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AN EVALUATION OF ILIZAROV TECHNIQUE IN TREATING PATIENTS WITH OPEN FRACTURES OF TIBIA

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ABSTRACT

ORIGINAL RESEARCH ARTICLE

Introduction: Open fracture of the tibia is a very common incidence in the orthopedic treatment arena. Ilizarov method is a popular method of treating open fractures of the tibia after debridement and open reduction. It is comparatively a newer method in Bangladesh and has many advantages. We have very little research-oriented data regarding the effectiveness of this technique in treating open fractures of the tibia.
Aim of the study: The aim of this study was to evaluate the Ilizarov technique in the treatment of open fractures of the tibia.
Methods: This was a prospective observational study which was conducted in the Department of Orthopedics, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh during the period from January 2019 to December 2019. In total 27 patients with open tibial fractures were selected as the study population. Before starting the intervention, the written consents of the participant were taken and this study was approved by the ethical committee of the mentioned hospital. All data were processed, analyzed, and disseminated by MS Office and SPSS program as per need.
Results: According to the Karlstrom and Olerud criteria outcomes were assessed. Among total participants, the majority portion got 'excellent' results which were in 66.67%. Then 22.22%, 7.41%, and 3.70% participants got 'Good', 'Fair' and 'Poor' results respectively. As postoperative complications, local pain with motion and local edema was seen in 3 cases and painful tenting of skin in 5 cases. Delayed complications included pin tract infection in 6 patients, loss of 80 ankle dorsiflexion in 2 cases, shortening of 1 cm was seen in 1 case, 2 cases (5%) of united in 70 recurvatum as calculated radiologically, 2 cases of

muscle wasting of the leg from 0.4 to 1.5 cm were found. No case developed deep infection, non-union or unacceptable malunion. Only one patient got 2 weeks more treatment than all the others patients.

Conclusion: In this current study, no case developed a deep infection, non-union, or unacceptable mal-union. The Ilizarov device is used worldwide for the treatment of several types of fractures. Low blood loss, prompt healing and minimum complications may be considered as some good features of Illizarov technic for the treatment of open fracture of tibia.

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I INTRODUCTION

Open fracture of the tibia is a very common incidence in the orthopedic treatment arena. Ilizarov method is a popular method of treating open fractures of tibia after debridement and open reduction. It is comparatively a newer method in Bangladesh and has many advantages. We have very little research-oriented data regarding the effectiveness of this technique in treating open fractures of the tibia. Tibial fractures are the most common long bone fractures in the body[1]. Open fractures are common in this bone especially in the middle third of its length.[2] Treatment of open tibial fractures is very common but the treatment of open tibial fractures has controversy among orthopedic surgeons.[3] Currently, non-surgical procedures like using casts, braces or interventional attempts like inserting of the plate, intramedullary nailing, and external fixators are used for the treatment of open tibial fractures.[4] Selection of any of all the methods are related with the surgeon's decision and the economic status of the patients. In North America, most surgeons do ream nailing for the treatment of open or closed tibial fractures.[4] In developing countries because of low facilities and lack of medical instruments, the selection of each method may differ.[5] Recently, external fixators like Ilizarov or AO external fixators are used extensively in developing countries but the rates of mal-union and infection are relatively high.[6] With AO external fixator, the efficacy of treatment in two studies were reported to be 20-31%.[7] Open fractures are classified into three major categories, depending on the mechanism of injury, soft tissue damage, and degree of skeletal involvement.[8] Type I open fracture is characterized by a puncture wound around 1cm or less in diameter and is relatively clean in condition. Type II open fracture has laceration more than 1 cm long and less than 10 cm, without extensive soft tissue, flaps, or avulsion, with a minimal to the moderate crushing component. The fracture is usually with minimal comminution. Besides these, type III open fracture involves extensive damage to the soft tissue, including muscles, skin and neurovascular structures. The type III open fractures are further divided into three subtypes. Type IIIA indicates open fracture with adequate soft-tissue coverage of a fractured bone despite extensive soft tissue laceration or flaps, or high-energy trauma (gunshot and farm injuries) regardless of the size of the wound[9]. Type IIIB indicates open fracture with extensive soft-tissue loss and periosteal stripping and bone damage. Usually associated with massive contamination[10] which will often need further soft-tissue coverage procedure. On the other hand, Type IIIC indicates open fracture associated with an arterial injury requiring repair, irrespective of the degree of soft-tissue injury. Different methods for the treatment of open fracture shaft tibia (after debridement & open reduction) include POP cast immobilization, external fixation, open reduction and plating, locked intramedullary nailing. According to

