

Simultaneous Bilateral Patellar Tendon Ruptures Treated with Primary Repair and Dermal Allograft Augmentation: A Case Report

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Learning Point of the Article:

This report adds to the body of literature describing simultaneous bilateral patellar tendon ruptures as well as a novel use for the ArthroFLEX Decellularized Dermal Allograft (Arthrex, Naples, FL).

Abstract

Introduction: Patellar tendon ruptures are a relatively common injury encountered by orthopedic surgeons and typically only occur unilaterally. However, there are rare reports of bilateral patellar tendon ruptures occurring simultaneously, in patients with underlying systemic disorders, higher energy mechanisms, or injury or overuse in high-level athletes. When patellar tendon ruptures occur, and the extensor mechanism is disrupted, patellar tendon repair versus reconstruction is warranted to restore functionality. The use of dermal allografts for the reconstruction of chronic patellar tendon ruptures is well described; however, there is not much literature describing their use in the acute setting. This report describes the primary repair of simultaneous bilateral patellar tendon rupture with the use of the ArthroFLEX Decellularized Dermal Allograft. This is a novel use for this allograft, as it is currently indicated for use in the treatment of various tendon repairs/reconstructions as well as hallux rigidus and hip capsule reconstruction. There are no reports describing the use of the ArthroFLEX Decellularized Dermal Allograft in the acute setting as augmentation of primary patellar tendon repair in a patient with simultaneous bilateral patellar tendon ruptures in the absence of underlying systemic disease; thus, this report presents a novel use for this dermal allograft.

Case Report: This patient is a 40-year-old African American male with no active underlying systemic diagnosis who sustained simultaneous bilateral patellar tendon ruptures from a low-energy mechanism. He subsequently underwent bilateral patellar tendon repair during which a dermal allograft augment was utilized to further strengthen this repair. In addition, a defunctioning purse string suture was used to further protect the patellar tendon repair by offloading the extensor mechanism.

Conclusion: This report adds to the body of literature surrounding the rare entity of simultaneous bilateral patellar tendon ruptures in otherwise healthy patients while also presenting a novel use for the ArthroFLEX Decellularized Dermal Allograft in the acute repair of a patellar tendon rupture. This report also supports the use of a defunctioning purse string suture to help offload the healing extensor and decrease the amount of tension across a healing tendon repair.

Keywords: Simultaneous bilateral patellar tendon ruptures, primary patellar tendon repair, dermal allograft augmentation, ArthroFLEX decellularized dermal allograft.

Introduction

Patellar tendon ruptures are a well-documented and studied orthopedic injury that occurs at a rate of about 1 per 100,000

people, most commonly occurring in African American males in the third to fourth decade of life [1-3]. This injury is typically seen unilaterally; however, in rare cases, can occur bilaterally simultaneously. There are currently about 50 reports of patients

Author's Photo Gallery



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Access this article online

Website:
www.jocr.co.in

DOI:
<https://doi.org/10.13107/jocr.2025.v15.i05.5548>

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Submitted: 03/02/2025; Review: 13/03/2025; Accepted: April 2025; Published: May 2025

DOI: <https://doi.org/10.13107/jocr.2025.v15.i05.5548>

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Figure 1: Preoperative lateral X-ray of the right knee showing patella alta and increased Insall-Salvati ratio.



Figure 2: Preoperative lateral X-ray of the left knee showing patella alta and increased Insall-Salvati ratio.

sustaining simultaneous bilateral patellar tendon ruptures. About half of these reports are of patients with an underlying systemic disorder (i.e., lupus erythematosus, chronic kidney disease, diabetes mellitus, hyperparathyroidism, rheumatoid arthritis, and osteogenesis imperfecta) and those requiring long-term oral steroid use for a variety of reasons [4]. For those patients with underlying systemic disease, tendon ruptures typically occur with lower energy mechanisms of injury (i.e., ground-level falls, running, or strong eccentric contractions of the quadriceps muscles). This injury is also described in younger, healthier patients without any underlying systemic disease, as a result of chronic patellar tendon steroid injections, chronic repetitive overuse, higher energy mechanisms (i.e., falls/ jumps from height or motor vehicle accidents) and recent antibiotic use (most commonly fluoroquinolones) [4].

