



## Original Research Article

## Surgical outcome of tibial condyle fracture with MIPPO technique

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## ABSTRACT

**Background:** Tibial condylar fractures are very common in road traffic accidents; however, sports injury, fall and other trivial trauma can frequently produce these fractures. These are unstable fractures and quite challenging to manage. This study was undertaken to evaluate locking compression plate (LCP) fixation in proximal intra articular tibia fractures by MIPPO (minimally invasive percutaneous plate osteosynthesis) technique.

**Materials and Methods:** The study was conducted from October 2016 to 2018. 20 cases who had sustained tibial plateau fractures (Schatzker type I- VI) and operated with LCP fixation using MIPPO technique were included in this study after obtaining informed consent. Follow-up was done at 6 weeks, 12 weeks, 18 weeks and 24 weeks after the surgery and they were evaluated in accordance with modified Rasmussen knee scoring system.

**Results:** Modified Rasmussen functional knee scoring system and modified Rasmussen criteria for radiological assessment was used to analyse the functional outcome among the cases. After evaluation it was observed that 90% of the patients had good to excellent performance.

**Conclusion:** MIPPO technique enables soft tissue stripping via a small surgical incision and provides a rigid fracture reduction. There is also a reduced chance of post traumatic soft tissue injury. Proximal Tibial locking plate is a good device to stabilize the fractures of Tibial plateau (intra articular), especially when used in conjunction with meticulous intraoperative handling of the soft tissues and active participation of the patients in the rehabilitation programme is ensured.

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## 1. Introduction

Tibial plateau fractures comprise of 1% of all the fractures and 8% of fractures in the elderly.<sup>1</sup> Tibial condylar fractures are very common in road traffic accidents; however, sports injury, fall and other less violent trauma can frequently produce these fractures.<sup>2</sup> They have various configurations depending upon the force of injury. The comminuted type is characterized by the loss of articular congruity, dissociation of the diaphysis from the metaphysis and is often associated with severe soft tissue injuries around the knee that require special clinical attention.<sup>3</sup> Complex fractures of the tibia are difficult to treat and they represent

one of the most challenging tasks in orthopaedic surgery.<sup>4</sup> Complex fractures of the tibial plateau constitute significant bony and soft-tissue injuries within and around the knee joint.<sup>5</sup>

There is a wide range of treatment options that are available for proximal tibial fractures. Locking plates may decrease the need for dual plating in certain bicondylar fracture patterns. Locking plate placed in the lateral side in case of bicondylar tibial fractures might be a stable enough fixation when medial condyle is not comminuted and there is no separate posteromedial fragment. Dual plating is needed in cases of bicondylar tibial condyle fractures with a separate posteromedial segment or when there is complete separation of the entire medial plateau and medial articular comminution.<sup>6</sup> Plating (open or minimally invasive) and

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external fixation (circular or hybrid constructs) have been used for the management of complex fractures of the Tibial plateau. However, due to the diverse characteristics of the fracture and certain patient related characteristics, there have been contradictory results noted regarding the effectiveness of each technique.

## 2. Materials and Methods

### 2.1. Source of data

The proposed study is a hospital based prospective study conducted at Kempegowda institute of medical science and research center during the time period of October 2016 - 2018. The results were compiled & analyzed using modified Rasmussen scoring system and modified Rasmussen criteria for radiological assessment.

### 3. Method of collecting data

All cases presenting to the outpatient and emergency department fulfilling the below mentioned criteria were recruited for the study.

#### 3.1. Inclusion criteria

1. Age group more than 18 years.
2. Closed fracture.
3. Schatzker type I to VI

#### 3.2. Exclusion criteria

1. Pathological fractures
2. Untreated fractures, for more than 3 weeks
3. Fractures with compartment syndrome or impaired circulation
4. Compound fracture
5. Patients medically unfit for surgery

Patients subjected to surgery were followed up at regular intervals with clinical and radiological evaluation. Assessment was done based on a Performa containing all necessary information.

