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Ilizarov fixation: As a treatment modality of complex tibial diaphyseal fractures

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Abstract
Introduction: Treating difficult non-unions with the Ilizarov technique has been the gold standard method for the last few decades. Here we have used Ilizarov for treating complex tibial fractures. The temporary management of compound fractures of the tibial diaphysis is commonly done with provisional external fixators which is followed by internal fixation. Ilizarov can also be used as a definitive fixation method besides it is more superior and can be the primary and definite choice of fixation where expertise is available.
Materials and Methods: This was a prospective study conducted between august 2020 to august 2021 were 30 patients participated. Patients with complex tibial shaft fractures willing for regular follow up and surgical procedure were part of this study. All 30 0articipants were assessed for fracture union radiological and clinically using ASAMI functional and radiological score. The patients were evaluated at regular intervals until fracture union is observed.
Results: From total of 30 patients 90% (26 patients) of fracture healed after Ilizarov ring fixation. The frame removed on an average of 177 days from the point of original injury. The healing time of closed fractures was a mean of 164 days. The open fracture healed in a mean time of 212 days. We encountered non-union in 4 patients after primary fixation. All the 4 cases were high velocity injury, classified under 42C2 or 42C3. All the 4 cases were open fractures.
Conclusion: Ilizarov ring fixation is a versatile management option for the management of complex tibial diaphyseal fracture which also helps to manage and correct limb length discrepancies, correction of deformity in sagittal and coronal plane, along with managing fracture with bone gap and bone loss.

Keywords: Ilizarov, complex tibia fracture, fracture union, union time

Introduction
Tibial shaft fracture are common injury and management of open tibial fracture still continues to be a challenge for the orthopedic surgeons [1]. Road traffic accidents, falls, contact sports and high velocity motor vehicle accidents includes the mode of injury for diaphyseal tibial fractures and can cause multi-fragmentary fracture [2]. Treating difficult non-unions with the Ilizarov technique has been the gold standard method for the last few decades [3, 4]. Here we have used Ilizarov in the definitive care of complex tibial diaphyseal fractures. The temporary management of open fractures of the tibial shaft is commonly done with external fixators which is followed by internal fixation [5]. This can also be used as a definitive method of fixation [6]. Ilizarov is more superior and can be the primary and definite option where expertise is available. Non-union can be due to numerous factors such as soft tissue loss, velocity of injury, fracture reduction methods [7]. This study was performed to evaluate clinical and radiological parameters following management of complex tibial diaphyseal fractures.

Materials and Methods
This was a prospective study performed between august 2020 to august 2021 among the participants. The data was collected over a period of 1 year with 30 patients diagnosed with complex tibial shaft fractures. All surgeries were performed by same surgeon using same surgical technique and same company implants. Inclusion criteria includes- Skeletally mature patients, patients fit for surgery, open injury.

