

Case Report

# Impending Compartment Syndrome Secondary to Pseudoaneurysm following Stabilization of Proximal Tibia Shaft Fracture: A Case Report

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## Keywords

Compartment syndrome · Tibia fracture · Case report · Pseudoaneurysm

## Abstract

Compartment syndrome secondary to pseudoaneurysm formation following surgical stabilization of tibia shaft fracture is a rare entity. Early recognition as early as possible can prevent associated morbidities and significant disabilities by surgical decompression of leg compartments. A 56-year-old male patient presented to our clinic during his routine postsurgical follow-up with a progressive painful right leg swelling, which progressed over 2 months following right tibia shaft stabilization secondary to a road traffic accident. The patient underwent further investigation of this swelling. After infection was ruled out, it was found to be a pseudoaneurysm. Following diagnosis, the patient underwent endovascular coiling of the pseudoaneurysm feeding vessel, and surgical decompression with evacuation of the hematoma was performed. Multiple causes for compartment syndrome do exist; pseudoaneurysm is different from other causes in that it has a feeding vessel. Careful preoperative endovascular coiling is important to prevent and control intraoperative bleeding, which prevents further development of compartment syndrome. Moreover, aggressive postoperative physiotherapy should be avoided in the early period, especially soft tissue manipulation, as this might be a leading cause for the development of such a condition.

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## Introduction

Compartment syndrome is a surgical emergency with multiple traumatic and nontraumatic causes [1]. There have been reports of uncommon multiple conditions leading to acute compartment syndrome outside the scope of trauma such as diabetes mellitus, hypothyroidism, leukemia infiltration, nephrotic syndrome, rhabdomyolysis, and the use of anticoagulation [2–5]. The relation between tibia shaft fracture and compartment syndrome has been well established in the literature, and the gold standard treatment of such a fracture is intramedullary nail fixation with surgical decompression of the leg compartments [6, 7]. Postoperative complications are rare and these include infection, delayed fracture healing, non-union, and malunion [8]. Other rare complications have been reported in the literature, and one of these important complications is pseudoaneurysm formation, whether secondary to direct trauma or caused by the surgeon [9–17]. We report a 56-year-old male patient with an unusual presentation of impending compartment syndrome following intramedullary nail fixation, which developed during his clinical follow-up secondary to pseudoaneurysm formation. The patient underwent surgical decompression of the leg compartment following endovascular coiling.

## Case Report

A 56-year-old healthy male presented to our trauma unit after he sustained a direct hit by a car with a chief complaint of isolated severe right leg pain, swelling, and inability to bear weight. On examination, he was hemodynamically stable, and the right leg revealed stony hard leg swelling with pain out of proportion. The pain exacerbated by passive ankle and toe dorsiflexion. The overlying skin and peripheral pulses were intact, while the sensation over the dorsum of the toes was diminished; the clinical picture was consistent with right leg compartment syndrome. The radiological evaluation confirmed the presence of a displaced fracture involving the proximal third of the tibia shaft (Fig. 1).

The patient was taken urgently to the operating theater for right leg compartment decompression and fasciotomy along with intramedullary nail fixation of a tibia fracture. All four leg compartments were released through dual medial-lateral 10-cm incisions. Intraoperatively, the muscles bulged through the deep fascia as soon as they were released; they were severely contused but viable, and hemostasis was secured. The tibia fracture was fixed utilizing a medial parapatellar approach of the knee, and a T2 Stryker intramedullary tibia nail was used for fracture fixation and stabilization (Fig. 2).

In the postoperative period, the patient was started on prophylactic antibiotics; he was vitally stable with good clinical improvement of his symptoms. The sensation over the dorsum of the foot was restored with intact motor function. Peripheral pulses were palpable. Laboratory results showed low hemoglobin (HG) of 7.1 gm/dL, which required transfusion of 2 units of packed red blood cells. On the 2nd postoperative day, the patient started non-weight-bearing ambulation on the right side. On the 3rd postoperative day, the patient underwent a second look debridement of the fasciotomy, which showed healthy muscles and some minimal hematoma, which was removed, and a negative pressure dressing over the wound was applied. Five days following fasciotomy, the patient underwent surgical wound closure in the operating theater. A couple of days later, he was discharged home with regular follow-up in the physiotherapy department and orthopedics trauma clinic.

