

FUNCTIONAL OUTCOME OF ILIZAROV EXTERNAL FIXATOR IN A COMMUNUTED TIBIAL PLATEAU FRACTURE

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Abstract

Background:

The cominuted tibial plateau fractures are complicated injuries that often occur because of high-energy trauma and often are linked to severe soft-tissue injuries. It is a challenge to fix the biological environment and at the same time achieve a stable fixation. Circular fixator systems and external fixation have become a convenient alternative to internal fixation of such fractures.

Objective:

To establish the functional outcome of the use of Ilizarov external fixators in patients with comminuted tibial plateau fracture.

Methods:

The study was a descriptive study that was undertaken in the Department of Orthopedics, Khyber Teaching Hospital, after six months of study. Non-probability consecutive sampling was used to enroll a total of 170 patients aged between 18-60 years, of both gender who were diagnosed with comminuted tibial plateau fractures. Every patient was definitively fixed by the application of an Ilizarov external fixator by the consultant orthopedic surgeons. Basic pin-site management, early knee mobilization, and gradual weight bearing were all sources of postoperative care. The Wilde modification of the Neer Knee scoring system was used to determine functional outcomes at 12 weeks. The SPSS version 25 was used to analyze the data.

Results:

Most of the patients attained positive functional outcomes. Most of the cases showed excellent results in over half and a significant percentage of the cases resulted in good results. Minority of patients were recorded to have fair and poor outcomes. The most frequent complication was superficial pin-tract infection, which was treated in a conservative way. There were no instances of deep and non-union.

Conclusion:

External fixation is a safe and efficient modality in the management of comminuted tibial plateau fractures, which deliver satisfactory short-term functional results with a desirable complication profile.

INTRODUCTION

Tibial plateau fractures are complicated intra-articular injuries referring to the weight-bearing side of the proximal tibia and consuming about 1-percent of all fractures and up to 8-percent of fractures in the geriatric population [1]. The high-energy causes of these injuries include road traffic accidents or height falls in young people, and low-energy in osteoporotic bone [2]. The main objectives of treatment are to restore the congruity of the joint, to support the limb in position, to retain the soft tissue integrity, and to be in early motion towards the best functional results.

Fractures of the tibial plateau are especially difficult because they are severely fragmented in the articular area, have lost metaphyseal bone and generally have compromised the soft tissue [3]. Such fractures are often complexed with the swelling, fracture blisters and contusion of soft tissues that pose a high risk of complications of the wound being managed with the use of open reduction and internal fixation (ORIF) [4]. Consequently, the fixation method is a critical factor in deciding the recovery in the short-run and the long-term knee functionality.

The goals of conventional management using ORIF are to obtain anatomical restoration of the articular surface but in highly comminuted fractures, stable fixation may be hard to accomplish without additional damage to the soft tissues [5]. The complications that have been reported to be high include infection, wound dehiscence, implant failure, and post-traumatic osteoarthritis, in both high-energy Schatzker type V and VI fractures [6]. Such issues have created a growing interest in alternative fixation methods which reduce trauma of surgery.

External fixation which is especially through hybrid or circular Ilizarov external fixator has become a useful management of comminuted tibial plateau fractures [7]. Ilizarov external fixators can use ligamentotaxis to indirectly reduce fracture fragments without damaging the surrounding soft tissues and fracture biology. This method minimizes the surgical exposure required and has been linked to the reduced number of incidences of deep infection in specific cases [8].

The other benefit of external fixation is that it will allow the provision of stable fixation and

early knee mobilization and weight-bearing as tolerated, which are critical in preventing joint stiffness and muscle atrophy [9]. Also, Ilizarov external fixators may be repositioned after surgery in order to keep them aligned, and are especially helpful in metaphyseal comminution fractures or bone loss [10].

Irrespective of these benefits, there are issues of pin-tract infections, patient pain, knee stiffness, and technical challenges of external fixation [11]. The literature on functional outcomes of patients with external fixation is inconsistent because it depends on the severity of the fracture, patient variables, rehabilitation regimes, and fixation duration [12]. Thus, the role of external fixation in the contemporary fracture treatment should be thoroughly analyzed to identify its place.

