

# A Comparative Study of Operative Management of Internal Fixation of Closed Tibial Plateau Fracture by Plates with Screws and only Cannulated Cancellous Screws.

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Received: April 2018

Accepted: April 2018

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## ABSTRACT

**Background:** Management of tibial plateau fractures remains challenging because of their number, variety and associated soft tissue injuries that further augment their complexity. proper management of the initial injury aims to obtain a stable, painless, mobile joint and to prevent the development of osteoarthritis. Anatomical restoration of articular surface and stable fixation are essential to achieve this goal. This study highlights the operative reduction and internal fixation of tibial plateau fractures and compare the results of fixation with only cannulated cancellous screws and plates. **Methods:** Institution based randomized, prospective, retrospective and observational study comprising of 30 patients attending Orthopaedics emergency or O.P.D. of age group 25-65 years with closed tibial plateau fractures. The outcome of treatment is assessed clinico-radiologically. **Results:** In our study we obtained overall excellent (76.2% cases) to good functional results (23.8% cases) by operative treatment with plate osteosynthesis for Tibial plateau fractures. All the patients treated with only cannulated cancellous screws had excellent functional outcome. **Conclusion:** The operative management of Tibial plateau fractures has definite advantages over conservative management. Percutaneous or open fixation using cannulated cancellous screws gives excellent functional results. But it is not suitable for severely depressed or comminuted fractures. Percutaneous and minimally invasive plate fixation method is more biological, requires less surgical time, less hospital stay, has minimum complications and has a good functional outcome. There is no ideal implant for these fractures, however, soft tissue handling is very important during surgery.

**Keywords:** Tibial plateau, Locking plates, cannulated screw, knee injury.

## INTRODUCTION

Intra-articular fractures of proximal tibia resulting from high velocity trauma continue to be the cynosure of discussion for the difficulty in getting accurate joint reconstruction and stabilization without compromise of already traumatised soft tissue envelope. The tilting of articular surfaces and overload cause mal-alignment of the leg and secondary overloading and instability of the knee.<sup>[1]</sup> Management of tibial plateau fractures remains challenging because of their number, variety and associated soft tissue injuries that further augment their complexity.<sup>[2]</sup> The choice between surgical and conservative management and the proper method of operative management is not an easy

decision anymore. Since the introduction of improved surgical techniques and implants there has been a trend towards the surgical management of these fractures. The surgical treatment was advocated to restore joint congruity and limb alignment to allow early knee movement with stability of joint. The present study is done to highlight the operative reduction and internal fixation of Tibial plateau fractures and compare the results of fixation with only cannulated cancellous screws and plates with screws.

### Aims & objectives

1. Detail the clinical parameters and to review the results of plate osteosynthesis in managing various types of tibial plateau fractures in relation to age, sex, functional assessment of knee (pain, walking capacity, range of movement etc.) and anatomical assessment ( articular depression, angulation etc.).
2. Detail the clinical parameters and to review the results of cannulated cancellous screw fixation in managing various types of tibial plateau fractures in relation to age, sex, functional assessment of

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knee (pain, walking capacity, range of movement etc.) and anatomical assessment (articular depression, angulation etc.).

3. Assess any disadvantage of use of only cannulated cancellous screws and plates with screws in fixation of any specific type of tibial plateau fractures.
4. Assess the complications of both the methods.
5. Compare the result outcomes of only cannulated cancellous screws fixation with plate and screws fixation.

## MATERIALS AND METHODS

### Study Area

Patients attending orthopaedics OPD and Emergency in a tertiary care institute.

### Study Population

30 patients with closed tibial plateau fractures.

