Bilateral Extensor Mechanism Allograft Reconstruction for Chronic Spontaneous Rupture

A Case Report and Review of the Literature

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Abstract

Case: A 51-year-old woman, affected by end-stage renal disease, presented with 16-month-old ruptures of the right patellar tendon and the left quadriceps tendon. Since she had been nonambulatory for more than a year, the authors decided to perform a bilateral one-staged reconstruction with an Achilles tendon allograft on the right side and a full extensor mechanism allograft on the left side, achieving excellent clinical and functional results at 57 months' follow-up.

Conclusions: Bilateral spontaneous rupture of the extensor mechanism of the knee is a rare but dramatic occurrence. Allograft can be considered as a treatment option in case of chronic lesion or delayed reconstruction, with satisfactory midterm outcomes.

Spontaneous rupture of the extensor mechanism of the knee is a rare occurrence, but it is associated with considerable patient morbidity. Systemic diseases, steroids treatment, and trauma are known to be risk factors. In the current literature, there have been only few reports on patellar and contralateral quadriceps tendon ruptures, which have always been treated with direct repair or autograft augmentation. We describe a case of chronic bilateral extensor mechanism disruption, successfully treated with bilateral single-staged allograft reconstruction. To our knowledge, this treatment has not been reported previously.

The patient was informed that data concerning the case would be submitted for publication, and she provided consent.

Case Report

A 51-year-old woman presented with chronic bilateral extensor mechanism disruption (Fig. 1). Sixteen months before presentation, she had an acute failure of the left knee,

Fig. 1

X-rays showing right patellar tendon and left quadriceps tendon ruptures.

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (http://links.lww.com/JBJSCC/A790).

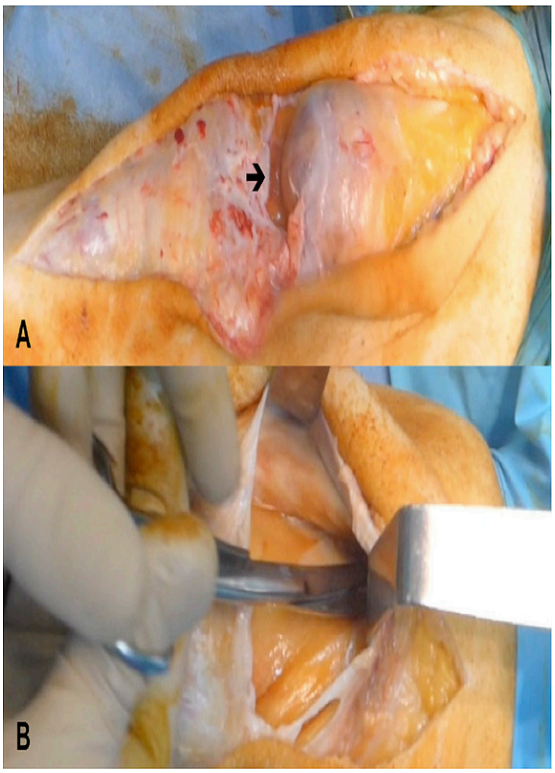

Fig. 2
Intraoperative findings: patellar tendon lesion on the right knee (**Fig. 2-A**) and quadriceps tendon lesion on the left knee (**Fig. 2-B**).

occurred while she was getting up from a chair, with sudden onset of pain. Nevertheless, she continued to walk with a cast until, 30 days after, she had an acute failure of the right knee while she was walking at home. From that moment, she was unable to walk and became wheelchair dependent. She was receiving hemodialysis due to an end-stage renal disease for 8 years. On clinical examination, the passive range of motion was 0° to 120°, but the patient was unable to perform complete active extension, with 90° of extensor lag bilaterally. Under direct palpation, there was an evident interruption in the continuity of both the extensor mechanisms, beneath the inferior pole of the patella on the right knee and at the distal third of the quadriceps tendon on the left. Both patellae did not move under the attempt of a quadriceps contracture. Preoperatively, knee score (KS) was 40 points and function score (FS) was 0 points bilaterally. The patient underwent bilateral sequential extensor mechanism reconstruction under the same anesthetics. Intraoperative findings included a full-thickness lesion on the patellar tendon for the right knee (Fig. 2-A) and on the quadriceps tendon for the left knee (Fig. 2-B). Both lesions were near patellar insertion. End-to-end repair of the tendons was not considered, due to the loss of substance (4 to 5 cm) and to the collagenous atrophy of the tendons' margins. A request to the bone bank for a pair of fresh frozen allografts was done 1 month before the planned procedure. As soon as the bank had the graft available, the case was immediately scheduled for the following 48 hours. The reconstruction on the left side has been executed according to the surgical steps described by Burnett et al.[1], using a full extensor mechanism allograft (EMA) consisting of the tibial tubercle, patellar tendon, patellar bone, and quadriceps tendon.

