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# An outcome of surgical management of the tibial plateau fractures

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## ABSTRACT

**Background:** Advance in mechanization and acceleration of travel has been accompanied by an increase in number and severity of fractures and those of the tibial plateau are not an exception. As it is one of the major weight bearing joints of the body, fractures around it will be of at most importance. **Aims:** (1) To restore articular congruity and limb alignment by open reduction and rigid internal fixation. (2) To enable early knee motion and improve quadriceps and hamstring power. (3) To study the role of surgical treatment and functional outcome in tibial plateau fractures and its complications. **Settings and Design:** A prospective study was carried out, 32 cases of the tibial plateau fractures, which were admitted from August 2010 to April 2012 at Department of Orthopedics of our Hospital. **Materials and Methods:** 32 patients underwent surgical treatment for tibial plateau fractures. Fractures were classified according to the Schatzker's system. The indications for surgery were defined as the presence of displacement, depression and instability being more than 4 mm, 10 mm and 10 degrees. The mean follow-up was 12 months. The selected patients were evaluated and were taken up for surgery. The indicated fractures were treated with closed reduction and internal fixation with percutaneous cannulated cancellous screws, external fixator, open reduction and internal fixation with buttress plate with or without bone grafting. The range of motion was started soon after surgery. The patients were advised nonweight bearing up to 6-8 weeks. Total weight bearing deferred until 12 weeks or complete union of fracture. **Statistical Analysis:** All parameters before and after the treatment were expressed in mean  $\pm$  standard deviation and analyzed by the Student's *t*-test using SPSS version 16. **Results:** The knee range of motion was excellent to very good and weight bearing after

complete union was satisfactory. Malunion in two cases, knee stiffness in three, redepression in one case, wound dehiscence in two cases and no cases of nonunion were recorded.

**Key words:** bone graft, buttress plate, fracture, tibial plateau

## INTRODUCTION

Tibial plateau fractures are one of the commonest intra-articular fractures. Tibial plateau fractures usually result from axial loading in combination with varus/valgus stress forces. These fractures encompass many and varied fracture configurations that involve lateral, medial or both plateaus with many degrees of articular depressions and displacements. Each fracture type has its own characteristic morphology and response to treatment. Apart from bony injury, meniscal tear and ligament injuries also should be assessed. There have been a lot of changes in the medical field, especially in orthopedic trauma. A better understanding of biomechanics, quality of implants, principles of internal fixation, soft-tissue care, antibiotics and asepsis have all contributed to the radical change. Thus we have advanced from the conservative approach to internal fixation in fractures as an acceptable mode of treatment. Fractures of the upper tibia are extremely difficult to treat apart from the usual problems of confining the patients to bed. Treating such fractures conservatively at any age may be complicated by malunion, knee stiffness and nonunion. Open reduction and internal fixation (ORIF) has been advocated using various implants including Buttress

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plates, cancellous screws, and external fixators etc., to achieve good fracture union and optimal knee function. When treating such intraarticular fractures, the aim is to obtain a stable joint permitting early range of motion for cartilage nourishment and preservation.<sup>[1]</sup> The aim of the study is to analyze the outcome of percutaneous and ORIF by cancellous screws, buttress plate with or without bone grafting in split depression tibial plateau fractures.

