e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(5); 1721-1725

Original Research Article

# Surgical Management of Open Tibial Fracture (Type I, II & III) with Limb Reconstruction System (LRS)

**Amit Kumar[1], Indrajeet Kumar[2], Santosh Kumar[3]**

[1,2]Senior Resident, Department of Orthopaedics, Indira Gandhi Institute of Medical Sciences, Patna, Bihar

[3]Professor and HOD, Department of Orthopaedics, Indira Gandhi Institute of Medical Sciences, Patna, Bihar

**Received: 10-01-2024 / Revised: 13-02-2024 / Accepted: 10-03-2024**
**Corresponding Author: Dr. Amit Kumar**
**Conflict of interest: Nil**

**Abstract:**

**Background:** Tibial diaphyseal fractures are one of the commonest long bone fractures encountered by most of the orthopaedic surgeons. Because most of the length of tibia is subcutaneous throughout, open fractures are more common in tibia than in any other major long bone. Because of high prevalence of complications associated with these fractures, management is often is difficult and the optimum method of treatment remains a subject of controversy.

**Methods:** This study was performed with 25 open fractures of tibia with LRS in Department of Orthopaedics, IGIMS, Patna, Bihar from May 2014 to April 2015. All the cases were fresh fractures and traumatic in nature. They were done with procedure as early as possible and the secondary procedures of skin grafting and musculocutaneous flap were done when needed. The cases were followed up for an average period of 6-24 months.

**Results:** Open fractures of the tibial shaft managed with LRS gave good functional results and patient satisfaction. It involves minimal surgical trauma and less blood loss. It provides the advantages of early ambulation, lower rates of infection, delayed union, non-union and malunion compared to other treatment modalities. It provides with early weight bearing and earlier returns to work.

**Conclusion:** It was concluded that early stablisation of open tibial fracture with LRS with immediate soft tissue coverage resulted in good fracture union and minimal rates of complications compared to other modalities of treatment. It is cost effective with minimal hospital stay and early return to work. Over all morbidity is reduced and better patient satisfaction noted.

**Keywords:** Limb reconstruction system, open tibial fracture.



## Introduction

Injuries and fractures have become so common in the present day, main reason being increased population, with increase in vehicular traffic congestion and urbanization, mechanization and agriculturization. The causes of fractures vary according to age groups as in younger population it is due to high energy trauma, as in motor vehicle accidents and fall from height. In contrast to elderly, it is due to trivial trauma, secondary to generalised osteoporosis.

The tibia being the most commonly fractured long bone [1] and its fracture management contributes significantly to the cost of orthopaedic care being provided worldwide. Epidemiological studies suggest that motor vehicle accidents are the most common causes of tibial diaphyseal fractures, followed by sports related injuries.High energy trauma which imparts more kinetic energy that causes fractures which are often severe with associated soft tissue injury. Treatment options for tibial fractures vary according to the type of fracture, age group, bone density, soft tissue status and associated complications. Conservative methods used are casting or bracing for stable closed fractures. Because of improper anatomical alignment and associated soft tissue injuries, these conservative methods have become less useful. Operative techniques used are fixation with plates and screws, intramedullary nailing and external fixation.

Intramedullary interlocking nails used widely for fixation of unstable, closed and type I and type II compound tibial fractures. External fixators are indicated for type IIIA, IIIB and IIIC compound fractures, severely contaminated fractures, delayed treatment of open tibial fractures, open periarticular

fractures and in polytraumatized patients. By its very location, the tibia is exposed to frequent injury. Because one-third of the tibial surface is subcutaneous, through most of its length, open fractures are more common in the tibia than in any other major long bone. Further the blood supply to the tibia is more precarious than that of bones enclosed by heavy muscles especially in the lower third which is covered by only tendons.

The leg is especially vulnerable to trauma due to thin soft tissue coverings and its subcutaneous location, this means that even trivial soft tissue injury can lead to serious problems such as ulceration, sloughing and loss of skin and osteomyelitis. In the elderly these soft tissues are thin and unhealthy, reflecting the effects of ageing, and venous stasis. In the young, tibial fractures are common due to increased vigorous activity and thin soft tissue coverage may lead to open injuries. Reduction of blood supply to the bone, caused by stripping of attached soft tissues, and the risk of contamination add greatly to the risk of non-union and infection of the fracture. At the junction of the middle and lower thirds of the tibia the blood supply to the bone is relatively poor. Fractures here are less likely to unite within stipulated time.

