

Management of Infected Non-union Tibia with Ilizarov External Fixator: Study on Tertiary Hospital in Bangladesh

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Abstract

Original Research Article

Introduction: Infection is the most prominent cause of delayed or non-union in tibial fractures because of the bone's sensitive subcutaneous location. Ilizarov external fixator application is regarded as the best approach for treating them because of several benefits. Analysis of the role of Ilizarov fixation in infected tibial non-union was the goal of this investigation and evaluating clinical & functional outcomes of infected tibial non-union. **Materials and Methods:** A Multicenter based non-randomized quasi-experimental prospective study was performed in Rajshahi Medical College Hospital, Rajshahi, Bangladesh. From 1st January 2015 to 31st December 2020. The study comprised a total of 61 (n=61) Tibial non-union patients treated with the Ilizarov fixator who also had an infection. ASAMI score criteria were used to evaluate the outcome. **Results:** The most common organism for infection was identified to be at *Staphylococcus Aureus*. The final follow-up showed that all but one patient had achieved union; one patient had to amputate due to infection and non-union. ASAMI score rating methodology for bone and function results rated the majority of patients as outstanding. Pin tract infections were the most prevalent problem discovered in this research. **Conclusion:** The Ilizarov external fixator is safe and successful for treating infected non-union of the tibia since it can offer a stable mechanical environment, bone transfer, rectify deformities, eradicate the infection, and allow patients to bear weight. Therefore, we still suggest it despite its disadvantages.

Keywords: Non-union of tibia, Infection, Ilizarov technique, Rajshahi Medical College Hospital.

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INTRODUCTION

There has been an increase in complicated and compound long-bone fractures recently because of the increased number of high-energy trauma incidents [1]; particularly those involving motorcycles. Long bones can be broken; however, the tibia is the most commonly fractured because of its use. Some of the often acquired problems include delayed or non-union as a result of infection [2, 3]. Tibia fractures are more likely than other bone fractures to fail to heal. An infection, soft tissue loss, or a mismatch in limb length and deformity can exacerbate a fracture that does not heal [4]. Orthopaedic surgeons have long struggled with non-union of the infected tibia [5]. Different therapeutic methods are available in the event of persistent diaphyseal infections linked to non-union, including thorough debridement with local tissue rotational flaps

[6]. Antimicrobial cement beads packing, Papineau-type open cancellous bone grafting, tibiofibular synostosis, free microvascular soft tissue and bone transplants, and the Ilizarov operation are some of the other options [7].

However, each approach has advantages and disadvantages. Bony deficiency can be compensated for, the bone union can be achieved by bone histogenesis, and infection can be eliminated using the Ilizarov procedure, which has specific benefits. Distraction creates micromotion, which aids in fracture healing by creating a favorable biological environment. The study's major goal was to examine the effect of Ilizarov fixation in infected tibial non-union [8], infection rates, bony union, functional results, and related problems.

MATERIALS AND METHODS

The hospital records of 61 patients treated with the Ilizarov method for infected non-union of the tibia were prospectively evaluated from 1st January 2015 to 31st December 2020. There were two inclusion criteria for this study. A Tibial non-union lasting at least six months and infection at the non-union site and either a bone defect is measuring at or greater than 2.5 centimeters or an attempt to achieve bony union that failed to heal following an intervention as doing exchange nailing or bone grafting. The study eliminated tibial non-union that was not caused by infection, as well as infected fractures that had not healed in six months or less.

In addition to the patient's demographics, the etiology of the original injury was recorded and the number of prior procedures, type of fixation, and organisms identified. If the infection is active or quiescent and much bone has been lost, a non-union is classified. A proforma was used to gather information on any further operations that may have arisen due to the initial surgery's difficulties.

Open reduction and internal fixation (ORIF) was the initial therapy for 17 patients, whereas external fixation was used for 20, intramedullary nailing was used for 12, and a cast was applied to 10 patients. Two patients received Ilizarov application as their first therapy option for a fracture and had since developed a non-union. The average number of operations before this one was two (range: 0-14). Supine patients were placed on a radiolucent table for the examinations. Patients' limb length, the location of the infected non-union, and the health of their ankle and knee joints were taken into consideration when building the Ilizarov fixator. After that, the incision was indicated, and the resection's scope and the pre-selected osteotomy location.

