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Limb reconstruction system as a primary and definitive mode of fixation in open fractures of long bones

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ABSTRACT

Background: Management of open fractures of long bones by the traditional systems is very complex. Limb reconstruction system (LRS) was considered as very effective, and offers rigid stabilization of fracture fragments and with an easy access to soft tissue care. The aim of the study was to determine the efficacy of LRS for treatment of open fractures of long bones.
Methods: This prospective study included 30 cases of both the sexes aged between 11-60 years. Patients with closed fractures of long bones and fractures treated conservatively were excluded from the study. Their clinical and radiological evaluation will be done at presentation and certain specific intervals and evaluated for signs of bone union and associated complications.
Results: The mean age of the patients participated in the study was 35.6 years with male predominance (93.3%). All patients (100%) were injured by road traffic accidents. 50% of the cases were of Grade 2 type of fractures. The most common complication encountered was pin tract infections seen in 8 cases. We had good results in 24 patients, moderate in 5 and poor in 1 patient using modified Anderson and Hutchinson's criteria.
Conclusions: LRS is an alternative to the traditional system of fixation in the primary management of open fractures of long bones. It is less cumbersome to the patient and more patient friendly in terms of reducing financial burden also. It is a definitive single stage procedure.

Keywords: Open fractures, Long bones, Limb reconstruction system

INTRODUCTION

Now-a-days, occurrence of open fractures of long bones are intensifying due to the increase in road traffic accidents (RTA) leading to increased incidence of complex nonunions. These patients are usually operated upon several times for healing or to eradicate infection, which in turn require skin grafting, muscle pedicle graft or bone grafting. Sometimes they end up with deformity, limb length discrepancy, joint stiffness, disuse osteo-porosis and soft tissue atrophy even after treatment.[1] Hence, it is considered to be one of the most complex and challenging orthopedic situations to manage.[2] External fixation is able to address these problems instantaneously.[3,4] Traditionally complex nonunions or open fractures are managed by the Ilizarov ring fixators. But, it is heavy and complicated to manage, both for the surgeon and the patient.[5] Limb reconstruction system (LRS) was considered as a definitive management for open fractures. It has the advantage of allowing distraction and compression at fracture site. It also allows dynamization of the fracture site which is the essential principle in the treatment of nonunions and open fractures.[6]

This study was conducted with the objective to assess the efficacy, union rates, limb lengthening, postoperative mobilization and the complications associated with the use of LRS in open fractures.

METHODS

Thirty prospective cases of open fractures of long bones with or without bone loss treated by using the LRS to achieve union or lengthening simultaneously constituted the study. Their clinical and radiological evaluation will be done at presentation and certain specific intervals and evaluated for signs of bone union and/associated complications. The study was conducted at our hospital for a period of three years from 2010-13 after getting approval from institutional ethics committee.

The inclusion criteria were patients between 11-60 years of both the sexes with open fractures of long bones irrespective of the type or grade of fracture. Patients with closed fractures of long bones and patients with open fractures treated conservatively and consisting of pathological fractures were excluded from the study.

Operative procedure

Open fracture without bone loss

The open fracture on presentation is applied splintage and antibiotics are started immediately. In the OT, the wound is debrided and fracture is reduced & temporarily fixed with K-wire or 4 Hole DCP plate which is removed at end of surgery. The required length of rail of LRS along with minimum one template clamp (if possible two) on either side of fracture is taken. Double sleeve is taken and two Schanz screws are inserted in proximal most & distal most holes of template clamp on either side of fracture. The Schanz screws close to joint should be parallel to joint line.

Then Schanz screws are inserted closest to fracture site at distance of 2.5 cm (minimum) from fracture site. The remaining Schanz screws are then inserted. The template clamp is then replaced with final clamp. Nuts are tightened with Alen key and compression distraction union is applied across fracture site. While inserting Schanz screw proximal cortex is driled with 4.8 mm & far cortex with 4 mm drill bit. Then 5/6 mm Schanz screw is passed. There should be minimum three Schanz screws on either side of fracture. These Schanz screws are best passed in 1, 3, 5 position hole of clamp. If only 2 Schanz screws are being placed in a clamp, they are best placed in 1, 5 position.

