Original Article

To Evaluate the Outcome of AO External Fixator Technique for the Management of Grade II, Grade IIIA and Grade IIIB of Open Tibia Fracture

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ABSTRACT

OBJECTIVE: To Evaluate the AO External Fixator technique outcome in managing open tibia fracture Grade II and IIIA & IIIB.

METHODOLOGY: This descriptive cross-sectional study was conducted in the Department of Orthopaedic Surgery, PUMHSW Hospital, Shaheed Benazirabad (Nawabshah), in 2021 after approval. All the patients were selected from Orthopaedics OPD/Emergency Department. The sample size was 101. Data was analyzed using Statistical Package for Social Science (SPSS) software Version 21. Quantitative data were presented with Mean ± SD. Qualitative data were presented in percentages and frequencies. A chi-square test was used to measure categorical variables.

RESULTS: Out of 101 patients, 81 were male and 20 were female. The mean age of the patient was 31.05, and SD was 9.511. The Modes of injury: 5 were pedestrian, 3 were bicycle, 61 were a motorcycle, 30 were a car, one fall from height and one from machine injury. The injury site on the right side of the tibia occurred in 56 patients; from the left were 43 patients, and in the bilateral were two. 23.8%, 42.6% and 33.7% of patients had Grade II, IIIA, and IIIB open tibia fractures. 43 (42.6%) patients had simple fractures, 38 (37.6%) patients had wedge fractures, and 20 (19.8%) patients had complex fractures.

CONCLUSION: Using an AO External Fixator in open tibia fracture has seen fewer complications in grades II, IIIA, and IIIB. Fracture union was obtained in 90%. Pin tract infection was common and observed in some patients, but antibiotics healed it.

KEYWORDS: AO External Fixator, Open Tibia Fracture, Grade II, Grade IIIA, Grade IIIB

INTRODUCTION

A tibia fracture is the most frequent long bone fracture, with about 25% being open fractures. The modern urban society regularly has seen open tibia fractures. Such fractures are still most frequently caused by automobile accidents[1]. Due to the limited blood supply and soft tissue cover of the tibia shaft, which makes fractures susceptible to infection and non-union, it is still a significant therapeutic challenge in managing open tibia fractures. An open fracture is one of the most frequent musculoskeletal injuries due to their frequency and severity. Notably, open tibia fractures have drawn attention. According to estimates, there are seventeen to twenty-three open tibia fractures for every 100,000 people per year. These fractures are the 2nd most frequent open bone injury[2]. In addition, about 60% of severe soft tissue lesions are associated with occur due to high-energy injuries in open tibia fractures. Severe complications from open tibia fractures include osteomyelitis, mal-union, amputation and non-union. Both fracture stabilization and soft tissue treatment strategies are essential. Gustilo type III injuries are typically categorized as high-energy open fractures. Due to the bone's proximity to the skin, open tibia fractures are more frequent in other long bone fractures[3]. With a mean age of 37 years, in the population of 100,000, approximately 26% is annual incidence, and due to RTA and contact sports, males are more affected than females. Several treatment methods have been proposed for this injury. The most common management options include plate fixation, External fixator, and intramedullary nail[4].

Poor socioeconomic backgrounds and Lack of education cause a delay in the proper surgical planning process and presentation, further complicating the situation. Due to the high risk of infection, which occurs mainly in open tibia fractures, it can result in non-union, a more extended hospital stay, delayed union, high morbidity and multiple surgeries[5]. These fractures must be managed using a multidisciplinary strategy to facilitate the patient's early ambulation and rapid healing. In the literature, various classifications have been suggested to determine the severity of the initial injury and provide helpful prognostic indications for selecting the best treatment. The Gustilo-Anderson classification, most commonly used, categorizes patients into three groups based on

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the severity of the soft tissue damage, the level of contamination, and the size of the open wound[6,7].

