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Original Research Article

Evaluation of Illizarov Principle of Infected Nonunion Tibia

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Abstract

Background: Among several treatment options for the management of infected nonunion tibia, Illizarov technique is a newer one.Illizarov technic has many good advantages and features. But in Bangladesh we have very few research-based information regarding the effectiveness and outcomes applyingIllizarov principle in treatinginfected nonunion tibia. ***Aim of the study:*** The aim of this study was to evaluate the effectiveness and outcomes Illizarov principle in treating infected nonunion tibia. ***Methods:*** This prospective observational study was conducted in the Department of Orthopedics, Holy Family Red Crescent Hospital Dhaka Bangladesh during the period from January 2018 to December 2019. In total 27 patients with infected nonunion tibia were selected as the study population. Illizarov technic was applied for all of the patients. Before starting data collectionproper written consentsfrom all the participants were taken. A pre-designed semi-structured questioner was used in collecting necessary patient data. All data were processed, analyzed and disseminated by MS Office and SPSS version 20.0 as per need. ***Results:*** In this study, as postoperative complications, local pain with motion, local oedema, painful tenting of skin and pin tract infection were found in 3.705, 7.41%, 14.81% and 18.51% participants respectively. There was not a single case of deep infection or unacceptable malunion or non-union. As the final outcomes of this technic as per the Karlstrom and Olerud criteria, the highest 59% patients got 'excellent' result. Then 30%, 7% and the rest 4% patients got 'good', 'fair' and 'poor' result respectively. Conclusion: For the management of infected nonunion tibia,Illizarov technic opened a new era. Considering the god features of this technic like less blood loss, lower complication rate, shorter duration of hospital staying and prompt healing physicians can take this principle as the method of choice in treating infected nonunion tibia.

Keywords: Illizarov, Infected, Nonunion tibia, Complication, Outcome.

1. INTRODUCTION

Among several treatment options for the management of infected nonunion tibia, Illizarov technique is a newer one. Illizarov technic has many good advantages and features. Infected nonunion of tibia is associated with many challenges to the respective surgeons and the patients. Challenges include recalcitrant infection, sclerotic bone ends, complex deformities, shortening and/or large bone gaps as well as joint stiffness [1]. In the management of such cases, debridement of soft tissue may lead to loss of cover which may best be filled with a muscle flap [2]. Treatment of open tibial fractures is a common but the treatment of such fractures has controversy among the orthopedic surgeons [3]. Currently, non-surgical procedures like using casts, brace or interventional attempts like inserting of plate, intramedullary nailing and external fixators are applied for the treatment of open tibial fractures [4]. Selection the methods are related to the surgeon's decision and economic status of the patients. In North America, most of the surgeons do reamed nailing for the treatment of open and/or closed tibial fractures. [4]In developing countries of the world, because of low facilities and lack of medical instruments, the selection of the methods may differ [5]. Recently, external fixators as like Ilizarov or "AO

external fixator" are applied extensively in developing countries but the rates of mal-union and infection are relatively high [6]. With the "AO external fixator", the efficacy of the treatment in two studies were reported to be 20-31% [7]. Open fractures are usually classified into three major categories, as per the mechanism of injury, soft tissue damage, and the degrees of skeletal involvement [8]. In generally, 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 regardless of the sizes of wound [9]. On the other hand, Type IIIB indicates open fracture with extensive soft-tissue loss and periosteal stripping and bone damage and usually associated with massive contamination [10] that may often need further soft-tissue coverage procedure. Different methods for the treatment of open fractures, shaft tibia include POP cast immobilization, open reduction and plating, external fixation, locked intramedullary nailing. According to Trafton [11], complications include deep infection, chronic or acute osteitis or ostiomyelitis, non-union, delayed union, mal- union, loss of alignment in brace or cast, fixation problems. The Ilizarov ring supports transfixional K-wire or haft pins, that can be fixed at the many holes site on the 360-degree ring. It has two or more connected rings which form a frame of the apparatus. Those rings bear supplementary part of the frame necessary for dynamic bone treatment [12]. The main objective of this study was to evaluate the effectiveness and outcomes Illizarov principle in treating infected nonunion tibia.

