

## A Study of Non-Union of Tibia Treated with Bone Transport

Neetin Pralhad Mahajan<sup>1</sup>, Yogesh Savliram Gangurde<sup>1</sup>, Sangeet Keshav Gawhale<sup>1</sup>

<sup>1</sup>GGMC and Sir JJ group of hospitals, Mumbai-08.

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### Address of Correspondence

Dr. Yogesh Savliram Gangurde

Assistant Professor In Dept. Of Orthopaedic

At Govt.Medical College, Aurangabad-431001

Email: dryogeshg18@gmail.com



Dr. Neetin P Mahajan



Dr. Yogesh S Gangurde



Dr. Sangeet K Gawhale

**Abstract:** Background: Our study is planned to assess closure of intercalary defect non union with segment transport over nail and without nail with ring fixator and problems during the procedure and complications of the procedure.

Methods: 32 Cases of nonunion of tibia following compound injury were taken into consideration for present study.

Results: In our series we achieved excellent results in 60 % cases, good to fair in 37 % and poor results only in 3% cases. We found that due to incorporation of tibia interlocking nail in the ring fixator construct Ilizarov fixation was only required for transportation of middle fragment. It avoided prolonged treatment with fixator. This gave patient high comfort and allowed to perform good Knee and ankle function.

Conclusion: Bone transport technique for treating nonunions in tibia though technically very demanding and with potential complications has emerged as most effective single treatment modality for management of all kinds of nonunions in Tibia.

Keywords: Ilizarov, bone transport ,tibia -nonunion.

## THESIS SUMMARY

### Introduction

Non-Union of Tibia following compound injury is one of the challenging problems to Orthopaedicians. One may come across difficulties like Bone loss, Deformity, Infection, draining sinuses and osteomyelitis, Limb length discrepancy, Joint stiffness and non-union. Conventional methods of treating such problems are extensive debridement, local soft tissue rotation flap.

Ilizarov's techniques (distraction osteogenesis) has been beneficial in infected defect nonunion as it allows simultaneous treatment of bone loss, infection, nonunion and deformity. Bone transport has been one of the good techniques for treating difficult post-traumatic tibial defects. During this procedure, the various difficulties are encountered like Axial deviation, Deformities, Anatomical malalignment, Soft tissue invasion at docking site, Prolonged fixator time, Pin tract sepsis, Longer hospital stay and associated antecedent psychological problems.

Incorporation of tibial nail in the fixator construct and using fixator only to transport bone segment over the nail is an alternative to avoid above difficulties, provided infection is under control for smaller

defects, acute docking and subsequent lengthening of tibia is an alternative for reconstruction. Our present study is being conducted to study different levels of bone transport in post traumatic non unions of tibia.

### Material & Methods

32 Cases of nonunion of tibia following compound injury in road traffic accident from 1995 to 2004 admitted in the J. J. Group of Hospitals, Mumbai were taken into consideration for present study. All the patients were assessed on admission for level of non-union in tibia, shortening of extremities, neurovascular deficit, deformity, previous surgical procedure performed, extent of infection, conditions of soft tissue over the anteromedial aspect tibia, function in the knee and ankle joints on clinical examination, the nonunion was classified as stiff or mobile and limb length discrepancy calculated.

Preoperative radiological evaluation was done to determine level of nonunion in tibia, deformity, assessment of alignment, classification of nonunion as atrophic or hypertrophic and to look



**Figure 1:** Transporting fragment locked after docking

for evidence of osteomyelitis. The patients with soft tissue defects on the anteromedial side (shin of tibia) were subjected to soft tissue coverage. The patients with active draining sinuses and wound were subjected to a. Curettage / sinus excision b. Debridement accompanied by resection of non-viable necrotic bone until punctuate bleeding from the cortex was seen.

Infected material was sent for culture sensitivity and antibiotics were administered for at least for 3 weeks as per sensitivity.

