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Functional and radiological outcome of primary fixation of compound tibial fractures with LRS and antibiotic beads: A prospective case series

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Abstract
Open fractures are more common in tibia than in any other long bones due to its distal location and less soft tissue envelope. The conventional goals for treatment of open tibial fractures include prevention of infection, soft tissue coverage, and fracture stabilization leading to union. LRS (limb reconstruction system) considered as a definitive treatment option, as it offers rigid fixation of fracture fragments and allows early weight bearing and reduces economic burden for patients. In this study, we are using antibiotic beads (as the local prophylactic device to prevent future infection) along with Limb Reconstruction System (LRS) to allow for the aseptic union of fracture while the patient is mobile throughout the period of treatment and without the requirement of another surgery.

Keywords: Tibial fractures, antibiotic beads, limb reconstruction system

Introduction
More than 4.5 million open fractures occur per year in India [1]. Open factures have to be treated as surgical emergency after ruling out life threatening conditions. Open fractures are more common in tibia than in any other long bones due to its distal location and less soft tissue envelope [1, 2].
The conventional goals for treatment of open tibial fractures include prevention of infection, soft tissue coverage, fracture stabilization leading to union [3, 6]. Managing multifactor compound fractures with substantial bone loss is easier said than done due to the existence of soft tissue injury & loss, associated contamination [4].
The specific method of treatment options ranging from external fixators, ring fixators, nailing, plating, tibial synostosis, free or vascularized bone grafting all have their own set of complications [5, 6].
The disadvantage of this technique is need for several procedures, longer period of hospitalization, increased chance of infection, financial burden and need for prolonged immobilization [1, 2, 4, 6, 9].
To overcome these LRS (limb reconstruction system) considered as a definitive treatment option, as it offers rigid fixation of fracture fragments and allows early weight bearing and reduces economic burden for patients [2, 4, 7, 8].
In this study we are using antibiotic beads (as the local prophylactic device to prevent future infection) along with Limb Reconstruction System (LRS) to allow for the aseptic union of fracture while the patient is mobile throughout the period of treatment and without requirement of another surgery.

Materials and Methods
A prospective study conducted in department of orthopaedic surgery at Sri Siddhardha Medical College and Hospital from 2020-2022. All patients attending the emergency and orthopaedics OPD with compound metaphyseal & diaphyseal tibial fractures who met the inclusion criteria were counseled regarding the fractures and the study and those willingly consenting to participate in the study were selected.

Informed and written consent was obtained from all patients with consent form approved by the institutional ethical committee.

Inclusion criteria
- Compound fractures of tibia grade 2 and 3
- Age group 18-60 yrs
- Without any associated neurovascular injury
- Compound segmental fractures of tibia

Exclusion criteria
- Grade 1 compound and Closed diaphyseal fractures
- Pathological fractures
- Congenital causes
- Fractures from metabolic bone diseases
- Patients not fulfilling above inclusion criteria

Surgical procedure
- All patients underwent routine investigations and clinical evaluation was done for soft tissue injury, bone loss and neurovascular injury. Splinting of the fracture was done and antibiotics started immediately. Antero-Posterior & lateral views of x-rays of affected limb were taken and fracture was classified according to Gustilo & Anderson classification. Stable patients were taken to surgery after anaesthesia fitness.

The patient was placed in supine position with bump under ipsilateral hip and C-arm from the contralateral side, tourniquet applied to ipsilateral proximal thigh under spinal anaesthesia, scrubbing, painting and draping of the involved limb done under sterile conditions.

Schanz pins of 5/6 mm were inserted on the antero-medial surface of tibia, hence preventing the risk of neurological, vascular or tendon injuries. First the proximal most pin placed parallel to the knee joint at the level of fibular head. Second schanz pin placed parallel and 2 cm above to ankle joint. The rail of 250/300 mm was used with clamps and the remaining schanz pins placed as a guide by placing the rail parallel to the long axis of the bone.

All schanz pins were inserted under C-arm control with the help of T-handle manually. Each clamp is fixed with 3 or 4 pins and screws are tightened with Alen key and C-D clamp fixed. In case of bone loss corticotomy was done. At the open fracture site pre-prepared sterilized antibiotic beads placed and approximation of the skin was done. Hemostasis secured, pressure bandage applied tourniquet removed.

