

Original article

Management of open fracture shaft of tibia with Ilizarov external fixator

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Abstract

Background: The aim of this study was to evaluate the outcome of application of Ilizarov external fixator (IRF) in the management of open fracture shaft of tibia. **Methodology:** It was a prospective multicenter observational study which was carried out between June 2018 and December 2022. 36 patients with open fracture shaft of tibia with and without infections reported in outpatient department were included in the study. Both radiological and clinical evaluation was done. Skeletal, and functional results were obtained by using Association for the Study and Application of Methods of Ilizarov (ASAMI) scoring system. **Results:** Thirty-six patients with open fracture shaft of tibia were managed by IRF. Out of them, 21(58.3%) were male and 15(41.6%) were female. 26(72.2%) patients had age below 40 years, 8(22.2%) were between 40 to 60 years and 2(5.5%) were above 60 years of age. 4(11.1%) of them had Gustilo II, 19(52.7%) had Gustilo IIIA, 11(30.5%) had Gustilo IIIB and 2(5.5%) had Gustilo IIIC fractures, respectively. 17(47.2%) patients needed soft tissue coverage, among them split thickness skin grafting was done in 5(13.8%) cases and flap coverage was needed for 12(33.3%) patients. Fracture was successfully united in every patient. The average time for successful union was 6.3 months (4-9 months). The average duration for frame removal was at 6 months (5-10 months). Results were made by the ASAMI scoring system and in our study bone results were excellent in 29, good in 5, fair in 2 and no poor. Functional results were excellent in 30, good in 5, fair in 1 and no poor. Most frequently occurring complication was pin track infection. Other complications were loosening of the frame, breakage of Ilizarov wires, poor quality of bone regenerate. In our study, no major complication occurred. **Conclusion:** Ilizarov ring fixator is an excellent choice of treatment for open fracture of tibia regarding the management of bone loss, eradication of infection, limb-length equalization and limb function.

Keywords: Ilizarov; Open fracture; Tibia; ASAMI, IRF

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Introduction:

Tibial fractures are the most common long bone fractures, with around 25% being open fractures. The majority of open comminuted diaphysealtibial fractures result from high velocity trauma such as road traffic accidents and falls from height. Management of open diaphysealtibial shaft fractures can be comminuted due to lack of soft tissue coverage and blood supply of the tibialshaft. Prognosis depends on displacement, comminution, and soft tissue injury. Advanced bone reconstruction and soft tissue coverage is required to poses bone and soft tissue healing. Fracture shaft of tibia occurs very frequently and open fracture occurs most commonly in tibia. For fracture of tibia high energy trauma is required like road accident or fall from height etc.¹⁻⁴ Open fracture shaft of tibia frequently associated with many complications, like malunion, non-union, infection, soft tissue injury etc.⁵⁻⁹ Infected open fracture is very difficult and challenging problem to treat. The incidence of nonunion in closed tibial fractures is 2.5%, and it increases many times for open fractures with contaminated wound and severe soft-tissue loss and infection. Due to various local problems, such as bone deformity, bone loss, and prior implant failure treatment of open fracture of tibia become very difficult.^{10,11} Ilizarov technique is a popular method of management of open fracture of long bone. This method involves extensive debridement of the operative site, covering the fracture site as early as possible the stabilization of the fracture site with percutaneous wires and Ilizarov frame construct.^{10,12,13} Ilizarov external fixator (IRF) allows compression, distraction, lengthening and deformity correction. Immediate weight bearing is possible after IRF and joints mobilization of proximal and distal joints also possible. Corticotomy and bone transport is possible for bone defects. Extensive wound debridement helps to control the bone infection.^{10,12,13,14} The aim of our study was to evaluate the outcome of management of open fracture shaft of tibia by Ilizarov technique.

Materials and methods

Study design& sites: The study was prospective observational study which was carried out at Bashundhara Ad-din Medical College Hospital, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) and few private clinics in Dhaka between June 2018 and December 2022.

Study population

With open fracture shaft of tibia, a total number of 36 patients reported in outpatient department were included in the study. Both the infected and noninfected cases were included in the study.

Ethics statement

The study was approved by the ethics committee of the respective hospitals.

Patient management

Initially all patients were managed by thorough surgical toileting, wound debridement and broad-spectrum antibiotic was given. Immobilization was done by uniaxial external fixator or by long leg back slab. Open wounds were closed by split thickness skin grafting or flap coverage.

