

Case Report

Open tibial fracture with severe soft tissue injury and bone loss managed with ipsilateral fibular transport and its complications: a case report

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ABSTRACT

Massive segmental bone defects of tibia present as a challenging task to manage specially when associated with extensive soft tissue injury. A 30 year old male presented to Paras HMRI hospital, Patna, post road traffic accident with Gustilo Anderson 3B comminuted open tibia shaft fracture and with an external fixator in situ with a grossly inflamed and infected wound. Initially patient was managed with serial wound debridement and skin grafting was done early to obtain adequate soft tissue coverage. The patient then underwent application of Ilizarov external fixator with plan of one level fibular osteotomy for ipsilateral fibular transport. With good outcome of the procedure clinically and radiologically, Ilizarov fixator was removed after time duration of about 1.3 years and limb was immobilized in plaster of Paris (POP) cast which was removed after 8 weeks. Within 1 month of removal of POP cast the patient presented to hospital again with complaints of pain and instability when his leg was run over by his child's bicycle while playing. Diagnosed as fracture of proximal (transported) fibula he was managed then with locking plates; one of which was used as an internal fixator and the other as external fixator which was outside the body and acted as a support to the operated limb. After about 1 year the external locking plate was removed and patient was able to bear weight on his extremities. Despite various modalities to treat massive tibial gap, fibular transport procedure with Ilizarov external fixator seems to be the most viable option.

Keywords: Open tibial fracture, Ipsilateral fibular transport, Ilizarov external fixator

INTRODUCTION

Massive segmental tibial bone defects following trauma is a limb threatening situation and present as a challenging task for an orthopedic surgeon to manage especially when associated with extensive soft tissue injury and massive bone loss.¹ The decision whether to salvage or to amputate a limb is also controversial.²⁻⁵

In contrast to the various techniques developed to treat large segmental tibial defects such as autogenous cortical bone grafts, tibio fibular synostosis, ipsilateral fibular graft

and allograft reconstruction, amputation is considered the simplest surgical solution, although it is not always acceptable to patient and their relatives particularly when the patient presents with good foot and ankle with intact distal neurovascular status.⁶⁻⁹ Therefore it seems reasonable to explore alternative limb salvage procedures.

Although some authors have stated that the cost for amputation is considerably less, William suggested that the repeated need for prostheses when taken into account collectively are even more than a successful Ilizarov reconstruction.^{2,4,9}

Ipsilateral fibular graft to treat massive tibial bone loss was first credited to Hanh in 1884 and Nichols who in 1904 first presented the use of an ipsilateral fibular graft as a treatment for an infected tibia.^{10,11} Kim et al reported use of a ring fixator to transport a fibular segment to replace 17-cm tibial bone loss in one patient.⁴ The technique involves partial dissection of the muscle attachments and an osteotomy of the ipsilateral fibula followed by its medial transport.

Zahiri et al modified this procedure to treat chronic osteomyelitis of the entire tibial shaft in nine children wherein they performed osteotomies at both metaphyseal ends followed by transport of the fibula towards tibial stumps.¹² Proximally fixation was achieved by locking the end of the fibula into the center of the metaphysis whereas distally, an unthreaded Steinmann's pin was passed from the calcaneum, talus, and tibial epiphysis into the medullary canal of the transferred fibula thereby achieving stable fixation.

Similarly experiments on Macaca monkey demonstrated that fibular transport was a viable option in bridging massive tibial gap.¹³

The Ilizarov method has been used to successfully transport bone longitudinally to treat tibial bone loss and at times to close an accompanying soft tissue defect.¹⁴⁻¹⁶ A less common use of this frame is transverse bone transport which allows the gradual transport of fibula to manage massive segmental tibial gap towards salvage and acceptable restoration of limb functions.

We present a case report of a patient with massive segmental tibial bone loss and extensive soft tissue injury post trauma, who was managed initially via fibular transport procedure using Ilizarov external fixation and secondarily by use of locking plates used as both internal and external fixator when he presented with subsequent trauma after removal of Ilizarov frame.

