

## “An Assessment of Surgical Management of Tibial Plateau Fracture”

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### Abstract

### Original Research Article

**Background:** Fractures around the knee joint especially tibial plateau fracture are very crucial for surgical management. Low and high-energy tibial plateau fractures usually result from axial loading in combination with valgus stress forces, present a variety of soft tissue and bony injuries that can produce permanent disabilities. Since there are various modalities for fixation of these fractures with satisfactory results, but there is no general consensus as to which modality is the best in terms of functional outcome. **Aim of the study:** The aim of this study was to assess the functional outcome of surgical management of tibial plateau fractures. **Methods:** This prospective observational study was conducted in the Department of Orthopedics, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh during the period from January 2020 to December 2020. In total 28 patients of several age groups with tibial plateau fractures attended to the mentioned hospital during the first six months of the study were selected as the study population. Gustilo Anderson Grade I fractures of tibial plateau presenting in patients requiring open or closed reduction and internal fixation to restore the articular anatomy were finalized for this study. All data were processed, analyzed and disseminated by MS Office and SPSS program as per need. **Result:** In this study, for most of the cases the treatment duration was < 10 days which was among 75%. As complication ‘knee stiffness’ was found among the highest number of patients which was in 10.71%. The average duration of hospitalization of the participants was 7.5 days (range 4-8 days). In this study, we found satisfactory outcome in 25 patients which was 89% and not satisfactory in 3 patients which was 11% among all the participants. Finally, the end result as per Rasmussen’s criteria was ‘Excellent’ in 15 (53.57%), ‘Good’ in 10 (35.71%), fair in 2 (7.14%) and poor in 1 (3.57%) patient. **Conclusion:** In this current study we found satisfactory outcome among most of the patients which was in 89.29%. Such outcome indicates the satisfactory effectiveness of this tenure of surgery for the management of tibial plateau fractures. Besides these, low blood loss, prompt healing and lower rate of complications were noticeable characteristics of this study.

**Keywords:** Tibial plateau fractures, Management, Outcome, Axial, Gustilo Anderson Grade.

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## I. INTRODUCTION

Fractures around the knee joint especially tibial plateau fracture are very crucial for surgical management. Low and high-energy tibial plateau fractures usually result from axial loading in combination with valgus stress forces, present a variety of soft tissue and bony injuries that can produce permanent disabilities. Since there are various modalities for fixation of these fractures with satisfactory results, but there is no general consensus as to which modality is the best in terms of functional outcome. The tibial plateau is the region of proximal tibia, which comprises of the superior articular surface.

It constitutes a major weight bearing area in the body. Its fractures classically were described as bumper or fender’s fractures. They gravely affect the biomechanics, stability and range of motion of the knee joint [1, 2]. These injuries present with a wide array of fractures, varying from minor hairline cracks with excellent functional outcomes even after conservative treatment to challenging fracture configurations requiring highly experienced surgical hands. The management of these types of injuries has for long been subject of controversies. The spectrum of treatment ranges from simple casting and bracing to skeletal traction and early motion to open reduction and internal

fixation [3]. Moreover, the appropriate treatment for injuries of different severities is unclear. A brief review of literature reveals that different avenues are being explored for these fractures. Ali, et al. reported a 31% fixation failure for tibial plateau fracture in their elderly population [4]. Stevens et al. noted that only 57% of cases showed good functional outcome after surgical management of tibial plateau fractures in age <40 years [5]. Open reduction and internal fixation has a significant complication rate [6]. So a middle path of minimally invasive technique of closed reduction by ligamentotaxis and stabilizing the fracture by limited internal fixation was developed and practiced to overcome the drawbacks of non-operative and operative modalities [7]. These techniques utilize percutaneous screws and Kirschner wires (K wires), external fixation frames or combination of external fixation with limited internal fixation [8]. The minimally invasive technique of closed reduction by ligamentotaxis and fixation with percutaneous screws and K wires, combines attributes to both operative and non-operative philosophies. The treatment of tibial plateau fractures is continuously evolving. Various techniques have emerged over the last few decades. Until the seventies, these fractures were essentially treated conservatively with a variety of modalities such as traction, cast bracing and spica casting [9]. In the eighties, as the science of internal fixation progressed rapidly, more and more tibial plateau fractures started to get operated [10]. Surgically treated fractures yielded favorable results due to the achievement of better articular congruity, higher stability and early mobilization. As the propensity of high velocity trauma increased, the incidence of complex fractures also increased and thus more and more fractures were subjected to surgical reductions. As more tibial plateau fractures are surgically treated, surgical complications have become relatively common. Surgical methods for reducing and fixing tibial plateau fractures have evolved over the last three or four decades in order to identify techniques that minimize complications and other techniques that optimize the treatment of complications when they occur.