### Inclusion Criteria

- I. Age group 25 years to 65 years
- II. Closed tibial plateau fractures

### Exclusion Criteria

- I. Open fractures
- II. Presence of active infection near fracture site
- III. Co-morbid conditions
- IV. Compartment syndrome and other neurovascular complications

**Study Period:** 24 months

**Sample Size:** Thirty patients (n=30)

**Sample Design:** Study is done till desired number of sample size is obtained.

**Study Design:** Institution based randomized, prospective, retrospective and observational study.

### **Parameters to be studied:**

- i. Functional recovery
- ii. Anatomical evaluation,
- iii. Post-operative complications

### **Study Technique**

Patients were treated by Open or Closed reduction and Internal Fixation using standard approaches or by Minimally Invasive Plate Osteosynthesis (MIPO), [Chart 4]. Ligamentotaxis was done by either manual traction or by applying spanning external fixator (femoral distractor).

Articular depression was elevated using a punch and hammer through the same exposure (in open reduction) or a small incision (in closed reduction) by the cortical window under image guidance and resultant cavity was filled with bone graft (in selected cases). Once the reduction was acceptable, definitive fixation was done with only cannulated cancellous screws or contoured locking or non locking buttress plates or proximal tibial LCP and screws.

The results were graded as excellent, good, fair, and poor as compared with grading system done by Poul S. Rasmussen

### **Data Analysis**

The patients are evaluated in details in pre and post-operatively both clinically and radiologically at a regular interval and results are analysed.

### **Treatment protocol**

- a) Initial management and resuscitation
- b) Pre-operative evaluation and anaesthetic fitness
- c) Radiological assessment and planning
- d) Counselling
- e) Surgical intervention

### **Post-operative management**

1. The operated lower limb was kept elevated in a compression bandage and long leg slab over a pillow in immediate post operative period.
2. Check X-ray of the affected knee-AP and lateral view done.
3. Close observation done for any features of compartment syndrome.
4. The patients were encouraged active quadriceps, exercises, foot and ankle exercises from first post-operative day as far as the pain permitted.
5. The drain was removed after 48 hours.
6. Active assisted knee bending started after 2 weeks of operation (after suture removal) in a ROM knee brace.
7. DVT prophylaxis was given in some patients until ambulation was possible.
8. Check dressing done on 4th or 5th post-operative day.
9. Suture removal done on 14th post-operative day.
10. Patients were discharged from hospital either after first check dressing or after suture removal depending upon clinical need and socio-economic condition.
11. Non weight bearing walking started after 14th post operative day with axillary crutch support upto approximately 6 weeks post-operative period.
12. Elderly and non motivated patients were allowed only active and active assisted movements at bed. They were not allowed crutch walking.
13. The ROM knee brace adjusted at regular interval to gradually increase the range of motion.
14. Knee brace is discarded post operatively at 6 weeks.
15. Then partial weight bearing started after 6 weeks post-operative period till 12 weeks (post-operative).
16. Full weight bearing walking started after approximately 12 weeks post-operative period depending upon fracture type and radiological progress.

**FOLLOW-UP:** Routine follow up done at OPD with proper rehabilitation protocol with proper

clinical and radiological assessment- at 2 weeks, 6 weeks, 3 months, 6 months, 9 months and 18 months.

**RESULTS**

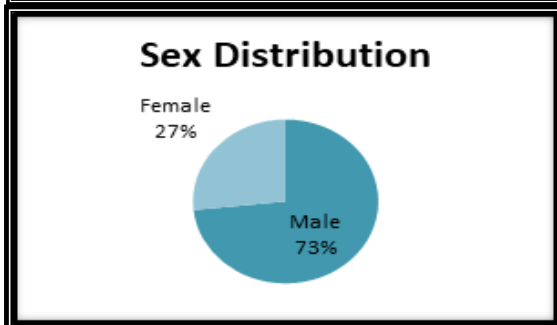
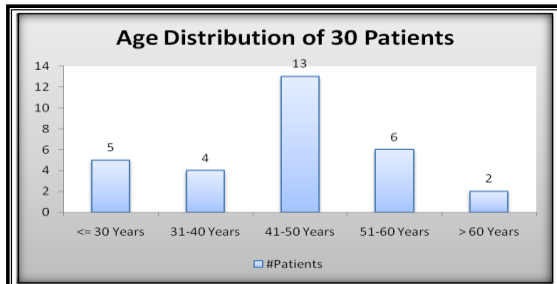


