

## ORIGINAL ARTICLE

# Displaced Tibial Plateau Fractures: Is There A Role Of Conservative Treatment In The Present Scenario

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## Abstract

This retrospective case series includes 92 closed tibial plateau fractures treated by operative (66 patients) and conservative (26 patients) methods at our institution. The means and mean differences of grades of the objective variables of extensor lag and range of motion and articular step were better in the surgically treated patients ( $p$  value  $<0.05$ ), while those of axial alignment and side to side instability did not show any statistical significance. An average articular step of more than 1.6 mm significantly deteriorated the functional outcome. Achieving articular congruity is the most important factor for the successful outcome of tibial plateau fractures. Operative treatment in the presence of adequate expertise and infrastructure gives satisfactory results. Type V and VI fractures are highly unstable fractures and need to be treated by more stable fixation in the form of dual plating and/or locked compression plating. The variables like extensor lag, range of motion and radiological articular step directly correlate with the functional outcome of tibial plateau fractures. The conservative treatment should only be accepted as last option in case of displaced tibial plateau fractures.

## Key Words

Tibial Plateau, Fractures, Knee

## Introduction

Tibial plateau fractures require appropriate treatment and rehabilitation to obtain a stable, pain-free and mobile joint (1). The variables like extensor lag, condition of the articular cartilage, range of motion, instability, axial malalignment, and articular incongruity have been reported to determine the functional outcome in tibial plateau fractures (2-8). A number of treatment modalities including dual plating, external fixators alone or in combination with plating, and conservative treatment have been reported to have satisfactorily treated the various types of tibial plateau fractures in different settings; at times a similar fracture has been preferred to be satisfactorily treated differently by the proponents of different modalities (2,9-11). The scarcity of studies from the developing countries on tibial plateau fractures, probably, facilitates the practice of conservative treatment of these fractures. Ironic though it may seem, this provided us an opportunity to obtain a data of both the operative and conservative treatments of similarly placed tibial plateau fractures. The aim of the present study is to

present the experience of treating such fractures by operative and non operative methods and to study their outcome in relation to the objective variables.

## Material & Methods

92 patients out of a total of 122 patients with closed tibial plateau fractures treated at our institution (a tertiary level health-care institution) between January 2000 and May 2004 were included in the retrospective study. The patients with inadequate follow-up (those who stopped visiting the clinic before the fracture union was clinically and radiologically established and the patients who could not be functionally evaluated), and those with undisplaced type I fractures were not included in the study. We included all the other patients. Since the age of the patients in the conservatively treated patients was 22 to 55 years, we excluded the patients older than 60 years from the operated group. The classification system proposed by Schatzker et al. was used to classify the fractures (12). Open reduction and internal fixation was recommended to all patients with displaced tibial plateau fractures.

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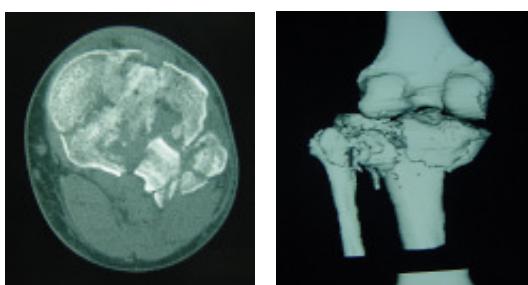
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**Fig. 1 A & B X ray Showing Mainly Displaced Lateral Condyle with Reasonably Aligned and Minimally Displaced Medial Condyle**



**Fig 2 A & B. Fixation with Single Non Locking Plate of the Patient in Fig 1 resulting in Late Varus Collapse**



**Fig 3 A- B. A badly Comminuted Tibial Plateau Fracture Seen in CT Reconstructions**

Conservative treatment was employed in patients who refused surgery on personal or social grounds (those who could not afford the cost of the implants) or the patients labelled to be having poor skin condition at the initial examination. In the absence of any specific scientific contraindications to surgery, the allocation of patients into the conservative group was purely non-technical. However, this unplanned allocation of the patients in either of the two groups resulted in a sort of random allocation of fractures into the two groups. Although the number of patients in each group was markedly different (66 versus 26), the percentage of patients in each category of the Schatzker classification were more or less similar (*Table 1*). The base line demographics of all the patients are shown in *table 2*. The patients included in the study were divided into two groups: Operative: 66 operatively treated fractures. Non-operative: 26 conservatively treated fractures. In the operated group, open reduction and internal fixation with or without bone grafting was done at the earliest available time in the operating room. Collateral ligament repair was done when gross instability was present after stabilization of the fracture. Post-operatively, patients were encouraged to perform static



