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Original research article

Outcome assessment of locking plate osteosynthesis for proximal tibia fractures

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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 two years. The study was started after getting approval from the institutional ethical committee and the informed consent was obtained from all the study subjects involved in our study. 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 100 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 was shown that type II tibial plateau fracture (38%) was the most common type followed by type VI fracture (21%) and type V (15%) and the incidence of type I, and III was 10%, type IV was 6%. 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 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, Rasmuseen score, functional outcome

Introduction

Tibial plateau fractures occur when the proximal tibia bears an excessive axial load and commonly occur in road traffic accidents and sports injuries. It constitutes 1% of all orthopedic fractures and 8% of fractures in the elderly and complex bicondylar fractures constitute 30% of all Tibial plateau fractures [1]. These fractures are intra-articular; therefore, their fixation is an important issue [2]. These fractures classically were described as bumper or fenders fractures. Seventy-five years ago, fractures of the proximal tibia were described as “bumper fractures” because they resulted from low energy pedestrian versus car fender accidents [3]. They gravely affect the biomechanics, stability, and range of motion of the knee joint [4, 5]. Presently, the majority of such fractures are secondary to high velocity injuries like high-speed motor vehicle accidents or falls from heights. Due to this increase in the velocity of the injuring mechanism, we are faced with more number of complex Tibial condyle fractures. Tibial plateau fractures result from direct axial compression, usually associated with a valgus [more common] or varus [less common] component, and an indirect shearing force [6].

In younger individuals high energy fractures are more common whereas in older people low energy fracture is more common as it occurs secondary to osteopenia [7]. 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 [8]. 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.

There was a controversy for a long time in the treatment options for tibial plateau fractures, as it is

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managed both by operative and conservative management. Unfortunately, there is no gold standard treatment approach for various types of tibial plateau fractures; therefore, different methods have been employed depending on the type of fracture. 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 [7].

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 [9]. One of the commonly applied types of these plates is the locking compression plate that provides greater stability in these unstable fractures and creates a stronger connection between the articular components [10]. Stabilizing the joint surface by this method, due to its less invasiveness, not only seems to cause a significant decrease in side effects but also reduces the length of hospital stay and hospital costs [11, 12]. This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven toworth in complex fracture situations and in osteoporosis.

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 two years. The study was started after getting approval from the institutional ethical committee and the informed consent was obtained from all the study subjects involved in our study. 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 100 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 drapped. 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 Rasmuseen 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	10	5	15 (15%)
30 – 40	22	8	30 (30%)
41 – 50	20	7	27 (27%)
51 – 60	9	9	18 (18%)
>60	9	1	10 (10%)
Total	70	30	100 (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.

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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	10	10
Type II	38	38
Type III	10	10
Type IV	6	6
Type V	15	15
Type VI	21	21
Total	100	100

The type of tibial plateau fracture was classified as per Schatzker classification. In the present study it was shown that type II tibial plateau fracture (38%) was the most common type followed by type VI fracture (21%) and type V (15%) and the incidence of type I, and III was 10%, type IV was 6%.

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	10	0	0	0	10
Type II	0	26	12	0	38
Type III	0	0	10	0	10
Type IV	0	6	0	0	6
Type V	0	4	6	5	15
Type VI	0	0	8	13	21
Total	10	36	36	18	100 (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 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	10	0	0	0	10	0.024
ORIF + EV + Buttress plate	28	7	1	0	36	
ORIF + EV + BG + Buttress plate	14	14	8	0	36	
ORIF + Dual plating	0	10	6	2	18	
Total	52	31	15	2	100	

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	10	10	0.001
ORIF + EV + Buttress plate	10	0	0	2	24	36	
ORIF + EV + BG + Buttress plate	6	0	8	0	22	36	
ORIF + Dual plating	5	5	0	0	8	18	
Total	21	5	8	2	64	100	

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

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significant (p<.05). As a long term complication varus type of deformity was reported in only one patient for whom buttress plating was performed.

Fig 1: Pre-op X-ray and Post-op X-ray

Fig 2: Pre-op and Post-op X-ray

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 was shown that type II tibial plateau fracture (38%) was the most common type followed by type VI fracture (21%) and type V (15%) and the incidence of type I, and III was 10%, type IV was 6% and 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* [22], one case had wound infection for which wound debridement and re-suturing was done leaving the implant in-situ.

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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.

