Bifocal Avulsion Fracture And Fixation Of The Patellar Tendon: A Case Report

Ran Atzmon MD1, Eitan Iohanes MD2, Jeremy Dubin MS3, Alex Rosenthal MD2, Michael Drexler MD2, Seth L Sherman MD1.

1. Stanford University, Department of Orthopaedic Surgery, Stanford, California, USA.

2. Assuta Medical Center, Department of Orthopaedic Surgery, Affiliated with the Faculty of Health and Science and Ben Gurion University, Ashdod Israel

3. Tel Aviv Medical Center, Department of Orthopaedic Surgery, Affiliated with the Sackler Faculty of Medicine and Tel Aviv University, Tel Aviv Israel

Ran Atzmon - ranatzmon@gmail.com

Eitan Iohanes - tema.isma@gmail.com

Jeremy Dubin - dubinjeremy@gmail.com

Alex Rosenthal - lx.rosenthal@gmail.com

Michael Drexler - mt.drexler@gmail.com

Seth Lawrence Sherman - shermans@stanford.edu

Corresponding Author:

Seth L. Sherman

Email: shermans@stanford.edu

Phone: (650) 723-5643

Address: 450 Broadway, MC 6342, Redwood City, CA 94063
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Abstract

Acute distal patella tendon avulsion from the tibial tubercle (TT) is a relatively rare injury that is usually described in the adolescents or elderly population in their 7th or 8th decades. Bifocal avulsion fractures of the patella tendon from the tibial tubercle and the distal pole of the patella are exceptionally rare in adults. In this case report, we present a 52-year healthy old male who was treated for bifocal avulsion of the patellar tendon with open reduction and internal fixation augmented with two ULTRA-TAPES. To our knowledge, this is the first case report to describe this injury in a healthy middle-aged patient.

Key Words: Patellar tendon, Avulsion fracture, Bifocal, Patella, Case report
Case Report:

- A rare case of 52-year old healthy male who was treated for bifocal patellar tendon avulsion
- He was treated with open reduction and internal fixation using two half-threaded cannulated screws augmented with two ULTRA-TAPES.
- The patient achieved a full active range of motion ten weeks following the surgery with no extension lag and a Tegner Lysholm Knee Score of 91 out of 100. In addition, he resumed his preinjury activity level.

Lessons Learnt:

- This uncommon bifocal patellar tendon avulsion injury can happen in a relatively young and healthy patient.
- Despite the rare injury pattern, standard surgical practices successfully restored the patient's extensor mechanism.
- Adequate preparation using various imaging modalities and tailor-made treatment is essential for successfully treating this type of injury.
Introduction

Acute avulsion of the tibial tubercle (TT) is an uncommon injury, with reported incidence rates of 0.4% to 2.7% of all epiphyseal injuries, and less than 1% of all physical injuries in the adolescents population. [1-3] Compared to adults, young children and adolescents who are skeletally immature, are more likely to suffer from avulsion fractures at the tendons' attachment site than tearing the tendon itself. [1, 2, 4] Therefore, this injury may seldom be seen and is considered relatively rare among adults, with only a handful of literature reports. Bifocal disruption of knee extensor mechanism with a concurrent avulsion fracture of the patellar tendon from the patella's inferior pole and the tibial tuberosity (TT), is an extremely rare injury that requires precise extrinsic force acting simultaneously on both ends of the patellar tendon. [4-6]

Several injury mechanisms were proposed for this injury: a direct blow on the distal patella combined with forceful flexion of the lower leg; a central blow to the patellar tendon with forces spreading divergently against the two bony insertions; or a quadriceps overload causing an eccentric contraction of the muscle as the knee is forced into flexion. [4]

To the best of our knowledge, there are only several similar cases reported previously in the literature, involving either adolescents or skeletally mature patients in their 7th or 8th decades with rich medical backgrounds and co-morbidities. [4-9] In this case report, we present a relatively young and healthy patient in his early fifties with a bifocal avulsion of the patellar tendon, which was treated operatively with an open reduction and internal fixation. We will also include his injury's unique clinical aspects and mechanism, postoperative follow-up, and functional results. The study was approved by the institutional review board and the patient consented to us using their medical information.

