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Dr. Rajesh Kumar Sharma
Senior Resident, Department of Orthopaedics, SMS Medical College, Jaipur, 64, Nayawasi Street- Sarundla, Achalpura, Dausa, Rajasthan, India

Dr. Arun Kumar Sharma
Assistant Professor, Department of Orthopaedics, SMS Medical College, Jaipur, A-176, Shivshakti Nagar, Model town, Jagatpura, Jaipur, Rajasthan, India

Dr. Heera Lal Dhawan
Assistant Professor, Department of Orthopaedics, SMS Medical College, Jaipur, Iris- 203, Manglam Ananda, near Sanganer railway station, Jaipur, Rajasthan, India

Dr. Avtar Singh Balawat
Assistant Professor, Department of Orthopaedics, SMS Medical College, Jaipur, 2/2, Heerabagh Flats, Narayan Singh Circle, Jaipur, Rajasthan, India

Corresponding Author:
Dr. Rajesh Kumar Sharma
Senior Resident, Department of Orthopaedics, SMS Medical College, Jaipur, 64, Nayawasi Street- Sarundla, Achalpura, Dausa, Rajasthan, India

A prospective study of management of infected non-union of tibia using ilizarov technique: Our results & complications

Dr. Rajesh Kumar Sharma, Dr. Arun Kumar Sharma, Dr. Heera Lal Dhawan and Dr. Avtar Singh Balawat

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Abstract
Background: Treatment of patients with infected non-union of long bones, is one of the most difficult challenge in Orthopaedic surgery. The purpose of this prospective study was to evaluate functional outcomes, effectiveness and complications of Ilizarov technique in the management of infected non-union of tibia.
Materials and Methods: Thirty patients, with infected non-union of the tibia, were managed by adequate debridement, resection of infected portion, and stabilization by Ilizarov frame with docking or corticotomy & bone transport as per standard protocol. The results of follow-ups were analyzed clinically and radiologically, using 'Association for the Study and Application of Methods of Ilizarov (ASAMI)' scoring system.
Results: In present study, all fractures of tibia united completely without any persistent infection. Out of 30 patients, bone results were excellent in 19, good in 8, and fair in 3 patients. We didn't observe any poor bone result. Functional results were excellent in 15, good in 11, fair in 3, and poor in 1 patient. The most common complication was pin tract infection (16 patients/53%), which was managed accordingly. There was no need of amputation in any patient of our study group after application of Ilizarov technique.
Conclusion: Ilizarov technique is the wonderful one stage procedure to eradicate infection, achieve satisfactory bone union and better functional results in cooperative patients with infected non-union of tibia.

Keywords: Infected non-union, iizarov, ASAMI

Introduction
Infected non-union of a long bone is a state of failure of union for 6 to 9 months with persistent infection at the fracture site [1]. It is one of the most difficult and formidable challenge faced by an orthopaedic surgeon. Patients with infected non-union face functional disabilities, economic hardship, deprivation of self-esteem as well. Infected non-union of tibia due to it's vulnerable subcutaneous location, is more common in clinical practice [2]. It usually develops after an open fracture, after a previous surgery, or a sequelae to chronic hematogenous osteomyelitis.
In spite of difficult to treat, several procedures have been mentioned in the literature as treatment modalities for infected non-union of tibia. These include enormous debridement and free microvascular soft tissue and bone transplants, antibiotic impregnated bone cement, Papineau type open cancellous bone grafting and/or Masquelet technique. All these methods have certain limitations, such as multiple hospitalizations, donor site morbidity, stress fracture, poor vascularity, persistence of infection, limited quantity of autologous bone graft, extensive bone defects and severe deformity [3].
A structured approach, with ample debridement, necrotic tissue ablation, antimicrobial therapy and repair of the bone and soft tissues, is highly significant to eradicate infection and restore function [4]. Nowadays, Ilizarov technique is gaining popularity and has become the main treatment of choice for infected non-union of long bones including tibia. The Ilizarov technique has based on the principle of controlled distraction osteogenesis. It is an immediate single-stage procedure [5], which can eradicate infection, correct the deformities, and

compensate bone defects by gradually translocating a segment of bone from a healthy area into a region of bone loss [6]. Furthermore, It allows early mobilization, early weight bearing by providing stable fixation and maintains functional activity of the muscles and joints [7, 8]. Although, it has some disadvantages like the awkward cosmetic appearance, complex and heavy design of frame, and the prolonged period of treatment [9].

The purpose of this study was to evaluate the treatment efficiency, complications, merits and demerits of Ilizarov technique in dealing with infected non-union of tibia by using a standardized protocol.

