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Original Research Article.

Management of Complex Non Union in Long Bones with Limb Reconstruction System (Rail Fixator) Application

Vinod Kumar Anand[1], Awadhesh Bhati[2], Ritesh Kumar[3]

[1]CMO, [2]Secondary DNB (Final Year), [3]GDMO, Department of Orthopaedic Surgery, North DMC Medical College & Hindu Rao Hospital, New Delhi, India.

ABSTRACT

Introduction: Nonunion is complete suspension of the process of union because of arrest of the repair process and radiological or clinical evidence of healing has not been seen for months. There is still controversy regarding union rates and complications associated with rail fixator. So this study has been done to assess the union rates, infection control and complications associated with the device.

Materials and Methods: The present prospective clinical study has been conducted on 42 patients with complex non-union of long bones managed with application of rail fixators. Fixation was performed using a monolateral external fixator. A single- level corticotomy and distraction was performed through healthy tissue when the gap or shortening was more than 2 cm. Patients were followed up regularly in OPD every two weeks for the first two months and thereafter every month till docking of the fracture fragments was achieved.

Results: Majority of the patients had an external fixator or infected implant at the time of presentation. No special investigations were required in our study except for frequent X-Rays and pus culture and sensitivity. Corticotomy was done in almost half (55%) of the patients. Two patients required additional bone grafting and one patient required freshening of bone ends as secondary procedures. Another secondary procedure adopted was PRPP injection in 1 patient at the docking site to achieve union but it ultimately failed to unite Out of 42 patients treatment has been completed in 22 patients while remaining 18 patients are still undergoing treatment and one patient lost to follow up. Mean treatment duration was 7.9 months ranging from 4 months to 14 months.

Conclusion: In conclusion, complex nonunion can be managed satisfactorily with rail fixators. It is a good alternative to Ilizarov fixation in management of complex nonunion of long bones. An active involvement and participation of the patients is necessary for successful treatment by rail fixator.

Keywords: Corticotomy; Complex Nonunion; Rail Fixators.

***Correspondence to:**

Dr. Ritesh Kumar,
GDMO, Department of Orthopaedic Surgery,
North DMC Medical College & Hindu Rao Hospital,
New Delhi, India.

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INTRODUCTION

Non-union is complete suspension of the process of union because of arrest of the repair process and radiological or clinical evidence of healing has not been seen for months. In practice non unions are divided into atrophic and hypertrophic types depending upon the amount of callus present at fracture site. Atrophic non unions are caused by loss of osteogenic power, such as a large bone defect, severe vascular compromise around the fracture site and infection whereas hypertrophic non-union is caused by insufficient stability. Non-union, whether septic or aseptic, must be carefully determined. Associated shortening must be given due importance when treatment methods are designed. Non operative methods of treatment such as load bearing, electrical stimulation, ultrasound, shockwaves are, although effective, but with lower success rates than operative methods.[1]

For aseptic non-union of long bones plating and locked nailing have similar success rates but the latter is technically simpler and is the treatment of choice. Sometimes, plate augmentation may be useful near metaphyseal regions. For infected non-union, one strategy is treatment of the infection first with non-union being treated later and other strategy is concomitant treatment of infection and non-union. When non unions are combined with shortening of more than 2 cm, gradual lengthening with secondary internal fixation may be performed.[2]

Complex non-union can be defined as an established non-union of at least six months in duration with one or more of the following criteria: infection at the site of non-union; a bone defect of more than 4 cm (defect non-union); an attempt to achieve union that failed to heal after at least one supplementary intervention, for example, bone grafting or exchange nailing. Incidence of fractures of long bone is increasing day by day due to increased incidence of road traffic accidents leading to increased complex non union cases. Management of complex non-union is considered one of

the most difficult and challenging orthopedic situations due to presence of infection, deformities, shortening, joint stiffness, disuse osteoporosis, soft tissue atrophy and multiple surgeries in the past. Infection at the site of nonunion may lead to soft tissue devitalization with multiple sinuses, osteomyelitis, osteoporosis, stiffness of adjacent joints and multi-drug resistant infection. These factors complicate the treatment and recovery. The function of the salvaged limb may also be disappointing due to presence of residual pain, joint stiffness and neurovascular deficit.[3]

The specific method of skeletal fixation and soft tissue management in complex nonunion of long bones continues to be a topic of debate in orthopaedic traumatology. Complex nonunion of long bones is not only a complex surgical problem but also chronic and at times debilitating condition leading to loss of self-esteem. There is still controversy regarding union rates and complications associated with rail fixator. So this study has been done to assess the union rates, infection control and complications associated with the device.