Because of the open fracture's communication with the outside environment, infectious complications are increased. Prophylaxis antibiotics are typically given before, during, and following intraoperative surgical fixation. No study has yet assessed the organisms growing in all grades of infected open tibia fracture, even though nosocomial bacteria are frequently linked to deep surgical site infection[8]. Based on specific characteristics of the injury, the Gustilo classification ranks fractures according to their worsening prognosis in the context of infection. The five-tier Gustilo classification is Grade I injuries, which involve minimal soft tissue injury and low energy. A more extensive soft tissue damage characterizes Grade II and moderate energy injury. Grade III fractures are high-energy injuries with severe soft tissue damage and complex patterns of fracture[9].

There are three sub-tiers for type 3 fractures: IIIA, IIIB, and IIIC; the treatment they require, with IIIB, is flap coverage, and IIIC requires vascular repair, making them most accessible to distinguish. This diverse group of fractures can be well-represented using the Gustilo system. As soon as possible, a consultation with an Orthopaedic surgeon should be initiated to begin planning for definitive treatment. Recent research shows that external fixation is still the best option for more severe injuries. For orthopedic surgeons, one of the most significant obstacles remains the management of open tibia fractures[10].

The treatment objectives in open fracture are well-known, including preventing infection, bony union, and restoring function. Essential guidelines include antibiotics, the timing of the first surgical procedure, the type of wound closure, the administration of antibiotics, wound irrigation, tetanus protection, and additional management to help promote the union of fractures. The (ATLS) principles and recommendations should always be followed to evaluate a patient with an open limb fracture[12]. A goniometer is used in the clinical examination to measure the ROM of the ankle and knee compared to the contralateral healthy side. The primary goal of treatment for an open tibia fracture is to return the limb to its pre-injury condition with minimal problems so that the patient can return to work and social activities. The treatment outcome was determined by the presence of complications and the time of fracture union. Fracture union was evaluated clinically and by radiology at six weeks, three months and six months. If the patient has no tenderness, pain or abnormal movement at the fracture site and a bridging callus that crosses three or four cortices, as seen in the radiograph, the fracture is considered united. After four to six months of healing, the fracture was diagnosed as a delayed union if no callus was formed. An angle of varus or valgus more than 5º, or an anterior or posterior angle of more than 10 4 degrees, was considered non-union. Clinical signs of infection include localized skin redness, tenderness, swelling, and a positive bacterial culture[13,14].

To find the better treatment option, the study aimed to determine the AO external fixator outcome in managing Grade II, Grade IIIA, and Grade IIIB in open tibia fractures.

METHODOLOGY

This descriptive cross-sectional study was conducted in the Department of Orthopaedic Surgery, PUMHSW Hospital, Shaheed Benazirabad (Nawabshah), in 2021 after approval. The sample size was 101. Data was analyzed using Statistical Package for Social Science (SPSS) software Version 21. Quantitative data were presented with Mean ± SD. Qualitative data were presented in percentages and frequencies. A chi -square test was used to measure categorical variables.

All the patients were selected from Orthopaedics OPD/Emergency Department. A comprehensive history, clinical examination, and all baseline tests and X-rays were performed. Every open fracture was graded according to Gustilo Classification, and an AO External fixator was used to stabilize the fracture. Primary wound care was provided in the emergency room following the initial resuscitation, and the wound was covered with a sterilized dressing before the back slab was applied. After giving IV fluid, IV antibiotics, Analgesic and ATS, Baseline investigations and x-rays were done, and the patient was shifted to the Operation room. After Debridement, an AO External fixator was applied. Next, Debridement was done after 24 hours, depending on the wound's condition. On the second Debridement, the remaining necrotic tissue and deviated should have been cut out. After multiple debridements, the wound is clean and tidy, and bone grafting and soft tissue cover it. When it was suspected that union would be delayed or when cortical bone defects and gaps were present, bone grafting was impregnated. The local fasciocutanous flap, myocutanous flap, split-thickness skin grafting and skin release incisions should provide soft tissue coverage in a random pattern. When an excellent soft callous was seen on X-rays, the patient could walk with crutches or a walker for part of the day.