External fixation is a cheap and efficient method of treating complex tibial plateau fractures in a resource-limited environment where more complicated implants and staged surgery might not be available at all times [13]. The evaluation of the level of functional outcomes in these contexts is a good source of information on the efficiency of this approach and aids in making treatment choices.

The current research intends to find out the functional consequences of the use of Ilizarov external fixator in comminuted fracture of tibia plateau concerning the postoperative knee functions, complications, and the overall recovery of the patient. This assessment aims at providing evidence to justify the correct fixation techniques to use with complex proximal tibial injuries.

MATERIALS AND METHODS

Design, Setting and duration of the study.

The study was a descriptive one and carried out in the Department of Orthopedics, Khyber Teaching Hospital, Peshawar, during a six-month duration following the approval of the study synopsis.

Sample Size and Sampling Technique.

To determine the sample size, the world health organization formula of sample size was used based on an expected rate of excellent results of 54.16, a margin of error of 7.5, and a confidence level of 95, which led to the total sample size of

170 patients. Non probability consecutive sampling was adopted.

Sample Selection

Patients with either gender with a diagnosis of comminuted tibial plateau fracture between the age of 18-60 years were included. Patients having compound fractures, ipsilateral fracture of the other limb, pathological fracture or having diabetes mellitus history were excluded.

Surgical Procedure and Data Collection.

Data collection was done after ethical approval was obtained by the hospital research review board. The eligible patients were recruited at the orthopedic indoor ward with the informed consent. Demographic and clinical baseline data were taken. Every surgery was conducted by the consultant orthopedic surgeons by using Ilizarov external fixation system with standardized four-ring construct. Pin site care, early mobilization of the joints, delayed weight bearing and planned rehabilitation procedures were adhered to. The Wilde modification of the Neer Knee scoring system was used to measure functional outcomes at 12 weeks by following up the patients in the outpatient clinic. When the fracture had been radiographically seen to be united, the Ilizarov external fixator was removed.

Data Analysis

IBM SPSS version 25 was used to analyze data. The quantitative variables were represented by the mean and standard deviation or median (interquartile range) and the qualitative variables represented by frequencies and percentages. Stratification of functional outcomes was based on age, gender, BMI and laterality, and correct statistical tests were used. A p-value was taken to be statistically significant as 0.05.

RESULTS

Only 170 patients with comminuted tibial plateau fractures previously fixed with the help of external fixation were included in the final analysis. The average age of the study population was 38.6±10.4 which was between 18 and 60 years. Most of the patients were men, 118 of

them (69.4%) and 52 of them (30.6%) were women. The functional and socioeconomic implications of these injuries were also emphasized by the fact that most patients were at the age to be economically active. Table 1 summarizes the baseline demographic characteristics.

Right-sided tibial plateau injuries were more prevalent and were found in 96 patients (56.5 percent) as compared to left-sided injuries in 74 patients (43.5 percent). The mean body mass index (BMI) among the patients was 26.8 3.9kg/m². Table 2 gives the distribution of the laterality of injuries and the BMI categories.

All the patients were treated conclusively using the Ilizarov external fixator. The average period of the external fixation was 14.2 weeks + 2.6. The number of postoperative complications was rather low. The most frequent complication was pin-tract infection, which was detected in 18 patients (10.6%), which were all superficial and treated without any difficulties with local treatment and oral antibiotics. In 14 (8.2%) patients, knee stiffness was observed and loss of reduction in 6 patients (3.5%). There were no instances of deep infection and neurovascular injury or non-union. Table 3 describes the postoperative complications.

The Wilde modification of Neer Knee scoring system was used at 12-weeks to measure functional outcomes. Good outcomes (28.2%) were obtained in 92 patients (54.1%), fair outcomes (11.8%) in 20 patients, and poor outcomes (5.9%) in 10 patients. On the whole, 140 patients (82.3%) were provided with a satisfactory functional outcome (excellent and good). Table 4 indicates the functional outcome distribution.

