

# Research Journal of Pharmaceutical, Biological and Chemical Sciences

## Analysis Of The Functional And Radiological Outcome Of Tibial Plateau Fractures Treated By Open Reduction Internal Fixation With Locking Compression Plate Based On 3D CT Three Column Four Segment Specific Fixation: A Prospective Study.

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### ABSTRACT

Tibial plateau fractures are caused by high-energy trauma. Historically, the Schatzker and AO/OTA classification systems are widely used, In 2010 Luo et al in China has developed *Three-Column Four segment specific fixation* for complex Tibial plateau fractures. To analyse the functional outcome and radiological outcome of Tibial plateau fractures treated by Open Reduction Internal Fixation (ORIF) with Locking Compression Plate (LCP) based on Three-Column Four segment specific fixation. This is a prospective study of 36 patients with Tibial plateau fractures with column specific involvement based on preoperative CT were selected for the study after getting ethical clearance in duration from Dec 2019 to June 2021. Outcome of surgery was evaluated using knee society scoring system and Modified Rasmussen Radiological Assessment criteria. In our study we had all 100% study population (33 patients) had RTA as mode of injury with male predominance of 81% with age range of 20–60. In this, 73% had more than one column fracture. 2 patients temporarily stabilized with external fixation while others with above knee slab, then definitive management by column specific fixation by ORIF with LCP. We achieved union in all cases within range of 10-15 weeks of post operative period with few complications. We allowed full weight bearing after clinical and radiological signs of union at an average of 12-14 weeks. About 85% had good functional range of movements and able to perform their daily activities. Column based concept makes the surgeon to prepare better for the choice in approach, implant selection and column specific fixation which gives better biomechanical strength and rigid construct than unilateral plating. Early joint mobilization and weight bearing was started around 2-3 months and contributes to better final knee range of motion.

**Keywords:** column specific, Tibial plateau.

<https://doi.org/10.33887/rjpbcs/2024.15.1.65>

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## INTRODUCTION

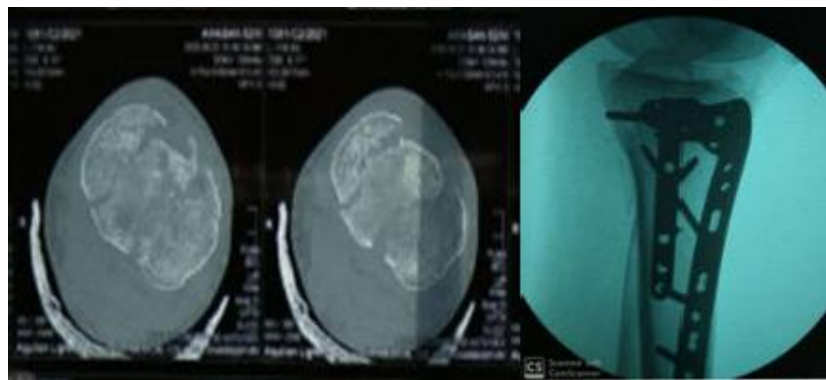
Tibial plateau fractures are caused by high-energy trauma [1]. It is one of the most common intra-articular fractures often involving the lateral Tibial condyle (50 % to 70%) than the medial condyle. These fractures accounts for 1% of all fractures and 8% of fractures in elderly population. The proximal portion of the Tibial plateau forms the lower surface of the knee joint and it consists of two condyles – medial and lateral separated by the Tibial spines [2]. Intact articular surface of Tibial plateau is a key to keep the geometry and alignment of the knee joint to act in harmony to perform its crucial function as a flexible weight bearing joint [4]. Historically, the Schatzker [5] and AO/OTA classification systems are widely used to guide treatment. Luo et al [4] in China has developed Three-Column Four segment specific fixation for complex Tibial plateau fractures which emphasize column specific fixation. We, in our study have managed complex Tibial plateau fractures in adults treated with Open Reduction Internal Fixation (ORIF) with Locking compression plate (LCP) based on 3 column 4 segment specific fixation which developed by Lou et al [4].

## MATERIALS AND METHODS

This is a prospective study of 36 patients with Tibial plateau fractures with column specific involvement based on preoperative CT were selected for the study after getting ethical clearance in duration from Dec 2019 to June 2021. Outcome of surgery was evaluated using knee society scoring system and Modified Rasmussen Radiological Assessment criteria. We have included all patients above 18 years of age of either sex, closed complex Tibial plateau fractures, Tibial plateau fractures which are difficult to treat conservatively and excluded Patients with age below 18 years, open Tibial plateau fractures, patients medically unfit for surgery and not willing for surgery, pathological fractures, pre-existing deformity, neurovascular injuries

### Surgical technique

Each case was individualized and treated accordingly by conventional surgical techniques based on column involvement with specific medial, posteromedial, lateral, or combined approach to proximal tibia.



a

b



c

d

e

a) Pre op CT with medial and lateral column fracture. b) Intra op c-arm c) 6 months follow up bicolumn plating e) intra op.

