

Functional Outcome of Infected Non Union in Fractures of Long Bones Treated by Distraction Osteogenesis using Limb Reconstruction System

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Abstract: ***Objective:** To assess the functional outcome of the treatment of infected non union of long bone fractures by distraction osteogenesis using limb reconstruction system. **Methods:** From January 2014 and November 2019, 20 patients who underwent treatment for infected non union were reviewed. The average ages of the patients were 40 years (26 to 60 years). Most common mode of injury has been road traffic accident. 2 patients had fall of heavy object over the leg. Out of this, 14 cases were infected non union after internal fixation, 6 persons had Open Grade III b Gustilo Anderson fractures initially treated with external fixator. Among this all open Grade III b fractures are treated with skin or flap cover. Antibiotic bone cement spacers were used for 14 cases. Bone grafting done for 8 patients at the docking site. We did acute docking for 3 cm of gap at the non union site followed by corticotomy and distraction at the other end in two of our cases. Results were evaluated based on Association for Study and Application of the Method of Ilizarov (ASAMI) scoring. **Results:** Mean follow-up was 12 months. All the cases got primary bone union, and infection was controlled. Bone results were 10 excellent, 6 good, 3 fair and 1 poor and functional results were 15 excellent, 3 good, 1 fair and 1 poor. The mean lengths of time in healing for all patients were 4.5 months. The mean length of regenerate bone was 3.5 cm. The most common complication was pin tract infection, and 1 case refractured at the docking site. **Conclusions:** Limb reconstruction system can be used effectively in cases of infective non union of long bones using internal bone transport technique. Devitalized bone resection and secondary bone lengthening helps in attaining a functional limb. LRS external fixation technique is helpful in re-establishing the limbs, which would have been at high risk of amputation.*

Keywords: Fracture, Long Bone, Distraction Osteogenesis, Limb Reconstruction System

1. Introduction

Non union of long bone fractures have become a common problem in orthopaedics. Infected nonunion of long bones not only a source of functional disability but also can lead to economic hardship and loss of self-esteem. This is due in part to the fact that open fractures frequently result from high velocity injuries and deteriorating road conditions. The United States Food and Drug Administration defines *nonunion* as “established when a minimum of 9 months has elapsed since injury and the fracture shows no visible progressive signs of healing for 3 months.” Brinker et al provided a note in his definition, ‘non union is a fracture that, in the opinion of the treating physician, has no possibility of healing without further intervention’. Despite improvements in management, the prevalence of infected nonunion of long bones still remains high. The reasons line up like tissues cicatrisation due to previous surgeries, infection, sequestrum, necrosis of the fracture ends due to thrombosis of haversian system. Infected non-union is associated with multiple problems like osteomyelitis, bone and soft tissue loss, sinuses, osteopenia, joint stiffness and multidrug-resistant infections. This study was conducted in Department of Orthopaedics, Government Dharmapuri Medical College to assess the union rates, infection control, lengthening and the complications associated with the LRS in the treatment of infective non union of long bones.

Aim

To assess the functional outcome of the treatment of infected non union of long bone fractures by distraction osteogenesis using limb reconstruction system.

2. Materials and Methods

This study was done between January 2014 and November 2019, in the department of Orthopaedics, Government Dharmapuri medical college. There were 20 patients, out of which 16 were males and 4 females. The average age of the patients was 40 years (26 to 60 years). Most common mode of injury has been road traffic accident. 2 patients had fall of heavy object over the leg. Out of this, 14 cases were infected non union after internal fixation, 6 persons had Open Grade III b Gustilo Anderson fractures initially treated with external fixator. Among this all open Grade III b fractures are treated with skin or flap cover. Antibiotic bone cement spacers were used for 14 cases. Bone grafting done for 8 patients at the docking site. We did acute docking for 3 cm of gap at the non union site followed by corticotomy and distraction at the other end in two of our cases.