The functional outcomes were related to patient-related variables like age, gender, BMI, and laterality of injury. The relationships between better functional outcomes were more common in younger patients and normal BMI, but none of them were statistically significant ($p > 0.05$).

The functional outcomes after external fixation are graphically presented in the Figure 1 to show the presence of more excellent and good results in the study population.

Table 1: Demographic Characteristics of Patients (n = 170)

Variable	Frequency (n)	Percentage (%)
Age (years), mean ± SD	38.6 ± 10.4	–
18–30 years	54	31.8
31–45 years	76	44.7
46–60 years	40	23.5
Gender		
Male	118	69.4
Female	52	30.6

Table 2: Laterality of Injury and Body Mass Index Distribution

Variable	Frequency (n)	Percentage (%)
Laterality		
Right	96	56.5
Left	74	43.5
BMI category		
Normal (18.5–24.9)	58	34.1
Overweight (25–29.9)	74	43.5
Obese (≥30)	38	22.4

Table 3: Postoperative Complications

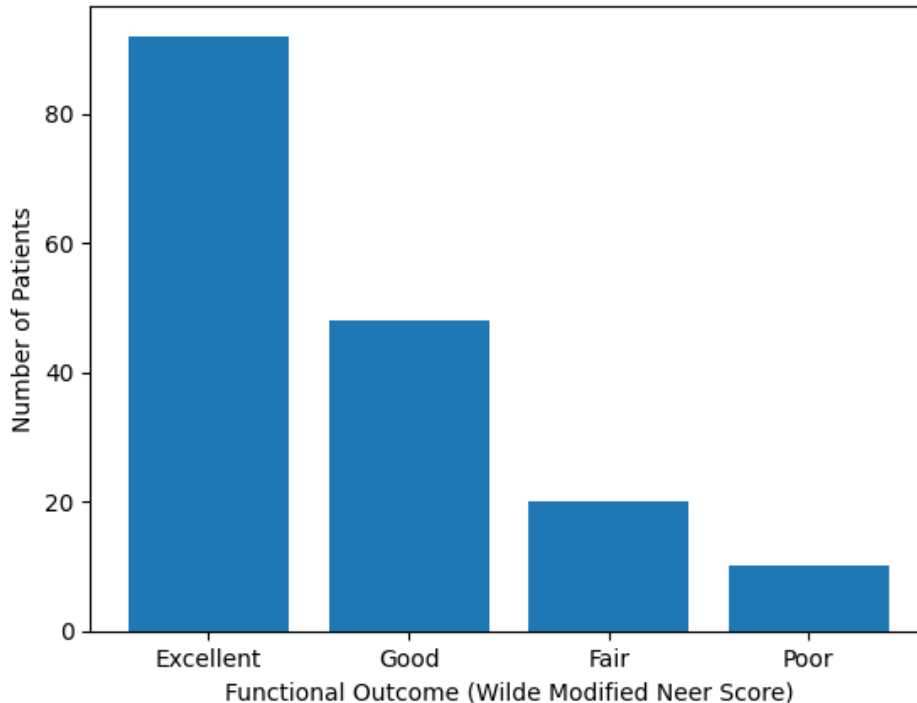
Complication	Frequency (n)	Percentage (%)
Pin-tract infection	18	10.6
Knee stiffness	14	8.2
Loss of reduction	6	3.5
Deep infection	0	0
Neurovascular injury	0	0

Table 4: Functional Outcomes Based on Wilde Modified Neer Score

Functional Outcome	Frequency (n)	Percentage (%)
Excellent	92	54.1
Good	48	28.2
Fair	20	11.8
Poor	10	5.9

Figure 1: Functional Outcomes after Ilizarov external fixator for Comminuted Tibial Plateau Fractures (A bar graph showing distribution of excellent, good, fair, and poor outcomes, with excellent outcomes being the most frequent.)