After primary management, adequate soft tissue coverage of exposed bones was done. For all cases surgery were done under spinal anaesthesia. Initially Ilizarov frame was built according to the radiological findings and per operative assessment. Taking best possible care of soft tissues incision was made in suitable site and all dead and devitalized tissues was removed extensively, freshening of fracture ends done and bleeding was seen from bone ends. Then the frame was fixed with 1.8mm Ilizarov wires and for more stability Olive wires were used when needed. After refreshing and debridement if gap at fracture site was found less than 4 cm primary docking was done and we started distraction of 1mm per day at corticotomy site from 7th postoperative day.¹⁵ And if gap at fracture site was found more than 4 cm primary docking was not done and compression at fracture site and distraction at corticotomy site was started from 7th postoperative day. We did Corticotomy in all cases where shortening was more than 2cm. Upper tibial Corticotomy was done in 22 cases. With fracture of tibia, fibula was fractured in most of the cases. In some cases, fibula was fractured in such a way that it may complicate the tibial union. In those cases, partial Fibulectomy were done, otherwise they were left alone. distal neurovascular status was checked after surgery and limb was kept elevated during post-operative days. On the first postoperative day, a check x-ray was performed. Frame stability, pins sites were checked and dressing done on the first or second postoperative day. When pain permits, we advise the patient to do exercise at adjacent joints. With the help of axillary crutches, the patient started bear weight from the second postoperative day. Every patient was followed up by regular radiographs at appropriate times to access union, alignment of bone fragments and/or development of any angular deformity.¹⁰ Pin track infection was the commonest complication. Other complications were loosening of the frame, breakage of Ilizarov wires, and poor quality of bone regenerate.

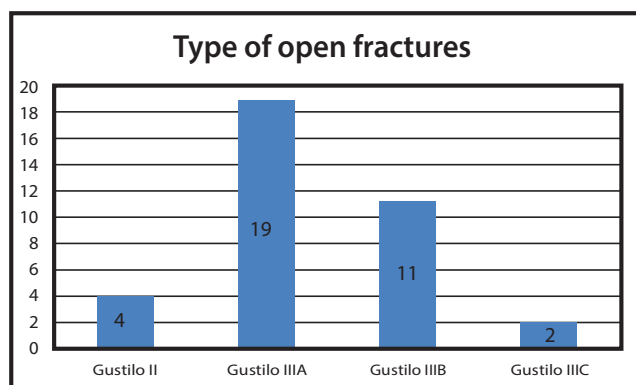


Figure 1. Distribution of patients according to types of open fractures

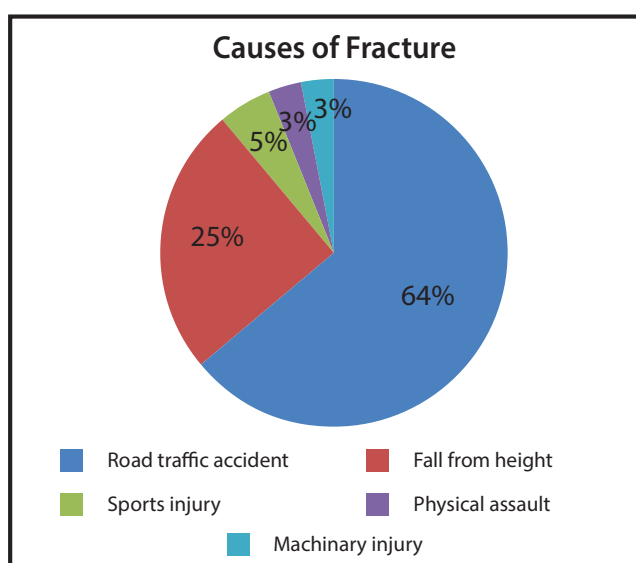


Figure 2. Distribution of patients according to cause of injury

Table 1: Association for the Study and Application of the Methods of Ilizarov scoring system

ASAMI scoring systems	Description	Score
Bone results		
Excellent	Union, no infection, deformity $<7^\circ$, limb-length discrepancy <2.5 cm	29
Good	Union + any two of the following: Absence of infection, $<7^\circ$ deformity, and limb-length inequality of <2.5 cm	5
Fair	Union + any one of the following: Absence of infection, $<7^\circ$ deformity, and limb-length inequality of <2.5 cm	2
Poor	Nonunion/re-fracture/union + infection + deformity $>7^\circ$ + limb-length inequality >2.5 cm	0
Functional results		
Excellent	Active, no limp, minimum stiffness (loss of $<15^\circ$ knee extension/ $<15^\circ$ dorsiflexion of ankle), no RSD, insignificant pain	29
Good	Active, no limp, minimum stiffness (loss of $<15^\circ$ knee extension/ $<15^\circ$ dorsiflexion of ankle), no RSD, insignificant pain	5
Fair	Active, with three or all of the following limb, stiffness, RSD, significant pain	2
Poor	Inactive (unemployment or inability to return to daily activities because of injury)	0
Failures	Amputation	

