

## Functional Outcome of Proximal Tibial Sagittal Fractures Treated with Minimally Invasive Plate Osteosynthesis

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### Abstract

**Background:** Tibial plateau fractures are common intra-articular fractures, representing 1-2% of all fractures. Modern locking plate systems provide increased angular stability, have a low implant profile, improved design matching the peri-articular bone surface and are compatible with minimally invasive techniques. We evaluated the functional outcome of tibial plateau sagittal fractures using a locking compression plate done via a minimally invasive technique.

**Material and methods:** 60 cases of sagittal plane proximal tibial fractures of Schatzker type I, IV, V, and VI fractures were treated using locking compression plate via minimally invasive techniques and were assessed for functional outcome by Modified Rasmussen's score.

**Results:** A total of 52 patients with a mean age of 43.71 years were included in the study (8 patients were lost in follow-up). 39 were male and 13 were female. 30 patients (58%) had excellent, 19 patients (36%) had good, 3 patients (6%) had fair functional outcome and none of the patients had a poor outcome. The mean Rasmussen score in the series was 25.85.

**Conclusion:** Internal fixation of proximal tibial sagittal fractures with locking plates, following the principles of MIPO (Minimally invasive percutaneous osteosynthesis) provides, satisfactory fracture reduction, less damage to soft tissues, allows early mobilization and excellent to good functional outcome even in these complex tibial plateau sagittal fractures.

**Keywords:** Tibial plateau fracture, Locking compression plate, Proximal tibial fracture

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### Introduction

Proximal tibial fractures account for 5-11% of all tibia fractures. These fractures are quite challenging to manage because they are associated with severe soft tissue injuries and are notoriously difficult to reduce, align and stabilize [1-3]. These fractures usually result from direct axial compression, with a valgus (more commonly) or varus movement along with indirect shear forces [4,5]. Schatzker classification is the most commonly used classification as it defines the patho-anatomy of the fracture and suggests optimal treatment

strategies. A new CT scan-based classification system was recently developed that takes into account the medial, lateral and posterior aspects of the tibial plateau which provides accurate delineation of all significant fracture planes. This column based classification also helps in pre-operative planning, for the treatment of these fractures [6].

Conservative treatment of proximal tibial fractures is commonly associated with problems of knee stiffness, prolonged treatment, mal-union, deformity, and arthritis [7,8]. Conventional open plating may lead to

reduction loss, loosening of the implant, wound infections, skin necrosis, and extensive soft tissue dissection. External stabilization with pins and rods may cause pin site infections, septic arthritis, malunion, and deformity. Minimally invasive percutaneous plate osteosynthesis techniques (MIPO) overcome these complications and have led to improvement in the outcome of these fractures owing to the advantages of indirect reduction technique, preservation of soft tissues, and vascularity of the bone, preservation of the osteogenic hematoma, and improved quality of fixation with locking compression plates. We evaluated the functional outcome of proximal tibial sagittal fractures treated with a locking compression plate done by minimally invasive percutaneous plate osteosynthesis.

### Material and methods

This study was conducted at our center from September 2018 to July 2020 in 60 patients of proximal tibial sagittal fractures treated by locking compression plate using a minimally invasive approach. The study was approved by the institutional ethical review committee and written informed consent was obtained from all the participants.

All patients of closed proximal tibial sagittal fractures of more than 18 years of age with Schatzker type I, IV, V, or VI i.e. sagittal plane fracture without depression were included in the study. Fractures with associated neurovascular injury, Schatzker type II or III (depressed fracture which needed elevation of the fragment), open or pathological fractures were excluded from the study.

After stabilizing the patient haemodynamically and primary care, patients were assessed radiologically by standard AP and lateral views, and a CT scan of the involved knee joint was done. The fractured limb was initially immobilized with above-knee slab application and was kept elevated over Bohler-Braun splint to decrease the swelling. Preoperative investigations were done and fitness for surgery was obtained. Minimal invasive plate osteosynthesis by locking

compression plate was planned for all the patients, once the swelling subsided.

All patients were operated in a supine position with a bolster under the knee in spinal anesthesia under a tourniquet via minimal invasive anterolateral approach using single proximal and multiple distal stab incisions. Under the guidance of the image intensifier, the fracture was reduced closed or by using k wire joysticking technique and following this a submuscular single lateral hockey locking plate was slid over the periosteum and fixed with appropriate size locking screws, both proximally and distally (fig 1).

