Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Orthopaedic Surgery

Management of Infected Non-Union of Tibia Treated with Ilizarov External Fixator and Fibular Graft; Our Experience

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DOI: 10.36347/sjams.2023.v11i11.015 | **Received:** 11.10.2023 | **Accepted:** 17.11.2023 | **Published:** 22.11.2023

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Abstract **Original Research Article**

Introduction: Tibia is the most widely recognized long bone fractured due its weak subcutaneous location and most frequently associated with acquired complications of delayed union or non-union because of disorder. Among the different treatment options, the Ilizarov outer fixator application is considered as better due than its various benefits. ***Aim of the study***: The purpose of this study was to examine the role of Ilizarov fixation in infected tibial non-union and its outcomes. ***Methods***: This retrospective study was completed in the 250 Bed General Hospital, Khulna, Bangladesh. The duration of this research was 1 year, from June 2021 to May 2022. Total of 102 patients with tibial non-union associated with infection who treated with the Ilizarov fixator were selected for this study. Patient feedback and medical reports were reviewed for union of bone, bone and functional outcomes and complications. ***Result:*** The most well-known organic entity for infection was identified to be Staphylococcus Aureus. At the time of last subsequent all patients had accomplished union with the exception of two, one of whom needed to go through amputation because of non-union and sepsis. Larger part of the patients had a great score according to ASAMI evaluating framework for bone and capability results. The most common complexity noted was pin track infections. ***Conclusion***: Ilizarov outer fixator is more qualified for contaminated non-union of tibia since it can give a stable mechanical environment, bone transport, correct deformities, and enable weight bearing and thus its utilization can be suggested for the same.

Keywords: Non-union of tibia, infection, Ilizarov technique, bony union.

INTRODUCTION

The occurrence of perplexing and compound fractures of long bones is on an increasing trend because of expanding number of high energy trauma occasions in recent times [1]. Tibia is the most widely recognized long bone fractured due its weak subcutaneous location. Deferred union and non-union because of contamination are a portion of the ordinarily obtained complications [2]. Non-union is more normal in tibia fractures contrasted with different bones of the body. Also, non-union of fracture is often confounded by other coexisting issues, for example, persistent infection, loss of soft tissues and bone, limb length discrepancy and limb deformity [3]. Infected tibial non-union has consistently represented a test for orthopaedic surgeons [4]. There are various choices accessible for the administration of persistent diaphyseal contaminations related with non-union which incorporate extensive debridement with local soft-tissue rotational flaps [5], packing the defect with antibiotic cement beads, Papineau-type open cancellous bone grafting [6], tibiofibular synostosis, free microvascular delicate tissue and bone transfers and the Ilizarov method. The Ilizarov technique has certain advantages as it can overcome most of the difficulties; it can make up for bony deformities, consider bony union through bone histogenesis as well as eliminate infection [7].

As a subcutaneous bone, it is vulnerable to injury and its breaks are normal which are for the mostly open and complex among the long bone cracks. Postponed union, non-union with related contamination are somewhat normal inconveniences seen. The non-union goes from 3% to 11% of all tibia fractures. Treatment of contaminated non-union of tibia is one of the confounding quandaries in orthopaedic surgery due to its deferred administration after a high energy injury, as it has slender delicate tissue inclusion with poor vascular supply and complex fracture patterns that outcome ordinarily in an ominous result. After numerous

surgeries with colossal weight of cost as well as drawn out time of immobilization makes the patient life miserable, that being said the final products are unsuitable alongside removal might in any case be the result. To eradicate infection and to establish bony union with a good functional extremity often requires a courageous measure. The treatment of tainted non-union of tibia by interruption osteosynthesis utilizing Ilizarov method can likewise address a harmonizing disfigurement, bone misfortune, shortening or infection [20]. According to Ilizarov, to dispose of infection and obtain bony union, concerned vascularity must be increased. In this strategy, vascularity is expanded by corticotomy and use of a circular outer fixator. It likewise gives micro motion because of interruption and gives an astounding biological environment for fracture healing [21]. Ilizarov procedure enjoys the extra benefit of proficient obsession which permits early mobilization and keeps up with articular capability, eliminates the requirement for bone grafting and has negligible complications [22].