Functional Outcomes after External Fixator for Comminuted Tibial Plateau Fractures



DISCUSSION

The current research examined the outcomes of Ilizarov external fixation among patients with comminuted tibia plateau fracture and indicated that most of the patients recorded satisfactory outcomes. Over four-fifths of the population studied achieved excellent to good functional outcomes depending on Wilde modification of Neer Knee scoring system. These results justify the use of external fixation as a viable treatment modality in the management of fractures of the tibial plateau especially when soft tissue involves is too fragile to allow the use of internal fixation [9].

The fractures of the tibial plateau are usually of high energy and they are quite challenging because they may lead to articular surface compromise, metaphyseal comminution and soft tissue damage. The benefits of Ilizarov external fixation are that it also provides ligamentotaxis, which means that articular fragments can be indirectly reduced and the amount of additional soft tissue insult is reduced. The positive results of this study are consistent with other series of studies that

indicated satisfactory functional recovery and alignment recovery with the use of a circular or hybrid Ilizarov external fixator in complex plateau fractures [10,11].

The prevalence of superior and good results in younger patients as in our cohort is also in line with the current literature that indicates that age is a significant factor in determining postoperative functional recovery. The young patients are usually younger, better bone quality, more rehabilitation as well as fewer comorbidities and that is why their outcome after fracture fixation is better [12]. Even though the results were found to deteriorate with age, external fixation in all age groups was still offering acceptable performance in this research study.

The most common complication that was experienced was pin-tract infection, but this was superficial and could be treated effectively with local care and oral antibiotics. This complication profile has been similar to previously conducted researches which have reported pin-tract infection to be the most frequent adverse event in external fixation typically without a major

influence on ultimate functional result [13,14]. The fact that the deep infection was not prevalent in our study also indicates the advantage of using the external fixation to decrease the complications of the soft tissue.

A small percentage of patients also had knee stiffness which was probably due to the intensity of the initial injury, the time taken in fixing the knee and the patient adherence to physiotherapy. Prevention of stiffness is an important role of early mobilization and systematic rehabilitation plan and research has highlighted meticulous postoperative physiotherapy as a primary factor to maximize the knee functioning following external fixation [15]. The early knee movement was facilitated by the proximal 5/8 ring used in our construct that might have contributed to the relatively low stiffness rate.

The non-union and deep infection in this study highlights the biological benefit of external fixation in ensuring fracture vascularity. Ilizarov external fixators preserve local blood flow and fracture healing by foregoing large-scale periosteal stripping, which has been reiterated in the treatment of high-energy proximal tibia fractures [16,17].

External fixation has been demonstrated to provide similar functional results as open reduction and internal fixation in comminuted fractures, and lower wound complication rates in selected patients. Although ORIF still remains the orthopedic method in choice in less complex patterns, external fixation is still an option of worth in fracture with severe comminution or insufficient soft tissues [18]. This role is also strengthened by our findings.

External fixation is especially beneficial in settings that are resource constrained as it is economical, flexible and does not require staged processes. The positive functional results demonstrated in this research indicate that external fixation when done with appropriate technique and follow up offers credible results even in difficult fracture pattern [19,20].

Limitations:

This research was limited in a number of ways. Its descriptive nature and single center setting can restrict the applicability of the results. This is due to the lack of a comparative group that has

a different fixation method; therefore, direct comparison of results is limited. The functional evaluation was not extended to long-term effects like the post-traumatic osteoarthritis, but was restricted to short-term follow-up. The future perspective, comparative studies with longer follow-up time is suggested to further clarify the position of external fixation of comminuted tibial plateau fractures.

CONCLUSION

External fixation was found to be a viable and efficient method of treatment of comminuted tibial plateau fracture, which returns satisfactory functional results in most of the patients. The method provided the opportunity to fix fractures in a stable manner with minimal losses to soft tissues, early joint mobilization, and a reasonable complication rate. These results justify the application of Ilizarov external fixators, especially in complicated patterns of fractures and where internal fixation is not possible, hence the necessity of proper surgery, and planned postoperative rehabilitation to achieve maximization of functional recovery.

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