

Assessment of the Functional Outcome of Osteosynthesis of Tibial Plateau Fractures using Different Surgical TechniquesAbhinav Kumar¹, Abhishek Anand², Swati Singh³, Puja Sinha⁴¹Assistant Professor, Department of Orthopaedics, Narayan Medical College & Hospital, Sasaram, Bihar, India²Assistant Professor, Department of Orthopaedics, Narayan Medical College & Hospital, Sasaram, Bihar, India³Senior Resident, General Medicine, Narayan Medical College & Hospital, Sasaram, Bihar, India⁴Medical Officer, CHC, Palkot, Gumla, Jharkhand, India

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Abstract**Aim:** The aim of the present study was to evaluate the functional outcome of osteosynthesis of tibial plateau fractures using different surgical techniques after a minimum period of 6 months by using Rasmussen scoring system.**Methods:** A prospective longitudinal study was conducted for a period of one year at department of Orthopedics. All patients with proximal tibial fracture in the age group between 20 and 60 years were included as our study subjects. Patients presented with neurovascular injuries were excluded from the study and a total of 50 patients satisfying our inclusion and exclusion criteria were taken as our study subjects.**Results:** In our study majority of the study patients were in the age group between 30 and 50 years with more males as compared to females. The type of tibial plateau fracture was classified as per Schatzker classification. In the present study it is shown that type II tibial plateau fracture (40%) was the most common type followed by type VI fracture (22%) and type V (14%) and the incidence of type I, III and IV was 8%. In our study for patients with type I tibial plateau fractures closed reduction with cancellous screw fixation was performed for all the patients, among patients with type II fractures open reduction with internal fixation along with elevation plateau and buttress plating was done for majority of the subjects and for 7 patients with type II fractures bone grafting was done along with this procedure and a similar type of procedure was performed for patients with type III, IV and V tibial plateau fractures. ORIF with dual plating was performed for majority of the patients with type VI fractures. **Conclusion:** In the management of tibial plateau fractures, open reduction with internal fixation using plate screws with lesser soft tissue dissection would lead to excellent functional outcome.**Keywords:** Tibial plateau fracture, open reduction and internal fixation, Rasmussen score, functional outcome.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Knee joint is one of three major weight bearing joints in the lower extremity. The proximal tibial fractures are one of the commonest intraarticular fractures, generally these injuries falls into two broad categories, high energy fractures and low energy fractures. [1-3] The aim of surgical treatment of proximal tibia fracture is to restore congruent articular surfaces of the tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in the knee joint. [4] The various clinical studies established that bone beneath a rigid conventional plate are thin and atrophic which are prone for secondary displacement due to insufficient buttressing and secondary fractures after

removal of plate, fracture site take longer period to Osteosynthesis due to interruption of vascular supply to bone due to soft tissue and periosteal stripping.

Proximal tibia fractures (AO/OTA type 41-C) with diaphyseal involvement are serious injuries and present treatment challenges. [5] The management of high-energy proximal tibial fractures requires the surgeon to take very good care of the soft-tissue envelope as the anteromedial surface of the tibia is covered only with skin and subcutaneous tissues. [6] Poor bone quality and comminuted fracture patterns create difficulty in achieving stable fixation. Any surgical strategy for fracture fixation should demand

the minor infection rates and high union rates without bone grafting and recover the good functional outcome.

Minimally invasive locking plate osteosynthesis (MILPO) is a burgeoning technique providing an alternative to intramedullary devices, external fixation and conventional plate osteosynthesis in complex proximal tibial fractures management. [7,8] The use of MILPO technique, which is rather flexible and allows reducing the surgical trauma. Still articular fractures seem to require precise and stable fixation. [9] The biological complication results from extensive surgical stripping of bone blood supply in an attempt to achieve perfect reduction and absolute stability. Depending on more tolerant, forgiving technologies of internal fixation, single lateral locking plate using MIPO technique has been advocated as a means of decreasing the risk of skin damage, ligament damage, and surgical site infection. [10-12]

The aim of the present study was to evaluate the functional outcome of osteosynthesis of tibial plateau fractures using different surgical techniques after a minimum period of 6 months by using Rasmussen scoring system.

Materials and Methods

A prospective longitudinal study was conducted for a period of one year at department of Orthopedics, Narayan Medical College & Hospital, Sasaram, Bihar, India. All patients with proximal tibial fracture in the age group between 20 and 60 years were included as our study subjects. Patients presented with neurovascular injuries were excluded from the study and a total of 50 patients satisfying

our inclusion and exclusion criteria were taken as our study subjects.