## II. METHODOLOGY & MATERIALS

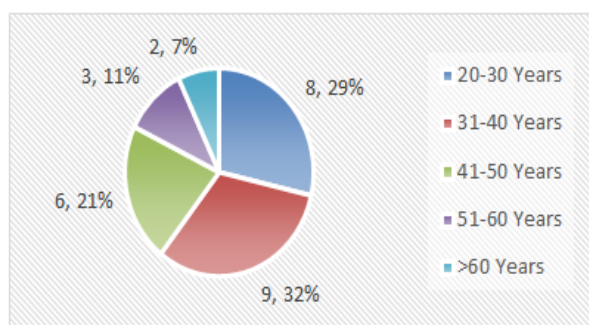
This prospective observational study was conducted in the Department of Orthopedics, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh during the period from January 2020 to December 2020. In total 28 patients of several age groups with tibial plateau fractures attended to the mentioned hospital during the first six months of the study were selected as the study population. Gustilo Anderson Grade I fractures of tibial plateau presenting in patients requiring open or closed reduction and internal fixation to restore the articular anatomy were finalized for this study. As per the exclusion criteria of the study, any fracture having Gustilo Anderson severity of more than Grade I, all pathological fractures or fractures having associated condition such as compartment syndrome, ipsilateral meniscal or ligamentous injury, floating knee

or any other polytrauma were rejected. After recording identification data, antero-posterior and lateral roentgenograms were used to classify the fracture according to Schatzker classification. Surgical intervention was done under suitable antibiotic cover and fluoroscopic control and as soon as local soft tissue conditions were favorable, operation was performed. Fracture site reduction was done under fluoroscopic guidance with the use of percutaneous clamps and distracters judiciously and repeat fluoroscopic assessment was done to assess anatomical reduction. Wherever needed open reduction was performed. Buttress plates were used since the proximal end of tibia contains a large amount of cancellous bone and has a tendency of axial deviation or bending under the effect of compression or shearing forces. The different types used were T shape having a vertical and horizontal limb and helps in preventing a thin cancellous bone from collapsing, L shape having a right or left offset and a double bed to fit into the plateau and Hockeystick plate which is stouter and majority of times used to buttress the lateral plateau. Locking compression plates were used in cases of high energy bicondylar fractures, severe comminution and in osteoporotic bones. Inter-fragmentary compression cannot be achieved by locked plate alone and therefore, supplementary use of inter-fragmentary screws may be required to prevent loss of reduction and to ensure adequate compression of fragments. For this purpose, cortical screws (4.5 mm of various diameters), cancellous screws (16 mm, 32 mm, partially and fully threaded) and locking screws were used. The implants used were selected according to the fracture configuration and the preference of the surgeon. Post operatively patients were kept on injectable antibiotics for 3 to 5 days and static quadriceps and ankle pump exercises were started from 2<sup>nd</sup> day. If the fixation was deemed stable then intermittent knee mobilization was started once pain subsided. Weight bearing was deferred until evidence of union was seen on X ray. Partial weight bearing was started at around 10 to 14 weeks depending upon the fracture configuration. The results of this study were evaluated using the functional grading of Rasmussen et al. [11]. All data were processed, analyzed and disseminated by MS Office and SPSS program as per need.

