealed that at 120 deg/s, she generated 371 N and 397 N of quadriceps torque in her left and right legs, respectively. At 180 deg/s, she generated 305 N and 334 N of quadriceps torque in her

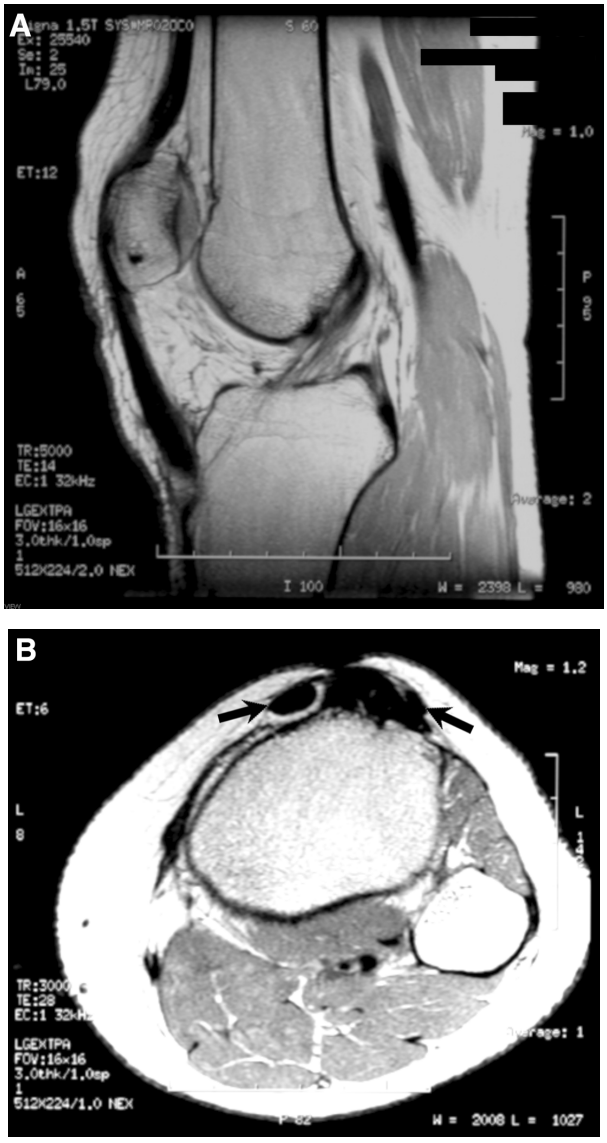

Figure 4. Follow-up MRI scan 63 months after patellar tendon reconstruction with autogenous hamstrings. The patellar tendon appeared to heal with incorporation of the hamstring reconstruction tissues: A, sagittal view; B, axial view, left knee. Arrows indicate the autogenous hamstrings grafts on the axial view.

left and right legs, respectively, and at 240 deg/s, she generated 275 N and 274 N of quadriceps torque in her left and right legs, respectively.

DISCUSSION

In children, traumatic patellar tendon ruptures usually occur distal to the tendon by an avulsion fracture of the tibial tuberosity[5,13,15,16] or proximally as a patellar sleeve fracture.[6,15] Untreated patella alta increases the risk of the patient developing patellofemoral osteoarthritis[1,8,11] and patellar dislocation.[11,17] To our knowledge, this case is the first reported case of a traumatic stretch injury to the patellar tendon. The patient had no history of steroid injections

or patellar tendinitis and she had no underlying systemic disease. Intrasubstance injuries of the patellar tendon should be considered as a possible cause of extensor mechanism malfunction.

In this patient, the primary treatment principle was to restore proper patellar height to allow for normal extensor mechanism function, to prevent the premature development of patellofemoral osteoarthritis, and to provide a strong patellar tendon reconstruction graft to allow for early knee motion. Because of this patient's severely limited function and activity level resulting from her profound extensor mechanism weakness, conservative treatment of this injury was not an option. In this case, reconstruction with autogenous gracilis and semitendinosus tendons was performed to achieve normal patellar height and extensor mechanism function.

Treatment of patients with open physes requires special consideration. The management of ACL injuries in skeletally immature patients is a controversial topic because of possible injury of the physes during reconstruction. However, this argument does not apply to this case, because the tibial tunnel does not traverse the physes as it does in an ACL reconstruction. Furthermore, because of the placement of the tunnels in this reconstruction technique, only physiologic forces are applied to the graft, and therefore we believe there is no additional traction force on the physis after this reconstruction. The use of this autogenous hamstring patellar tendon reconstruction technique avoided her open physis and resulted in normal knee function at 9 years of follow-up.

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