The management of compound fractures of tibia is an enigma to orthopedic surgeon. Numerous methods have been described and came out with varying results for the management of compound fractures of tibia. Introduction of external fixator is a revolution in the management of compound fractures of tibia and it has saved many limbs from amputation.

External fixator, a boon and an important weapon in the armamentarium of the orthopedic surgeon, it has undergone 'sea of change' from a simple frame to more and more complex frame, and pin arrangements. External fixator fixes the fractured fragments. The term external fixation is a misnomer, in that, it is achieved by pins traversing the bony fragments at an angle to the long axis of bone, the protruding pins are joined outside the limb by a rigid scaffolding of which many different designs exist. It is this scaffold that is external and lends the name of the method.

In external fixation; fracture fragments can be realigned, compressed or distracted, without the need of opening fracture site.With improved components, and a better understanding of the principles, that govern their safe and effective use, external fixator has become indispensable tools in the hands of the experienced trauma surgeon.

External fixators have the unique capability to stabilize bone and soft tissues at a distance from the operative or injury focus. If correctly applied, they provide unobstructed access to the relevant skeletal and soft tissue structures for their initial assessment and also for those secondary interventions needed to restore bony continuity and a functional soft tissue sleeve. The additional vascular trauma to bone and soft tissue following the application of external fixation is minimal and therefore risks of infection are minimal, much lower than with internal fixation devices. Patient can be mobilized almost immediately with more rigid external fixator. Number of external fixators is available with varying degrees of function and complexity. It is left to the choice of the orthopedic surgeon for his needs and to his adaptability to the particular fixator.

A planned approach is necessary before using any external fixator. Appropriate roentgenogram is essential. A complete set of instruments should be available.

In our study, we have used unilateral frame with half pins, the system is named as Limb Reconstructive System (LRS). This system is very effective, and offers rigid stabilization of fracture fragments and with an access to soft tissue care. Though, initially these fixators are expensive, but on a long run they are cheap, as these can be repeatedly used without any compromise. Our patients are from the rural side, and the use of such a simple and effective external fixator is necessary in order to reduce the economic burden and to obtain the maximum benefit.

## Material and Methods

Present study was conducted at Orthopaedics Department of Indira Gandhi Institute of Medical Sciences, Patna, Bihar from May 2015 to April 2016. Twenty-five cases of open fractures of both bones of leg were selected, treated and followed up. Both male and female patients were included under the study, most common causes were of road traffic accidents. Maximum number of patients was between 20 and 40 years. Patients were initially seen in casualty. Thorough examination was done to rule out other systemic injury like head injury, cardiorespiratory and abdominal status. Patients with hypovolaemic shock were treated with IV fluids like plasma expanders, dextrose, normal saline, ringer lactate solution. Immediate intravenous antibiotics and intramuscular tetanustoxoid, tetanus immunoglobulin was given. Meanwhile airway and breathing was maintained. If needed, according to severity of soft tissue damage and degree of contamination, patients were given anti gas gangrene serum, 5,000-10,000 IU infusion in dextrose after test dose within 24 hours.

Once the patient is hemodynamically stabilized, clinical evaluation and primary wound debridement was done in OT under anaesthesia. Wounds were graded according to Gustilo Anderson's classification as Type 1, 2, 3A, 3B and 3C based on the size of wound, degree of soft tissue injury, level

of contamination, degree of bony injury and presence or absence of neurovascular injury. In our study type II and type IIIA and type IIIB were common. Wound debridement was done under spinal anaesthesia, 5 to 6 litre of normal saline, betadine and hydrogen peroxide were used. Antiseptic solution irrigation for washing wound is used. For type II and type IIIA and IIIB fractures, thorough wound debridement was done and shifted to radiology department for X-ray evaluation. In our series, compound lower one-third fracture both bones of leg were more common. Slightly common on right side than the left leg. In our series, segmental fractures were seen in 2 cases and comminuted compound fracture in 4 cases. Butterfly fragment in 5 cases and oblique fracture in 3 cases and transverse fracture in 11 cases. Application of LRS external fixator was carried out in major OT after investigations. Before the application of LRS external fixator, we have to know in which plane it has to be applied and why. The principle of applying instrumentation or implants is to apply at tensile force side. Whereas this instrumentation has to be applied only at compressive force side, that is medially or anteromedially because to nullify the compressive force of the muscles which are present at posterolaterally which is the side of tensile force.

