

Management of Infected Non-Union Tibia Fracture by Ilizarov Method-A Prospective Study**Qadir Anwar Tak¹, Mahaveer Meena², Manohar Lal Carpanter³, Naveen Ratawal⁴, Pradeep Khinchi⁵, Purushottam Jhanwar⁶**^{1,4,5} Resident, Department of Orthopaedic, JMC, Jhalawar²Professor, Department of Orthopaedic, JMC, Jhalawar³Assistant Professor, Department of Orthopaedic, JMC, Jhalawar⁶Senior Professor, Department of Orthopaedic, JMC, Jhalawar

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Abstract:

Background- Infected non-union of long bones is a chronic and debilitating disorder. It is difficult to treat infected non-union. Various treatment modalities used to treat infected nonunion and ilizarov is one of them. The aim of the study to evaluate outcome of infected non-union tibia fracture managed by ilizarov method using A.S.A.M.I. criteria and also evaluation of complications related to process.

Methods- The study was on 15 patients, 13 males and 2 females, Mean Age between 22 to 55 including study period from august 2020 to march 2022. Functional result and bony result were assessed using A.S.A.M.I. criteria.

Results- The study included 15 cases of with 13 males & 2 female, mean age 37.53 yrs. 100 % were compound fractures. All cases were treated by tibia corticotomy – 53.33% proximal, 46.66% distal. Improved ROM was noted in all cases. 66.66% cases had excellent & 26.66% had good bone results. 60% cases showed excellent and 33.33% cases showed good functional result. We achieved union in 100 % cases, eradicated infection in all. 1 case had persistent pain and all cases return to activities of daily living (ADL). We had some complications, PTI was commonest (60% cases).

Conclusion- Ilizarov method now a days is a good technique to check infection and achieve union in infected non-union of tibia by the principal of distraction osteogenesis.

Keywords- ilizarov, infected non-union tibia, ASAMI criteria.

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Introduction

Infected non-union of long bones is a chronic and debilitating disorder to manage in terms of cost and time effective treatment[1].

Various factors which cause infected non-union of long bone fracture is generally inherent to the fracture, like compound fracture, loss of soft tissue or bone, severe comminution and gross displacement, insufficient immobilisation, infection after internal or external fixation, chronic osteomyelitis and surgical debridement of infected bone[2].

According to Gustilo[3], problems associated with infected non-union are avascularity at the fracture site due to scarring and cicatrisation as a result of multiple surgeries, drug resistance to pathogenic organisms, restriction of neighbouring joint motion, and gap non-union. Infection creates an unfavourable environment for fracture healing, especially when it is associated with mechanical instability[4]. Excellent knowledge of the

pathophysiology of lesions and the biomechanical concept of fixation techniques is essential for better functional outcome[5].

It is difficult to treat infected non-union because of following reasons:

- Previous surgeries would have resulted in scarring and fibrosis of the soft tissue with an avascular environment around the fracture site due to periosteal stripping.
- The presence of dead bone or sequestrum at the fracture site prevents union.
- Thrombosis of blood vessels of Haversian canals leading to non-viable bone at fracture site leading to non-union.
- Non-weight bearing, prolonged immobilization, multiple surgeries with fibrosis of the muscles leading on to a stiff joint / fracture disease.

- Resistance to the systemic antibiotic therapy poses a problem in controlling the infection and achieving union.
- Several parameters will help identify infected non-union of a tibial fracture[6].
- Exposed bone that has been devoid of vascularized periosteal coverage for more than 6 weeks,
- Purulent drainage,
- Positive bacterial culture from the depths of the wound, and
- Histological evidence of necrotic bone containing empty lacunae.

In earlier days, infected non-unions were treated by a staged protocol, the first stage comprises of debridement with or without antibiotic cement bead insertion and systemic antibiotics to convert an infected non-union to an aseptic non-union. The second stage is performed to achieve stability by either external or internal fixation with or without bone grafting[7].

Antibiotic cement impregnated intramedullary nail (ACIINs) provides a high concentration of antibiotics locally, fills dead space, gives good mechanical stability at fracture site and there by promotes bone healing[8]. It is associated with fewer side effects as compared to systemic antibiotics.