Post-operatively, the patients were mobilized with knee range of motion from day two. Initially, partial weight-bearing was started which gradually progressed to full weight-bearing as per the pain tolerance. Functional outcome was assessed by Modified Rasmussen's score and pain, walking capacity, knee extension range of motion, stability, and power of quadriceps were also assessed. The Chi-Square test was used to calculate the statistical significance and a probability value of  $<0.05$  was considered significant.

### Result

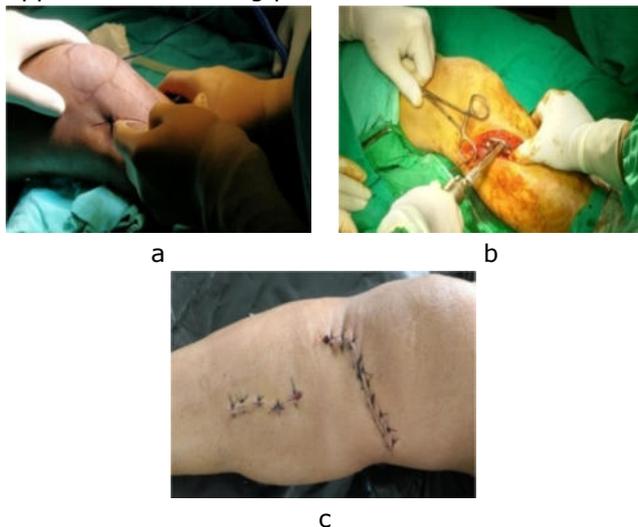
60 patients with proximal tibia sagittal plane fractures treated with minimal invasive plating were included in the study. 8 patients were lost to follow-up and hence 52 patients were available for assessment at final follow-up. The mean age of the patients was 43.71 years (range 24 to 69 years). 39 were male and 13 were female. 30 patients sustained an injury on the right side whereas 22 patients had an injury on the left side. The most common mode of injury was road traffic accident as seen in 45 patients whereas 7 had an injury due to fall from height. Schatzker type I, IV, V, and VI fracture was seen in 20, 7, 16, and 9 patients, respectively.

The mean duration of surgery was 73.09 min (range 67 min to 84 min). Union was seen in all patients in a mean duration of 13.30 weeks (range 9 to 18 weeks). The mean Rasmussen score was 25.85 (range 24 to 28). At the final follow-up, 30 (58%) patients had excellent

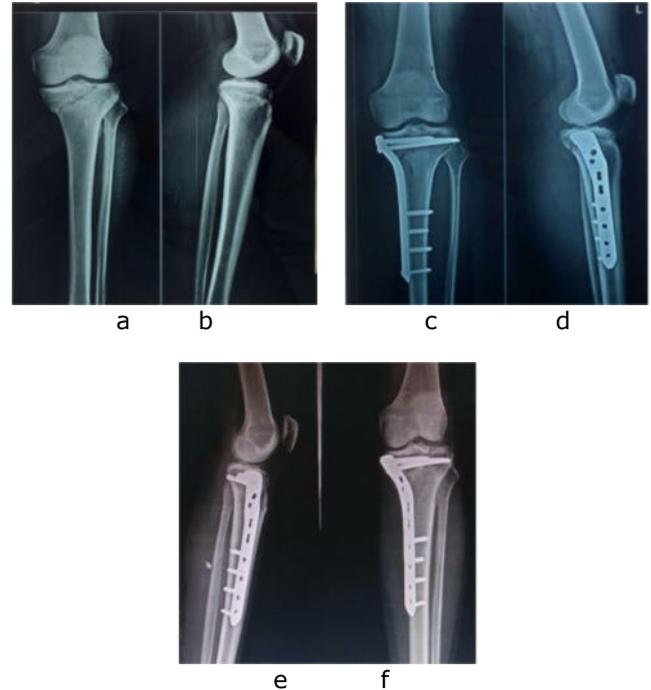
outcomes, 19 (36%) patients had a good outcome and 3 (6%) patients had a fair outcome. None of the patients in our series had poor outcome (fig 2). The time to union and functional outcome by Rasmussen score as per the Schatzker classification is given in table 1.

