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Early, Bilateral Re-Rupture of Quadriceps Tendon After Previous Bone-Anchor Repair for Simultaneous, Low-Energy, Bilateral Quadriceps Rupture: A Case Report and Literature Review

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Patient: Male, 42-year-old
Final Diagnosis: Bilateral quadriceps tendon re-rupture
Symptoms: Disability • pain
Medication: —
Clinical Procedure: —
Specialty: Orthopedics and Traumatology

Objective: Unusual clinical course

Background: Bilateral simultaneous quadriceps tendon rupture is a relatively rare injury, more commonly seen in patients older than 50 years and is usually associated with underlying metabolic or inflammatory diseases.

Case Report: We report the case of an otherwise healthy, 42-year-old man who sustained a bilateral, quadriceps tendon rupture while he was trying to pound a branch of an olive tree into the ground. On clinical examination, a defect in both proximal patella poles was found on palpation, with complete discontinuity of the extensor apparatus. A meticulous surgical repair was performed using 3 bone anchors with an uneventful postoperative rehabilitation. A biopsy specimen taken at surgery showed evidence of chronic inflammation. He had a second episode while walking fast on the beach 3.5 months postoperatively, and presented again with bilateral quadriceps rupture. He was successfully managed with bilateral allograft reconstructions, showing a very good outcome at 18 months of follow-up. Our systematic literature review covering a 20-year period (2000-2020) revealed 10 articles on bilateral quadriceps ruptures in 14 healthy patients without comorbidities. All these injuries occurred in males, with a mean age of 56.8 years, during walking, descending stairs, or participating in recreational sports; the functional outcome was good to excellent in most cases, without any reported re-ruptures. To the best of our knowledge, no similar case has been reported in the literature.

Conclusions: Bilateral quadriceps tendons rupture is a rare injury, especially in young patients without associated comorbidities. The risk of recurrence is low, but when it occurs, more complex techniques of reconstruction are needed.

Keywords: Allografts • Quadriceps Muscle • Reconstructive Surgical Procedures • Rupture • Wounds and Injuries

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/932723

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Background

Bilateral rupture of the quadriceps tendons is a very rare injury, more commonly seen in mild-aged men after a minor traumatic event in the presence of an underlying systematic condition such as chronic renal failure, diabetes mellitus, hyperparathyroidism, systemic lupus erythematosus, rheumatoid arthritis, gout, severe vitamin D deficiency, osteogenesis imperfecta, alkaptonuria, and amyloidosis [1-4]. Other predisposing factors include inherited conditions like sickle cell trait and collagen type V polymorphism, as well as obesity and the use of fluoroquinolones, corticosteroids, anabolic steroids, and simvastatin [4-7]. Surgical repair using holes drilled into the patella or bone anchors is usually successful, with a very low (2-6%) incidence of recurrence [8,9]. We report a case of an otherwise healthy, 42-year-old man, who sustained a low-energy, bilateral, quadriceps tendon rupture, complicated early with bilateral re-rupture during fast walking, that was successfully managed with allograft reconstructions.

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

Case report

A 42-year-old White man, without any medical illness, presented to our department with inability to walk and extend his knees after a simple fall while harvesting olives. He was 1.72 m tall and weighed 87 Kg. The injury had occurred 4 h earlier when he was trying to pound a branch of an olive tree into the ground. He felt a sharp pain in both knees and fell down, suddenly being unable to bear weight on his legs. He was physically fit and he had never received any medication or surgical treatment. On clinical examination, he had moderate swelling over both knees, tenderness at the suprapatellar region, and a complete inability to perform a straight leg raise on both sides. A defect in both proximal patella poles