#### 3.3. Approach and incision

Due to the relatively subcutaneous nature of the tibia and the associated soft-tissue injuries with Tibial condyle fracture, there is a high risk for wound complications. The matter is further complicated by the extent of fracture, need for a good fracture visualization and excellent reduction as well as a stable fixation.

The amount of soft-tissue dissection necessary with single or double incisions varies significantly. When the likelihood of future knee arthroplasty is also taken into consideration, it becomes clear that the surgical approach in Tibial condyle fracture is of utmost importance.<sup>7</sup>

Although a single anterior incision allows access to both Tibial condyles and poses the least issues for future arthroplasty surgery, it necessitates extensive soft-tissue dissection and has the potential of wound complications. A dual-incision approach for double plating reduces the risk of wound breakdown when compared to a single incision due to more direct access to the fracture and less dissection.

Locking-plate technology might obviate the need for medial exploration and instrumentation. It also provides for minimally invasive techniques through an anterolateral incision in many bicondylar Tibial condyle fractures.<sup>7</sup>

### 3.4. Recommendation

A two-incision approach centered over the fragments but not directly over the plates is recommended for bicondylar Tibial condyle fractures that are not amenable to lateral locking-plate fixation alone. Care must be taken to leave an adequate skin gap between the incisions.<sup>7</sup>

A single anterolateral incision is sufficient for fractures that can be stabilized with lateral buttress plating or locking plates and the dissection can be further minimized by using minimally invasive techniques.<sup>7</sup>

A posteromedial incision is indicated for medial fracture dislocations, posteromedial-plateau fractures and posterior metaphyseal-wedge fractures.<sup>7</sup>

## 4. Results

This was a prospective study to evaluate Tibial plateau fractures managed by MIPPO technique with locking compression plates. The study includes cases of Tibial plateau fractures presenting to the emergency and outpatient department at Kempegowda institute of medical science and research center, Bangalore from October 2016 to May 2018.

20 patients of tibial plateau fractures, who met the inclusion criteria were selected for the study after obtaining an informed consent from each of them.

### 4.1. Age incidence

It was observed that fractures of Tibial plateau were more common amongst the younger and middle-aged population with a higher incidence noted between the 3<sup>rd</sup> to 6<sup>th</sup> decade. The age group of 31-60 years is perhaps the most productive period of one's life. Thus, severe injuries seen in this age group are bound to have a negative effect on the quality of life and it necessitates the need for an appropriate treatment of these injuries.

### 4.2. Fracture grade (Schatzker classification)

All the 20 fractures analyzed in this study were graded in accordance to the Schatzker classification. It was observed that most of these fractures, i.e., 12 out of 20 (60%) were type V and VI. This signified that majority of the fractures

in this study included severely comminuted intra-articular fractures and were attributed to high velocity trauma.

#### 4.3. Pre-operative complications

In our study, impending compartment syndrome was observed in 3 patients i.e. 15%. Thus, stressing on the need of careful pre-operative examination of the neuro-vascular status of these patients. This also signifies the severity of the trauma in such fractures.

#### 4.4. In our complications

study, complication in the form of infection was observed in 1 case (5%). As it was noted to be a superficial infection, treatment was initiated with intravenous antibiotics according to the culture and sensitivity report. This can be attributed to the wound management protocol in the emergency department in conjunction with radical debridement, ensuring skillful handling of soft tissues and perioperative antibiotic coverage.

Finally, modified Rasmussen functional grading and modified Rasmussen criteria for radiological assessment were applied to analyze the outcome among the cases in this study. The criteria involved pain, range of motion at the knee, walking capacity, residual extension lag and stability for functional outcome whereas articular depression, condylar widening, valgus and varus stress and progression to osteoarthritis were used for radiological assessment to determine the final outcome. After evaluation, it was observed that 60% of patients had excellent performance (12 patients), 30% showed good performance (6 patients) and 2 were noted to have fair results. 90% had satisfactory results (excellent and good results) in our study. The average range of motion in our study was 0 (range 0-15 degrees) to 130 degrees (range 100-140 degrees).

