Case Report

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Ilizarov's Accordion Manoeuvre for Treating Tibial Shaft Infected Non-union with Extensive Bone Loss: A Case Report

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Abstract

Introduction: The most commonest long bone to be fractured in an acute traumatic setting is tibia followed by femur. Due to low soft tissue coverage over the bone, they have a higher propensity to end up in open fractures. The fracture variety is described based on location as well as on the type of shearing injury. Due to the delicate inherent vascularity to the tibia bone, in an acute setting with high shearing mechanism, there is a higher chance for the primary fixation to fail due to the fractured ends going into non-union or mal-union. We report a case of a middle aged man, who met with a road traffic accident (RTA) and had presented to the casualty with an open injury and deformity of the left leg.

Case presentation: A comprehensive history and clinical examination revealed a lacerated wound on the lateral aspect of the distal third of the left leg, accompanied by swelling and visible deformity, though vital signs remained stable. Radiographs confirmed fractures of the distal third of tibia and fibula. Initial treatment involved wound debridement with application of an AO external fixator, but due to the extent of contamination it led to a bone infection that required resection, resulting in a 55-millimeter segmental bone loss. Following careful pre-operative planning, a four-ring Ilizarov external fixator (IEF) was applied, along with a proximal corticotomy and the accordion manoeuvre. The patient was monitored with serial radiographs for nearly 30 months, during which a 71-millimeter bone regenerate was achieved. The external fixator was then removed, and the patient was fitted with a knee-ankle-foot orthosis (KAFO) for four weeks, along with supportive physiotherapy. Post-surgery, the patient is now able to fully bear weight, has achieved 90° knee flexion, experiences limited ankle movement, and has a 3-centimeter limb length discrepancy.

Conclusion: Open tibia fractures are in itself a challenge to treat and if primary reduction fails, the main mode of management would include limb salvage procedures of which IEF application holds the torch to all other techniques. Removal of the infected bone segment and application of four ring IEF construct gave satisfactory results in regaining the bone regenerate.

Keywords: Segmental bone loss tibia, Ilizarov external fixator, Accordion manoeuvre.

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INTRODUCTION

In the field of orthopaedics, there a handful conditions which are treated as an emergency of which, traumatic open fractures is one such injury which is most commonly dealt with across the world. The incidence of open fractures is about 11.5 per 100,000 people per year with male predominance of which, tibia is the most commonly affected long bone followed by femur.[1] The fractures of the tibia can be further classified based on the anatomic location, the nature of injury and the mechanism leading to it. The vascularity to the tibia is quite dainty and hence poses problems in fracture healing. They often lead to either non-unions or malunions, former being higher in incidence. Here, we present a case report of an open tibia shaft fracture caused due to a high velocity injury where the primary stabilisation had failed and led to infection of the bone resulting in non-union at the fracture site and eventual resection of the infected portion was don. In-spite of segmental bone loss, the limb was salvaged and length was restored by using IEF and accordion manoeuvre.

CASE DETAILS

A 36-year-old male, who is a known hypertensive, presented with an alleged history of RTA sustaining injury to his left lower limb. He presented to the casualty with a lacerated wound over the lateral aspect of distal one-third of left leg, accompanied with a deformity. There were no other associated injuries. Patient complained of pain and inability to bear weight over the affected limb.

Fig. 1: Clinical picture of the open lacerated wound over the lateral aspect of left distal one-third tibia and radiographs depicting the distal tibia and fibula fractures respectively