References

1. Robert, Egol KA, Koval KJ, Zuckerman JD. Handbook of Factures. 4th ed. Chapter 36. Tibial plateau. Philadelphia, PA; c2010. p. 455.
2. Kulkarni GS, Babhulkar S. Guidelines in Fracture Management Proximal Tibia. 1st ed. Chapter 3. Noida: Thieme Medical and Scientific Publishers Private Limited; c2014. p. 61.
3. Dendrinos GK, Kontos S, Katsenis D, Dallas K. Treatment of high energy tibial plateau fractures by Ilizarov external fixator. J Bone Joint Surg. 1996;78B:710-71
4. Leadbetter GW, Hand FM. Fractures of the tibial plateau. JBJS. 1940;22:559-68.
5. Barr JS. The treatment of fracture of the external tibial condyle:(Bumperfracture). J Ame Med Assoc. 1940;115:1683-7.
6. Kennedy JC, Bailey WH. Experimental tibial plateau fractures. J Bone Joint Surg. 1968;50:1522.
7. Papagelopoulos PJ, Partsinevelos AA, Themistocleous GS, Mavrogenis AF, Korres DS, Soucacos PN, *et al*. Complications after tibia plateau fracture surgery. Injury. 2006;37:475-84.
8. Watson JJ, Wiss AD. Fractures of the proximal tibia and fibula, chapter 44 in Rockwood and Green's fractures in adults, Bucholz RW and Heckman JD, Ed. 5th ed. Philadelphia: Lippincott Williams and Wilkins. 2001;2:1799-1839.
9. Cole P, Levy B, Schatzker J, Watson JT. Tibial plateau fractures. In: Browner B, Levine A, Jupiter J, Trafton P, Krettek C, eds. Skeletal Trauma: Basic Science Management and Reconstruction. Philadelphia, PA: Saunders Elsevier; c2009. p. 2201-2287.
10. Tejwani NC, Hak DJ, Finkemeier CG, Wolinsky PR. High-energy proximal tibial fractures: treatment options and decision making, Instructional Course Lectures. 2006;55:367-379.
11. Nikolaou VS, Tan HB, Haidukewych G, Kanakaris N, Giannoudis PV. Proximal tibial fractures: early experience using polyaxial locking-plate technology, International Orthopaedics. 2011;35(8):1215-1221.
12. Jones CB. Locked plates for proximal tibial fractures, Instructional Course Lectures. 2006;55:381-388.
13. Joon-Woo K, Chang-Wug O, Won-Ju J, Ji- Soo K. Minimally Invasive Plate Osteosynthesis for Open Fractures of the Proximal Tibia. Clin Orthop Surg. 2012;4(4):313-320.
14. Monappa AN, Arora G, Tripathy SK, Rao SK. Clinical and radiological outcome of percutaneous plating in extra-articular proximal tibia fractures: A prospective study. Injury 2013;44(8):1081-1086.
15. Cole P, Levy B, Schatzker J, Watson JT. Tibial plateau fractures. In: Browner B, Levine A, Jupiter J, Trafton P, Krettek C, eds. Skeletal Trauma: Basic Science Management and Reconstruction. Philadelphia, PA: Saunders Elsevier; c2009. p. 2201-2287.
16. Papagelopoulos PJ, Partsinevelos AA, Themistocleous GS, Mavrogenis AF, Korres DS, Soucacos PN. Complications after tibia plateau fracture surgery. Injury. 2006;37:475-84.
17. Watson JJ, Wiss AD. Fractures of the proximal tibia and fibula, chapter 44 in Rockwood and

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Green's fractures in adults, Bucholz RW and Heckman JD Ed.
18. Honkonen SE. Indications for surgical treatment of tibial condyle fractures. Clinical Orthopaedics and Related Research®. 1994 May 1;302:199-205.
19. Stenroos A, Pakarinen H, Jalkanen J, Mälkiä T, Handolin L. Tibial Fractures in Alpine Skiing and Snowboarding in Finland: A Retrospective Study on Fracture Types and Injury Mechanisms in 363 Patients. Scandinavian Journal of Surgery. 2016;105(3):191-196.
20. Schatzkar J, Mc Broom R, Bruce D. The tibial plateau fractures-Toronto experience. Clin Orthop. 1979;138:94.
21. Krettek C, Gosling T, Schandelmaier P, Muller M, Hankemeier S, Wagner M, *et al*. Single lateral locked screw plating of bicondylar tibial plateau fractures. Clin Orthop Relat Res. 2005;439:207-14.
22. Raza H. Minimally invasive plate osteosynthesis for tibial plateau fractures, Journal of orthopaedic surgery. 2012;20(1):42-7.
23. Jong-keun O, Chang-wug O, In-Ho J, Sung-Jung K, Hee-Soo K, Il-Hyung P, *et al*. Percutaneous plate stabilisation of prximaltibial fractures. J Truama. 2005;5:431-7.