

## Study of Functional Outcome of Proximal Tibial Fractures Managed With Locking Compression Plate

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### Abstract:

**Background:**With day to day increase in Road Traffic Accidents, there is also a considerable increase in the incidence of proximal tibia fractures. Knee is a major weight bearing joint of the lower limb consequently any fractures involving the proximal tibia will definitely compromise the knee function and stability. Proper anatomical reduction and soft tissue management is necessary for obtaining stable, congruent mobile joint. With the development of LCP (Locking Compression Plate), and MIPPO (Minimally Invasive Percutaneous Plate Osteosynthesis) technique has revolutionized the treatment of proximal tibia fractures which help in minimizing soft tissue injuries and damage to vascular integrity of fracture fragments.

**Aim:**To restore of anatomical articular congruity, stability, and management of soft tissue injuries along with concomitant ligamentous injuries and to promote early mobilization of knee joint.

**Objective:**The present study was done to evaluate the effectiveness of Locking Compression Plate in the management of proximal tibia fractures.

**Materials and methods:**The study was carried out in Department of orthopaedics, Siddhartha medical college, Govt. General Hospital, Vijayawada, Andhra Pradesh from November 2019 to June 2021.

**Results:** The clinical assessment was made according to Rasmussen's functional grading system. End results showed excellent outcome in 23 cases and good outcome in 6 cases and fair outcome in one case. Out of them 2 patients had infection, 2 patients had stiffness and one patient had varus deformity at the end of final follow-up.

**Conclusion:**In order to attain optimal knee function, surgical management of proximal tibial fractures with Locking Compression Plate will result in excellent anatomical reduction and rigid fixation to restore articular congruity, promote early mobilization, and reduce post-traumatic osteoarthritis.

**Keywords:** Proximal tibia fractures, locking compression plate, minimally invasive percutaneous plate osteosynthesis (MIPPO).

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### I. Introduction

Knee is a major weight bearing joint of the lower limb consequently any fractures involving the proximal tibia will definitely compromise the knee function and stability.

There are two categories of proximal tibial fractures: Articular and non-articular. Articular fractures are termed tibial plateau or tibial condylar fractures. Fractures of the tibial plateau account for around 1% to 2% of all long bone fractures<sup>1</sup>. These fractures represent a wide spectrum of severity ranging from minimally displaced articular injuries that heal predictably well with nonoperative treatment to high-energy comminuted fractures that present multiple challenges to the treating orthopaedic surgeon. Comminuted fractures are more common in younger individuals due to high-energy mechanisms of injury such as motor vehicle accidents, fall from height, and sports-related injuries, etc. these are also more common in males with 70% occurring in young adult men with a mean age of 43 years.<sup>1</sup> Low-energy falls are generally the predominant mode of injury in the elderly population who sustain unicondylar or bicondylar tibial plateau fractures. Treatment concepts rely on obtaining and maintaining a stable articular reduction and adequate limb alignment with early range of motion (ROM)<sup>1</sup>. Historically we have seen immobilization for 6 weeks in traction or plaster immobilization causing stiffness. If operated with extensive dissection for the purpose of reduction it resulted in delayed union and infection. This forms the cause of evolving an in between approach, [Minimally invasive approach]<sup>2</sup> which not only reduces stiffness but is also biological. Locked plate technology<sup>3</sup> is widely used in managing complex tibial plateau fractures. With the advent of newer implants and minimally invasive techniques, complex tibial plateau fractures which were once considered difficult to treat, are now having successful outcomes.

## II. Materials and Methods

The study was carried out in Department of orthopaedics, Siddhartha medical college, Govt. General Hospital, Vijayawada, Andhra Pradesh from November 2019 to June 2021. The total number of cases studied was 30 patients, who were Adults (aged over 18 years) both male and female.

**Study design:** A Prospective study

**Study location:** This is a tertiary care teaching hospital based on study done in Department of Orthopaedics, at Siddhartha medical college/ Government General hospital, Vijayawada, Andhra Pradesh, India.

**Study Period:** November 2019 to June 2021

**Sample size:** 30 patients

**Inclusion criteria:**

- 1) Adult (aged over 18 yrs) both male and female
- 2) Closed / Open Gustilo-Anderson<sup>4</sup> Type I, II
- 3) Intraarticular and Extraarticular proximal tibial fractures of Schatzker<sup>5</sup> Type I, II, III, IV, V, VI.

