

Original Research Article

Functional outcome of Schatzker type V and VI tibial plateau fractures managed by open reduction and internal fixation using dual plates

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ABSTRACT

Background: High-energy bicondylar tibial plateau fractures (Schatzker type V and VI) occur as a result of road traffic accidents, falls from height, and sports injuries, and mostly affect the younger age group in productive life years. This study aimed to evaluate the functional outcome of high-energy tibial plateau fractures (Schatzker type V and VI) treated by dual plating through anterolateral and posteromedial incisions.

Methods: This was a hospital-based clinical trial study conducted in the department of orthopaedics and traumatology, Chittagong medical college hospital, Chattogram, Bangladesh, from January 2018 to December 2019. Our study included 50 adult patients of both genders with high-energy tibial plateau fractures through a consecutive sampling technique. The knee function of the patients was evaluated according to the Oxford knee scoring system.

Results: Out of 50 cases, 38 cases (76%) were male and 12 cases (24%) were female with a mean±SD age was 43.95±10.89 years. All the cases (100%) were due to RTA, 70% had Schatzker type VI and 30% had type V injury. Mean±SD time interval from injury to fixation was 11.05±3.20. The average duration of operation in minutes was 107.0 (±12.07). At the final follow-up, 41 (82%) and 05 (10%) patients had excellent and good outcomes respectively.

Conclusions: Open reduction and internal fixation in high-energy tibial plateau fractures using dual plates through two incisions can provide excellent to good functional results and minimal soft tissue complications in appropriately selected cases.

Keywords: Tibial plateau fractures, Schatzker type V and VI, Open reduction, Internal fixation, Functional outcome

INTRODUCTION

The knee joint is a superficial joint of the lower extremities and complex movements take place during motion at the knee joint. Proximal tibial articular fractures can be caused by auto accidents and injuries from bumper collisions. Less severe trauma, such as falls or sports injuries, can also frequently result in them, especially in older patients with osteopenia.¹ Proximal tibial plateau fractures are among the most common intra-articular

fractures. Either direct trauma that produces axial compressive patterns or indirect trauma that produces coronal fracture patterns are the causes of them. This makes up 1% of all fractures.² The fracture patterns are very complex and may involve medial, lateral, or both the tibial plateaus.

There are various classification systems for Tibial plateau fractures but a widely accepted classification method was developed by Schatzker. High-energy tibial plateau

fractures remain a challenge to orthopedic surgeons, with the bicondylar type (Schatzker type V) and the comminuted type (Schatzker type VI) fractures being the most difficult to treat.³ Schatzker type V and VI fractures are high-energy fractures often accompanied by other local and systemic injuries.

The amount of energy involved at the time of injury determines the severity of tibial plateau fracture. Complex fracture patterns with comminution and extensive soft tissue involvement are seen in high-energy trauma. However, low-energy trauma leads to simple fracture patterns and minimal soft tissue involvement. Bicondylar fractures have both tibial plateau fractures, usually with depressed fractures of lateral tibial plateaus, meniscal tears, and anterior cruciate ligament (ACL) avulsions.⁴

There are several treatment options for high-energy tibial plateau fractures, such as single plating, dual plating, and definitive external fixation; nevertheless, there is ongoing debate on the most effective approach. Major wound complications have occasionally been linked to the open reduction and internal fixation procedure, particularly when it is applied via wounded soft tissues. Due to the delayed mobilization of the knee joint, the use of external fixators as a therapy method frequently results in joint stiffness.⁵

Treatment by open reduction and internal fixation either with a single or dual plate through a single midline incision causes extensive soft tissue injury of the proximal tibia, causing de-vascularization of the fracture fragments, thereby decreasing fracture healing and leading to risks of wound complications.⁶ To improve the outcome of high-energy tibial plateau fracture treatment, fixation using double buttress plates via a medial and lateral incision is widely used.

The standard method of treatment is ORIF with dual plating is the most considerable mechanical construct in tibial plateau fractures.⁷ The advantage of this approach is optimal visualization of the fracture for reduction and fixation, absolute stability, and restoration of joint congruity with the drawbacks are extensive soft-tissue dissection over the subcutaneous proximal end of the tibia, excessive periosteal stripping, devascularization of the periosteum, skin necrosis, and infection.^{8,9}

The treatment of Schatzker type V and VI tibial plateau fractures with a midline longitudinal incision and dual-plate fixation resulted in optimal clinical and radiological outcomes. This can be a good option when treating Schatzker type V and VI tibial plateau fractures.¹⁰ Rohra et al concluded that open reduction and internal fixation of high-energy tibial plateau fractures with dual plates via two incisions give excellent to good functional outcomes with minimal soft tissue complications.¹¹

Therefore, this study aimed to evaluate the functional outcome of Schatzker type V and VI tibial plateau

fractures treated by open reduction and internal fixation using dual plates.