Fig 1: Intaoperative image showing finalized fixation with LRS & antibiotic beads

Preparation of antibiotic beads

40 g of bone cement is taken and 1g of injection vancomycin mixed and made paste with cerium nitrate liquid then it is mounted to 18mm SS wire, sterilized and stored. Post operatively limb elevation with analgesics and antibiotics continued according to wound status. All patients were made to do static and dynamic quadriceps exercises from pod 2 or 3. Few patients underwent fasciocutaneous muscle pedicle graft and split thickness skin grafting after 3wks of healing the wound.

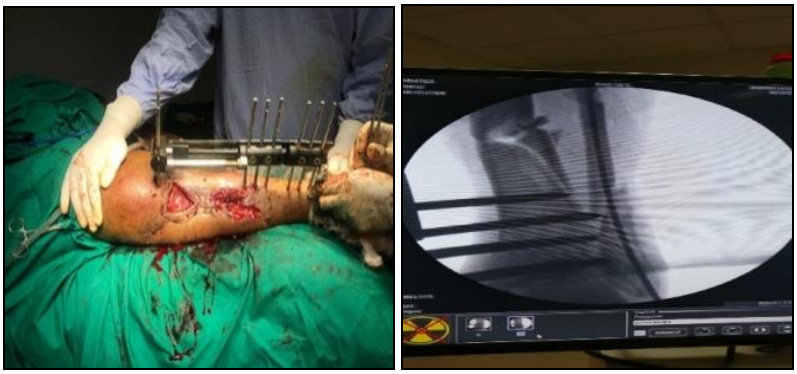


Fig 2: Image showing final wound closure with pins in position under C-arm

Patient attenders were taught about 1 mm distraction in 4turns per day and were discharged after 5 days of the surgery. Sutures were removed after 2 weeks. Patient was followed for 4 weeks, 8 weeks and 12 weeks with AP & lateral views of X-ray for union of fracture site, wound appearance, knee & ankle range of movements using ASAMI score.

Pre op X-ray

Post op X-ray

Pre op X-ray

Post op X-ray

Pre op X-ray

Post op X-ray

Fig 3: Clinical images of pt with wound healing and functional movements

Results

All patients ranged from 20-60 yrs of age, there were 9 males and 1 female patients had undergone surgery.

According to Gustilo Anderson's classification 6 were of type-II (60%), 2 were of type-IIIA (20%), 2 were of type-IIIB (20%).

Table 1: Side which fracture has occurred.

Diagnosis	Frequency	Percent
Type 2 open fracture Lt tibia	3	30.0
Type 2 open fracture Rt tibia	3	30.0
Type 3A open fracture Lt tibia	1	10.0
Type 3A open fracture Rt tibia	1	10.0
Type 3B open fracture Rt tibia	2	20.0
Total	10	100

The mean time of partial weight bearing was 3-4wks, full weight bearing was 7-8wks and the bone union time was 22 ± 3weeks.

Secondary procedures were done in 3 cases like fasciocutaneous muscle graft with split thickness skin grafting.

Table 2: Extra-procedures done.

Extra-procedures	Frequency	Percent
Fasciocutaneous muscle graft with skin graft	2	20.0
Split thickness skin grafting	1	10.0
Nil	7	70.0
Total	10	100

In our study complications like delayed union was found in 1 case later got union after 2months, shortening of more than 2cm found in 1 case which was treated by high heel shoe rise and chronic osteomyelitis was observed in 1 case which was treated by sequestrectomy with higher antibiotic injections.