Materials and Methods

This study was carried out during the years 2016 to 2019 in the department of Orthopaedics, SMS Medical College and attached group of hospitals, Jaipur (Rajasthan). After approval of our institutional ethics committee, a prospective study was designed with sample size of 30 patients, met with inclusion criteria. We received written informed consent from all the patients of the study group.

Inclusion Criteria: Adult patients, with clinical and radiological evidence of infected non-union of unilateral tibia and willingness to participate in the study, were included.

Exclusion Criteria: Patients with bilateral involvement, neurological or vascular deficit, uncontrolled diabetes mellitus, spinal deformities, and any other severe systemic diseases which would interfere with postoperative rehabilitation were excluded.

In this study, out of 30 patients, 23 were male and 7 were female, with mean age of 32.5 years (range 18- 51). Three patients (10%) had infected non-union of the proximal third of tibia, 18 patients (60%) had middle third tibia involved, and rest of the nine patients (30%) had lower third tibia involved. Out of 30 patients, 23 had a road traffic accident, five had a history of fall from height, and 2 had history of gunshot injury. Initially, all 30 patients had open fracture of tibia. External fixator was applied in 16 patients, 10 had intramedullary nail, and four had plating done initially at some other institutes. All the patients involved in the study were presented to outpatient door of our department with clinical and radiological evidence of infected non-union of tibia. Average three previous operative procedures (range 2-5) were carried out in each case before applying Ilizarov frame [Table 1].

Surgical technique

All surgeries were performed under combined spinal epidural anaesthesia. Ilizarov frame was assembled according to preoperative clinical and radiological findings. The non-union site at tibia was extensively debrided, and bone ends were adequately freshened until Paprika sign appeared. Any sequestrated bone or hardware was removed. The medullary canal of tibia was reamed and thoroughly lavaged with hydrogen peroxide, povidone-iodine solution and normal saline after removing the intramedullary nail. After freshening of bone ends, generated bone defect was measured. Out of 30 patients, 11 had shortening of <2.5 cm; hence, docking at fracture site was done and 19 patients had shortening >2.5 cm; hence, corticotomy at a suitable site on tibia was done. Usually a 160 mm, 4/5 ring construct for Ilizarov frame was used, although we modified it according to patient need. We used 1.8 mm Ilizarov wires in all the procedures. Whenever needed fibulectomy was done. Already fractured fibula was left alone if it would not interfere with tibial union. The operated limb was elevated, and the distal neurovascular status checked in each patient after completion of surgery. Antimicrobial treatment was used as per culture sensitivity report.

Post-operative follow-up

We checked Ilizarov frame stability on the first postoperative day by ensuring that all wires were adequately tensioned and all nut bolts were properly tightened. On the 2nd postoperative day, full weight bearing and adjoining joint mobilization exercises were started. From 7th postoperative day (range 7-9 days), distraction of 1 mm per day was started in patients with corticotomy (19 out of 30) [10], while Accordion maneuver (alternate compression and distraction) was started in remaining 11 patients [11]. All the patients were taught properly about way of distraction, Accordion manuver and pin tract caring and were discharged on the 10th to 15th postoperative day.

At every follow‑up, Illizarov frame stability, pin tract condition, and range of motion of adjoining joints were examined. Complications were recorded and treated. Dahl's grading was used for assessment of pin tract infection [12]. Xrays were taken at appropriate times to assess bone union and/or quality of regenerate on the basis of Fernandez Esteve grading [13].

Table 1: Showing demographic variables of the study

Demographic variables		Features
Study period		2016-2019
Study design		Prospective study
Number of patients		30
Mean age (range)		32.5 (18-51) years
Male: Female ratio		23:7
Mean previous operative procedures (range)		3 (2-5)
Mean size (range) of bone defect of tibia		4.85 (2.15- 8.50) cm
Type of non-union of tibia	Infected; active, draining	18
	Infected; active, non-draining	7
	Infected; quiescent, non-draining	5
Organisms isolated from culture	Staphylococcus aureus	14
	Pseudomonas aeruginosa	8
	Escherichia coli	5
	Eterobacter cloacae	3
Mean delay from initial injury to Ilizarov treatment (range)		7.9 (4- 15) months
Mean time of bone transport (range)		75 (45- 135) days
Mean Ilizarov frame application time (range)		3.8 (3- 4.5) months
Mean follow-up time (range)		15 (12-26) months

Results

Association for the Study and Application of Methods of Ilizarov **(**ASAMI) protocol was used for clinical evaluation of follow-ups. Mean delay from initial injury to Ilizarov treatment was 7.9 months (range 4-15 months). The mean bone transport time was 75 days (range 45–145 days). The mean Ilizarov frame application time was 3.8 months and mean patient follow-up time was 15 months (12-26 months) [Table 1].

