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Case Report

Management of long bone fractures in patients with cerebral fat embolism syndrome☆,☆☆

Rebecca D. Chase[a], Sheena J. Amin[b,*], Rakesh P. Mashru[c,d], Henry J. Dolch[c,d], Kenneth W. Graf[c,d]

[a] Philadelphia College of Osteopathic Medicine, Philadelphia, PA, United States of America
[b] Drexel University College of Medicine, Philadelphia, PA, United States of America
[c] Cooper Medical School of Rowan University, Camden, NJ, United States of America
[d] Cooper University Hospital, Camden, NJ, United States of America

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ABSTRACT

Fat embolism syndrome (FES) is a rare complication associated with long bone fractures. Intramedullary nailing is the gold standard for treating patients with these injuries and early surgical intervention can prevent FES. However, there is a paucity of data on managing these patients once FES has developed. The purpose of this study is to present 3 unique cases of polytrauma patients with long bone fractures who underwent fixation with Taylor Spatial Frame, open reduction and internal fixation, or submuscular plating for treatment of these injuries. All 3 patients had complete cognitive and physical recovery.

Introduction

Fat emboli occur in 90–95% of patients with long bone fractures [3,4]. The presence of fat emboli after these injuries can lead to fat embolism syndrome (FES), which has an incidence rate of 1–10% [3,4,7]. The classic triad of symptoms for FES includes hypoxia, petechia, and altered mental status, with other symptoms consisting of tachycardia, fever, anemia and thrombocytopenia [1,2,7].

Intramedullary nailing (IMN) is the gold standard for treating long bone fractures, and studies have shown that the risk of developing FES is lower for patients who undergo early operative fixation [1,7,9]. However, there is a paucity of data in regard to management of these injuries once FES has developed. The purpose of this report is to present 3 cases of patients with long bone fractures and cerebral FES prior to definitive fracture fixation. Due to concerns for exacerbation of these patients' clinical condition, we deviated from IMN to either a Taylor Spatial Frame (TSF), open reduction and internal fixation (ORIF), or submuscular plating (SMP) for treatment.

Patient cases

Case 1 is an 18-year-old male who presented with an open midshaft tibia and fibula fracture. Initial Glasgow Coma Score (GCS) was 15. He underwent emergent irrigation and debridement (I&D) with external fixation. Postoperatively, he was not arousable and had a depressed mental status with a GCS of 5, decerebrate posture, leftward gaze preference, and nystagmus. Magnetic resonance

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* Corresponding author at: Cooper University Hospital, 3 Cooper Plaza Suite 400, Camden, NJ 08103, United States of America.
E-mail address: saa322@drexel.edu (S.J. Amin).