2. METHODOLOGY

This prospective observational study was conducted in the Department of Orthopedics Holy Family Red Crescent Hospital Dhaka Bangladesh during the period from January 2018 to December 2019. In total 27 patients with infected nonunion tibia were selected as the study population. Illizarov technic was applied for all of the patients. Before starting data collection proper written consents from all the participants were taken. A pre-designed semi-structured questioner was used in collecting necessary patient data. As per the exclusion criteria of this study, patients with closed fracture, type IIIC fractures and pathological fractures were excluded from this study. Necessary electrolytes and fluids replacement or whole blood transfusion (WBT) were ensured as per the requirement of the patients. Definitive treatment of fracture was confirmed as routine case usually in a week. Patients were operated under spinal or general anaesthesia as per need. One day prior to surgery, pre-assembly of the frame was done. According to the fracture anatomy, distance between the rings was adjusted. Fracture with "minimal comminution" and length loss <1cm was usually managed by a four-ring frame and more complex fractures were in needed a greater number of rings. Wires were fixed to the rings with the ring fixator bolt after tensioning up to 90-110 kg using a dynamometer. All the rings were kept '2 finger breadths' from skin all around. Reduction was also checked with C-arm image intensifier on the table and the adjustments were done according to the same setting. The pin tract wounds of the patients were dressed properly by 10% povidone iodine solution and covered with pad. Pin sites were cleaned everyday with povidone iodine (10% solution) or spirit. If clot and/or crust was present, weak solution of H_2O_2 (Hydrogen peroxide) was applied to remove it. As soon as the patient could tolerate the pain, partial weight bearing (With axillary crutch) was allowed. The wire and frame were checked whenever the patients complained regarding pain or stability. All 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 the period of 1 year. Check-radiographs were taken on the next day and then at 6th week, 12th week and 36th week. All the patients were evaluated clinically for the range of movement of the knee and ankle respectively, anterior knee pain, pain at the fracture site, ankle joint symptoms, infection, clinical union, muscular atrophy, difficulty in walking and performing daily routine. After only clinico-radiological union, frames were removed. If the frame was removed long before the union of fracture because of superficial infection or frame intolerance patellar tendon bearing, proper POP cast was applied. At the end of follow-up period, the results were grouped into excellent, good, fair, and poor using modified criteria of Karlstrom and Olerud. All data were processed, analyzed and disseminated by MS Office and SPSS version 20 as per need.

3. RESULT

In this current study, among total 27 participants 59% were male and 41% were female. So male was dominating in number and the male-female ratio was 1.9:1. In age distribution of the participants, we found 44% from 18-30 years' age group which was the highest number. Then 30% from 31-40 years' age group, 15% from 41-50 years' age group, 7% from 51-60 years' age group and rest 4% from >60 years' age group. In analyzing the patterns of open fractures, we found highest 44% patients had comminuted fracture followed by 26% had transverse, 19% had oblique, 7% had spiral and rest 4% had segmental open fractures. On the other hand, among total 27 participants, the highest 56% patients had middle location fractures followed by 26% had proximal location and rest 19% had distal location fracture. Among total study population the highest 59% patients had right side open fracture whereas 41% had left side open fractures. In analyzing the mode of injuries, we found the highest 80.56% participants were from road traffic accidents (RTA) followed by 11.11% from sports injury and rest only 8.33% from general falls (falls from height).The total duration of the treatment with the fixator was 12-24 weeks in average of 16 weeks. In total 15 patients wore a PTB cast for an additional period of 4 weeks. In this current study, total 27 cases were debrided on the same

