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Resistant and Refractory Distal Tibia Non-Union Using an Intramedullary Free Fibular Graft and Ilizarov Fixation – An Illustrative Case Report

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Learning Point of the Article:

Resistant and refractory non union of distal tibia fractures can be managed effectively with a free fibular graft used as a biological intramedullary nail.

Abstract

Introduction: Resistant and refractory non-union of distal tibia extra-articular fractures is very common even following internal fixation due to poor blood supply to the distal tibia metaphyseal region. The management can be challenging.

Case Report: A 50-year-old diabetic male had sustained closed distal tibia extra-articular fracture at the junction of diaphysis and metaphysis. Intramedullary interlocking nailing was done elsewhere. The fracture did not unite. Nail removal, bone grafting, and plate fixation were done elsewhere. The fracture did not unite and implant failure occurred. The nonunion was successfully managed by plate removal, intramedullary free fibula bone grafting, and Ilizarov fixation. Union required 6 months but patient finally was able to return to his work with good function and without any signs of infection.

Conclusion: This case illustrates the successful incorporation of a stabilized intramedullary fibula graft which enabled union of a resistant distal tibia fracture nonunion.

Keywords: Resistant tibia non-union, avascular fibular strut graft, distal tibia non union, ilizarov fixation

Introduction

Fractures of tibia are relatively common with incidence of about 16.9/100,000/year [1]. Distal tibia fractures tend to heal slowly due to poor blood supply to the distal metaphyseal region and its longer subcutaneous border [2]. Delayed union is defined as the absence of radiographic healing 3–5 months following the injury in tibia diaphyseal fractures. For fractures that had not healed after 9 months, non-union was described [3]. Tibial non-union can be treated with revision nailing with a larger nail or with plating along with bone grafting. A subset of the patients who fail to unite will develop hypertrophic non-unions, which are due to excessive motion at the fracture site, preventing full mineralization of the fibrocartilaginous callus [4-6]. After repeated implant failures, non-unions are resistant to treatment [7]. Resistant non-union – cases which have been treated at least twice to achieve union – pose a challenge to the treating surgeon and the patient [8-12]. These are refractory to repeated treatment. In this case report, we discuss the case of a resistant non-union of distal tibia treated with a simple technique of intramedullary fibular graft along with an Ilizarov fixation. Patient was able to achieve union in a period of 6 months and is mobilizing well without external support.

Case Report

A 50-year-old diabetic obese male sustained a closed distal one

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Author's Photo Gallery


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Figure 1: X-ray post-trauma-February 08, 2021.

Figure 2: Status post-intramedullary interlocking nailing (first procedure)-February 11, 2021.

Figure 3: Status post-open reduction internal fixation with plating + Bone grafting (second procedure)-September 30, 2021.

third shaft of tibia and fibula fracture (Fig. 1). Patient was managed with closed reduction and intramedullary interlocking nailing elsewhere (Fig. 2). Seven months after nailing patient had no signs of union. The cause of the non-union seems to be improper reduction of the fracture and unstable fixation as there is deformity at the fracture site. He underwent nail removal, plate fixation along with bone grafting for the same elsewhere (Fig. 3). Three months after plating and bone grafting, patient presented to us with difficulty in weight bearing and pain over right leg. Fortunately he did not have any signs of infection. Patient had a history of right distal fibula plate fixation 19 years back. Presenting X-ray of right leg showed implant failure which is the cause of non-union of tibia in the second procedure and a malunited fibula fracture (Fig. 4). Initially implant exit for tibia and fibula was done. Free fibula graft of length 10 cm was removed from middle third of fibula, with the distal 8–9 cm of the fibula being left in place for ankle stability. But unfortunately, the full thickness fibula graft was found to be thicker than the medullary canal and could not be inserted into the canal as an intramedullary graft. Graft was split longitudinally into two halves and was inserted into the fracture gap and the medullary canal of proximal and distal fragments. Cancellous bone grafting from iliac crest was packed around the fibula graft. The wound was partially closed. The fracture was stabilized using an Ilizarov fixation (Fig. 5). Ilizarov fixation was chosen since the distal fragment was small and did not have enough bone stock for screws fixation due to the previous plate fixation. Patient had a procurvatum deformity at the fracture site with Anterior Distal Tibial Angle of 93.3 degrees which was not corrected as it was acceptable. Due to the deformity, arc of motion of the ankle changed which resulted in decreased dorsiflexion and increased plantar flexion at the ankle joint. Patient had dorsiflexion of 10° and plantar flexion of 30°. It did not cause any significant difficulty in gait. Malalignment in the sagittal plane is better tolerated and is of less significance than similar degrees of malalignment in the frontal plane as it is