The devitalized soft tissue and necrotic bone required extensive debridement. As a result, every bone end with a bleeding margin was regarded important. A sub-periosteal transverse osteotomy was used to do a fibular osteotomy and excision of the fibula segment in limbs with deformity or shortening. When the fixator

was complete, it was attached to the tibial shaft so that the Ilizarov rings were placed parallel to the corresponding joints on the proximal and distal pieces, and the pins were inserted in the same plane remaining perpendicular to the mechanical axis of the tibia.

After surgery, all patients received a 5-7-day course of intravenous antibiotics based on culture and sensitivity. A broad spectrum of antibiotics encompassing gram-positive and gram-negative pathogens was prescribed to patients with negative cultures for four weeks. From the first post-operative day on, patients were urged to bear full weight while using crutches and perform isometric exercises and range-of-motion drills. 5-7 days of delay preceded bone transfer, and the distraction rate was 1 mm per day. Following completion of the bone transfer, a 0.25mm compression was applied to the docked ends of the tibia every six hours to ensure complete contact was maintained until the patient complained of pain at the docking site.

External fixation and bone transfer time, external fixation index, and any complications were all recorded and analyzed. Radiographs were taken and evaluated every two weeks during the distraction period and every month during the consolidation phase. There was convincing evidence of docking site union when it was decided to remove the Ilizarov fixator. Images 1 and 2 show at least three intact cortices in the regenerated region. X-ray imagine of two patients treated before and after surgery and follow-up pictures at various time points are displayed in Figures 1 and 2. The ASAMI classification [9] was utilized to categorize the surgically-induced changes in bone and function.

RESULTS

The research comprised 61 patients in total. People in the research had an average age of 45.65 ± 16.69 years. There were 61 patients in all, with 48.8% men and 12.2% women. the Ilizarov fixator lasted on average 10 months, whereas the average follow-up length was 36.84 months (the range was 3-45 months). Patients with tibial non-union most commonly had an injury in a car accident, followed by a fall, FFH, and other injuries (Table I).

Table I: Initially injured mechanism

Initial mechanism trauma	Frequency	Percentage
Accident involving a motor vehicle	45	74.82%
Fall form height	9	14.62%
Other injuries	7	10.56%
Total	100	100%

Thirty-three individuals (54 percent) had positive cultures, with the most frequent pathogen found to be *Staphylococcus aureus* (Table II). Cultures from 24 patients contained a single organism, whereas cultures from 4 patients had two organisms at various stages of development.

Only two patients had trouble bearing weight after the last follow-up, out of 58 who could. Unfortunately, non-union and uncontrollable infections necessitated amputation in one case. 13 patients had discomfort when they tried to bear weight, compared to 48 who had no pain at all by their last checkup. Defects

in the bone ranged from 2 to 5 centimeters on average. The external index ranged from 45 to 120 days/cm, with the average reading at 60. The soft tissue defects in six individuals necessitated the use of artificial soft tissue substitutes. There was a local flap utilized. The typical surgery took 180 minutes to complete (range: 120-300minut). Three of the remaining five patients had leg length discrepancies of less than 2 centimeters, whereas 30 patients had preoperative limb length disparity that was resolved in 23 patients. In 61 individuals, the infection had been eradicated clinically and radiologically. Thirty-three people received exceptional

ratings from the ASAMI bone grading technique; 18 people received good scores; seven people received fair scores, and three people had poor scores.

In the last follow-up, 49 patients were able to walk without a crutch or other walking help on the unaffected limb. Six patients complained of discomfort when walking as part of their regular routine. At the latest follow-up, 5 patients had an apparent limp, although only one of these patients was unable to conduct daily living tasks.