Radiological examination revealed 80% had good to excellent results (9-excellent, 7-good) and 20% had fair results. There were no cases of nonunion or mal-union in the study.

## 5. Discussion

High energy intra articular fractures involving the tibial plateau are serious injuries and are usually associated with problems related to management such as; wound dehiscence and severe comminution leading to malalignment. They are also associated with significant secondary early and late complications.

A prompt diagnosis, thorough preoperative assessment of the bony and soft tissue trauma, adequate soft tissue monitoring and resuscitation, anatomic reduction as well as a stable fixation allows for early joint mobilization and good clinical results. In the current study, we had final a follow up of 20 patients.



**Fig. 1:** Pre operative planning x ray



**Fig. 2:** Implant



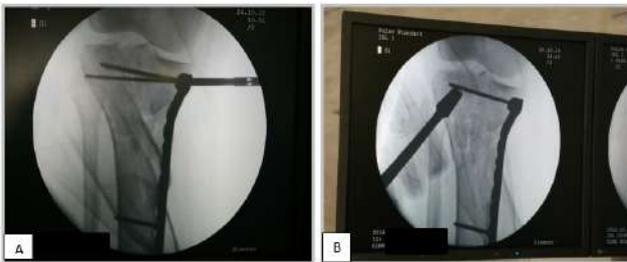
**Fig. 3:** Intra operative planning of incision



**Fig. 4:** Elevation of tibialis anterior



**Fig. 5:**

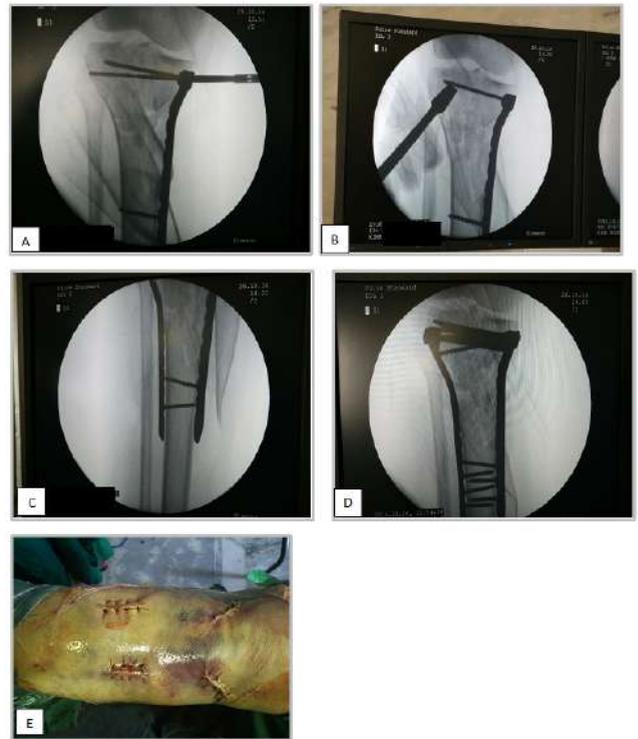


**Fig. 6:**

**5.1. Age and sex incidence**

In our study it was observed that fractures of tibial plateau were more prevalent in the younger and middle-aged population with the mean age being 44.35 years (range 23-70 years). Men were more commonly affected than women (12 males and 8 females). The results were comparable to those obtained in previous studies, as listed below (table 1)

Proximal Tibial fractures seen in younger and middle-aged population is more common probably due to the increased likelihood of involvement in outdoor activities and



**Fig. 7:** Intra operative percutaneous fixation

hence they are also prone to injury as a result of vehicular accidents.<sup>12-14</sup>

**5.2. Mode of injury**

In our study majority of the patients suffered such fractures after road traffic accidents (70% of cases; 14 patients) and the remaining were noted to have a history of fall (30% of cases; 6 patients).