Two months following the surgery, he was seen again in the trauma clinic with a history of progressive swelling and pain in his right leg not responding to analgesia. The pain started

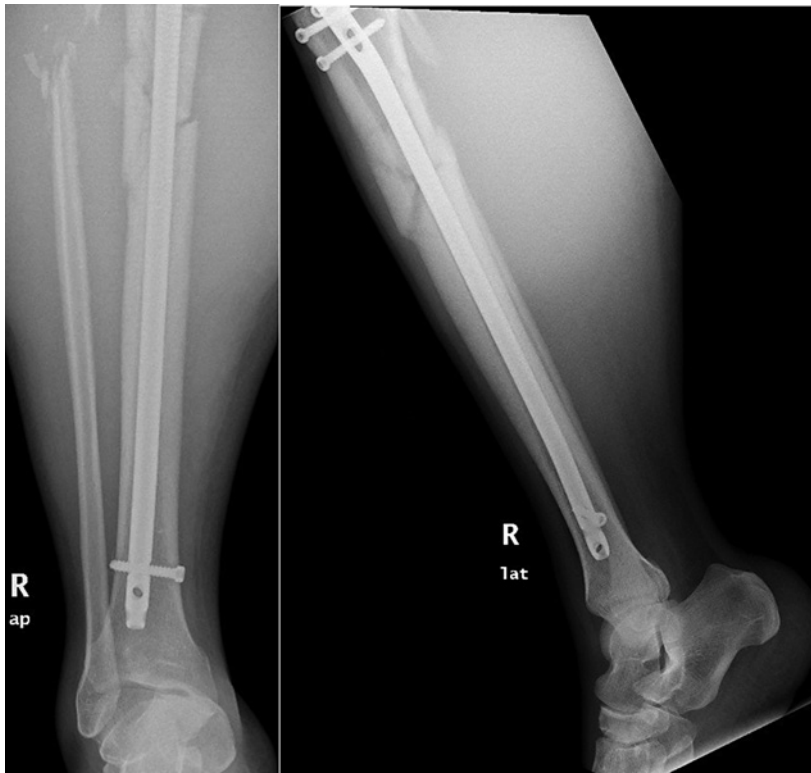


**Fig. 1.** Anteroposterior radiograph of the right tibia and fibula showing displaced fracture involving the proximal 3rd of tibia shaft at initial presentation.

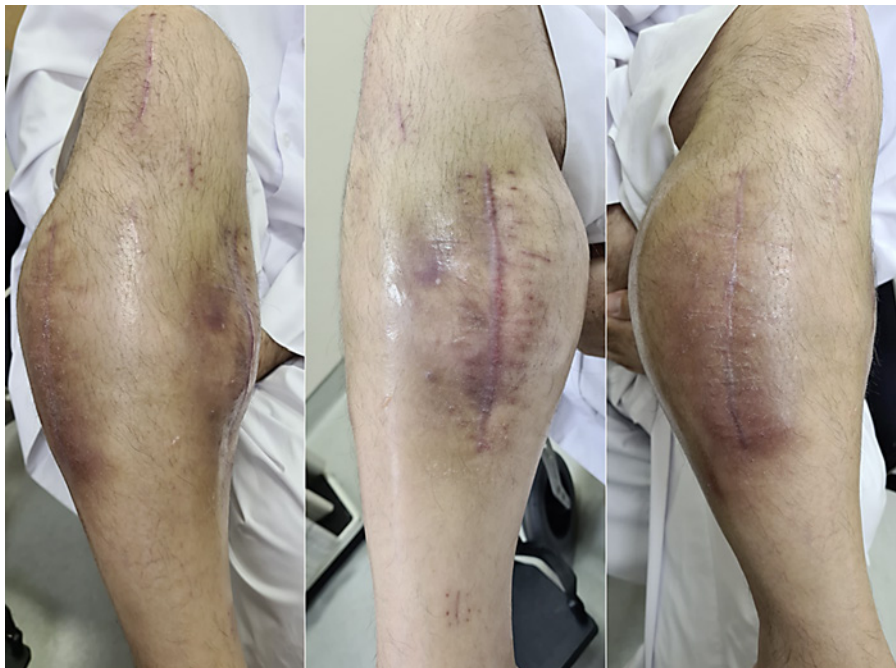
around 3 weeks before this visit, following aggressive soft tissue manipulation by physiotherapy. Clinical examination of the leg showed well-healed surgical scars with no signs of infection. There was significant diffused firm swelling of the right calf, and no neurovascular compromise was detected (Fig. 3). Laboratory investigation demonstrated high levels of C-reactive protein (CRP) 115 mg; the patient was admitted to the hospital for further investigation including septic workup and radiological workup. Magnetic resonance angiography of the right leg showed a large calf hematoma at the popliteal artery bifurcation, associated with a large patent pseudoaneurysm communicating with the tibio-peroneal trunk. The distal posterior tibial artery and the distal peroneal artery are reformed by collateral flow with maintained peripheral runoff (Fig. 4).