Table II: Organisms isolated from culture

Organisms (n=33)	Number	Percentage
Staphylococcus aureus	22	(66.3%)
Escherichia coli	3	(10.9%)
Pseudomonas aeruginosa	6	(18.8%)
Proteus mirabilis	2	(4.0%)

Table III: After Ilizarov, there were complications

Complications	Frequency	Percentage
Pin track infection	7	(46.88%)
Non-union	4	(23.5%)
Wire loosening/broken	2	(7.24%)
Re-infection	1	(5.22%)
Limb length discrepancy	2	(17.16%)
Total	16	100%

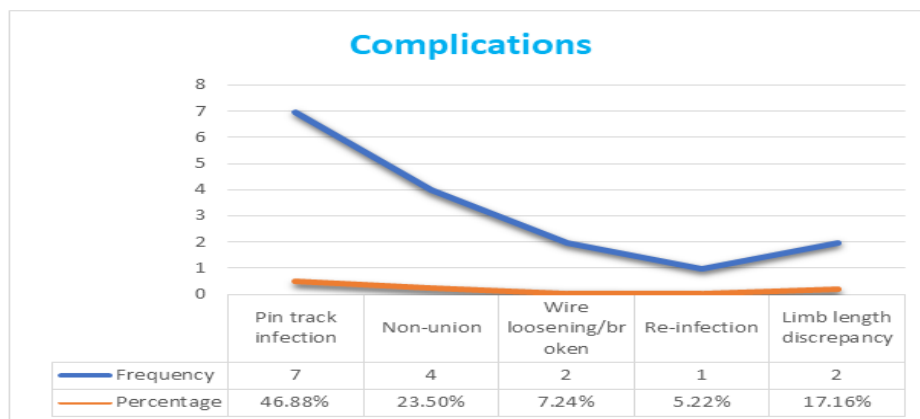


Fig-1: Complications after Ilizarov

Table IV: Results of the Association for the Study and Application of Ilizarov Methods

Bone results	Criteria	Number of patients
Excellent	Union, no infection, deformity < 7°, limb-length discrepancy < 2.5 cm	33
Good	Union + any two of the following: absence of infection, < 7° deformity and limb-length inequality of < 2.5 cm	18
Fair	Union + only one of the following: absence of infection, deformity < 7° and limb-length inequality < 2.5 cm	7
Poor	Nonunion/re-fracture/union + infection + deformity > 7° + limb-length inequality > 2.5 cm	3
Functional results	Criteria	Number of patients
Excellent	Active, no limp, minimum stiffness (loss of < 15° knee extension/< 15° dorsiflexion of ankle), no reflex sympathetic dystrophy (RSD), insignificant pain	34
Good	Active, with one or two of the following: limp, stiffness, RSD, significant pain	21
Fair	Active, with three or all of the following: limp, stiffness, RSD, significant pain	5
Poor	Inactive (unemployment or inability to return to daily activities because of injury)	1

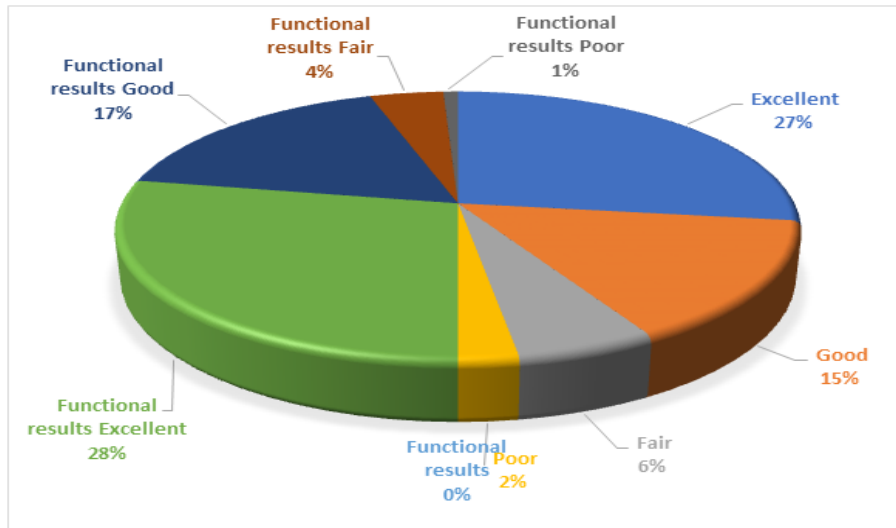


Fig-2: Bone and functional outcomes



a) Pre-operative x - ray showing fracture Tibia & Fibula



b) After 8 weeks follow-up



c) Union complete



d) After union removal of Ilizarov

Fig-3: Tibial non-union before and after surgery, shown from the side

34 patients had outstanding functional outcomes, 21 had acceptable results, 5 had mediocre results, and 1 had a bad outcome (Fig 3, Table IV). Nine patients experienced post-operative pin-track infections treated with antibiotics, but no peri-operative complications were found. Two patients each had wire loosening and an inability to reattach the sutures leg abscess patient reinfection. No one died as a result of the therapy (Table III).

