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A RARE CASE OF AN ISOLATED OPEN ANTERIOR TIBIAL TUBEROSITY FRACTURE IN AN ADULT PATIENT: HOW WE TREATED IT.

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AUTHOR AND AFFILIATION

Mamfoumbi Mbadinga Noel Juslin, Moustapha Etape, Ekono Nna Albert Patrick, Hamza Kettani, Djibril Mohamed Idriss, Badr Chalouah, Ismael El Antri, Azzelarab Bennis, Omar Zaddoug, Mohammed Benchakroun, Salim Bouabid

Department of Orthopedic surgery and traumatology I, Mohammed V Military Teaching Hospital, Faculty of Medicine and Pharmacy, Mohammed V University, 10100, Rabat, Morocco

Corresponding author: Moustapha Etape .

ABSTRACT

Isolated fractures of the anterior tibial tuberosity (ATT) are uncommon, primarily affecting adolescents during sports activities. Open ATT fractures are even rarer, with very few cases reported in the literature. This article presents a unique case of an isolated open ATT fracture in a 34-year-old man following a physical assault involving a sword. The patient sustained a Gustilo-Anderson Type II open knee injury, with radiologic evaluation confirming a displaced avulsion fracture. Surgical management included open reduction, lag screw fixation, and tension band wiring, followed by structured post-operative rehabilitation. The patient demonstrated progressive improvement, achieving full range of motion at three months and returning to full functional capacity at ten months postoperatively, with a Knee Injury and Osteoarthritis Outcome Score (KOOS) of 98. This case underscores the importance of timely diagnosis, appropriate surgical intervention, and structured rehabilitation in achieving optimal outcomes. Additionally, it highlights an unusual mechanism of injury, contributing to the limited literature on isolated open ATT fractures.

KEYWORDS

Anterior tibial tuberosity fracture, tension band, open knee injury, open tibial tuberosity fracture.

MAIN ARTICLE

Introduction

Fractures of the anterior tibial tuberosity are relatively uncommon, accounting for approximately 3% of all proximal tibial fractures and less than 1% of all physeal fractures. They primarily occur in adolescents, with an increasing incidence likely due to greater participation in youth sports. Reported incidence rates range from 0.4% to 2.7%. These fractures are typically closed injuries and are most often seen in athletes engaging in sports that involve forceful quadriceps contraction against resistance or rapid knee flexion, such as jumping and running [1,2,3,4].

Anterior tibial tuberosity fractures in adults are extremely rare, and open variants are even more uncommon, with very few cases reported in the literature.

Diagnosis is primarily based on plain radiographs, while computed tomography can provide further characterization of the fracture pattern and joint involvement. Associated injuries may include ligamentous damage and tibial plateau fractures.

Anterior tibial tuberosity fractures can be classified using the Ogden classification, which categorizes them into five types based on the fracture level and the presence of fragment displacement.

In this paper, we present a rare case of an isolated open anterior tibial tuberosity fracture in an adult, occurring in an unusual context. The injury resulted from direct trauma to the limb with a sharp sword during a physical assault.

Case report

A 34-year-old man with no significant medical history sustained an open injury to his right leg during a physical assault. He was referred to the emergency department of our facility for the management of an open knee trauma.

On admission, he complained of severe pain in his right knee and an inability to bear weight on the affected limb. He reported that the injury resulted from a direct trauma inflicted by a sharp sword. Additionally, he experienced pain in his face, left forearm, chest, and thighs. However, he denied any loss of consciousness.

The patient stated that he was a victim of a physical assault, which resulted in an open knee injury along with multiple bruises scattered across his body. He initially received treatment at a primary healthcare center before being admitted to our facility. There, he was administered antibiotics, tetanus prophylaxis, analgesics, and wound care, including cleaning and dressing. He arrived at our facility approximately four hours after the traumatic event.

On physical examination, the patient appeared healthy, with normal vital signs. His right knee was swollen, and a 2 cm transverse wound with sharp edges was observed over the anterior tibial

tuberosity (Figure 1 A). He was unable to actively extend the knee. A distal neurovascular examination of the right lower limb was unremarkable. Additionally, multiple bruises were noted on his face, forearm, chest, and thigh.

Radiographic and computed tomography imaging performed in the emergency department revealed an avulsion fracture of the right anterior tibial tuberosity (Figure 1 B, C, and D). Following an unremarkable preoperative workup, the patient was taken to the operating room for surgical management under spinal anesthesia.

The procedure began with thorough irrigation and debridement of the traumatic wound. A midline anterior approach, extending distally beyond the wound (Figure 2 A), was used to access the knee. The fracture site was meticulously cleaned and reduced using a tenaculum. Fixation was achieved with two anteroposterior lag screws, inserted obliquely to avoid injury to the popliteal neurovascular bundle (Figure 2 B). To reinforce the knee's extensor mechanism, a cerclage wire anchored on a third screw was placed (Figure 2 A and B). After another round of thorough irrigation, the surgical wound was closed over a negative suction drain.

During the first two postoperative days, the patient received intravenous antibiotics in accordance with the local protocol for managing open fractures. A hinged brace was applied to stabilize the injured knee, and the operated limb was elevated to reduce edema. Isometric quadriceps exercises and active range-of-motion activities were initiated on the first postoperative day. The patient was allowed full weight-bearing ambulation with the support of two crutches, while the hinged brace provided knee stabilization, permitting up to 30° of flexion. The suction drain was removed on the second postoperative day.

On the third postoperative day, the patient was discharged with oral analgesics and antibiotics, following the local protocol. A follow-up appointment was scheduled for two weeks later to assess wound healing.

Results

The patient's recovery progressed smoothly. By the fourth postoperative week, the brace was removed, control X-ray images were obtained (Figures 3 A), and knee flexion beyond 30° was gradually introduced (Figures 3 B and C). Continuous rehabilitation allowed the patient to achieve full weight-bearing without support by six weeks. With ongoing physiotherapy, range of motion was regained progressively and he started partial squad exercises and cross-legged sitting position by two months (Figures 4).

At the final follow-up, ten months postoperatively, the patient demonstrated normal muscle strength, reported no pain or functional limitations, and achieved a Knee Injury and Osteoarthritis

Outcome Score (KOOS) of 98. He successfully reintegrated into social activities and resumed his preferred recreational sport, soccer.

Discussion

Anterior tibial tuberosity avulsion fractures are uncommon, and these injuries typically occur in mature-appearing adolescent boys involved in jumping sports, particularly basketball. These avulsion fractures of the anterior tibial tuberosity occur when the amount of traction by the patellar ligament exceeds the combined strength of the physis beneath the tuberosity, the surrounding perichondrium, and the periosteum adjacent to the tuberosity. The developmental anatomy of the tibial tuberosity explains the likelihood of avulsion fractures seen in adolescents [1].

In adults, anterior tibial tuberosity fractures typically occur as an associated injury in cases of tibial plateau fractures [5]. However, isolated anterior tibial tuberosity fractures which are relatively rarer occur by direct trauma to the proximal tibia in non-sport contexts.

With appropriate management, anterior tibial tuberosity fractures have an excellent overall outcome and a low complication rate. Restoration of extensor mechanism isometry and congruency of the articular surface of the tibia are primary treatment objectives. These goals can be achieved by closed means in patients with non-displaced or minimally displaced closed fractures in which the knee can be actively or passively extended to 0° (knee hinge immobilization). Open fractures or closed displaced fractures are managed by open reduction and internal fixation by tension band, cerclage wire, anchor, and/or lag screw fixation.

Lag screw fixation is the most commonly used technic. With this technic, the fractured anterior tibial tuberosity is reduced and fixed to the posterior tibial cortex with two lag screws. A popliteal neurovascular injury may occur because of the penetration of the screw into the posterior tibial cortex. To reduce the risk of posterior neurovascular injury, it is recommended to use an oblique direction for drilling and placing the screws [5].

Although complications are uncommon, treating providers should be aware and recognize the signs of post-operative complications such as compartment syndrome, bursitis and hardware prominence, and re-fracture [1,5].

In this case, although the trauma mechanism was unusual (assault by a sharp sward) this is consistent with previous literature patterning to cause of isolated anterior tibial tuberosity fractures that stipulate that they result from direct trauma in non-sport contexts. The choice of definitive treatment was based on current guidelines. Two lag screws placed in an oblique direction for the avulsed anterior tibial tuberosity, associated with tension band anchored on a third screw in order to reinforce the extensor mechanism was used.

This case demonstrates an excellent outcome, as the patient experienced a prompt and complete recovery. Follow-up revealed full range of motion recovery and an absence of pain in the injured knee with an excellent KOOP score (98).

Highlights

• Isolated open anterior tibial tuberosity fractures are rare clinical entities;

• Complications are uncommon when these injuries are treated promptly;

• Careful and personalized rehabilitation therapy following knee surgery permit optimal functional outcome with rapid social reintegration.

Conclusion

This case underscores the exceptional nature of an isolated open anterior tibial tuberosity fracture in an adult, sustained through a direct traumatic mechanism. Successful management through meticulous surgical intervention, including fixation with two lag screws and the reinforcement of the extensor mechanism of the knee with a cerclage wire, resulted in excellent functional recovery. Early rehabilitation and progressive weight-bearing allowed the patient to regain full range of motion and muscle strength without complications. This case also underscores the importance of individualized surgical approaches and structured rehabilitation protocols in achieving optimal outcomes for rare open anterior tibial tuberosity fractures.

