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A clinical study of Ilizarov technique in infected non union of fracture shaft of tibia

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Abstract
Background and Objectives: Infected non-union is a chronic and debilitating disorder that still poses a very complex problem to the surgeon today in terms of cost and time-effective treatment. Application of the Ilizarov frame to treat complex tibial non-union has become an established orthopaedic procedure. The results in achieving union and eradicating infection are well documented. The purpose of the study is to assess the role of Ilizarov's technique in infected nonunion in minimizing the morbidity and to gain a deeper understanding of the results and problems associated with this technique.
Methods: The present study was a prospective study of 22 patients with infected nonunion shaft of tibia satisfying the inclusion criteria admitted in KIMS, Hubli between the study period of November 2007 to October 2008. Cases were selected according to inclusion criteria.
Results: In our series of 22 cases, there were 21 males and 1 female, with a maximum age of 72 years, minimum age of 19 years and the mean age of 34.5 years. In most of our cases, mode of injury was Road traffic accident (75%). Most patients (59%) were having Draining type of Nonunion. Bony results were excellent in 72.72% of cases, good in 18.18% and fair in 4.5% of cases. Functional results were excellent 82% of cases, good in 9% and in 9% poor.
Conclusion: Ilizarov technique, despite few unfavourable results and complications, after clearing infection and resection of sequestrated bone, it not only allowed repair of defect but also restoration of activity and limb length. It gave satisfactory results in treatment of infected nonunion of shaft tibia. Joint function and weight bearing while on treatment, is an advantage which cannot be matched by any other technique.

Keywords: Ilizarov, RTA, infected non-union

1. Introduction
Tibia is the most subcutaneous bone in the body and vulnerable to trauma and therefore its fractures are commonest among the long bone fractures [1, 2]. This increase in the number of tibial fractures both close and open is due to the high speed Road Traffic Accident (RTA) injuries. Even the best treatment of these fractures results in complications like non-union or malunion along with infection are common [3, 4, 5]. It is chronic and debilitating disorder that still poses a very complex problem to the surgeon today in terms of cost and time-effective treatment. Traditionally, treatment of non-union follows a two-stage procedure. The first stage comprises of debridement with or without antibiotic cement bead insertion and systemic antibiotics to convert an infected non-union to aseptic non-union. The second stage is performed to achieve stability either by external or internal fixation and bone grafting [6]. Single-staged procedures such as debridement and application of Ilizarov fixator[7] or use of antibiotic cement-impregnated intramedullary nails (ACIINs) have been described in the literature[8]. In this study, we have evaluated the results obtained by treatment of infected nonunion of tibia by Ilizarov external fixator [9, 10, 11].

2. Materials and Methods
Twenty two patients admitted in the Inpatient Department of Orthopedics at Karnataka Institute of Medical Sciences, Hubli, during Nov 2007 to Oct 2008 with infected non-union of tibia, were included in the study. Infected Nonunion with tibial nerve damage, cases of pathological fracture in chronic osteomyelitis and metaphyseal nonunion were excluded from the study.

The standard pre-operative protocol was followed. Depending on the clinical assessment and radiographs, appropriate Ilizarov frame was assembled prior to surgery. To avoid wound closure problem, an oblique skin incision was used. Non-union site was debrided and ends freshened, until the punctate cortical bleeding in seen (Paprika sign). All cases were treated in two stages. At first stage, radical debridement of the nonunion site was done, followed by fixation, and corticotomy in second stage. Wires were tensioned up to 110 kg. We used De Bestiani technique for corticotomy in all our cases. Whenever union was delayed, we augmented non-union site with Bone marrow injection or bone grafting. Rhythm and rate of distraction are not fixed numbers. Initially to start with when pain was more, we distracted the limb at 0.25 mm x 3 times of day, for 2-3 days. Followed 0.25 mm early 6th hourly. Passive stretching of ankle. Fixator was removed when patient was able to walk without pain, patient was able to stress the limb in a functional manner and X-rays revealed good new bone formation. We used protective casts for 1 month. Strenuous activities and sports were avoided till such time as all four cortices were seen clearly and medullary cavity was recanalised. Final results of all patients were analyzed and evaluated according to criteria laid down by ASAMI for Bone results and Functional results.