The patient underwent occlusion of the injured tibio-peroneal trunk and pseudoaneurysm endovascular coiling (Fig. 5). The following day, he underwent surgical exploration with hematoma evacuation of the pseudoaneurysm. Intraoperatively, there was atrophy of the muscles without any purulent discharge from the tissues, and a tissue sample was sent for culture and sensitivity, which showed no growth of any organism (Fig. 6). Postoperatively, the patient had significant symptom improvement and started ambulation on the first postoperative day. Then he was discharged home on the 5th postoperative day with regular follow-up in the clinic.

At 10-month postoperative follow-up, clinical examination showed well-healed surgical wounds, range of knee motion, and mild right ankle stiffness, with soft leg compartments (Fig. 7).



**Fig. 2.** Postoperative anteroposterior and lateral radiographs demonstrating the fixation of the tibia fracture using T2 Stryker intramedullary nail.



**Fig. 3.** Clinical picture of the right leg at 2-month follow-up, showing the anterior, medial, and lateral aspects of the leg, with diffused swelling of the calf muscles and well-healed surgical scars of the first compartment decompression surgery.



**Fig. 4.** Magnetic resonance angiography (MRA) of the right leg demonstrating a large hematoma associated with a large patent pseudoaneurysm communicating with the tibio-peroneal trunk as pointed with the arrow.