Radiographic evaluation was done to determine level of nonunion, deformity and defect in cms with or without shortening. In smaller defects less than 5 cm acute docking of the fragments and subsequent lengthening after Corticotomy and fibular Osteotomy was planned, bifocal osteosynthesis was planned for tibial defects requiring more than 5 cm of bone transport. Trifocal osteosynthesis was planned using proximal and distal corticotomies for tibial defect requiring larger transport (more than 12 cm) to reduce the time of distraction. In larger defects, tibia-interlocking nail was planned in fixator construct to get normal alignment of tibia and reduce the fixator time. Preplanned custom-made tibia interlocking nail was ordered with provision for proximal and distal locking and with provision for the locking of transport fragment near docking site.

### Observation & Result

There were 32 tibial non-unions following compound injury in vehicular accident of them 28 males and 4 females. The mean length of segmental defects following sequestrectomy in tibia or removal of nonviable diseased bone was 7.7 cm [3.5 to 14 cms]. In all cases, the defect was successfully reconstructed using bone transport either by biofocalosteosynthesis or trifocal osteosynthesis. The mean latency period in our series was 7 days [7-10days]. The patient was allowed to weight bear as soon as pain subsided. Knee and ankle mobilization exercises was started preferably on 2nd day of surgery The mean duration of external fixator was 7.56 months [3 months-21 months]. The mean time required for consolidation of regenerate bone was 4.5 month [2 months-6 months].

### INDICES TRANSPORT

The mean distraction gap was 7.7 cm [3-14cm] The mean external fixation index was 1.13 month/cm [0.38-3.7 months/cm] The mean distraction index was found to be 34

days/cm [5.53-93 days/cm] The mean distraction consolidation index [maturation index] was 21/6 days/cm [1.08-102 days/cm]

### UNION

All the patients in our series united successfully except in 2 patients A] In one, union could not be achieved using proximal corticotomy and needed revision of fixator and corticotomy distally and union was achieved at 7.5 months. B] In one patient with bilateral nonunion, tibia failed to unite on one side. He was treated with removal of assembly and open interlocking nailing and bone grafting, is still undergoing treatment for delayed union.

### INFECTION

Infection was effectively controlled by debridement, sequestrectomy and preoperatively antibiotics for at least 3 weeks as per culture and sensitivity of material. In all cases, discharging sinuses healed completely. But in only one patient, there was recurrence of infection one year after removal of fixator, with a sequestrum formation. He was treated successfully with sequestrectomy and curettage.

### JOINT FUNCTIONS

All patients had fairly good range of movements in knee and ankle.

- Except in five patients, in whom average loss of movement was found to be around 50-60 % when compared to normal side but this existed before the above treatment was started.
- Knee and ankle movements were fairly good in cases that have undergone transport over nail.
- One patient needed triple arthrodesis for uncorrectable foot deformity.

### FIXATOR TIME

- The fixator time was longer in patient with transport without nail from 4-18 months. It was significantly reduced by performing bone grafting at docking site [5-8 months]
- The fixator time was found to be less [3 months to 14 months] in transport over the nail.

- The fixator time in acute docking and lengthening was found to be 10 to 13 months.

### PIN SITE INFECTION

- There were on an average 3 episodes of pin site infection which were treated with dressings.
- One patient developed pin site abscess was treated with incision and drainage and antibiotics.

### MALALIGNMENT AND AXIAL DEVIATION

- Malalignment and axial deviation of transporting fragment was noticed in four patients at distraction site and this was successfully controlled by adjustment of the Ilizarov assembly.