CASE REPORT

A 30-year-old patient with high energy right open tibia fracture with massive soft tissue injury and bone loss (Gustilo Anderson 3B) presented to Paras HMRI hospital with a grossly inflamed and infected wound and an external fixator in situ. The patient was initially managed with serial wound debridement and skin grafting was performed early to obtain soft tissue coverage and avoid infection. Subsequently after one month he underwent an application of Ilizarov fixator along with one level fibular osteotomy for bone transport.

A 6 ring frame was applied to span the entire bone defect and to stabilize the distal and proximal bone segments in line with each other. After one week one level osteotomy of the fibula was planned at the level of tibial defect and two olive wires were placed against the fibula thereby pulling it from posterolateral to anteromedial aspect. The fibular transport was started immediately post operatively and was achieved in span of 12 days.



Figure 1: (a) Radiographs at initial presentation to the hospital, and (b) status of soft tissue at the time of initial presentation (grossly inflamed and infected wound with external fixator in situ).

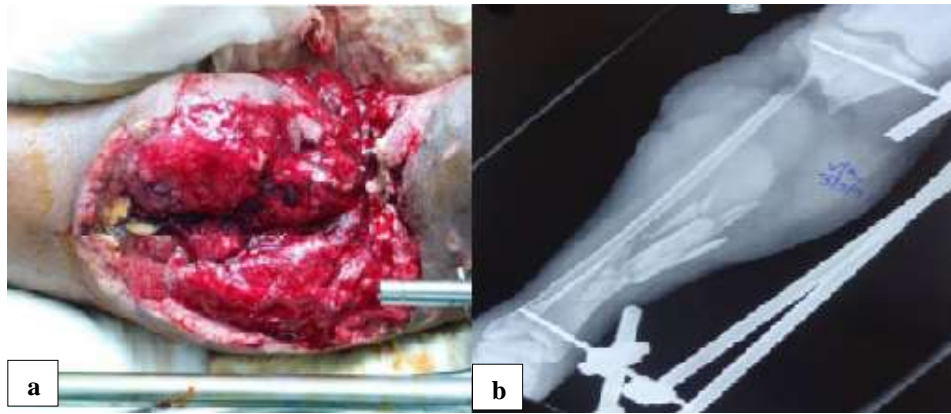


Figure 2: (a) Status of soft tissue after initial wound debridement, and (b) radiograph after initial wound debridement.

