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A prospective study on the role of limb reconstruction System in infective non-union of femur and tibia

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Abstract
Introduction: Infected non-union of long bones is the state of failure of union and the persistence of infection at the fracture site for a period of 6 to 8 months or more. This condition possesses a challenge for optimal treatment to the orthopaedic surgeon. Limb reconstruction system (LRS) is a single bar device with telescoping facility which allows increased axial movement at the fracture site by permitting conversion from rigid to dynamic fixation resulting in formation of external bridging callus. The regenerated bone restores length and eliminates infection. This procedure does not require much expertise of the treating orthopaedic surgeon and is associated with high patient compliance.
Materials and Methods: 20 adult patients with infective non-union of femur and tibia were admitted in Silchar Medical College and Hospital, Silchar between September 2019 to August 2020 after being diagnosed clinically and radiologically as infective non-union. Preoperative radiographs were taken to assess the type of non-union, presence of infection, implants, quality of bone stock and level of non-union. Patients were classified according to the classification by Rosen *et al.* in the A.O. manual into quiescent, active and draining types. Follow up was done every 4 weeks and Association for the Study and Application of Methods of Ilizarov (ASAMI) score was used to categorize the outcome into excellent, good, fair and poor.
Results: It was observed that 90% patients showed excellent to good functional as well as bone healing outcomes.
Discussion: Results of mean bony transport, mean implant index and outcomes are comparable to previous studies conducted.
Conclusion: LRS application to infective non-union of long bones is a cost-effective procedure which favours both the surgeon and patient as compared to other available treatment modalities.

Keywords: Infective non-union, femur, tibia, Limb Reconstruction System, ASAMI score

Introduction
Infected non-union is the state of failure of union and the persistence of infection at the fracture site for a period of 6 to 8 months or more. This condition presents a great challenge for optimal treatment to the orthopaedic surgeon. Infected non-union of long bones are most commonly, a result of severe open fracture with extensive comminution and segmental bone loss or a comminuted closed fracture which underwent internal fixation. Factors associated with infective non-union include exposed bone with devascularized periosteal coverage for 6 weeks or more, purulent discharge from wound, a positive bacteriological culture taken from the wound, and evidence of empty lacunae of necrotic bone seen histologically. Complications in treatment and recovery include osteomyelitis, osteopenia, stiffness of adjacent joint, smoking, multidrug resistant polymicrobial infections, multiple draining sinuses, limb-length inequality-associated deformities and smoking [1]. Methods conventionally used for treatment of infected non-union include external fixation, sequestrectomy, cancellous bone grafting and are often unsuccessful due to factors which include graft quality, poor vascularity, persistence of infection and extensive deformities and defects of bone [2-4]. Limb reconstruction system (LRS) is a single bar device with telescoping facility which permits conversion from rigid to dynamic fixation very easily, which in turn allows for increased axial movement at the fracture site resulting in formation of external bridging callus. The regenerated bone restores length and eliminates infection successfully. In cases of infected non-union, the LRS can be used to attain maximum stability [5].

Materials and Methods

This study was approved by the institutional ethical committee. All participants gave written informed consent to participate in the study.

Study Population

This prospective study was carried out from September 2019 to August 2020 on 20 patients diagnosed clinically and radiologically as infective non-union of femur and tibia, attending the Department of Orthopaedic Surgery, SMCH. Preoperative radiographs were taken to assess the type of non-union, presence of infection, implants, quality of bone stock and level of non-union. Patients were classified according to the classification by Rosen *et al.* in the A.O. manual into quiescent, active and draining types [6]. All patients having infective non-union of femur and tibia with competent neurological and vascular status of limb and having well-functioning contralateral limb were included in the study. Patients having medical contraindications for surgery and those patients failing to take part in post-op rehabilitation were excluded from the study. Procedures and follow ups were conducted at the same centre and outcomes were assessed and recorded.