Now a days ilizarov method is also a better option to treat infected non-union.

Ilizarov technique is based on the principles of Tension-stress effect and distraction histogenesis. When a living tissue is distracted in a controlled way, it produces new tissue of the same kind called as regenerate. Ilizarov technique uses external fixation principles providing multiplanar stability. Ilizarov External fixation provides correction of all the complications associated with non-union, bone gap, infection, shortening, and deformities. Corticotomy, stable fixation, and bone transport employed reduces or eliminates infection at the same time achieving bone union and correction of limb length discrepancy. Prof. Ilizarov's famous quote "Infection burns in fire of Regeneration" speaks of the infection, hither to very difficult to control, that almost literally gets burnt out due to the increased blood supply (fire) due to the regenerate.

Material and Methods

15 patients of infected non- union tibia admitted in Jhalawar medical college and hospital, Department of Orthopaedics for period of august 2020 to march 2022 were included in the study. 13 were male and 2 were female in this prospective type study.

Inclusion criteria: fractures tibia with infected non-union (new and already operated cases) with active or quiescent infection, Diaphyseal & Metaphyseal

fracture of tibia, Persistent pus drainage for at least 3 months, Bone gap up to <10 cm and Age >18yrs.

Exclusion criteria: Age <18 years, Patients with medical comorbidities and Bone gap > 10 cm.

Preoperative evaluation- Detailed clinical history and examination with inquiry about the initial injury and previous surgeries. Patient admitted with fracture of tibial shaft with infected non-union were thoroughly examined and questioned. When it was decided for treating, the patient with Ilizarov apparatus, he was shown the fixator and informed in detail as to what procedures we are going to perform on him. Ring measurements are taken by measuring the greatest circumference of the limb with additional two finger breath increments for ring skin clearance. Pre-operative frame construction saves time during surgery. All laboratory investigations were done before procedure.

Procedure- After this planning, the patient was operated under suitable anaesthesia (General anaesthesia, spinal anaesthesia, epidural anaesthesia and regional anaesthesia). The limb was prepared, draped and positioned. The operating surgeon and two assistants performed the surgery. The assistants hold the leg and the Ilizarov construct and position it. The limb was held in ideal position. The ring construct is placed over the limb in the correct way so that the limb is ideally in the middle of the ring in its whole length. It was placed / held with 2 finger breadths anteriorly and 3 finger breadths posteriorly. Finer adjustment of the Ilizarov rings with respect to its exact placement over the limb is done. The first and the last rings were then fixed to the limb with an Ilizarov wire. This would position the entire Ilizarov construct ideally and hence these two transverse Ilizarov wires were known as "Reference wires." The rest of the Ilizarov wire and half pins were inserted and fixed as planned till a stable Ilizarov external fixator is applied to the limb. Tensioning can be done either manually or by using dynamometric tensioner.

Corticotomy can be done either at the proximal / distal tibial metaphysis. Level of corticotomy can be planned depending on the level of fracture and bone gap. Completeness of corticotomy was ensured both clinically and radiological at the end of the procedure. Fibular osteotomy may also done. The wound was closed in layers.

Other surgeries like implant removal, excision of infected non- unions were done earlier.

Postoperative care- The pin tracts were sealed with Povidone-Iodine soaked gauze pieces. Post operatively distraction started on 7th or 10th day at the rate of 1mm per day. The patients were taught about the distraction, the pin site care and physiotherapy adjacent joints. Antibiotic treatment was given (average duration of about 2 weeks even

in MRSA infection). Short courses of antibiotics & pin track injections using Gentamycin were given for pin track infections. Weight bearing was taught using crutches and were encouraged to bear full weight during the treatment. Regular radiographs were done after a week of distraction to confirm the movement & later again repeated after 3 to 4 weeks to assess the type of regenerate. After consolidation the ring fixator was removed & below knee Patella tendon bearing walking cast applied for 4-6 weeks and patient was advised to continue full weight bearing walkig.

The total duration of treatment averaged 6- 8 months.

