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Incomplete rupture of the quadriceps tendon with complete rupture of the vastus intermedius: Case report and brief review of relevant literature

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Abstract

Introduction: Rupture of the quadriceps tendon is an uncommon injury with an incidence of 1.37/100000. Incomplete rupture is characterized as having an intact extensor mechanism while complete rupture presents with an inability to extend the knee. Incomplete ruptures are typically treated non-operatively whereas complete ruptures require surgical intervention. Existing literature reporting partial tears of the tendon is limited. Specifically, isolated vastus intermedius tendon injury has been reported in two case reports thus far. The purpose of this report is to outline the rare case of an incomplete quadriceps tendon rupture with complete rupture of the vastus intermedius, treated with early surgical repair that resulted in an excellent patient outcome.

Methods: A 35-year-old male truck driver presented with right knee pain, joint effusion, and decreased range of motion following an injury while jumping in a basketball game. Ultrasonography revealed a partial-thickness tear of the quadriceps tendon with complete rupture of the vastus intermedius. MRI confirmed the diagnosis of a high-grade partial-thickness complete tear involving 60% of the quadriceps tendon with significant retraction of the vastus musculature. It is the opinion of the senior author (JA) that this injury pattern combined with his known extensor lag was unlikely to improve without surgical intervention. This was discussed with the patient and they underwent successful quadriceps tendon repair.

Results: Six months post-operatively, the patient had no pain with rest or walking. He had returned to work without limitation. On examination, his gait was normal and knee range of motion was full. There was no tenderness to palpation over the quadriceps tendon and no crepitus with movement. Straight leg raise and single-leg squatting were performed without difficulty. The patient's quadriceps muscle bulk was approximately 80% of the contralateral side and his power was 5/5.

Discussion: This report outlines the rare case of complete vastus intermedius avulsion from the quadriceps tendon, with partial tendon rupture. Similar injuries have traditionally been managed non-operatively. We illustrate how surgical repair can be performed successfully with an excellent clinical outcome. An understanding of predisposing factors for partial tears can also be gained through review of the literature.

Keywords: Lipoma, giant, palmar, hand, excision

Introduction

Injury of the quadriceps tendon is a relatively uncommon injury with a potentially significant impact on day-to-day life. Incomplete rupture is generally characterized as maintaining an intact extensor mechanism while complete rupture presents with an inability to extend the knee. The incidence of complete rupture is 1.37/100000 and mostly occurs in the 4th decade of life [1]. Injury is believed to occur in the flexed knee with active quadriceps contraction such as deep-squat jumping. Risk factors include previous microtrauma, past surgical interventions to the knee, obesity, and co-morbid conditions such as diabetes mellitus and connective tissue disorders [2]. In general, incomplete ruptures are treated non-operatively as the extensor mechanism is intact, whereas complete ruptures require surgical intervention. Surgical repair of complete quadricep tendon ruptures is associated with excellent functional outcomes with a low overall re-rupture rate of 2% [3].

As stated, incomplete tears are generally treated non-operatively. However, we will describe a case of an incomplete quadriceps tendon rupture with complete rupture of the vastus intermedius that was treated with early surgical repair [4]. This case has been reported in line with the SCARE criteria [5].

Presentation of Case

A 35-year-old male presented to the emergency department after sustaining an injury to his right knee while jumping in a basketball game. The patient works as a truck driver and lives an active lifestyle. His past medical history includes hypertension, borderline Type 2 diabetes mellitus and obesity (BMI = 35 kg/m²). Initial imaging by ultrasound showed a partial thickness tear of the distal quadriceps tendon (Figure 1).

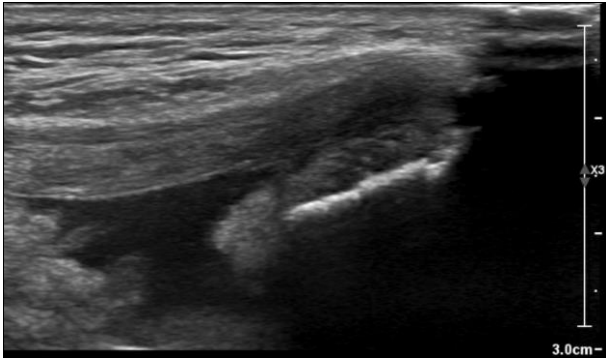


Fig 1: Ultrasound of the quadriceps tendon with the probe oriented longitudinally over the tendon. There is notable tearing and retracting of the underlying vastus musculature with intact tendon superiorly in the image.