Surgical Procedure

The patient was put in supine position after administration of spinal anaesthesia. Radical debridement of the wound was performed followed by fracture reduction. Approximate position of the clamps over the railing were adjusted, and the railing was held parallel to the leg on the anteromedial aspect. In case of femur, the LRS was applied to the lateral aspect. Stab incision was made and with the help of 4.5mm drill bit, holes were drilled in the bone and Schanz pins were introduced. The Schanz pins were anchored to clamps and railing after fine adjustment, following which compression across the fracture site was given and the clamps were tightened. Corticotomy was done accordingly. It was done 1.5 cm distal to the distal pin of the proximal clamp. The wound was thoroughly irrigated with large volume of normal saline and the wound was closed in layers with sutures along with pin tract dressing. Adjacent joint mobilization was started the next day. Ambulation with partial weight bearing was started on second or third postoperative day depending on the patient's compliance, pain and the condition of local soft tissues. Compression or distraction across the fracture site was started on the 10^{th} or 12^{th} post-operative day, and cyclical compression and distraction on a weekly basis. The corticotomy area was distracted at the rate of 1mm/day divided into four times a day [7]. The patients and attendants were educated about the timing and procedure of compression and distraction. Follow-up was done at regular intervals of 4 weeks on OPD basis. Healing of non-union, absence of infection, absence of deformity and limb length equality were the four parameters of the ASAMI score (Association for the Study and Application of Methods of Ilizarov) used to assess the results [8]. Pin tract infections, loosening of pins, bolts and clamps were addressed on periodic follow-ups and assessment of state of union and fracture fragment position was done using check X-ray. LRS external fixator was removed after radiological union of fracture site was visualized and patellar tendon bracing for tibia and high groin cast for femur was applied, following which the patient was advised ambulation with support for 2 to 3 weeks. Removal of cast was done after assessing check X-rays and the patient was advised to resume routine activities.

Results

The study was conducted among 20 cases. 18 cases were males and the rest 2 cases were females with mean age of 30.1 years and an average follow-up period of 4.45 months. Femur was the most common affected bone involving 12 of the cases and the rest 8 cases involved tibia. The commonest type of non-union were found to be of quiescent (45%) and draining (45%) types, while the active type (10%) occupied a minor portion of cases. The average bone defect was found to be 5.8 cms. 60% of the cases were treated with bone transport while 40% were treated with acute docking. The total duration of treatment on an average was 10.23 months. Joint stiffness was found to be the most common complication affecting 13 cases, while pin tract infections ranked second affecting 12 cases. Based on the ASAMI score, excellent results were seen in 70% of the patients, good results in 20% and poor results in 10% of the patients.



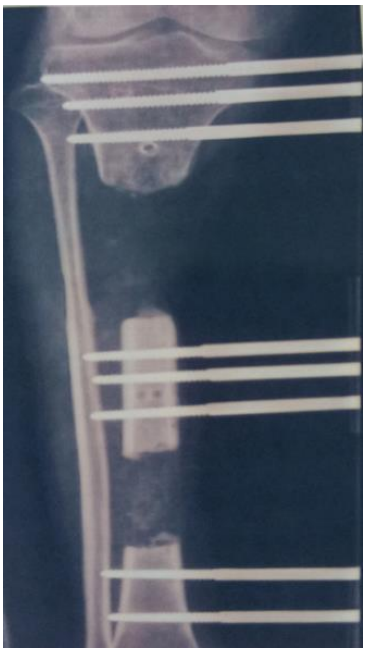


Fig 1: Infected gap non-union femur **Fig 2:** Debridement with LRS application **Fig 3:** Callus formation **Fig 4:** Distraction complete