Follow up- Initially biweekly or weekly to inspect wounds. Later fortnight for the assessment clinically and radiographically. During follow up the outcomes analyzed were 1. Union, 2. Complications, 3. Bone Results and 4. Functional Results.

1. Union- The fracture was considered to be united when it appeared so roentgenographically, when there was no motion at the site of fracture after loosening of the connecting rods and when the patient was able to walk without pain and had a feeling of solidity of the limb.

2. Complications- Problem was defined as the difficulty which resolved completely before the fixator removal by non-operative means. Obstacle was defined as difficulty which resolved completely before the fixator removal by operative means. True complication was defined as problems that persisted even after fixator removal. The true complications were divided as minor (that did not affect the outcomes significantly) and major (that affected the outcome significantly).

3. Bone results- According to ASAMI protocol bone results were divided in to - Excellent, good Fair and poor considering the union, effectively controlled infection, deformity less than 7degree and limb length discrepancy less than 2.5cm.

- Excellent- united, no infection, deformity less than 7 degree, LLD less than 2.5cm.
- Good - united, any two of the other three criteria.
- Fair -union and one of the other criteria.
- Poor – Non-union or refracture; Union but none of the three criteria.

4. Functional results- According to ASAMI protocol functional results were divided in to - Excellent, good, fair and poor considering-

1. Noteworthy limp.
2. Stiffness of knee/ankle (knee FFD more than 15 deg, ankle -loss of dorsiflexion of more than 15 degrees compared other side).
3. Soft tissue dystrophy.

4. Pain that reduced activity or disturbed sleep.
5. Inactivity (unemployment or an inability to return to daily activities).

Results

The bone results, functional results, and complications of these patients were evaluated. 7 patients were younger age group in this series. Average age was 37.53 years. Male predominated in the present series. 7 patients were of infected non-union of upper 1/3 leg bone, 3 were of middle 1/3 and 5 were of lower 1/3 of leg bone. 10 patients were of right sided involved of limb and 5 were of left sided involved. 9 cases were initially fixed with applying of simple external fixator before ilizarov done, 4 were of intramedullary nailing and 2 were of plating.

In all of the cases bifocal corticotomy was done. Proximal tibia corticotomy done in 8 patients and in distal tibia corticotomy done in 7 patients. 8 out of 15 infected non-union was B3 type (Gap with shortening) according to D Paley modification of ilizarov classification of infected non- union, 6 were of type B1(gap but no shortening) and 1 of type B2(shortening but no gap). Average duration of ilizarav fixator application was 7 to 9 months.

In Bone results –

Union achieved in all cases.

- There is no persistent infection in patients.
- Deformity $> 7^{\circ}$ in 2 cases and
- no case of Limb length discrepancy(LLD) $> 2.5\text{cm}$.

In Functional results-

- All patients returned to active daily living.
- Limping and stiffness present in 3 and 5 cases respectively.
- There is no soft tissue dystrophy reported in this series.
- Persistent Pain reported in single case.

Complications-

At least 1 or 2 complication per patient were encountered in the present series. Pin tract infection was most common complication encountered in 9 patients. However it was superficial in most of the cases, controlled by dressing and antibiotics, but infection was deep seated in one case requiring removal of wire and drainage and in others knee stiffness in 5, Equinus foot in 5, deformity in 4, Transient neurapraxia in 3, Deviation of Transported Bone segment in 3, Corticotomy related complications were in 3 cases. According to ASAMI criteria Bone results were excellent in 66.66% cases, good in 26.66%, fair in 6.66% cases. Functional results were excellent in 60% cases, good in 33.33%, fair in 6.66% cases.

Table 1: Bone result

	No. of patients	Percentage
Union	15	100
Persistent infection	0	0.00
Deformity >7°	2	13.33
LLD> 2.5cm	0	0.00

Table 2: Functional Result

	No. of patients	Percentage
Activity of daily living (ADL)	15	100
Limp	3	20
Stiffness	5	33.33
Soft tissue dystrophy	0	0
Pain	1	6.66

Table 3: Result: ASAMI criteria

Bone Result	No. of patients	Percentage
Excellent	10	66.66
Good	4	26.66
Fair	1	6.66
Poor	0	0
Functional Result		
Excellent	9	60
Good	5	33.33
Fair	1	6.66
Poor	0	0