Fig 2: Side by side AP/Oblique X-ray of the affected knee. There is a small, avulsed fragment of the proximal patellar pole that is best appreciated with the lateral radiograph.

Radiographs obtained of the joint revealed a large joint effusion with a calcification proximal to the superior pole of the patella, suggesting a potential avulsion type of injury (Figure 2). On physical examination, the patient was able to perform a straight leg raise with a five-degree quadriceps extensor lag that was absent in the contralateral knee. There was no palpable gap in the tendon proximal to the patella, which was consistent with ultrasound findings. The limb was distally neurovascularly intact with palpable pulses. The patient was scheduled for magnetic resonance imaging (MRI). In the interim they were immobilized and made weight-bearing as tolerated (WBAT) in a removable knee immobilizer. MRI confirmed the diagnosis of a high-grade partial-thickness complete tear involving 60% of the quadriceps tendon with significant retraction of the vastus musculature (Figure 3). The tear measured 3.7 cm at the deep central surface of the tendon with an associated 1.4 cm retraction. The anterior tendon (rectus femoris) was intact with an anterior posterior depth of 9 mm, associated with a large joint effusion. All other ligaments of the knee were intact. It is the opinion of the senior author (JA) that these

radiological findings, along with an observed extensor lag clinically, were unlikely to improve without surgical intervention. In a young individual with a significant defect in the quadriceps tendon as described in this case, surgical intervention would aim to ensure the restoration of full quadriceps power and knee ROM. This was discussed with the patient and informed consent was obtained for open quadriceps tendon repair.

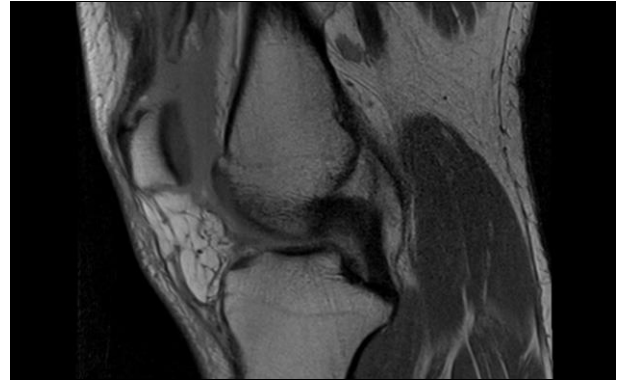


Fig 3: Sagittal cut of the affected knee showing the intact superficial portion of the quad tendon with the underlying avulsed vastus intermedius retracted proximally.

Surgical Approach

The patient was placed supine and underwent a proximal medial parapatellar arthrotomy. This allowed for the defect in the deep quadriceps tendon to be identified. The underlying muscle belly was freed from surrounding adhesions to obtain adequate excursion. A modified Krackow stitch using a Fiber Wire suture was performed on the medial aspect of the tendon. A suture anchor was then placed in a trough on the lateral aspect of the superior pole of the patella. The suture was passed using a modified Krackow fashion up and down the lateral aspect of the patella. Reduction of the quadriceps tendon into the patellar trough allowed for use of a knotless suture anchor on the Fiber Wire along the medial side of the patella. Once reduced, a knotless anchor was used to secure the lateral side. Knee flexion ranged from 0-30 degrees after final sutures were placed. The patient was placed in a removable knee immobilizer and made Toe-touch weight-bearing with follow-up scheduled for 2 weeks post-operatively.

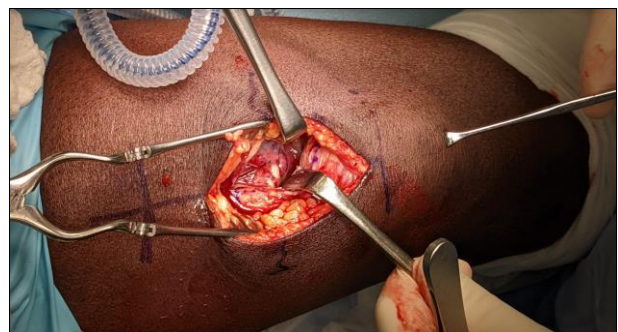


Fig 4: Intra-operative photograph showing the proximal medial parapatellar arthrotomy giving access to the retracted portion of the musculature.