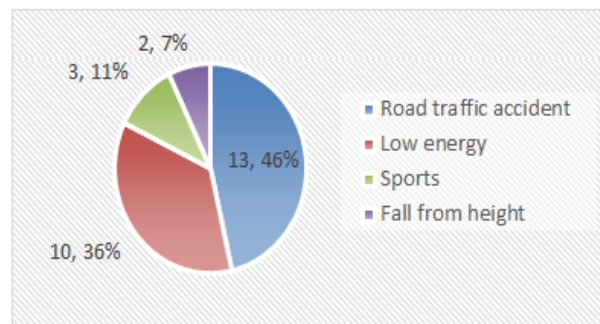
## III. RESULT

In this study, among total 28 participants, 16 were male which was 57% and 12 were female which was 43%. Among total population, the highest 32% (n=9) were from 31-40 years' age group. Then 29% were from 20-30 years', 21% were from 41-50 years', 11% were from 51-60 years' and only 7% were from >60 years' age group. In analyzing the mechanism of injuries of the participants we found, the highest 46% injuries occurred by road traffic accidents (RTA). Then in 36% cases the mechanism was low energy, in 11% cases it was sports and in 7% cases it was fall from height. As per the types of surgery for 46.43%, 25%,

17.86%, 7.14% and 3.57% patients ‘ORIF with buttress plate and screws’, ‘Percutaneous cancellous screw fixation’, ‘ORIF with buttress plate and bone graft’, ‘Cancellous screw and bone grafting’ and ‘ORIF with buttress plate and external fixator’ had been applied respectively. As per Schatzker classification, pure cleavage, cleavage with depression, bicondylar fracture, medial condyle fracture, metaphysiodiaphyseal dissociation and central depression were with 32.14%, 17.86%, 17.86%, 14.29%, 10.71% and 7.14% patients respectively. In this study, for most of the cases the treatment duration was < 10 days which was among 75%. Then ‘up to 3 weeks’ and ‘up to 6 weeks’ were in needed for 17.86% and 7.14% patients respectively. As complication ‘knee stiffness’ was found among the highest number of patients which was in 10.71%. Besides this, malunion, varus deformity, extensor lag and re-depression were found among 7.14%, another 7.14%, 3.57% and another 3.57% participants respectively. The average duration of hospitalization of the participants was 7.5 days (range 4-8 days). In total 19 patients were operated within 2 to 3 days of injury and showed excellent to good results. Nine patients presented at 5-7 days of injury. Amongst them, those patients who had swelling around the proximal leg were kept on skeletal traction and were operated as soon as local tissue condition was optimized for surgery. Average time gap between operation and partial weight bearing was around 8.75 weeks (8 to 13 weeks). The mean period of radiological union was 12.75 weeks (range 12 to 16 weeks). Most of the patients were allowed complete weight bearing at 11 to 14 weeks. Average time gap for complete weight bearing was 13.25 weeks. Most of the patients (n=34) had 120° or more knee flexion. Average range of motion was 112.8°. In this study we found satisfactory outcome in 25 patients which was 89% and not satisfactory in 3 patients which was 11% among all the participants. Final end result as per Rasmussen’s criteria was ‘Excellent’ in 15 (53.57%), ‘Good’ in 10 (35.71%), fair in 2 (7.14%) and poor in 1 (3.57%) patient.



**Fig-I: Age distribution of participants (N=28)**



**Fig-II: Distribution of mechanism of injuries (N=28)**

**Table-I: Distribution of surgery methods among patients (N=28)**

Methods of treatment	n	%
ORIF with buttress plate and screws	13	46.43
Percutaneous cancellous screw fixation	7	25.00
ORIF with buttress plate and bone graft	5	17.86
Cancellous screw and bone grafting	2	7.14
ORIF with buttress plate and external fixator	1	3.57
Total	28	100

**Table-II: Distribution of patients as per Schatzker classification (N=28)**

Type of fractures	n	%
Pure cleavage	9	32.14
Cleavage with depression	5	17.86
Bicondylar fracture	5	17.86
Medial condyle fracture	4	14.29
Metaphysiodiaphyseal dissociation	3	10.71
Central depression	2	7.14
Total	28	100

**Table-III: Period of immobilization of participants (N=28)**

Period of immobilization	n	%
< 10 days	21	75.00
Up to 3 weeks	5	17.86
Up to 6 weeks	2	7.14
Total	28	100