Case report
A 52-year-old male presented at the emergency room with an acute right knee injury after an abrupt knee movement trying to prevent a fall. Apart from being overweight (BMI 29.3), the patient had no significant medical history or previous surgeries, and did not use any chronic medications. A detailed analysis of the mechanism of injury revealed a non-contact knee injury while trying to avoid a fall with a flexed knee after slipping near his pool. At the time of the event, the patient felt a popping sensation and heard an audible click, followed by acute pain in his right knee. Shortly afterward, the knee became swollen and the patient was unable to bear weight due to pain and feeling of giving way.

The physical examination revealed an inability to bear weight, moderate knee edema and swelling, and tenderness over the anterior knee, especially at the inferior pole of the patella and the tibial tuberosity. Additionally, a visible defect was seen at the inferior edge of the patella with the impression of a high-riding patella. The patient had an active extension lag of 40 degrees, with a full passive knee extension and limited knee flexion due to pain. The knee was stable to other ligaments (Anterior-posterior and valgus–varus), as were the motor, sensory, and vascular examinations distal to the injury site.

**Imaging**

Trauma series radiographs of the right knee, including AP, Lateral, Merchant (Sky), and Tunnel views, revealed bifocal patellar tendon avulsion fractures at the inferior pole of the patella and the tibial tuberosity (Figure 1). Computed tomography (CT) imaging showed 1.58 centimeters proximal retraction of the TT fragment, with no additional fractures or osseous pathologies (Figure 1). The patient also underwent magnetic resonance imaging (MRI) in order to assess the integrity of the patellar tendon and other soft tissue elements about the knee, which demonstrated an extensive bone marrow edema in the
proximal tibia, partial rupture of the patellar tendon, interstitial tear of the quadriceps tendon, and horizontal tear of the medial meniscus. (Figure 1)

Figure 1 - Right knee images showing a bifocal avulsion of the patellar tendon. (A) Lateral Radiographic imaging; (B) Sagittal CT-scan; (C) Sagittal MRI; (D) 3-D Reconstruction.

*SCT – Computed tomography

**MRI - Magnetic resonance imaging

Surgical Technique

Upon arrival to the ER, the knee was placed in a temporary non-weight-bearing posterior splint, and surgery was recommended once the initial swelling was reduced. The procedure was performed under general anesthesia with the patient in the supine position. The operated leg was sterilized and draped with a bump placed under the ipsilateral thigh. An 11-cm midline longitudinal incision was done, starting proximally over the patella and continuing distally to the TT. After evacuating the hematoma, the TT fracture was anatomically reduced and temporally fixated using 2-millimeter Kirschner wires. (Figure 2). Once we confirmed adequate reduction under fluoroscopy, both the tibial tuberosity and the inferior pole of the patella fractures were fixed with a single 4.0 mm diameter half-threaded cannulated screw (Synthes, West Chester, PA, USA) and a washer. (Figure 3) In order to limit knee flexion to 90 degrees and relieve the tension from the two fracture sites, the fixation was further augmented. The leg was positioned at 90°, and the construct was augmented using two pre-loaded anchors with ULTRATAPEs (HEALICOIL™ Suture Anchors, Smith & Nephew, Andover, MA, USA). The anchors were placed adjacent to both sides of the TT, circling the proximal pole of the patella underneath the rectus femoris tendon, creating an X shape closed loop between the patella and the TT. (Figure 2). Before closing, the knee was tested
throughout the range of motion and reached full extension and at least 100° of flexion. The incision was closed in layers using Vicryl Coated absorbable sutures number 0 and 2-0 (Johnson & Johnson) for the deep and superficial layers, respectively. Finally, the skin was closed with running subcutaneous absorbable Ethicon Monocryl sutures.

**Figure 2** – Intraoperative images of the right knee, (A) showing the fracture gap of the tibial tuberosity avulsion fracture, (B) Reduction and temporary fixation with Kirschner wire; (C) Augmentation of the fixation with two ULTRA-TAPEs and anchors.

