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Post-Operative Wound Infection after Treatment of Open Fracture Type II and Type IIIA by Applying Ilizarov Fixator: A Single Centre Experience in Bangladesh

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Abstract

Background: Treatment of open fracture type II and type IIIA is difficult problem as because there is chance of formation of infection (osteomyelitis) and ultimate nonunion of fracture. **Objective:** The purpose of the present study was to assess the rate of post-operative wound infection by application of Ilizarov fixator among open fracture of tibia in type II and type IIIA. **Methodology:** This was a non-randomized clinical trial which was conducted in the Department of Orthopedic Surgery at Ad-Din Sakina Women's Medical College, Jashore, Bangladesh and at different private institutes in that area from January 2017 to December 2022 for a period of six years. The patients with the age group of 20 to 70 years were selected as study population. **Results:** A total number of 25 patients were recruited for this study. Out of 25 patients, 20 cases were male and 5 cases were female. Out of 25 patients 3 patients were diabetic and 2 patients were hypertensive. Affected side were on both side. The patients were included in this study and obtained excellent result with ilizarov procedure. Success rate was considered almost 100 present. Three patent developed minor wound infection. **Conclusion:** In conclusion no wound infection is found among the patients presented with open fracture of type II and type IIIA by application of Ilizarov fixator.

Keywords: Post-Operative; wound infection; open fracture type II and type IIIA; Ilizarov fixator

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Introduction

Open tibial fractures are the most common open fractures involving the long bones with an annual incidence of 5.6 per 100,000 persons in the United States[1]. These fractures continue to pose a challenge to orthopaedic surgeons worldwide. The precarious blood supply and lack of soft-tissue cover of the shaft of the tibia make these fractures vulnerable to non-union and infection[2]. The acceptable goals for open tibial diaphyseal fractures remain the prevention of infection; maintenance of normal length, alignment and rotation of the extremity; minimizing additional damage to soft tissue and bone; preserving the remaining circulation and providing a mechanical environment which stimulates periosteal and endosteal responses which favour bone healing[3].

Treatment of open fracture type II and type IIIA are challenging and common problem[4]. Though application of ilizarov fixator is a difficult procedure it creates best immobilization of fracture side and no chance of formation of implant reaction and infection. Despite its frequency, the ideal management of open tibial fractures remains controversial. Modern day management of this injury has focused on thorough debridement and immediate bony stabilization with tissue cover to enable early mobilization and restoration of optimum function[5]. Plate fixation and the conventional half-pin fixators are associated with high rates of non-union and the need for secondary

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procedures[6].

In the developed countries, primary debridement and intramedullary nailing is now increasingly becoming the preferred treatment of these fractures[7]. However, in developing countries such as India, where the patients present late to the hospitals and adequate facilities in terms of manpower and theatre facilities are not always available, the situation is different. In our hospital, as in most centres in the less developed regions, open tibial fractures have been traditionally managed by external fixators[8]. The high rate of failure associated with this management protocol made us to look to the Ilizarov external fixator (IEF) as an alternative. IEF is a step forward in the management of open tibial fractures in the settings where patients present late, have bone loss, and facilities for emergency nailing are not available. The purpose of the present study was to assess the rate of post-operative wound infection by application of Ilizarov fixator among open fracture of tibia in type II and type IIIA.

Methodology

Study Settings and Population: This was a non-randomized clinical trial which was conducted in the Department of Orthopedic Surgery at Ad-Din Sakina Women's Medical College, Jashore, Bangladesh and at different private institutes in that area from January 2017 to December 2022 for a period of six years. The patients with the age group of 20 to 70 years were selected as study population. Fractures were on both sides. The ages of defects were from few days to months.