Figure 1: Implants and Instruments

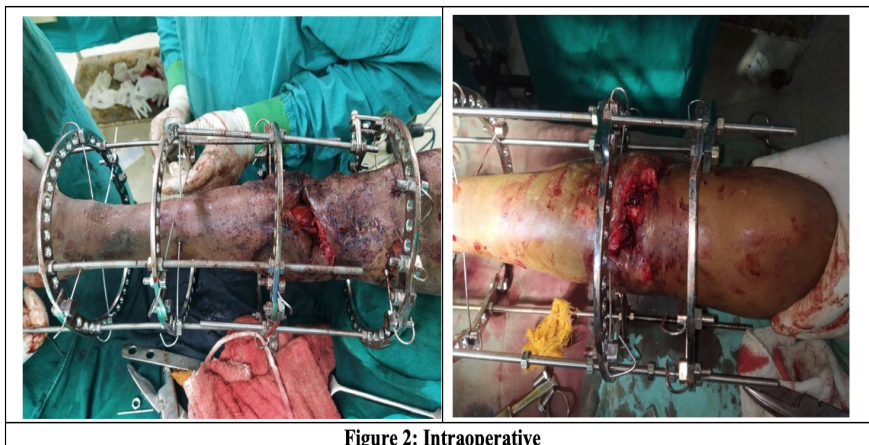


Figure 2: Intraoperative

Case 1:

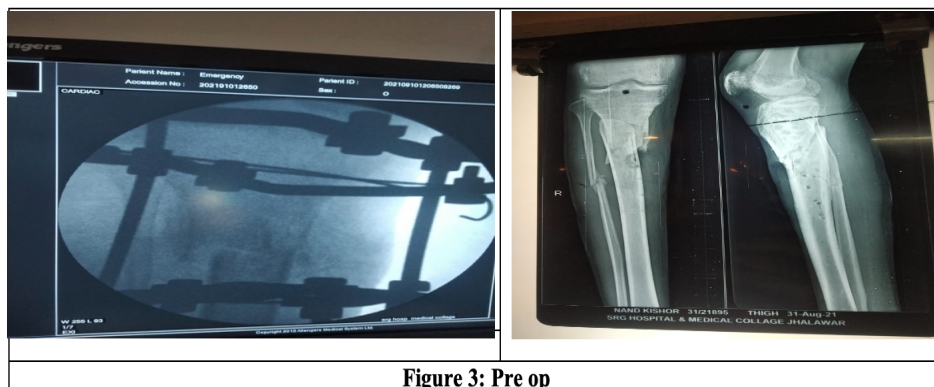


Figure 3: Pre op



Figure 4: 2 weeks follow up



Figure 5: 10 months follow up

Case 2:



Figure 6: Pre op

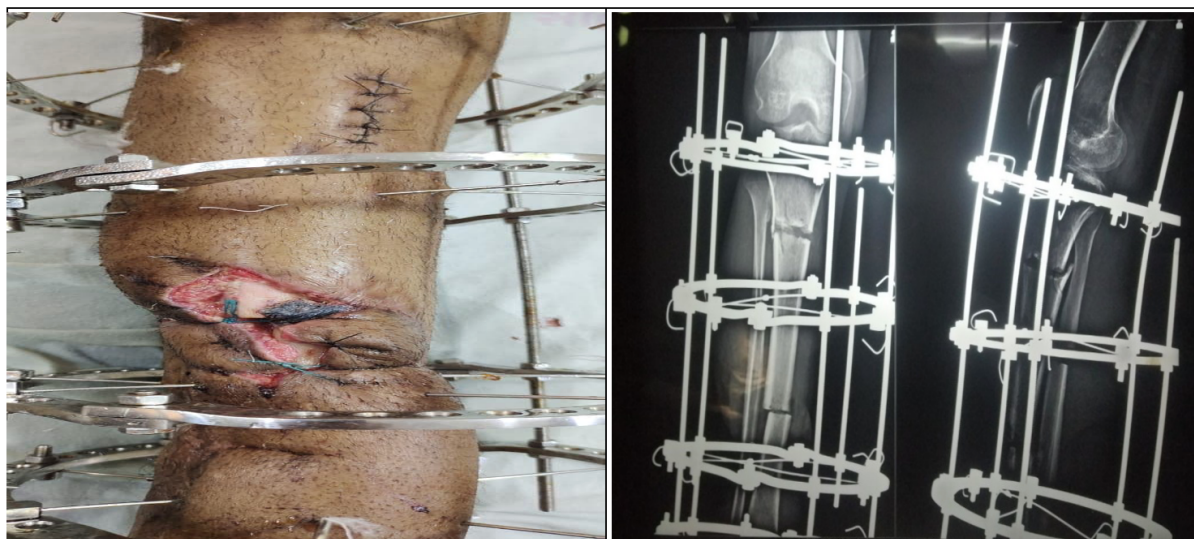


Figure 7: 2 Weeks follow up



Figure 6: 20 weeks follow up

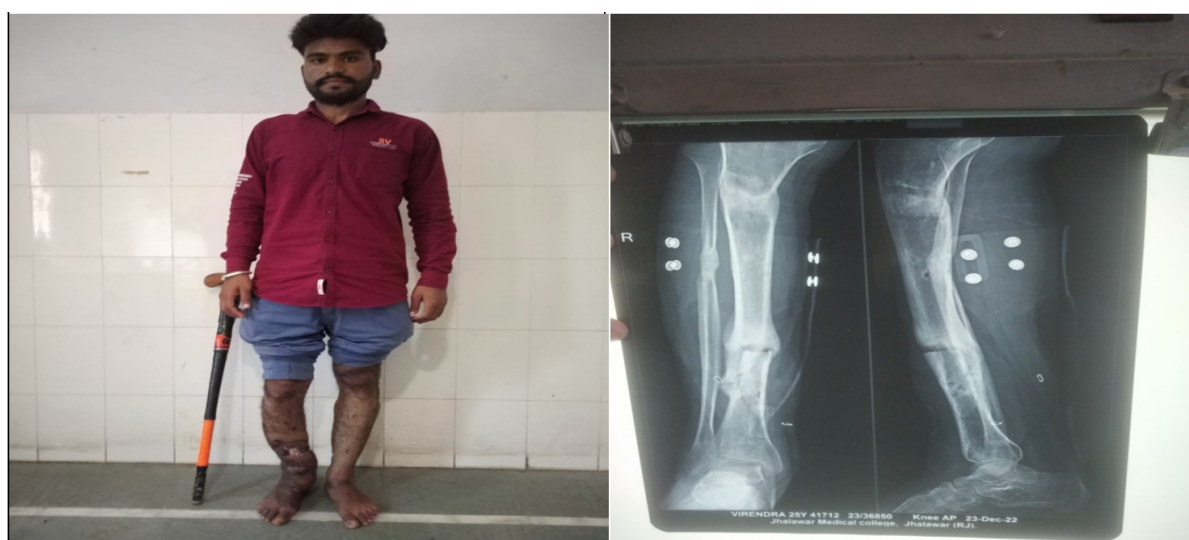




Figure 7: 18 months follow up

Discussion

A fracture non-union is a significant problem to the patient and the surgeon. In many instances the patient has undergone one or more surgical

procedures, has lost considerable time from his or her job and has been forced to alter his or her life style. Furthermore, the psychological and physical trauma to the patient when faced with the prospect

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of another surgery is often underestimated. In many instances consolidation of the non-union must be achieved with correction of axial and rotational mal-alignment.