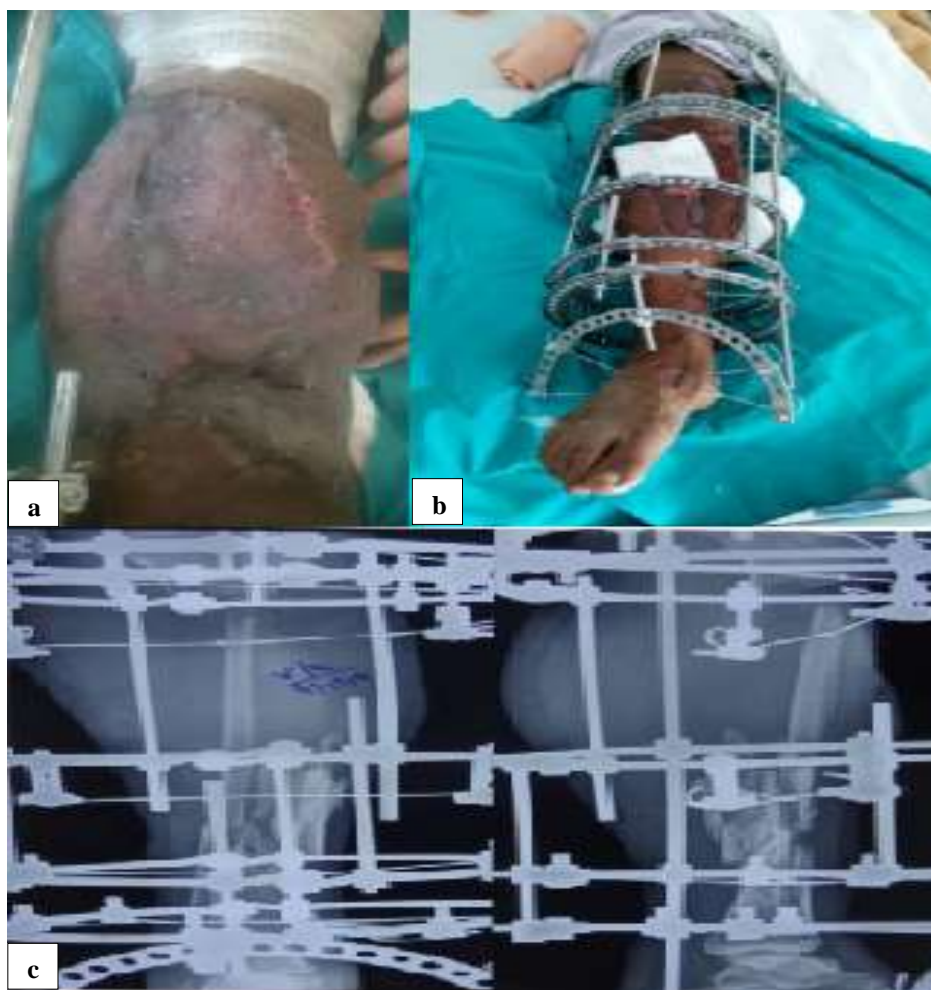


Figure 3: (a) Soft tissue coverage via skin grafting, (b) application of 6 ring Ilizarov fixator to span the entire tibial defect, and (c) radiograph after application of Ilizarov ring fixator.

16 weeks after the application of frame and fibular transport, bone grafting procedure was carried out to optimize the contact between the tibia and transported fibula wherein the distal olive wires were removed and fibula was affixed to the distal aspect of tibial remains via 1 lag screw. Auto iliac bone grafting was used to promote healing at proximal and distal tibio fibular region. At 6

months following surgery, the bone showed good alignment and progression of healing.

The frame was removed after 1 year and 3 months following which the leg was placed in long leg cast for 8 weeks, and upon cast removal, was able to tolerate partial weight bearing on a caliper.

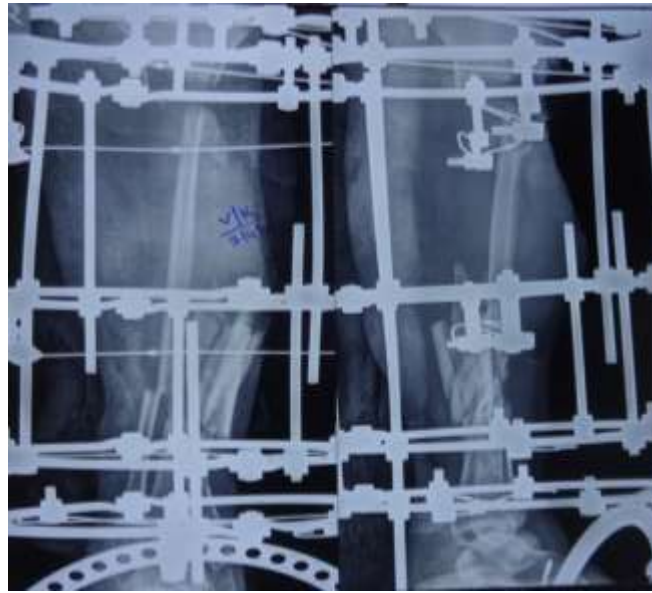


Figure 4: One level fibular osteotomy for ipsilateral fibular transport.