2.1 Observations

Twenty two cases of infected nonunion shaft tibia, in adult patients were managed by Ilizarov Technique. Majority of our patients were in the age group of 21-40 years (Mean= 34.5 years) and 21 (95.45%) were males and 1 (4.5%) was female. Most of our patients, i.e. 45% had type III A open fracture and type II in 41% of them. Most common side injured in our patients was right i.e. 64%. In 75% of our cases, lower 1/3rd nonunion was found to be involved. Most of our cases occurred following, RTA (75%), followed by fracture due to fall (15%). Three patient had ipsilateral fracture femur and one patient had ipsilateral Fracture patella. Duration of external fixation insitu was for 5-7 months in 13.63% of patients and 7-9 months in 63.63% of patients, followed by 9-10 month in 9.09% of patients and 11-12 months in 13-63 patients as shown in Fig. 1 (Mean duration of 8.1 months). Mean bone loss was 5.87 cm.

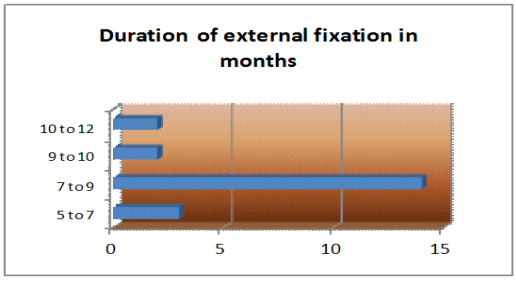

Fig 1: Duration of Fixator

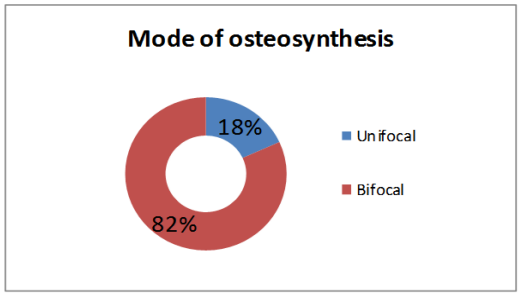

Fig 2: Mode of Osteosynthesis

2.2 Osteosynthesis

81.81% of patients were treated by bifocal osteosynthesis, i.e. acute docking of the nonunion site followed by corticotomy and distraction at other site. In 18.18%, we used monofocal osteosynthesis, where there was no defect as shown in Fig. 2. Average limb lengthening achieved is 5.1 cm. All of our patients who had defect after debridement were treated with limb lengthening. 4-6 cm of limb lengthening was done in 77% of cases and in 4.5% of cases 6-8 cms of lengthening was done. Mean lengthening done was5.1 cms. In 27.3% of cases there was no limb length discrepancy after treatment and mean limb length discrepancy was 0.85cm. Most of our cases were followed up for a minimum period of 6 month. Maximum follow-up being 14 month (Mean of 8.2months).

In our study we noticed pin tract infection in 9 cases. Distraction pain was seen in majority of cases and managed with analgesics. Delayed union was noticed in 4 cases, which were managed with bone grafting and bone marrow injection. Patients who were not co-operative for physiotherapy and with irregular follow up developed knee stiffness (in 3cases) and equines deformity at ankle (in 2 cases).

3. Results

Results were assessed according to classification by ASAMI. In our study, we had excellent results in 72.72% of cases, good in 18.18% fair in 4.5% of cases. Functional results were, excellent in 82% of cases, good in 9% and poor in 9%.