## MATERIALS AND METHODS

A prospective study was conducted at Department of Orthopedics of our Hospital for the period of 20 months from August 2010 to April 2012. 32 patients (Mean age of 41 years [20-60 years]) underwent surgical treatment for tibial plateau fractures. Fractures were classified according to the Schatzker's system [Table 1], being Type 1 (10 fractures), Type 2 (6), Type 3 (2), Type 4 (4), Type 5 (6), and Type 6 (4). To avoid bias, all the patients were evaluated and operated by single Orthopedic Surgeon and assisted by another. Inclusion criteria were as the presence of displacement, depression and instability being more than 4 mm, 10 mm and 10 degrees respectively. The exclusion criteria were: age less than 18 years, patients who are medically unfit for the surgery, compound tibial plateau fracture, associated ligament injuries were evaluated by magnetic resonance imaging (MRI). The mean follow-up was 12 months. Preoperative planning consisted of anteroposterior and lateral views in all cases and amount of displacement, depression and angulation were recorded. Computed tomography (CT) scan was kept as an option in cases where fracture pattern or amount of depression was unclear. Condylar depression was measured from a reference line level with the reference level of uninjured plateau; In case fracture pattern was not clear, it was well-defined using a reconstructive CT scan. Condylar widening was obtained by measuring total width of the tibial plateau just below the joint line and measuring the width of femoral condyles just above the joint line. Based on the radiograph, fractures were classified according to Schatzker's classification staging system. As soon as the operation was planned, certain routine procedures were

regularly followed like use of antibiotics preoperatively and continued until the removal of sutures, preparing the part for surgery, selection of proper size of buttress plate, condylar screws and cortical screws, to check for any associated fractures, if there is an element of depression in the fracture then bone grafting is done. The patients were operated using spinal anesthesia. The type of surgical procedure undertaken was determined in part by the condition of soft tissues by MRI and other factors that determine the "personality of the fracture." In minimally displaced fractures without depression, 6.5 mm cancellous screws were used to fix the fracture fragments. The articular surface was reconstructed and depressed fracture fragments reconstituted with autogenous bone grafts from the iliac crest. Once near anatomical reduction was obtained, fractures were fixed with 6.5 mm cancellous screws, cannulated screws or a precontoured T or L buttress plate [Table 2]. On completion of osteosynthesis, the stability of fractures and knee were checked and any ruptured collateral ligaments repaired in four cases. The C-arm was used to check the adequacy of reduction before closure. A tension free, layered closure was carried out over a suction drain. Whenever rigid internal fixation was achieved, the patient was mobilized after 48 h after removal of the drains, for 2-5 days the range of motion allowed was 0-20°, from the 5<sup>th</sup> day the range of motion was gradually allowed to be increased to 90° or more. After suture removal, full range of movement was allowed. Whenever there was doubt about the rigidity of fixation, external splinting in the form of plaster of paris slab was given for support. Range of motion exercises (CPM) were done daily under careful supervision and splint reapplied. All the patients were taught and advised to do static quadriceps exercises and dynamic exercises with a quadriceps board as much as possible and throughout the day. Partial weight bearing was delayed until 6-8 weeks and full weight bearing allowed after 12-16 weeks. We found the best time for ORIF was within 4 h of injury or 1 week after the injury, when the swelling and the inflammatory reactions have subsided. We found the best time for ORIF was within 4 h of injury or 1 week after the injury, when the swelling and the inflammatory reactions have subsided. Twenty cases were operated within 4 h and 12 cases after 1 week. Most of the patients were satisfied with the treatment the patients were followed up in the outpatient department at 3 weeks, 6 weeks, 3 months, and 6 months.

## RESULTS

Observation and analysis of results was performed in relationship to age, sex, occupation, laterality of fracture,

**Table 1: Schatzker's classification**

Type of fractures	No. of cases	Percentage
Pure cleavage	10	31.25
Cleavage with depression	6	18.75
Central depression	2	6.25
Medial condyle fracture	4	12.5
Bicondylar fracture	6	18.75
Metaphysiodiaphyseal dissociation	4	12.5

type of fracture, method of treatment, duration of immobilization, complications and the remarks of different age groups in details as follows: The youngest being 24 years and the eldest being 60 years. Final evaluations included 32 patients (32 knees). During each visit the patients were evaluated both subjectively and objectively, using the Rasmussen's 30-point clinical grading system and Rasmussen radiological evaluation of knee [Table 3]. This system evaluated the patients both subjectively and objectively and thus gave a comprehensive picture of the patient's condition. The results were analyzed in relation to fracture type, adequacy of reduction, associated injuries and time of knee mobilization. Relevant complications of the operative procedure and any subsequent secondary surgeries performed were also recorded.