**Exclusion criteria:**

- 1) Patients aged below 18 years.
- 2) Patients with pathological fractures.
- 3) Patients medically unfit for surgery.
- 4) Gustilo-Anderson type<sup>4</sup> III injuries.
- 5) Patients with distal neurovascular deficit.

**Procedure methodology:** A total of 30 patients with proximal tibia fractures were enrolled in the study. The Functional outcome was assessed using Rasmussen's scoring system.<sup>6</sup>

**Modified Rasmussen's scoring system<sup>6</sup>**

Parameter	score
A) PAIN	
1. None	6
2. Occasional pain	5
3. Stabbing pain in certain position/ moderate pain	4
4. Severe pain, constant pain around the knee after activity	2
5. Rest pain	0
B) WALKING CAPACITY	
1. Normal walking capacity for age	6
2. Walking outdoor at least 1 hour	4
3. Walking outdoor >15 mins	2
4. Walking indoor only	1
5. Wheelchair / bed ridden	0
C) KNEE EXTENSION	
1. Normal extension	6
2. Lack of extension (0-10 degree) 4	
3. Lack of extension (>10 degree) 2	
D) TOTAL RANGE OF MOTION	
1. At least 140 degree	6
2. At least 120 degree	5
3. At least 90 degree	4
4. At least 80 degree	2
5. At least 30 degree	1
6. No range of movements	0
E) STABILITY	
1. Normal in extension and 20 degree flexion	6
2. Abnormal instability in 20 degree flexion	5
3. Instability in extension < 10 degree	4
4. Instability in extension >10 degree	2
D) POWER OF QUADRICEPS	
1. Grade 5	2
2. Grade 3-5	1
3. Grade <3	0
MAXIMUM SCORE	30
EXCELLENT	27-30
GOOD	24-26
FAIR	20-23

POOR

<19

**Statistical analysis:** Simple proportions and percentages for comparing different variables like age, sex, etc. were used. Comparison was tested for statistical significance using Chi-square test & t tests wherever applicable.

### III. Results

We studied 30 patients with 30 proximal tibial fractures who were treated with locking compression plate.<sup>3</sup>

**Table 1: Age Distribution**

Age group	No.of patients	Percentage
18-20	2	6.67%
21-30	4	13.33%
31-40	8	26.67%
41-50	6	20.00%
51-60	6	20.00%
61-70	2	6.67%
71-80	2	6.67%
<b>Total</b>	<b>30</b>	<b>100.00%</b>

Table 1 -Age Distribution

Most of the patients belong to 31-40 years of age group who are more prone for RTA(82.76%) followed by fall from height(17.24%).The mean age in our study is 44.37 years.

**Table 2: Sex Distribution**

Sex	No. of Patients	Percentage
Female	5	16.67%
Male	25	83.33%
<b>Total</b>	<b>30</b>	<b>100.00%</b>

Table 2 -Sex Distribution

83.33% of our patients were male 16.67% were females. It reflect the general population which visit our both out patient as well as the emergency trauma section.

**Table3: Type of fracture and percentage of cases : schatzker's<sup>5</sup> classification**

Schatzker <sup>5</sup> fracture type	number	percentage
I	2	6.67%
II	1	3.33%
IV	6	20.00%
V	7	23.33%
VI	14	46.67%
<b>Grand Total</b>	<b>30</b>	<b>100.00%</b>

Table 3 - Schatzker's<sup>5</sup>Type of fracture and percentage of cases

Above data shows the fracture distribution according to Schatzker<sup>5</sup> classification. Study shows that Schatzker<sup>5</sup> type VI is the most common fracture type accounting to 46.67%.

**Table 4:Method of Reduction and Fixation**

Method of reduction and fixation	Number	Percentage
MIPPO <sup>2</sup>	5	16.67%
ORIF <sup>7</sup>	25	83.33%
<b>Grand Total</b>	<b>30</b>	<b>100.00%</b>

Table 4 -Method of Reduction and Fixation

We used MIPPO<sup>2</sup> technique in 16.67% of patients both duration of procedure and soft tissue injuries are less compare to ORIF<sup>7</sup> technique. Wound healing also better and faster compare to ORIF<sup>7</sup> technique. It demands

more surgical techniques and we found as the study progressed that the operative time need for MIPPO<sup>2</sup> decreased as we matured more in this technique.

**Table 5: Time of union of fractures**

STATISTICS	TIMEOFUNION
MEAN	17.40
MEDIAN	17
STANDARDDEVIATION	1.276
MINIMUM	15
MAXIMUM	21

Table 5 -Time of union

In our study average duration for complete radiological fracture union was 17.40 weeks with standard deviation of 1.276.