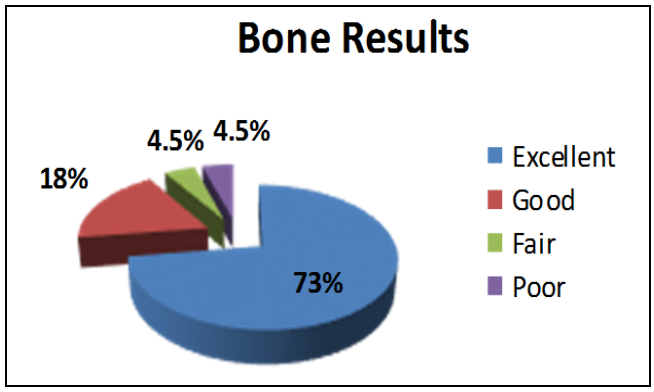

Fig 3: Bone Result

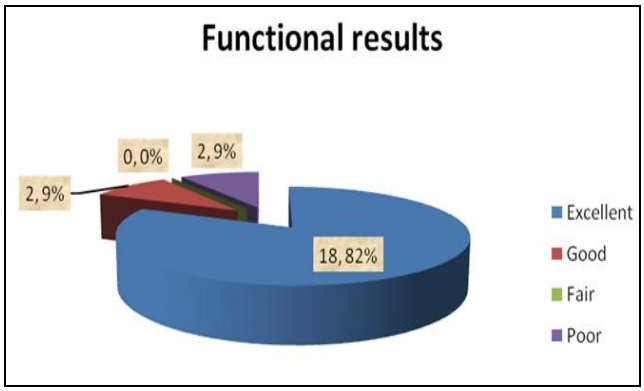

Fig 4: Functional Result

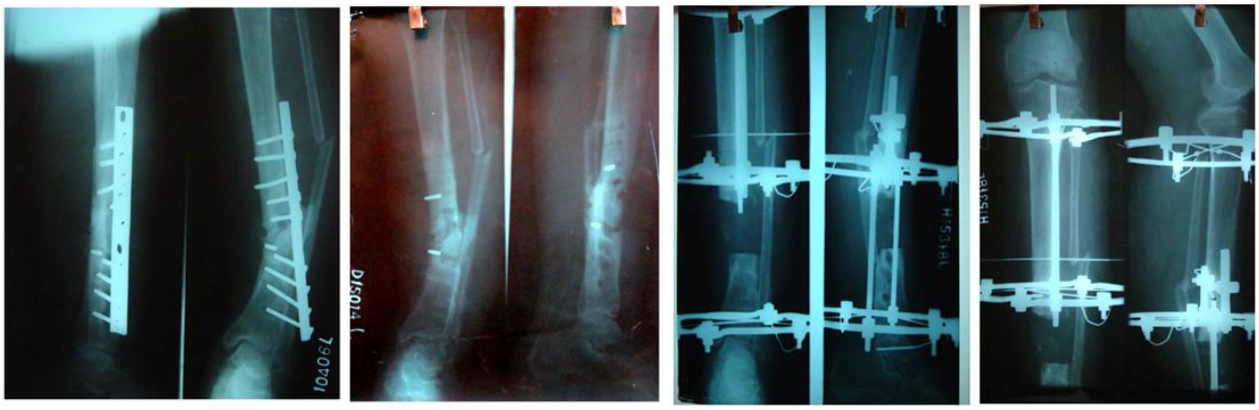

Fig 5: Pre – operative X-rays and Bone Transport after 15 days and 1month

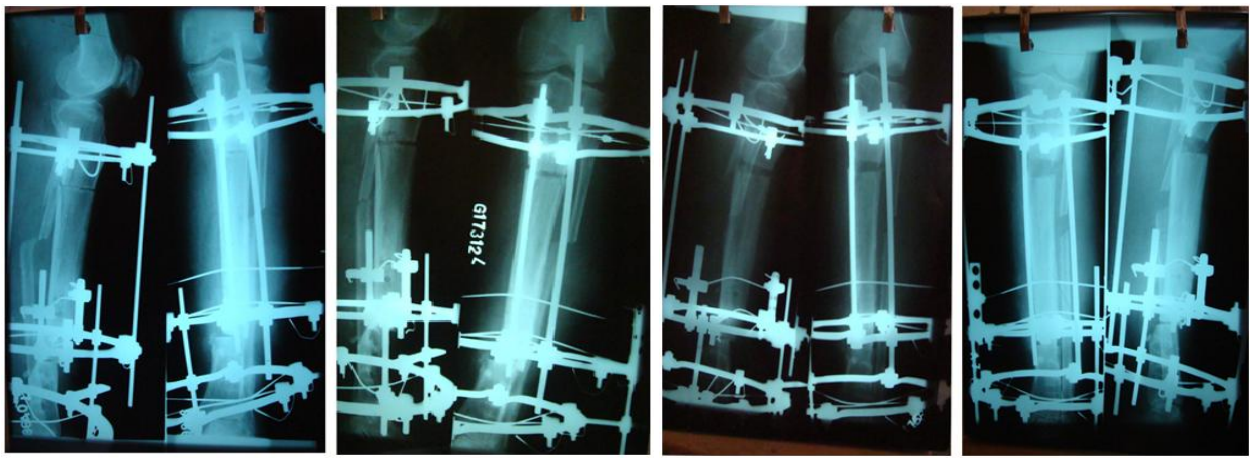

Fig 6: After corticotomy First week & Bone transport after 15 days and 1 month

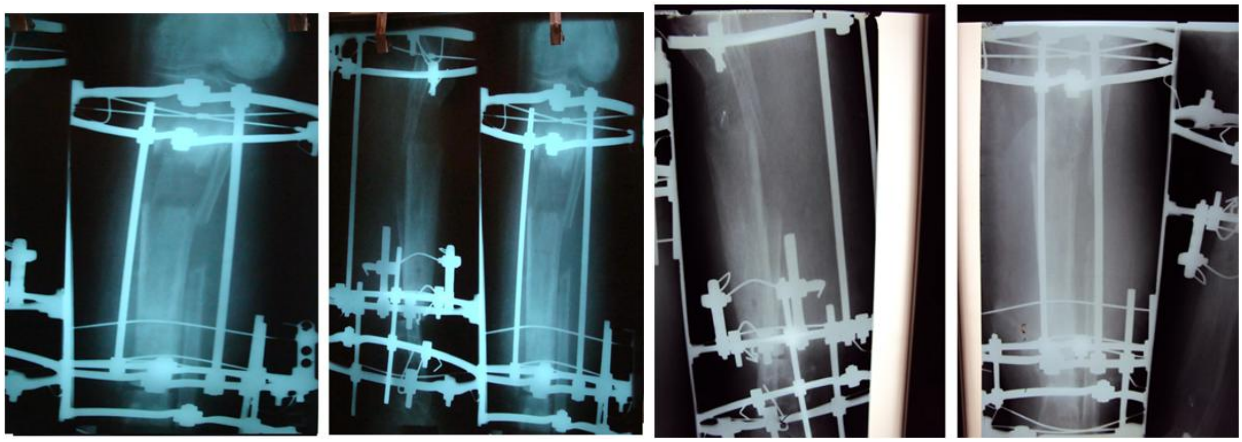

Fig 7: Consolidation of the regenerate & after union before removal of the fixator

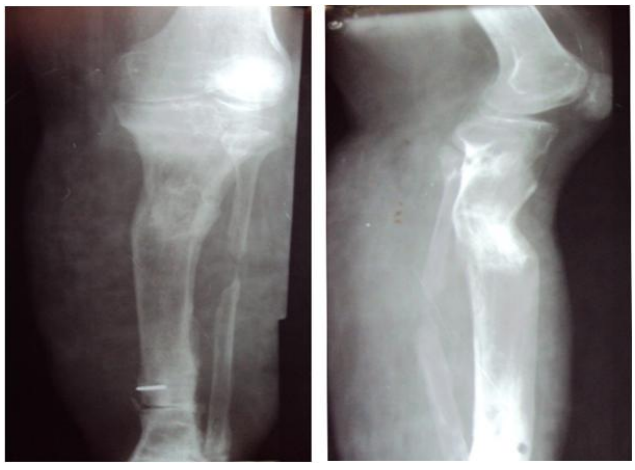

Fig 8: Final radiograph after fixator removal

3. Discussion

It must be emphasized that this study is only short-term follow-up with average follow-up of 7.2 months, and discussion that follows is essentially a preliminary assessment. The aim of the study is to evaluate the results of Ilizarov technique for infected non-union shaft tibia in adults. Infected nonunion is a challenging problem to an orthopaedic surgeon. Many methods have been used to treat this problem like radical debridement, local flaps, muscle flaps, bone graft (Papineau technique), tibio fibular synostosis, cancellous allograft, fibrin mixed with antibiotics, antibiotic beads, antibiotic cement impregnated intramedullary nail and vascularised bone transplants. Even though these methods improve results, they do not fully solve this clinical problem. Radical debridement often leads to large gaps which are difficult to reconstruct without disability. Internal fixation is