**Figure 3** – Postoperative Lateral fluoroscopy of the knee

**Postoperative management and rehabilitation**

After surgery, the patient received prophylactic aspirin for 2 weeks to prevent blood clot formation, and the leg was placed in a hinged knee brace in full extension for 6 weeks. Three days after the surgery, the patient was allowed to weight bear as tolerated with the assistance of crutches. A gradual progressive range of motion was initiated after a 4-week follow-up examination with the assistance of a continuous passive motion (CPM) machine, starting with 30 degrees of passive and active flexion, and advancing to 120° of flexion in a stepwise fashion. Accordingly, the knee brace was gradually adjusted to allow more flexion and was replaced with a soft knee sleeve four months post-surgery for additional two months. The patient achieved a full active range of motion ten weeks following the surgery, with full active extension and 130° of flexion (**Figure 4**). Six months post-surgery, the patient returned to light sports activity, and one year after surgery, the patient resumed his full pre-injury
level. Physical therapy was initiated immediately after the surgery twice a week for 9 months, as well as self-exercise.

On his last follow-up visit two years after the surgery, the patient reported slight pain during squatting after vigorous activity accompanied by occasional knee swelling, with a calculated Tegner Lysholm Knee Score of 91 out of 100. [10] The patient was satisfied with the surgery and ability to get back to his normal daily activities.

Figure 4 – Postoperative picture at 4-month follow-up, demonstrating a full active range of motion with no extension lag.

Discussion

In this case report, we present a 52-year healthy old male who was treated for bifocal avulsion of the patellar tendon with open reduction and internal fixation augmented with two ULTRA-TAPES. The patient was able to resume his pre-injury level without the need for additional surgery or hardware removal.

Avulsion fractures of the tibial tubercle and the distal pole of the patella are uncommon. [6] Patellar tendon avulsion fractures from the inferior pole of the patella are usually attributed to chronic overuse due to repetitive ligamentous injury, typically following a history of knee pain. [4] Several etiologies may predispose the patella to a tendon avulsion; among them are "jumper's knee," patellar sleeve avulsion, and Sinding-Larsen-Johansson syndrome. [11] Tibial tuberosity avulsion fractures in adolescents is often preceded by various degrees of Osgood–Schlatter disease. Although the adolescent population is more prone to avulsion injuries, the reported incidence of bifocal injury is comprised of only a few known case reports, with none of the patients having any predisposing factors. [4, 12] Among
the adult population, this combination is even rarer, with only a handful of reported cases. [6, 9, 13]

S. Kang et al. [6] classified bifocal disruption of the knee extensor mechanism into five types based on anatomical locations and injury patterns, with type 4 being avulsion fracture of the tibial tubercle in combination with an avulsion fracture of the inferior pole of the patella. The previously published case reports described a similar fracture pattern in the elderly population. [6, 9, 13] Yoon et al. [9] reported on a 72-year-old male with an ectopic ossified patellar tendon after a twisting injury. Similarly, Chautems and colleagues. [13] reported on a 90-year-old woman with type 2 diabetes mellitus who suffered from the same injury after falling on her knee. Kang et al. [6] also described a motorcycle injury in an 84-year-old male. All the patients were treated with open reduction, internal fixation, and additional tendon repair as needed.

Based on previously described cases, considering the patient's age, it was logical to assume that the decreased bone quality is a major contributor to this injury. According to our knowledge, this injury pattern was not described in an otherwise healthy middle-aged patient. Theoretically, for such injury to occur, simultaneous and equal forces must be applied on both sides of the patellar tendon. This type of injury is challenging and requires careful pre-operative assessment and surgical planning. The pre-operative planning should take into consideration the bone stock and the osseous quality of the detached fragment, and the ability to achieve anatomical reduction without further insult to the extensor mechanism such as patella baja. As the CT scan indicated adequate bone stock, primary fixation was the preferred option. Of note, an inadequate bone stock may require staged intervention. Moreover, the quality and retraction of the patellar tendon should also be considered. Though the MRI demonstrated an intact tendon, an intraoperative inspection was done to assess
whether an additional augmentation or reconstruction using an allograft was needed.

Eventually, the intra-operative inspection revealed only a small-partial superficial tear which was repaired during the surgery. Finally, several augmentation and protective techniques were described in the literature, such as a circular cerclage wire which usually requires a second surgery for its removal in due course. [13] Hence we chose to use ULTRA-TAPES and anchors, which are less rigid and can be cut in a mini-invasive technique post-operatively if needed.

In conclusion, this is the first published case report depicting bifocal patellar tendon avulsion in a healthy, middle-aged patient, which was treated successfully with a primary fixation and ULTRA-TAPES augmentation.
References:


