



## Case report

# Extensor mechanism reconstruction and joint preservation surgery following a tibial tuberosity fracture in giant cell tumor of bone: A case report

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## ABSTRACT

**Introduction and importance:** Pathologic fractures of the tibial tuberosity secondary to giant cell tumor of bone are rare injuries. While there are several well-described methods in the literature to reattach the tibial tuberosity, these techniques rely on good quality bone. However, in the presence of diseased and weak bone, additional factors have to be considered.

**Case presentation:** A 47-year-old man with a Giant Cell Tumor of bone affecting the proximal tibia presented with a displaced avulsion fracture of the tibial tuberosity. The patient underwent surgical curettage, bone grafting and osteosynthesis with reattachment of the tibial tuberosity. Eighteen months after surgery there is no evidence of tumor recurrence, and despite mild knee pain and a limited range of movement, the patient has returned to work.

**Clinical discussion:** The extensor mechanism was repaired by first reinforcing the tuberosity fragment with an autograft before reattaching it using a tension band FibreWire® suture. Without access to a tumor endoprosthesis we used a joint sparing approach to treat the Giant Cell Tumor.

**Conclusion:** Patients with dual-pathology present technical challenges in repairing the extensor mechanism and treating the underlying condition. Surgeons must address competing priorities in a holistic, patient-centred approach consistent with their working environment.

## 1. Introduction

An avulsion fracture of the tibial tuberosity is an uncommon injury, typically seen in adolescent males. These fractures are classified according to Ogden and constitute <3 % of all epiphyseal injuries [1]. The mechanism of injury is often attributed to a powerful quadriceps contraction which overwhelms the strength of the tibial pysis resulting in a fracture [2]. However, isolated tibial tuberosity fractures in adults are extremely rare, and most are caused by high energy trauma and associated with complex knee injuries [3,4].

In exceptional circumstances, pathological conditions which weaken the bone may result in a fracture of the tibial tuberosity. Giant Cell Tumor of bone (GCTB) is a locally aggressive benign tumor typically found in the meta-epiphyseal region of the knee joint. Between 10 and 12 % of GCTBs will present as a pathologic fracture. There is only one previous case report of a GCTB presenting as a partial avulsion fracture of the tibial tuberosity [5].

We describe the clinical challenges in treating a 47-year-old man with a pathologic fracture of the tibia tuberosity secondary to a giant cell tumor of bone. This work has been reported in line with the SCARE 2020 criteria [6].

## 2. Presentation of case

A 47-year-old man presented to the Accident and Emergency department with a swollen, painful left knee after falling down a flight of stairs. He recalled hearing an audible “pop” and felt his knee buckle beneath him. On physical examination, his knee was swollen and painful, and he was unable to actively straight leg raise or extend the joint. Initial radiographs revealed a large lytic area occupying almost the entire tibial metaphysis with an avulsion fracture of the tibial tuberosity. Fig. 1. On further questioning, the patient admitted that two years before this accident he was being investigated in an orthopedic clinic for swelling around his knee and a “cyst” in the bone.