DISCUSSION

Orthopaedic surgeons face a difficult challenge when dealing with non-union caused by significant bone abnormalities. Various treatment options are available, including ring fixators, modified AO fixators, and customized intramedullary nails. On the other hand, the Ilizarov fixator is preferable for treating complicated non-unions (defects more than 4cm).

This study was performed in Rajshahi Medical College Hospital, Rajshahi, Bangladesh. The Ilizarov technique is used to treat infected tibial non-union. To determine if the Ilizarov technique effectively treated these conditions, we calculated the ASAMI score. A total of 80% (48.8/61) of patients had excellent or satisfactory bone results using the ASAMI score, while 88% (53.6/61) had functional outcomes [10] had similar results. Thus these numbers are comparable. In contrast to other studies of similar types, such as those by Magadum *et al.*, and Farmanullah *et al.*, in which the bone score was superior to the functional score (76 % >60 % and 58.9% >56.9%, prospectively), the functional outcome was superior in ours [10, 11]. Our findings are in line with those of another study that found that bone density had a greater impact on functional ability than did functional ability on bone density [13]. A possible explanation for this discrepancy is that the functional score relies on many other parameters, including the patient's pain threshold and the health of their muscles, bones, and joints [12].

Only one patient had a relapse of infection after successful bone union in more than 96% of cases. Researchers found that employing the Ilizarov method for infected non-union of the tibia had similar outcomes, with 100% of the patients having their bones fused and no one developing a deep infection as a side effect [13].

Compared to patients who had a single surgery before using Ilizarov and who had a shorter interval between the first injury and using Ilizarov, individuals who had multiple operations before using Ilizarov fared poorly. Infection risks increase with the time that elapses between injury and surgical intervention. A pin site infection is more likely to arise in a region with a lot of motion or under much pressure. According to recent research, excessive movement at the fixator pin-bone interface can cause pin site discomfort and infection [14, 5]. Seven patients in our research had pin

site infection, which was treated by changing the dressing regularly. It is critical to take regular care of the pin site to treat pin site infections effectively [10].

Previous guidelines for Ilizarov external fixation included the use of 2mm wires and tensions between 1,000 and 2,000 N. Rigid fixations can be achieved by inserting four of these wires into the fracture at the proximal and distal ends, respectively. Bone development and hence bone union can take place in a stable biomechanical environment. However, in the middle or late stages of bone transport and mineralization, steel wires might break because of severe fatigue [13]. The wire broke two cases throughout the research, but because the callus in both cases was towards the end of its mineralization phase, there was no need to replace it.

Two of our patients failed to heal, and one of them had to have an amputation despite many treatments. In our study, we found two instances of Ilizarov failure. There was a failure rate of about the same as in the study by Yin *et al.*, where 7 percent of patients had malunion, and 4 percent had limb amputation [10]. Reinfection in one patient was treated with severe debridement, and antibiotics in the knee were treated with arthrotomy and improved following the procedure. Arthrotomy was also a successful treatment for septic arthritis [15].

To sum it up, only when the local infection has been controlled, necrotic tissue has been removed from the nidus, and a stable biological and biomechanical environment has been created can union be accomplished in infected non-union of the tibia. In underdeveloped nations like Pakistan, where resources and knowledge are scarce, the Ilizarov method for treating infected tibial non-union is successful, according to the current study results. The success rate and difficulties are comparable to international literature despite the limitations of a resource-constrained context.

However, there is a drawback to this study: there was no control group. This prospective study's findings, such as the prevalence of pin tract infection, may be overestimated owing to information bias (some were only grades 1-2 and were not recorded). As a result, larger prospective and multi-center investigations, particularly from developing countries, are needed to verify the current study's findings.

CONCLUSION

The Ilizarov external fixator is more suited for treating infected non-union of the tibia because it can create a stable mechanical environment, transport bone, rectify abnormalities, and allow patients to bear weight during therapy. Even though there were issues with the pin tract infection and technological challenges, infected non-union of tibial fractures should be treated

with an Ilizarov external fixator, which has a high success rate and allows the limb to be salvaged rather than amputated.

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