Patients of both gender of varying age group with infected non-union of long bones were chosen. Patients who are associated with other multiple co-morbid ailments are excluded from this study. There were 16 tibial non unions and 4 cases of femur non unions. Presenting symptoms, duration, medical history, presence of tenderness, sinus, and pus discharge, skin condition, shortening, deformity,

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function of the limb and neurovascular status of the nearby joints were recorded.

Results were evaluated based on Association for Study and Application of the Method of Ilizarov (ASAMI) scoring.

Bone results	Criteria
Excellent	Union No infection Deformity <7° Limb length discrepancy (LLD) <2.5 cm
Good	Union + any two of the following: Absence of infection Deformity <7° LLD <2.5 cm
Fair	Union + any one of the following: Absence of infection Deformity <7° LLD <2.5 cm
Poor	Nonunion/refracture/union + infection + Deformity >7° + LLD >2.5 cm
Functional results	Criteria
Excellent	Active No limp Minimum stiffness (loss of <15°, knee extension/ <15° ankle dorsiflexion) No reflex sympathetic dystrophy (RSD) Insignificant pain
Good	Active with one or two of the following: Limp Stiffness RSD Significant pain
Fair	Active with three or all of the following: Limp Stiffness RSD Significant pain
Poor	Inactive (unemployment or inability to return to daily activities because of injury)

3. Surgical Technique

All the 20 cases were done under spinal anaesthesia. Patients were placed supine on the operating table with one sand bag under the thigh and another under the heel leaving the entire operating area free for the surgeon. Thorough wound debridement and removal of all necrotic bone and soft tissues were done in all cases prior to the application of fixators (LRS). Bone debridement continued until residual bone showed evidence of punctate cortical bleeding (the paprika sign). The system is usually mounted anteromedially which is convenient for the patient.

Case 1:



Figure 1.1



Figure 1.2



Figure 1.3



Figure 1.4

The proximal screw is inserted first in the metaphyseal region parallel to the knee joint line, avoiding the joint capsule. The distal most screw was inserted next, parallel to ankle joint line. The remaining screws were inserted in a similar fashion and the clamps were fixed to the rail, leaving a distance of about 3-5 cm between the skin and the rail. We used a 4.5 mm drill bit for inserting the 6mm schanz screws, in the 1,3,5 positions in the proximal and the distal clamps and in the 1 and 5 position in the transporting clamp.

In most of the cases, infection control is achieved by insertion of antibiotic coated Bone cement spacer. It is composed of Polymethyl methacrylate (78%), Vancomycin (as vancomycin hydrochloride, 2 gm / 40 gm cement).. After discharge free and infection free interval of 6 weeks cement spacer was removed, corticotomy and bone transport were initiated. In other cases, infection control is achieved with oral and intravenous antibiotics alone, which is confirmed by blood investigations and infection profile.

Corticotomy was done about 1.5 cm below the distal screw of the proximal clamp (metaphyseal region) or proximal screw of the distal clamp. Postoperative protocol is mobilisation of adjacent joint on 1st post operative day. Partial weight bearing with walker started after 4-6 weeks. In our study distraction at corticotomy site started 7 days after corticotomy, and done at the rate of 1mm per day at the rhythm of 0.25mm 4 times a day.

Check x ray taken after 1 week of distraction and confirmed. All the patients are followed up in the distraction phase every fortnightly radiologically to assess the regeneration of new bone and its alignment.

In the consolidation phase, monthly follow up done.

The fixator was not removed until bone consolidation. In few cases preparation of the docking site includes debridement of fibrous tissue, refreshment of the bone ends to maximize bony contact and minimize deformity and addition of bone graft.