In our study, bone union resulted in all 30 patients. As per ASAMI classification, bone results were excellent in 19 patients, good in 8 patients, and fair in 3 patients. None of the patient had poor bone results [Table 2]. Functional results were excellent in 15 patients, good in 11 patients, fair in 3 patients, and poor in 1 patient [Table 3].

Table 2: Evaluation of the bone results according to 'Association for the Study and Application of Methods of Ilizarov (ASAMI)' classification.

Bone Results	Number & percentage of Patients	Criteria
Excellent	19 (63.33%)	Bone union, No infection, Deformity < 7°, LLD (Limb length discrepancy) < 2.5 cm
Good	8 (26.67%)	Bone union plus any two of the following: Absence of infection, deformity < 7°, LLD < 2.5 cm
Fair	3 (10%)	Bone union plus any one of the following: Absence of infection, deformity < 7°, LLD < 2.5 cm
Poor	0 (0%)	Nonunion/ refracture/ plus Failure to meet three of above criteria

Table 3: Evaluation of the functional results according to 'Association for the Study and Application of Methods of Ilizarov (ASAMI)' classification.

Functional Results	Number & percentage of Patients	Criteria
Excellent	15 (50%)	Active, No limp, Minimum stiffness (loss of <15° knee extension/<15° ankle dorsiflexion), No RSD (Reflex sympathetic dystrophy), Insignificant pain
Good	11 (36.67%)	Active, with one or two of the following: Limp, stiffness, RSD, significant pain
Fair	3 (10%)	Active, with three or all of the following: Limp, stiffness, RSD, significant pain
Poor	1 (3.33%)	Inactive (unemployment or inability to return to daily activities because of injury)
Failure	0 (0%)	Amputation

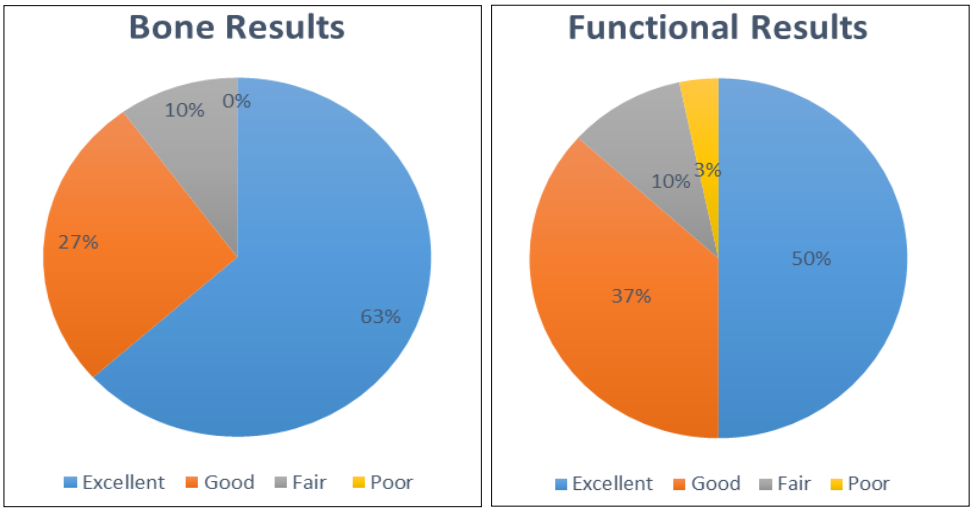

Fig 1: Showing bone results and functional results according to ASAMI classification

Complications

In present study, pin tract infection was seen in 16 (53.33%) patients. It was the most common complication. Other complications of our study are shown in Figure 2.

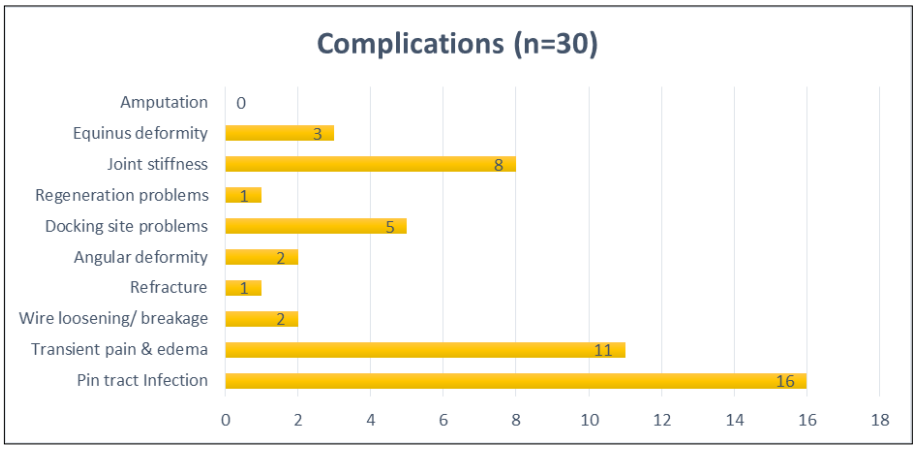

Fig 2: Showing number of the patients of various complications of Ilizarov treatment in our study group (n=30).