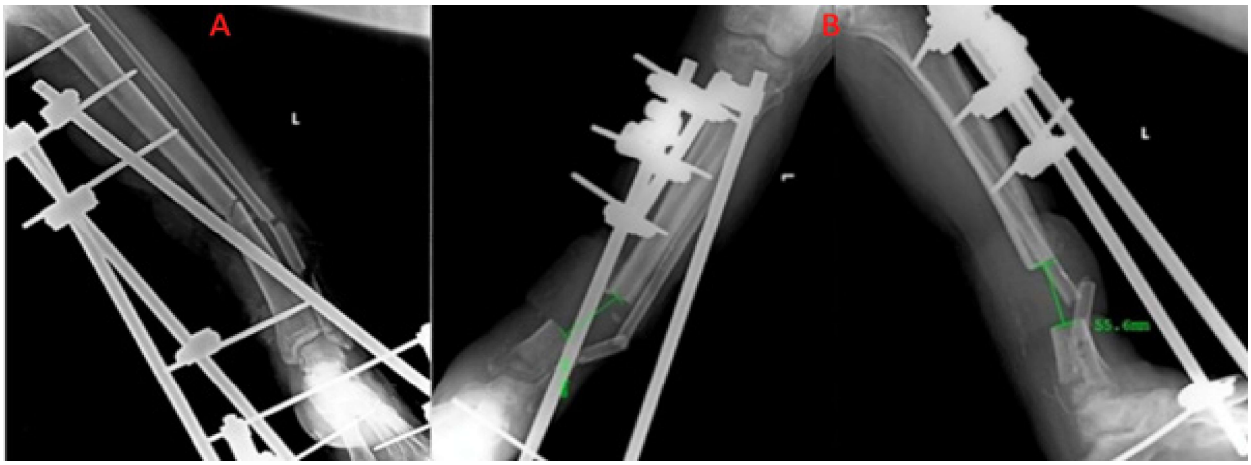

Fig. 2: Radiograph A depicts the immediate post-operative fixation using **A** - External fixator whereas radiograph **B** depicts post removal of the infected bone segment with a bone loss of 55 millimeters three months following index surgery

On examination, the left lower limb was found to be externally rotated with knee in 100 of flexion with a visible swelling and deformity. Further a cut lacerated wound measuring 5.5 x 2 centimetres was found on the lateral aspect of distal one-third of the left leg. On palpation, tenderness was elicited diffusely over the entire lower aspect of the leg, painful and restricted movements at the knee and ankle. Peripheral pulses were felt. Once the patient was stabilised, the limb was immobilised and radiographs of the left leg in antero-posterior and medio-lateral views were taken which showed an oblique fracture pattern of distal one-third tibia with segmental fracture of distal one-third fibula and was classified as Gustilo-Anderson Open fracture type-3 A (Fig. 1). Initially, the patient underwent thorough wound debridement and application of an AO external fixator instead of primary in-situ fixation due to higher prevalence of infection and implant failure. There were no intra-operative complications and was followed up post-operatively for three months. During the third month, patient developed a discharging sinus from the wound site. Patient underwent open debridement and removal of devitalised and infected bone segment. Post-operatively, keeping the AO-external fixator intact, a segmental bone loss of tibia of about 55 millimetres was measured (Fig. 2). To bridge this gap, bone transport was planned using a four ring IEF construct and pre-operative measurements were taken. A pre-operative ring construct was made according to the patient limb size and sent for autoclave (Fig. 3).

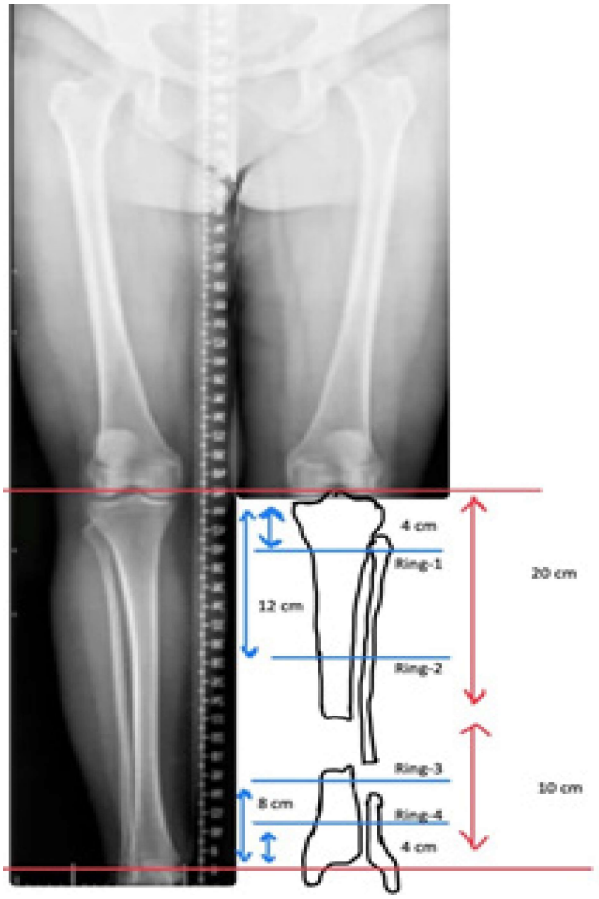

Fig. 3: Pre-operative surgical planning prior to application of IEF. Blue lines signify the sites of ring placement, distance measured proximally from the tibial plateau and distally from the ankle joint. The fracture is divided into 2:1 ratio, proximal greater than distal