Complications seen were knee stiffness in one case and wound dehiscence in one case, both of which were managed by physiotherapy and conservative treatment by regular dressing, respectively. Two of our patients had infection, of which one required implant removal whereas the other healed with dressing and antibiotics only.

**Fig 1.** Intra-operative clinical photographs (a to c) demonstrating minimal invasive anterolateral approach and locking plate fixation.



**Fig 2.** Pre-operative (a,b), immediate postoperative (c,d), and 1-year final follow-up (e,f) anteroposterior and lateral X-ray of tibial plateau fracture treated by MIPO locking plating, respectively.



**Table 1.** Union time and functional outcome as per the Schatzker classification

Schatzker classification	No of patient	Time of union (in wk)	Mean Rasmussen score
Type I	20	10	28.2
Type IV	07	14.85	27
Type V	16	15.75	26.56
Type VI	09	15.11	25.3

**Table 2.** Comparison of our results with other studies

S.No	Author	Year	Patients	Criteria	Follow up (in month)	Complications	Results
1	Our study	2021	52	Rasmussen	12	1 case (knee stiffness) 2 cases (deep seated infection) 1 case (wound dehiscence)	95%
2	Biggi et al [8]	2010	58	Rasmussen	18	3 cases (non-union)	78%
3	Raza et al [9]	2012	41	Rasmussen	12	1 case (late onset deep infection)	90%
4	Rambold [10]	1960	30	Lansingers	6	None	93%
5	Honkonen [11]	1994	60	Rasmussen	6	2 cases (knee stiffness) 1 case (malunion) 3 cases (infection & wound dehiscence)	86%
6	Schatzker [12]	1979	30	Rasmussen	6	3 cases (Knee stiffness)	86%
7	Prasad [13]	2015	30	Rasmussen	6	None	83.4%

## Discussion

Management of tibial plateau fractures requires anatomical reduction, rigid fixation, and early mobilization. Conventional non-locking plating has a high rate of complications owing to the fact that it requires open reduction, extensive soft tissue dissection, high wound healing complication, provides poor stability, loosening of the implant, loss of reduction, delayed mobilization, and knee stiffness. Locking plate by virtue of its features, like increased stability, minimally invasive approach, indirect reduction, anatomically pre-contoured shape and preservation of soft tissue have given excellent results [4,5].

We evaluated the outcome of 52 proximal tibial sagittal fractures treated with minimally invasive percutaneous plate osteosynthesis with a mean age of 43 years and found that more than 90 % of the patients had excellent to a good outcome and none of the patients had poor outcome as per Rasmussen criteria. In our series, the mean score was 25.85 at the final follow-up of 12 months, and the mean union time was 13.30 weeks.

The patient profile in our study was almost comparable to the studies by Biggi et al, Raza et al, Rombold et al, Honkonen et al and Schatzker et al in respect to mean age, number of patients, male to female ratio, and mode of injury (table 2) [8-12]. But results in our study were marginally better than these studies because we included only sagittal plane fractures in our study that included Schatzkertype I, IV, V and VI and have excluded type II and type III (depressed) fractures. While other studies have included all types of fractures. Type II and III fractures typically involve a depressed fragment and management of these fractures needs

elevation of the depressed fragment and buttress below the fragment to prevent the re-depression.

The complications in our study, were also marginally lower than the complications as seen with other studies [13-23]. Complications found in our study were stiffness and wound dehiscence in one patient each. A patient with stiffness was treated by a range of motion exercise whereas a patient with wound dehiscence was treated by regular dressing, on which the wound healed. Infection was seen in two of our patients, which was treated by implant removal in one patient and regular dressing and antibiotics in another. Both of which healed well. Tibia being a subcutaneous bone and tibial plateau fractures being associated with severe soft tissue trauma, the internal fixation of the proximal tibia fractures is associated with severe wound healing-related complications. Minimal invasive plate osteosynthesis provides advantages of greater stability, with minimal damage to the soft tissue envelope. Hence it provides early rehabilitation, early return to the range of motion with the early union, and hence excellent results as seen in our study. Our study is limited by shorter follow-up, lesser number of patients and lack of control group.

## Conclusion

Tibial plateau fractures treated by minimally invasive plate osteosynthesis result in rapid healing of fractures without many wound healing problems due to lesser tissue damage, preservation of fragment vascularity and minimal disturbance of fracture site biology. It also provides increased stability and early rehabilitation due to the use of locked plates.

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