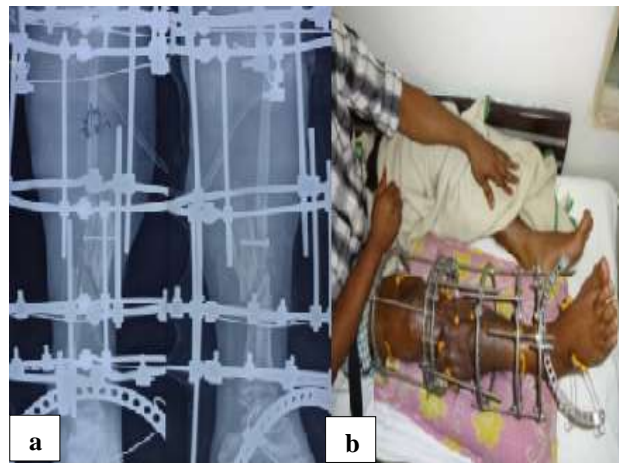


Figure 5: (a) Distal olive wires removed and distal fragment fixed with screw and bone graft, and (b) clinical picture of patient's leg at subsequent visit to hospital.

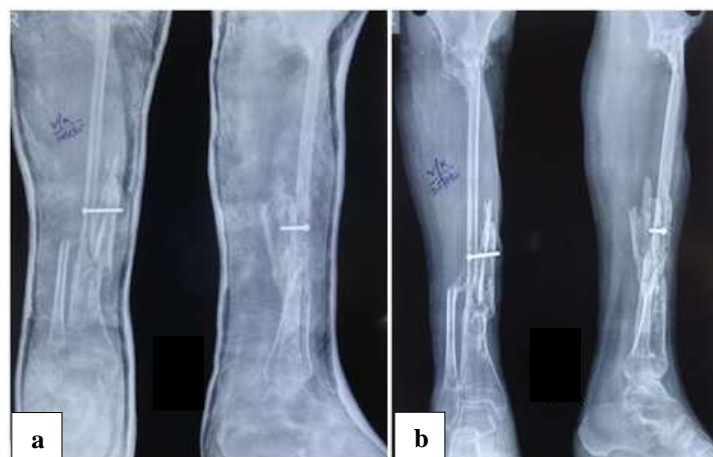


Figure 6: (a) Removal of Ilizarov fixator and application of cast, and (b) radiograph depicting good consolidation of at the proximal and distal aspect of tibialized fibula.



Figure 7. Radiograph showing fracture of the proximal aspect of tibia and fibula.

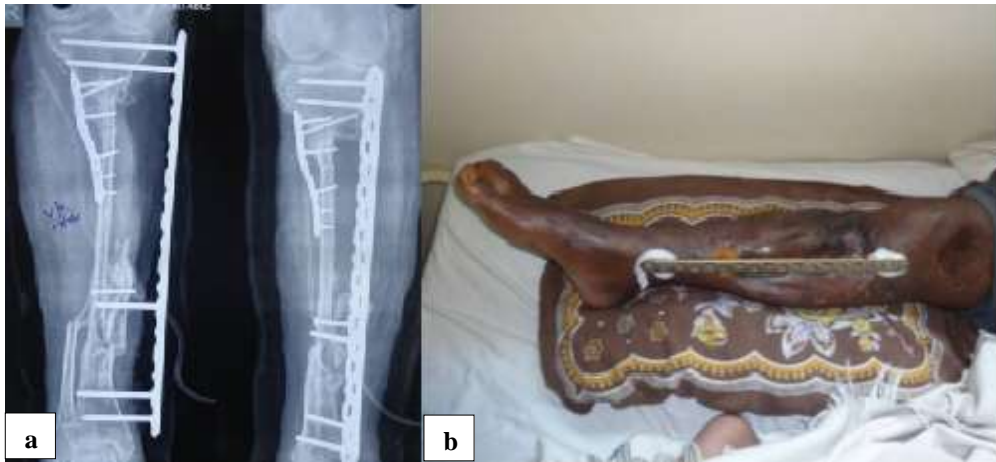


Figure 8: (a) Application of locking plates one of which acted as an internal fixator and another locking plate outside the body which acted as an internal fixator, and (b) clinical picture of patient depicting the locking plate outside the body.