Exclusion criteria includes- Skeletally immature patients, patients not fit for surgery, patients not willing for follow-up.
The series comprised 22 male and 8 female patients with a mean age of 44 years (23 to 68); 8 patients had associated injuries requiring surgery, including neuro-surgery, laparotomy and fixation of other bones. The mechanisms of injury included a road traffic accident in 19 patients (50%), falls in 4 (25%), sports injuries in 2 (15%), work related accidents in three (8%) and assault in 2 (2%). The fractures were open in 11 patients. These were graded according to Gustilo and Anderson as 3A in 3 patients and 3B in 8. A free flap or split-thickness skin graft was not required in any patients. The time from date of injury to application of the Ilizarov frame was a mean of 8 days (0 to 35). The fractures were classified by the OA/OTA system as:42B1 in 1 patient, 42B3 in 2 patients, 42C1 in 8 patients, 42C2 in 9 patients and 42C3 in 10 patients.
All the patients were initially stabilized with splints, ice packs application and limb elevation. All the cases were treated by direct definitive management, staged procedures were not included in the study. The open wound was debrided and closure was achieved.
This procedure was performed under spinal anesthesia with antibiotic cover. The patient was placed on radiolucent table. C-arm used in all procedures for optimum wire placement Since these group of patients are more prone for developing compartment syndrome, nerve block and tourniquet not given. Percutaneous method of fracture reduction was employed and A 4 ring ilizarov assembly which was pre-fabricated was applied, it consists of 2 rings proximally and 2 ring distally. Two 1.8mm wire was used for each ring and was tensioned manually. Each ring was connected using 4 rods in order to obtain more stable ring construct. Corticotomy was done proximally. Post-operatively after latency period of 1-week distraction started at corticotomy site by instructing the patient to do 4 quarter turns amounting to 0.2mm/turn which is equivalent to 1mm per day. Distraction continued until equalization of limb length achieved.
Post Post-operatively 2 doses of i.v antibiotics were given. Full weight bearing walking was initiated in the immediate post-operative period along with active mobilization with knee and ankle. Patients were taught regarding importance of pin tract care and was instructed to perform with themselves and with attenders help as we believe that it helps in decreasing pin tract infection. Statistical analysis was performed with the collected data using SPSS 11. A p-value of less than 0.05% was considered to be statistically significance.

Results

Total of 30 patients were included in this study. Out of 30 participants, 23 were male and 7 females. 16 patients had fracture in right limb and 14 patients had fracture in left limb. Mechanism of injury was RTA in more than 50%. Followed by fall from height was the cause of injury. 8 patients had associated injuries most of them are due to RTA. 4 patients had associate head injury, humerus fracture and olecranon fracture were seen in 1 patient, distal radius fracture in 2 patients. From total of 30 patients 26 patients (90%) the fracture healed following Ilizarov application. The overall time to union from the date of injury to removal of frame was a mean of 177 days. Closed fracture healed in a mean time of 164 days. The open fracture healed in a mean time of 212 days. A total of 4 patients did not heal after the first Ilizarov frame. All the 4 cases were high velocity injury, classified under 42C2 or 42C3. All the 4 cases were open fracture. The site of nonunion were proximal in 2 patients and distal in 2 patients. Complications such as pin tract infection also was noticed among 15 patients (Figure 1).

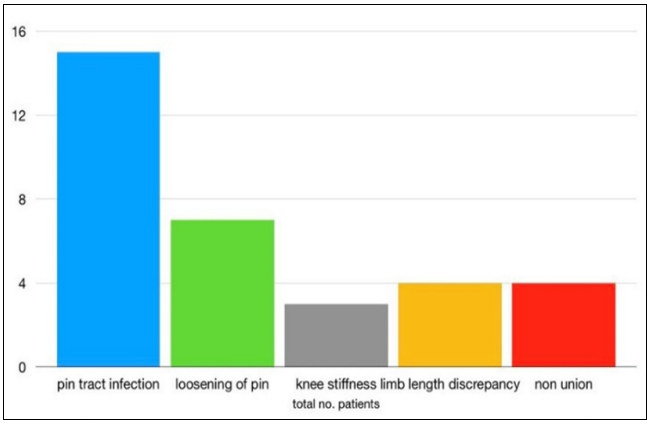

Fig 1: Complications in our study

Mode of injury of all these patients being RTA with high velocity injury. 5 patients had open injury classified under Gustilo grade 3A and 3B. Fig 3 shows Bone results using the ASAMI scoring system, showed Excellent for 16 patients, good outcome for 5 patients, fair outcome for 5 patients and poor outcome for 4 patients. Functional results using ASAMI scoring system showed Excellent outcome for 3, good outcome for 15 patients, fair outcome for 8 patients and poor outcome for 4 patients (Figure 2 & 3).