Chart 1,2: Age and Sex distribution of patients

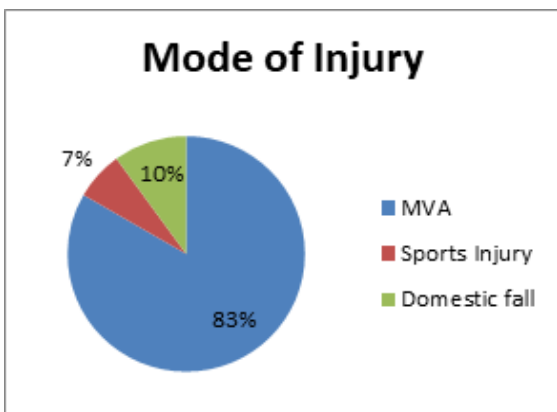


Chart 3: Distribution of study population according to mode of injury

Table 1: Distribution of study population according to Schatzker's classification

Type (Schatzker)	No. of Cases	Percentage
I	1	3.3%
II	9	30%
III	5	16.7%
IV	4	13.3%
V	6	20%
VI	5	16.7%
Total	30	100%

Table 2: Distribution of study population according to method of reduction

Method	No. of Patients	Percentage
ORIF	15	50%
CRIF	10	33.3%
MIPO	5	16.7%
Total	30	100%

Table 3: Distribution of study population according to Complications

Complication	No. of Cases	Percentage
Superficial infection	1	3.3%
Deep infection	1	3.3%
Collapse	4	13.4%
Osteoarthritis	5	16.7%
Total Cases	30	100%

Table 4: Distribution of study population according to Clinical and radiological union

No. of weeks	Clinical Union		Radiological Union	
	No of patients	Percentage	No of patients	Percentage
4 to 8 weeks	5	16.7%	0	0%
8 to 12 weeks	23	76.6%	4	13.3%
12 to 16 weeks	2	6.7%	25	83.4%
16 to 20 weeks			1	3.3%
Total	30	100%	30	100%

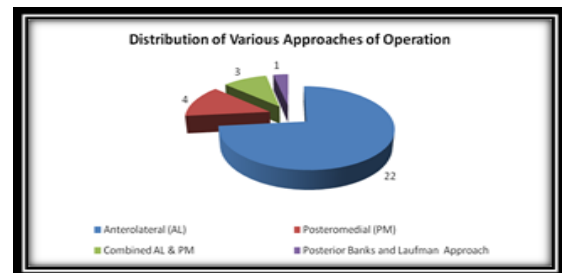


Chart 4: Distribution of study population according to approaches of operation



Figure 1: Pre-Operative Skiagrams (Type III)



Figure 2: Skin incision and pointed reduction clamp application under image guidance

**Table 5: Comparison of results of fixation by only Cannulated Cancellous Screws and Plates and Screws**

Factors	Type of fixation	Mean (SD)	t-Value	df value	P-Value
Pain	Only CCS	5.89(0.33)	1.74	22	0.096 (>0.05)
	Plates and screws	5.62(0.5)			
Walking capacity	Only CCS	5.56(0.88)	-0.19	14	0.856(>0.05)
	Plates and screws	5.62(0.8)			
Knee ROM	Only CCS	5.89(0.33)	2.23	27	0.034
	Plates and screws	5.48(0.68)			
Depression	Only CCS	5.78(0.67)	0.23	16	0.818 (>0.05)
	Plates and screws	5.71(0.72)			
Condylar widening	Only CCS	5.56(0.88)	-0.79	11	0.447 (>0.05)
	Plates and screws	5.81(0.6)			
Angulation	Only CCS	6(0)	t-test cannot be performed as standard deviation for one sample is Zero		
	Plates and screws	5.62(0.8)			