day and were stabilized with "Ilizarov ring fixator". The operation time duration ranged from 90 minutes to 120 minutes (Mean was 100±6.75 minutes). The Ilizarov external fixator was withdrawn when there was completedclinico-radiological union. The duration of the treatment with the fixator ranged from 12-24 weeks (Mean was 16±3 weeks). The time to union varied from 21-27 weeks (average was 24.25 weeks). The average time of union was 22 weeks for the Type I open fractures, 22.25 weeks for the Type II open fractures and 26 weeks for the Type IIIA open fractures. The complications of compound fracture of tibia with Ilizarov ring fixator were divided into intra-operative, post-operative and delayed complications. There was no intraoperative complication in this study. In this study as postoperative complications, local pain with motion, local oedema, painful tenting of skin and pin tract infection were found in 3.705, 7.41%, 14.81% and 18.51% participants respectively. In our study, no case developed deep infection, unacceptable malunion or non-union. Exceptionally, 2 patients got 2 weeks more treatment than all others patients. As final outcomes of this technic as per the Karlstrom and Olerud criteria, the highest 59% patients got 'excellent' result. Then 30%, 7% and the rest 4% patients got 'good', 'fair' and 'poor' result respectively.

Table 1: Demographic status of participants (N=27)

Characteristics	n	%
Age distribution		
18-30 yrs.	12	44%
31-40 yrs.	8	30%
41-50 yrs.	4	15%
51-60 yrs.	2	7%
>60 yrs.	1	4%
Gender distribution		
Male	16	59%
Female	11	41%

Table 2: Fracture status of participants (N=27)

Characteristics	n	%
Patterns of fractures		
Comminuted	12	44%
Transverse	7	26%
Oblique	5	19%
Spiral	2	7%
Segmental	1	4%
Location of fractures		
Distal third	5	19%
Proximal third	7	26%
Middle third	15	56%
Sides of fractures		
Right	16	59%
Left	11	41%

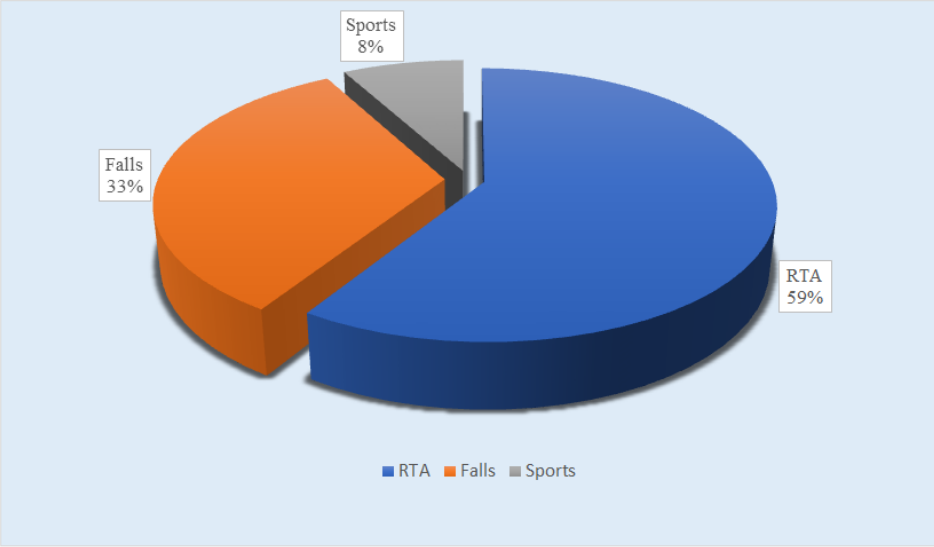

Figure 1: Mode of injury of participants (N=27)

Table 3: Complication among the participants (N=27)

Complication	n	%
Local pain with motion	1	3.70
Local oedema	2	7.41
Painful tenting of skin	4	14.81
Pin tract infection	5	18.51