**Fig 4. Soft Tissue Condition of the Patient & Fig 5 A & B. Final Follow up X rays with Dual Plating of the Patient**



**Fig 6 A & B. Range of Motion of the patient**

quadriceps exercises. Gentle progressive range of motion exercises of knee were started after suture removal. In the conservatively treated group, the patients were either treated with POP cast for 6-8 weeks followed by a cast brace or skin/ skeletal traction for 2-4 weeks, followed by a cast brace for next 6-8 weeks. In both the groups, patients were followed-up fortnightly till 3 months, every month thereafter for 6 months, and every three months thereafter. The union was thought to be achieved when radiologically at least three of the four cortices showed intervening bone formation, and the patient was able to bear full weight. Average follow-up was 6.4 years (range 5 years to 8 years). Final assessment was done by observers, who were not part of the operating team (HS and RK). Both the groups were observed for extensor

lag (in degrees), range of movement (in degrees), instability (in degrees), axial malalignment (in degrees), articular step (in millimetres), and functional outcome (in grades). For measuring the functional evaluation, pain and walking ability of the patient was measured (Column 6 of *Table 2*). Each of these variables was awarded a grade between 1-5 (*Table 2*), based on modifications of the grading systems used by Hohl *et al.*, and Rasmussen *et al.*(4,5). Grade 5 means the best and grade 1 means the worst outcome. The mean score and mean difference amongst the two groups of each variable (in grades) was calculated for both the groups by applying the 95% confidence interval limits. The relative values for both the treatment modalities were statistically analyzed. The statistical analysis was done and the p-values < 0.05 were considered significant.

**Table 1. Distribution of Fractures According to Schatzker Classification & Age Distribution**

Fracture Type	Operative			Non Operative		
	N	%	Average Age	N	Average Age	
I *	(6)	4	34.10	2	33.20	
II	(27)	23	41.90	4	40.10	
III	(8)	6	54.50	2	55.70	
IV	(7)	5	52.00	2	49.00	
V	(12)	8	46.36	4	45.38	
VI	(32)	20	45.72	12	47.80	

## Results

The study included 92 patients, 70 males and 22 females, with the average age of 44.3 years. *Table 1* describes type of fracture. Right side was involved in 50 patients. 66 patients had sustained injuries in road traffic accidents, 25 by accidental falls or skidding, and one patient sustained an open fracture when he was hit by a bull. The surgical treatment was done in 66 patients at an average pre-operative delay of 6.4 days (2-12 days) after sustaining injury. The surgery was delayed for an average of 9.4 (6-11) days in 8 patients due to associated chest/head injuries, while 27 patients presented to us with an average initial delay of 8.6 days (4- 12 days). None of the patients with poor skin condition constituted the part of the operated group because we were treating such patients conservatively during that time. Average post-surgery hospitalization was 5.9 days (3-12 days). The fracture fixation was done with screws alone (n =15), buttress plating (n= 44), and dual plating (n=7). Lateral collateral ligament repair was done in 2 patients. The union in the operative group occurred at an average of  $15.4 \pm 2.6$  weeks. 2 patients developed superficial infection which responded to local wound care and antibiotics. There was

no deep infection, non-union or implant failure in this study. Of the 26 conservatively treated patients, 20 patients were treated by above knee POP cast for 6-8 weeks, followed by cast brace/ long knee brace for another 6-10 weeks. 6 patients were treated by skeletal traction for 3-4 weeks followed by knee brace for 6-13 weeks. In the conservatively treated group, union occurred at an average of  $15 \pm 2.9$  weeks. At the time of final assessment, at average follow up of 6.4 years (range 5 years to 8 years), scoring was done as per *table 2*. The final results are shown in *table 3*. Ninety five percent confidence intervals for the means and mean difference were calculated for all the variables (*Table 4*). The data shows that the variables like residual extensor lag, the total range of motion at the knee, the articular step, and the functional outcome showed improvement in the

surgically treated patients group, while side to side instability and axial malalignment was almost equally seen in the patients treated with both the modalities.

## Discussion

Tibial plateau fractures constitute 1% to 8% of the fractures of the lower limb (13). Poor functional outcome in these patients is due to pain, stiffness, and development of post-traumatic arthrosis (3,14). The variables like extensor lag, range of movement, instability, articular incongruity, axial malalignment, walking capacity, and pain have been used by various authors to grade the results (4-6,12,15,16). We have used the same variables with some modifications in grading the outcomes (*Table 2*). Since pain and walking ability determine the eventual function, we have modified the grading system to combine the same under the heading of functional outcome. The contra lateral uninjured knee was used for comparison. Restoration of these parameters to as close to their pre-injury status as possible, as recommended in various studies, was the goal of our treatment (2,3,8,10). Both conservative as well as operative treatment has been reported to give satisfactory outcome depending upon the type of the fracture and the experience of the treating

