

Case Report

## Simultaneous bilateral quadriceps tendon rupture in a patient on hemodialysis: A case report

Srijan Utkarsh<sup>1</sup>, Sushma Manral<sup>1</sup>, Neha Nischal<sup>1</sup>

<sup>1</sup>Department of Radiology, Holy Family Hospital, New Delhi, India.

**\*Corresponding author:**

Neha Nischal,  
Department of Radiology, Holy Family Hospital, New Delhi, India.

[neha.nischal@gmail.com](mailto:neha.nischal@gmail.com)

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### ABSTRACT

Simultaneous bilateral quadriceps tendon rupture is an uncommon but disabling clinical entity that usually has an underlying cause of tendon weakening. We present a case of a 36-year-old male who presented with full-thickness tears of both quadriceps tendons following a fall on the knees and was found to have underlying calcific tendinopathy secondary to chronic kidney disease and hemodialysis. Imaging with radiographs and ultrasound scans usually suffices for the evaluation of tendon pathology in cases of clinical suspicion of quadriceps tendon rupture.

**Keywords:** Bilateral quadriceps rupture, Chronic kidney disease, Calcific tendinopathy, Ultrasound knee, Magnetic resonance imaging

### INTRODUCTION

Complete rupture of the quadriceps tendon is not common in clinical practice, and bilateral quadriceps rupture is an even rarer entity. It is a disabling injury and can result from either a direct mechanism or more commonly, an indirect mechanism. It is more likely to occur in the presence of an underlying systemic disease such as diabetes, chronic renal failure, and hyperparathyroidism. Other predisposing conditions include crystal arthropathies such as gout and inflammatory arthritis such as rheumatoid arthritis and obesity. Medications such as quinolones and long-term systemic steroids can also be underlying causes.<sup>[1]</sup> Here, we present a rare case of simultaneous bilateral quadriceps tendon rupture following a trivial injury in a patient on long-term hemodialysis.

### CASE REPORT

A 36-year-old man presented to the orthopedic department with complaints of bilateral knee pain and an inability to walk following a trivial fall on the floor. The patient had a history of chronic kidney disease (CKD) and had been on twice-weekly hemodialysis for the past 3 years, along with anti-hypertensive medications and vitamin D supplementation. The cause of renal failure was not known. There was no history of diabetes mellitus or any other chronic disease.

Examination revealed substantial swelling in the suprapatellar region of both knee joints. On palpation, there was tenderness over the area with a defect in the continuity of the quadriceps

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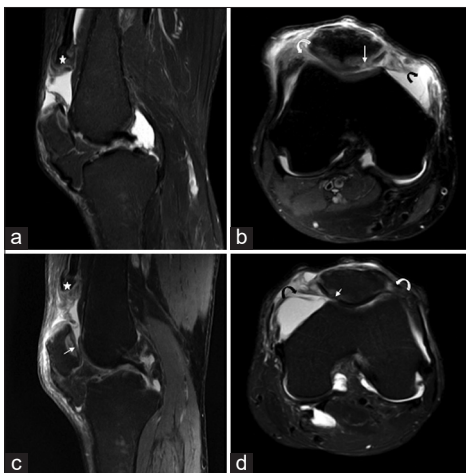
tendon which was exaggerated with active knee extension, and inability to perform a straight leg raise test.

The patient was referred for magnetic resonance imaging (MRI) of both knees which revealed full-thickness tears of the quadriceps tendons from their respective patellar attachments with retraction of the torn ends which were bulbous in appearance [Figure 1]. There was an injury to the medial as well as lateral patellar retinaculum on either side with moderate joint effusion. There were no meniscal or cruciate ligament tears. Plain radiographs revealed faint calcified deposits in the retracted quadriceps tendons [Figure 2]. Ultrasound scan done for academic purposes better depicted the underlying calcific tendinopathy along with hemarthrosis [Figure 3].

Laboratory investigations revealed deranged renal function test values with mildly reduced serum calcium levels and normal parathyroid hormone levels. Uric acid levels were within normal range. There was no chondrocalcinosis of any other joint. The patient was managed surgically by repair of the ruptured quadriceps tendons.

## DISCUSSION

Bilateral quadriceps tendon rupture is a rare entity and only about 105 cases have been reported until now in both English and German literature since the first case was reported by Steiner and Plamer in 1949.<sup>[2]</sup>



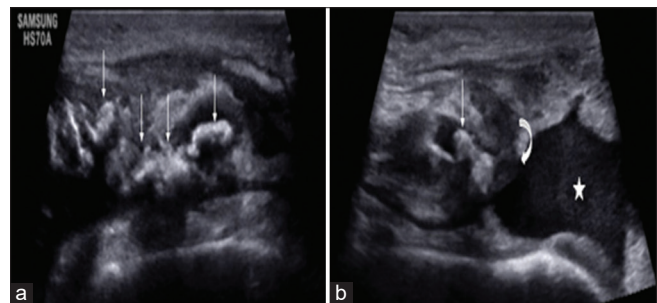
**Figure 1:** (a and c) Sagittal *proton-density* fat saturated, (b and d) axial short-tau inversion recovery images of the right (a and b) as well as left (c and d) knee magnetic resonance imaging reveal complete tear of the quadriceps tendon with retracted, bulbous end (star in a and c) along with focal full-thickness chondral defect of the medial patellar facet (arrows in b-d). There is also tearing of the medial (curved black arrows in b and d) as well as lateral (curved white arrows in b and d) patellar retinacular structures.