Fig 5: After LRS removal

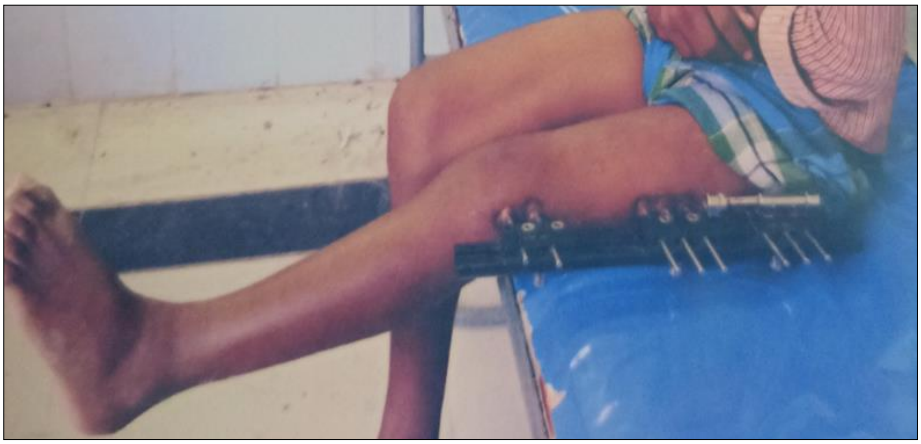

Fig 6 and 7: Clinical photographs

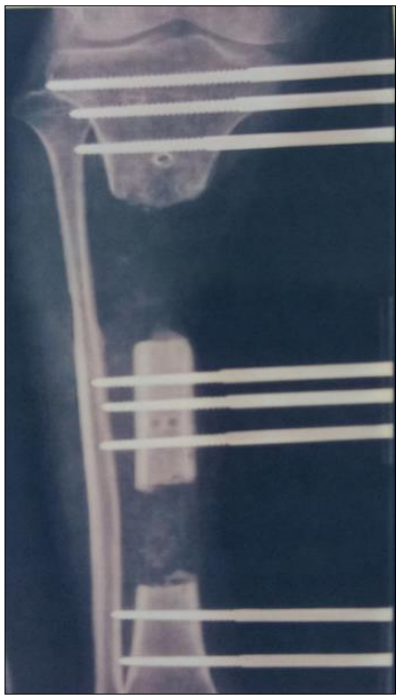

Fig 8: Infected gap non-union tibia **Fig 9:** Debridement with LRS application **Fig 10:** Callus formation

Fig 11: Distraction complete **Fig 12:** After LRS removal

Fig 13, Fig 14: Clinical photographs

Discussion

Persistence of infection at the fracture site for a duration of 6 to 8 months or more following severe open fracture with extensive comminution most commonly due to road traffic accidents lead to infective non-union of long bones. Infective non-union of long bones can be managed by the LRS external fixator, which is a unilateral half pin external fixator with the same basic principles of the Ilizarov external fixator. Conventional treatment methods with acute docking like nailing or fixators had a high rate of complications including bone loss leading to shortening, soft tissue healing problems, increased chances of malunion and non-union. Ring fixators like Ilizarov have been the most reliable solution but requires a steep learning curve and has a high rate of patient dissatisfaction and is also cumbersome [9]. In this study, non-union of femur and tibia in all 20 cases were established clinically and radiologically and were treated with LRS external fixator application. Ease of application, stability and high patient compliance were offered by the LRS external fixator. Correction of angulation and limb length discrepancies as well as fine adjustments and realignments were possible [10]. Removal of LRS was done as an OPD procedure after clinical and radiological confirmation of fracture union. Cases were mostly males within the 2nd to 4th decade of life with quiescent and draining types being the most common variants as per classification by Rosen *et al.* in the A.O. manual. The rate of union was found to be 80% with an average treatment duration of 10.23 months. Infection control was seen in 90% of cases. Joint stiffness (65%) and pin tract infections (60%) were the main complications which were successfully managed with post-operative physiotherapy and pin tract dressing along with oral antibiotics. Excellent results were seen in 70% patients, good results in 20% patients and poor results in 10% of the patients participating in the study. The mean bone transport was 5.8 cms, which is almost comparable to findings of Robert *et al.* (6 cms), Sen *et al.* (5 cms), Mekhail *et al.* (5.7 cms), Donnan *et al.* (6.4 cms), Bumbasirevic *et al.* (6.9 cms). The mean implant index was 1.76 months/cm, which is almost similar to findings of Sen *et al.* (1.4 months/cm), Mekhail *et al.* (2.42 months/cm), Bumbasirevic *et al.* (1.48 months/cm), Wani *et al.* (1.5 months/cm), Robert *et al.* (54 days/cm), and Atef and El-Tantawy (45 days/cm). Excellent to good results were observed in 90% cases, which is comparable to findings of McKee *et al.*, Robert *et al.*, Sen *et al.*, Mekhail *et al.* and Donnan *et al.*, all of which showed excellent to good results in 80-90% cases [11].