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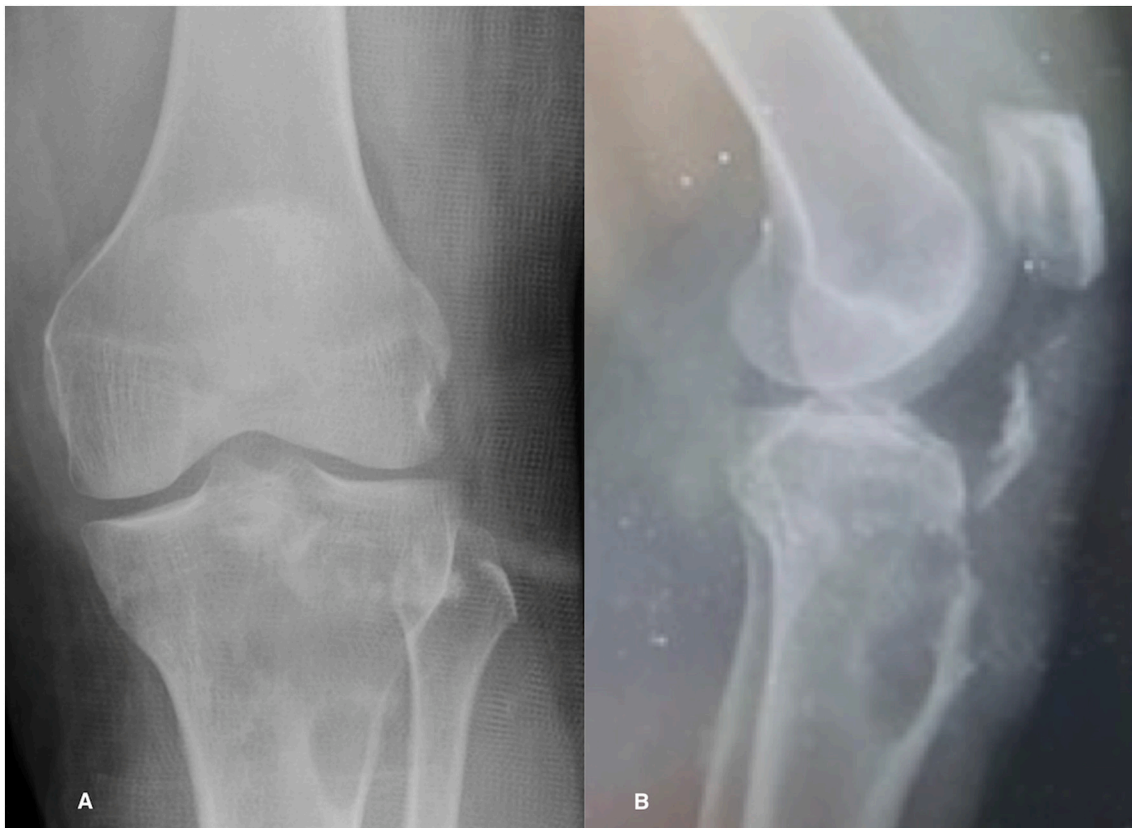
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**Fig. 1.** Anteroposterior (A) and lateral (B) radiographs of the knee demonstrating a cystic area in the proximal tibia with a displaced avulsion fracture of the tibial tuberosity.

A magnetic resonance imaging (MRI) scan reported a T2W high signal heterogeneous mass involving the tibial metaphysis with a cortical breach into the surrounding anterolateral soft tissues but no intra-articular penetration. Fig. 2. These findings suggested a malignant tumor, and a biopsy was recommended. An incisional biopsy confirmed the mass was a Giant Cell Tumor of bone and the chest computed tomography (CT) scan was negative for pulmonary metastasis. Based on the available information, we classified the lesion as Campanacci Grade III [7]. After informing the patient of his diagnosis and explaining the surgical plan, final preparations were made for surgery.

Using a pneumatic tourniquet to achieve a bloodless feel, we made a 15 cm midline incision and raised full-thickness skin flaps revealing retinacular tears along the borders of the patella tendon and a displaced tuberosity fragment. We encountered a mass of soft, friable, reddish-brown material emanating from a breach of the lateral tibial metaphysis. Extending the cortical window allowed a better view permitting the use of multiple curettes. We removed the tumor until there was punctate bleeding from the endosteum. Tissue samples were sent for histopathology and microbiology analysis. A high-speed power burr denuded the exposed endosteal bone, ensuring a more thorough debridement. Finally, taking care to protect the soft tissues, the cavity was treated with phenol (80 %) for 5 min, followed by copious normal saline irrigation. At the end of the procedure, the cortical window measured approximately 2 cm × 2.5 cm and was partially encroaching on the footprint of the tibial tuberosity. Morselised allograft was used to pack the cavity, and it was contained using a polypropylene mesh secured with suture anchors.

We stabilised the proximal tibia with a seven-hole lateral tibial locking plate and then turned our attention to the thin and weak avulsed tibial tuberosity fragment (Fig. 3A). We used a block of tricortical iliac crest autograft and overlapped it with the tuberosity fragment bound together with 2 Vicryl sutures through drill holes. The manufactured

composite was more robust, which facilitated a secure reattachment with FibreWire® (Arthrex Inc. USA) sutures using the tension band technique described by Parinyakhup and Booriong and reinforced with a retinacular repair [2] (Fig. 3B). Intraoperative testing demonstrated stability of the repair up to 90° of flexion.