Objective of the Study

- ***General objective****:* The aim of the study is to analyse the role of Ilizarov fixation in infected tibial non-union.
- ***Specific objective****:* The purpose of the study is to assess infection rates, bony union, functional outcomes and related complications.

METHODOLOGY & MATERIALS

This retrospective observational study was conducted during June 2021 to May 2022, in 250 Bed General Hospital, Khulna, Bangladesh. 104 patients treated for infected non-union of tibia with Ilizarov technique were selected for this study. But two of the study patients were excluded due to data loss during the study.

- ***Inclusive criteria****:* Patients with tibial non-union of minimum duration of six months and infection at the site of non-union with an additional criterion of either a bone defect of more than 2.5cm or an attempt to attain bony union that failed to heal following an intervention and who signed the written consent paper were included in this study.
- ***Exclusion criteria****:* Any patients with tibial non-union not associated with infection and infected fractures of less than six months duration were also excluded.

The primary treatment of the fracture had been open reduction and internal fixation (ORIF) in 34 patients, external fixation in 28 patients, intramedullary nailing in 22 patients, and cast application in seven patients. 4 patients with Ilizarov application as the initial choice of treatment for the fracture had presented with development of non-union. The mean number of previous surgeries was four (range: 0-14). The study patients were positioned supine on a radiolucent table. Ilizarov fixator was assembled according to length of the patient's limb, site of infected non-union and functional status of the ankle and knee joints. The assembled Ilizarov fixator was used at the tibial shaft in a way where the Ilizarov rings were positioned on the proximal and distal fragments parallel to the respective joints and the pins were inserted into the same plane to keep them perpendicular to the mechanical axis of the tibia under image intensifier control. Radical debridement was carried out for the necrotic bone and infected soft tissue. A course of appropriate IV antibiotics was given for two weeks to all patients postoperatively according to culture and sensitivity. Full weight bearing involving supports and isometric activities as well as those for range of movement were encouraged from the principal postoperative day. The latency period before bone transport was 5-7 days, while the interruption rate was 0.25mm each 6 hours. After completion of bone transport, the tibia docked ends were compressed by 0.25mm each day to provide full contact until the patient felt pain at the docking site. Union for the Study and Application of the Method of Ilizarov (ASAMI) classification [8], was used to evaluate the bone and functional results. Ethical clearance was taken from the ethics committees as required. Signed informed consent was obtained from patients prior to their enrollment.

RESULT

Mean age of 102 study population was 44.65±17.60 years where eighty two patients (80%) were males and twenty patients (20%) were females. The follow-up period was 12 months while the mean Ilizarov fixator time was ten months. Road traffic accident was the most common reason among patients presenting with tibial non-union followed by fall, gunshot and blast injury [Table-1]. Cultures were positive in 54 patients (52.94%) where *staphylococcus aureus* was the most common organism isolated [Table-2]. Out of all the patients, 26 patients complained of pain on weight bearing. On the other hand, 76 patients were free of pain at the time of their last follow-up. The mean bone defect was 3.5 (range: 2-5) cm. The mean external index was 60 days/cm (range: 45-120days/cm). 16 patients had soft tissue defect that required soft tissue coverage. Among 14 patients, local flap were used while free flap was used for two of the study patient. The mean surgical time was 180 minutes (range: 120-300minutes). Pre-operative limb length discrepancy was found in 60 patients which was corrected in 36 patients. 14 patients had residual limb length discrepancy, of whom 10 had less than 2cm leg length discrepancy. Eradication of infection, both clinically and radiologically, was achieved in 100 patients. According to ASAMI grading system for bone, 22 patients had excellent, 19 good, seven fair and three had poor results... No perioperative complication was seen but 18 patients had postoperative pin-track

infections who were treated with antibiotics. Wire loosening and non-union occurred in two patients each. Reinfection, leg abscess and septic arthritis occurred in two patient. None of the patients died during the treatment process [Table-3]. The functional result was excellent in 24 patients, good in 21, fair in five and poor in one [Table-4].