Through an anterior central approach, the patella was divided in 2 parts with a sawblade and removed from the tendinous portion. The tibial bone block of the graft was fixed with two 20-gauge cerclage wires and one 6.5 mm self-threading screw into a trough created in the proximal tibia; proximally, the graft was passed underneath the host quadriceps tendon portion and was secured to it. The overlapping host and graft tissues, respectively distally and proximally tightly tensioned in full extension, were then sutured with nonabsorbable sutures (Fig. 3). Tourniquet time was 65 minutes.

Then, the right knee was operated. The rupture was complete at the patellar tendon with loss of substance and atrophic margins. The patellar bone was intact. With this anatomy of the lesion, an Achilles tendon allograft (ATA) with a calcaneal block was our preferred choice. The calcaneus bone block was fixed in a trough in the proximal tibia with two 6.5 mm screws and one cerclage wire. The tendinous portion of the graft was split into 2 branches, one passed into a 9 mm tunnel drilled through the patella and the other branch was passed along the medial arthrotomy. Both branches were then retrieved out and up at the level of the host quadriceps

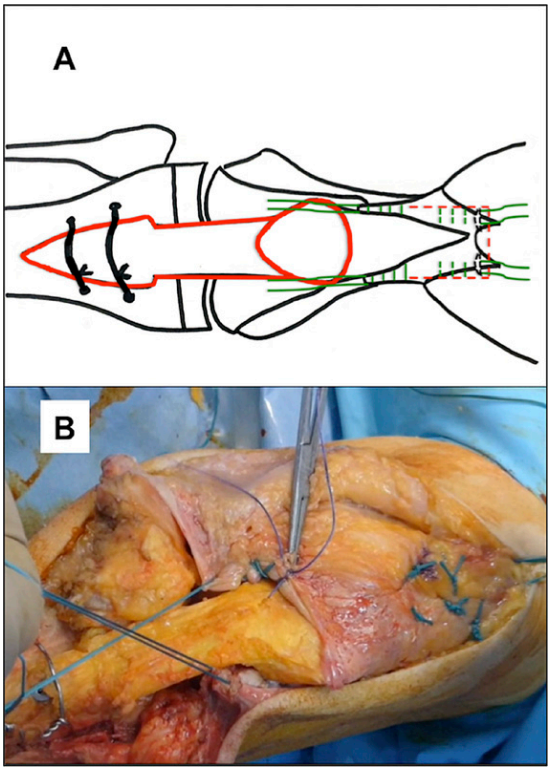

Fig. 3
Extensor mechanism allograft reconstruction: schematic illustration (**Fig. 3-A**) and intraoperative appearance (**Fig. 3-B**).

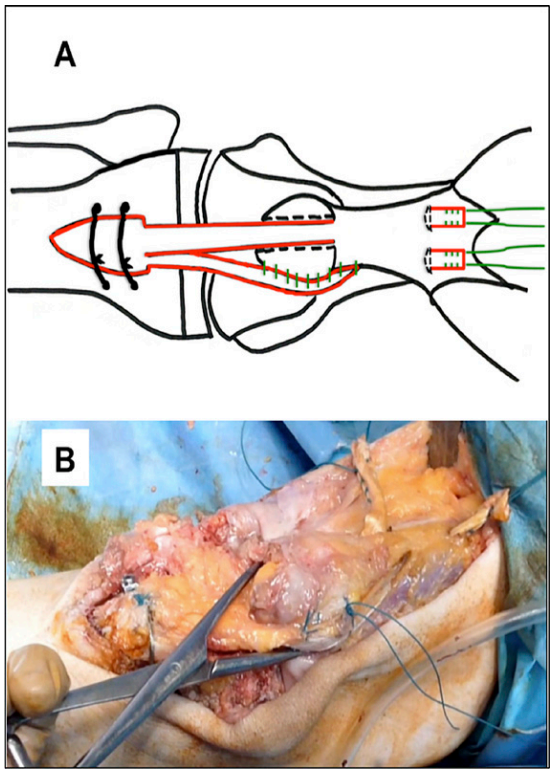

Fig. 4
Achilles tendon allograft reconstruction: schematic illustration (**Fig. 4-A**) and intraoperative appearance (**Fig. 4-B**).

tendon and were sutured together with nonabsorbable stitches (Fig. 4). Tourniquet time was 55 minutes. Total time of the surgery was 120 minutes. Postoperative X-rays are reported in Fig. 5.