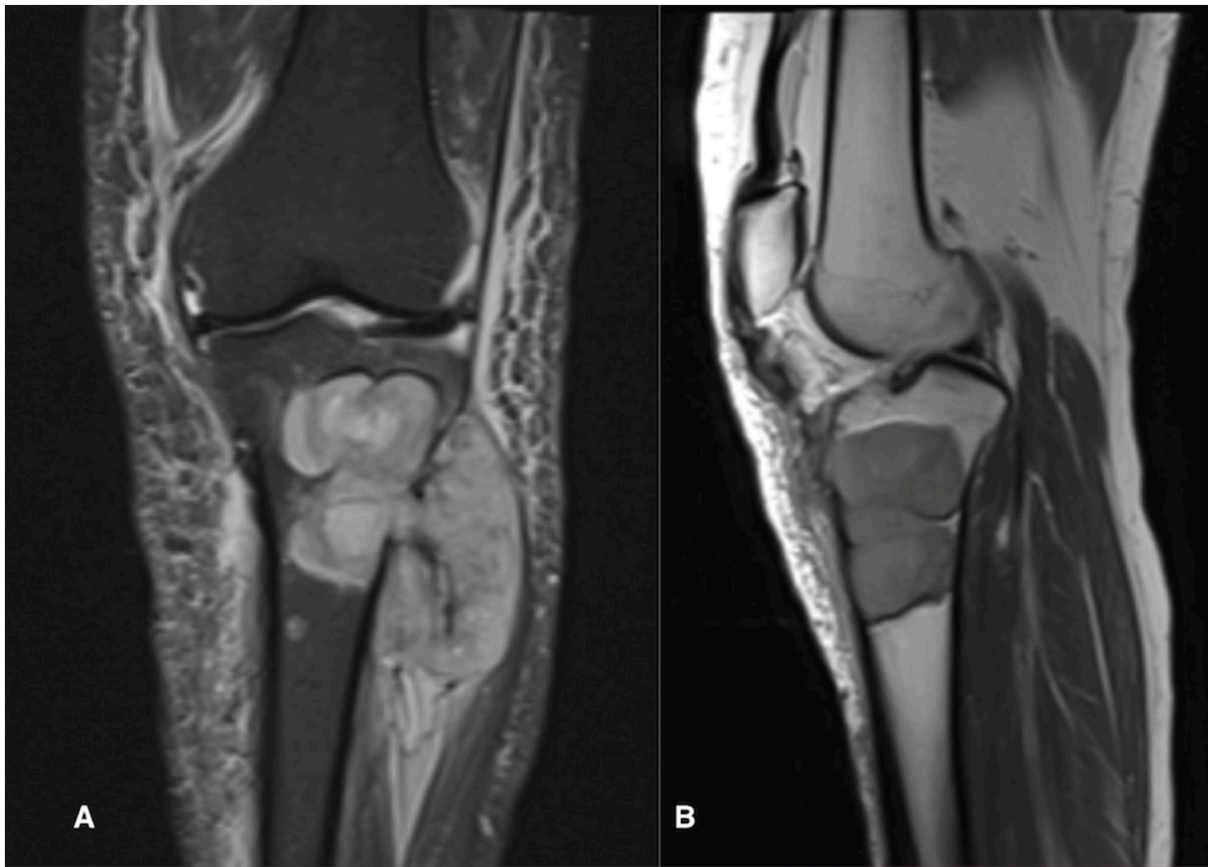
Postoperatively, the patient was placed in a range of movement (ROM) knee brace and allowed motion from 0 to 30° coupled with partial weight-bearing using crutches. Fig. 4. Six months post-surgery, radiographs showed satisfactory graft healing, but persistent skin irritation caused by a prominent screw prompted us to remove the lateral plate and screws.

Eighteen months after surgery, the patient reports mild knee pain, and radiographs show no evidence of recurrence (Fig. 5). He uses a walking stick for balance, and although he has a limited range of knee movement (0 to 60°), he works as a self-employed vegetable vendor.

### 3. Discussion

An isolated tibial tuberosity fracture in an adult is very uncommon. Our literature search revealed only five reports describing this injury in normal bone, three in Paget's disease of bone and in one case involving a Giant Cell Tumor of bone [2,5,8–14]. Table 1. In diseased bone, the tibial tuberosity is the weakest link in the extensor mechanism and is especially vulnerable. In situations where a tuberosity fracture occurs through diseased bone two priorities have to be considered (1) securely reattaching the tibial tuberosity and restoring the extensor mechanism and (2) definitive treatment of the underlying bone disease. We discuss our management of both priorities in this unique case.