In our series, percutaneous cancellous screw fixation were done in eight cases (25%), cancellous screw fixation with bone grafting in two cases (6.2%), ORIF with buttress plate and screws in 15 cases (46.8%), buttress plate with bone grafting in six cases (18.8%) and buttress plate with external fixator in one case (3.2%) [Table 2 and Figure 1]. Most of the patients were satisfied with the treatment based on the criterion described by Rasmussen,<sup>[3]</sup> there were excellent, good, moderate, and poor in 14 knees (44%), 14 knees (44%), two knees (6%), and two knees (6%),

respectively [Table 3]. Postoperative complications included superficial infections (two patients), knee stiffness (two patients), and extensor lag (one patient). The complete results were mentioned in Figure 2.

### Statistical analysis

All of the study parameters before and after the treatment were expressed in mean  $\pm$  standard deviation and analyzed by Student's *t*-test using SPSS Inc., Chicago, USA software version 16. The results of  $P < 0.05$  were statistically significant in this study.

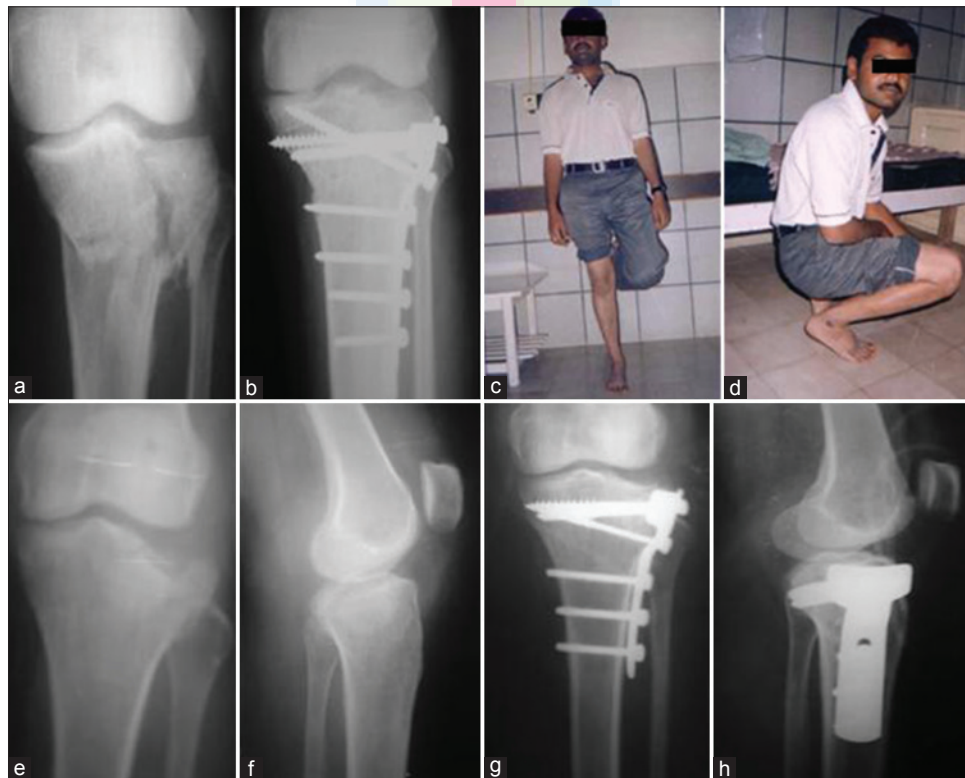
**Table 2: Methods of treatment**

Methods of treatment	No. of cases	Percentage
Percutaneous cancellous screw fixation	8	25
Cancellous screw and bone grafting	2	6.2
ORIF with buttress plate and screws	15	46.8
ORIF with buttress plate and bone graft	6	18.8
ORIF with buttress plate and external fixator	1	3.2