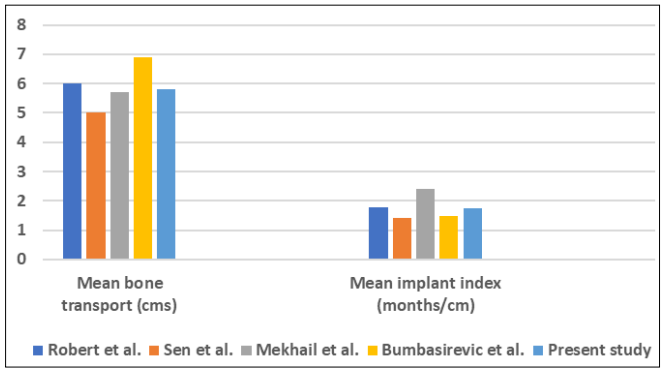

Fig 15: Mean bone transport and mean implant index in various studies

Conclusion

LRS external fixator application helps create the most favourable biomechanical conditions at every stage of the healing cycle in patients of infective non-union of femur and tibia by virtue of its minimally invasive techniques which improves the functional recovery. It is a simple and cost-effective dynamized external fixator system that addresses most of the complications associated with infective non-union. It also allows easy accessibility for secondary plastic procedures owing to its uniplanar nature. In contrast to the Ilizarov external fixator system, LRS external fixator is easy to handle for both the surgeon and the patient. LRS application has simple surgical technique and has short learning curve. Its light weighted monolateral simple design helps in early mobilization of the patient. It also allows easy access to soft tissue and wound management and is minimally invasive resulting in lesser morbidity and shorter hospitalization thus permitting early rehabilitation and less economic burden. It is patient-friendly and allows for simple compression distraction movements across the fracture site.

References

1. Struijs PA, Poolman RW, Bhandari M. Infected nonunion of the long bones. J Orthop Trauma. 2007 Aug;21(7):507-11. doi:

10.1097/BOT.0b013e31812e5578. Erratum in: J Orthop Trauma. 2013 Dec;27(12):e274. PMID: 17762489.
2. Ueng SW, Wei FC, Shih CH. Management of femoral diaphyseal infected nonunion with antibiotic beads local therapy, external skeletal fixation, and staged bone grafting. J Trauma. 1999;46:97-103
3. Cabenela ME. Open cancellous bone grafting of infected bone defects. Orthop Clin N Am. 1984;15:427.
4. Gordon L, Chin EJ. Treatment of infected nonunion and segmental defect of tibia with staged microvascular muscle transplantation and bone grafting. J Bone Joint Surg Br. 1988;70A:377-386
5. Seenappa HK, Shukla MK, Narasimhaiah M. Management of complex long bone nonunions using limb reconstruction system. Indian J Orthop. 2013;47(6):602-607. doi:10.4103/0019-5413.121590
6. Rosen H (1998) Nonunion and malunion. In: Browner BD, Levine AM, Jupitar JB (eds) Skeletal trauma: fractures, dislocations, ligamentous injuries. WB Saunders, Philadelphia, 1988, 501-541
7. Heckman JD, Ryaby JP, McCabe J, *et al*. Acceleration of tibial fracture healing by non-invasive, low intensity pulsed ultrasound. J Bone Joint Surg Am. 1994;76:26-34.
8. Paley D, Catagni MA, Argnani F, *et al*. Ilizarov treatment of tibial nonunions with bone loss. Clin Orthop Relat Res. 1989;241:146-165
9. Paley D. Problems, obstacles, and complications of limb lengthening by the Ilizarov technique. Clin Orthop Relat Res. 1990;250:81-104
10. Eralp L, Kocaoglu M, Bilen FE, *et al*. A review of problems, obstacles and sequelae encountered during femoral lengthening: uniplanar versus circular external fixator. Acta Orthop Belg. 2010;76:628-635.
11. Ajmera A, Verma A, Agrawal M, Jain S, Mukherjee A. Outcome of limb reconstruction system in open tibial diaphyseal fractures. Indian J Orthop. 2015;49(4):429-435. doi:10.4103/0019-5413.159638