Reattachment of the tibial tuberosity should follow the principles of fracture management: stable fixation, which permits early knee movement. We faced two problems in repairing the extensor mechanism: the thin tuberosity fragment and the poor bone quality of the tumor-affected



**Fig. 2.** Magnetic resonance imaging (MRI) of the knee.

Coronal T2-weighted image (A) shows a heterogeneous high signal soft tissue lesion at the tibial metaphysis with a breach of the cortex and extension into the surrounding soft tissues

Sagittal T1-weighted image (B) shows a low signal intensity lesion at the proximal tibia and an avulsion fracture of the tibial tuberosity.

proximal tibia. To address this, we created a more robust and larger composite by suturing together the tuberosity fragment and tricortical autograft, then reattaching it with a tension band FibreWire® suture. Tension band wiring is ideal for these situations as it converts tensile forces to compression forces during knee movement. Radiographs at one year show healing between the autograft and tibia proximally, with a fibrous non-union of the tuberosity and heterotopic ossification of the patella tendon. Critically, the extensor mechanism was restored to allow active knee extension and acceptable function.

Surgery is the treatment of choice for Giant Cell Tumors of bone. Our patient had an extensive (>50 % circumference), Campanacci grade III tumor with an associated fracture and may have benefited from en-bloc excision and endoprosthesis reconstruction. However, we do not typically have access to these complex and expensive implants in the public hospitals. In this instance we were fortunate to have a relatively large stock of freeze-dried allograft that was donated by a visiting health team. We used only allograft supported by a lateral locking plate to reconstruct the defect. This decision was driven by our belief that a biological reconstruction would provide the best long term durability and ease of future reconstructive procedures. In a retrospective study of 43 patients with Campanacci grade III GCTB, Benevenia et al. compared

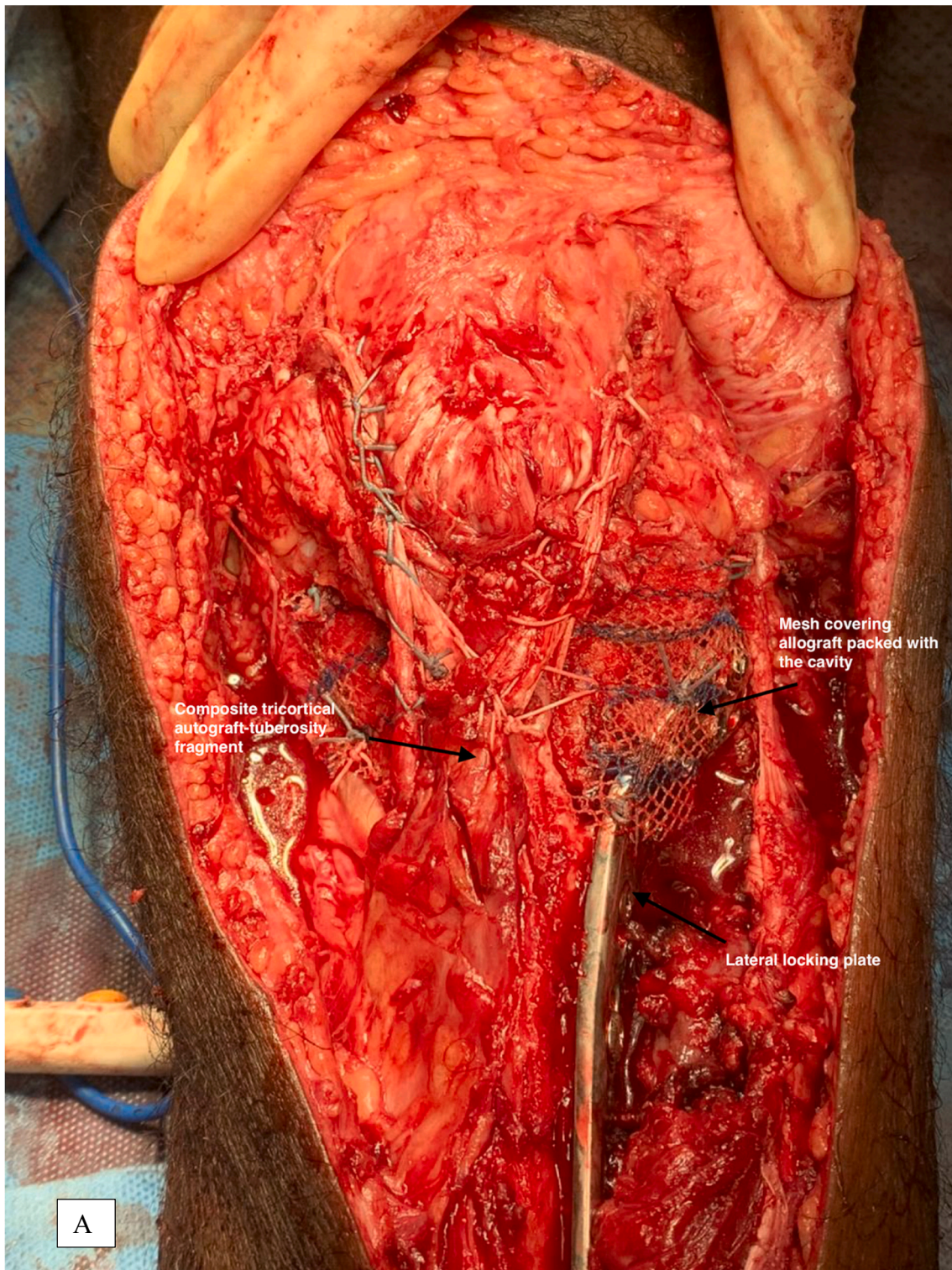
patients reconstructed using allograft ± polymethylmethacrylate (PMMA) to PMMA alone. They found that patients using allograft ± PMMA had significantly fewer non-oncologic complications, with no difference in recurrence rates and mean Musculoskeletal Tumor Society (MSTS) scores [15]. In hindsight, we may have achieved a better result by combining PMMA with allograft. The construct would have provided immediate stability, permitting early weight-bearing without plate osteosynthesis.