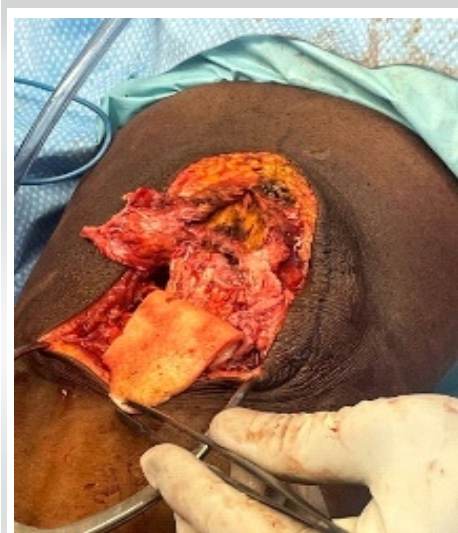


Figure 3: Intraoperative photo of the left knee showing the primary patellar tendon repair with dermal allograft augment sutured to the inferior portion of the tendon with #2 FiberWire.

Regardless of the underlying cause

of the injury, the overall health of the patient or the mechanism of injury, patients with a disrupted extensor mechanism require surgical intervention to restore functionality. There are numerous options for repair or reconstruction. Repair options include primary end-to-end repair in the acute setting, repair of the tendon back to the patella with bone tunnels or suture anchors in the case of an inferior pole avulsion or open reduction and internal fixation in the case of tibial tubercle avulsions. Reconstructive options include the use of autograft (hamstring, gracilis or quad tendon, or contralateral bone-patellar tendon-bone grafts) or allograft. The use of allograft in the repair or reconstruction of patellar tendon ruptures is well described, especially in the chronic rupture or revision setting [5-8]. The use of acellular dermal allografts has been shown to provide

increased mechanical strength to repair and can help induce healing by providing a scaffolding for new tissue formation and even lower re-rupture rates [9-12]. The use of dermal allografts has also been well described in the augmentation of rotator cuff repairs, distal biceps tendon repairs, Achilles tendon repairs, hip capsule reconstructions, and flexor tendon repairs [9-13].

There are numerous options for acellular dermal allografts, one of which is the ArthroFLEX Decellularized Dermal Allograft (Arthrex, Naples, FL), a cadaveric extracellular matrix that undergoes a rigorous decellularizing process to lower the risk of immunogenicity while retaining the collagen scaffold, elastin and biomechanical properties of human dermal tissue [14]. This dermal allograft graft is currently marketed for augmentation of rotator cuff repairs, extensor tendon repairs, hip capsule reconstructions, Achilles tendon repairs, distal biceps repairs and the treatment of hallux rigidus. There is only one report describing the use of the ArthroFLEX Decellularized Dermal Allograft in the augmentation of patellar tendon suture anchor repair in the revision setting after the failure of unilateral primary repair [15]. There are no reports of this graft being used in the acute repair setting as augmentation of a suture-based repair in an otherwise healthy patient who sustained simultaneous bilateral ruptures. To our knowledge, this is the first report of the ArthroFlex Decellularized Dermal Allograft being used in this manner.

Case Report

The patient in this report is a 40-year-old African American



Figure 4: Intraoperative photo of the left knee showing allograft augment sutured in place over the patellar tendon repair, using #2 FiberWire with tails of native patellar tendon superiorly.



Figure 5: Intraoperative photo of the left knee showing tails of native patellar tendon sewn over the medial and lateral aspects of the allograft augment using 2-0 FiberWire.

male with no active systemic disease. At the age of 25, he was found to have proteinuria, which led to a diagnosis of focal segmental glomerulosclerosis (FSGS) after a complete investigation. At that time, he was treated with ACE inhibitors and after about 2 years, his labs had normalized, and treatment

was discontinued by his nephrologist. He denies any further medical issues since that time and currently has no diagnosis of kidney disease, diabetes mellitus, or autoimmune disorders. He is a former college football player and states that over the last year or so, he has begun working out heavily again, running, lifting weights and cycling. He denies any history of chronic steroid use, recent antibiotic use, or antecedent knee pain prior to this injury. He presented to the emergency department of a level 1 trauma center for further evaluation of bilateral knee pain after falling backward with his knees in a

flexed position while wrestling at a charity event. He describes running at full speed and then planting his feet to jump when he experienced immediate bilateral knee pain, fell to the ground, and was unable to ambulate. The diagnosis of bilateral patellar tendon ruptures was made radiographically and clinically after imaging was obtained, and the patient was evaluated in the emergency department. AP and lateral radiographs of the bilateral knees demonstrate bilateral patella alta, according to the Insall-Salvati ratio (ISR) (1.77 on the right and 1.8 on the left), as shown in Figs. 1 and 2. On clinical examination, the patient was unable to perform a straight leg raise bilaterally, indicating disruption of the knee's extensor mechanism; he also had palpable defects in the anterior knee where the patellar tendon is typically present and a high riding patella bilaterally. With bilateral extensor mechanism injuries, the need for surgical intervention was explained to the patient, who agreed to this plan. He was placed in bilateral knee immobilizers and admitted to the hospital for surgical repair. Two days after admission, he was taken to the OR by the orthopedic surgery trauma team.