Table 1: Mechanism of initial injury

Mechanism of initial trauma	Frequency	Percentage
Road traffic accident	66	64.71%
Fall form height	20	19.61%
Gun shot	12	11.76%
Blast injury	4	3.92%

Table 2: Organisms isolated from culture

Organisms (n=54)	Number	Percentage
Staphylococcus aureus	34	62.96%
Staphylococcus aureus	6	11.11%
Pseudomonas aeruginosa	12	22.22%
Proteus mirabilis	2	3.70%

Table 3: Complications observed after Ilizarov

Complications	Number	Percentage
Pin track infection	18	17.65%
Non-union	4	3.92%
Wire loosening/broken	4	3.92%
Re-infection	2	1.96%
Leg abscess	2	1.96%
Schanz Screw broken	2	1.96%
Septic arthritis	2	1.96%
Limb length discrepency	17	16.67%

Table 4: Bone and functional outcomes using Union for the Study and Application of the Methods of Ilizarov (ASAMI) system

Outcomes	Parameter	Criteria	Number of patients
Bone results	Excellent	Union, no infection, deformity < 7˚, limb-length discrepancy < 2.5 cm	44 (43.14%)
	Good	Union + any two of the following: absence of infection, < 7˚ deformity and limb-length inequality of < 2.5 cm	38(37.25%)
	Fair	Union + only one of the following: absence of infection, deformity < 7˚ and limb-length inequality < 2.5 cm	14(13.73%)
	Poor	Nonunion/re-fracture/union + infection + deformity > 7˚ + limb-length inequality > 2.5 cm	6(5.88%)
Functional results	Excellent	Active, no limp, minimum stiffness (loss of < 15˚ knee extension/< 15˚ dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), insignificant pain	48(47.06%)
	Good	Active, with one or two of the following: limp, stiffness, RSD, significant pain	42(41.18%)
	Fair	Active, with three or all of the following: limp, stiffness, RSD, significant pain	8(7.84%)
	Poor	Inactive (unemployment or inability to return to daily activities because of injury)	4(3.92%)

DISCUSSION

The ASAMI score to analyse the effectiveness of Ilizarov method has been used in the present study. The excellent and good rates of bone result using the ASAMI score came out to a total of more than 80% while that of the functional outcome was more than 88%. These values are found to be similar to the results of a study done by Yin *et al.,* [10]. In the current study, the functional result was better than the bone result differing from most studies of this kind such as Magadum *et al.,* and Farmanullah *et al.,* both of which had a better bone

score than the functional score (76%>60% and 58.9%>56.9% respectively) [11, 12]. A previous study also demonstrated a similar result as ours with a better functional score than the bone score (64%>60.8%) [13]. This distinction could be credited to the functional score being reliant upon various different variables including the patient's pain limit and the states of the muscles, bones and joints [9].

Management of the non-union with enormous bony deformities can be a difficult issue for orthopaedic surgeons. There are numerous approaches to treating them, for example, with ring fixators, altered Arbeitsgemeinschaft für Osteosynthesefragen (AO) fixators or particular intramedullary nails. Besides, for complex non-unions (deformity >4cm) it is seen that Ilizarov fixator gives a more unrivaled technique for treatment [9]. A research exhibited a comparative outcome as the present study with a preferred practical score over the bone score (64%>60.8%) [13]. This distinction could be credited to the practical score being subject to different variables including the patient's pain threshold and the states of the muscles, bones and joints [9].

Over 96% of the patients accomplished bone union while recurrence of infection was noticed exclusively in two patients. Comparative outcomes were displayed in a review led by *Xu et al.,* in which 100 percent of the patients accomplished union while none of the patients grew profound contamination as a complexity of involving Ilizarov method for tainted non-unions of the tibia [14]. The patients who went through various systems previously Ilizarov application and made some higher memories span between starting injury and Ilizarov application had less ideal results instead of the people who went through a solitary surgery before the Ilizarov method and had less time length between initial trauma and Ilizarov application.