In the study by Biggi F et al.,<sup>8</sup> automobile and motorcycle collision were the most common mode of injury (61%; that is 35 out of 58 patients) followed by domestic fall accounting for 21% (12 out of 58 patients) as the cause of injury. Whereas in the study by Rademakers et al,<sup>15</sup> motor vehicle crash was the most common mechanism of injury noted in 78% of cases and similarly, Sangwan et al<sup>16</sup> also enlisted road traffic accident to be the mode of injury in 21 out of 25 patients in his study.

Lee et al.<sup>9</sup> in his study noted the cause of injury to be; automobile-versus pedestrian accident in 17 patients, motor vehicle accident in 11 patients (approximately, 71% by accidents), a history of fall in 4 patients, and the remaining cases were attributed to other causes. Thus, proximal Tibial fractures are more common after high energy trauma especially motor vehicular accidents.

**Table 1:** Comparison of the mean average age and gender in tibial plateau fractures.

	Mean age (years)	Gender	
		Male	Female
Current study	44.35	12	8
Biggi F et al <sup>8</sup>	43	39	19
Lee et al <sup>9</sup>	42	23	12
Stannard et al <sup>10</sup>	42	25	12
Schutz et al <sup>11</sup>	42	16	6

### 5.3. Fracture type and grade

All the 20 fractures analyzed in this study were graded in accordance to the Schatzker classification and have been listed below in comparison to a study conducted by Sangwan et al<sup>16</sup> previously (table 2).

Majority of fractures included in the study were severely comminuted intra-articular fractures. Higher grade of these fractures is due to high velocity trauma.<sup>14,17–21</sup>

### 5.4. Fracture union

Clinical union is defined as a painless fracture site during full weight bearing and radiographic union as bridging trabeculation across the fracture lines on three out of four cortices seen on orthogonal projection in the absence of migration, loosening, or breakage of hardware.<sup>14</sup>

The healing process was determined both clinically and radiographically. In our study the mean time to union was 14.6 weeks, with 50% of fractures uniting in 12–16 weeks.

In the study by Biggi F et al.,<sup>8</sup> 94% cases had radiological union by 16–18 weeks' time. Similarly, Stannard et al<sup>10</sup> noted the average time duration to be 15.6 weeks in a study including 34 fractures.

Thus, in our study the rate of fracture union was in accordance with the other studies using locking plates.

### 5.5. Compartment syndrome

In our study there were 3 cases (15%) of impending compartment syndrome. Patients were managed conservatively with strict immobilization; foot end elevation and anti-edema measures were taken to reduce the intra compartmental pressure.

Zura et al.<sup>22</sup> in his study reported the incidence of compartment syndrome after Tibial plateau fracture to be as high as 31% with a positive correlation to fracture severity.

In one of the studies by Barei et al.<sup>23</sup> on high energy Tibial plateau fracture, 14.5% had an associated compartment syndrome and Schutz et al.<sup>11</sup> noted 15 out of 22 patients to develop closed soft tissue damage; amongst whom 8 cases required incision of the compartments. Whereas in another study by Egol et al.,<sup>24</sup> multiple debridement's and eventual split thickness skin grafting before fixation was required in one patient who developed acute compartment syndrome.

These studies indicate the need for a heightened awareness towards the development of compartment syndrome after high-energy Tibial plateau fractures.

### 5.6. Complications

In our study complication in the form of superficial infection was observed in 1 case (5%), which was treated with intravenous antibiotics according to culture and sensitivity report. In the study conducted by Lee et al.,<sup>9</sup> deep tissue infection developed in two patients (8%) and was attributed to the high-energy trauma which are often associated with a high rate of soft tissue complications. Whereas, Stannard et al.<sup>10</sup> reported an incidence of 5.9% cases with tissue infection and two cases being superficial infections.

The incidence of infection as a complication in our study is comparable to other studies that have been conducted before.