METHODS

This hospital-based clinical trial study was conducted in the department of orthopaedics and traumatology, Chittagong medical college hospital, Chattogram, Bangladesh, from January 2018 to December 2019. This study included 50 adult patients of both genders with high-energy tibial plateau fractures through a consecutive sampling technique. These are the following criteria to be eligible for enrollment as our study participants: a) Patients aged more than 18 years; b) Patients with closed Schatzker type V and VI tibial plateau fractures; c) Patients with open fractures up to Gustilo-Anderson type I ;d) Patients who were willing to participate were included in the study And a) Patients with the ipsilateral neuro-vascular deficit; b) Patients with dislocation of the knee joint; c) Patients with compartment syndrome; d) Patients with any history of acute illness (e.g., renal or pancreatic diseases, ischemic heart disease, asthma, COPD etc.) were excluded from our study.

Data collection

History was taken and clinical examination was performed following the standard procedure of clinical methods. A questionnaire was prepared considering the key variables like age, gender, side and mechanism of injury, type of injury, close/open injury, fracture blister, comorbidities, the time interval from injury to fixation, duration of operation, and functional outcome of surgery which were verified by the guide. A consecutive type of non-probability sampling technique was used according to the availability of the patients. After proper counseling and anaesthesia fitness patients were operated on. Post-operative follow-up was given in 2nd week, 6th week, 3rd month, and 6th month. The Oxford knee scoring system was used to evaluate the knee function of our study subjects.

Surgical procedure

All patients underwent an anterolateral approach for the lateral plate and a medial or posteromedial approach for the second plate. All patients were posted for surgery under regional-spinal or general anaesthesia. Patients were placed on a radiolucent table in a supine position with a sandbag under the ipsilateral gluteal region for the anterolateral approach and a sandbag on the contralateral hip for the posteromedial approach. All patients were operated on with a tourniquet inflated during surgeries. A one-inch longitudinal skin incision was used for a minimally invasive medial approach. The medial or the posteromedial fragment was exposed subperiosteally by elevating the pesanserinus with a periosteal elevator. Once the medial fragment was reduced, a small buttress plate was placed beneath the pesanserinus. Small stab incisions were used to fix the plate to the bone. Adequate

visualization of fragments was done to aid in anatomical reduction. T buttress plate or a 3.5-mm locking proximal medial tibial plate was used. Anterolateral approach for the proximal tibia was done by a curvilinear longitudinal incision starting from the lateral femoral epicondyle and curving over Gerdy's tubercle and parallel to the tibial shin, just lateral to it. Closure was done over a suction drain. After the operation, a long leg back slab was applied.

Statistical analysis

All data were recorded systematically in preformed data collection form. Quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Continuous variables were compared by student's t test between two parameters, and analysis of variance (ANOVA) test when parameters were more than two. Qualitative variables were analyzed by Chi-square test. Statistical analysis was performed by using SPSS 25 (Statistical package for social sciences) for Windows version 10. The study was approved by the ethical review committee of Chittagong medical college hospital.

RESULTS

Most of the study population (76%) was in ≥ 40 years of age group, followed by 12 (24%) patients aged <40 years. The mean age of the patients was 43.95 ± 10.89 years with a range of 26-60 years.

Table 1: Distribution of the study population by their age, (n=50).

Age (in years)	N	Percentage (%)
<40	12	24
≥ 40	38	76
Total	50	100
Mean$\pm$SD	43.95 ± 10.89	
Range	26-60	

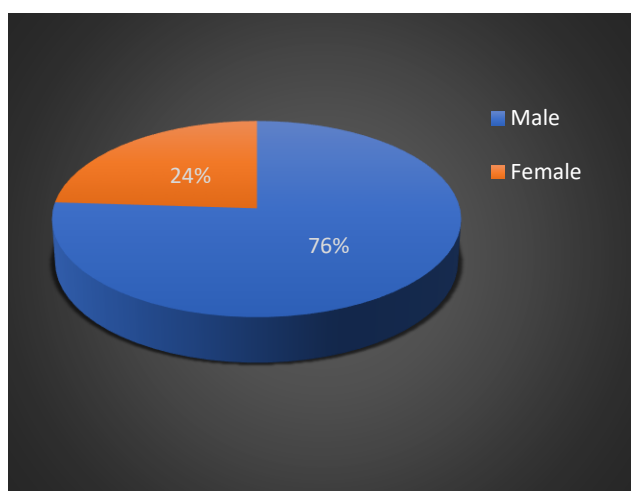


Figure 1: Gender distribution of the patients, (n=50).