MATERIALS AND METHODS

The present prospective clinical study has been conducted on 42 patients with complex non-union of long bones managed with application of rail fixators in the Orthopaedic wards of NDMC, Medical College and Hindu Rao Hospital, Delhi. All patients with complex non-union who satisfied inclusion criteria have been included in the study. Inclusion criteria includes infection at the site of non-union bone defect of more than 4 cm and cases with an attempt to achieve union that failed to heal after at least one supplementary intervention, for example bone grafting or exchange nailing. Complex non-unions due to congenital disorders and cases following pathological fractures (except due to infection). Patient demographics, presenting symptoms and duration, medical history, the presence of tenderness, sinus, and pus discharge, skin condition, shortening, deformity, and function and neurovascular status of the nearby joints were recorded. All data were recorded on a preformed proforma. Radiological examinations of the involved part as well as routine investigations were done. Complete blood counts, erythrocyte sedimentation rate, and C - reactive protein level were measured. All patients were explained completely about the nature and type of surgical procedures as per the protocol and other supplementary procedures that can be performed if needed. Full informed consent was taken from each patient regarding the intervention performed, its complications and drawbacks. The patients were prepared for either regional or general anaesthesia. Pre-operative assessment of soft tissue defect and planning for subsequent reconstruction was done. Under appropriate anaesthesia, the part was scrubbed, painted and draped taking all aseptic precautions. Any implant, such as a plate or an intramedullary nail, present in situ was removed first. All the dead bone were resected and the infected scarred soft tissues and sinus tracts were debrided adequately. Cortical bleeding known as the paprika sign was considered the end point of bone resection. Resultant bone gap was measured intra operatively with a sterile scale. Tissues were obtained for aerobic and anaerobic cultures and biopsy. Injectable antibiotics (ceftriaxon and amikacin) were started empirically.

Fixation was performed using a monolateral external fixator. 300 mm fixator was used for humerus and ulna, 350 mm or 400 mm for tibia and femur. We used the Rail External Fixator System from SH Pitkar Orthotools, Pune, India, Newlife Surgical Works, New Delhi, India, and Kaushik Orthopaedic Pvt. Ltd. Delhi, India. A single- level corticotomy and distraction was performed through healthy tissue when the gap or shortening was more than 2 cm. No corticotomy and distraction was done for humeral non unions. The soft tissue reconstructive procedure required depending upon the location and extent of soft tissue defect was done with the help of plastic surgeons. The wound was lavaged thoroughly and closed in layers over a suction drain.

Patients were followed up regularly in OPD every two weeks for the first two months and thereafter every month till docking of the fracture fragments was achieved.

RESULTS

35 patients (83%) developed complex non-union following RTA, 2(5%) following fall from height, 2(5%) following machine injury and 3(7%) following chronic osteomyelitis (figure 1).

14 patients were of gap nonunion and 28 patients were of infected nonunion (figure 2).