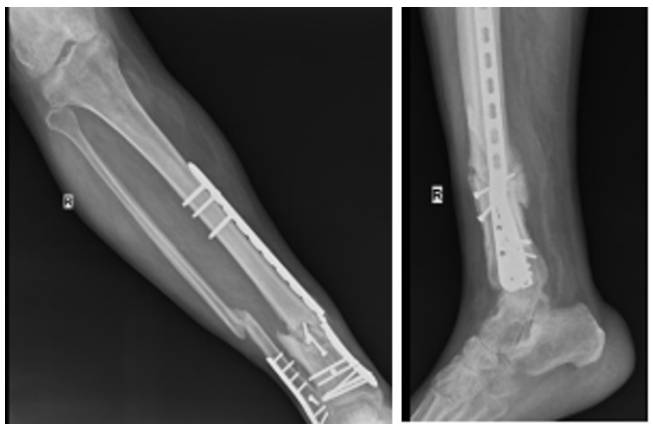

Figure 4: Presenting X-ray - Distal tibia non-union with implant failure-February 10, 2022.

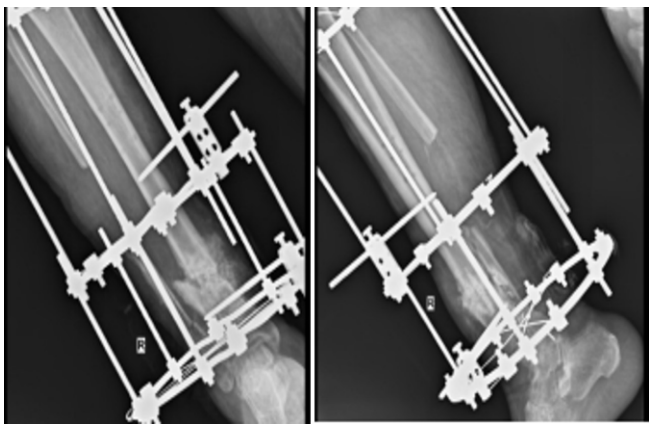

Figure 5: Status post-Ilizarov fixation with fibula strut grafting-February 28, 2022.

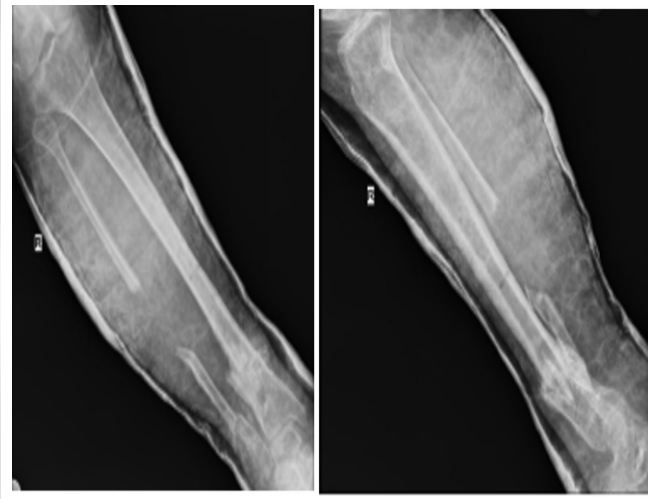

Figure 6: Immediate post-operative X-ray after Ilizarov exit.

Figure 7: 2-year follow-up X-ray.

compensated by the hip, knee, ankle, subtalar, and foot joints [13]. The posterior proximal tibial angle was 100.2° (Normal-81 ± 3) and the anterior distal tibial angle was 93.3° (Normal-80 ± 2) (Fig. 6-10). Patient was allowed partial weight bearing mobilization with support following the surgery. Radiographs were taken at 6 weeks, 3 months and 6 months to assess healing of the fracture. After 6 months, Ilizarov fixator was removed and patient was put on patella tendon bearing (PTB) cast. After 45 days, the PTB cast was removed and the patient was mobilized. Patient is mobilizing well and does not have pain or any signs of infection. Patient has returned back to his work with a follow-up of 2 years (Fig. 6 and 7).