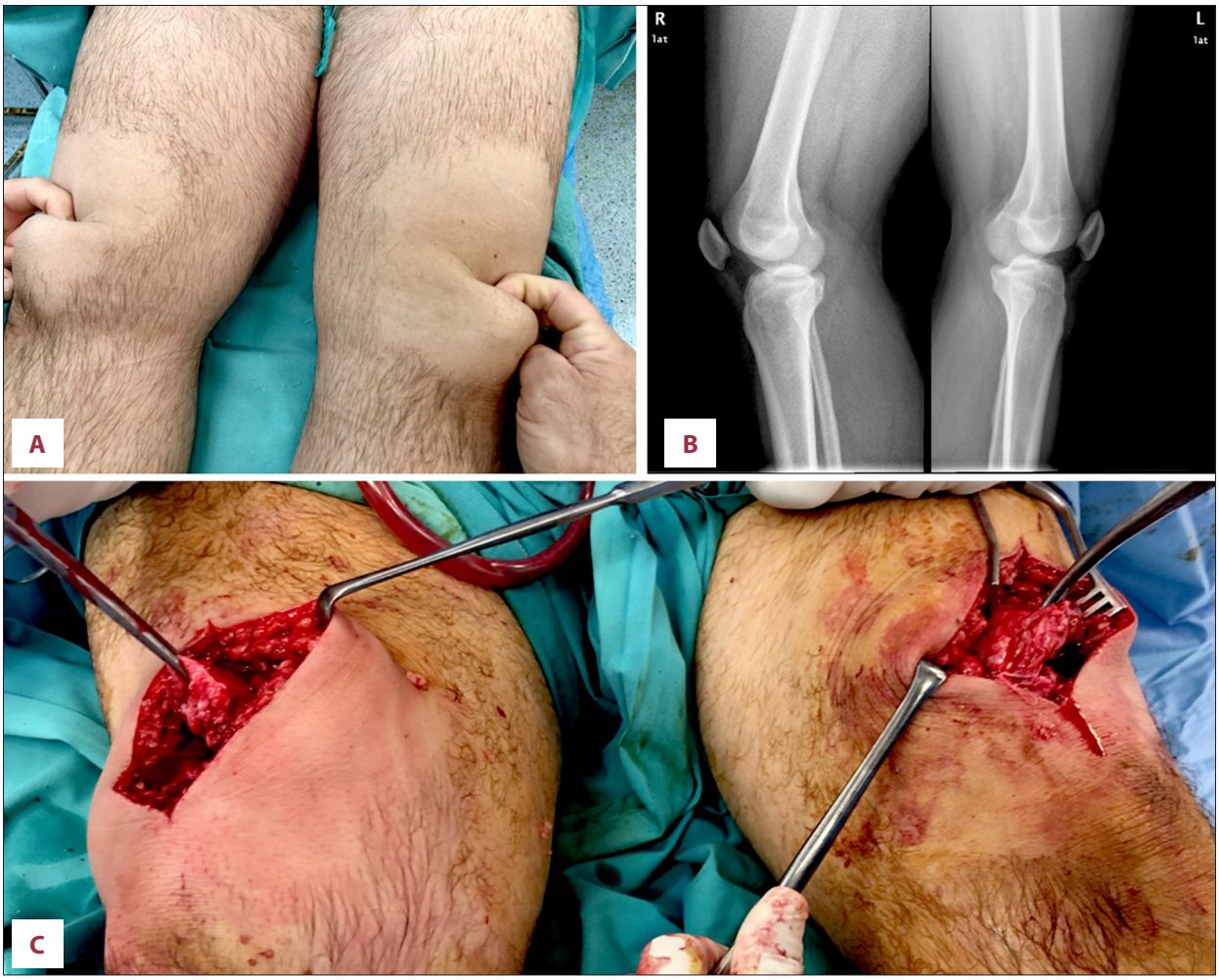

Figure 1. (**A**) Intraoperative clinical picture demonstrating bilateral suprapatellar gap due to complete disruption of quadriceps tendons at bone interface, (**B**) lateral radiographs showing patella baja, without evidence of tendinitis or spur formation, (**C**) intraoperative picture showing bilateral quadriceps rupture.