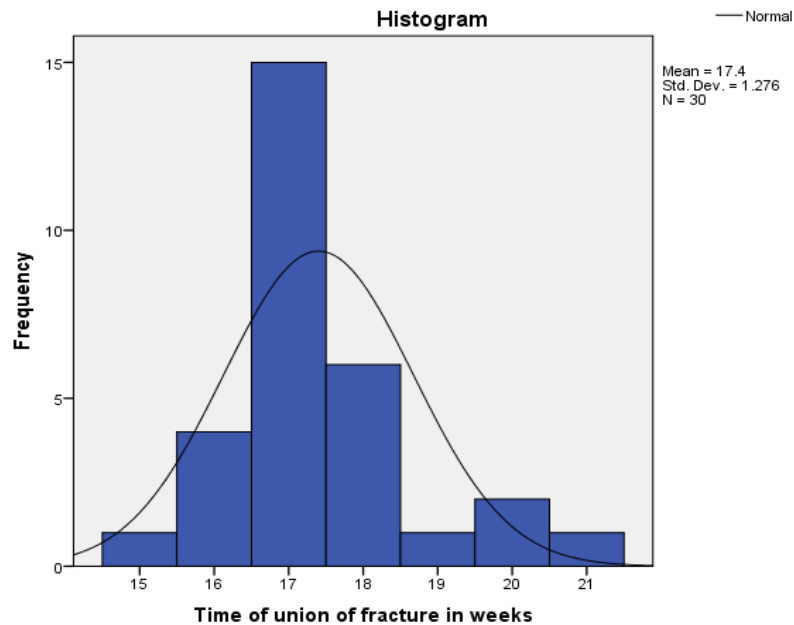


Figure 1 - Time of union

**Table 6: Rasmussens scoring<sup>6</sup>**

Table 6- Rasmussens score<sup>6</sup> at 6 weeks, 12 weeks, 6 months and 1 year

Rasmussens score <sup>6</sup>	6 weeks		12 weeks		6 months		1 year	
	No. of cases	Percentage	No. of cases	Percentage	No. of cases	Percentage	No. of cases	Percentage
Excellent	18	60.00%	21	70.00%	22	73.33%	22	73.33%
Good	10	33.33%	8	26.67%	7	23.33%	7	23.33%
Fair	2	6.67%	1	3.33%	1	3.33%	1	3.33%
Poor	0	0.00%	0	0.00%	0	0.00%	0	0.00%
<b>Grand Total</b>	<b>30</b>	<b>100.00%</b>	<b>30</b>	<b>100.00%</b>	<b>30</b>	<b>100.00%</b>	<b>30</b>	<b>100.00%</b>

60% of patients showed excellent outcome in 6 weeks. About 70% of patients showed excellent results in 12 weeks. 73.33% of patients showed excellent result in 6 months. Finally 73.33% of patients got excellent result at end of study which is 1 year.

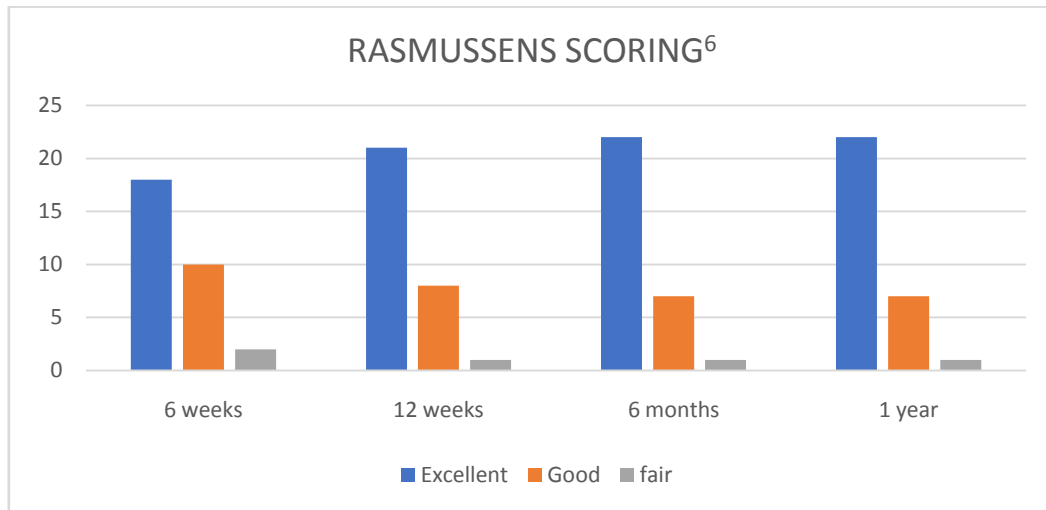


Figure 2 - Rasmussens score<sup>6</sup> at 6 weeks ,12 weeks,6 months and 1 year

**Table 7: Clinical Results**

clinical results	percentage
excellent	76.67%
fair	3.33%
good	20.00%
<b>Total</b>	<b>100.00%</b>