Figure 9: (a) Radiograph showing the removal of central screw from the external locking plate, followed by removal of the plate, and (b) good consolidation of the tibia and fibula proximally and distally.



Figure 10: Latest clinical photograph of the patient.

The twist in the story

After about one month the patient presented to orthopedics OPD once again with complaints of pain and instability of his operated limb after being run over by his child's bicycle. On investigation he was diagnosed with a fracture in his proximal aspect of tibiazied fibula.

Subsequently he was managed with a locking compression plate as an internal as well as an external fixator (to support the operated limb). In a span of 1 year the external fixator was removed (first the central screws of the plate was removed and the peripheral screws in subsequential order) and the patient was able to tolerate weight bearing, though stiffness at knee joint persisted.

DISCUSSION

A large segmental defect of the tibia is a difficult problem to treat especially if accompanied with massive bone and soft tissue loss.^{17,18} Various modalities to fill segmental gap include rib, iliac crest, vascularized pedicle graft as well as allograft reconstruction.¹⁹⁻²¹ A below knee amputation also seems to an alternative but is usually not acceptable to the patient as well to the relatives especially for patients with normal foot and ankle and intact distal vascular status.²²

The cost difference between amputation and reconstruction in patients with a severely injured leg has been debated, resulting in wide variations in surgical and medical expenses across hospitals and rehabilitation centers. Bondurant et al suggested the initial hospitalization costs are considerably less for amputation than limb salvage.²

Kim et al, describing a patient with a large tibial defect treated with ipsilateral fibular transfer using a ring fixator, calculated the total cost of the multiple procedures was five times more than amputation.⁴ In agreement with Williams, we think the long-term costs of amputation with a need for repeated prostheses are considerably greater than for a successful reconstruction using the Ilizarov method.³

Each method has its own advantages and disadvantages. Vascularized rib and iliac crest grafts may not provide enough bulk if the amount of bone loss is substantial apart from resulting in donor site morbidity which should be taken into account.²³ Though allograft transplantation has been described as a well-known procedure after tumor resection, implantation of cadaveric tissue in large amount in post trauma environment may result in infection, non-union and failures.²¹ Ilizarov external fixation though a useful and a very effective modality takes considerable amount of time to bridge large tibial defects.

Gradual medial transport of fibula with help of Ilizarov frame has many potential advantages over other modalities of treatment which was advocated from the good functional outcome post operatively in our report. Apart from avoiding donor site morbidity distant to the injured limb, it also does not poses immunogenicity problem which is commonly encountered with allograft. Gradual ipsilateral fibular transfer using the Ilizarov apparatus allows fibular transfer even if the fibula is fractured, providing the fibula shows evidence of healing and the ability to replace massive tibial bone loss.

CONCLUSION

We therefore conclude that applying the Ilizarov frame for ipsilateral fibular gradual transport provides a reasonable alternative for surgeons addressing limb salvage in patients with massive tibial bone loss.

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Ethical approval: Not required

REFERENCES

1. Hansen ST Jr. Overview of the severely traumatized lower limb: reconstruction versus amputation. Clin Orthop Relat Res. 1989;243:17-9.
2. Bondurant FJ, Cotler HB, Buckle R, Miller-Crotchett P, Browner BD. The medical and economic impact