15 cases of our study had mean age 37.53 yrs. Our range was 22 to 55 years of age. Many other series have shown similar results. The age group in many other series like Paley D et al[8] - 34 year, Green et al[9] - 32.8 year, P Yin et al[10] - 37.06 yrs. Farmanullah et al[11] - 30 yrs. Some series had mean age younger than ours and some had older, but majority of studies in non-unions have mean & range of age similar to our group. This is also expected being the most active & mobile age group. We had high male preponderance in our series (86.66%) as Indian male are more exposed to road traffic accidents in comparison to females. The male preponderance was also demonstrated by many western series like Paley D et al[8] 19/25 males. Our series consisted of 6(40%) cases of type B1, and 1(6.66%) of type B2 & 8 (53.33%) cases of type B3. In our study open fractures were classified according to Gustilo Anderson Classification. Of the total 15 patients, 2 patients belong to Grade II, 7 patients to Grade III A and 6 patients to Grade IIIB. 100 % of our cases were compound. The Average bone loss in our series had been 5.0 cm (range 3 to 7 cm). We were in agreement with Paley D et al[8] 6.2 cm (1. - 23 cm) Dendrinios GK et al[12] -6 cm, P Yin et al[10] 6.27 cm. 100 % of cases of our study had under gone pre - op surgical procedures in an attempt for union by conventional methods, 60% cases had been fixed by external fixator, 26.66% by intramedullary nail and 13.33 % by plating had been fixed with implants before application of ring. We achieved union in all cases. In few cases union were achieved by accordion maneuver. The bone results in our study were excellent in 10 cases (66.66%), good in 4 cases (26.66%), fair in 1 case (6.66%). Paley D et al[8] achieved excellent in 72%, good 20%, fair 8%. Bone results were affected by number of pre - op surgical procedures. More the number of pre - op surgical procedures, worse are the bone results. The possible explanation for this observation is that more pre Ilizarov surgical procedures could cause greater chance of infection, poor local skin & soft tissue vascularity and scarring effecting over all bone results adversely. The mean fixator time in our study (union time) was 7.8 months (range 7 -9 months). Paley D et al[8] 13.6 months, Green et al[9] 9.6 months.

In our study we treated infection in all cases, we reported 0% cases of persistent infection, achieved union in all cases, no case of LLD >2.5cms, persistent deformity in 2(13.33%) cases. Paley D et al[8] reported persistent infection in 12 % case, nonunion and LLD 4 % cases and persistent deformity in 16 % cases. Dendrinios et al[12] had persistent infection in 10.5 % case (more than ours).

Almost all series including ours had eradication of infection in more than 80 % cases., justifying the phrase of great Ilizarov – “Osteomyelitis burns in fire of regeneration.” This eradication of infection is achieved by increasing local blood supply at union site by two basic procedures, 1- Corticotomy and 2- Distraction osteogenesis.

Overall improvement was noted in pre - op joint functions in proximal joints ROM (Knee in tibial fractures) and in distal joints (ankle in tibial fractures).

The reason for good range of movement in our study was because only some of the cases in our study had pre - op stiffness in joints distal to nonunion site, which we improve by aggressive physiotherapy. Our many of the follow - up are shorter thus we still hope improvement in certain patients. Paley D et al[13] found improved range of movement in 76 % cases (our 80%) with only knee in 56 % and only ankle in 48 % cases, Dendrinios GK et al[12] found good to excellent ROM in 43 % cases.

We reported in this study our all patients returned to active daily living, limping in 3(20%) and stiffness present in 5(33.33) cases. There is no RSD reported in this series and pain reported in single case. In our study the functional results were excellent in 9 cases (60%), good in 5 cases (33.33%) and fair in 1 case (6.66%) comparable to D Paley et al[13] excellent in 64%, good in 28%, fair in 4% and poor in 4% cases. We noted Complications of transient neuropraxia 20%, deviation of transported bone segment in 20% cases, pin tract infections (PTI) 60 % cases, corticotomy related complications 13.33% cases. In our study we had no case of persistent infection, no case of LLD >2.5 cm and pain in 1 case, no reflex sympathetic dystrophy. The chief complications reported by Paley D et al[13] - Persistent infection - 12 % cases, soft tissue obstruction to bone transportation - 12 % & delayed consolidation -4 % cases but pin tract infection & wire loosening were chief complications. Schwartsman et al[14] also had mainly PTI. PTI was major but easily manageable complication in majority of series.

Conclusion

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 on principle of distraction osteogenesis . We therefore recommend the use of Ilizarov external fixator for infected non-union of tibial fractures due to its high success rates and because it offers an opportunity to salvage the limb without eventually going for amputation. However, patient discomfort due to long-lasting treatment duration, is one of the key disadvantages of this treatment modality.

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