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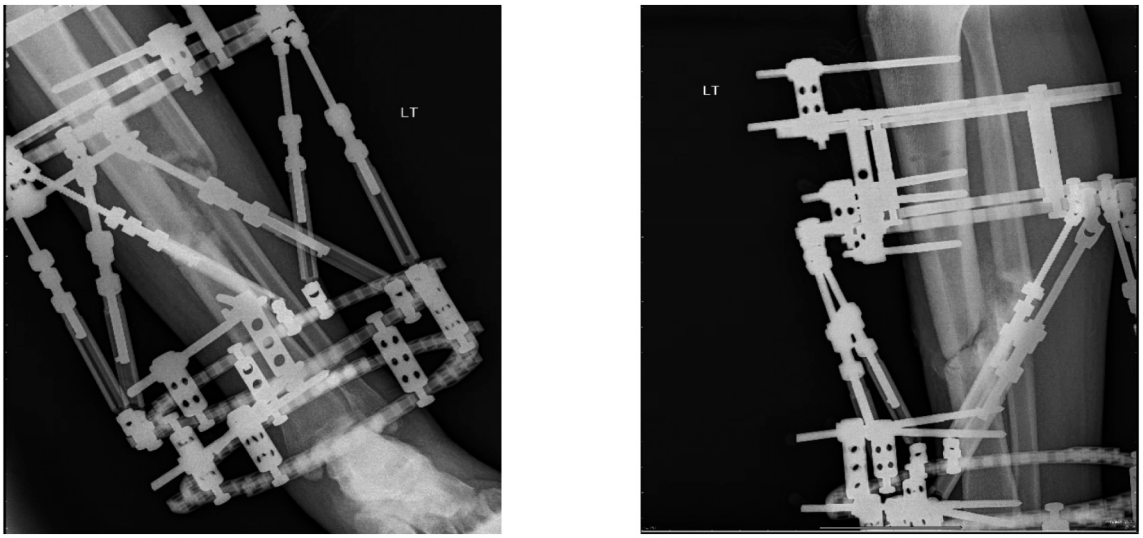
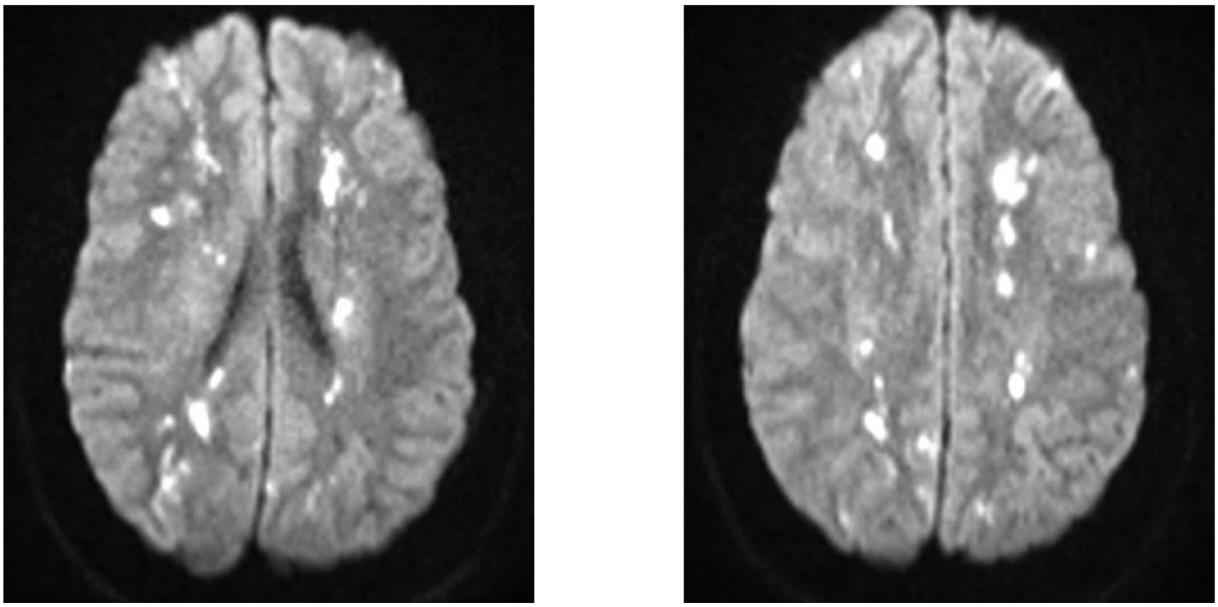


Fig. 1. a & b. Post-operative X-rays of the ringed external fixator (REF) used in Case 1. (a) AP tibia. (b) Lateral tibia X-rays.

Fig. 2. a & b. Follow-up X-rays 1 year after placement of REF (removal at 6 months) for Case 1. (a) AP tibia. (b) Lateral tibia.

imaging (MRI) of the brain demonstrated multiple foci of punctate abnormality consistent with cerebral FES. The patient remained intubated and was given supportive care. One month after injury, he underwent removal of the static external fixator and placement of a TSF (Fig. 1a–b). The patient had complete resolution of all neurologic symptoms and had TSF removed 6 months postoperatively. By one year postoperatively, he returned to normal cognitive and physical function (Fig. 2a–b).



a b

Fig. 3. a & b. MRI Brain of case 2 showing multiple embolic infarcts.

Case 2 is a 26-year-old female who presented with bilateral open comminuted femoral shaft fractures and a segmental humeral shaft fracture. Upon arrival, she was intubated and had a GCS of 3 with improvement to 11 after trauma resuscitation protocols. The patient underwent I&D, wound closure, bilateral external fixation of the femur fractures and splinting of the left humerus. The patient had a gradual decline of GCS through postoperative day 3. MRI of the brain showed multiple emboli compatible with cerebral FES (Fig. 3a–b). The patient underwent repeat I&D, ORIF with SMP, and antibiotic bead placement for her left femur fracture on post-operative day 6 (Fig. 4a–d). Four days later, she underwent ORIF with SMP of her right femur (Fig. 5a–d). She had ORIF of her left humerus four days after. The patient had complete resolution of all neurologic symptoms by 1 month postoperatively and was discharged to rehab.