A semi-structured questionnaire was formed to collect the socio-demographic details and the details related to the nature of trauma. The tibial fractures were classified based on schatzker type of fracture classification. Anesthesia fitness was obtained for all patients involved in the study and the operative procedure was done either under general or spinal anesthesia. The operating limb was cleaned and draped. Fracture reduction was done under C-arm guidance by closed methods using ligamentotaxis. Combined traction with Valgus or varus strain was done in flexion or extension of knee as per the need of the individual case. Compression bony clamp was used in cases to bring the fracture fragments together. After confirming the reduction under C-arm guidance fixation of the fracture was done with locking plate. In cases of schatzker type III tibial plateau fracture, the fracture depression was elevated with bent Steinmann pin introduced from the opposite condyle with or without bone grafting. After proper wound wash, wound was closed in layers with drain insitu. Postoperatively standard anteroposterior and lateral radiographs were taken. Functional outcome assessment of knee joint was done after six months post-operatively by using Rasmussen score, which includes pain perception, walking capacity, extension at knee joint, range of movements and stability. All data were entered and analysed using SPSS version 24. Mean and SD were calculated for all parametric variables and percentage was derived for frequency variables.

Chi-square test was used to derive the statistical inference.

Results

Table 1: Age and gender wise distribution of the study subjects

Age group	Male	Female	Total
<30	4	2	6 (12%)
30 – 40	10	7	17 (34%)
41 – 50	8	6	14 (28%)
51 – 60	4	4	8 (16%)
>60	4	1	5 (10%)
Total	30	20	50 (100%)

In our study majority of the study patients were in the age group between 30 and 50 years with more males as compared to females.

Table 2: Distribution of the study subjects based on type of tibial plateau fracture as per Schatzker classification

Type of tibial plateau fracture	Frequency	Percentage
Type I	4	8
Type II	20	40
Type III	4	8
Type IV	4	8
Type V	7	14
Type VI	11	22
Total	50	100%

The type of tibial plateau fracture was classified as per Schatzker classification. In the present study it is shown that type II tibial plateau fracture (40%) was the most common type followed by type VI fracture (22%) and type V (14%) and the incidence of type I, III and IV was 8%.

Table 3: Type of tibial plateau fracture and the mode of interventional procedure

Type of tibial fracture	Operative procedure				Total
	Closed reduction with percutaneous cancellous screw fixation	ORIF + EV + Buttress plate	ORIF + EV + BG + Buttress plate	ORIF + Dual plating	
Type I	4	0	0	0	4(8)
Type II	0	13	7	0	20 (40)
Type III	0	0	4	0	4 (8)
Type IV	0	4	0	0	4 (8)
Type V	0	2	3	2	7 (14)
Type VI	0	0	4	7	11 (22)
Total	4	19	18	9	50 (100)

In our study for patients with type I tibial plateau fractures closed reduction with cancellous screw fixation was performed for all the patients, among patients with type II fractures open reduction with internal fixation along with elevation plateau and buttress plating was done for majority of the subjects

and for 7 patients with type II fractures bone grafting was done along with this procedure and a similar type of procedure was performed for patients with type III, IV and V tibial plateau fractures. ORIF with dual plating was performed for majority of the patients with type VI fractures.

Table 4: Type of operative procedure and the functional outcome assessed by Rasmussen functional grading

Operative procedure	Rasmussen grading				Total	P value
	Excellent	Good	Fair	Poor		
Closed reduction with percutaneous cancellous screw fixation	4	0	0	0	4	0.024
ORIF + EV + Buttress plate	14	5	1	0	20	
ORIF + EV + BG + Buttress plate	7	7	3	0	17	
ORIF + Dual plating	0	5	3	1	9	
Total	25	17	7	1	50	

Patients functional outcome was assessed using Rasmussen functional grading in which the grading ranges from excellent to poor. For majority of the patients who had undergone closed reduction with cancellous screw procedure or open reduction and

internal fixation with buttress plate and bone graft had the functional outcome between excellent and good whereas patients who had underwent dual plating had a fair to poor outcome and this difference was found to be statistically significant ($p < .05$).