Trafton[11], complications include deep infection, acute or chronic osteitis or osteomyelitis, delayed union, non-union, mal-union, loss of alignment in cast or brace, fixation problems. Gavril A Ilizarov, a Russian physician, devised this method of treatment of open fractures of the tibia. The Ilizarov ring supports transfixion K-wire or haft pins, which can be fixed at the many holes site on the 360-degree ring. It has two or more connected rings that form a frame of the apparatus. The rings bear a supplementary part of the frame necessary for dynamic bone treatment. They are elastic types of external fixators and allow axial micro-motion that is conducive to the healing of fractures and regenerate. Forces acting in the circular fixator are in a plane. It is a multilevel and multi-planner fixator. The circumferential rings of Ilizarov distribute stresses more evenly across the fracture or osteotomy sites. Therefore, three-dimensional corrections become possible. Axial distraction or compression angular and translational corrections are all possible using gradual mechanical techniques. On the other hand, a circular fixator is a stable and elastic fixator. These types of fixators allow immediate weight-bearing and function. As the wires are thin, the holes are small. Circular fixators can have the capacity for three-dimensional corrections. The Ilizarov devices can control shear at the fracture site while allowing axial and bending flexibilities producing an ideal environment for bone healing. Wire stoppers add shear rigidity to the system. Circular fixators are better for patients with osteoporosis using wire.

II OBJECTIVES

a) General objective:

- To evaluate the Ilizarov technique in treating patients with open fractures of the tibia.

b) Specific Objectives:

- To assess the demographic status of participants.
- To assess the clinical presentation of patients.
- To assess the mode of injury for open tibial fractures among participants.
- To assess the outcomes among participants.

III METHODOLOGY & MATERIALS

This was a prospective observational study which was conducted in the Department of Orthopedics, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh during the period from January 2019 to December 2019. In total 27 patients with open tibial fractures were selected as the study population. Before starting the intervention, the written consents of the participant were taken and this study was approved by the ethical committee of the mentioned hospital. According to the exclusion criteria of this study, patients with closed fractures, pathological fractures, and type IIIC fractures were rejected. The fractures were assessed by AP and Lateral X-ray. Fractures were classified according to Gustilo's fracture classification of open fractures. Patients with compound tibial fractures were taken to the operating room for debridement as soon as possible. These fractures were managed provisionally in long leg posterior slab or long leg posterior cast with a window for dressing changes. Necessary fluids and electrolytes replacement or whole blood transfusion were given as per the requirement of each patient. Definitive treatment of fracture was done as a routine case usually in a week. Patients were operated under general or spinal anesthesia as per need. Pre-assembly of the frame was done one day before surgery. Distance between the rings was adjusted according to the fracture anatomy. Fracture with minimal comminution and length loss less than 1cm was usually managed with a four-ring frame, more complex fracture needed more number of rings. Wires were fixed to the rings with ring fixator bolt after tensioning up to 90-110 kg using a dynamometer. The rings were kept 2 finger breadths from skin all around. The