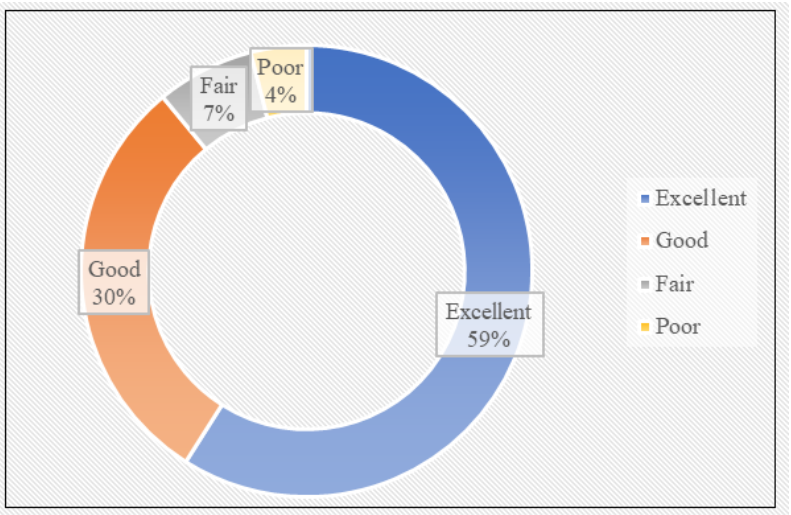

Figure 2: Final outcomes as per Karlstrom and Olerud criteria (N=27)

4. DISCUSSION

The aim of this study was to evaluate the effectiveness and outcomes Illizarov principle in treating infected nonunion tibia. There are several methods for stabilizing open tibial fractures as well asinfected nonunion tibia. In this current study, among total 27 participants 59% were male and 41% were female. So male was dominating in number and the male-female ratio was 1.9:1. In age distribution of the participants, we found 44% from 18-30 years' age group which was the highest number. Shtarker H *et al*., [13] reported that, male preponderance over female in their study. In our study, we found among total 27 participants, the highest 56% patients had middle location fractures followed by 26% had proximal location and rest 19% had distal location fracture. These findings were similar to that of Shtarker *et al*., [14] who reported 81.3% 'middle third', 15.7% 'proximal third' and 3.1% 'lower third'. However, in this 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 [14] who reported that the operating time varied from 120 minutes to 210 minutes, though later it was reduced from 1 to 1.5 hours. In our current study, the Ilizarov external fixator was removed after an average of 17 weeks which is in line with that of Shtarker *et al*., [13] removed on an average of 16 weeks. Keating [15] reported, the average time of 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 which findings are very nearer to our findings. On the other hand, Hulth [16] reported that, the current concept of fracture healing was based on two variables namely blood supply and stability. In this study as postoperative complications, local pain with motion, local oedema, painful tenting of skin and pin tract infection were found in 3.705, 7.41%, 14.81% and 18.51% participants respectively. In our study, no case developed deep infection, unacceptable malunion or non-union. Exceptionally, 2 patients got 2 weeks more treatment than all others patients. As final outcomes of this technic as per the Karlstrom and Olerud criteria, the highest 59% patients got 'excellent' result. Then 30%, 7% and the rest 4% patients got 'good', 'fair' and 'poor' result respectively. Tuker [14] reported approximately 10% of pin tract infection. Holbrook *et al*., [17] evaluated 28 open tibial fractures treated with external fixation and found a 14% rate of deep infection. Keating *et al*., [15] reported a rate of 3.3% in his series of open tibial fractures treated by locking intramedullary nailing. In this observational study we found some positive features of Ilizarov in treating infected nonunion tibia.

Limitation of the study

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

5. CONCLUSION & RECOMMENDATION

For the management of infected nonunion tibia, Illizarov technic opened a new era. Considering the god features of this technic like less blood loss, lower complication rate, shorter duration of hospital staying and prompt healing physicians can take this principle as the method of choice in treating infected nonunion tibia. We recommend for frequent use of this technic in the treatment arena off tibial fractures. For getting more specific findings we would like to recommend for conducting similar more studies with larger sized samples in several places.

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