**Figure 2:** Ilizarov's fixator assembly in Transport without Nail.



**Figure 3:** Ilizarov's fixator assembly in Transport over Nail.

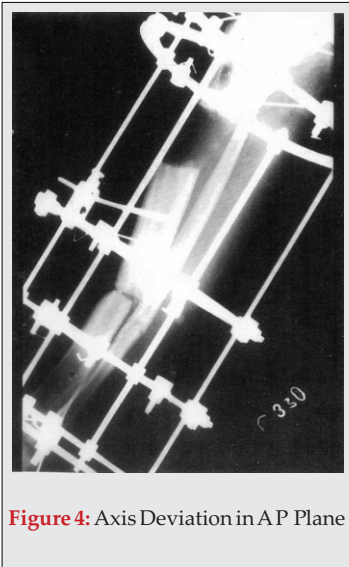


Figure 4: Axis Deviation in AP Plane

- No malalignment was seen in cases with transport over nail... REGENERATE
  - Poor quality regenerate was seen on x-ray in 3 patients and needed reduction in rate of distraction. [0.5mm/day]
  - Hypertrophic regenerate was seen in one patient required increase in rate of distraction to two folds. [2mm/day].
  - Normotrophic regenerate was seen in 28 patients.
- NEUROVASCULAR PROBLEM**
- There was no evidence of immediate neurovascular injury due to placement of pins.
  - No patient suffered from any

delayed neurovascular injury during distraction phase.

**LIMB LENGTH DISCREPANCY**

The limb length discrepancy was not significant in our series. With the proper preoperative planning, it was almost corrected in the segment transport. It ranges from 0.5 to 2 cm.

**REFRACTURE**

- Refracture was seen in only one patient who sustained direct blow on united tibia with a heavy stone after 6 months of union. He was treated with Bone grafting and plaster cast. Union was achieved after 4 month.

**OTHER COMPLICATIONS**

- In our series, on patient suffered from any psychiatric illness after thorough counselling about the treatment.
- There was no evidence of compartment syndrome after syndrome.
- No patient developed hypertension during treatment period.
- There was no evidence of any stress fracture during removal of fixator.

**HOSPITAL STAY**

- The hospital stay in our series ranges from 4 months to 6 months.
- It was found to be less in patients with transport over nail from 2 to 3.5 months.

**Discussion**

The Ilizarov method of bone transport is an ideal treatment for all kinds of tibial nonunion with bone loss, which presents with many perplexing problems to the treating surgeon. This method is advantageous in treating infected nonunions, reconstructions of tibial defects, correction of deformities, maintaining limb length and allows early weight bearing with fixator. Conventional methods as stated have limited application in treating defects and taking years to corticalise and function. In our study, we have

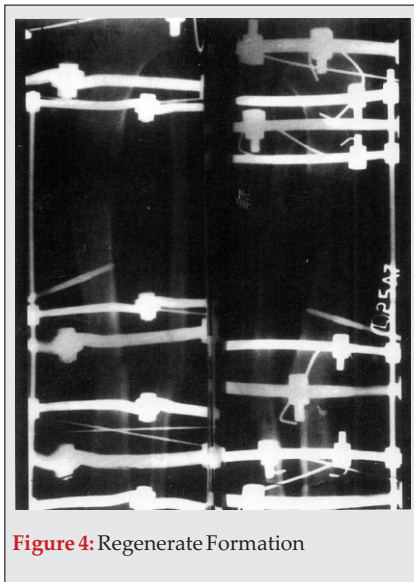


Figure 4: Regenerate Formation

experienced good results following radical debridement and restoring medullary canal and bone grafting at docking site. Similar results were obtained in the study of F. Dagher et al. In our study, bone grafting at docking site reduced the fixator time. But only single radical debridement of diseased bone exposing vascular cortex and good antibiotic coverage before application of ring fixator was good alternative for complete eradication of infection from Tibia. No patient in our study required PMMA beads at nonunion site for eradication of infection. They united completely without any residual infection. Whereas multiple debridements were required for treating infection in the study of LesleNeggaret et al. In our experience, we found that bone grafting at docking site definitely reduces the fixator time and helps in achieving early union. But for longer defects, trifocal osteosynthesis using proximal and distal corticotomies are ideal to fill the defect early, achieve good consolidation and avoiding bone grafting at regenerate site and further chances of refracture of regenerate bone. Malalignment was not significant in our study with use of 2 halfshanz pins in the transporting fragment in

addition to single ring. No malalignment was seen in patients with transport over nail. Functional result, joint functions, malalignment and deformity etc. complications were prevented using nail in the construct. One patient required recorticotomy and multiple adjustment. In our series also, 2 hypertrophic nonunion treated with acute docking and corticotomy [lengthening] achieved union after 6 months. Bone grafting at docking significantly achieved early union in one patient and reduced duration of fixation. In remaining 6 patients union was achieved with segment transport only. No bone grafting was performed at docking site. Similar results were seen in study of M, Cattagniet et al. We state the corticotomy is alone a potent stimulus for union in Hypertrophic nonunion once the stable fixation is achieved.