reduction was checked with a C-arm image intensifier on the table and adjustments done according to at the same setting. The pin track wounds were dressed by a povidone-iodine solution (10%) and covered with pad. Pin site was cleaned every day with spirit or povidone-iodine (10% solution). When clot and crust was present, a weak solution of hydrogen peroxide (H_2O_2) was applied to remove it. When the pin tract wound was inflamed or discharge was present, oral antibiotics were given. Partial weight-bearing with an axillary crutch was allowed as soon as the patient could tolerate the pain. The frame and wire were checked whenever the patients complained of pain, stability. The tension of the wire was checked and re-tensioning was done as per need. Check X-ray was taken on the first or second postoperative day and reduction was checked. Equinus deformity was prevented by active and passive movement of the ankle. If ankle movement was painful, the foot was supported with a slipper or boot cast tied to the last ring. The patients were followed up at an interval of 2 weeks for a minimum period of 8 weeks, thereafter every month for 3 months and subsequently 3 monthly till a period of 1 year. Check-radiographs were taken on the next day and then at 6th week, 12th week and 36th week. The patients were assessed clinically for the range of movement of the knee and ankle respectively, pain at the fracture site, anterior knee pain, ankle joint symptoms, infection, muscular atrophy, clinical union, difficulty in walking and performing daily routine. Frames were removed after the clinico-radiological union. At the end of the follow-up period, the results were grouped into excellent, good, fair and poor using the modified criteria of Karlstrom and Olerud[12].

IV RESULTS

In this observational study among total 27 participants, 59% were male and 41% were female. So male participants were dominating in in number. In analyzing the ages of the participants, we observed the highest number of patients were from 18-30 years age group which was 40.74%. Then 33.33% from 31-40 years age group, 14.81% from 41-50 years age group, 7.41% from 51-60 years age group and the rest 3.70% from >60 years' age group. According to the data the highest 48% of participants was with type II open fracture followed by 37% with type I open fracture and the rest 15% with type III-A open fracture. On the other hand, among total 27 participants, the highest 67% of patients had middle third location fractures followed by 22% who had a proximal location, and the rest 11% had distal location fractures. In analyzing the patterns of open fractures, we found the highest 48.15% patients had comminuted fracture followed by 22.22% had transverse, 14.81% had oblique, 11.11% had spiral and rest 3.70% had segmental open fractures. Among the total study population majority portion (56%) had right side open fracture whereas 43% had left side open fractures. In analyzing the mode of injuries, we observed, for most of the participants (n=22) RTA (road traffic accident) was the mode of injury. Besides this, for 4 patients fall from height and for only one patient sports injury was the mode of injury. The duration of treatment with the fixator was 12-23 weeks (average 16 weeks). Fifteen patients wore a PTB cast for an additional period of 4 weeks. In our study total of 27 cases were debrided on the same day and stabilized with Ilizarov ring fixator after a period of 5 to 12 days from the date of injury. The operation time ranged from 90 minutes to 120 minutes (Mean 102±5 minutes). The Ilizarov external fixator was withdrawn when there was a clinico-radiological union. The duration of treatment with the fixator ranged from 12 to 22 weeks (Mean 16±4 weeks). The time to union varied from 21 to 28 weeks (average 24.6 weeks). The average time of union was 21 weeks for Type I open fractures, 22.5 weeks for Type II open fractures and 27 weeks for Type IIIA open fractures. The

complications of compound fracture of tibia with Ilizarov ring fixator were broadly divided into intra-operative, post-operative, and delayed complications. There was no intraoperative complication. As postoperative complications, local pain with motion and local edema was seen in 3 cases and painful tenting of skin in 5 cases. Delayed complications included pin tract infection in 6 patients, loss of 80 ankle dorsiflexion in 2 cases, shortening of 1 cm was seen in 1 case, 2 cases (5%) of united in 70 recurvatum as calculated radiologically, 2 cases of muscle wasting of the leg from 0.4 to 1.5 cm were found. No case developed deep infection, non-union or unacceptable malunion. Only one patient got 2 weeks more treatment than all the others patients. According to the Karlstrom and Olerud criteria outcomes were assessed. Among total participants, the majority portion got 'excellent' results which was in 66.67%. Then 22.22%, 7.41%, and 3.70% participants got 'Good', 'Fair' and 'Poor' results respectively.