Discussion

Resistant and refractory non-union of distal tibia after multiple procedures is a challenge to be treated as the bone refuses to unite. The bone also becomes osteoporotic making it more difficult to treat. In our case, patient had additional risk factors for non-union like obesity and diabetes.

Figure 8: Clinical picture on 2-year follow-up.

Options of treatment included revision internal fixation and bone grafting. But in view of the void, a large volume of bone graft would berequired. We also did not have access to bone bank and allograft.

The next option would have been Ilizarov fixation, proximal tibial corticotomy and bone transport to manage the gap. However, this entails a long period of ring fixation till the regenerate consolidates. Usually, additional bone grafting would have also been required at the docking site.

The fibular strut graft acts as a biological intramedullary nail providing mechanical support and also being osteoconductive at the same time, helping also to fill the bone void. In our case, patient had a small distal fragment with multiple voids due to screws from multiple procedures making us resort to Ilizarov fixation. Fibular grafting along with plating can also be done if the bone has sufficient screw purchase. In that case, incorporating an intramedullary fibular graft also helps in increasing the screw purchase.

A difficulty we faced in our case – the fibular strut graft was larger in diameter than the medullary canal and we had to divide the fibular graft longitudinally to insert the graft into the medullary canal. Proper preoperative planning, involving assessment of the medullary canal, diameter of the fibula, length of the fibular graft required can be useful in avoiding difficulties intraoperatively. A narrow medullary canal might require reaming in order to accommodate the fibular strut graft. Whereas in a wide medullary canal graft, it can be placed without reaming. Kirshcner wire can also be passed into the graft to strengthen the graft [10]. Additionally cancellous bone grafting can be done for its osteoinductive properties which can augment healing and union. In our patient, 6-month postoperatively, the fracture achieved union. Nine-month

Figure 9: Clinical picture on 2-year follow-up with range of motion of knee and ankle.

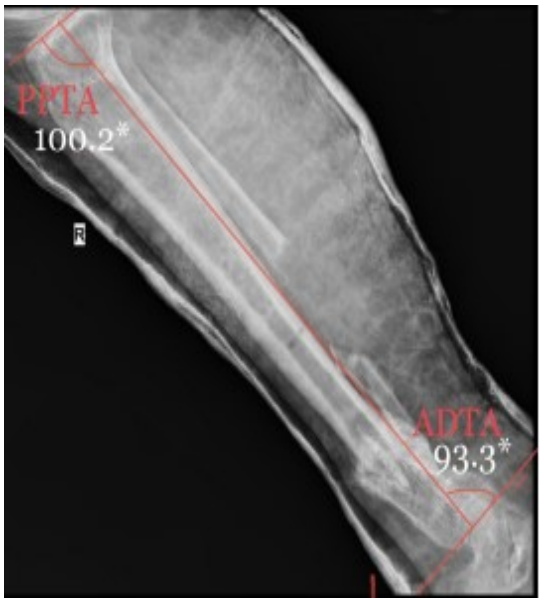

Figure 10: Posterior proximal tibial angle and anterior distal tibial angle.

postoperatively, patient was able to mobilize without any external support with good function making him return to his day-to-day activities with a visual analog score of 0/10. Patient does not have any pain or infection and is mobilizing well with a follow-up of 2 years.

The fibular strut is to be inserted immediately after removal from the donor site to encourage the retention of viable properties [8]. It has been reported that if the autologous bone graft is fixed to the recipient bone immediately after it is retrieved, the osteogenic cells on and in the graft survive [10, 11]. The long bone diaphyseal non-union after intramedullary nailing occurs usually due to instability [6]. Yadav et al. stated that the free fibular graft acts as a biological nail and when the medullary canal is reamed to appropriate size of the fibular graft, three borders of the fibula fix firmly to the inner cortices of the fractured fragments and sufficiently reduce the undesirable movements that are observed with non-locking intramedullary nail. Larger the contact area between the graft and the host bone, better is the union [10]. Hence, the size of the fibular graft needed is to be planned preoperatively for better outcomes.

Conclusion

Fibular strut grafting is a simple and effective way to treat refractory non-union of tibia refusing to unite even after multiple procedures. It is a bone in bone fixation and is more biological which helps in healing even resistant non-union of long bone fractures.

Clinical Message

This case report explains a simple and effective way of successfully treating resistant non-union of distal tibia fracture with a free fibular graft. This method can also be used in treating refractory non-union of any long bone.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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