

Case Report

Disruption of the quadriceps tendon in a healthy individual: a case report and literature review

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Abstract: Tendon ruptures, such as flexor tendon rupture and Achilles tendon rupture, are common and lead to pain, disorder, and lost productivity. However, quadriceps is one of the largest and most powerful muscles in the human body and has great influence on knee function and independent walking ability. The rupture of quadriceps tendon occurs rarely. Most patients with quadriceps tendon ruptures usually combine with systemic diseases. The present case was a 27-year-old male, a member of local police force, who presented with pain and inability to extend his right knee after missing his step in the daily training. His physical examination revealed the presence of a suprapatellar gap and disability of extending his right knee. The magnetic resonance imaging (MRI) also confirmed diagnosis of his right quadriceps tendon was ruptured. He denied having systemic disease and taking neither steroid nor fluoroquinolone. The patient underwent a successful operative repair. Intraoperatively we found that the right quadriceps ruptured transversely at the join of tendon and muscle belly area, which was rarely reported. During the two-month follow-up after the surgery, patient was receiving a fully rehabilitation and recovered satisfactorily.

Keywords: Quadriceps, tendon rupture, closed injury, MRI, reconstruction, rehabilitation

Introduction

Quadriceps is one of the largest and most powerful muscles in the human body [1]. The ruptures of Quadriceps tendons are associated with systemic disease such as chronic renal failure, hyperparathyroidism, rheumatoid arthritis, systemic lupus erythematosus, and connective tissue diseases [2-7]. Quadriceps tendon ruptures are uncommon and occur typically in male patients older than 50 years old [8], the disruption of the quadriceps tendon in adolescent without comorbidities are rarely report. This report describes a 27-year-old male patient with quadriceps tendon rupture because of missing his step in the daily training. Both physical examination and MRI revealed the presence of quadriceps tendon rupture. After a 2-week immobilization period for knee extension, the patient received a passive flexion exercise. The passive flexion could reach 120° until 8th week. After that, the patient started

an exercise of active flexion without weight loaded.

Case report

Our patient was a 27-year-old male, with pain and the inability to extend his right knee, presented to the Orthopaedic Surgery Department of First Affiliated Hospital of Dalian Medical University in October 2016. The injury had occurred to him 15 days ago when he was attending the daily training. The patient was a member of local police force, and used to be strong and healthy. He had never received other surgical treatment. Because of missing his step in the daily training, his right knee had to suffer a sudden load of his body weight, the quadriceps muscle had to contract strongly in order to against knee flexion and keep balance, which caused the injury. Besides, the patient had denied neither comorbidities nor systemic diseases.

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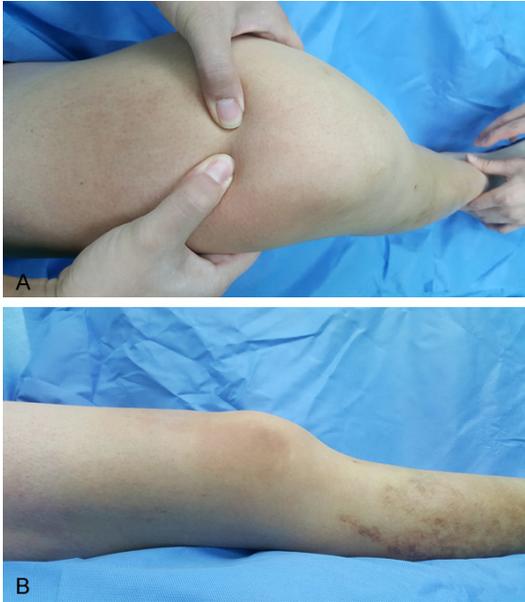


Figure 1. Physical examination. The presence of a suprapatella gap (A) and conspicuous swelling in the region of the injury on right knee joint (B) had been observed by palpation. Right patella could be moved over a wider range than the normal.

The physical examination revealed the presence of a suprapatella gap and conspicuous swelling in the region of the injury on right knee joint. Palpation showed joint cavity and the superior patellar joint capsule effusion. Moreover, the deep-level organizational structure under the quadriceps tendon was easily felt (**Figure 1**). The remainder of his physical examination was normal. His past medical history was unremarkable, and he had no history of steroid or fluoroquinolone intake. The MRI showed that the continuity of the quadriceps tendons was avulsed from the superior pole of the patellae (**Figure 2**), and biochemical tests showed no significant abnormalities. Therefore, a diagnosis of bilateral quadriceps tendon rupture was made.