In the operating room, the patient was placed in the supine position with both legs prepped and draped simultaneously. The left leg was addressed first. A standard midline approach was utilized, beginning just distal to the tibial tubercle and extended proximally to about three fingerbreadths above the superior pole of the patella. The deep retinaculum and subcutaneous soft tissues were incised, and the tendon ends were exposed. There was a proximal $\frac{1}{3}$ mid-substance rupture



Figure 6: Intraoperative photo of the left knee showing allograft augment in place with 2-0 FiberWire purse string suture in place. Purse string suture was passed through a drill hole in the tibial tubercle, around either side of the patellar tendon and around the quadriceps tendon.



Figure 7: Postoperative lateral X-ray of the right knee showing restored patellar alignment.

Figure 8: Postoperative lateral X-ray of the left knee showing restored patellar alignment.

of the patellar tendon, leaving approximately one centimeter of poor-quality tendon off the inferior pole of the patella. The decision was made to advance the inferior portion of the patellar tendon, still attached to the tibial tubercle, up to the inferior pole. The proximal portion of the tendon was preserved as much as possible so it could be over-sewn on the repair. A footprint on the inferior pole of the patella was prepared to dock the tendon on bleeding cortical bone. A four-strand running Krackow stitch was then made and the tails were passed through three bone tunnels that were made using a Beath pin. The knee was then extended, and under minimal tension, the Krackow stitches were tied down over the bone tunnels at the superior aspect of the patella, docking the tendon nicely.

Due to the poor quality of tissue, noted at the time of surgery, an allograft was then used to augment this repair and help take tension of the docking site of the tendon on the inferior pole of the patella. A 3 mm dermal allograft (ArthroFLEX Decellularized Dermal Allograft, Arthrex, Naples, FL) was trimmed to fit the repair and oversewn onto the patellar tendon (Fig. 3). It was also docked to the anterior aspect of the patella with 1 knotless suture anchor. The edges of the graft were then secured to the patellar tendon with #2 FiberWire (Arthrex, Naples, FL) suture (Fig. 4). The remainder of the superior portion of the patellar tendon was sewn over the allograft (Fig. 5). The medial and lateral retinaculum were then repaired using 2-0 FiberWire (Arthrex, Naples, FL) and a defunctioning #5 FiberWire (Arthrex, Naples, FL) suture was placed in a purse string fashion around the patella and patellar tendon and then through a drill hole just distal to the tibial tubercle. The knee

was extended, and the defunctioning FiberWire was tied to help unload the tension from the healing tendon (Fig. 6).

The same approach described above was then used on the contralateral extremity. This was noted to be a much less severe injury and the remaining soft tissue and tendon were in better condition with less soft tissue loss. In a similar fashion to the left, a footprint on the inferior pole of the patella was prepared, and a 4 strand Krackow suture repair through three bone tunnels in the patella was performed. The tendon was noted to dock well into the prepared bony footprint. No allograft augmentation was utilized in this repair. The medial and lateral retinaculum were repaired, using a 2-0 FiberWire, and a defunctioning cable through a drill hole just inferior to the tibial tubercle was placed to offload the healing repair as described previously.

Both wounds were closed in a layered fashion with #1 Vicryl followed by 0 Vicryl to repair the deep fascia, 2-0 Vicryl to repair deep dermal layers, and staples to repair skin. The patient was then placed in a sterile compression absorbent dressing and bilateral knee immobilizers. He was made weight bearing as tolerated with the knee immobilizers in place. Postoperative imaging demonstrates improved and appropriate alignment of the bilateral patellas (Fig. 7 and 8). He recovered in the hospital as expected, began ambulating with physical therapy on postoperative day 1 and was discharged to acute rehab on postoperative day 5. Patient lives in a different state than the one where his surgery was performed and will follow-up with an orthopedic surgeon in his hometown.

Discussion

Simultaneous bilateral patellar tendon ruptures are a very rare injury that is usually the result of low-energy mechanism in a patient with an underlying systemic disease, overuse injury, or high-energy trauma. In this report, we presented a case of a 40-year-old African American male with no active underlying medical history who sustained bilateral patellar tendon ruptures from a low-energy mechanism. With approximately 50 simultaneous bilateral patellar tendon ruptures reported, this is a rare injury that appears to occur in a variety of patient populations. This report adds to the growing body of literature describing patients who sustain this injury from a low-energy mechanism of injury. After reviewing and discussing this case, we recommend the work-up for this injury include investigation of underlying systemic disease (i.e., kidney disease, autoimmune disorders, diabetes mellitus, etc.) if the patient does not already carry one of these diagnoses. Although this patient was lost to follow-up after discharge from the hospital as he lives out-of-state, and it was not thought to be further investigated at the time of injury, this injury could be a result of this patient's prior FSGS, or the result of an active underlying

disorder that has not been diagnosed. Further investigation during the patient's hospital stay could have helped further determine the cause of injury as this injury may be the first presenting symptom of an underlying systemic disorder.