ASAMI –Association for the Study and Application of Methods of Ilizarov; RSD – Reflex sympathetic dystrophy

Result:

Thirty-six patients with open fracture shaft of tibia were included. For follow-up patients came to the hospital regularly. The mean follow-up period was 22.5 months (6-37 months). Out of 36 patients, 21(58.3%) were male and 15(41.6%) were female. 26(72.2%) patients had age below 40 years, 8(22.2%) were between 40 to 60 years and 2(5.5%) were above 60 years of age. Out of 36 cases, right sided tibia fracture was on 25(69.4%) cases and left sided tibia fracture was on 11(30.5%) cases. Primarily all patients had open fracture of tibia, among them 4(11.1%) had Gustilo II, 19(52.7%) had Gustilo IIIA, 11(30.5%) had Gustilo IIIB and 2(5.5%) had Gustilo IIIC fractures, respectively (Fig 1).

Out of 36 patients, road traffic accident was 23(63.8%), 9(25%) had history of fall from height, 2(5.5%) had sports injury, 1(2.7%) had history of physical assault and 1(2.7%) had history of machinery injury (Fig 2).

Out of 36 patients, 25(69.4%) were initially managed by uniaxial external fixator and 11(30.5%) were managed by long leg back slab and then Ilizarov external fixator was applied. In our study, 17(47.2%) patients needed soft tissue coverage, among them split thickness skin grafting was done in 5(13.8%) cases and flap coverage was needed for 12(33.3%) cases. From starting, the primary management to application of IRF mean interval was 5 weeks. Fracture was united in every case. The mean time for successful union was 6.3 months (4-9 months). The average duration for frame removal was at 6 months (5-10 months). Clinical follow-up results were evaluated according to the ASAMI protocol. Bony unions were achieved in all cases of our study. Bone results were excellent in 29, good in 5, fair in 2 and no poor case. Functional results were excellent in 30 cases, good in 5, fair in 1 and no poor case (Table 1).

Discussion:

The incidence of open fracture shaft of tibia is increasing rapidly and now very common in outpatient and emergency departments. This injury in many cases are associated with soft tissue loss, shortening or deformity of the limb and most dangerously associated with

infection.^[16,17] For a trauma surgeon, management of a case of open fracture of shaft of tibia is still now very challenging.^[18] Inter fixation gives very poor outcome in management of open fractures but IRF gives better outcome. That is why IRF has gained popularity. In cases of shortening of the limb, a unifocal or bifocal corticotomy can be done. After 7 days distraction started at the corticotomy site and compression was given at fracture site. This is called tension stress effect and this is the principle of Ilizarov ring fixation.^[19]

In our study, the overall union rate was 100% which is similar to the union rates reported in four other series.^[20-22] Bone results were excellent in 29(80.5%), good in 5(13.8%), fair in 2(5.5%) and no poor case. Functional results were excellent in 30(83.3%), good in 5(13.8%), fair in 1(2.7%) and no poor case. In every case we tried to preserve the blood supply of bone and meticulous soft tissue dissection was done always. These may be the causes of our higher union rate.^[13] With IRF, fixator modification was possible anytime, if necessary. This may also help in fracture union. Various deformity, like angulation, shortening can be corrected during the course of treatment with IRF. In case of delayed union accordion maneuver can be applied which stimulates callus formation by cyclic compression-distraction.^[23,24]

Open fracture of tibia has some serious complications, like osteomyelitis, amputation etc. In our study, we have shown that these major complications can be minimized with application of IRF. Other complications, like superficial infection, pin-site infection (23%) were minimum in our study which was comparable with other studies.^[25] Oral antibiotics were given for this type of infection. Actually, this type infection should be considered as problem of open fracture, not a true complication.^[26]

In every case, full weight bearing walking started from second or third postoperative day after removal of drain tube and check dressing. But still the Ilizarov frame have some troublesomeness, like as clothing difficulty and positioning problem during rest and sleeping.^[26]

Conclusion:

Management of open fracture tibia has high complication risks because it is high energy trauma and often associated with severe soft tissue loss. To avoid infection wound debridement should be done very accurately and proper antibiotic should be given for optimum duration. During application of IRF principles of Ilizarov technique should be followed properly. Adequate tension should be given in wires and frame should be aligned properly with the leg to give adequate space for swelling. If corticotomy was done, distraction usually started after 7 days of corticotomy at the rate of 0.25 mm per 6 h. Patient should be under regular follow-up to find out any developing complication, so that management of complication will be less difficult. IRF is an outstanding treatment option for open fracture of tibia regarding the management of bone loss, control of infection, limb-length equalization and functional improvement of limb.

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