**Table 2. Grades Assigned To Outcome Parameters**

Level of grade	Extensor lag	Range of motion	Instability (Sum of varus and valgus instability )	Articular step	Axial alignment	Functional outcome
Grade 1	Normal	>120°	Normal	<2 mm	Normal	No pain, unlimited walking
Grade 2	<4°	90°-120°	<5°	2-4 mm	Valgus <5°	Mild pain on walking > ½ hour
Grade 3	5°-7°	60°-90°	5°-10°	4-6 mm	Valgus 5-10°	Pain on walking < ½ hour
Grade 4	8°-10°	30°-60°	10°-15°	6-8 mm	Valgus > 10°	Constant pain on walking
Grade 5	>10°	<30°	>15°	>8 mm	Varus	Pain at rest

**Table 3. Values of Outcome Parameters**

	Operative	Non-operative	p-value
<b>Extensor Lag</b>	4.60 ± 0.57	4.07 ± 0.62	<b>p&lt;0.05</b>
<b>Total Range of Motion of The Knee</b>	4.24 ± 0.81	3.4 ± 1.0	<b>p&lt;0.05</b>
<b>Instability</b>	3.82 ± 0.89	3.53 ± 0.64	p>0.10
<b>Articular Step</b>	4.6 ± 0.66	4.26 ± 1.0	<b>p&lt;0.05</b>
<b>Axial Alignment</b>	4.07 ± 1.0	4.00 ± 1.0	p>0.10
<b>Functional Outcome</b>	4.40 ± 0.79	3.69 ± 0.61	<b>p&lt;0.05</b>

surgeon. Jenson *et al* in 1990 have reported conservative method to be a well comparable option of treatment for tibial plateau fractures, although finally suggesting that more such comparative studies were required to further strengthen their notion (12). Yong and Choon in 2005 in a study comparing the results of conservative and operative treatment of tibial plateau fractures reported that the recognition and restoration of joint stability and articular surface congruency were important factors for a satisfactory outcome of a treatment method (17). In the recent years, there had been a worldwide tilt in favour of operative modality of treatment especially for the displaced fractures (3,8,20,25,26). Out of the 26 patients managed conservatively, 17 were those who were recommended operative treatment but chose to be managed conservatively due to one of the socio-economic reasons discussed above, while 9 patients were offered conservative treatment due to the subjective observation of poor local skin condition at the time of the first

examination. Since the conservative treatment gave overall inferior functional results we feel that such fractures should be treated by delaying the definitive fracture surgery until healing of local skin condition rather than treating them conservatively (18).

In the present series, the two groups are unequal in size because the total number of patients receiving conservative treatment has significantly reduced in the last few years. We included all the patients treated conservatively during the period of our study and those who fell in to our inclusion criteria. The total number was 26 only. On the contrary, the number of patients in the operated group is quite high (66). Since the two groups are unequal in size and there was no formal randomization amongst the groups, we are presenting this study as a case series rather than a formal comparative study.

The surgery was delayed for an average of 9.4 (6-11) days in 8 patients due to the associated chest/ head injuries. All these patients were observed preoperatively so that they were stable enough to avoid postoperative intensive care. 27 patients presented to us with an average initial delay of 8.6 days (4- 12 days). Due to lack of organized health insurance system, the patients have to spend at their own for the transportation as well the medical treatment. This results in many patients avoiding coming to the specialized centres especially from the far areas and resorting to getting treatment from local bone setters. The maximum delay in resorting to surgery was 12 days & the reduction of widely displaced fragments can be difficult in delayed surgery. In our series, extensor lag was more commonly seen in the conservatively treated

**Table 4. 95% Confidence Intervals of Means and Mean Difference**

Parameter	Group	Mean	95% confidence interval	Mean difference	95% confidence interval of mean difference	p-VALUE
Extensor lag	<b>Operative</b>	4.60 ± 0.57	4.48 – 4.72	0.53	0.247 - 0.813	P<0.05
	<b>Non-operative</b>	4.07 ± 0.62	3.83 – 4.31			
Total range of motion	<b>Operative</b>	4.24 ± 0.81	4.07 – 4.41	0.84	0.395 - 1.285	P<0.05
	<b>Non-operative</b>	3.40 ± 1.00	3.02 – 3.78			
Instability	<b>Operative</b>	3.82 ± 0.89	3.64 – 4.00	0.29	-0.043 - 0.623	p>0.10
	<b>Non-operative</b>	3.53 ± 0.64	3.28 – 3.78			
Articular step	<b>Operative</b>	4.60 ± 0.66	4.47 – 4.73	0.34	-0.092 - 0.772	P<0.05
	<b>Non-operative</b>	4.26 ± 1.00	3.88 – 4.64			
Axial alignment	<b>Operative</b>	4.07 ± 1.00	3.87 – 4.27	0.07	-0.396 - 0.536	p>0.10
	<b>Non-operative</b>	4.00 ± 1.00	3.62 – 4.38			
Functional outcome	<b>Operative</b>	4.40 ± 0.79	4.24 – 4.56	0.71	0.402 - 1.018	P<0.05
	<b>Non-operative</b>	3.69 ± 0.61	3.46 – 3.92			