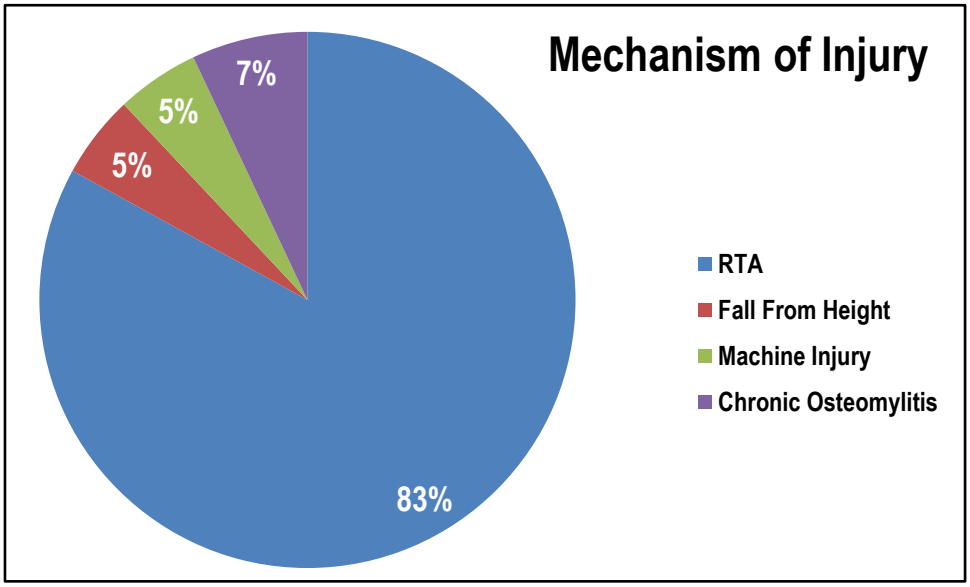

Figure 1: Mechanism of Injury

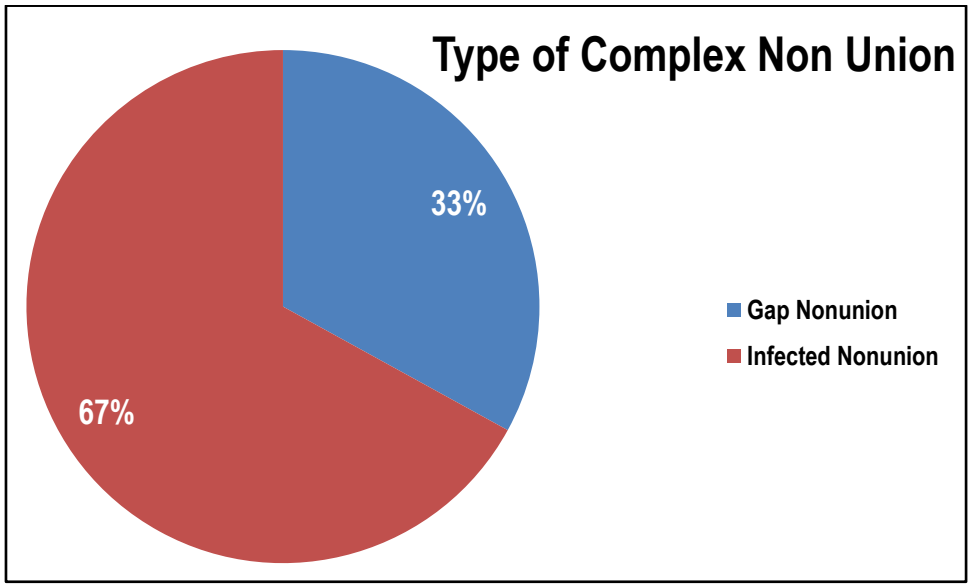

Figure 2: Type of Complex Non Union

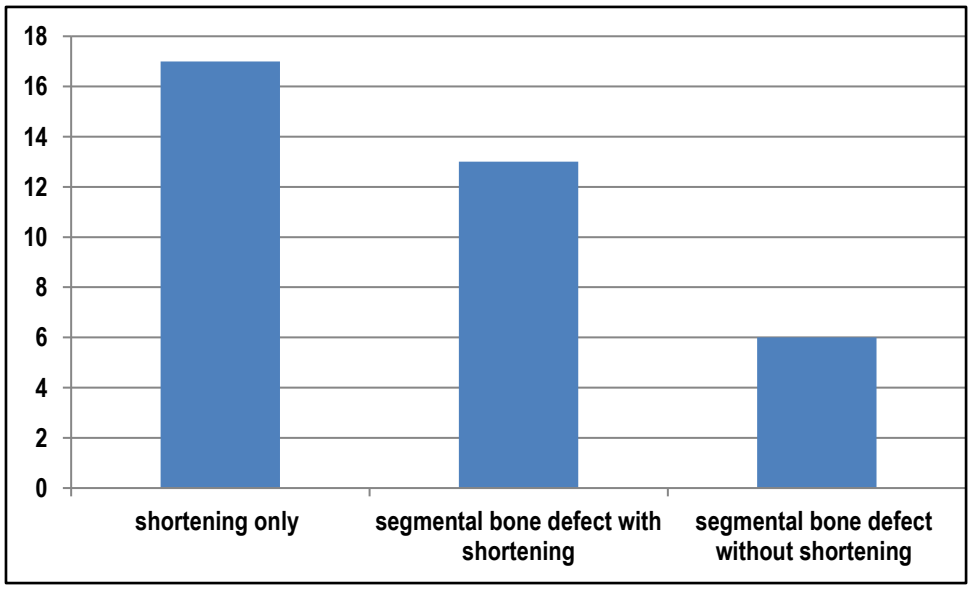

Figure 3: Fixation Device at Presentation

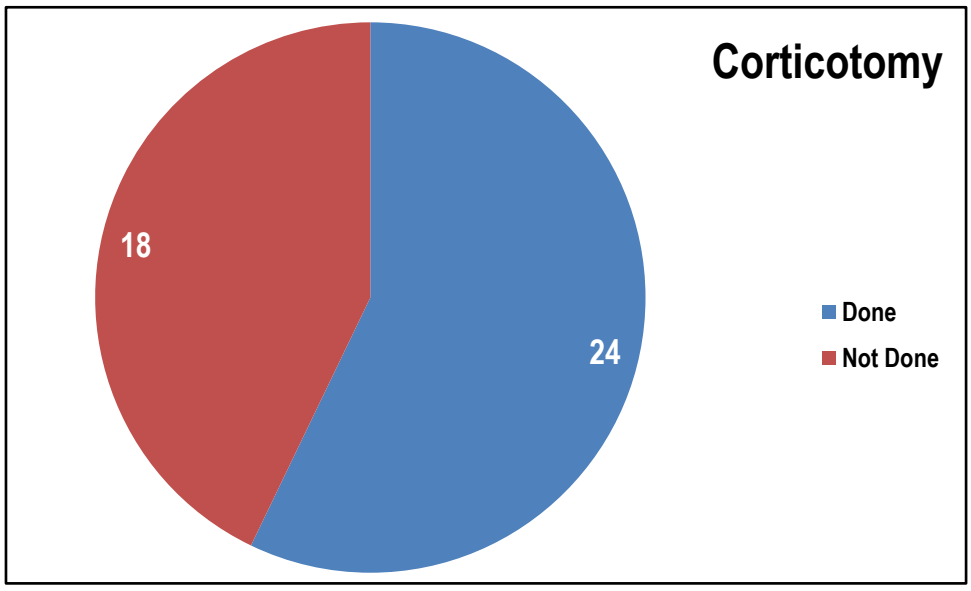

Figure 4: Corticotomy

13 patients had segmental bone defect with shortening, 17 patients had shortening only and 6 patients had segmental bone defect without shortening (figure 3).

At the time of presentation 12 patients (28.5%) presented with external fixator, 8 patients (19.1%) had no implant, and 22 patients (52.4%) had infected implant. Out of 22 patients with infected implant 12 had infected intramedullary nail and 10 had infected plate. Mean number of surgical procedures performed before presentation was 2.01 ranging from 1 to 5 procedures. Mean duration from trauma to presentation was 3.4 years (Range 6 months-12 years). 29 patients had discharging sinus and 4 patients had quiescent sinus at presentation. Mean bone defect after adequate debridement was 1.7 cm (range 2-9 cm).

Average shortening was 4.55 cm (1cm-15 cm). Corticotomy was done in 24 patients (55%) out of 42 patients (figure 4). In 7 patients corticotomy was not done because shortening was less than or equal to 2 cm. Two patients refused for corticotomy. 1 patient with shortening in the leg was lost to follow up. In 2 patients with shortening in the humerus corticotomy was not done as shortening does not matters much in arm.

Patients were discharged after training them about pin tract hygiene, dressing, cleaning of fixator and compression/distraction.

DISCUSSION

In our study we required pus culture and sensitivity in infected cases for administration of specific antibiotic, X-ray of the bone for planning surgery, routine investigations such CBC, RFT, ECG, Chest X Ray for pre anaesthetic checkup. No specific pre-operative investigations are required for this procedure in contrast to other reconstructive procedures such as vascularised bone grafting which requires serial Color Doppler for planning of surgery and subsequent evaluation of graft after surgery. However frequent follow up X-Rays were needed.

2 patients in our study required additional procedures in the form of bone grafting at the fracture site. 1 patient required freshening of bone ends at the docking site to achieve union.

One patient with complex non-union of humerus had associated brachial plexus injury of the same side that did not recover until last follow up, hence his limb function was not included in the present study.

The average healing index was 2.7 months/cm. While judging results in such a study, the severity of the patient condition and the available options has to be kept in mind. We achieved more than 90% success rate in eradicating the infections in our patients. Union at the fracture site has been achieved in 19 patients out of 42 patients.