Table 5: Type of operative procedure and the complications occurred

Operative procedure	Complications					Total	P value
	Pain	Knee stiffness	Infection	Varus deformity	Nil		
Closed reduction with percutaneous cancellous screw fixation	0	0	0	0	4	4	0.001
ORIF + EV + Buttress plate	5	0	0	1	14	20	
ORIF + EV + BG + Buttress plate	4	0	3	0	10	17	
ORIF + Dual plating	3	4	0	0	2	9	
Total	12	4	3	1	30	50	

In the present study we found pain, knee stiffness and infection as the complications occurred in the patients post-operatively and all these complications were reported in very minimal subjects. Among these complications knee stiffness and pain were most common among the patients for whom dual

plating was done and for the patients who had buttress plating and bone grafting, knee stiffness along with wound infection was common among the patients and the association was found to be statistical significant ($p < .05$). As a long term complication varus type of deformity was reported

in only one patient for whom buttress plating was performed.

Discussion

The most common mode of tibial plateau fracture is either from direct axial compression or due to indirect shearing force. The following are the factors that determine the nature of tibial fracture they are the direction and magnitude of the force, position of the leg at the time of injury and the quality of bone (bone density). The overall prevalence of tibial plateau fracture is 1.3% but when it comes to elderly it is much high of about 8% and among tibial fractures more than 50% are tibial plateau fracture. In younger individuals high energy fractures are more common whereas in older people low energy fracture is more common as it occur secondary to osteopenia. [13] These injuries if not properly managed it would lead onto complications such as non-union, infection and post-traumatic arthritis. Each type of tibial plateau fracture has its own characteristic morphology and the mode of treatment differs. [14] It is highly recommended to determine the force of injury along with the assessment of soft tissue and neurovascular damage before planning the operational management. Previous studies had shown satisfactory results in both open and closed treatment options depending upon on the type and tibial plateau fracture. [15] The various type of managing the tibial plateau fractures apart from conservative management are open reduction and internal fixation, closed reduction and percutaneous fixation and hybrid type of external fixation. [16] The ultimate objective in the management of tibial plateau fracture is to ensure anatomic reduction, restore the axial alignment and maintain a stable fixation such a way to prevent the secondary displacement of fracture fragment. [17]

In our study majority of the study patients were in the age group between 30 and 50 years with more males as compared to females. A study done by Seppo et al [18] almost correlates with our study mentioning the men age as 39.8 years. The type of tibial plateau fracture was classified as per Schatzker classification. In the present study it is shown that type II tibial plateau fracture (40%) was the most common type followed by type VI fracture (22%) and type V (14%) and the incidence of type I, III and IV was 8% and a similar type of scenario was also seen in a study done at Finland and Toronto. [19,20] In our study for patients with type I tibial plateau fractures closed reduction with cancellous screw fixation was performed for all the patients, among patients with type II fractures open reduction with internal fixation along with elevation plateau and buttress plating was done for majority of the subjects and for 7 patients with type II fractures bone grafting was done along with this procedure and a similar type of procedure was performed for patients with type III, IV and V tibial plateau fractures. ORIF

with dual plating was performed for majority of the patients with type VI fractures. Similarly in a study done by Krettek et al [21, 22], one case had wound infection for which wound debridement and re-suturing was done leaving the implant in-situ.

Patients functional outcome was assessed using Rasmussen functional grading in which the grading ranges from excellent to poor. For majority of the patients who had undergone closed reduction with cancellous screw procedure or open reduction and internal fixation with buttress plate and bone graft had the functional outcome between excellent and good whereas patients who had underwent dual plating had a fair to poor outcome and this difference was found to be statistically significant ($p < .05$). Hasnain Raza et al. in his study on functional outcome of tibial condyle fractures using Rasmussen functional scoring system found that majority of the patients had good to excellent functional outcome and only 10% had poor outcome with a mean rasmuseen score of 25.8. [23]

In the present study we found pain, knee stiffness and infection as the complications occurred in the patients post-operatively and all these complications were reported in very minimal subjects. Among these complications knee stiffness and pain were most common among the patients for whom dual plating was done and for the patients who had buttress plating and bone grafting, knee stiffness along with wound infection was common among the patients and the association was found to be statistical significant ($p < .05$). As a long term complication varus type of deformity was reported in only one patient for whom buttress plating was performed. Chang-Wug Oh et al [24] in their study on double plating for type V and type VI proximal tibial fractures using minimally invasive percutaneous osteosynthesis procedure have found more than 80% with excellent scoring and functional outcome with a mean rasmuseen score of 26 and the results are almost in par with our study with respect to type V and type VI proximal tibial fracture management.

Conclusion

In the management of tibial plateau fractures, open reduction with internal fixation using plate screws with lesser soft tissue dissection would lead to excellent functional outcome. Lesser the duration between injury and surgery, lesser the duration of immobilisation and reduced incidence of post-operative infection are the other factors that influence the functional outcome in tibial plateau fractures.

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