patients. Tscherne has also reported extensor lag in 31% of his patients treated conservatively, 8% having extensor lag of more than 10 degrees (8). The cause of the extensor lag could be attributed to the union of a type VI fracture in flexion and/or decreased efficiency of extensor apparatus due to union of a tibial tubercle in displaced position. All our patients with extensor lag, in both the groups, had a significantly inferior functional outcome ( $p<0.05$ ).

In surgically treated patients, range of motion in the present series was more in type I to IV fractures, whereas it was less in type V and VI fractures. In 21 of a total of 28 type V and VI fractures, which had been fixed using a single plate, an additional external support in the form of knee brace was given for 4-6 weeks thus delaying the range of motion exercises. These patients belonged to the early part of our series, when dual plating was not done by us in these patients for fear of a high complication rate(10,19,20). This cautious approach of ours for surgical treatment probably resulted in a lower rate of complications like deep infection and implant failure in our series, but at the cost of reduced knee motion. Gausewirth and Hohl have shown that operated patients tend to develop knee stiffness as early as two weeks if they are immobilized (3). In the later part of our series, a better range of motion and better alignment could be achieved in such fractures by using dual plating to provide stable fixation, thus facilitating early motion. The fractures requiring dual plating may have associated soft tissue

problems at the time of presentations. In such cases we elect to wait for 1-2 weeks till there is wrinkling in the soft tissues and aim for stabilizing the fracture so that early mobilization can be started (Fig 3-6). Although we did experience transient problems with respect to wound healing in two of the patients with dual plating, the overall results were not adversely affected by such delays in wound healing, and we believe that the fear of complications with dual plating may be unfounded if one sticks to meticulous surgical technique. Recently, use of minimal invasive methods of fracture reduction followed by stabilization with an external fixator or anatomically contoured plates has been reported to reduce the soft tissue problems in high energy tibial plateau fractures (21,22). Medio-lateral instability was found in both the groups, with an average of 5.8 degrees in the operated group and 6.1 degrees in the conservatively treated group. Weigel and Marsh noted instability in 12 out of 20 patients treated for tibial plateau fractures, a finding that may be explained by collateral ligament elongation or injury caused by the force producing the fracture (23). In two patients with gross instability, we performed collateral ligament repair along with fracture fixation, with satisfactory results. The axial malalignment amongst the operated and conservatively treated patients on an average was 3.6 degrees and 4 degrees respectively. The majority of axial malalignment was contributed by type V and VI fractures. The initial satisfactory minimally displaced fracture lines in either of the condyle in the preoperative X ray can

mislead the surgeon in electing to use only one plate, but ultimately resulting in late varus collapse (*Fig 1,2*). The decision for selecting an appropriate implant should be based solely on the basis of fracture geometry rather than the initial alignment as seen in the image intensifier at the time of surgery, and the final axial alignment has to be in anatomical limits to prevent progression of joint degeneration (4,24,25). The advent of locked compression plates in the recent years is supposed to solve the problem of late collapse to a great extent (26).

Average articular step was 1.6 mm in the operated group, and 2.8 mm in the conservatively treated group. In a study by Wiegel and Marsh, articular incongruity of < 3 mm did not affect the progression of post-traumatic arthrosis (23). In a study by Blokker *et al.*, a residual step of > 5 mm in 17 patients gave acceptable results (2). In a study by Mathur *et al.*, an articular step of < 4mm gave acceptable results (20). Burri *et al.* advocated open reduction if the articular step is more than 1 mm (27). Many authors recommend for articular surface reconstruction when articular step is between 4-6 mm and more (2,14,23). Our study shows that an average articular step of more than 1.6 mm significantly affected the functional outcome. Since, practically, it is extremely difficult to obtain an accurate measurement of the articular step of 1.6 mm, and knee joint being a major weight bearing joint, it is proposed that we should not accept any intraarticular step in tibial plateau fractures and should always aim for absolute congruity.

### **Conclusions**

We feel that in tibial plateau fractures, we should always aim for the absolute articular congruity. Operative treatment in the presence of adequate expertise and infrastructure gives satisfactory results. Type V and VI fractures are highly unstable fractures and need to be treated by more stable fixation in the form of dual plating and/or locked compression plating.

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