When the wound healed sufficiently and the radiological union advanced adequately, the AO removed the EF. After removing the fixator, a patella tendon-bearing (PTB) cast was put on, and a weight-bearing walk was gradually allowed until the union was reached. The patient received assistance during union, pin tract infection, non-union, shortening, and mal-union. Active physiotherapy was started after removing the cast to regain mobility in the knee and ankle joints.

RESULTS

According to this study, 101 Patients were included. Out of them 81(80.1%) were male and 20(19.9%)

were female patients. This study was conducted in the orthopedics department of PUMHSW.

The Mode of injury was 5(5%) were pedestrians, 3 (3%) were from bicycles, 61(60.3%) from motorcycles, 30 (29.7%) were from cars, 1(1%) from fall from height and 1(1%) from machine injury **Table I**.

Table I: Frequency Mode of injury in patients

	n=101	%
Pedestrian	5	5
Bicycle	3	3
Motorcycle	61	60.3
Car	30	29.7
Fall from height	1	1
Machine injury	1	1
Total	**101**	**100%**

The site of injury on the right side of the tibia occurred in 56(55.4%) patients, from the left side in 43(42.6%) patients, and bilateral in 2(2%) patients.

The Gustilo Anderson classification is also known as the Gustilo classification. According to the results, 24 (23.8%) patients had Grade II open tibia fractures, 43 (42.6%) patients had Grade IIIA open tibia fractures, and 34(33.6%) patients had Grade IIIB open tibia fractures.

AO classification was divided into simple fracture, wedge fracture and complex fracture. Out of 101 patients, 43(42.6%) patients had simple fractures, 38 (37.6%) patients had wedge fractures and 20(19.8%) patients had complex fractures, and all fractures were open tibia fractures.

Only 10(9.9%) patients had observed pain after managing an open tibia fracture, and 91(90.1%) patients had no pain. 11(10.9%) Patients had infection after management of open tibia fracture and 90 (89.1%) patients had no infection. 21(20.8) Patients had pin tract infections after managing open tibia fracture, and 80(79.2%) patients had no pin tract infection. Joint stiffness was present in 6(5.9%) patients after management of open tibia fracture and 94.1% had no joint stiffness after surgery. Shortening was present in 2.9% of patients after managing open tibia fracture, and 97.1% had no joint stiffness after surgery. Mal-union was present in 7(6.9%) patients after surgery for open tibia fracture, and 94(93.1%) patients had an absence of mal-union. Delayed unions were present in 11(10.9%) patients after surgery of open tibia fracture, and 90(89.1%) patients had an absence of delayed union. Non-union was present in 12(11.9%) patients after surgery of open tibia fracture, and 89(88.1%) patients had an absence of non-union (**Table II)**.

Table II: Outcome after treatment of Open Fracture

Pain		
Yes	10	9.9%
No	91	90.1%
Infection		
Yes	11	10.9%
No	90	89.1%
Pin tract infection		
Yes	21	20.8%
No	80	79.2%
Joint stiffness		
Yes	6	5.9%
No	95	94.1%
Shortening		
Verbal	3	2.9%
Physical	98	97.1%
Mal Union		
Yes	7	6.9%
No	94	93.1%
Delayed Union		
Yes	11	10.9%
No	90	89.1%
Non-Union		
Yes	12	11.9%
No	89	88.1%

Table III: Post-stratification analysis

Gustilo classification	
Parameters	**P-Value**
Pain	0.097
Infection	0.079
Pin Tract Infection	0.14
Joint Stiffness	0.95
Shortening	0.24
Malunion	0.11
Delayed union	0.09
Non-union	0.01

Post Stratification analysis showed a significant association between Gustilo classification and Non-union.