not possible due to anatomical reasons like loss of bone or definitive quality of the bone or infection. Internal fixation often results in recurrent infection. Though these techniques have promising advantages, but early weight bearing is not possible and fracture disease is accelerated. The mechanical advantage of rings and wires gives us an option of compression distraction and bone transport and early weight bearing. Patient age ranged from 19 yrs to 72 yrs and the mean age for 34.5 yrs. It shows that incidence of infected nonunion shaft tibia was common in 4th decade. Higher incidence in this age group probably is due to active lifestyle, which is prone for accidents and resulting in high velocity injuries. The incidence of nonunion in our study was more common in males 21/22 (95.45%) which can be attributed to the risk of injury due to occupational and ambulant life style led by them. In our study, most of the patients had draining type of non-union. This could be attributed to the mode of injury of which 81.8% of cases were due to RTA and the high velocity injuries usually tend to be open fractures and with contamination. In our study mean bone loss after debridement was 5.89 cms and maximum defect treated was 10 cms. Final mean limb length discrepancy noted was 0.85 cm. This aspect i.e. mean bone loss after debridement is important as it is going to determine the acute docking/bone transport. In our study we noted lengthening index i.e. duration required for formation of 1 cm of new bone, of 1.5 months. This is important aspect in the treatment, which determines approximate fixation period. In our study mean duration of external fixation was 8.1 months. In Paley *et al.* [12, 13, 14] studies, the average bone defect was 10.0 cms and lengthening index was 1.7 months. Fracture is considered to be united when clinically there is no abnormal mobility and radiologically at least three cortices are united. In our study bone union rate was 100%. In our studies, infection was eradicated in all patients at the end of treatment. Though Ilizarov had not used antibiotics, we have used i.v antibiotics depending on the culture report for 2-3 weeks.

In our study bone results were excellent in 72.72% of cases, good in 18.18% of cases, fair in 4.5%, poor in 4.5% of cases. One of the patients aged 72 years had refracture two months after the removal of fixator. This patient was reluctant to have additional lengthy treatment and chose to undergo amputation. Specimen obtained from the fracture site of the amputated limb revealed evidence of infection. Three patients who had delayed consolidation with poor initial bone results had good result after bone marrow injection in two patients and bone grafting in one patient. In 18% of cases where results were good, 2 cases had axial deviation of 7^{O} & 8^{O} at union site which account for 10% of axial deviation rate. One patient had fair result patient had shortening of 4 cm and axis deviation of 8^{o}. Results vary depending on the complexity of non-union. In our study function results functional results were excellent in 82% of cases, good in 9% of cases and poor in 9% of cases. Poor results were noted in (9%) 2 cases, one of the patient had limp, ankle rigidity, inactive with soft tissue dystrophy, another case 72 yrs old man with refracture considered as failure. In two cases (9%), the results were good. In both the cases, patients are active but associated with limp, joint stiffness. In our study we noticed total 35 complications / 22 patients at rate of 1.59 complications / patient. Among 22 problems 10 were pin tract infections. This high rate of pin tract infection may be attributed to rural area of the patients. After discharge from hospital most of our patients reside at village in a dusty environment and facilities for regular dressing were also less. Distraction pain is noticed in majority of cases. Some authors considered delayed union as a part of treatment of non-union. But we considered it in to an obstacle and whenever signs of union are not progressive over 5 months, we augmented with bone marrow injection in 2 patients and bone graft in 1 patient. Finally, they progressed to union. Two patients with equinus deformity of ankle were not willing for further surgery and rest five patients with true complications were satisfied with treatment.

4. Conclusion

In the light of these results, one can conclude that By Ilizarov technique despite few unfavorable results and complications, after clearing infection and resection of sequestrated bone it not only allows repair of defect but also restoration of activity and limb length. It gives satisfactory results in treatment of infected non-union of shaft tibia. The joint function and weight bearing while on treatment is an advantage which cannot be matched by any other technique.

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