For tibia, the LRS frame is applied on anteromedial side of leg while for femur, the frame is on lateral side of thigh. Knee spaning frame should be on lateral side so as to facilitate mobilization. The wound cover in form of primary closure or SSG or flap cover is done as per requirement of wound in same sitting

Open fracture with bone loss

In operative technique, the wound is debrided and fracture is aligned. Rail length is selected and three template clamps are taken. Corticotomy site is preplanned and Schanz srews are passed into all three clamps using above principles. Each clamp should have minimum 2 Schanz screws at 1, 5 (ideally 3 at 1, 3, 5 position). The template clamp is replaced by final clamp and nuts are tightened. The corticotomy is performed as planned and compression distraction unit (CDU) is applied. Distraction is started after 7 days of surgery.

RESULTS

The final outcome was calculated in all 30 cases. None of the patients were lost to follow up. The results were classified as good, moderate and poor depending the fracture union, degree of deformity, degree of shortening, range of motion at neighbouring joints using the modified Anderson and Hutchinson's criteria.[7]

Table 1: Details of the patients.

Variables	No. of patients
Age in years	
11 to 20	2
21 to 30	8
31 to 40	12
41 to 50	6
51 to 60	2
Sex	
Male	28
Female	2
Mechanism of injury	
Road traffic accidents	30
Type of fracture	
Grade 1	2
Grade2	15
Grade3a	3
Grade3b	10
Associated medical diseases	
Hypertension	1
Diabetes	1

Table 1 describes the details of the patients included in the study. The mean age of the patient was 35.6 years (range 11-60 years). Maximum number of patients was between the age group of 31 to 40 years. 93.3% of patients were males with road traffic accident (100%) as the major cause of injury. All were due to high velocity injury. According to Gustilo-Anderson classification, 50% of the cases of our study were Grade 2 followed by Grade 3b, Grade 3a and Grade1 in decreasing order. In our study, one patient with Grade 3b open tibia fracture was hypertensive and was managed effectively with antihypertensives. One patient with Grade 2 open tibia

fracture was type 2 diabetic and was managed effectively with human Actrapid insulin.

As given in Table 2 maximum number of cases was operated within the 1st week post trauma. 14 cases were operated within 24 hours of injury. Wound primarily closed in 10 cases. Additional skin grafting was done in 12 as shown in Figure 4, muscle pedicel graft in 7, bone grafting in 1 case. Revised surgery was advised in 1 case.

Table 2: Details of time and type of secondary procedure adapted to the patients.

Variables	No. of patients
Time of application of LRS	
Within 24 hours(day 1)	14
Day 2 to Day 7	15
7 to 14th day	1
Secondary procedure	
Wound primarily closed	10
Skin grafting	12
Muscle pedicle graft	7
Revision surgery advised	1
Bone grafting	1

The most common complication encountered was pin tract infections seen in 8 cases followed by shortening in 5, equinus deformity in 2 cases, malunion and nonunion each in 1 case respectively as shown in Table 3.

Table 3: Complications after surgery.

Complications	No of patients
Pin tract infections	8
Shortening	5
Malunion	1
Non union	1
Equinus deformity	2

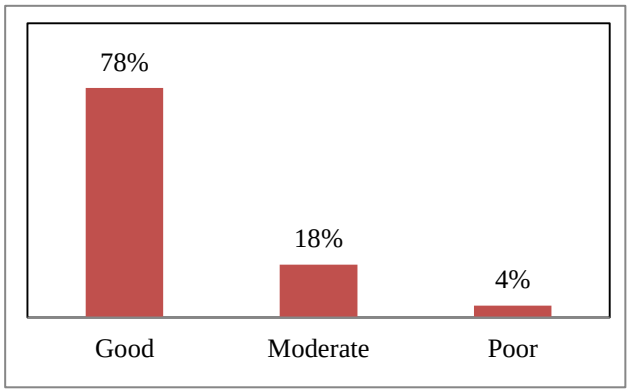

Figure 1: Outcome of the study.

The outcome of the result was graded according to modified Anderson and Hutchinson's criteria. Results were good in 24 patients, moderate in 5 patients and poor in 1 patient as given in Figure 1. The mean time for partial weight bearing was 5.96±1.78 and full time bearing was 6.3±1.78 months indicating that most of the fractures in the study united at an average period of 6 months.