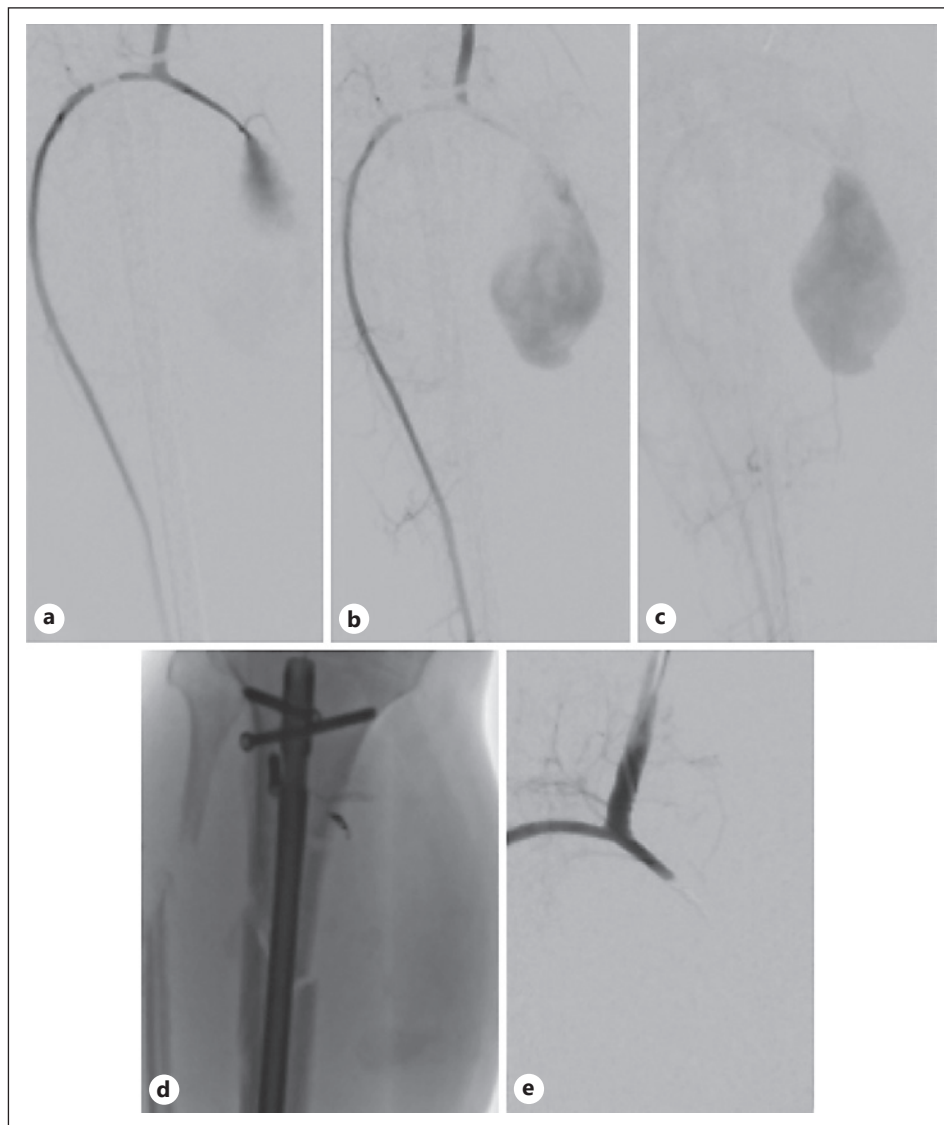
## Discussion

Pseudoaneurysms do not contain all three layers of arteries, and they occur secondary to damage of the adventitial layer. This leads to gradual, persistent extravasation of blood into the surrounding soft tissues that connect within the arterial lumen [18]. Blunt trauma is a common mechanism that can lead to the rise of pseudoaneurysms secondary to vessel injury; not only direct trauma but also fracture reduction maneuvers have been reported to be a cause of pseudoaneurysm formation [19, 20]. Traumatic pseudoaneurysms can be presented acutely or they can be discovered with the delayed presentation following unrecognized arterial injury [21].

Clinical presentation may vary according to the lesion site and size, and it is important to differentiate it from any surgery-related infection. Some clinical features may help in this differentiation, and the most common clinical finding in cases of pseudoaneurysm is a painful pulsating swelling [18]. Ideally, such a patient will need further invasive radiological investigation to help confirm the diagnosis as well as surgical planning. It can be diagnosed using Doppler ultrasound, computed tomography angiography, and magnetic resonance imaging [18, 19, 22]. Another modality is angiography, which is an invasive modality, not only helpful in investigating the lesion but also provides the possibility of performing an endovascular treatment procedure.

Compartment syndrome is one of the most important rare associated conditions with post-traumatic pseudoaneurysm that should be identified promptly to avoid associated morbidities [20]. It occurs secondary to progressive pressure elevation within the fascial compartment and the inability of the connective tissues to stretch [1]. Surgical decompression





**Fig. 5.** Right lower limb angiogram with endovascular coiling. **a–c** Blood flow into the pseudoaneurysm. **d** and **e** Endovascular coiling with occlusion of the feeding vessel.

of the compartment syndrome is mandatory regardless of the cause, as this will prevent further complications and disabilities. Regular follow-up of such patients is of great importance as an associated unrecognized arterial injury with tibia fracture may occur, and this may lead to slow development of increased intra-compartment pressure in the leg; the physician should be aware of such complications.

In our case, the patient had a drop in the HG level postoperatively, which needed a blood transfusion. This HG drop should have been an alerting sign of ongoing bleeding, which might have led to the increase of the inter-compartmental pressure. Furthermore, aggressive soft tissue manipulation following such a significant injury should be avoided in the early postoperative period as this might result in the development of unrecognized bleeding, leading to slowly progressive compartment syndrome. Such a presentation mandates further clinical and radiological evaluation with intervention to prevent complications.



**Fig. 6.** Intraoperative picture of surgical evacuation of the pseudoaneurysm hematoma.



**Fig. 7.** 10-month postoperative clinical picture of the patient post decompression of the pseudoaneurysm hematoma.

Endovascular coiling or embolization and surgical ligation are the treatment options for pseudoaneurysms of minor arteries such as tibial, ulnar, or radial arteries. This procedure can be done freely after diagnostic angiography with direct cannulation of the artery and/or embolization [18]. This will allow good control of bleeding and safer surgical removal of secondary hematoma from the pseudoaneurysm sac to decompress the muscles compartment.

### Conclusion

This case emphasizes that compartment syndrome secondary to pseudoaneurysm is a rare yet serious complication. Orthopedics and trauma surgeons should be aware of such rare presentations and complications. Clinical examination and early diagnostic escalation are important to prevent delayed treatment. Furthermore, carrying early surgical intervention of the compartment syndrome may lead to the prevention of developing devastating morbidities and significant disabilities. The care checklist has been completed by the authors for this case report, attached as supplementary material.

### Statement of Ethics

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 of this journal upon request. This article was approved by the Local Medical Research Center (MRC-04-22-319) for publication and by the IRB at our institute, Hamad Medical Corporation, Orthopedics Department, Doha, Qatar.

### Conflict of Interest Statement

The authors have no competing interests to declare.

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### Author Contributions

Jawad Nouraldeen Derbas: investigation and writing – original draft, review, and editing. Isam Moghamis: investigation and writing – review and editing. Aiman Mudawi: investigation, writing, and writing – review and editing. Syed Intakhab Alam: investigation, project administration, and writing – review and editing. Basim Shaman Ameen: investigation, supervision, project administration, original draft, and review and editing.

### Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.



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