Table I: Demographic status of participants (N=27)

Characteristics	N	%
Gender distribution		
Male	16	59.26
Female	11	40.74
Age in years		
18-30	11	40.74
31-40	9	33.33
41-50	4	14.81
51-60	2	7.41
>60	1	3.70

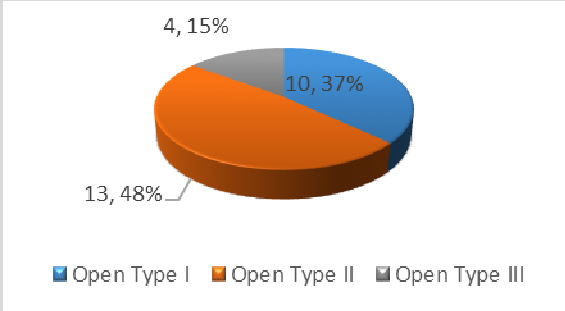

Figure I: Types of open fractures among participants (N=27)

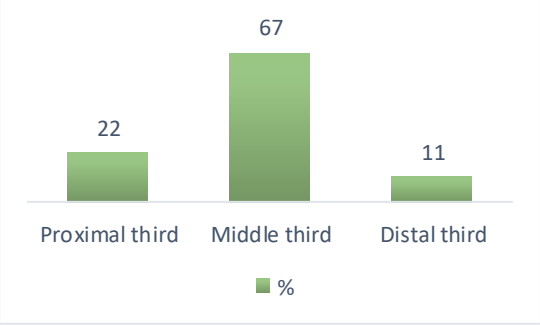

Figure II: Locations of open fractures among patients (N=27)

Table II: Distribution of patterns of open fractures (N=27)

Patterns	N	%
Comminuted	13	48.15
Transverse	6	22.22
Oblique	4	14.81
Spiral	3	11.11
Segmental	1	3.70
Total	**27**	**100**

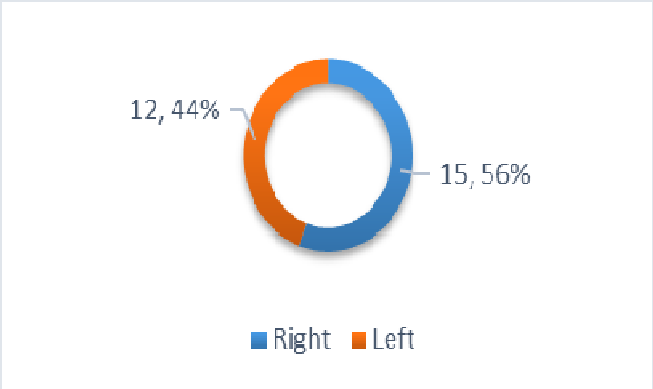

Figure III: Distribution of sides of open fractures (N=27)

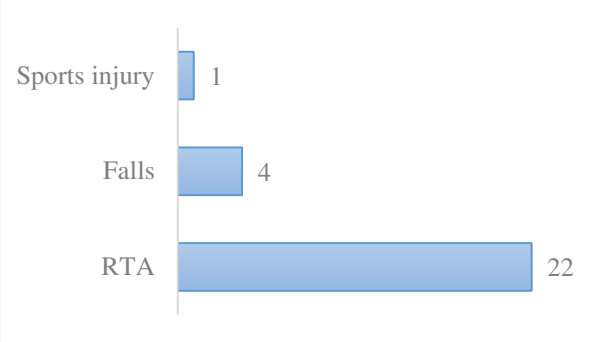

Figure IV: Distribution of mode of injuries among participants (N=27)

Table III: Final outcome according to Karlstrom and Olerud criteria (N=27)

Results	N	%
Excellent	18	66.67
Good	6	22.22
Fair	2	7.41
Poor	1	3.70

V DISCUSSION

This study aimed to evaluate the Ilizarov technique in the treatment of open fractures of the tibia. There are many methods for stabilizing open fractures of the tibia. The problems are attributable mainly to the injury