For the first 6 postoperative weeks, both knees were immobilized in extension with 2 full limb cast. Protected weight-bearing with an axillary walker was allowed, and isometric quadriceps muscle activation was encouraged, but straight leg raising was prohibited. From the 7th week, full weight-bearing was allowed and assisted flexion was started up to 40° and improving by 10° to 15° on a weekly basis. Ninety degrees of passive flexion was reached by the end of the 12th week. Active knee flexion was started at the 8th postoperative week.

Ten months after surgery, the patient reported a skin ulcer on the right side, at the level of the tibial fixation. She underwent surgical removal of the cerclage wire, which allowed uneventful skin healing in 2 weeks. X-rays obtained after 39 months showed osseointegration of the bone blocks (Fig. 6). At the last follow-up (57 months), the patient was able to walk without any aids, to climb and descend stairs, and to ride the car. She reached 115° of flexion with no extensor lag (Fig. 7). The Knee Society Score was 92 points in KS and 80 points in FS. Magnetic resonance imaging at the final follow-up showed good signal of the tendons, bone integration at the tibial bone, and no signs of tissue inflammation and/or synovial reaction (Figs. 8 and 9).

Discussion

Bilateral disruptions of the extensor mechanism of the knee are rare, but they are associated with considerable patient morbidity. Systemic diseases[2-16], systemic steroids treatment[17], local steroid injections[18,19], and trauma or repeated microtrauma[16,20-24] are all predisposing factors. A number of cases have been reported on acute rupture of the quadriceps tendon and the contralateral patellar tendon treated with direct repair or autograft augmentation (Table I). This is the first report on bilateral single-staged allograft reconstruction of the extensor mechanism of the knee. The choice of this specific surgical technique was mainly related to the length of time between injury and surgery and on the quality and the amount of viable tissue. In acute lesions, remnant tissue is almost always sufficient to allow a direct suture. Further augmentation with a neighboring tendon may provide good tension, enabling early mechanical loading, with relatively low risk of suture failure or insufficiency due to tendon lengthening. Conversely, in chronic lesions, the quality of remnant tissue is poor, making primary repair less suitable. Augmentation with autogenous grafts could provide some reinforcement, but this is a suitable solution only in relatively young patients, with good tissue quality. In older

Fig. 5
Postoperative X-rays.

Fig. 6
X-rays at 39-month follow-up.

patients, with poor tissue quality, often worsened by systemic disease, the autograft solution may yield poor outcomes, with high incidence of residual extensor lag or reruptures.

In chronic renal disease, many factors can lower the quality of the tendon tissue[25,26]. Although the exact mechanism of injury is still unknown, secondary hyperparathyroidism due to repeated hemodialysis treatment is considered to play a major role in the pathogenesis of tendon rupture, because it induces subperiosteal bone resorption with weakness of bone–tendon junction. Uremia and amyloidosis are other 2 postulated risk factors for tendon rupture in chronic renal disease[19,25-28].

In case of chronic lesion of extensor mechanism with compromised autologous tissues, allograft reconstruction may represent the best solution[29]. Main advantages of allografts are the ability to provide a fibrous network that can be colonized by fibrous tissue from the host and their considerable mechanical strength, without adding donor site morbidity. Theoretical disadvantages are represented by immune reaction, disease