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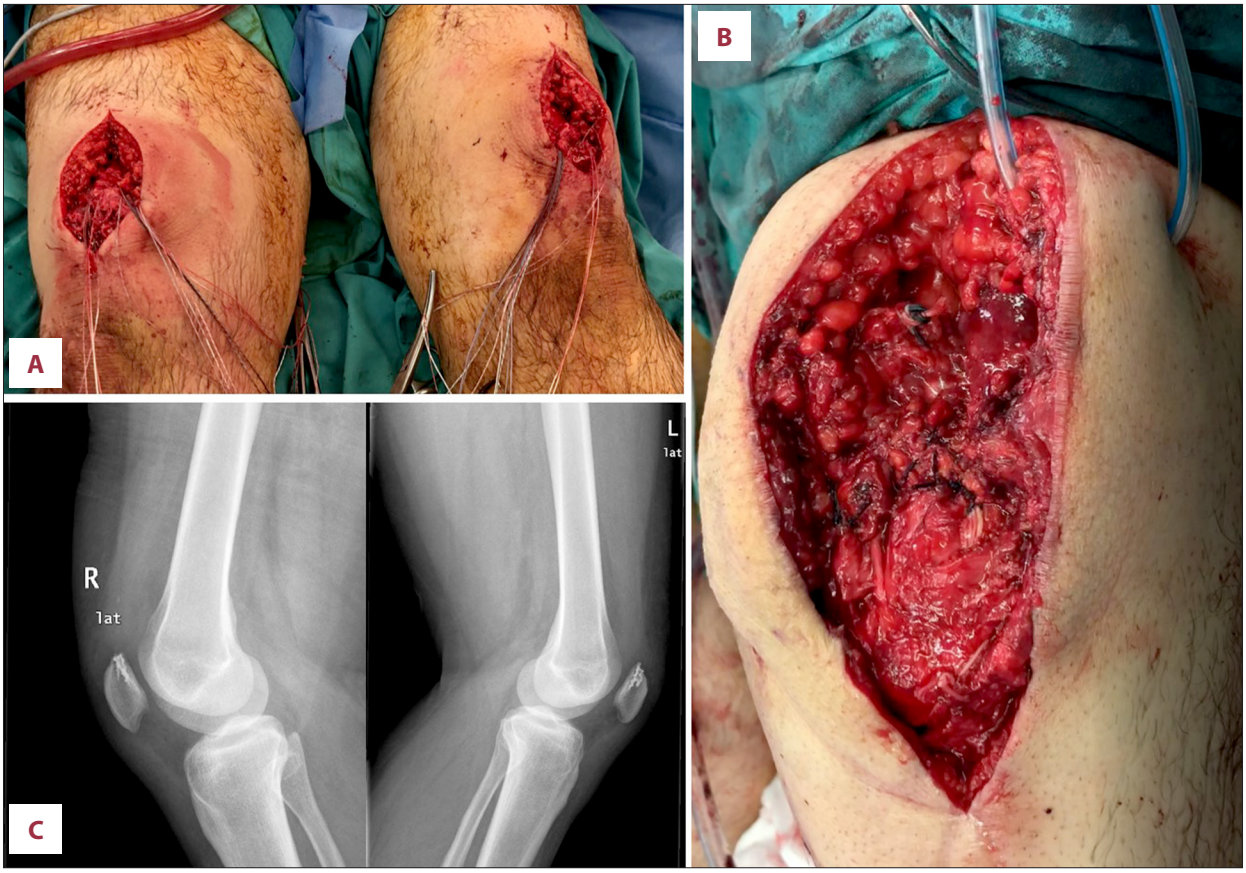

Figure 2. (**A, B**) Intraoperative picture showing the application of bone anchors in the upper pole of the patella in both knees and the final repair in the left side, (**C**) postoperative lateral radiographs showing the position of the anchors and the corrected patella height.

was found on palpation, with complete discontinuity of the extensor apparatus (**Figure 1A**). Plain lateral radiographs of both knees revealed patella baja (**Figure 1B**) without evidence of avulsion fractures or bony spurs. An ultrasound examination of both knees confirmed the clinical diagnosis, demonstrating complete rupture of both quadriceps and no evidence of severe degeneration. The patient was informed in detail and consented for surgical exploration and repair of both his tendons with bone anchors.