The patient underwent an operation on 17th October 2016. In the operating room, he was placed in the supine position and a tourniquet was inflated to 60 Kpa. An incision was made 10 cm length overlying the quadriceps tendon and proximal superior pole of right patella. The dissection exposed the ruptured quadriceps tendon. Complete rupture at the join of tendon and muscle belly was observed. The colour of quadriceps muscle belly stump was dark brown, which had a poor blood supplement and need-

ed to be removed. After removing part of the inactivate tissue, we made two parallel bone tunnel from the inferior pole to the superior pole of the patella. Two parallel interlocking sutures are placed in quadriceps tendon. Sutures (#5 Ethibon), which were placed distally through drill holes, were tied to the sutures in the quadriceps tendon while tendon was held in anatomical position. After that, we planted two anchors (TwinFix™ Ti 2.8 mm, Smith & Nephew Inc.) into the patella, two anchoring sutures (#2 Ultrabraid Suture) stitched directly into the quadriceps proximal stump in order to reduce the tendon suture tension at the fracture and strengthen the fixed effect (**Figure 3**). The knee could be flexed up to 120° and didn't cause the tendon rupture.

After a 2-week immobilization period for knee in full extension, the patient received passive knee joint movement at 0°-30°, the passive flexion movement achieved 60° until 4th week and 90° until 6th week. The passive flexion could reach 120° until 8th week, after that, the patient started an exercise of active flexion without weight loaded.

Discussion

As reported in literatures, tendon injuries are common and related with degeneration or trauma [9-11]. However, Quadriceps is one of the largest and most powerful muscle in the human body, and quadriceps tendon ruptures are rare injuries and conspicuously affect male patients older than 50-year-old [10]. There is a study of 2794 patients pointing that the incidence of the quadriceps tendon rupture showed significant differences in gender. The overall incidence of quadriceps tendon injuries is 1.37/100,000. Meanwhile, men have a higher incidence compared to women [12]. Quadriceps tendon rupture generally results from contraction of the extensor mechanism against a sudden load of body weight with the knee flexed [13, 14]. But the reported ruptures of the knee extensor mechanism are usually associated with systemic disease such as chronic renal failure, hyperparathyroidism, rheumatoid arthritis, systemic lupus erythematosus, and connective tissue diseases. Patients with systemic diseases have a higher risk of disruption. In addition, systemic intake steroid and fluoroquinolone or repeated microtrauma to the tendon contributes to tendon ruptures [10, 12,

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Figure 2. Lateral T1-weighted (A) and T2-weighted (B) MRI. The images showed the continuity of the quadriceps tendon was avulsed at the join of tendon and muscle belly (black arrows). The distal tendon stump still had a connection with patella.