Post-Operative Course

The patient was instructed to remain Toe-touch weight-bearing with ROM exercises within 0-30 degrees of knee flexion. He reported no instability or pain at initial follow-

up two weeks post-operatively. Physical exam showed 30 degrees of flexion and a normal straight leg raise, with no extensor lag or palpable gap within the tendon. At six weeks, the patient was transitioned to weight-bearing as tolerated with a referral to physiotherapy for ROM exercises. At twelve weeks post-operatively, the patient was pain-free while walking or at rest. He underwent physiotherapy and swam regularly, with self-reported improvement. His return to work was gradual with continued avoidance of heavy lifting. Normal gait and full ROM were seen on physical examination, with no crepitus or tenderness to palpation over the quadriceps tendon. Straight leg raise and double-legged squat were performed without difficulty. Quadriceps bulk was approximately 75% of the contralateral side and power was 4/5. At 6 months post-operatively, he was performing single leg squats with limited difficulty. Power was 5/5 and quadriceps muscle bulk was 80% of the contralateral side. He was found to have no limitations in activity or day-to-day life and followed up on an as needed basis.

Discussion

In this report we present a rare case of complete vastus intermedius avulsion from the quadriceps tendon. Consensus management of similar injury patterns has traditionally been non-operative [6, 7]. However, we outline how surgical repair can be performed successfully with excellent clinical outcomes. Risk factors for quadriceps tendon injury in this patient included obesity, borderline Type 2 diabetes mellitus and likely previous microtrauma [2]. Given the extent of muscular avulsion from the patella, there was concern regarding his diminished quadriceps strength. Remaining tendon integrity was also of concern, particularly due to the patient's elevated BMI and high overall functional status. Although his extensor mechanism remained partially intact, the decision was made for surgical repair to restore function and prevent further injury. This contrasts the standard approach of reserving surgical intervention for patients with full-thickness tears [4]. Thompson *et al.* (2008) provide examples of both operative and non-operative management for isolated vastus intermedius avulsion [7]. Their operative case required re-repair, with return to pre-injury clinical levels at 1 year post-operatively. While the patient managed non-operatively experienced a less complicated recovery, their return to pre-injury levels of activity took 2 years.

There are various techniques for surgical repair including Krackow, Scuderi and Codivilla. Surgical repair in our case consisted of end-to-end Krackow sutures with suture anchors, consistent with reported management of intra-tendon tears [4]. A prospective study of quadriceps tendon repair methods showed that best results were obtained from procedures which used suture anchors [8]. Post-operative use of a knee immobilizer splint to limit early ROM was also supported by the literature [9].

Existing literature regarding partial quadriceps tendon tears primarily consists of case reports [6, 7, 10, 11]. However, an understanding of the anatomy and pathophysiology leading to partial tears can be gained through review of other relevant studies. The components of the quadriceps tendon may attach to the patella separately or as one structure [12]. This anatomical variation could explain why some individuals suffer isolated muscle injuries. A study by Yepes *et al.* (2008) investigated the role of vascularization

in quadriceps tendon ruptures [13]. In this article, the authors subdivide the tendon into three zones. These zones are supplied by descending branches of the lateral circumflex femoral artery, branches of the medial and lateral superior geniculate arteries and branches of the descending geniculate artery [14]. Zone 2, the most intermediate and least vascular of the regions, is associated with the highest rate of rupture involvement. Yepes *et al.* suggest that the compressive forces from the femoral condyles on the articular side of the quadriceps tendon contribute to the decreased vascularity in this region [13]. Thus, increasing the likelihood of vastus intermedius rupture, as seen in our patient.

Conclusion

Partial quadriceps tendon rupture is a rare condition which typically occurs following traumatic injury. This case outlines the management of a partial-thickness tear of the quadriceps tendon with complete rupture of the vastus intermedius. The findings of this report supplement the limited literature surrounding the diagnosis and highlight our support for surgical repair of partial quadriceps tendon tears. As quadriceps tendon repairs become increasingly more common [15], further research is needed to optimize surgical technique and post-operative management.

Informed Consent

Written informed consent was obtained from the patient for use of their case and medical imaging results. A copy of the written consent may be furnished upon the editor's request.

Conflict of Interest Statement

None declared.

Sources of Funding

None declared.

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