The patient was positioned supine with a high thigh tourniquet applied on both legs and received general anesthesia. After proper preparation and draping of both limbs, a second dose of cephalosporin was administered for infection prophylaxis, the limbs were exsanguinated, and the tourniquets were simultaneously inflated to 350 mmHg. Two surgical teams performed the operations, located on either side of the patient. A longitudinal midline incision was made over the anterior aspect of both knees, extending from the upper pole of the patella to 7 cm above its proximal pole. After hematoma drainage, the quadriceps tendons were found to be retracted, frayed, and completely torn at the patella bone–tendon interface (**Figure 1C**). Both tendons were firmly re-attached to the patella bone using 3 bone anchors, placed in the center (two 5.5-mm IntraLine, Stryker) and at either side of the patella (three 3.5-mm IntraLine, Stryker and 1 Mitec GII, Depuy-Synthes). One limb of each anchor was whipstitched to a total length of 5 cm within the corresponding side of the quadriceps tendon, while the other free limb was free to slide through the anchor, giving the appropriate tension during tendon approximation and knot tying (**Figure 2A**). Before closure, a tendon specimen was taken for histopathologic examination to investigate possible underlying pathologic conditions. The knees were checked to allow for at least 90 degrees of passive flexion, without any compromise of the repair (**Figure 2B**). Suction drainage was applied in both knees and was removed on the second postoperative day. Lateral postoperative radiographs showed proper patella position and height (**Figure 2C**). Postoperatively, the patient was immobilized with a brace and he was not allowed full weight bearing for a period of 8 weeks. After a 2-week period, he received passive knee joint movement at 0°-30°, increasing by 30° every second week. The passive flexion could reach 110° until the 8th week, and after that he started active flexion and was able to bear weight on

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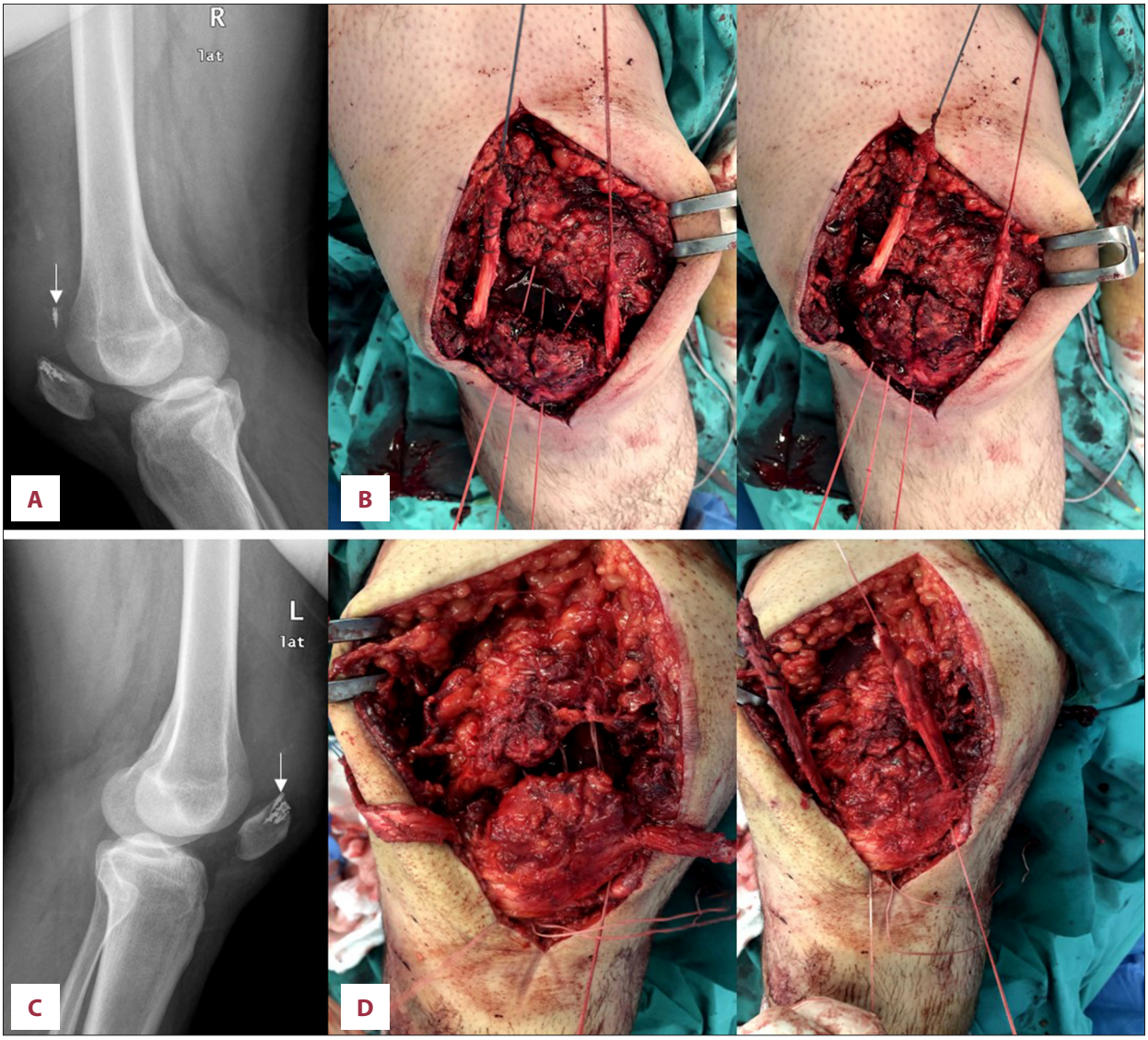