This report also describes a novel use for the ArthroFLEX Decellularized Dermal Allograft. The use of acellular dermal allografts has been shown to provide increased mechanical strength to a tendon repair and can help induce healing by providing scaffolding for new tissue formation and the factors necessary for soft-tissue healing while lowering retear rates [9-13]. Given the poor quality of the patient's native patellar tendon after this injury and the amount of tendon loss that occurred to perform a primary repair, an allograft was deemed necessary to augment the repair. The way this patient's left patellar tendon was repaired and then reinforced using the ArthroFLEX Decellularized Dermal Allograft is similar to the technique described by Sutton and Shybut [15]. In their report, they describe performing unilateral patellar tendon repair in the setting of recurrent traumatic patellar tendon ruptures and failed repairs. Their report also describes using suture anchors to achieve tendon fixation followed by augmentation of the repair with the ArthroFLEX dermal allograft. Our report differs from the Sutton and Shybut report as we describe the use of the ArthroFLEX dermal allograft in the acute setting at the time of primary repair, with the use of bone tunnels instead of suture anchors, in an otherwise healthy patient with simultaneous bilateral patellar tendon ruptures. This report presents a novel use of the ArthroFLEX dermal allograft, as this graft is currently only used as an augmentation of rotator cuff repairs, distal biceps tendon repairs, Achilles tendon repairs, hip capsule reconstructions, and flexor tendon repairs [9-13]. These reports could potentially serve as a launching point for further investigation into the use of the decellularized dermal allograft as augmentation for this injury.

When using the ArthroFLEX dermal allograft as augmentation for primary patellar tendon repairs, the graft should cover the entirety of the tendon to best aid in healing. We also recommend preserving as much of the native patellar tendon as possible to incorporate into the repair and allograft augment as described in this report. We theorize that leaving native tendon in place provides additional strength to the repair and provides a natural scaffolding for new tissue to grow and healing to take place.

In our case presentation, we also describe the use of a defunctioning cable suture, or tension-sharing suture, that was passed around the entire patella and patellar tendon in a purse string fashion to help decrease the tension across the tendon repairs. This technique was shown by Otsubo, et al. to decrease

the amount of gap formation at the repair site and improve overall outcomes and range of motion in patients undergoing patellar tendon repair [5]. They endorse the use of load-sharing suture reinforcement, especially in cases of acute patellar tendon ruptures in patients with underlying systemic disease and poor soft tissues. Our report on this technique adds a very small body of literature surrounding the use of suture augmentation for patellar tendon repairs. When performing this technique, we recommend using a thicker, braided suture that can help take the tension off a healing patellar tendon without possible failure, which can lead to gapping and possible re-rupture. Passing the suture through a bone tunnel in the tibial tubercle also provides a strong anchor point to prevent pull-out, which is more likely to occur in tendon or muscle alone.

Conclusion

This report adds to the body of literature surrounding the rare entity of simultaneous bilateral patellar tendon ruptures. Although this patient did not carry any active diagnoses at the time of injury, we recommend further investigating possible systemic disorders if the patient sustained this injury from a low-energy mechanism and does not already carry an underlying diagnosis. In this report, we also presented a novel use for the ArthroFLEX Decellularized Dermal Allograft: augmentation of primary patellar repair in the acute setting while also using a defunctioning purse string suture to decrease the amount of tension across a healing tendon repair and decrease the gapping seen after healing.

Clinical Message

Simultaneous bilateral patellar tendon ruptures are a very rare injury, especially in patients without any significant underlying medical history. This report adds to the growing body of literature surrounding this injury. We also recommend patients be properly worked up for systemic diseases (i.e., kidney disease, autoimmune disorders, diabetes mellitus, rheumatoid arthritis, etc.) if they do not already carry one of these diagnoses. We also present a novel technique for addressing this injury surgically to hopefully lower retear rates, by using the ArthroFLEX Decellularized Dermal Allograft. The use of this graft has not been described before in the acute repair of a patellar tendon rupture, especially in a patient undergoing bilateral primary patellar tendon repairs. This report also supports the use of a defunctioning purse string suture after the repair is completed to take tension of the healing tendon and decrease tendon gapping at the repair site.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Conflict of Interest: Nil

Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this case report

How to Cite this Article

Small T, Reen M, Mahoney K, Siebuhr K. Simultaneous Bilateral Patellar Tendon Ruptures Treated with Primary Repair and Dermal Allograft Augmentation: A Case Report. *Journal of Orthopaedic Case Reports* 2025 May;15(5): 37-42.