### 5.7. Functional outcome

In the current study, modified Rasmussen scoring<sup>15</sup> was applied to analyze the functional outcome among the cases. After evaluation it was observed that 90% of patients had satisfactory results (excellent -12 patients; good- 6 patients). Average flexion at the knee was 0 degree to 130 degree.

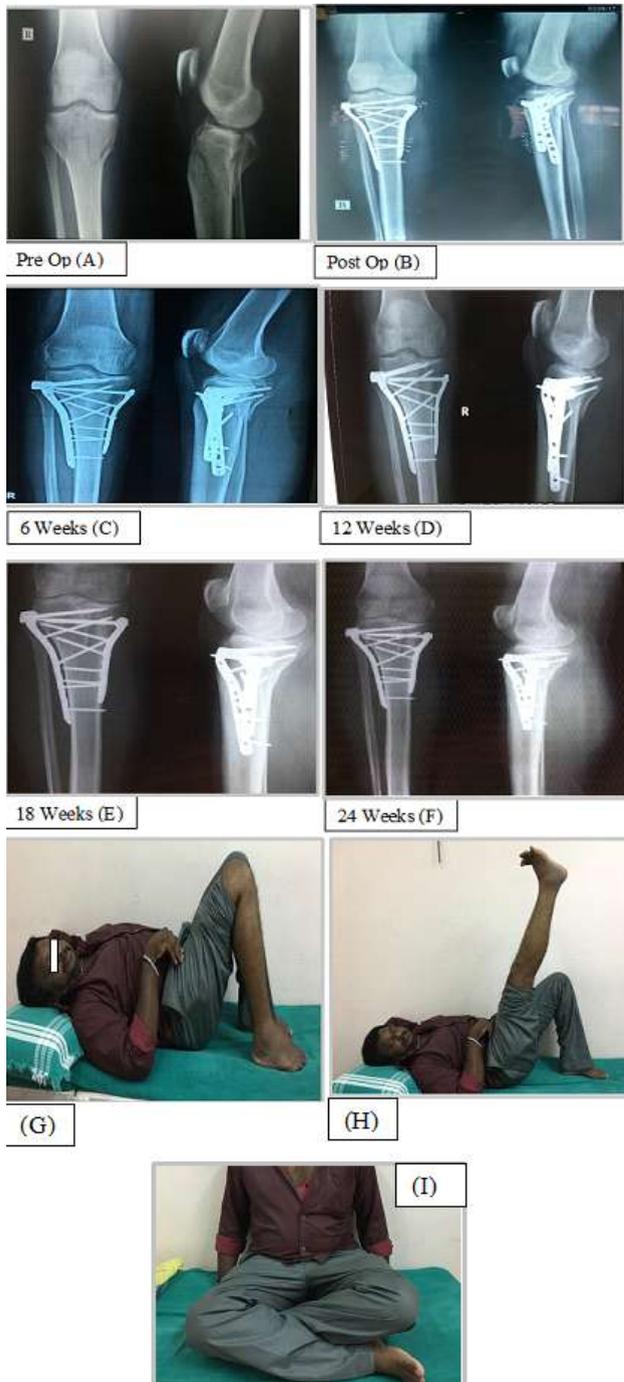
In the study done by Biggi F. et al.<sup>8</sup> the average Rasmussen score was 25 at the end of 6 months the and the results were good to excellent in 41 out of 58 patients (87%). Lee et al.<sup>9</sup> in his study concluded that the overall range of knee motion averaged 105 degree at the last follow-up. Whereas Stannard et al.<sup>10</sup> noted a mean range of 1 degree (range 0–10degree) -127 degree (range 90 -145 degrees) of knee motion in his study.

Schutz et al.,<sup>11</sup> concluded that proximal tibia LCP system ensured stable fixation until healing when applied for the treatment of proximal Tibial fractures. The range of motion noted was 0–105 degree. In three cases after complete healing, a restriction averaging 85 degree was observed at the knee joint and an extension deficit of 10 degree was observed in one case.