Figure 3. (**A, C**) Lateral radiographs at 3.5 months follow-up, after the new incidence of bilateral ruptures of quadriceps tendons, showing mild ossification, patella baja and pull-out of 1 of the anchors in both knees (arrows), (**B, D**) intraoperative pictures of both knees showing the transosseous drill holes in the patella; the quadriceps tendons were reapproximated while pulling the sutures, and each limb of the middle tunnel was firmly tied with the ipsilateral pair of the medial and lateral sides. The Achilles tendon allograft that had passed in the middle of the patella prior to drilling was then passed through quadriceps substance and was sutured to itself in 60 degrees of flexion.

his knees with crutches. The histopathological examination of both tendons showed an acute, non-specific, inflammatory response. Biochemical, rheumatological, and endocrine laboratory tests were also normal. At 3 months, he was back at his sedentary job and he had started to receive special rehabilitation to build strength.

Three and a half months later, he had a sudden fall while walking fast on the beach and sustained another bilateral rupture of his quadriceps tendons. The clinical presentation was similar to the first, with effusion, suprapatellar gap, and inability to walk or perform a straight leg raise. Radiological examination revealed decreased patella height, mild tendon ossification in both knees, and pull-out of one of the anchors in both knees (**Figure 3A, 3C**). After informed consent was obtained, the patient was transferred to the operating room for allograft tendon reconstruction. Again, 2 surgical teams performed the operations utilizing a split Achilles tendon allograft whipstitched at both ends, similar to the ACL graft preparation. The ACL guide wire (2.7 mm) and a cannulated ACL drill (7 mm diameter) were used for bone tunnel preparation at the midline of the patella; the allograft was then passed through

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Figure 4. (**A**) Final radiological evaluation at 18 months follow-up demonstrating good alignment and height of the patella; there was 1 pulled anchor in the tendon substance at the left side that was not visible to be removed at the revision surgery, (**B**) range of motion in both knees at 18 months follow-up.

the patella tunnel. After adequate debridement, we microfractured the patella and made 3 parallel bone tunnels (with the ACL guide) from the superior to the inferior pole. Three parallel interlocking fiberwire sutures were placed in the quadriceps tendon and their free ends were passed through the bone tunnels using the ACL guide wire. The quadriceps tendons were reapproximated while pulling the sutures, and each limb of the middle tunnel was firmly tied with the ipsilateral pair of the medial and lateral side (**Figure 3B, 3D**). The allograft was then passed through the quadriceps tendon and sutured to itself at 60 degrees of flexion; sided sutures were placed as well. The reconstruction was checked for uncompromising flexion up to 60-70 degrees. The patient was immobilized in bilateral long leg casts for 3 weeks, followed by hinged brace immobilization for another 8 weeks. His physiotherapy regimen was very slow, being able to perform active knee flexion at 10 weeks and full weight bearing at 3 months. At his last follow-up, 18 months postoperatively, he had a Lysholm knee score of 90 in both knees, a Tegner scale of 3, and he was able to perform light recreational activities. Both patellae had a good height in the lateral radiograph (**Figure 4**).