#### 4. Conclusion

A tibial tuberosity fracture involving Giant Cell Tumor of bone affecting the proximal tibia can be successfully treated by curettage and bone grafting, plus tension band suturing. This method avoids the need for endoprosthesis reconstruction and is suitable for a low-resource healthcare environment.

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Nil.



**Fig. 3.** A. Intraoperative clinical photograph of the knee showing the reattached composite tricortical autograft-tuberosity fragment. The polypropylene mesh is seen containing the allograft within the cavity next to the lateral locking plate.  
B. Illustration of the composite tricortical autograft-tuberosity fragment reattached to the proximal tibia and the allograft-packed cavity covered by polypropylene mesh.

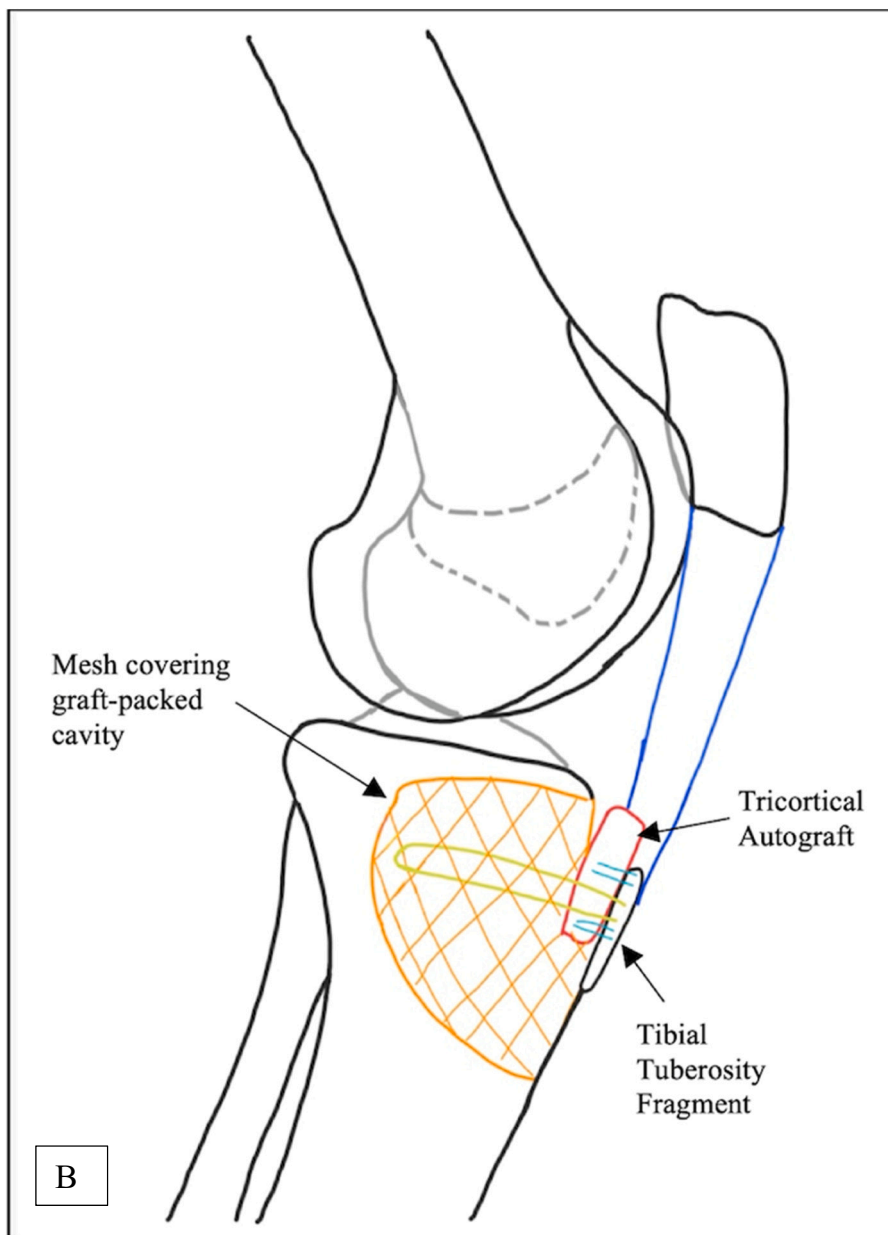


Fig. 3. (continued).

**Ethical approval**

Not required.

**Consent**

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

**Author contribution**

Marlon M. Mencia revised the first draft and wrote final manuscript. Reena Moonsie collected the data, conceptualised the case report, and wrote the first draft. Both authors read and approved the final manuscript.

**Registration of research studies**

Not applicable.

**Guarantor**

Marlon M. Mencia.

**Provenance and peer review**

Not commissioned, externally peer-reviewed.

**Declaration of competing interest**

Nil.