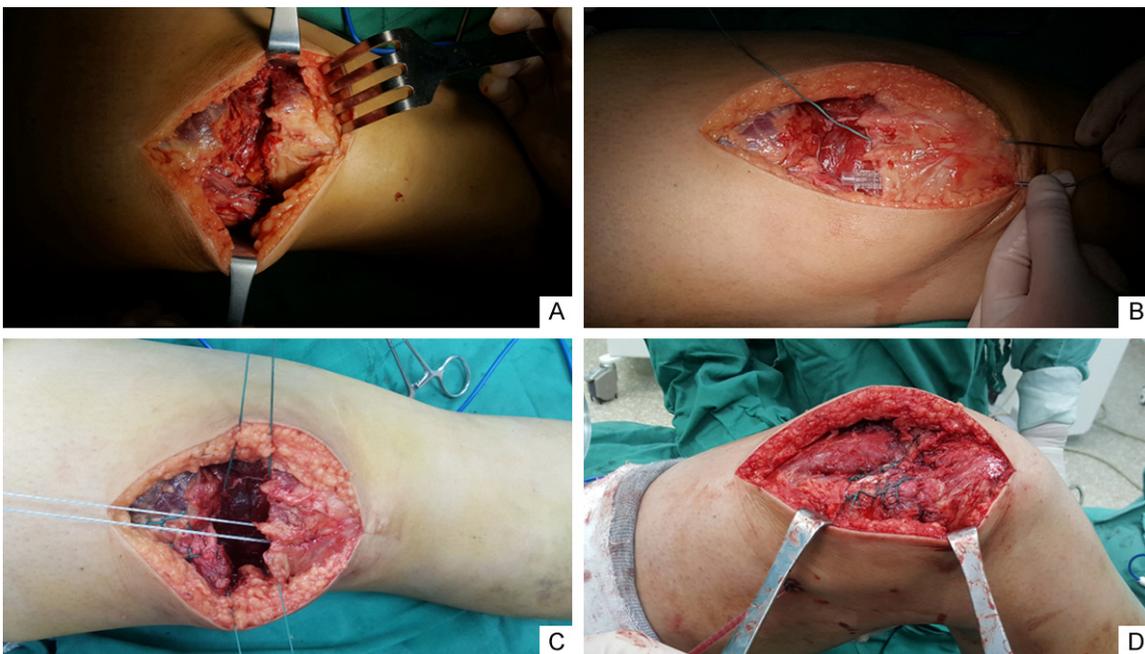


Figure 3. Surgery procedures on the patient. A. Complete rupture at the join of tendon and muscle belly was observed. The colour of quadriceps muscle belly stump was dark red, which had a poor blood supplement and needed to be removed. B. Sutures, which were placed distally through drill holes, were tied to the sutures in the quadriceps tendon while tendon was held in anatomical position. C. Two anchors were implanted into the superior pole of patella, two anchoring sutures (white sutures) stitched directly into the quadriceps proximal stump in order to reduce the tendon suture tension at the fracture and strengthen the fixed effect. D. The knee could be flexed up to 120° and didn't cause the tendon rupture.

15]. However, the rupture of quadriceps tendon is rare injury in an otherwise healthy person. In our report, the patient was serving in the local police force, and used to be strong and healthy. The patient's right knee joint had to against a

sudden load of his body weight because of missing his step in the daily training, the powerful contraction of quadriceps lead to a complete rupture at the join of tendon and muscle belly. Similar cases have not been reported, but

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Table 1. Summary of the reported cases of spontaneous quadriceps tendon rupture

Reporter	Year of public	Age/ Sex	Associated diseases	Medication history	Treatment	Outcomes
R.Glick, et al [13]	2015	73/M	Essential hypertension, gastroesophageal reflux disease, recurrent prostatitis	Pantoprazole, norfloxacin, testosterone	NM	NM
Rajinder Singh Gaheer [17]	2010	65/M	N	N	Surgical repair by using Mitek anchors, immobilization of both knees at 10° of flexion for 6 weeks, non-weight bearing for 2 weeks	ROM was 0° to 120° flexion until 16 weeks
Soo Yong Chua, et al [18]	2006	45/M	Alkaptonuria	NM	Surgical repair, immobilization of full extension, non-weight bearing for 2 month, active extension of both knees from the 3rd month	ROM was 0° to 110° flexion and recovered ability of walking
Martin Rysavy, et al [19]	2005	47/M	Chronic anemia, hypertension, end-stage renal disease	NM	Surgical repair, weight bearing was allowed 5 weeks after surgery and ambulation without support was allowed 7 weeks after surgery.	4 months after surgery, ROM was 120° of flexion of both knees
David Figueroa, et al [20]	2006	28/M	Type I osteogenesis imperfecta	NM	Surgical repair, immobilization for 6 weeks, performing a full range of motion from 6th week	A year after surgery, the Lysholm score achieved 95 points
Kaliopi ALPANTAKI, et al [21]	2004	85/M	Spinal stenosis, grade II degenerative tear of the right medial meniscus, grade I degenerative tear of the left knee medial meniscus	NM	Surgical repair, immobilization for 6 weeks, performing a controlled flexion exercise for 6 weeks	ROM was 0° to 120° on both sides 4 years later.
Raj Bhole, et al [16]	1985	71/M	Diabetes mellitus	NM	Surgical repair, immobilization of full extension for 6 weeks, quadriceps strengthening exercises for 3 weeks.	2 years after surgery, the patient had a 5° extension lag in both knees and was walking freely.

M= male F= female N= none NM= not mention ROM= range of motion MRI= magnetic resonance imaging.