Discussion

Bilateral quadriceps tendon ruptures are relatively rare, with most of the patients having more than one of the aforementioned predisposing factors [2,4]. In a systematic review by

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Table 1. Literature review of bilateral quadriceps tendons ruptures without medical comorbidities or medication intake.

Author/year	Age/gender	Mechanism of injury	Operation	Biopsy	Immobilization	Follow-up/outcome
Shah & Jooma (2002) [10]	39/Male	Fell on to the basketball court with both knees flexed underneath his body	Transosseous drilling holes in the patella	–	6 weeks, cast immobilization	6 months, full extension, flexion up to 90 degrees, not able to play basketball again
Katz et al (2006) [11]	46/Male	He fell down while he was sprinting toward the net during tennis game	Transosseous drilling holes in the patella	–	6 weeks plaster in extension	8 years, full activity
Arumili et al. (2009) [12]	54/Male	Both knees were buckled after he got stuck in the mud, history of chronic tendinopathy	Tendon to bone repair (non-specified)	–	3 weeks splint in extension	3 years, excellent outcome, Lysholm score 99
Gaheer & Hawkins (2010) [13]	65/Male	While walking down stairs at home	Transosseous drilling holes in patella	–	6 weeks hinged brace	16 weeks, full ROM, back to his athletic activities (horse riding, golf, 2 miles walking)
Chiu & Forman (2010) [14]	43/Male	He has stubbed his right toe and fallen; while trying to catch his balance, felt the left side ruptured as well,	Transosseous drilling holes in patella	–	6 weeks hinged brace, locked in extension	10 weeks follow-up, back to his normal daily living activities
Ellanti et al (2012) [15]	67/Male	He struck his left knee against a wall	Transosseous sutures	–	6 weeks plaster cast	3 years, normal function
Chang et al (2015) [16]	Case 1: 58/Male Case 2: 44/Male Case 3: 68/Male Case 4: 48/Male	1: slip/fall off tractor 2: fall down stairs 3: fall down stairs 4: diving	Transosseous drilling holes in patella (Krackow repair)	–	6 weeks hinged brace locked in extension	1: 26 months, IKDC 34.4 (remained disabled) 2: 25 months, IKDC 91.6 3: 29 months, IKDC 89.7 4: 22 months, IKDC: 54
Moriya & Yoshihiro (2016) [17]	Case 1: 72/Male Case 2: 69/Male	Case 1: slipped off a step Case 2: fell down on a small hill Both cases were misdiagnosed initially	Transosseous drilling holes in patella	Case 1: Granulation formation	6 weeks plaster casts in both cases	Case 1: 26 months, Lysholm 97, Tegner 2, 120 flexion, full extension Case 2: 24 months follow-up. Lysholm 99, Tegner 2, 140 flexion, full extension
Pagliari et al (2019) [18]	62/Male	Fell down one step at home Bone spurs at upper patella poles	Transosseous drilling holes in patella (Krackow repair)	–	6 weeks, hinged brace	10 months, very good outcome
Onuoha et al (2020) [19]	60/Male	Fell down suddenly, without trauma	Transosseous drilling holes in patella (Krackow repair)	–	6 weeks	6 months, full ROM and straight leg raise