FIGURES:

Figure 1: *Pre-operative images. (A) Clinical image showing the traumatic wound aligned with the anterior tibial tuberosity. (B) X-ray revealing a displaced fracture of the ATT. (C, D) 3D computed tomography images providing a detailed view of the fracture pattern.*

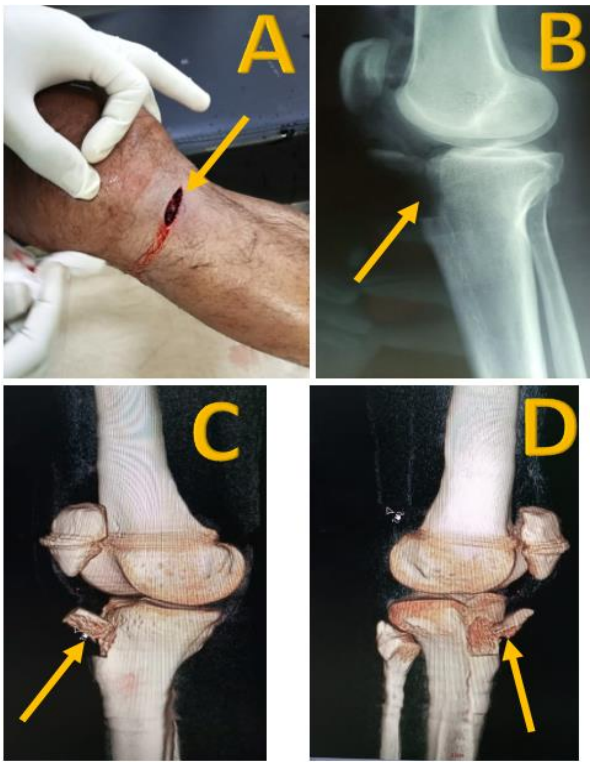

Figure 2:*Intra-operative images (A) Clinical image showing the surgical approach and the avulsed anterior tibial tuberosity. (B, C) Lateral and anteroposterior C-arm fluoroscopic images demonstrating two lag screws securing the ATT, with a tension band wire anchored on a third screw reinforcing the extensor mechanism.*

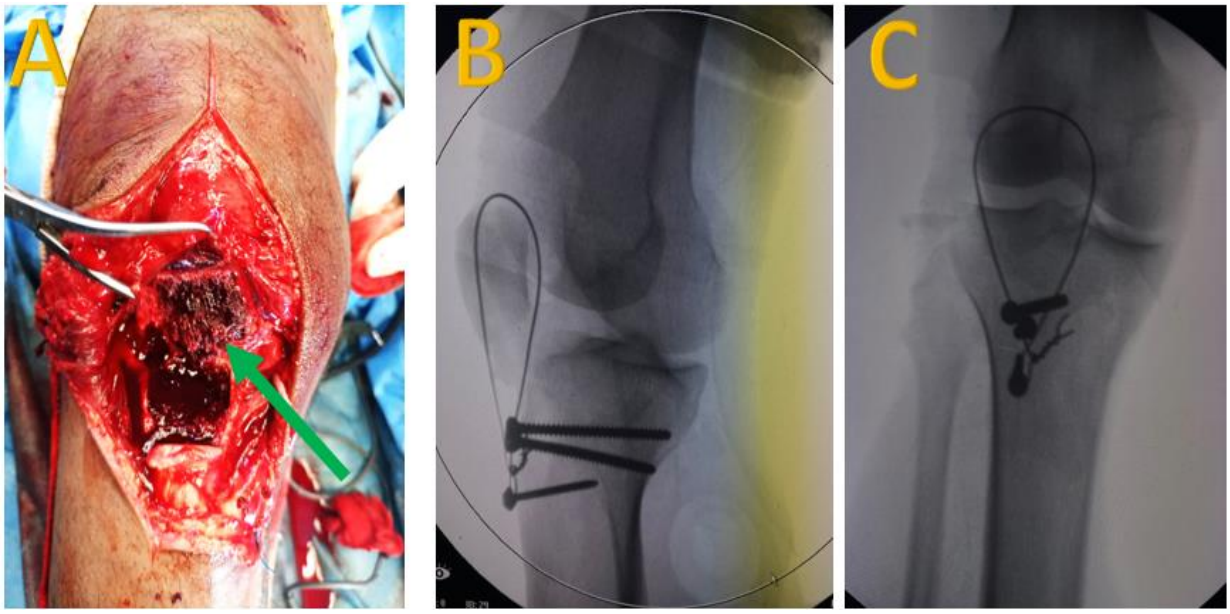

Figure 3: *(A) Antero-posterior and lateral views of X-ray images obtained at four weeks postoperatively. (B, C) Clinical images demonstrating functional rehabilitation using an "arthro-motor" to facilitate knee flexion beyond 30°.*

Figure 4: *Clinical images illustrating the progressive recovery of knee range of motion at two months postoperatively: (A) Active knee flexion at 120° in the supine position. (B) Squat exercise. (C) Cross-legged sitting position.*

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