Table 7 -clinical results

Out of 30 cases treated, 76.67% cases gave excellent result ,20% cases came out with good result, fair in 3.33% cases.

**Table 8:Complications**

Complications	Number	Percentage
Infection	2	6.67%
Nil	25	83.33%
Stiffness	2	6.67%
Varus deformity	1	3.33%
<b>Grand Total</b>	<b>30</b>	<b>100.00%</b>

Table 8– Complications

In our study two cases of infection(6.67%), two knee stiffness (6.67%)and one varus deformity(3.33%) occurred. We had no cases of any purely implant related complication like screw loosening, screw breakage or plate failure.

#### IV. Discussion

Tibial plateau is the most important load bearing area in the body. The goals of operative treatment are anatomical articular alignment, stable internal fixation, early mobilization, and early functional rehabilitation of knee.

In this prospective study, 30 cases of proximal tibia fractures were evaluated for the results with locking compression plate<sup>3</sup> using MIPPO<sup>2</sup> and ORIF<sup>7</sup> technique. These patients were followed up on 6 weeks, 12 weeks, 6 months, and 1 year of postoperative period. The average time of union and functional outcome were assessed with Rasmussen's<sup>6</sup> scoring system.

Keeping our aims of the study at high, we presented the clinical study of surgical treatment of 30 proximal tibial fractures. The analysis of the results were made in terms of age of patients, sex distribution, occupation of patient, laterality of fracture, mode of violence, analysis of the types, method of reduction and fixation, the principle of LCP<sup>3</sup> fixation, surgical approach and complications.

#### AGE DISTRIBUTION

The average mean age in the present study was 44.37 years with range from 19 to 80 years. Mayank patel, Jayanth sharma et.al<sup>8</sup> found mean age of 38.43±15.16 years in their study. Prateek Girotra et.al<sup>9</sup> in their study found the average mean age to be 40.40 years ranging from 23 to 68 years.

#### SEX DISTRIBUTION

In our study, 83.3% were male and 16.7% were females, which shows the male predominance in tibial plateau fractures. Mayank patel, Jayanth sharma et.al<sup>8</sup> found, out of 30 patients 25 male and 5 female which is similar to our study. David P Barei et.al<sup>11</sup> had 23 (56%) male patients and 18 (44%) female patients.

Male preponderance was found in our study, probably because males sustained this high energy fractures more owing to their more active life style. As a majority of the cases were caused by road traffic accidents in our study increased incidence of these fractures among males is explainable.

#### MODE OF INJURY

It means proximal tibia fracture is common in young age group. In our study the main mode of injury of the proximal tibial fracture patients is RTA in 83.3% and fall from the height in 16.7% of the cases. Mayank patel, Jayanth sharma et.al<sup>8</sup> found 75% of were due to road traffic accidents. Prateek Girotra et.al<sup>9</sup> in their study found the main mode of injury is Road Traffic Accidents in 73.3% and fall from the height in 16.7% of the cases. Ryan J Krupp et.al<sup>10</sup> in their series of 28 patients with Tibial Condyle fractures treated by Locking plate fixation, 22 patients (78.5%) had sustained the fracture following a road traffic accident and 6 patients (21.5%) had fall and sustained the fracture.

#### EXTREMITY AFFECTED

In our study, 63.33% (19) were right sided and 36.67% (11) were left sided tibial plateau fractures which suggests right sided predominance of these fractures. Mayank patel, Jayanth sharma et.al<sup>8</sup> found 70% were right side and 30% were left side in their study. Ryan J Krupp et.al<sup>10</sup> in their series of 28 patients with Tibial Condyle fractures treated by Locking plate fixation, 14 patients (50%) had fracture of the right and 14 patients (50%) had fracture of the left tibial condyle.

As most of the road traffic accidents are following a two wheeler accident, the tendency of the individuals to use the right leg more and falling on the right side may be a factor for more involvement of the right side.