**Figure 1: Knee extension and dorsiflexion after LRS removed**

**Figure 2: Knee flexion after LRS removed**

## Results

A study of 25 cases of open tibia fractures managed with LRS (limb reconstructive system) external fixator has been presented. Preview of literature about external fixator in open fractures of tibia as primary fixation has been presented. Open fractures are slightly predominating in the age group between 20-40 years of age. Open fracture of tibia is common among males(72%).Road traffic accidents are common cause. Most of the fractures were type II (52%) and rest are type III(48%). More common in the lower 1/3$^{rd}$ of leg. More often associated fibula fracture was present. All patients were initially seen in casualty, examination was done to exclude, head injury, other vital organ injury and cardiorespiratory function. Patients with hypovolaemic shock treated with IV fluids like

plasma expanders, dextrose, normal saline and ringer lactate solution.

Immediate intravenous antibiotics and intramuscular tetanus toxin, antigas gangrene serum and tetanus immunoglobulin were given within 24hours.Patient is hemodynamically stabilized and immediate wound debridement and fracture stabilization was carried out in minor OT. Fracture was fixed with LRS external fixator in major OT as early as possible. Static quadriceps exercise was begin during immediate postoperative period. Knee and ankle motion was allowed 4 weeks from the operative day. Secondary procedures like soft tissue repair, skin grafting, bone grafting, proximal corticotomy and lengthening was done according to the individual needs at a later period. Cycles of compression and distraction of the fracture site to promote fracture healing was started 1 week after the surgery at a rate of 1 mm of compression or distraction per week alternatively. Partial weight bearing was allowed in non-comminuted fractures 4-6 weeks later. In case of comminuted fractures 8-10 weeks after the surgery. Full weight bearing was allowed when there was radiological evidence of union. The aim of the management was to prevent amputation, osteomyelitis and to restore the function of the limb as near to normal limb.

## Discussion

Open fractures of tibia are very common in this modern world because of high velocity road traffic accidents. Although newer and better treatment approaches for the management of open fractures are available, open fractures remain to be one of the important challenges in orthopaedic trauma. Because the study has been done in a tertiary care centre, a lot of compound fractures were encountered. According to Behrens and Searls [2], every year two cases out of 1000 injuries were compound tibial fractures and this rate was even greater than 0.2% in developing countries. The various modalities of treatment available for tibial compound fractures are minimal osteosynthesis, biological fixation and internal fixation with intramedullary nailing or external fixation with different types of fixators. Irrespective of which treatment method is used, the aim of the surgery should be to obtain maximum functionality to the fractured extremity and to maintain patient's life quality with minimum damage or complication [3-5].

Use of external fixators in comminuted, defective, and contaminated open fractures like Gustilo-Anderson types IIIB and IIIC open fractures, is routinely accepted these days [6,7]. According to Yokoyama K, treatment of grade IIIB and IIIC with intramedullary nailing was risky as it lead to deep infection and nonunion in 20.3% cases [8]. Therefore, external fixators are preferred modality because they are easy to use and allow soft tissue treatment. But the problems associated are prolonged immobilization and need for revision surgery for definitive fixation at a later stage.

Therefore, LRS, which is different from the simple external fixators in allowing full weight bearing immediate postoperatively like an intramedullary fixation was used. LRS fixation technique also has an added advantage of salvaging the limb and preventing amputation. On other side, it has its own complications like pin loosening and pin tract infection. In this case series of 54 cases, pin loosening was noted and pin replacement was required only in 1.85% cases and moreover, in 92.59% cases, complete union was achieved within 8 months. The complications of nailing or fixators with acute docking are shortening, soft tissue healing problems, increased morbidity, multiple surgeries, prolonged hospital stay and its consequences like deep vein thrombosis, bedsores, nosocomial infection which eventually leads to increased chances of mal union and non-union and increased financial burden [9]. In a study conducted by Edward in 1988, Grade III open tibial fractures were treated with external fixator, where in 93% of the fractures united well and 89% patients had satisfactory clinical function16. Even in patients treated with secondary nailing after primary external fixator or after delayed primary nailing there are more chances of infection10. The cause for infection was thought to be poor nutritional status, nosocomial infection and patient's inability to afford costly antibiotics. In the series by Bhandari et al. [2]Illizarov ring fixator is a good modality of treatment but is cumbersome for the patient and difficult to master by the surgeon as compared to LRS. According to a study done by Ajmera et al., LRS proved to be an effective modality of treatment in cases of open fractures tibia with bone loss as definite modality of treatment for damage control as well as for achieving union and lengthening [11].