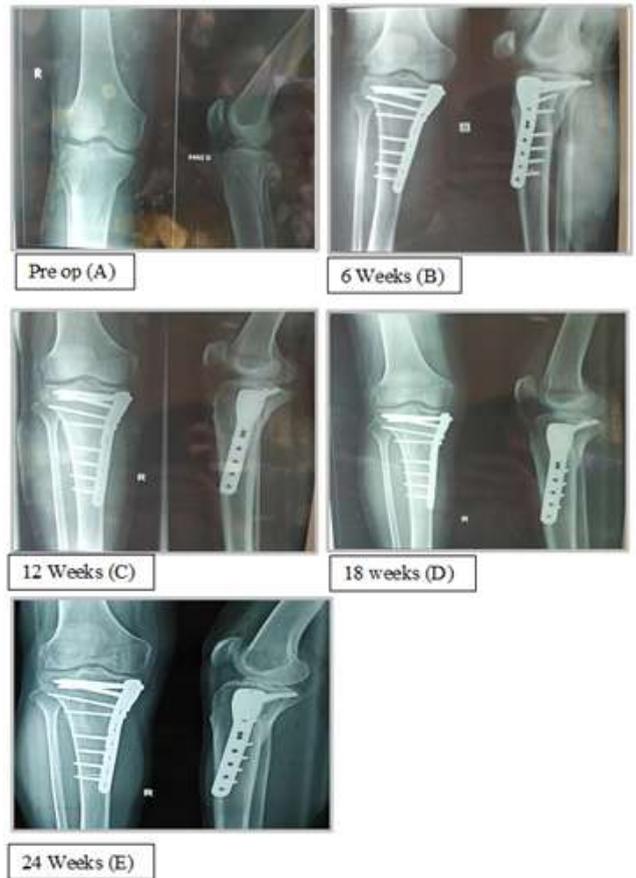
In another study by Egol et al.<sup>24</sup> at the last follow-up, the mean knee extension was 1° (0–15°) and the mean knee flexion was 109.3° (60–135°), they believed the locking plate to be a sound option for the treatment

**Table 2:** Comparison of tibial plateau fracture grade according to Schatzker classification

Schatzker type:	I	II	III	IV	V	VI
Current study (no. of patients):	5	2	-	1	7	5
Sangwan et al <sup>16</sup> (no. of patients):	9	1	-	5	2	8



**Fig. 8:** Good results



**Fig. 9:** Good results



**Fig. 10:** Functional outcome (Good Results)



**Fig. 11:** Fair outcome



**Fig. 12:** Functional outcome (Fair Outcome)



**Fig. 13:** Impending compartment syndrome



**Fig. 14:** Infection (Superficial)

of bicondylar tibial plateau fractures as it provided stable internal fixation with a low rate of complications and very good clinical results. Furthermore, they felt that fractures that have historically required plating through two separate incisions could be treated with one laterally placed implant.

Reduced knee motion after tibia plateau fractures is a common occurrence, which is due to articular involvement. These effects are greatly magnified by immobilization after fracture or internal fixation. Early stable fixation of the fracture, meticulous soft-tissue handling and immediate mobilization of the knee maximize the chances of optimal outcomes after most Tibial plateau fractures.<sup>25,26</sup>

## 6. Conclusion

Proximal Tibial locking plate is a good device to stabilize the fractures of tibia plateau (intra articular) especially when used in conjunction with meticulous intraoperative handling of soft tissues and active participation of the patients in the rehabilitation programme is ensured.

MIPPO technique is expected to minimize the size of the surgical incision, and it also enables soft tissue stripping via a small incision to provide a rigid fracture reduction and reduced post traumatic soft tissue injury. Since MIPPO technique provokes limited surgical insult to surrounding soft tissue and to the healing process, infection rates are minimal and fracture healing is better with decreased chances of non-union; thereby also reducing the incidence of complications.

## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

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