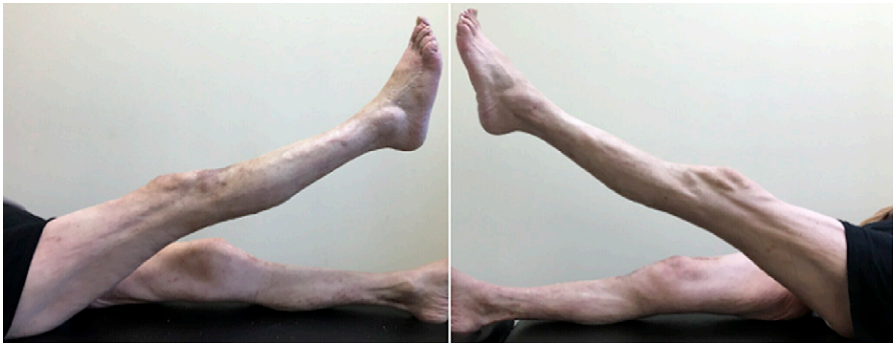

Fig. 7-A

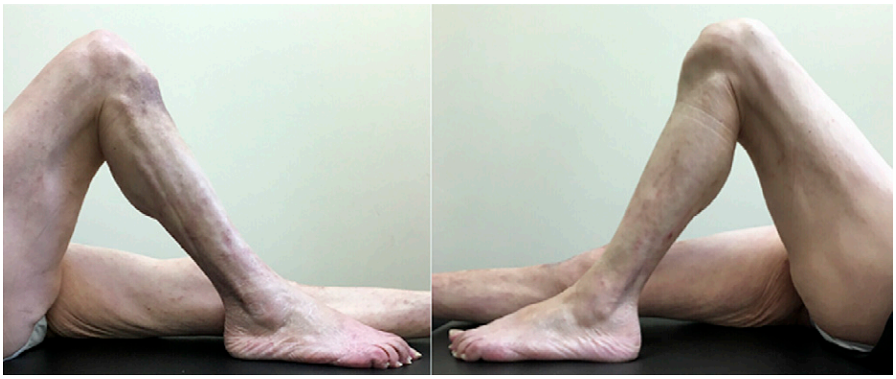

Fig. 7-B

Fig. 7 Full active extension with no extensor lag (**Fig. 7-A**) and full range of motion at 39-month follow-up (**Fig. 7-B**).

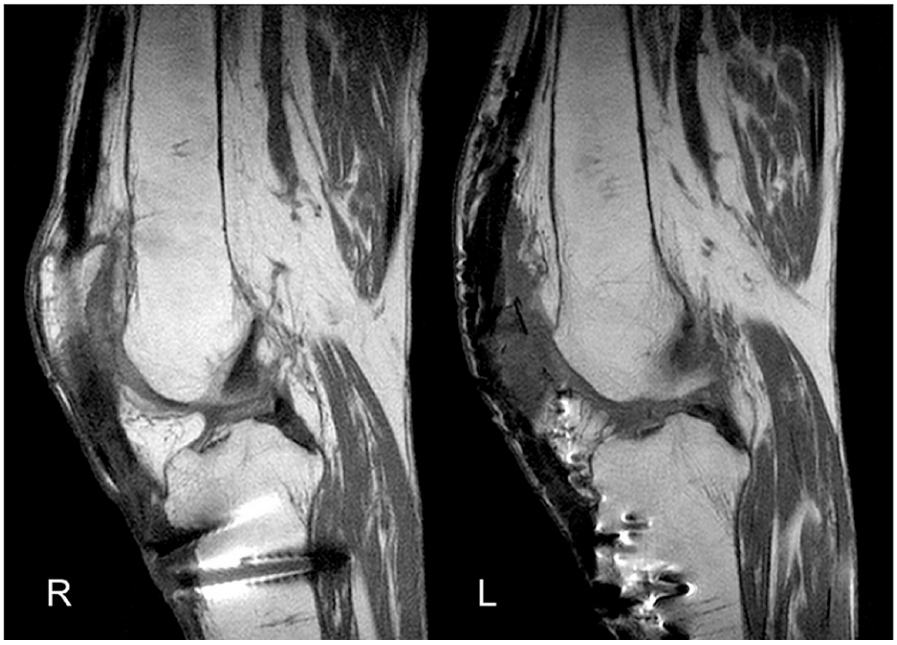

Fig. 8

Sagittal T1-weighted magnetic resonance imaging scan showing good signal of the tendinous portion and complete integration at the tibial level both for Achilles tendon allograft (right knee) and for extensor mechanism allograft (left knee).

transmission, and poor mechanical properties of the tissue, which are nowadays minimized by using fresh-frozen allograft[30].

The authors decided to perform a bilateral, single-staged procedure because the patient was bedridden for 1 year and she would not have had enough strength to sustain weight-bearing activities with the opposite nonoperated leg. Extensor mechanism repair procedures need a relatively long immobilization time in extension. Bilateral single-staged procedure has the advantage of a single immobilization period for the patient, and the same postoperative regimen for both limbs could be applied.