- of severely injured lower extremities. *J Trauma.* 1988;28:1270-3.
3. Williams MO. Long term cost comparison of major limb salvage using Ilizarov method versus amputation. *Clin Orthop Relat Res.* 1994;301:156-8.
 4. Kim HS, Jahng JS, Han DY, Park HW, Chun CH. Immediate ipsilateral fibular transfer in a large tibial defect using a ring fixator: a case report. *Int Orthop.* 1998;22:321-4.
 5. MacKenzie EJ, Bosse MJ, Castillo RC, Smith DG, Webb LX, Kellam JF, et al. Functional outcomes following trauma-related lower-extremity amputation. *J Bone Joint Surg.* 2004;86:1636-45.
 6. Enneking WF, Eady JL, Burchardt H. Autogenous cortical bone grafts in the reconstruction of segmental skeletal defects. *J Bone Joint Surg Am.* 1980;62:1039-58.
 7. Hertel R, Pisan M, Jakob RP. Use of the ipsilateral vascularised fibula for tibial reconstruction. *J Bone Joint Surg Br.* 1995;77:914-9.
 8. Mankin HJ, Hornicek FJ, Raskin KA. Infection in massive bone allografts. *Clin Orthop Relat Res.* 2005;432:210-6.
 9. Ottaviani G, Randelli P, Catagni MA. Segmental cement extraction system (SEG-CES) and the Ilizarov method in limb salvage procedure after total knee cemented prosthesis removal in a former osteosarcoma patient. *Knee Surg Sports Traumatol Arthrosc.* 2005;13:557-63.
 10. Hanh E. Eine methode. Pseudoarthrosen der Tibia mit grossen Knochendefekt zur Heilung zu Gringen. *Zentrab f Chir.* 1884;11:337-41.
 11. Huntington TW. Case of bone transference. Use of a segment of fibula to supply a defect in the tibia. *Ann Surg.* 1905;41:249-51.
 12. Zahiri CA, Zahiri H, Tehrany F. Limb salvage in advanced chronic osteomyelitis in children. *Int Orthop.* 1997;21:249-52.
 13. Shapiro MS, Endrizzi DP, Cannon RM. Treatment of tibial defects and nonunions using ipsilateral vascularized fibular transposition. *Clin Orthop Relat Res.* 1993;296:207-12.
 14. Rozbruch SR, Pugsley JS, Fragomen AT. Repair of tibial nonunions and bone defects with the Taylor spatial frame. *J Orthop Trauma.* 2008;22:88-95.
 15. Cattaneo R, Catagni M, Johnson EE. The treatment of infected nonunions and segmental defects of the tibia by the methods of Ilizarov. *Clin Orthop Relat Res.* 1992;280:143-52.
 16. Sen C, Kocaoglu M, Eralp L. Bifocal compression–distraction in the acute treatment of grade III open tibial fractures with bone and soft-tissues: a report of cases. *J Orthop Trauma.* 2004;18:150-7.
 17. Atkins RM, Madhavan P, Sudhaker J. Ipsilateral vascularized fibular transport for massive defects of the tibia. *J Bone Joint Surg Br.* 1999;81:1035-40.
 18. Catagni MA, Ottaviani G, Camagni M. Treatment of massive tibial bone loss due to chronic draining osteomyelitis: fibula transport using the Ilizarov frame. *Orthopedics.* 2007;30:608-11.
 19. Ueng SW, Chuang DC, Cheng SL, Shih CH. Management of large infected tibial defects with radical debridement and staged doublerib composite free transfer. *J Trauma.* 1996;40:345-50.
 20. Eisenschenk A, Dihlmann SW, Weber U. Indications, results and complications in connection with free vascularized bone transplants for extremity preservation. *Chir Organi Mov.* 1993;78:207-12.
 21. Brien EW, Terek RM, Healey JH, Lane JM. Allograft reconstruction after proximal tibial resection for bone tumors: an analysis of function and outcome comparing allograft and prosthetic reconstructions. *Clin Orthop Relat Res.* 1994;303:116-27.
 22. Lange RH. Limb reconstruction versus amputation decision making in massive lower extremity trauma. *Clin Orthop Relat Res.* 1989;243:92-9.
 23. Amr SM, El-Mofty AO, Amin SN. Anterior versus posterior approach in reconstruction of infected nonunion of the tibia using the vascularized fibular graft: potentialities and limitations. *Microsurgery.* 2002;22:91-107.

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