DISCUSSION

Open fractures are surgical emergencies, that perhaps should be thought of as incomplete amputation.[8] The goal of all doctors responsible for health care decisions must be life preservation, limb preservation, infection avoidance and functional preservation of the limb.

In our study the mean age group of the patients in maximum cases (40%) was 35.6 years with male predominance 93.3% (28 cases). This was in accordance with the study conducted by Thakur et al in 79 patients with mean age group of 38 years in males predominantly (83.5%).[9]

In this study, road traffic accidents were the major cause of injury in all patients. While in the study conducted by Adrover et al, road traffic accident was the major cause of injury in 81.9% of patients in Group A and 90% of patients in Group B where as in Thakur et al series, 87.3% of patients with open fractures were caused by road traffic accidents.[9,10]

In our study, maximum number of cases were belonging to the Gustilo-Anderson Grade 2 group accounting for 50% (15 cases) of the cases followed by Grade 3b (33%), Grade 3a (10%) and Grade 1(7%) as shown in Figures 2-4. It is in contrast with the study conducted by Granhed et al, in which 45% of the patients were of the type 3b and rest 55% patients were belonging to type 3c Gustilo-Anderson group.[11]

Figure 2: Grade 2 open tibia fibula fracture stabilized with LRS. a) Fracture at tibia fibula, b) Correction by LRS, c) Immediate postop X-rays, d) X-ray at 7 months showing bony union.

Figure 3: Grade 3a open tibia fibula fracture stabilized with LRS. a) Fracture at tibia fibula, b) Correction by LRS, c) X-ray at 6 months postoperatively: callus formation, d) X-ray at 8 months post-op, e) X-ray at 9 months post-op showing bony union, f) X-ray after removal of LRS at 9 months.

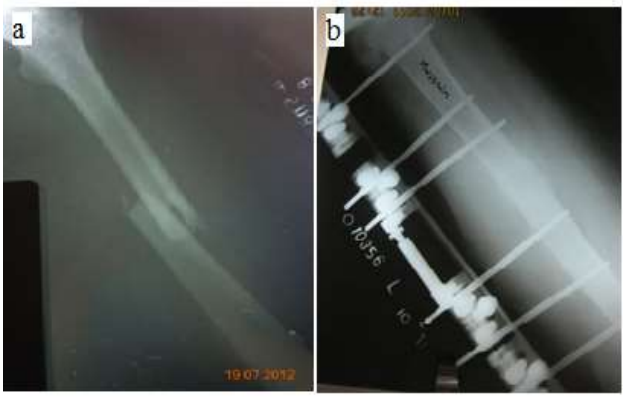

Figure 4: Grade 3b open femur shaft fracture treated with LRS. a) Fracture at femur shaft, b) X-ray of fracture union at 7 months.

Figure 5: Skin defect treated with skin grafting.

At final follow up, union occurred in all patients except in one case who had poor results due to nonunion at docking site which required bone-grafting for union.[12] 12 patients needed skin grafting as given in Figure 5 and muscle pedicel graft required in 7 patients. These results were comparable with the studies of Tornetta.[13]

The most common complication, in accordance with previous studies, was pin tract infection which was seen in 8 (28%) of our patients, 5 (16%) had limb shortening, which healed on suitable parenteral antibiotics after culture and sensitivity.[14-20]

Our study showed a good result in 80%, moderate in 17% and poor in 3% of patients which was comparable to the results of other series like Ajmera et al and Patil et al.[21,22]

The mean time for weight bearing was 6 months indicating that most of the fractures in the study united at an average period of 6 months. These results confirmed that LRS fixator provides immediate stability to fracture fragments and allows immediate weight bearing which ultimately promotes early fracture healing and reduced financial burden.

CONCLUSION

LRS is a simple and easy technique which can be used for all open fractures. Fixation with LRS is a cost effective and single definitive surgery. It saves the time of the patient by reducing hospital stay and financial burden. It can also be used for bone lengthening / transportation, deformity correction, in patients with infective non-union and osteomyelitis.

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Ethical approval: The study was approved by the institutional ethics committee

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