Surgical Procedure: The patients were operated under regional and general anesthesia. With aseptic precaution and after draping the operated area incision was made a longer for good debridement of necrotic tissue and removal of contaminations. After proper surgical toileting fracture ends were hold with bone holding forceps and reduction done. After reduction 02 rings of ilizarov fixator were placed proximal to the fracture side and another 02 rings placed distal to fracture side. Then first four pins were applied by drill machine through the bone from one side of the rings to opposite sides and pins were hold by pin holders. Then fracture side was fixed with connecting the four rings by tie rods. Then another four cross pins were applied. In some cases, olive was applied for good alignment. Then wound was closed with keeping a drain tube in situ.

Follow up and Outcomes Measures: After 48 hours' drain tube removed and on 12th POD stitches off. And sometime compression was applied for rigid fixation and usually after one-month patient were allowed to walk with 50.0% weight bearing and successively advised to walk with full weight bearing and without crutch and patient also advised to come for follow up.

Statistical Analysis: Statistical analyses were performed with SPSS software, versions 27.0 (IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp.). Continuous data that were normally distributed were summarized in terms of the mean, standard deviation, median, minimum, maximum and number of observations. Categorical or discrete data were summarized in terms of frequency counts and percentages. For end points analysis, Chi-square test was used for categorical variables and an analysis of variance (Student t Test) for continuous outcomes. Baseline characteristics were presented by treatment group. When values are missing, the denominator were stated. Every effort were made to obtain missing data, even after the follow-up time had passed. A two-sided P value of less than 0.05 was considered to indicate statistical significance. Patients who will withdraw consent to participate in the study were included up to the date of withdrawal, with the exception of the analysis of death from any cause. For survival analyses, Kaplan–Meier estimates was generated. We were calculated Kaplan–Meier estimates of the cumulative proportion of patients with events, with the number of patients at risk indicated below the plot at specific time points. In efficacy time-to-event analyses, we were censored data for patients in whom the event of wound infection had not occurred at either the censoring date for the primary analysis.

Ethical Clearance: All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the local ethics committee. Participants in the study were informed about the procedure and purpose of the study and confidentiality of information provided. All participants consented willingly to be a part of the study during the data collection periods. All data were collected anonymously and were analyzed using the coding system.

Results

A total number of 25 patients were recruited for his study after fulfilling the inclusion and exclusion criteria. Most of the patients were in the age group of

20 to 40 years which was 16(64.0%) cases followed by 40 to 60 years and less than 20 years which were 8(32.0%) cases and 1(4.0%) cases respectively. The mean with the SD of the study population was 37.6±10.52 years with the range of 20 to 60 years (Table 1).

Table 1: Age Distribution among the Study Population (n=25)

Age Group	Frequency	Percent
Less Than 20 Years	1	4.0
20 to 40 Years	16	64.0
40 to 60 Years	8	32.0
Total	**25**	**100.0**
Mean±SD (Years)	37.6±10.523(20-60)	

In this study male was predominant than female which was 20(80.0%) cases and 5(20.0%) cases respectively. The ratio between m ale and female was 4:1 (Figure I).

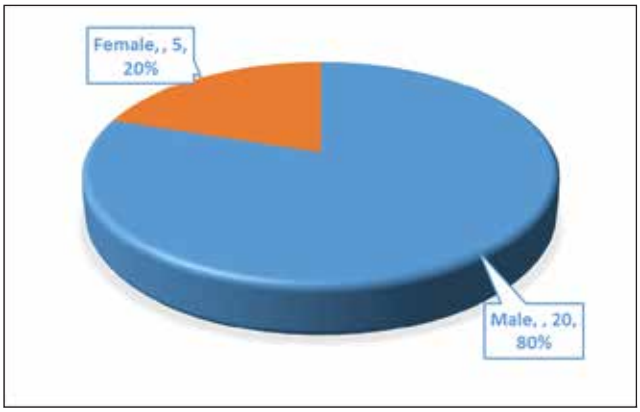

Figure I: Map of Manikganj District showing the COVID-19 Cases

Non-smoker was more than smoker which was 15(60.0%) cases and 10(40.0%) cases respectively. Most of the patients were without Diabetes mellitus which was 22(88.0%) cases. Again hypertension was absent in majority of the patients which was 23(92.0%) cases (Table 2).