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there are seven cases of spontaneous rupture of quadriceps tendon have been reported in the literature [13, 16-21], however, most of them were combined with chronic diseases. **Table 1** summarises all of them.

A diagnosis of tendon rupture based on clinical and physical examinations, such as X-Ray, ultrasonogram, and MRI are commonly used [22-28]. In the present case, the diagnosis was mainly based on physical examination, which revealed the presence of a suprapatella gap and conspicuous swelling in the region of the injury on right knee joint, the right patella could move a wider range than normal. Meanwhile, the MRI had shown a disruption at the suprapatella region and the quadriceps discontinuous which confirmed the diagnosis. However, cases reported in the literature have shown up to 50% of quadriceps tendon rupture cases had been misdiagnosed, which might affect the outcome of clinical treatment. Thus, it is important that to assess the possibility of a quadriceps tendon rupture in patients with complaints of acute knee joint pain, disability of knee extension, or a conspicuous soft-tissue swelling in the region of superior pole of patella, especially in patients with chronic or systemic diseases.

The quadriceps tendon usually ruptures at the osteotendinous junction in older patients and at the mid tendon area in younger patients. A hypovascular zone is found in the quadriceps tendon 1 to 2 cm from the superior border of the patella [29], corresponding to the area of spontaneous ruptures reported in the literature. In patients with renal failure, a decrease in glomerular filtration rate leads to retention of phosphorus, which leads to hypocalcemia, and a reduced serum calcium concentration leads to a proportional increase in the level of parathyroid hormone, which results in the release of calcium by osteoclast stimulation High bone turnover. As a result, patellar bone resorption takes place at the quadriceps tendon insertion site [2, 3]. In previous literature, nutritional calcification and periosteal resorption can be observed on plain radiographs. In this situation, repeated avulsion injuries can easily occur without severe trauma. As a results tendon rupture may occur [30, 31]. Duration of dialysis is considered to be associated with spontaneous tendon rupture [30, 32]. In this case, the patient was young and healthy, and not exposed to any risk factors. The causation of disruption

was a strong contraction of quadriceps to extend the knee joint in order to against the sudden load of body weight after missing his step. However, the ruptured area, which is different from other reports in literatures, is located at the join of tendon and quadriceps muscle belly.

In typical acute and complete rupture of quadriceps tendon, surgical repair is a recommended method of treatment [33]. The quadriceps tendon injury is mainly manifested as disability of knee extension, any delays in operative treatment can complicate the operation and result in unsatisfactory outcomes. In another word, the operative repair should be done as soon as possible when diagnosis has been confirmed. Our patient was hospitalized 15 days after the injury. Intraoperatively, we found that the quadriceps tendon stump in the presence of a large number of blood scab, necrotic tissue and old granulation tissue, which must be appropriate to be removed [33, 34]. To prevent the tendon from breaking again and reduce the tension of ruptured tendon, a method of putting sutures through drilled holes on the superior border of patella and insertion of sutures into the proximal stump of quadriceps muscle, is common used to repair quadriceps tendon ruptures. Meanwhile, the suture anchor fixation is becoming popular in other types of orthopaedic surgery. However, it is an efficient and strong technique which is also used for the repairmen of quadriceps tendon rupture. For this current case, two anchors were implanted into the superior pole of patella and two pairs of sutures were inserted through quadriceps. This approach achieved using Bunnel's suture technique to reduce tension. Then the knee joint was immobilized for 2 weeks. Afterwards, the patient underwent physiotherapy to achieve full recovery.

Conclusion

Overall, quadriceps tendon ruptures are rare injuries that require early surgical repair and subsequent physiotherapy. Clinicians, especially emergency physicians, need to pay attention to the physical examination of the quadriceps tendon rupture to prevent misdiagnosis.

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Disclosure of conflict of interest

None.

Authors' contribution

J Chu and MZ Song contributed to seeking the references, manuscript writing. M Lu did the operation of this case. M Lu and SY Wang were responsible for our manuscript. MZ Song and LT Yan contributed to the critical revision of the manuscript for intellectual content. LT Yan, XL Tian, Z Zhang, JW Zong and S Zhang helped to write and to revise the manuscript. All authors read and approved the final manuscript.

Abbreviations

MRI, magnetic resonance imaging.

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