Figure 1.1: Infective non union of Right tibia

Figure 1.2: LRS fixation and corticotomy done

Figure 1.3: Distraction and docking

Figure 1.4: Consolidation phase



Case 2:



Figure 2.1: Infective non union with external fixator



Figure 2.2: LRS fixation and Antibiotic spacer



Figure 2.3: Corticotomy done at the distal segment



Figure 2.4: Bone grafting done at the docking site

Case 3:



Figure 2.1: Infected non union of Right Tibia – Post LRS fixation

Figure 2.2: Corticotomy





Figure 2.3: At 3 months of consolidation phase



Figure 2.3: At 6 months of consolidation phase

Case 4



Figure 4.1: Infected non union of Left femur
Post LRS fixation and distraction



Figure 4.3: At 3rd month of consolidation

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Figure: 4.4: At 5th month of consolidation



Figure 4.5: Post LRS removal. Complete bony union is achieved



Case 5: Infected non union of left Tibia after removal of external fixator



Figure 5.1: After Sequestrectomy and LRS removal



Figure 5.2: After LRS removal, complete bony union is achieved

Complications:

There were 7 cases of Pin tract infections, which were superficial infection, treated with local pin care and antibiotics. Realignment of pin done for 3 cases under sterile aseptic precautions.

3 cases of Limb length discrepancy, with minimal shortening which were managed by alteration in the foot wear.

2 cases had varus angulation for which realignment of the fixator was done. There were 2 cases of Equinus deformity, treated by tendoachilles lengthening

Refracture in 1 case at the docking site.

6 cases of Delayed union mainly at the docking site. 2 cases managed by dynamization alone, 4 cases were managed by additional surgery with bone grafting.

There were 3 cases of Joint stiffness (knee and ankle joint) treated with passive stretching and active mobilisation exercises.

No neurovascular complications reported in our study.

4. Results

The results were assessed based on bone results and functional results by using Association for Study and Application of the Method of Ilizarov (ASAMI) scoring.

Grading	Bone Results	Percentage	Functional Results	Percentage
Excellent	10	50%	15	75%
Good	6	30%	3	15%
Fair	3	15%	1	5%
Poor	1	5%	1	5%

Out of 20 cases, 18 people returned back to their previous manual works and vocationally rehabilitated. 2 people performing their normal household chores without dependency. Average time of union was 4.5 months. Average of 3.5 cm bone transport was achieved.

Comparative analysis

	Sangkaew	Pasha	Paley	Our study
No. of patients	70	11	25	20
Bone transport(cm)	5.6	6.7	6.2	3.5
Avg.healing time(months)	8	14	10.6	4.5

5. Discussion

Open fractures are becoming much common in this millennium, owing to trending rapidly in racing the vehicles especially. The bad result of few fractures may be non union with or without infection. De Bastiani et al in 1987, established that distraction osteogenesis can occur in a surgical corticotomy site. In such a case of infective non union, infection eradication is prime goal, which to be followed by bone transport which fills up the bone gap happened due to non union and debridement. Ilizarov postulated the ideology of ring fixator which provides stabilization with the purpose of serving compression and distraction. Limb reconstruction system is less cumbersome, patient friendly, mono planar rail fixator with compression and distraction unit. It also allows dynamisation at the fracture site which is the basic principle of treatment of non union. Wearing clothes over Monorail fixator (especially traditional Indian dresses) is very much easier than Ilizarov system. Limb reconstruction system has an easy learning curve. Furthermore no further major surgical procedures are needed after application of monorail fixator, though adjustments in alignment may be needed. Monorail fixator is low in cost as compared to ring fixator

In case of infectious non union, infection should be addressed first; this is followed by non union treatment. Limb reconstruction system can be used in infective non union treatment, with easy learning curve and good patient compliance. The only disadvantage of LRS is that it cannot correct angular or rotational deformities. It is a good choice

for the correction of non union with uniplanar deformity and for bone transport following corticotomy.

The principle of distraction osteogenesis using the monoaxial external fixator system simultaneously addresses the problem of non union, infection, shortening and deformity. Initially infection control is achieved by sequestrectomy and antibiotics. In most of the cases, antibiotic bone spacer was used. It is to be removed after 6 weeks of infection control and distraction phase is started after corticotomy. Limb reconstruction system is removed after the completion of distraction and consolidation.

6. Conclusion

Limb reconstruction system can be used effectively in cases of infective non union of long bones, using internal bone transport technique. Devascularized bone resection and secondary bone lengthening helps in attaining a functional limb. LRS external fixation technique is helpful in re-establishing the limbs, which would have been at high risk of amputation.

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