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Neubauer et al [3] in 2007, 105 cases were retrieved in a 50-year period (1949-2004); interestingly, 30% of these patients had a delayed diagnosis or no diagnosis at all. Camarda et al [9], in their systematic review of bilateral extensor mechanism ruptures (excluding single case reports), found that: a) spontaneous tears occur twice as frequently than with trauma, b) quadriceps ruptures were 5 times more common than patella tendon ruptures, and c) chronic renal disease is the most common comorbidity, followed by diabetes mellitus and obesity. Our systematic literature review (**Table 1**) within a 20-year-old-period (2000-2020) revealed a total of 244 articles on bilateral quadriceps ruptures (using the terms bilateral AND quadriceps AND rupture). We were able to identify 10 articles reporting on 14 healthy patients without comorbidities [10-19], including 1 case of chronic tendinitis and another with spurs in the lateral radiograph. All these injuries occurred in males, with a mean age of 56.8 years (range, 39-72 years), during walking, descending stairs, or participating in recreational sports. Repair of the tendons was made through transosseous drilling of holes in the patella, followed by immobilization in extension utilizing a cast, splint, or hinged brace for at least 6 weeks in all cases except 1. A biopsy specimen was obtained in only 1 case, which showed formation of granulated tissue without evidence of chronic tendinitis, as in our case. The functional outcome was good to excellent in most cases, without any reported re-ruptures. We found no cases of recurrent bilateral quadriceps ruptures in healthy patients in the literature, but Camarda et al [9] reported 2 such cases in patients with history of chronic renal disease. Our case is unique, not only because of the absence of an underlying disease, obesity or medications, but also due to the early bilateral and low-energy re-rupture that happened as soon as the patient returned to his daily living activities (3.5 months postoperatively). The reason for this failure may have been the use of bone anchors, but they have been proved equal to or superior to transosseous suturing in terms of pull-out strength in both cadaveric and clinical studies; they also allow less surgical time, smaller incision, absence of non-absorbable material at the apex of the patella, less incidence of patella fractures, and smaller dead-length of sutures, thus facilitating early rehabilitation [20-24]. In our patient, we used fully threaded titanium anchors (except for 1 Mitec GII), showing high pull-out strength and resistance to failure in various studies. Petri et al [20] performed a comparative study in 30 tenotomized cadaveric quadriceps tendons between titanium (TA) or peek (HA) anchors vs classic transosseous suture (TS) repair; both anchors demonstrated less gap formation during cyclic loading (20^{th}-250^{th} cycle: TA 1.9±0.1, HA 1.5±0.5, vs TS 33.3±1.9 mm, $P<0.05$) and resisted significantly higher ultimate failure loads (TA 740±204 N, HA 572±67 N) compared with transosseous sutures. TS 338±60 N, $P<0.05$). Sherman et al [21], in a similar cadaveric study, showed that suture anchor repair demonstrated a similar biomechanical profile regarding cyclic loading and ultimate load to failure when compared with the criterion standard of transosseous tunnel patellar tendon repair, with a trend toward less gapping in the suture anchor group. From the clinical point of view, Plesser et al [22] compared anchor fixation (9 patients, 2 bilateral) vs transosseous suture repair (7 patients, 1 bilateral) and showed good to excellent results independent of the surgical technique used and without any significant differences in overall patient outcomes. Similarly, Tucker and Jones [23] reported on 3 obese patients who sustained bilateral quadriceps tendon ruptures and found that the suture anchor-based construct allowed for a secure repair, early initiation of physical therapy, and a noted improvement in pain scores on the Visual Analog Scale. In contrast, Mehta et al [24], in a recent systematic review of clinical outcomes after repair of quadriceps ruptures using sutures or anchors, showed no significant differences in functional outcome between these techniques but a statistically significantly greater final ROM with suture repair. There was also a statistically significantly higher rate of postoperative complications using suture anchor technique, but not a significant difference in re-rupture rate. Other possible reasons for failure include the length of brace immobilization and restriction of full weight bearing (8 weeks) that is considering adequate in a healthy individual and comparable to similar reports and the presence of chronic inflammation in the biopsy specimens but nevertheless without any severe underlying disease in the connective tissue. Trobisch et al [25] reported that quadriceps tendon rupture, especially in younger patients, can occur in the absence of pathologic tendon degeneration. It is unclear if a primary tendon repair with transosseous sutures, knotless anchors with suture tapes, or an additional tendon reinforcement at the first operation would have prevented the recurrence in our patient.

Conclusions

Bilateral simultaneous rupture of quadriceps tendons is a rare injury, especially in patients without associated disease. Repair of the tendons using transosseous drills or bone anchors is usually successful, with a very low incidence of recurrence. When recurrence happens, more complex techniques of reconstruction are necessary.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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