**Fig. 4.** Immediate post-operative radiographs of the knee. Anteroposterior (A) and lateral (B) views showing the lateral locking plate and the allograft filling the cavity.



**Fig. 5.** Late post-operative radiographs of the knee following the removal of the locking plate. Anteroposterior (A) and lateral (B) views demonstrating almost complete incorporation of the graft with no evidence of recurrence. Note that the tricortical autograft has united but there is a fibrous non-union of the tibial tuberosity and heterotopic ossification of the patella tendon.

**Table 1**  
Summary of studies describing the treatment of adult tibial tuberosity fractures.

Study	Year	Comorbidity	Sex	Age (yrs)	Mechanism of injury	Fixation method
Kanawati and Lorentzos [14].	2009	Nil	F	88	Low energy fall	Cannulated Screw and Tension Band Wiring
Hirschmann et al. [12]	2009	Nil	F	81	Knee gave away while descending stairs	Screws and Arthrex FibreWire®
Pires e Albuquerque et al. [11]	2013	Nil	M	62	Direct trauma	Cannulated Screws 6.5 mm
Parinyakhup and Boonrieng [2]	2020	Nil	F	64	Direct trauma	Arthrex FibreWire®
Brown et al. [13]	2020	Nil	M	86	Low energy fall	Screw and Arthrex Corkscrew® Suture Anchor
Coombes W [10].	1972	PDB	M	32	Low energy fall	Sutures through the bone
Douglas D.L. [9]	1983	PDB	M	32	Knee gave way	Screw and K-wires
			M	29	Knee gave way while gardening	Screws
Raad et al. [8]	2021	PDB	M	54	Knee gave way while standing	Screw and Tension Band Wiring
Cipriano et al. [5]	2010	GCTB	M	20	Knee gave way while running	Sutures through the bone

PDB-Paget's Disease of Bone; GCTB-Giant Cell Tumor of Bone; NA-Not available.

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