The pie chart shows the gender distribution of the study patients and depicts that, there was a male predominance (76%) over female (24%). We found a male and female ratio of about 3.17:1 in the present study.

Table 2: Fracture description and co-morbidities of the patients, (n=50).

Variables	N (%)	
Mechanism of injury	RTA	50 (100)
Side of injury	Right	37 (74)
	Left	13 (26)
Type of injury	Type V	14 (28)
	Type VI	36 (72)
Pattern of injury	Closed	42 (84)
	Open	08 (16)
Fracture blister	Present	07 (14)
	Absent	43 (86)
Co-morbidities	Absent	40 (80)
	HTN	02 (4)
	DM	08 (16)

In the present study, out of 50 cases, all of the cases (100%) were due to RTA. The right tibia was affected in the majority of the cases (74%). Among Schatzker type, type VI was in most of the patients (72%). Most (84%) injury was closed. Fracture blister was present in only 7 (14%) cases. Among the patients, 8 (16%) were diabetic and only 2 (10%) were hypertensive.

Table 3: Distribution of the patients according to the time interval from injury to fixation and duration of operation, (n=50).

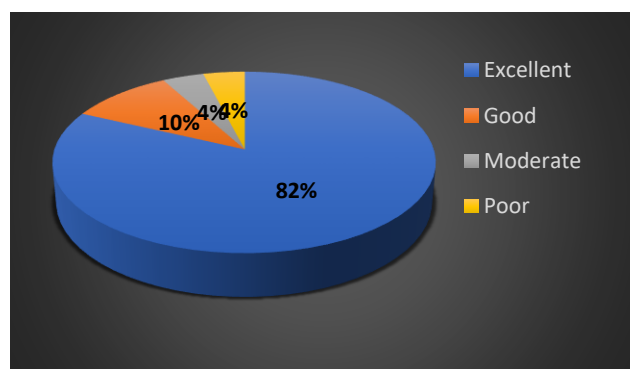
Variables	N	Percentage (%)
The time interval for fixation		
7-11 days	36	72
12-16 days	12	24
17-21 days	2	04
Total	50	100
Mean±SD	11.05±3.203	
Range	7-19 days	
Duration of operation		
90-110 minutes	33	66
111-130 minutes	17	34
Total	50	100
Mean±SD	107.0±12.074	
Range	90-130 minutes	

The table shows that the time interval from injury to fixation was 7-11 days in maximum (72%) patients. The mean $\pm$ SD interval from injury to fixators in the study subjects was 11.05 ± 3.203 days with a range between 7-19 days. Out of 50 patients, 33 (66%) patients needed 90-110 minutes, and 17 (34%) patients needed 111-130 minutes for operation. The mean $\pm$ SD duration of operation was 107 ± 12.074 minutes (range: 90-130 minutes).

Table 4: Functional outcome at 2nd week, 6th week, 3 months, and 6 months.

Follow-up schedule	Functional outcome, (n=50)				P value
	Excellent	Good	Moderate	Poor	
At 2 weeks	00 (0%)	00 (0%)	00 (0%)	50 (100%)	<0.00001
At 6 weeks	00 (0%)	00 (0%)	22 (44.0%)	28 (56.0%)	
At 3 months	23 (46.0%)	22 (44.0%)	02 (4.0%)	03 (6.0%)	
At 6 months	41 (82.0%)	05 (10.0%)	02 (4.0%)	02 (4.0%)	

Table 4 shows, at 2nd week follow-up, all 50 (100%) patients had poor outcomes, at 6th week follow-up, 28 (56%) patients had poor and 22 (44%) patients had moderate, at 3rd month follow-up, excellent and good outcomes were among 23 (46%) and 22 (44%) patients in each group respectively and the moderate outcome was in 2 (4%) patients, and at 6th month final follow-up, the excellent outcome was in 41 (82%) patients and good outcome were in 05 (10.0%) patients, both moderate and poor outcome were found in 02 (4%) patients.