Case 3 is a 26-year-old male who sustained a posterior column/posterior wall acetabulum fracture with hip dislocation, Denis II S2 sacral fracture, distal tibial shaft and fibula fracture, humeral shaft fracture, nondisplaced femoral neck fracture, subtrochanteric femur fracture, talus fracture, navicular fracture and cuboid fracture. He presented with a GCS of 15. His right hip dislocation was reduced, and bilateral distal femur traction pins were placed. He underwent external fixation of his tibia and femur fractures with percutaneous pinning of his femoral neck fracture. The patient remained intubated and continued to have a decline in mental status throughout the hospital course with diffuse muscle flaccidity, left-sided gaze preference, and extensor-posturing of the extremities. MRI of the brain demonstrated emboli consistent with cerebral FES, which was treated with supportive care. Once medically stable, the patient underwent removal of the external fixator and ORIF with SMP of the left femur (Fig. 6a–c). Three days later, he underwent ORIF of his right acetabulum. Right sacro-iliac screw fixation, ORIF with SMP of the right tibia, and flexible nailing of the fibula were performed on hospital day 7 (Fig. 7a–d). ORIF of the humerus was performed on hospital day 10. The patient had a gradual improvement in neurologic function. At 1-year follow-up, he had a complete resolution of cognitive deficits and had returned to normal function with radiographic imaging showing healed fractures (Figs. 8a–d and 9a–c).

Discussion

We describe the cases of 3 trauma patients who were treated with TSF, ORIF, and SMP after the onset of cerebral FES. FES is a rare complication that can occur after long bone fractures and be prevented with early surgical intervention [1,7,9]. Some studies and case reports have observed that delayed fracture fixation can increase the risk of FES [1,7,9]. Pinney et al. found that delayed definitive treatment, defined as > 10 h after injury, had a higher incidence of FES [7].

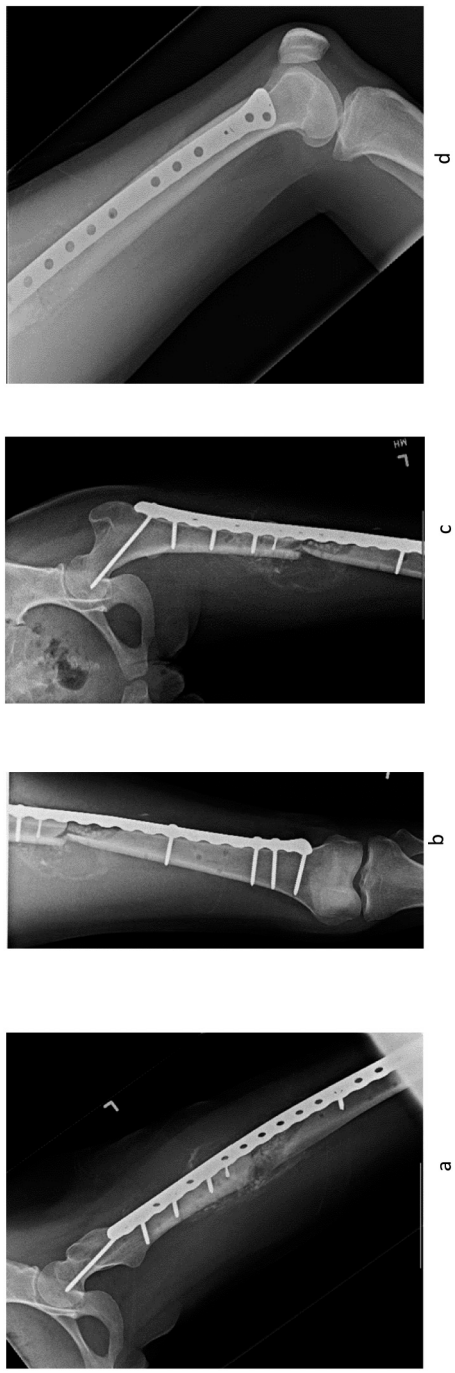


Fig. 4. a–d: Submuscular plates for left open femur fracture with antibiotic beads of Case 2. (a) Proximal lateral of femur. (b and c) Proximal and distal AP of femur. (d) Distal lateral of femur.