Past examination likewise showed that expanded stretch between injury and careful mediation brought about higher rates of infection [15]. Then again, there have been numerous examinations that go against this standard, for example, an extensive literature review done by Crowley *et al*., which proposed that the 6-hour rule among injury and careful intercession should be re-evaluated [16]. Pin site disease for the most part happens in regions where there is a more prominent scope of movement and high stress. A report by Ceroni *et al*., proposed that extreme development at the fixator pin-bone connection point prompts pin site disturbance and infection [17]. In this study, pin site contamination happened in 18 patients and was overseen by changing the dressing routinely. Such everyday pin site care assumes a significant part in the treatment of pin site infections [18].

For Ilizarov external fixation, past suggestions included utilization of wires with measurement of 2mm and strain between 1,000 and 2,000 N. It has been demonstrated the way that rigid fixation can be achieved with the utilization of four such wires each in the proximal and distal ends of fracture. This can thusly establish a stable biomechanical climate for bone development and along these lines bone union. Nonetheless, because of excessive fatigue, the steel wires can break during the center or later phases of bone transport and mineralization [14]. Two such instances of wire breakage were additionally seen in this study, at the same time, as the callus in the two cases had nearly arrived at the late mineralisation stage, there was compelling reason need to change the wire in the two cases.

Non-union happened in two of the study patients with one of them going through removal even after multiple procedures. Hence, Ilizarov failure was found in two cases in our gathering. This failure rate was like that of Yin *et al*., with malunion being seen in 7% and appendage removal in 4% of the patients [10]. Two patient had reinfection which was treated with extremist debridement and anti-infection agents while one patient created septic joint pain of the knee and went through arthrotomy, working on after the mediation. A randomized clinical preliminary directed by Peres *et al*., likewise showed arthrotomy to be a viable strategy for managing septic arthritis [19].

Limitations of the Study

The study has some limitations, including the absence of any control group. Outcome of this retrospective study might be underestimated because of the biasness of information, such as the incidence of pin tract infection (some were only grade 1-2 and were not recorded). There is still need for large scale prospective and multi-center studies, focusing developing countries to substantiate the results of the present study.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the present study has found Ilizarov external fixator is better suited for infected non-union of tibia because it can provide a stable mechanical environment, transport bone, correct deformities, and enable weight bearing during the course of treatment. The use of Ilizarov external fixator for infected non-union of tibial fractures can be the first choice due to its high success rates and because it offers an opportunity to salvage the limb without eventually going for amputation.

Declaration of the Patients' Consent

The informed consent from the patients were obtained during data collection and sampling. We ensured permission of the Hospital Ethics Committee before starting the study.