The AO external fixator was removed, remnant edges of tibia post resection of the infected segment was freshened, followed by reaming of the medullary cavity. Acute docking at the non-union site was done prior to IEF frame application which was followed by cross Kirschner wire (K-wire) application at tibial docking site. Following this, proximal tibia corticotomy with lengthening was performed (Fig. 4).

Fig. 4: Intra-operative proximal corticotomy done using Gigli Saw

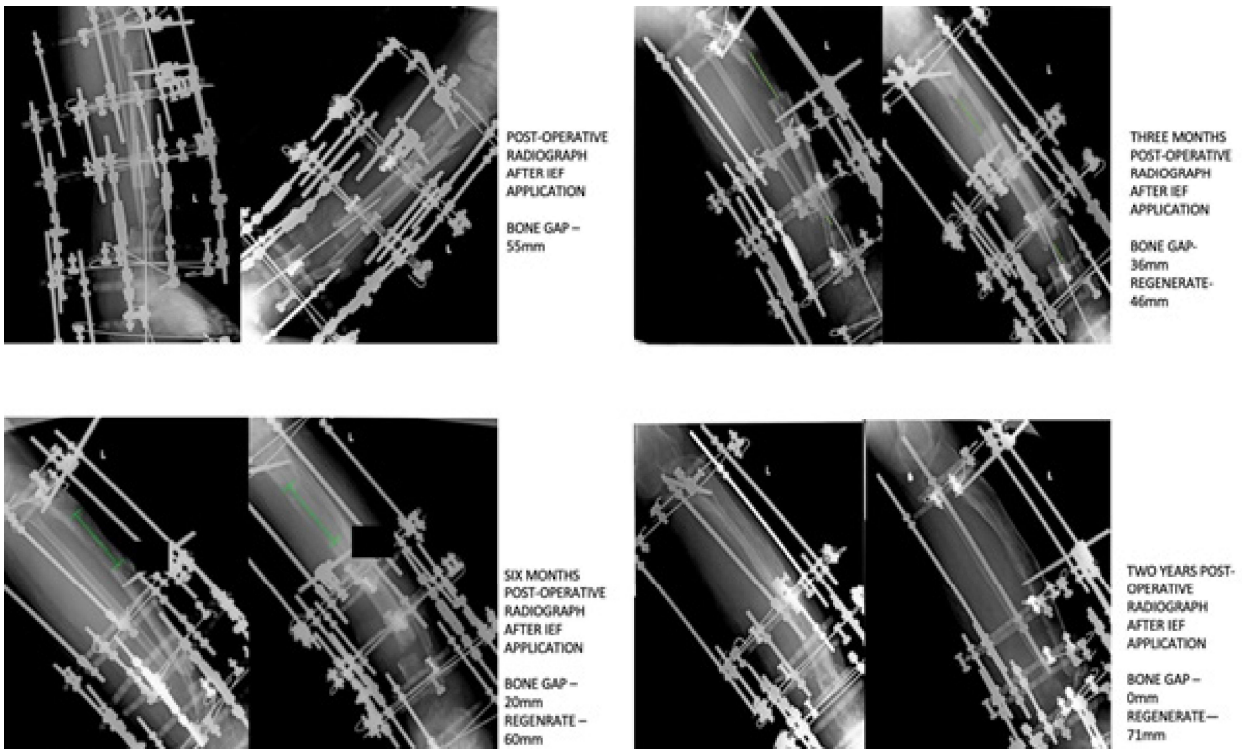

Fig. 5: Series of events radiographically after IEF application and their follow ups as to the measurement of the regenerate formed throughout

Post-operatively, patient was made to bear full weight over the limb. Using the principle of accordion manoeuvre, 1 millimetre of compression of R-2 and R-3 was done on day one followed by 0.5 millimetre of distraction for the next 4 days. The same cycle was repeated for a period of 2 years. Patient was followed up in regular intervals with radiographs, pin-tract dressings and supportive physiotherapy (Fig. 5).