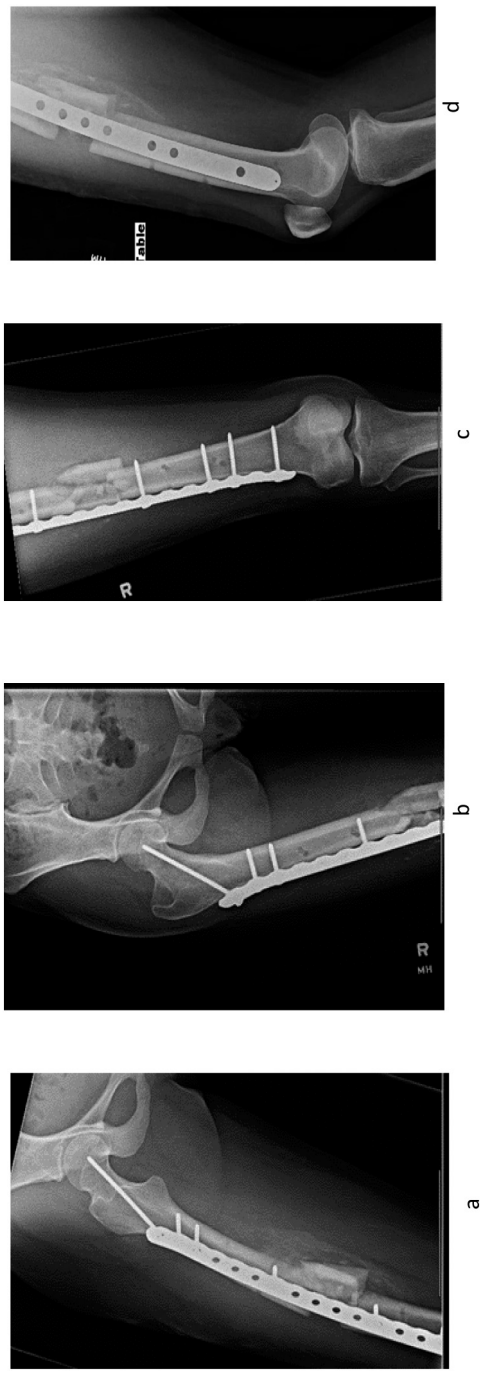


Fig. 5. a–d. Submuscular plates for right femur fracture of Case 2. (a) Proximal lateral of femur. (b) and (c) Proximal and distal of femur. (d) Distal lateral of femur.

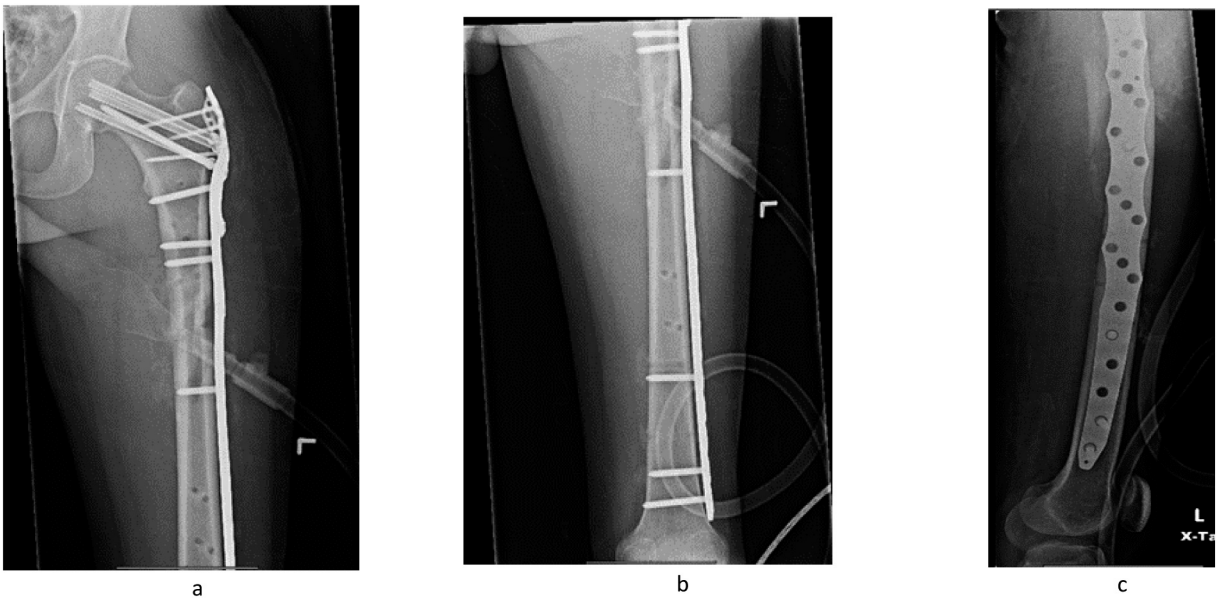


Fig. 6. a–c. Submuscular plating for left femoral shaft fracture in Case 3. (a and b) Proximal and distal AP of femur. (c) Distal lateral of femur.