**Table-IV: Complications among participants (N=28)**

Complications	n	%
Knee stiffness	3	10.71
Malunion	2	7.14
Varus deformity	2	7.14
Extensor lag	1	3.57
Re-depression	1	3.57

**Table-V: Final outcome regarding Rasmussen grading (N=28)**

Outcomes	n	%
Excellent	15	53.57
Good	10	35.71
Fair	2	7.14
Poor	1	3.57
Total	<b>28</b>	<b>100</b>

#### IV. DISCUSSION

The aim of this study was to assess the functional outcome of surgical management of tibial plateau fractures. Generally tibial plateau fractures, one of the commonest intra articular fractures, are major traumatic injury occurring due to road traffic accidents, fall from height, violence etc. It is sometimes associated with other bony or soft tissue injuries. Any fracture around the joint (especially weight bearing joint in the lower limb) is of paramount importance as it would result in significant morbidity and quality of life. Hence the treatment of upper tibial fractures with intra articular extension has become a challenge for orthopaedic surgeons. Keeping this aim at high, we presented the clinical study of surgical treatment of 28 closed tibial plateau fractures in this study. It is found that, the zeal of modernization, mechanization and industrial development made more automobile accidents due to increase in population and automobiles. In our study we observed the majority of fractures occur between 20 to 50 years of age with maximum incidence involving productive age group of 31 to 40 years (32%). The mean age in this study was 42.76 years. In a similar study done by Rasmussen et al. the average age of patients was 55 years [11]. In our study the majority of patients were male (57%). This can be attributed to our Indian subcontinent set ups where the female population largely remains indoors and is less prone to automobile accidents. In this study the commonest mode of injury was road traffic accident (46%). This did not correlate well with previous study by Chiaux et al who in their series reported that 71% of the injuries occurred due to RTA [12]. In this series we studied 28 cases of simple tibial plateau fractures treated only by surgical method. Different authors use different criteria for surgical management of these fractures. Seppo E Honkonen in his series of 130 tibial plateau fractures, conducted surgery taking into consideration condylar widening of >5 mm and lateral condyle step off >3 mm [13]. The indication for surgery in these types of injuries has evolved steadily with time. Burri, et al. in his study in 1979 advised internal fixation at 1 mm of depression, Hohl et al. and Segal et al. advocated fixation at 5 mm of depression and Honkonen et al. took 3 mm of depression in consideration in his study in 1993 [14, 15]. In this study the indication for surgery were the same standard indications as for those tibial plateau fractures, 3 mm depression was considered as an indication for surgery. In this study, we found satisfactory outcome in 25 patients which was 89% and not satisfactory in 3

patients which was 11% among all the participants. The period of immobilization was individualized depending upon the rigidity of fixation. The benefits of early knee movement include reduced knee stiffness and improved cartilage regeneration. However these benefits are to be cautiously weighted against their negative impact such as loss of fracture reduction, failure of internal fixation and compromised soft tissue healing. J Schatzker and Robert Mcbroom [5] stated that the prognosis is given by the degree of displacement, type of fracture, method of treatment and quality of post-operative care. In spite some complications we were able to achieve 53.57% excellent, 35.71% good results. In total 11% of patients had 'not satisfactory' outcomes. Ebraheim et al. in his series of 117 tibial plateau fractures had excellent results in 68% of cases, good in 13%, fair in 11% and poor in 8% of the patients [16]. Final end result of our study as per Rasmussen's criteria was 'Excellent' in 15 (53.57%), 'Good' in 10 (35.71%), fair in 2 (7.14%) and poor in 1 (3.57%) patient which was similar to many other international studies.

#### Limitations of the study

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

#### V. CONCLUSION AND RECOMMENDATIONS

In this current study we found satisfactory outcome among most of the patients which was in 89.29%. Such outcome indicates the satisfactory effectiveness of this tenure of surgery for the management of tibial plateau fractures. Besides these, low blood loss, prompt healing and lower rate of complications were noticeable characteristics of this study. For getting more specific findings we would like to recommend for conducting more studies regarding the same issue with larger sized sample.

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