**Figure 3: Screw fixation and skin closure over drain**



**Figure 4: Postoperative Radiograph**



**Figure 5: Knee and ankle movement after removal of brace**

The results were analyzed according to functional and anatomical grading system of Poul S. Rasmussen as described before. This table shows the functional results in lateral, medial and bicondylar tibial plateau fractures. Mean Functional score was 28.7, Mode was 30 and Standard Deviation was 1.9. Mean Anatomical Score was 17.2, Mode was 18 and Standard Deviation was 1.6. So on Functional and Anatomical assessment, excellent results were obtained in 25 patients (83.4%), good results were obtained in 5 patients (16.6%).

## DISCUSSION

Thirty patients of different types of tibial plateau fractures of age group 26years to 64years with mean age of 44.4 years had been selected in this study. Maximum patients (43.3%) were in age group of 41 to 50 years. Males were more frequently affected than females (Male: Female =2.75:1). The most common mode of injury was Motor Vehicle Accidents (in 83.3% patients) and the rest were injured in domestic falls (10%), sports injuries (6.7%) .



Left side (56.7%) was found to be more commonly injured than right side (43.3%).

Schatzker Type II fracture was found to be the commonest fracture type with 9 patients (30%), with Type V being the 2nd most common type (20%), Type VI and type III jointly ranked 3rd (16.7% each). Type I fracture were least common (3.3%).

All the patients had been treated by direct or indirect reduction method.

Out of these 30 patients 9 patients were treated with only cannulated cancellous screws. Rest 21 patients were treated with plates and screws.

Most of the patients (80%) underwent surgery within 1 to 6 days of injury.

In 15 cases (50%) fractures were fixed by Open Reduction and Internal Fixation; in 10 cases (33.3%) using Closed Reduction by indirect reduction technique and Internal Fixation and in 5 cases (16.7%) by MIPO technique with different types of plates and associated screws. MIPO was mainly employed in high energy fractures.

Only lateral condyle fixation was done in 22 patients (73.2%), whereas medial condyle fixation was done in 5 patient (16.7%) and bicondylar fixation was done in 3 patients (10%).

On follow-up, we found some complications like superficial infection (1 case), deep infection (1 case), varus collapse (4 cases) and osteoarthritis (5 cases).

Maximum number 23 (76.6%) of fractures clinically united in the time period of 6 to 8 weeks and in maximum number of cases 25 (83.4%) radiological union occurred in a period of 12 to 16 weeks. Mean time of union was 12.47 weeks with a Standard deviation of 1.72.

The results were graded in accordance with Poul S. Rasmussen's (1973) grading system.

Maximum number of follow-up patients (70%) had no pain and only 30% complained of occasional pain. Mean pain score  $\pm$  standard deviation was  $5.89 \pm 0.33$  in patients treated with only cannulated cancellous screws. Mean pain score  $\pm$  standard deviation was  $5.62 \pm 0.5$  in patient treated with plates and screws.

24 (80%) patients could perform normal walking, 6 (20%) patients had walking capacity outdoors of at least 1 hour. Among the patients fixed with only cannulated cancellous screws mean walking score  $\pm$  standard deviation was  $5.56 \pm 0.88$ . Among the patients fixed with both plates and screws mean walking score  $\pm$  standard deviation was  $5.62 \pm 0.8$ .

28 patients (93.3%) had no lack of extension, only 2 patients (6.7%) had lack of extension ( $<10^\circ$ ). Both the fractures were fixed with plates and screws. Mean ROM score  $\pm$  standard deviation was  $5.87 \pm 0.5$ .