The quadriceps tendon is formed from the junction of the rectus femoris, vastus lateralis, vastus intermedius, and vastus medialis. Together with the patella and patellar tendon, this comprises the extensor mechanism of the knee joint. Therefore, a rupture of the quadriceps tendon affects knee extension and overall functionality, the degree of affection depending on the severity of the damage.<sup>[3]</sup>

The blood supply to the quadriceps tendon is by three vascular arcades, namely, the medial, lateral, and peripatellar arcades. Based on the density of the vascularity, the quadriceps tendon can be divided into three vascular zones – zone 1 lies between 0 and 1 cm from the superior pole of the patella, zone 2 lies between 1 and 2 cm from the superior pole of the patella, and zone 3 lies >2 cm from the superior pole of the patella.<sup>[4]</sup> Studies have reported that typical quadriceps tendon ruptures occur most frequently between 1.3 and 2.0 cm from the superior pole of the patella or in zone 2, as this zone was found to be hypovascular.<sup>[5]</sup> Zone 1 is well



**Figure 2:** Lateral radiographs of the (a) right and (b) left knees shows amorphous calcifications in the torn retracted quadriceps tendons (white arrows) with low-lying patellae on either side (white stars).



**Figure 3:** Ultrasound image in the suprapatellar region of the right knee along (a) short and (b) long axis of the quadriceps tendon shows multiple calcifications in the torn retracted distal end (white arrows in a and b). Curved arrow in b points to the retracted bulbous tendon end with hemarthrosis (white star in b) in the suprapatellar recess.

vascularized and ruptures in this zone are rare and atypical.<sup>[4]</sup> In this case, the rupture was in zone 1.

Proposed mechanisms for rupture include knee flexion with simultaneous quadriceps contraction and extensive rotation with hyperflexion of the lower leg. Ruptures tend to occur at the myotendinous junction.<sup>[3]</sup>

CKD patients on long-term hemodialysis have the highest association with tendon degeneration, leading to ruptures. CKD leads to the accumulation of uremic toxins, renal osteodystrophy, and hyperparathyroidism. Elevated parathyroid hormone leads to increased bone turnover which eventually leads to the weakening of myotendinous junctions and increased potential for tendon rupture with minimal stress. Patients receiving dialysis with insufficiently permeable filters have higher serum beta-2 microglobulin levels, which then accumulate in bones, joints, and tendons, and weaken them, making them susceptible to rupture with minimal trauma.<sup>[3,6]</sup>

Patients with quadriceps tendon rupture usually report hearing an audible pop or tearing sensation followed by an inability to bear weight and acute knee pain with swelling. Physical examination will reveal a palpable gap at the superior pole of the patella. There will be a limitation in the active extension of the knee joint.<sup>[3]</sup> However, cases in the literature have reported that 50% of the cases of quadriceps rupture tend to be misdiagnosed affecting patient care and appropriate treatment.<sup>[7]</sup> An US scan or MRI of the knee joint may thus be a useful imaging modality in clinically doubtful cases to confirm the diagnosis. These can also be used to assess tendon healing, and associated features such as effusion, hematomas, and calcifications. Plain radiographs may reveal a discontinuity in the opacification of the quadriceps tendon, which may indicate the presence of a tear. Plain radiographs may also help in ruling out other associated injuries or conditions and determining patella position; an inferior position of the patella may indicate quadriceps tendon rupture, although it is not specific for it. Both US scans and MRIs have high sensitivity for quadriceps tendon injuries.<sup>[3]</sup>

The initial management of partial quadriceps tendon rupture is just like any other musculoskeletal injury and involves the usage of the PEACE protocol which includes protection of the limb, elevating the limb, avoiding anti-inflammatory medications, use of compression, and educating the patient about the injury. The definitive management of complete tears is early diagnosis and surgical repair to restore function and limit long-term disability and morbidity. The most common method used nowadays for repairing quadriceps tendon rupture is the insertion of sutures through the quadriceps tendon through drilled holes into the superior border of the patella. This method is being used extensively because it is a strong and effective technique for repair.<sup>[8]</sup>

In the case of renal failure, secondary hyperparathyroidism is believed to play a role in the weakening of the quadriceps tendon leading to their rupture as described above. Therefore, the treatment of secondary hyperparathyroidism in chronic renal failure patients can be considered a preventive measure. The treatment is predominantly medical, including, newer calcimimetics, phosphate binders, and vitamin D analogues.

## CONCLUSION

Bilateral quadriceps tendon rupture is an uncommon clinical entity and needs early diagnosis with early surgical intervention to maximize functional outcomes for the patient. Imaging, particularly high resolution ultrasound, should be considered in cases of diagnostic dilemma for confirmation of diagnosis and differentiating partial from full thickness tears.

## TEACHING POINTS

An US scan with radiographic examination usually suffices for confirmation of diagnosis and ruling out major bony avulsions in case of complete tears of bilateral quadriceps tendons.

The presence of underlying tendinopathy needs to be ruled out as strong tendons such as quadriceps need considerable force for tearing.

## MCQs

- Which systemic disease has the highest association with tendon degeneration leading to ruptures?
  - Diabetes mellitus
  - Chronic kidney disease
  - Gout
  - Rheumatoid arthritis

Answer Key: b

- What is the definitive management for full-thickness quadriceps tendon rupture?
  - Expectant management
  - Immobilization of limb
  - Medical management
  - Surgical repair

Answer Key: d

- Which is the most common location for spontaneous quadriceps tendon rupture?
  - Within 1 cm from the superior pole of patella
  - Within 1–2 cm from the superior pole of patella
  - More than 2 cm from the superior pole of patella
  - All the locations have the same incidence

Answer Key: b

## Ethical approval

Institutional Review Board approval is not required/waived-off.

### Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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### Conflicts of interest

There are no conflicts of interest.

### Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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