Radiological & clinical evaluations of follow-up

Fig 3

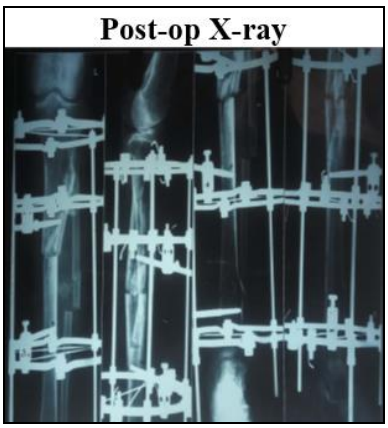

Fig 4

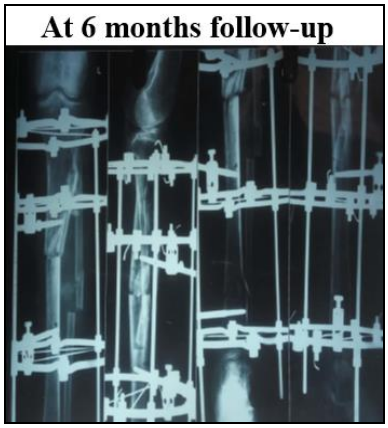

Fig 5

Fig 6

Fig 7

Fig 8

Fig 3-8: Radiological and clinical evaluations of a case with infected non-union proximal third tibia with bone loss, managed by Illizarov technique and distraction osteogenesis. (*SLR: Straight Leg Raising).

Discussion

Infected non-union of long bones including tibia, is one of the major challenging conditions for Orthopaedic surgeons. It requires scrupulous planning and management. Ilizarov technique has been implemented as a single stage successful treatment modality for infected non-unions of long bones [14, 15]. In the literature, Struijs *et al*. and other studies decribed the significant role of distraction histiogenesis about eradication the infection and achieving bone union of long bones [16, 17].

We attained bone union of tibia in all 30 patients without any persistent infection. In our study, bone results were excellent in 19 (63.33%) patients, good in 8 (26.67%) patients, and fair in 3 (10%) patients. We didn't observed any poor bone results. These results were comparable with results of previous studies. Dendrinos *et al*. [18] had 14 (50%) excellent, 8 (28.5%) good, 1 (3.5%) fair, and 5 (18%) poor bone results, in their study of 28 infected non-unions of tibia. Similarly, Magadum *et al*. [19] had 19 (76%) excellent, five (20%) good, and one (4%) poor bone results, in their study of 25 infected nonunions of tibia.

In the present study, functional results were excellent in 15 (50%) patients, good in 11 (36.67%) patients, fair in 3 (10%) patients, and poor in 1 (3.33%) patient. Magadum *et al*. [19] in their study of 25 infected tibial nonunions had 15 (60%) excellent, eight (32%) good, one (4%) fair, and one (4%) poor

fuctional results. Both studies had comparable results.

The most common post-operative complication in this study was pin tract infection which was seen in 16 (53.33%) patients. Transient pain and swelling was present in 11 patients. These complications were managed accordingly. Soft tissue contracture at ankle causing joint stiffness and equinus deformity in eight and three patients respectively. It was managed by physiotherapy, and/or TA lengthing and triple arthrodesis in one case as well. Other complications of this study were docking site problems (5 patients), wire loosening or breakage (2 patients), angular deformities (2 patients), refracture (1 patient), and regeneration problems (1 patients). All complications were managed accordingly. Amputation was not required in any patient of this study group. Similar rate of complications were noticed in previous studies by Vignes *et al.* [20], Paley D and Mora *et al.* [21], and Shabir *et al.* [22].

Limitations of our study

The present study lacks the direct comparison of Ilizarov technique with other treatment modalities for the treatment of infected non-union of tibia. Secondly, the sample size of our study group is too small to conclude more significant results and complication rates.