**RESULTS**

In our study we had all 100% study population (33 patients) had RTA as mode of injury with male predominance of 81%vsimilar to the case series reported by Eggli et al [7]. The mean age of the study participants was 43 with minimum age was 18 and the maximum age was 65 similar to Higgins et al [17] study. Around 11(33%) patients had co morbidities like diabetes, hypertension, etc., About 73% had involvement of *more than one column* fracture. This shows magnitude high velocity trauma in recent days. Nearly 40-45% patients had medial and lateral column fracture. Pure lateral column fracture around 20% and pure medial column fracture is 10%, other combinations fracture pattern accounts for 25-30%.We treated all patients with POP as temporary immobilization and skin condition to settle, except 2 patients in whom we temporarily stabilized with external fixation. We achieved union in all cases within range of 10-15 weeks post operative period with few complications. We allowed full weight bearing after clinical and radiological signs of union at an average of 12-14 weeks. About 85% had good functional range of movements and able to perform their daily routine activities. This is accordance with similar study conducted by Barei DP, Nork SE,Mills W], et al [6].

**Table 1: Demographic details of study participants**

Demographic parameters	Total number of cases (n=36)	
	Frequency	Percentage
Age (in years)		
21-30	03	8.33
31-40	08	22.22
41-50	15	41.67
51-60	09	25
>60	01	2.78
Gender		
Male	21	58.33
Female	15	41.67
Mode of injury		
Falling from height	10	27.78
Road traffic accidents	24	66.67
Assault	02	5.55
Side of injury		
Right side	17	47.22
Left side	19	52.78
Mean time from injury to surgery	3.45±0.66	

**Table 2: Associated complications observed during post-operative follow-up**

Complications	Total cases	
	Frequency	Percentage
Without complications	20	55.55
Implant irritation	03	8.33
Deep venous thrombosis	02	5.55
Superficial infection	02	5.55
Soft-tissue debridement	02	5.55
Delayed union	01	2.78
Non-union	01	2.78
Varus or valgus deformity	01	2.78
Knee stiffness	02	5.55

Outcome	Frequency (%)
Excellent	20 (55.55)
Good	13 (36.12)
Fair	02 (5.55)
Poor	01 (2.78)

Grading	Clinical outcome (%)	Radiological outcome (%)
Excellent	12 (33.33)	06 (16.6)
Good	16 (44.44)	23 (63.88)
Fair	05 (13.88)	04 (11.11)
Poor	03 (8.33)	03 (8.33)

### DISCUSSION

The management of proximal Tibial fracture has always been a subject of discussion because of their complexity and variety. The advantage approach. If the posterior column is not considered for fixation it may lead to varus collapse. Superior stability provided by medial buttressing and better functional outcome when it combines with either lateral or posterior columns. Laterally applied locking compression plates provide better stability in context of complex proximal 1/3rd tibia fracture associated with metaphyseal comminution. Dual plating [6] for two columns or three column fixations gives better biomechanical strength and rigid construct than unilateral plating thereby avoiding late collapse and loss of reduction. In our study, we have not formulated any criteria as to particular method of fixation for a particular column of fracture. Each case was individualized and treated accordingly as needed with good preoperative workup by assessing the radiograph of the knee, axial CT scan and intra-operative reduction with image intensifier.

We encountered 3 patients with stiffness out of 33 patients. Stiffness was treated by active and passive mobilisation exercises. Weigel DP, Marsh JL [8] in their long term follow up study showed similar knee stiffness. In our study, 2 patient got infection which got settled after a course of antibiotics based on culture and sensitivity, 1 patient had EHL weakness who got recovered in 3 months period of time, 1 patient had screw loosening which was removed at 6 months under local anaesthesia and 1 patient had screw site pain due to large size of the screw. For screw site pain patient implant was removed at the end of 15 months. 3 patients (6-10 %) had pain on squatting on terminal range. In our study we didn't fix any Posterolateral segment. About, 85% had excellent functional outcome and able to perform their daily routine activities. Good results in 12%. In addition we have 4% fair and 0% poor results. The above said clinical outcome results are comparable to the literature and on par with other documented standard studies like Seppo E. et al in 1993 [9], Joseph Schatzker et al [10] Chung wug oh et al [11]. Radiological analysis revealed maintenance of normal proximal Tibial knee joint orientation in all cases in our series. The normal value of medial proximal Tibial angle (MPTA) is 86+/-5 degrees, and the average value in our series was 85.8 degrees with range between 83 - 88 degrees. This proves that superior stability provided by bicolumn plating in bicondylar Tibial plateau fractures. Our study can be compared with other studies based on radiological outcomes and shows significant results like Weil Ya, Gardner MJ, Boraiah S [12] Lobenhoffer P, Gerich T, Bertram T [13] Berber R, Lewis CP, Copas D [14]. With stable internal fixation we proceed with early knee motion which reduce of knee stiffness, and improved cartilage healing (regeneration) and promote good callus formation and remodeling and provides good functional outcomes. These results show the superiority of the three-column concept.

### CONCLUSION

Dual plating for two columns or three column fixation [15, 16] by open reduction and internal fixation (46) provides accurate reconstruction which gives better biomechanical strength and rigid construct than unilateral plating. There were no major wound problems in any of these cases. Weight bearing was started around 2-3 months which is similar to our study. Early joint mobilization is possible with this technique and this contributes to better final knee range of motion. Column based concept classification-based 3D CT makes the surgeon better prepared for intra operative and post operative

complications and yields better results [18-20].

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