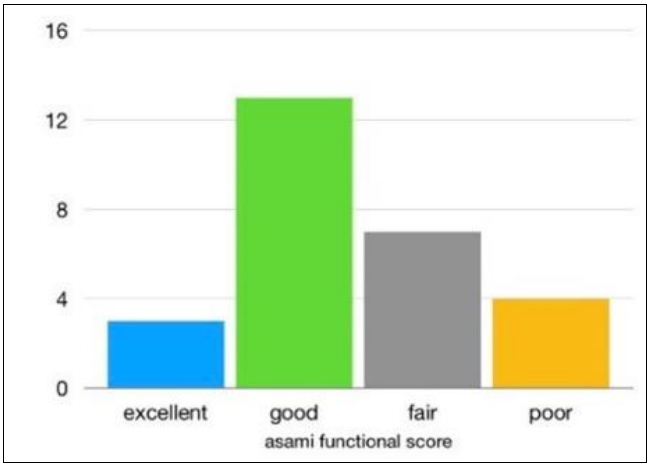

Fig 2: Outcome from study

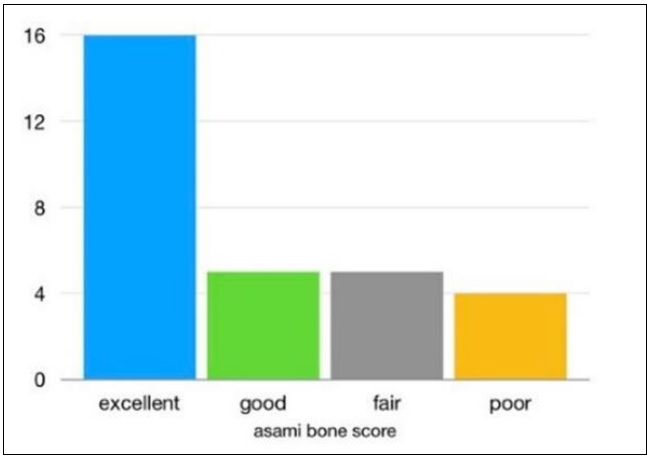

Fig 3: Outcome from the study

We did not lose any of the patients in this study to follow up (Table 1).

Discussion

Among open fractures involving long bones, complex tibial diaphyseal fractures are most commonly seen. The tibial diaphysis lies subcutaneous with inadequate layer of soft tissue surrounding it, along with a blood supply which is precarious as compared to other long bones. Making it more susceptible to infections and non-union [7, 8]. The fracture to be addressed are compound diaphyseal fracture of tibia, preservation of blood supply in order to avoid devascularizing the bone as well as to reduce the incidence of infection which are commonly seen with these type of injuries [9, 10]. Ilizarov associated with less complication in these fracture as opposed to other treatment modalities [11, 12]. The pin-site infection is said to be the most common complication. The pin site infection in this case series is comparably low rates (50%) and were successfully treated with oral antibiotic in outpatient basis. In our study, there were four nonunion. Time to union was a mean 164 days, for closed fractures and mean 212 days for open fractures, calculated from date of injury to removal of the frame. The rate of bone union was satisfactory compared to the similarity in the functional scores between the open and closed group showed satisfactory results. Similarly, Muhammad Atif *et al*., suggested that ring fixators are better in managing the complex tibial diaphyseal fractures in terms of better union rate and less complications [13]. In contrast Chandra Prakash *et al*., suggested that Limb reconstruction system fixators showed better results that ilizarov fixator [14]. The effect of fracture stabilization and subsequent reconstruction of injured limb by using ring. Unless there was a separate ipsilateral injury providing a contraindication, all patients were allowed to bear full weight throughout treatment with the Ilizarov frame in place. However, it is appreciated that the Ilizarov frame can cause physical inconvenience such as difficulty with clothing and sleeping. ASAMI functional and ASAMI bone score was used in evaluating the outcome of this study, which also showed satisfactory results.

Conclusion

Ilizarov ring fixation is a versatile management option for the management of complex tibial diaphyseal fracture which also helps to manage and correct limb length discrepancies, correction of deformity in sagittal and coronal plane, along with managing fracture with bone gap and bone loss.

Conflict of Interest

Not available

Financial Support

Not available

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