Table 2: Co-Morbidities among the Study Population

Co-Morbidities	Frequency	Percent
H/O Smoking		
• Non-Smoker	15	60.0
• Smoker	10	40.0
Diabetes mellitus		
• Absent	22	88.0
• Present	3	12.0
Hypertension		
• Absent	23	92.0
• Present	2	8.0

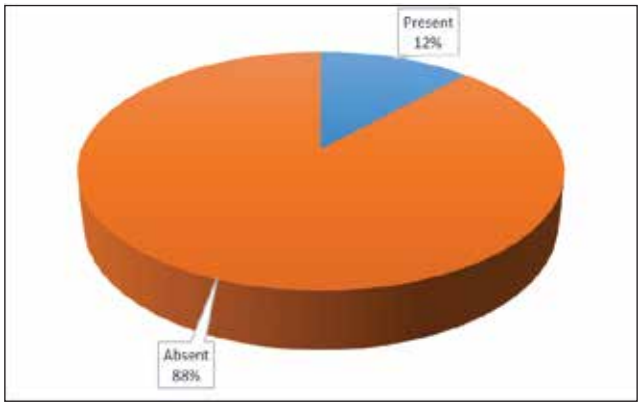

Figure II: Rate of Wound Infection after Operation among Study Population (n=25)

Table 3: Comparison between Different Variables with Rate of Wound Infection

Variables	Wound Infection		Total	P value	Crude OR (95% CI)
	Present	Absent			
Age Group					
• Less Than 20 Years	0(0.0%)	1(100.0%)	1(100.0%)	0.931	-
• 20 to 40 Years	2(12.5%)	14(87.5%)	16(100.0%)		
• 40 to 60 Years	1(12.5%)	7(87.5%)	8(100.0%)		
Gender					
• Male	3(15.0%)	17(85.0%)	20(100.0%)	0.358	0.85(0.707-1.022)
• Female	0(0.0%)	5(100.0%)	5(100.0%)		
Smoking History					
• Smoker	1(6.7%)	14(93.3%)	15(100.0%)	0.315	0.286(0.022-3.669)
• Non-Smoker	2(20.0%)	8(80.0%)	10(100.0%)		
DM					
• Absent	3(13.6%)	19(86.4%)	22(100.0%)	0.495	0.864(0.732-1.020)
• Present	0(0.0%)	3(100.0%)	3(100.0%)		
HTN					
• Absent	3(13.0%)	20(87.0%)	23(100.0%)	0.586	0.870(0.742-1.019)
• Present	0(0.0%)	2(100.0%)	2(100.0%)		

Wound infection was found in only 12.0% cases after surgery and the rest of the 88.0% cases were reported wound infection (Figure II).

Wound infection was compared with the different age group of the study population. In the age group of 20 to 40 years, the wound infection was most common which was 2(12.5%) cases out of 16 cases. The different age group was not statistically significant with the wound infection (p=0.931). All cases of wound infection was found among the male patients which was 3(15.0%) cases. The rate of wound infection was not statistically significant in relation with gender (p=0.358). The odds ratio was 0.85 (95% CI 0.707-1.022). Wound infection was found in only 1(6.7%) case among smoker group. The odds ratio was 0.286 (95% CI 0.022-3.669). Wound infection was common among non-diabetic patients which was 3(13.6%) cases. The difference between the rate of wound infection and diabetes mellitus was not statistically significant (p=0.495). The odds ratio was 0.864 with the 95% CI 0.732-1.020. The difference between the rate of wound infection and was not statistically significant (p=0.586). The odds ratio was 0.870 with the 95% CI 0.742-1.019 (Table 3).