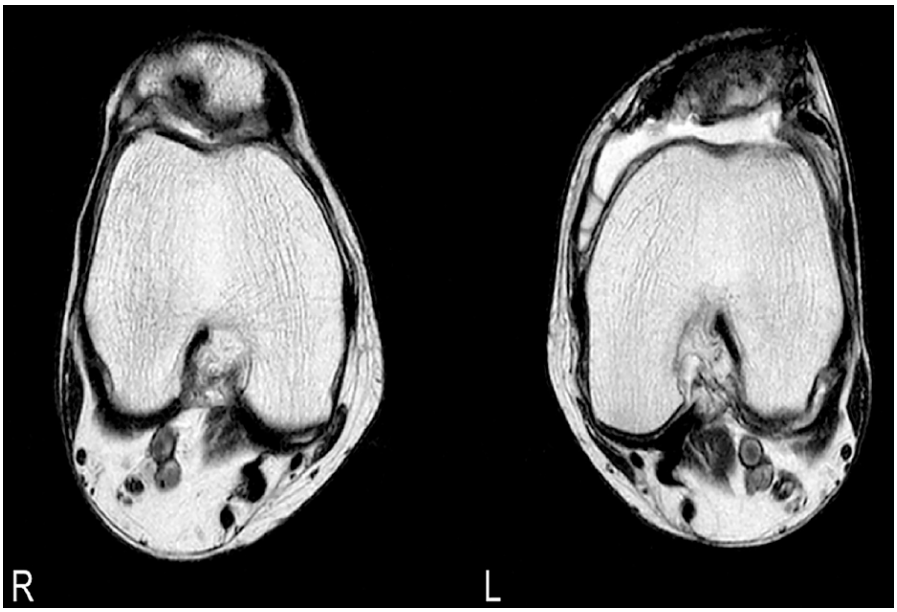

Fig. 9

Axial T1-weighted magnetic resonance imaging scan showing double bundle tendinous portion of the Achilles tendon allograft (one intraosseous branch in the patellar bone and one branch along the medial border of the patella) on the right knee, and 5° of medial tilt of the patella of the extensor mechanism allograft on a dysplastic trochlea on the left knee.

TABLE I Reported Literature on Simultaneous Spontaneous Rupture of the Patellar Tendon and the Contralateral Quadriceps Tendon

Authors	Year	Comorbidity	Age (yrs)/ Gender	Onset	Technique	Follow-up	Reported Outcomes
Karadimas et al.[31]	2011	Lupus	67/Male	Acute/spontaneous	Direct suture (+tension band for patellar tendon)	24 mo	ROM 0°-100°/0°-110° OKS 15
Kumar et al.[32]	2010	None (healthy individual)	48/Male	Acute/traumatic	Direct repair with Kessler suture	7 mo	ROM 0°-120°/0°-115°
Grecomoro et al.[33]	2008	Renal disease/tertiary hyperparathyroidism	48/Male	Acute	Direct repair with Krackow suture	7 mo	Excellent for pain; ROM 0°-110°
Chen et al.[34]	2006	Uremia/secondary hyperparathyroidism	30/Male	Acute/spontaneous	Direct repair	24 mo	ROM 0°-140°/0°-130°
Rysavy et al.[35]	2005	Chronic renal disease on hemodialysis/secondary hyperparathyroidism	46/Male	Acute/spontaneous	Pull-out sutures	4 mo	ROM 0°-120° bilaterally
Muratli et al.[23]	2005	Chronic renal failure on hemodialysis	21/Male	Acute/spontaneous	Anchors repair with Krackow suture (+cerclage wire)	18 mo	ROM 0°-120°
Munshi et al.[36]	1996	None (healthy athlete)	47/Male	Acute/traumatic (power lifting)	Direct repair	5 mo	Full ROM
Loehr et al.[22]	1983	Renal disease	27/Male	Chronic/spontaneous	Direct repair with Bunnell suture	6 mo	Full ROM and return to work

OKS = Oxford knee score, and ROM = range of motion.

Another unique feature of this report is that 2 different grafts have been used, according to specific choice criteria. In the authors' current practice, ATA is employed in case of a good patella status with no involvement of the quadriceps tendon. Conversely, a full EMA is preferred if the disruption involves the quadriceps tendon or if there is a severe damage or a comminution of the patella[29].

To the authors' knowledge, this is the first report describing a quadriceps tendon and contralateral patellar tendon reconstruction with allograft technique. In literature, there is paucity of data on reconstruction of chronic lesions. Overall results of case reports in acute lesions are good, but there may be a bias related to the quality of tendon tissue. In case of chronic lesion or delayed reconstruction, we suggest using allografts. The allograft type should be chosen taking into account the site of the lesion and the patellar bone conditions. When dealing with bilateral lesions, single-stage reconstruction could be a benefit for patient recovery, because both limbs undergo the same rehabilitation protocol. Weight-bearing activities would be difficult leaving one side nonoperated and still nonsupportive. Strict adherence to a postoperative management protocol, with cast immobilization in full extension for a 6- to 8-week long period, remains mandatory for tissue healing with no residual extensor lag. Results of this type of reconstruction are excellent and they do not deteriorate at the midterm follow-up. ■

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