LRS fixator provides immediate stability to fracture fragments and allows immediate weight bearing which ultimately promotes early fracture healing and reduced financial burden.

## Conclusion

Open fractures of tibia are quite common because of its subcutaneous location, high energy trauma, which are quite often encountered during high speed moving vehicles, especially with high vehicular congestion in our country due to increased number of vehicles, poor quality of infrastructure, poor maintenance of vehicles, rashness and negligent driving by youth.

Open tibia fractures are commonly seen in adult males between the ages of 20-40 years of age group

due to their higher level of activity. Patients with Gustilo-Anderson Type I and Type III open tibial fractures should be initially treated with irrigation, serial debridement, and antibiotic therapy, adequate fixation with external fixator (LRS) and with sufficient viable soft tissue coverage. External fixators are the choice of fixation in open fracture of tibia especially in comminuted and severe Gustilo-Anderson type III injury, as there were good to moderate results in our series by using LRS type of external fixator. Moreover in 96% of cases the fracture has united and one patient needed bone graft because of delayed union. Infection is effectively controlled by proper primary wound debridement within 24 hours and fracture fixation with LRS type of external fixator. LRS external fixation with the complexity of frame configuration provide good fixation. Soft tissue procedures like skin grafting, myocutaneous, muscle pedicle flap and cross leg flap repair can be easily accompanied with external fixator in position. Resection of devitalized bone, simultaneous compression of the fracture gap or site and secondary limb lengthening by proximal corticotomy and compression and distraction techniques can be accompanied with the LRS external fixator with low rates of infection and non-union. In the distal third tibia, due to its subcutaneous location and sparse blood supply and poor muscle coverage, fracture healing is difficult and in such cases external fixator is quite useful. Complications are minimal, with good range of movements at knee and ankle. It is not cumbersome like Iliazarov and easily maintains ableex-fixator. LRS external fixation technique is often successful in salvaging limbs which otherwise would have been at high risk foramputation.

## References


1. Whittle AP. Wood II GW. Fractures of lower extremity. Canale ST. Campbell's operative orthopaedics. 10th ed. Philadelphia. 2003; 2:754-73.
2. Behrens F. External fixation. 3rd ed. In: Manual of internal fixation, Muller ME, Allgower M, Schneider R, Willinegger H, eds. Berlin: Springer-Verlag; 1999,367-78.
3. Tucker HL, Kendra JC, Kinnebrew TE. Management of unstable open and closed tibial fractures using the Ilizarov method. Clinical orthopaedics and related research. 1992: 1(280): 125-35.
4. Bone LA, Stegemann PH, McNamara KE, Seibel RO. External fixation of severely comminuted and open tibial pilon fractures. Clinical orthopaedics and related research. 1993; 1(292):101-7.
5. Tornetta P, Bergman M, Watnik N. Treatment of grade IIIB open tibial fractures. J Bone Joint Surg 1994;76-B:13.
6. Hessmann M, Mattens M, Rumbaut J. Use of the unilateral external fixator (monofixator) in fracture treatment: experience in 50 fractures. Der Unfallchirurg. 1994;97(10):511-7.
7. Shaw DL, Lawton JO. External fixation for tibial fractures: clinical results and cost effectiveness. Journal of the Royal College of Surgeons of Edinburgh. 1995;40(5):344-6.
8. Checketts RG, Moran CG, Jennings AG. 134 tibial shaft fractures managed with the Dynamic Axial Fixator. Acta Orthopaedica Scandinavica. 1995;66(3):271-4.
9. Tu YK, Lin CH, Su JI, Hsu DT, Chen RJ. Unreamed interlocking nail versus external fixator for open type III tibia fractures. Journal of Trauma and Acute Care Surgery. 1995;39(2):361-7.
10. Edwards CC, Simmons SC, Browner BD, Weigel MC. Severe open tibial fractures. Results treating 202 injuries with external fixation. Clinical orthopaedics and related research. 1988;1(230):98-115.
11. Helland P, Bøe A, Mølster AO, Solheim E, Hordvik M. Open tibial fractures treated with the Ex-fi-re external fixation system. Clinical Orthopaedics and Related Research®. 1996; 326:209-20.