Table 3: Wound appearance and bony union using ASAMI score

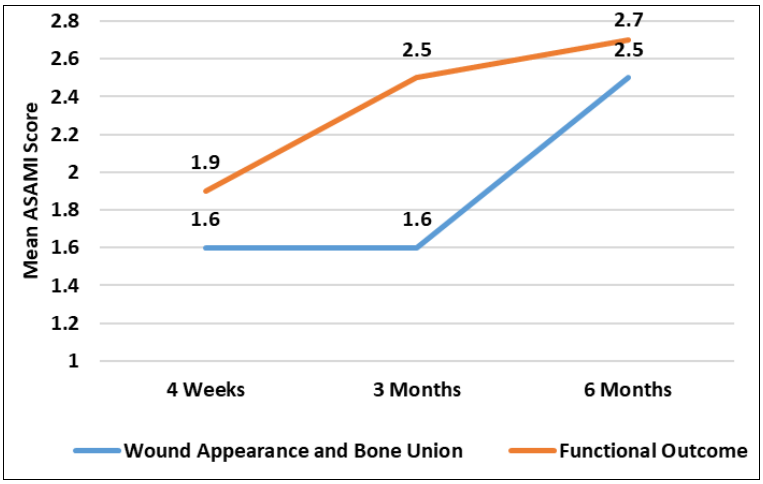
Wound appearance and bony union	4 Wks.	3 months	6 months	Chi square	P- value
Fair	4 (40.0%)	4 (40.0%)	1 (10.0%)	18.00	<0.001
Good	6 (60.0%)	6 (60.0%)	3 (30.0%)		
Excellent	0 (0.0%)	0 (0.0%)	6 (60.0%)		
Total	10 (100%)	10 (100%)	10 (100%)		
Mean+-SD	1.6+-0.5	1.6+-0.5	2.5+-0.7		
Mean rank	1.55	1.55	2.9		

Bony and functional outcome was assessed by ASAMI score. In our study wound appearance and bony union outcome in 6 (60.0%) patients were excellent, 3 (30.0%) patients were good, 1 (10.0%) patient is fair without any poor outcome.

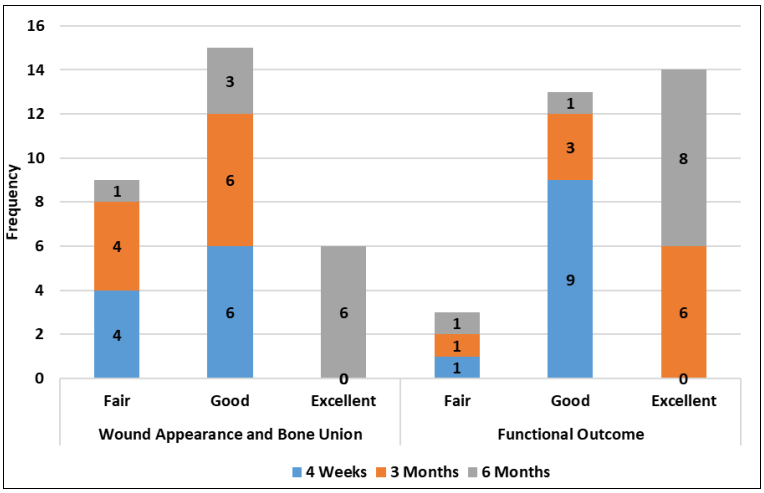
Table 4: Functional outcome using ASAMI score

Functional outcome	4 wks.	3 months	6 months	Chi square	P- value
Fair	1 (10.0%)	1 (10.0%)	1 (10.0%)	13.000	<0.001
Good	9 (90.0%)	3 (30.0%)	1 (10.0%)		
Excellent	0 (0.0%)	6 (60.0%)	8 (80.0%)		
Total	10 (100%)	10 (100%)	10 (100%)		
MEAN+-SD	1.9+-0.3	2.5+-0.7	2.7+-0.7		
MEAN RANK	1.3	2.2	2.5		

Functional outcome in 8 (80.0%) patients were excellent, 1 (10.0%) patient is good, 1 (10.0%) patient is fair without any poor outcome.



Graph 1: Mean ASAMI score



Graph 2: Frequency of functional outcome, wound appearance and bone union.

Conclusion

Primary fixation of compound tibial fractures with LRS & Antibiotic beads is a single definitive surgery, which allows for prevention of infection, wound healing, early mobilization with weight bearing and fracture healing.

It also has short learning curve, cost effectiveness and good patient compliance as compared to Ilizarov.

It is also helpful in bone transport, deformity correction and limb lengthening.

Conflict of Interest

Not available

Financial Support

Not available

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