Two cases needed augmentation by bone grafting at the docking site to achieve union. Though we believe in Ilizarov"s assertion that distraction alone is a potent stimulus for union, we also believe that bone grafting, particularly in atrophic non-unions, is a viable option for reducing the duration in frame. Green[4] grafted the docking site while Ilizarov freshened it with curette and osteotome. Pin tract infection was the most common complication that we faced as it is with most of the other studies.

A study done by Sangkaew C[5] showed average bone transport of 5.6 cm and average fixator time was 8 months in 70 patients. He used conventional external fixator in his study.

Bassiony et al[6] treated 8 infected non-union of diaphyseal fracture of the humerus by Rail fixator. Bone union was achieved in all cases. Mean time to union was 4.5 months (2-8). The use of Orthofix external fixator without bone grafting was successful in the treatment of the humeral shaft. It shortened the duration of hospitalization and immobilization with moderate functional recovery. Kamran A. et al[7] studied the problems, obstacles and sequelae encountered during femoral lengthening using the CEF versus UEF between September 1994 and January 2007. Pin site infection, fixator related problems, early/late consolidation, plastic deformation, joint dislocation, joint contracture/ stiffness were higher in CEF group. Advantages of UEF over CEF are less operation time, no preop frame assembly is required, less cumbersome to apply, less pain during lengthening and higher patient satisfaction. Tang Liu et al[8] treated twenty-three consecutive patients with tibial bone defects and limb-length discrepancy caused by osteomyelitis from January 1994 to January 2009 using monolateral external fixator. Mean lengthening was 9.3 cm (range, 5.8-12.1cm). Bone results were excellent in 16, good in 6, and fair in 1. Functional results were excellent in 15, good in 7, fair in 1.This study shows that distraction osteogenesis with an external fixator is an effective treatment for massive post-osteomyelitis bone defects and leg shortening.

Lavini F et al[9] treated 31 patients of non-union of humeral shaft using Monolateral external fixator. Union was achieved in all patients in a mean time of 4.9 months. The authors believe that this method is reliable, effective and low risk provided that the patient is cooperative; furthermore , the monolateral axial external fixator is tolerated well and allows movement of the shoulder and elbow throughout the period of treatment. Hashmi MA et al[10] reviewed a cohort of 107 non-union patients (60 tibiae, 38 femora, rest upper limb bones), treated by monolateral external fixation in Sheffield between 1987 and 1996. The mean time to bony union was 12.69 months (2.5-64months). The mean length gain was 4.5 cm (1.5-12cm). Mean angular correction achieved was 12 degrees (2-39 degree).They concluded that Monolateral external fixator (LRS) can provide stable fixation for the treatment of established non unions. The fracture environment can be carefully controlled and angulations and length corrected simultaneously.

Iqbal A et. al[11] reported average bone transport of 6.4cm in 9.4 months 23 fixator time using “Naseer and Awais” fixator. Using Ilizarov fixator Dendrinos[13] et al achieved healing in 9.6 months with 6 cm bone transport in 28 patients. Similarly in the study of Paley D[12] et al healing took 10.6 months with 6.2 cm bone transport in 25 patients. In our study average fixator time was 8.2 months for average bone transport of 3 cm. The complications can be divided in to two groups; one related to frame and fracture site and the other related to the distraction process. Majority of complications were related to the former. Pin tract infection was the most common complication in our study and was observed in 59.1% of patients. Iqbal A et al[11] reported 40.2% and 38% pin tract infection respectively. None of the patients in our study developed malalignment of the fracture fragments. Sangkaew C[5] reported malalignment in 5.7% of patient using monolateral conventional external fixator. With the use of multi planar Ilizarov fixator malalignment was reported in 4(16%) of patients by Dendrinos et al.[13] Another major complication at fracture site which required surgical intervention was delayed union. In our study 2(9.1%) patients required bone grafting for delayed union. This problem is less common with the use of Ilizarov frame.

Dendrinos et al[13] and Paley D[14] reported use of bone grafting at fracture site in 11% and 9% of patients in their series. Soft tissue related complications due to distraction are mainly nerve traction injuries and joint contractures. In our study there was no case of peroneal nerve paresis. Iqbal A et al[11] reported 13.3% and 7.7% equinus deformity of foot respectively. No patient required recorticotomy in our study as there was no premature consolidation of regenerate.

CONCLUSION

In conclusion, complex nonunion can be managed satisfactorily with rail fixators. It is a good alternative to Ilizarov fixation in management of complex nonunion of long bones. An active involvement and participation of the patients is necessary for successful treatment by rail fixator.

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