20 patients (66.7%) had knee range of motion at least  $140^\circ$ , 8 patients (26.6%) had flexion of at least

$120^\circ$ , 2 patients (5.8%) had stiffness with flexion upto  $110^\circ$  and  $100^\circ$ . Among the patients fixed with only cannulated cancellous screws the mean ROM score  $\pm$  standard deviation was  $5.89 \pm 0.33$ . Among the patients fixed with plates and screws the mean ROM score  $\pm$  standard deviation was  $5.48 \pm 0.68$ .

Maximum number of patients 29 (96.7%) had a stable joint in extension and in  $20^\circ$  of flexion. The only patient having instability at  $20^\circ$  of flexion, fixed with plates and screws had preoperative anterior crutiate ligament injury.

Only 4 patients had depression of articular surface (13.3%), 4 patients had condylar widening (13.3%) and 4 patients had varus angulations (13.3%).

Among the patients fixed with only cannulated cancellous screws the mean depression score  $\pm$  standard deviation was  $5.78 \pm 0.67$ . Among the patients fixed with plates and screws the mean depression score  $\pm$  standard deviation was  $5.71 \pm 0.72$ .

Among the patients fixed with only cannulated cancellous screws the mean score of widening of condyles  $\pm$  standard deviation was  $5.56 \pm 0.88$ . Among the patients fixed with plates and screws the mean score of widening of condyles  $\pm$  standard deviation was  $5.81 \pm 0.60$ .

Among the patients fixed with only cannulated cancellous screws the mean score of angulation  $\pm$  standard deviation was  $6 \pm 0$  as none of the patients operated with only cannulated cancellous screws had angulation. Among the patients fixed with plates and screws the mean score of angulation  $\pm$  standard deviation was  $5.62 \pm 0.80$ .

The Mean Functional score among the patients fixed with only cannulated cancellous screws was 29.33 with Standard Deviation 1.12. In these 9 patients, all had excellent functional outcome.

The Mean Functional score among the patients fixed with plates and screws was 28.48 with Standard Deviation 2.14. In these 21 patients, 16 patients had excellent functional outcome and 5 patients had good functional outcome.

The Mean Anatomical score among the patients fixed with only cannulated cancellous screws was 17.33 with Standard Deviation 1.41. In these 9 patients, 7 had excellent anatomical outcome and 2 patients had good anatomical outcome.

The Mean Anatomical score among the patients fixed with plates and screws was 17.14 with Standard Deviation 1.74. In these 21 patients, 16 patients had excellent anatomical outcome and 5 patients had good anatomical outcome.

In our study we found no fair and poor results.

## CONCLUSION

The operative management of Tibial plateau fractures has definite advantages over conservative management, as far as knee movement, absence of pain and swelling and valgus/ varus deformity of

knee are concerned; but infection, wound dehiscence and skin necrosis remain a threat and it requires a skilled surgical team and appropriate facilities which include a well-equipped operation theatre setup and image intensifier. Fixation by plates with screws is commonly used in high energy fractures whereas cannulated cancellous screws is more useful in fixing low energy fractures. Percutaneous or open fixation using cannulated cancellous screws gives excellent functional results. It offers a middle path approach for treatment of such fractures, with advantages of being minimally invasive, having minimal instrumentation, early mobilization, and less morbidity, without the need of any additional expensive medical equipment of surgical expertise. In our study we obtained overall excellent (76.2% cases) to good functional results (23.8% cases) by operative treatment with plate osteosynthesis for Tibial plateau fractures. All the patients treated with only cannulated cancellous screws had excellent functional outcome, though they had low energy fractures. Finally, there is no ideal implant for fixation of these fractures and the choice of implant depends on multiple factors like fracture geometry and soft tissue status, and often needs to be determined per-operatively.

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**How to cite this article:** Ghosh S, Sarkar A, Dugar N, Pal S. A Comparative Study of Operative Management of Internal Fixation of Closed Tibial Plateau Fracture by Plates with Screws and only Cannulated Cancellous Screws. *Ann. Int. Med. Den. Res.* 2018; 4(3):OR07-OR12.

**Source of Support:** Nil, **Conflict of Interest:** None declared