Conclusion

Ilizarov technique is the outstanding method to eradicate infection, achieve satisfactory bone union and better functional results in a single sitting procedure. It maintains equal limb length and preserve reasonable range of joint motion in cases of infected non-union of long bones such as tibia. Although, the awkwardness of the frame and multiple wires complexity are the main causes of inconvenience to the patients. This technique requires wearing the frame for a long duration, so uncooperative patients are not good candidates for Ilizarov technique.

References

1. Mahaluxmivala J, Nadarajah R. Ilizarov external fixator: acute shortening and lengthening versus bone transport in the management of tibial non-unions. Injury. 2005; 36(5):662-668.
2. Keating JF, Simpson AH, Robinson CM. The management of fractures with bone loss. J Bone Joint Surg. 2005; 87:142-150.
3. Haines NM, Lack WD, Seymour RB, Bosse MJ. Defining the lower limit of a critical bone defect in open diaphyseal tibial fractures. J Orthop Trauma. 2016; 30(5):e158-e163.
4. McNally M, Ferguson J, Kugan R, Stubbs D. Ilizarov Treatment Protocols in the Management of Infected Nonunion of the Tibia. J Orthop. Trauma. 2017; 31(Suppl. S5):S47-S54.
5. Gardner MJ, Toro-Arbelaez JB, Boraiah S, Lorich DG, Helfet DL. Surgical treatment and outcomes of extraarticular proximal tibial nonunions. Arch Orthop Trauma Surg. 2008; 128:833-839.
6. Ilizarov GA. The tension-stress effect on the genesis and growth of tissues. Part I. The influence of stability of fixation and soft-tissue preservation. Clin Orthop Relat Res. 1989; 47:249-281.
7. Hosny G, Shawky MS. The treatment of infected nonunion by compression distraction techniques using the Ilizarov external fixator. Int Orthop. 1998; 22:298-302.
8. Sanders DW, Galpin RD, Hosseini M, MacLeod MD. Morbidity resulting from the treatment of tibial nonunion with the Ilizarov frame. Can J Surg. 2002; 45:196-200.
9. Ayed A, Al Shahrani, SBOS, Jaya Shanker Tedla PhD, Irshad Ahmad PhD. Effectiveness of ilizarov frame fixation on functional outcome in aseptic tibial non-union cases at Abha, Kingdom of Saudi Arabia: An experimental study. Journal of Taibah University Medical Sciences. 2015; 10:216-221.
10. 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.
11. Golyakhovsky V, Frankel V. Operative Manual of Ilizarov Techniques. Saint Louis: Mosby‐Yearbook, Inc., 1993, 146-8.
12. Dahl MT, Gulli B, Berg T. Complications of limb lengthening. A learning curve. Clin Orthop Relat Res. 1994; 301:10‐8.
13. Catagni M. Imaging techniques: The radiographic classification of bone regenerate during distraction. In: Maiocchi AB, Aronson J, editors. Operative Principles of Ilizarov. London: Williams & Wilkins, 1991, 53-7.
14. Rohilla R, Siwach K, Devgan A, Singh R, Wadhwani J, Ahmed N *et al*. Outcome of distraction osteogenesis by ring fixator in infected, large bone defects of tibia. J Clin Orthop Trauma. 2016; 7:201-9.
15. Patil S, Montgomery R. Management of complex tibial and femoral nonunion using the ilizarov technique, and its cost implications. J Bone Joint Surg Br. 2006; 88:928-32.
16. Struijs PA, Poolman RW, Bhandari M. Infected nonunion of the long bones. J Orthop Trauma. 2007; 21:507-11.
17. Jain AK, Sinha S. Infected nonunion of the long bones. Clin Orthop Relat Res. 2005; 431:57-65.
18. Dendrinos GK, Kontos S, Lyritsis E. Use of the ilizarov technique for treatment of non‐union of the tibia associated with infection. J Bone Joint Surg. Am. 1995; 77:835-46.
19. Magadum MP, Basavaraj Yadav CM, Phaneesha MS, Ramesh LJ. Acute compression and lengthening by the ilizarov technique for infected nonunion of the tibia with large bone defects. J Orthop Surg (Hong Kong). 2006; 14:273-9.
20. Vignes GS, Arumugan S, Ramabadran P. Functional outcome of infected nonunion tibia treated by Ilizarov fixation. Int J Sci Stud. 2014; 2:7:87-92.
21. Paley D, Mora R. Nonunion of the Long Bones: Diagnosis and Treatment with Compression – Distraction Techniques. Italy: Springer Science & Business Media, 2006, 27-30.
22. Shabir M, Arif M, Satar A, Inam M. Distraction osteogenesis in segmental bone defects in tibia by monoaxial external fixator. J Postgrad Med Inst. 2010; 24:134-7.