#### TYPE OF FRACTURE

Our study shows 46.67% of schatzker<sup>5</sup> type-VI, the most common followed by 23.33% of schatzker<sup>5</sup> type -V, 20% of schatzker<sup>5</sup> type -IV, 6.67% of schatzker<sup>5</sup> type -I, 3.33% of schatzker<sup>5</sup> type -II. Mayank patel, Jayanth sharma et.al<sup>8</sup> in their study of 30 patients, 22 fractures were Schatzker<sup>5</sup> type V fractures, and 08 were Schatzker<sup>5</sup> type VI fractures. Kutbe S, Mahesh U et.al<sup>12</sup> in their study found 22 fractures were Schatzker<sup>5</sup> type V fractures, and 08 were Schatzker<sup>5</sup> type VI fractures. Raza H<sup>13</sup> et.al in his study according to the Schatzker<sup>5</sup> classification has 7% of Schatzker<sup>5</sup> type I, 22% of Schatzker<sup>5</sup> type II, 26% of Schatzker<sup>5</sup> type III, 15% of Schatzker<sup>5</sup> type IV, 17% of Schatzker<sup>5</sup> type V, and 12% of Schatzker<sup>5</sup> type VI.

#### TIME OF UNION

According to our study all the patients had a radiological and clinical union within a period of 15-21 weeks with a average period of 17.40 weeks. Prateek Girotra et.al<sup>9</sup> in their study found the mean time for union was 19.87 weeks. Mahesh Kumar Dindivanam<sup>14</sup> found that the time for union was 17 weeks in their study of 30 patients of Tibial plateau fractures.

#### FUNCTIONAL OUTCOMES

We evaluated the functional outcome of proximal tibia fractures fixed with Locking Compression Plate<sup>3</sup> using Rassmussen's scoring system.<sup>6</sup> By the end of 1 year, we observed that 73.33% of patients developed excellent outcome, 23.33% good and 3.33% fair results as the patients were started with early mobilization, regular knee physiotherapy, and regular clinical and radiological assessment of the patients. Mayank Patel et.al<sup>8</sup> obtained functional results which were excellent in 71.42%, Good in 21.42% and Fair in 7.14% in his study. In a prospective study by Prateek Girotra et.al<sup>9</sup>, 53.3% of the patients had excellent functional results, 36.7% of patients had good results and 10% had fair results with a significant relationship between the type of fracture and the functional results. Raza H<sup>13</sup> et.al noted functional outcome was 44% of excellent, 46% of good, and 10% of fair and poor results at the end of 12 months follow up. The mean Rassmussen<sup>6</sup> functional score was 25.3 (SD, 3.2; range, 14-29). Our study obtained better results, than studies done by Raza H<sup>13</sup> et.al which had 44% of excellent, 46% of good, and 10% of fair and poor results.

But the disadvantage of our study was the follow up was only for 1 year due to COVID -19 outbreak, whereas these above mentioned studies had a longer follow which may change the results further.

#### COMPLICATIONS

In our study post operative complications were seen in only 5 patients. Out of these patients, 2 patients developed post operative mild to moderate knee stiffness at end of one year, further knee physiotherapy was advised to these patients. Two patients developed post operative superficial surgical site infection, for which culture sensitivity was done followed by oral antibiotics and later patient improved. One patient had varus deformity of 7 degrees. In our study no peroneal nerve injury occurred unlike in other studies like Cole et al.<sup>15</sup> Phisitkul et al.<sup>16</sup> Nonunions and early losses of fixation were not occurred in our study unlike in Cole et al.<sup>15</sup> and no hardware removal, postoperative compartment syndrome were occurred unlike in Phisitkul et al.<sup>16</sup>

#### V. Conclusion

At the end of our study, conclusions could be drawn from the treatment of proximal tibia fractures with locking compression plate<sup>3</sup> as Proximal tibia fractures are increasing with the increase in outdoor activities like road traffic injuries. These fractures require good clinical and radiological assessment and treatment planning. Preoperative soft tissue status and their repair at the right time significantly affects the result outcome. Locking compression plate<sup>3</sup> offers a good treatment option for intra-articular and or juxta-articular fractures of proximal part of tibia without the need for additional medial stabilization as it provides-

- 1) better healing rates
- 2) Restoration of the articular congruity
- 3) Better biomechanical stability
- 4) Good range of motion
- 5) Early rehabilitation
- 6) Decreased rate of complications

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