DISCUSSION

External fixation (EF) is vital in treating open tibia fractures, particularly high-energy injuries with extensive soft tissue damage. The application of an EF to an open tibia fracture is well documented in the literature. It is widely used because of its relative simplicity, immediate stabilization, ability to create

space to treat associated soft tissue injuries, and minimal impact on the tibia's blood supply[15]. Function restoration, avoiding complications, and achieving properly aligned bone union are the main objectives of treatment. While some variables that affect outcomes are patient-related, others are impacted by management decisions[16]. The early treatment of open injuries by surgeons may significantly impact long-term outcomes, potentially as important as any acute care decisions they must make. Even though the number of evidence-based practice recommendations used to inform decisions is growing, some areas lack evidence. There was a significant association between Gustilo's classification and non-union. No significant relationship was found between age, genders, AO classification and Gustilo classification[17].

The mean age of the patient was 31 years, and SD was ±9.511. In previous studies, the mean age was 52. According to the literature, open fractures affect men more frequently than women. This finding can be explained by the fact that men are typically more likely to sustain injuries as a result of engaging in risky activities both at work (since they usually earn the majority of the income) and during leisure. According to previous studies, the majority of patients with this injury are typically men who are involved in traffic accidents and are of an economically productive age[18]. In our study, open fracture occurred more in males than females, which showed that 80.1% were male and 19.9% were female.

In this study, the Mode of injury was 5(5%) were pedestrian, 3(3%) were from bicycle, 61(60.3%) from motorcycle, 30 (29.7%) were from car, 1(1%) from fall from height and 1(1%) from machine injury. The Mode of injury in the previous study was 74% RTA, 11% fall from height, 9% sports trauma, and 6% other mechanisms responsible for injuries, respectively. 55% of traffic accident victims were involved in motorcycle accidents, while 36% were struck by a vehicle, and 5% were in a car accident. Another study revealed the methods of injury were RTA (70%), sports (5%), industrial crush injuries (4%) and gunshot injuries (1%)[19]. In open fractures, high-energy trauma, which is frequently associated with RTA, was the leading cause of injury; motorcycle and vehicle accidents were the two most common causes. One hundred ninety-five pedestrians hit by a car made up the third group. The prevalence of bicycle-related injuries, falls, and other mechanisms was lower[20].

In this study, Only 10(9.9%) patients had observed pain after managing open tibia fracture and 91(90.1%) patients had no pain. 11(10.9%) Patients had infection after management of open tibia fracture and 90 (89.1%) patients had no infection. 21(20.8) Patients had pin tract infections after managing open tibia fracture, and 80(79.2%) patients had no pin tract infection. Joint stiffness was present in 6(5.9%) patients after management of open tibia fracture and 94.1% had no joint stiffness after surgery. Shortening was present in 2.9% of patients after management of open tibia fracture and 97.1% had no joint stiffness after surgery. Mal-union was present in 7(6.9%) patients after surgery for open tibia fracture, and 94 (93.1%) patients had an absence of mal-union. Delayed unions were present in 11(10.9%) patients after surgery of open tibia fracture, and 90(89.1%) patients had an absence of delayed union. Non-union was present in 12(11.9%) patients after surgery of open tibia fracture, and 89(88.1%) patients had an absence of non-union.

CONCLUSION

In our study, using an AO External Fixator in open tibia fracture had seen less complication in Grades II, IIIA, and IIIB. Post-stratification showed a significant relationship between Gustilo's classification and non-union. Fracture union was obtained in 90%. No case has developed ischemia or vascular injury due to treatment. Amputation was not needed in any case. Pin tract infection was common and observed in some patients, but antibiotics healed it. There was no evidence of shortness or deformity in any of the patients. In any patient, no pathological movement was found. During the follow-up period, no refracture was observed.

Ethical permission: Peoples University of Medical & Health Sciences for Women, Shaheed Benazirabad (Nawabshah), ERC letter No. PUMHS/SBA/PVC/117.

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AUTHOR CONTRIBUTION

Abbasi AN: Manuscript writing
Akhund MA: Editing of manuscript
Khatri KK: Critical analysis
Usman M: Research and data collection
Ghumro AH: Research and data analysis
Soomro ZI: Research and data analysis

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