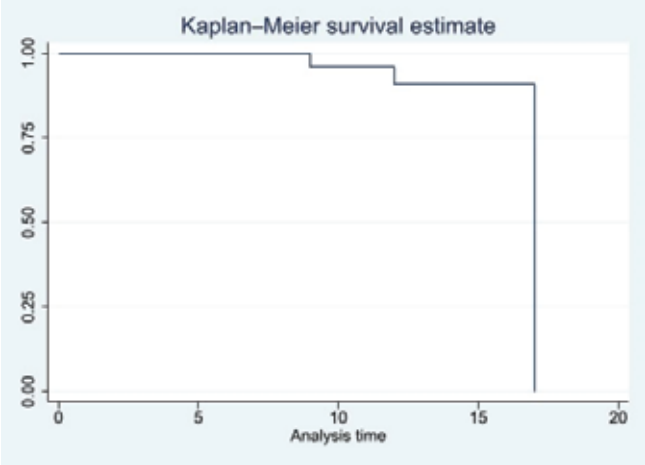

Figure III: Kaplan-Meier Curve showing the events among the study population

Discussion

In case of open fracture bone is exposed and fracture side communicate with external environment and usually contaminated[9]. Therefore, almost in every cases there is chance of infection and nonunion. Open fracture usually results from RTA, fall from Height, or direct violence. For treatment of open fracture of type II and IIIA with internal fixation device like DCP or IM nail aggravates infection due to implant reaction. That's why application of ilizarov fixator is the choice of treatment[10]. This procedure is difficult to both surgeons and patients. During operation surgeons may be injured with pins to their hands. There may be iatrogenic injury to nerves and vessels and after operation patients feels difficulties to bear this ilizarov rings for is extra weight. Yet this procedure is best as it creates destructive osteogensis for fracture healing by giving compression[11].

Plate fixation is associated with a number of complications, especially in communited fractures. A systemic review of 11 studies involving 492 open

Figure IV: Operative Procedure of Open Fracture of Tibia

tibial fractures managed by plating revealed a revision rate ranging from 8.0% to 69.0% and a pooled estimate of deep infection rate of 11% cases[12]. Allan and Sigvard reported severe osteomyelitis in 19.0% of the open tibial fractures treated by plate fixation[13]. External fixation has been popular because of the relative ease of application and the limited effect on the blood supply of the tibia, but these advantages have been outweighed by the high incidence of non-union and pin-track infection, difficulties relating to soft-tissue management and the potential for malunion. Papaioannou et al. reported non-union in 20.3% of patients with open tibial fractures managed by external fixators, especially types II and III[14-15].

Currently, primary intramedullary nailing has gained wide acceptance in open tibial fractures in developed countries[16]. However, even in expert hands, IM nailing is associated with problems of infections especially in type IIIB fractures and delayed union[17]. Although some reports coming from the developed world have shown good results with IM nailing, extending these to developing countries, where patients report late and adequate facilities are not always available, is not an option. In most centres, these fractures are initially managed by external fixator due to unavailability of adequate instrumentation and manpower in the emergency operation theatres. Intramedullary nailing in fractures initially treated by external fixation has been associated with a high rate of infection, especially when external fixation was associated with pin-track infection[17]. In the developing countries, external fixation remains the definitive treatment and a significant number of patients progress to non-union and malunion. Even in the centres with facilities for emergency IM nailing, the results have not been encouraging since most of the patients in our region report to hospital late. Joshi et al. had an infection rate of 10.7% in open tibial fractures managed by unreamed nailing, even after debridement and adequate soft tissue coverage[11]. They did not recommend nailing in type III fractures with delayed presentation to the hospitals.

Conclusion

The application of ilizarov fixator is the reliable and useful procedure for treatment of open fracture as it prevents formation of infection and nonunion. Healing of fracture is satisfactory. Therefore, this procedure was preferred and was performed the operations and all of the patients became well.

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Conflict of Interest
The authors have no conflicts of interest to disclose.

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Authors' contributions
Islam MN, Islam MR conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Islam MN contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Begum T, Islam MM involved in the manuscript review and editing. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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