**Figure 2: Functional outcome at 6th month, (n=50).**

The pie chart shows, that at the final follow-up most of the patients, 41 (82%) had excellent outcomes. Good and poor outcomes were in 05 (10%) and 02 (4%) patients respectively.

DISCUSSION

In the present study, most of the study population (76%) was in ≥ 40 years of age group. The mean age of the patients was 43.95 ± 10.894 years (range: 26-60 years). A recent study by Nawaz et al described the age distribution of the patients, it showed that 44 (48.89%) were between 19-30 years of age while 46 (51.11%) were between 31-50 years of age, mean $\pm$ SD was calculated as 31.25 ± 7.29 years.¹² Another recent study conducted by Tahir et al stated the mean age of the patients was 45.08 ± 10.52 .¹³ Maximum patients were between the age group 24 to 65 years (mean age 46.20 years).¹¹ Yu et al also showed the mean age was 45.2 years. This is the most productive phase of life with maximum mobility.¹⁴

Out of 50 patients, 76% were male and 24% were female. Tahir et al showed in their study the male-to-female distribution was 107/30 (78.1% and 21.89%).¹³ Nawaz et

al showed that 63 (70%) were male and 27 (30%) were females.¹² Rohra et al found out of 34 patients, 29 (85.29%) were males and 5 (14.71%) were females.¹¹ Another study revealed that females were 38.9% and males were 61.1%.¹⁴

Most injuries were predominantly on the right side. In this study, 37 (76%) were injured on the right side and 13 (24%) were injured on the left side. There was a slight right-sided predominance (55.88%), compared to the left side (44.12%) reported by Rohra et al while Yu et al found that 29 (53.7%) had an injury on the left side and 25 (46.3%) had an injury on the right side.^{11,14}

According to closed/open injury, out of 50 patients, 42 (84%) had closed injury and 8 (16%) had open injury. A study conducted by Bari et al found that 30 (75%) cases had closed injuries and 10 (25%) cases had closed injuries.¹⁵

In the present study, out of 50 patients, all the patients (100%) got trauma by RTA. Tahir et al showed regarding the mechanism of injury, road traffic accidents (RTA) were the primary cause of injury 96 (70.07%), falls were 21 (15.32%), and gunshots were 18 (13.13%). Rohra et al found that the tibial plateau fractures were most commonly due to RTA.¹¹

Regarding the type of injury, 36 (72%) had Schatzker type VI injury and 14 (28%) patients had Schatzker type V injury. Tahir et al found 74 were Schatzker type VI (54.01%) whereas 63 (45.98%) were Schatzker V.¹³ Type V (38.24%) and type VI (61.76%) was reported by Rohra et al.¹¹ Another study done by Yu et al showed that Schatzker V was 23 (42.6%) and Schatzker VI was 31 (57.4%).¹⁴

Among 50 patients, 07 (14%) had a fracture blister. Rohra et al showed blisters were present in 7 cases (20.59%).¹¹ Maximum patient's (72%) fixation was done within 7-11 days from injury in this study. In one study, patients were operated on between 0 to 17 days on an average of 6.5 days.¹¹ The average time to surgery for a fracture was 10.4 days.¹⁴ In this study, mean $\pm$ SD duration of operation was 107.0 ± 12.074 minutes in open reduction and internal fixation using dual plates. Mean operation time (minutes) was 158.4 (100-270) interpreted by Yu et al.¹⁴

According to Oxford knee score, patients were categorized into four subdivisions- excellent, good, moderate, and

poor.^{16,17} In this study after the week of follow-up, all 50 (100%) patients had poor outcomes. However, at the 6th month final follow-up, the excellent outcome was in 41 (82%) patients and the good outcome was in 05 (10%) patients. Rohra et al reported that 29 patients (85.29%) had excellent and 5 patients (14.71%) had good objective knee society scores.¹¹ Also, in the study done by Tahir et al excellent was 12 (17.6%), good was 34 (50%), fair was 12 (17.6%), and poor was 10 (14.7%).¹³

Limitations

Our study was a single-center study. We took a small sample size due to our short study period. After evaluating those patients, we did not follow up with them for the long term and did not know other possible interference that may happen in the long term with these patients.

CONCLUSION

In our study, we found that the functional outcomes indicate that the technique of open reduction and internal fixation using dual plates is a feasible treatment option for bicondylar and complex tibial plateau fractures. This method allows anatomical reduction of the fracture fragments, stable fixation, and early mobilization of the knee joint.

So further study with a prospective and longitudinal study design including a larger sample size needs to be done to validate the findings of our study.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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