ORIF: Open reduction and internal fixation

**Table 3: Clinical results Rasmussen criteria)**

Clinical results	No. of cases	Percentage
Excellent	14	44
Good	14	44
Fair	2	6



**Figure 1:** (a and b) Type VI tibial plateau fracture and postfixation after 6 months. (c and d) Clinical outcome after 6 months. (e and f) Type III fracture with lateral plateau involvement anteroposterior and lateral views. (g and h) 3 months follow-up fixation with buttress plate and bone grafting



MASTER CHART										
Age	Sex	IP No.	Occupation	Mode of injury	Laterality	Schatzkar # type	Treatment procedure	Immobilization period	Complication	Result outcome
38	M	100110789	Business	RTA	L	I	Canc screw fixation	< 10 days	-	Excellent
40	M	110224665	Farmer	Fall	R	V	ORIF with BP	< 10 days	-	Good
34	M	111789654	Business	RTA	R	VI	ORIF with BP	< 10 days	-	Excellent
60	M	100462369	Business	RTA	L	V	ORIF with BP	< 10 days	-	Good
32	M	111452568	Engineer	RTA	L	IV	ORIF with BP & Ext Fix	3 weeks	-	Good
40	M	120463280	Bank Manager	RTA	R	VI	ORIF with BP & BG	< 10 days	-	Excellent
24	M	111467133	Labourer	Assault	R	V	ORIF with BP & BG	3 weeks	-	Good
35	M	100472143	Business	RTA	L	I	Canc screw fixation	< 10 days	-	Excellent
39	M	111474165	Labourer	RTA	L	VI	ORIF with BP	3 weeks	Inf	Good
35	M	120483850	Business	RTA	L	V	ORIF with BP	< 10 days	-	Excellent
56	F	100488543	House wife	Fall	R	II	ORIF with BP	< 10 days	-	Good
42	M	111459981	Business	RTA	R	I	Canc screw fixation	< 10 days	-	Excellent
40	F	120456387	House-wife	RTA	R	II	ORIF with BP & BG	< 10 days	Inf, Stiffness	Fair
28	M	100457100	Engineer	Athletic	R	I	Canc screw fixation	< 10 days	-	Excellent
60	M	111469841	Farmer	Fall	R	III	ORIF with BP	< 10 days	Extensor lag	Good
50	M	100481008	Farmer	RTA	R	II	ORIF with BP	< 10 days	-	Excellent
40	M	121433689	Business	RTA	L	V	ORIF with BP	< 10 days	Varus	Good
24	M	111473233	Farmer	RTA	R	VI	ORIF with BP	6 weeks	Inf, Stiffness	Poor
39	M	121819634	Farmer	RTA	L	IV	ORIF with BP	< 10 days	-	Excellent
32	M	100478332	Business	RTA	R	II	ORIF with Canc screw & BG	3 weeks	-	Good
38	M	111229912	Farmer	RTA	R	I	Canc screw fixation	< 10 days	-	Excellent
42	M	121011008	Business	Assault	R	II	ORIF with BP & BG	< 10 days	-	Good
39	M	100483892	Labourer	RTA	R	IV	ORIF with BP	< 10 days	-	Excellent
38	M	121490089	Teacher	RTA	R	I	Canc screw fixation	< 10 days	-	Excellent
50	M	100496835	Labourer	Fall	L	I	Canc screw fixation	< 10 days	-	Good
32	M	102463849	Business	RTA	R	V	ORIF with BP	< 10 days	Valgus	Good
50	M	111472419	Business	Assault	L	IV	Canc screw fixation	6 weeks	Stiffness	Fair
45	M	100474326	Farmer	RTA	R	I	ORIF with BP	< 10 days	-	Excellent
44	F	102573210	Housewife	RTA	L	III	ORIF with BP & BG	3 weeks	Redepression	Good
56	M	111025312	Farmer	RTA	R	I	ORIF with BP	< 10 days	-	Excellent
50	M	100465321	Labourer	RTA	R	I	ORIF with Canc screw & BG	6 weeks	-	Poor
40	M	111028421	Business	RTA	L	II	ORIF with BP & BG	< 10 days	-	Good