Financial Support and Sponsorship: *Self-funded research.*

Conflicts of Interest: N/A

REFERENCES

1. Pal, C. P., Kumar, H., Kumar, D., Dinkar, K. S., Mittal, V., & Singh, N. K. (2015). Comparative study of the results of compound tibial shaft fractures treated by Ilizarov ring fixators and limb reconstruction system fixators. *Chinese Journal of Traumatology*, *18*(06), 347-351.
2. Dendrinos, G. K., Kontos, S., & Lyritsis, E. (1995). Use of the Ilizarov technique for treatment of non-union of the tibia associated with infection. *JBJS*, *77*(6), 835-846.
3. Jain, A. K., & Sinha, S. (2005). Infected nonunion of the long bones. *Clinical Orthopaedics and Related Research®*, *431*, 57-65.
4. Selhi, H. S., Mahindra, P., Yamin, M., Jain, D., William Jr, G., & Singh, J. (2012). Outcome in patients with an infected nonunion of the long bones treated with a reinforced antibiotic bone cement rod. *Journal of orthopaedic trauma*, *26*(3), 184-188.
5. Fitzgerald Jr, R. H., Ruttle, P. E., Arnold, P. G., Kelly, P. J., & Irons, G. B. (1985). Local muscle flaps in the treatment of chronic osteomyelitis. *JBJS*, *67*(2), 175-185.
6. Lortat-Jacob, A., Lelong, P., Benoit, J., & Ramadier, J. O. (1981). Complimentary surgical procedures following treatment of non-union by the Papineau method (author's transl). *Revue de chirurgie orthopedique et reparatrice de l'appareil moteur*, *67*(2), 115-120.
7. Meleppuram, J. J., & Ibrahim, S. (2017). Experiência na fixação de pseudartrose infectada da tíbia com a técnica de Ilizarov-Estudo retrospectivo de 42 casos☆. *Revista brasileira de ortopedia*, *52*, 670-675. doi: 10.1016/j.rboe.2016.11.008.
8. Paley, D., Catagni, M. A., Argnani, F., Villa, A., Benedetti, G. B., & Cattaneo, R. (1989). Ilizarov treatment of tibial nonunions with bone loss. *Clin Orthop Relat Res*, (241), 146-65.
9. Inam, M., Saeed, M., Khan, I., Durrani, A., Satar, A., & Arif, M. (2015). Outcome of ilizarov fixator in tibial non-union. *JPMA. The Journal of the Pakistan Medical Association*, *65*(11 Suppl 3), S94-9.
10. Yin, P., Zhang, L., Li, T., Zhang, L., Wang, G., Li, J., ... & Tang, P. (2015). Infected nonunion of tibia and femur treated by bone transport. *Journal of orthopaedic surgery and research*, *10*, 1-9.
11. Magadum, M. P., Yadav, C. B., Phaneesha, M. S., & Ramesh, L. J. (2006). Acute compression and lengthening by the Ilizarov technique for infected nonunion of the tibia with large bone defects. *Journal of Orthopaedic Surgery*, *14*(3), 273-279.
12. Khan, M. S., & Awais, S. M. (2007). Evaluation of management of tibial non-union defect with Ilizarov fixator. *Journal of Ayub Medical College Abbottabad*, *19*(3), 34-36.
13. Fleming, B., Paley, D., Kristiansen, T., & Pope, M. (1989). A biomechanical analysis of the Ilizarov external fixator. *Clinical Orthopaedics and Related Research (1976-2007)*, *241*, 95-105.
14. Xu, K., Fu, X., Li, Y. M., Wang, C. G., & Li, Z. J. (2014). A treatment for large defects of the tibia caused by infected nonunion: Ilizarov method with bone segment extension. *Irish Journal of Medical Science (1971-)*, *183*, 423-428.
15. Kindsfater, K., & Jonassen, E. A. (1995). Osteomyelitis in grade II and III open tibia fractures with late debridement. *Journal of orthopaedic trauma*, *9*(2), 121-127.
16. Crowley, D. J., Kanakaris, N. K., & Giannoudis, P. V. (2007). Irrigation of the wounds in open fractures. *The Journal of Bone & Joint Surgery British Volume*, *89*(5), 580-585.
17. Ceroni, D., Grumetz, C., Desvachez, O., Pusateri, S., Dunand, P., & Samara, E. (2016). From prevention of pin-tract infection to treatment of osteomyelitis during paediatric external fixation. *Journal of children's orthopaedics*, *10*(6), 605-612.
18. Kazmers, N. H., Fragomen, A. T., & Rozbruch, S. R. (2016). Prevention of pin site infection in external fixation: a review of the literature. *Strategies in Trauma and Limb Reconstruction*, *11*, 75-85.
19. Peres, L. R., Marchitto, R. O., Pereira, G. S., Yoshino, F. S., de Castro Fernandes, M., & Matsumoto, M. H. (2016). Arthrotomy versus arthroscopy in the treatment of septic arthritis of the knee in adults: a randomized clinical trial. *Knee Surgery, Sports Traumatology, Arthroscopy*, *24*, 3155-3162.
20. Aronson, J., Johnson, E., & Harp, J. H. (1989). Local bone transportation for treatment of intercalary defects by the Ilizarov technique. Biomechanical and clinical considerations. *Clin Orthop Relat Res*, (243), 71–9.
21. Ilizarov, G. A. (1989). 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*, (238), 249–81.
22. Marsh, D. R., Shah, S., Elliott, J., & Kurdy, N. (1997). The Ilizarov method in nonunion, malunion and infection of fractures. *The Journal of Bone & Joint Surgery British Volume*, *79*(2), 273-279.