In our series of 8 patients treated with transport over nail, we found that incorporation of tibia interlocking nail in the ring fixator construct compared to study of Hoffman G.O. et al. In fact, Ilizarov fixation was only required for transportation of middle fragment. Once the transport was complete and fragments were locked, fixator was removed. It avoided prolonged treatment with fixator. This gave patient high comfort and allowed to perform good Knee and ankle function. The most common problem in

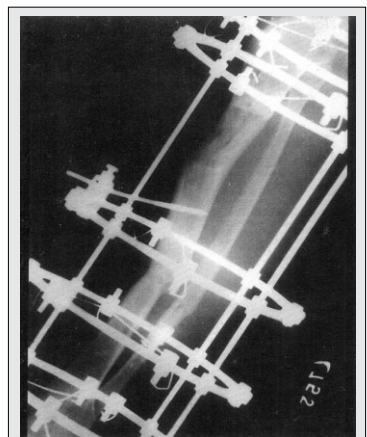


Figure 5: Consolidation of Regenerate

our series was pin site infection associated with wire loosening. This was adequately tackled with frequent for tension at weekly interval was must for success of bone transport.

There was no evidence of deep sepsis or intramedullary infection in cases of transport over nail. The time required for transport and external fixation in trifocal osteosynthesis was comparatively less as that for bifocal osteogenesis.

### Conclusion

Internal bone transport using Ilizarov's principles of distraction and transformational osteogenesis for nonunion of long bones especially tibia is an ideal method to achieve union, simultaneously correct the deformity and restore the normal limb length and maintain function in knee and ankle joint. We conclude that,

- For defects less than 5 cm, acute docking and subsequent lengthening of the corticotomy serves better alternative for treating smaller defects and hypertrophic nonunion.
- Bone grafting at docking site helps to reduce external fixation time and achieve union early.
- For defects more than 5 cm, with or without shortening, bifocal osteosynthesis using segment transport is an ideal method.
- Segment transport in cases requiring transport more than 18% of the original bone length in tibia has problems mainly due to long duration of transport and fixator.
- Bone transport over unreamed intramedullary interlocking nails in such situations significantly reduces external fixation time and complications.
- Use of nail in the construct neither compromises quality nor quantity of the regenerate.
- Its prevents complications such as Missed target and malalignments Deep pin tract infections Fracture of the regenerate bone 20.
- Bone transport over nail can be performed in infected nonunions of tibia after thorough debridement of necrotic bone and preoperative treatment with antibiotics for at least 3 weeks.
- thorough primary debridement and early good soft tissue coverage are mandatory for good results in such patients.
- Maintaining fixator till consolidation of regenerate is mandatory to achieve union without secondary procedures in transport without nail.
- Supplementation of autologous cancellous bone grafting after clearing of fibrous tissue from ends of bone two weeks prior to docking accelerates and facilitates healing.
- Distraction alone acts as a potent stimulus for union in hypertrophic nonunions of tibia as after corticotomy blood supply increases.
- Functional loading of leg and knee and ankle joint mobilization within first few days of fixator application helps in long-term functional rehabilitation of patient.
- Preoperative psychological counselling regarding long treatment and support throughout treatment is necessary for successful completion of treatment.
- Problems, obstacles and complications can be prevented and corrected by good preoperative planning and patient motivation.

Thus,

Bone transport technique for treating nonunions in tibia though technically very demanding and with potential complications has emerged as most effective single treatment modality for management of all kinds of nonunions in Tibia.

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