Figure 2: Demographics and clinical parameters of the patients

## DISCUSSION

Tibial plateau fractures may be divided into low energy or high energy fractures. Low energy fractures are common in older patients due to osteoporotic bone changes and are typically depressed fractures. High energy fractures are commonly the result of motor vehicle accidents, falls or sports related injuries. In our study, the most common mode of injury is being the automobile accident (75%), next common being fall from height (12.5%) and followed by violence (9.37%). The majority of fractures occur between the age of 20 and 60 years with maximum incidence being involving the productive age group 31-40 years (50.25%). This incidence of sex versus upper tibial fractures can be attributed to an overwhelming large proportion of male patients in our study.

In our series, majority of the patients were males 90.63%. This can be attributed to our Indian setup where the female population largely work indoor or in agricultural fields and do not travel much as the study is done in a rural population. Occupationally tibial plateau fractures were seen in people with high level of activity, movement and travel. It is most commonly seen with people who travel more like businessman and agriculturist. In our series, majority were businessmen followed by agriculturist, laborers, and housewives. Frequency of involvement of right and left knee is relatively equal. In our study, it was 17 left knees and 15 right knees. Injuries to the tibial plateau are so variable that no single method has proven uniformly successful. Genu valgus is observed commonly after central depression fractures, which are treated conservatively. Stable tibial condyles, properly aligned on the femoral condyles are

essential to prevent angular deformity of the knees. We have not formulated the stringent criteria as to particular method of fixation for particular type of fracture. So each case was individualized and treated accordingly as it needs. Most of the Type I, some Type II and a case of Type V were treated with percutaneous cancellous screw fixation. The split fracture, of >3 mm displacement was treated by ORIF.<sup>[2,4]</sup> Bone grafting was included along with ORIF with Buttress plate and screws in Type II, III, V and VI wherever necessary.<sup>[5]</sup> The major problem faced by us during the study was infection and wound dehiscence; hence immobilization was of longer in these patients (four cases). One patient had to undergo muscle flap cover and healed well later. The infection might be attributed to nosocomial infection. Earlier mobilization of the knee after tibial condylar fractures has reduced the incidence of stiff knee by preventing the formation of intra articular adhesions.

In spite of all these ligament injuries and complications, we are able to achieve 44% excellent result of 44% good results. (Overall 88% acceptable results) with our standard surgical care using various standard fixation methods. In addition, we have 6% fair and of 6% poor results in terms of functional outcome. The poor results were attributed to lack of physiotherapy and its knowledge as most of the patients are came from rural areas and one case being immobilize prolong due to infection and ultimately leading to stiffness. These results are comparable and on par with other documented standard studies. Recent trend is to do minimal invasive surgeries if possible. Many centers have shown good results with arthroscopic assisted internal fixation,<sup>[6,7]</sup> hybrid external fixator, minimal internal fixation supplemented with external fixation,<sup>[8]</sup> Ilizarov ring fixation and the minimal invasive percutaneous plate osteosynthesis. We have not employed any of these techniques though had satisfactory results with the standard conventional methods.

## CONCLUSION

These fractures need optimum treatment in order for patients to return to early productive life. Surgical treatment when indicated is advantageous to get stable knee. We found out that surgical treatment with adequate physiotherapy can give good results in tibial plateau fractures. In spite of infections, and certain complications we had comparable results as with other studies even though it was done on rural population. Hence, to conclude, the surgical management of tibial plateau fractures plateau is challenging and open reduction and rigid internal fixation, achieving a congruous joint surface, facilitates early knee mobilization and consequent good functional results in a majority of these controversial fractures

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