At the end of two years, the bone gap was bridged and the regenerate formed was measure to be 71 millimetres. Radiographic assessment was done on every follow up to visualise progressive callus formation and to asses antero-posterior and medio-lateral stability, which once deemed adequate led to the removal of the IEF construct. Patient was then put on KAFO for a period of four weeks with adjuvant mobilisation of joints being done (Fig. 6). The patient finally had a limb length discrepancy (LLD) of about 1.5 centimetres, knee flexion coming up to 900 and restricted movements at the ankle with plantigrade foot. The recent radiographs of the ankle with distal tibia showed consolidation at the distal tibia with complete degenerative arthritis at the ankle joint leading to joint ankylosis (Fig. 7). ASAMI score was 68 (Fair), Knee Society Score (KSS) was 72 (Good) and St. Pierre score was 2 (Fair), which gave us satisfactory results.

Fig. 6: After IEF removal, limb put in a KAFO

Fig. 7: Clinical pictures of the limb showing knee ROM up to 90°, minimal ankle ROM, limb length discrepancy of 1.5 cm and follow up ankle radiograph depicting the degenerative and arthritic changes in the ankle leading to ankylosis

DISCUSSION

The shaft of tibia is one amongst the most common fractured long bones with an annual incidence of 21.5 per 100,000 population.[2] Owing to the subcutaneous nature of the tibia, open tibial fractures are the most common type of open fractures, irrespective of the fracture pattern. Most of these fractures result from high velocity trauma, as seen in case of road traffic accidents but low velocity trauma can also result in fractures in case of pre-existing illnesses leading to bone osteopenia and in geriatric population where the bones are osteoporotic.

The tibia is notoriously known amongst orthopaedic surgeons for its fragile vascularity and hence should be managed with utmost care. In a study done by Maxwell et al in 102 patients, primary fixation of tibia shaft fractures with intramedullary nailing led to mal-union in 37% of the cases.[3] In another study, primary fixation of tibia shaft fractures in 940 patients went into non-union in 13% cases.[4] Similar results were obtained in our case where primary stabilisation of the fracture led to eventual infection at the fracture site and ultimately, non-union.

In a similar study done by Vishal et al, 20 patients were evaluated for the bone regenerate that can be achieved in cases of failed primary stabilisation either by plating, nailing or application of external fixator by IEF and functionality scales calculation done post-operatively of which the maximum regenerate formed was of 170 millimetre in one patient.[5] He had also outlined the principles of treatment which include maintenance of normal length and alignment, to minimize the soft tissue damage and preserve the circulation and lastly to provide mechanical environment for bone healing. Adhering to similar principles of treatment we had achieved 71 millimetre of regenerate.

Faisal et al had conducted a similar study to assess the efficacy of Ilizarov method in treating patients with tibial segmental bone loss following non-union in Gustilo-Anderson type 3 injuries of tibia shaft, which were initially managed with fixation and debridement but failed in 14 patients. He then treated such patients with an appropriate Ilizarov construct following the accordion manoeuvre and had achieved results over three years with almost no LLD with only one case having 1 centimetre LLD.[6] In our case, bone transport union and regenerate was formed by two years and LLD was about 1.5 centimetres.

To treat large segmental bone defects, Bowen et al had conducted a study in 62 patients to test the efficacy of using Taylor Spatial Frame (TSF) over IEF, but the results depicted no statistical difference in both methods, with the only difference being TSF is technically easier to apply compared to IEF.[7]

A retrospective study conducted to compare the outcomes whilst performing proximal over

distal bone transport in 50 patients, showed that patients who underwent proximal bone transport had lesser pin-tract infections, transient loss of ankle movements and foot drop as compared to the latter.[8]

CONCLUSION

In spite of the complexity of treatment of open tibia shaft fractures, careful consideration has to be done with regard to management and anticipation of the complications following the procedures. Tibial non-unions are notorious and one of the most efficient methods is the use of IEF with bone transport. Pre-operative planning of placement of the rings and application of the IEF frame with proximal corticotomy and bone transport followed by use of accordion manoeuvre gave satisfactory results in our case.

Consent:

Consent was obtained from the patient.

Conflicts of interest:

All authors confirm that they are not involved in any organization or entity with a financial interest or financial conflict with the subject matter or materials discussed in this paper.

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