There is a paucity of data available in regard to managing these patients after the onset of FES. There are only 4 case reports in the scientific literature of patients with femur or tibia fractures who developed FES before definitive surgical fixation [5,6,9,10]. Kim et al. presented a patient with segmental femur and tibial shaft fractures who developed cerebral FES 13 h after the injury [5]. Randelli et al. discussed a patient with bilateral femur fractures that developed cerebral FES and a pulmonary embolism before IMN [9]. Xu et al. described a patient with cerebral FES prior to fixation of her tibial shaft fracture [10]. All patients were treated with IMN and experienced complete cognitive and physical recovery with the exception of one that had a persistent speech disturbance [5,6,9,10].

Although IMN is the gold standard for treating fractures of the long bone, some reports have suggested that the process of reaming and placing an IMN can increase the pressure in the intramedullary canal, which can release fat emboli into the systemic circulation and propagate symptoms of FES [1,3,4]. Due to risk of fat emboli associated with reaming for IMN, the decision was made to treat our patients with cerebral FES with alternative techniques to allow for early fracture fixation without the risk of propagating symptoms of FES. All of our patients had successful resolution of cognitive and physical function with healed fractures. Based on the information provided by our current paper and previous case reports, cerebral FES may not preclude patients from definitive surgical fixation for their orthopaedic injuries since these individuals can have the potential for full neurologic and physical recovery.

Conclusion

Despite the grim acute presentation of patients with cerebral FES, they have the potential for complete cognitive and functional recovery. Although these patients are typically treated with IMN, there is no data to guide their operative management after the onset of FES. We presented 3 patients who had undergone alternative surgical techniques after long bone fractures and had successful return of cognitive and physical function with healed fractures.

Declaration of competing interest

None of the above authors have any financial disclosures or conflicts of interest.

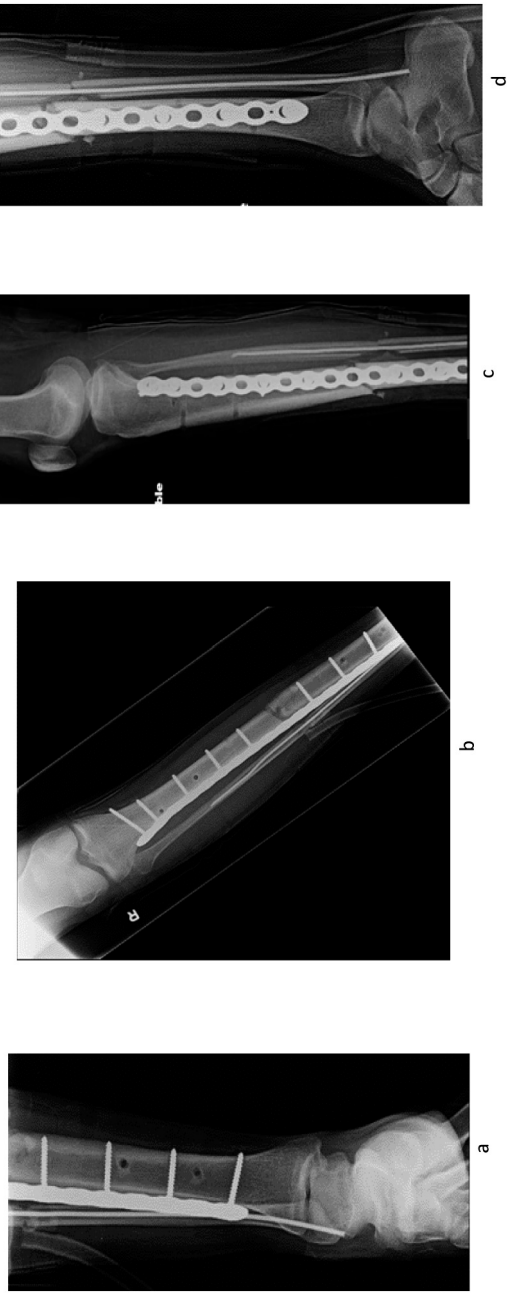


Fig. 7. a–d. Submuscular plating for right tibial shaft fractures in Case 3. (a and b) Distal and proximal AP of tibia. (c and d) Proximal and distal lateral of tibia.