of the skin, soft tissues and the severity of the bone damage. In our observational study among total 27 participants 59% were male and 41% were female. So male participants were dominating in in number. The sex incidence was similar to that of Tucker[13] where number of males was 23 (88.5%) and that of females were 3 (11.5%). Shtarker H et al[14] also reported male preponderance over females in their study. On the other hand, among total 27 participants the highest 67% patients had middle third location fractures followed by 22% had proximal location and rest 11% had distal location fractures. This finding is similar to that of Shtarker et al[14] who reported 81.3% middle third, 15.7% proximal third and 3.1% lower third. In analyzing the patterns of open fractures of this study, we found the highest 48.15% patients had comminuted fracture followed by 22.22% had transverse, 14.81% had oblique, 11.11% had spiral and rest 3.70% had segmental open fractures. This finding is near about similar to the finding of Shtarker et al[14] who found 20 cases (62.5%) in regard to comminuted fractures. In this study out of 40 participants, there were 11 (37.5%) open type I, 47.5% open type II and 15% open type III-A which is comparable with that of Shtarker et al[14]. On the other hand, in this study, according to the data the highest 48% of participants were with type II open fracture followed by 37% with type I open fracture and the rest 15% with type III-A open fracture. The period between admission and Ilizarov ring fixation varied from 2 to 12 days with an average of 7 days in general. It is generally agreed that ilizarov ring should be applied as soon as the general physical condition is allowed. However, in our study Ilizarov ring fixation had to be delayed from 2 to 12 days from the date of injury because of insufficient operating days and facilities for emergency Ilizarov ring fixation. The average operating time varied from 90 minutes to 120 minutes. The finding was slightly lesser than that of Tucker[13] who reported that the operating time varied from 120 minutes to 210 minutes, though later it was reduced from 1 to 1.5 hours. The partial weight bearing on crutches was started on the very next day or on the 3rd day and full weight-bearing after 2 to 3 weeks. This is comparable to that of Dagher and Ronkoz[9] who reported that partial weight-bearing was begum within 1st week of operation and full weight-bearing after 2 to 3 weeks. When using a uniplanar external fixator, Court-Brown et al[10] postponed weight bearing until the fixator was removed. In our study, the patients were discharged from the hospital on an average on the 5th post-operative day. The average duration of hospital stay in this intervention was 12 days. Split thickness skin grafting was done in 5 cases in those who failed to heal spontaneously. In this study, the Ilizarov external fixator was removed after an average of 17 weeks (ranging from 12 to 22 weeks) which is in line with that of Shtarker et al[14] removed on an average of 16 weeks (ranging from 11-21 weeks). In our series, the average time of clinic-radiological union was 24.5 weeks (ranging from 21 to 28 weeks). The average time of union was 21 weeks for type I open fractures, 25.5 weeks for type II open fractures and 25 weeks for type IIIA open fractures. Tucker[13] reported the range of time to the union as 12 to 47 weeks, with an average of 24.5 weeks. Shtarker et al[14] reported that the time to union was 21.5 weeks (ranging from 17.5 to 25.5 weeks). Keating[15] reported that the average time to union in reamed and unreamed locking intramedullary nailing in a series was 28 and 21 weeks for type I open fractures, respectively; 28 and 27 weeks for type II open fractures; 34 and 31 weeks for type IIIA open fractures. Weight-bearing, to some degree, stimulates bone healing. Hulth[16] reported that the current concept of fracture healing was based on two variables namely blood supply and stability. In the present study, there were 9 cases (33%) of pin tract infection, manifested by pain,

erythema, and purulent discharge around the pin sites which was controlled by oral antibiotic within 10 days. There was no case of deep infection in this study. In our study, according to the Karlstrom and Olerud criteria outcomes were assessed. Among total participants, the majority portion got 'excellent' results which were 66.67%. Then 22.22%, 7.41% and 3.70% participants got 'Good', 'Fair' and 'Poor' results respectively. All these findings were better than some other traditional methods for treating open fractures of the tibia.

Limitations of the study

It was a single-centered study with a small-sized sample. So, the findings of this study may not reflect the exact scenario of the whole country.

VI CONCLUSION AND RECOMMENDATIONS

In this current study, no case developed a deep infection, non-union or unacceptable mal-union. The Ilizarov device is used worldwide for the treatment of several types of fractures. Low blood loss, prompt healing and minimum complications may be considered as some good features of Illizarov technic for the treatment of open fracture of tibia. We recommend for wider uses of these methods in the treatment arena of orthopedics.

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