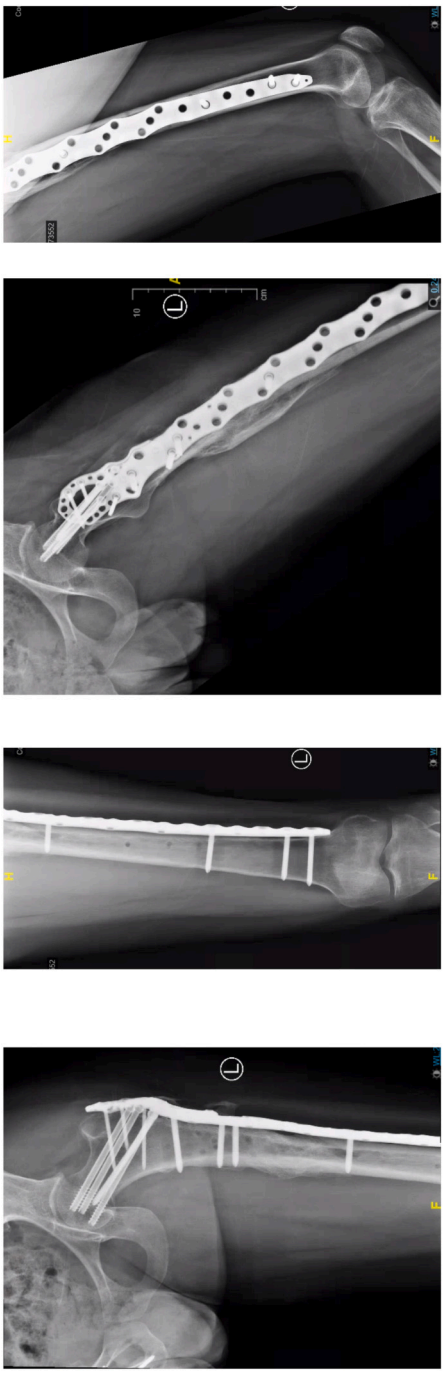


Fig. 8. a–d. Follow-up X-rays 1-year post-op for the left femur fracture of Case 3. (a and b) Proximal and distal AP of femur. (c and d) Proximal and distal lateral of femur.

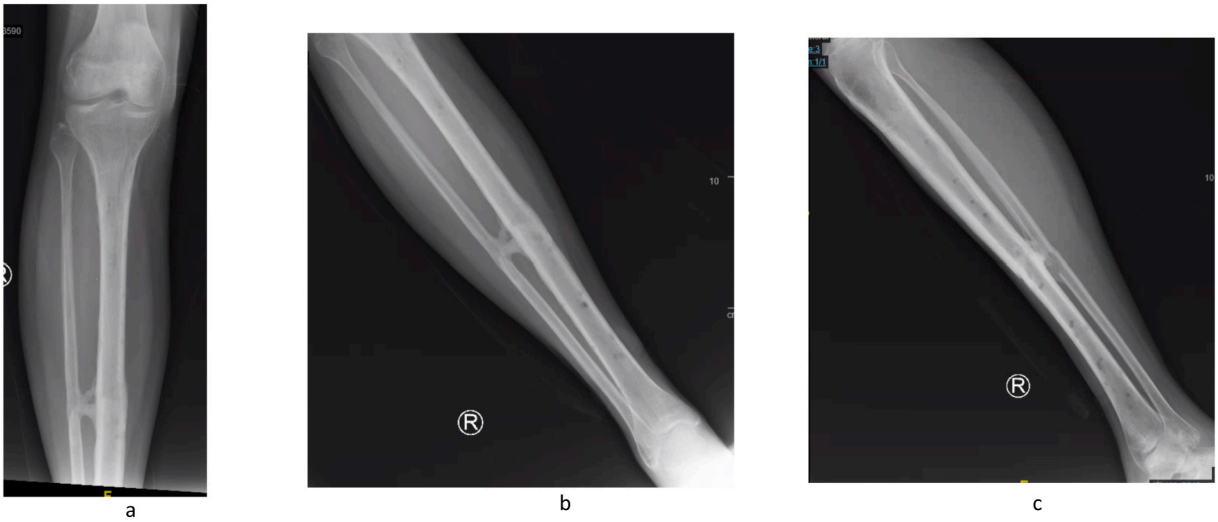


Fig. 9. a–c. Follow-up X-rays 1-year post-op after plate removal of the right tibia fracture of Case 3. (a and b) Proximal and distal AP of tibia. (c) Lateral of tibia.

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