

SURGICAL MANAGEMENT OF TIBIAL PLATEAU FRACTURE - A PROSPECTIVE STUDY

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ABSTRACT: BACKGROUND: Tibial plateau fractures are common injuries of the proximal tibia which vary in severity from minimally displaced stable injuries to high energy complex fractures. The emphasis in treating these fractures are anatomical restoration of fracture surface repair of soft tissue injury. Rigid fixation to obtain a stable painless knee with normal range of motion.

METHODOLOGY: 60 cases of tibial plateau fractures treated by various modalities were studied from June 2011 to June 2013 at our institution and followed for minimum of 6 months. The functional evaluation of knee joint graded by modified Hohl and Luck criteria. 33 patients underwent PCCS fixation. 3 patient underwent ORIF with BP. 21 patients underwent ORIF with BP and bone graft 3 patient was treated with Ilizarov ring external fixator.

RESULTS: The selected patients were evaluated clinically and radiologically. The indicated fractures treated as per the Schatzker's types. Accordingly with CRIF and percutaneous cannulated cancellous screws, ORIF with buttress plate with or without bone grafting and external fixator were used. We were able to achieve 50% of excellent result, 40% of good result (overall 90% acceptable results) with our standard surgical care using various fixation methods. In addition we had 10% poor results in terms of functional outcome.

CONCLUSION: Surgical management of tibial plateau fractures will give excellent anatomical reduction and rigid fixation to restore articular congruity, facilitate early motion and reducing post-traumatic OA and thereby achieving an optimal knee function.

KEYWORDS: Fracture, Tibial plateau, buttress plate, bone graft, Schatzker's classification.

INTRODUCTION Advance in mechanization and the acceleration of travel have been associated with increased number and severity of fractures. Fractures of the upper part of the tibia are no exception to this. Tibial plateau fractures are one of the commonest intra-articular fractures. It results from indirect coronal or direct compressive forces. It comprises of 1% of all fractures. Each fracture type has its own characteristic morphology and response to the treatment. It is essential to determine the force of injury since high-energy trauma is associated with considerable soft tissue and neurovascular damage. Apart from tibial plateau bony injury, meniscal tear and ligament injuries should also be assessed¹.

Tibial plateau fractures have evolved as a fascinating therapeutic challenge in the past two centuries. The indications for non-operative versus operative treatment vary widely among surgeons as do the specific methods of treatment for many fracture configurations and concomitant lesions. The objectives of treatment of tibial plateau fracture, is precise reconstruction of the articular surfaces, stable fragment fixation allowing early mobilization and repair of all concomitant ligamentous and other soft tissue lesions². Conservative treatment at any age, may be complicated by knee stiffness, malunion and nonunion. Open reduction and internal fixation has been advocated using various implants including Buttress plates, cancellous screws, and external fixators etc., to

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achieve good fracture union and optimal knee function³.

OBJECTIVES IF THE STUDY:

1. To study the outcome of surgical management of Tibial plateau fracture.
2. To document the functional outcome of the surgery using Modified Hohl and Luck Criteria.

MATERIALS AND METHODS: This is a prospective study of surgical management of tibial plateau Fracture conducted in the department of Orthopedics in Navodaya Medical College and Research Institute, Raichur, the study period is from June 2011 to June 2013.

INCLUSION CRITERIA: Patients above 18 years of age

Patients [both male and female] who are diagnosed to have Tibial Plateau fracture

EXCLUSION CRITERIA: Age: less than 18 years

Massive soft tissue loss. [Gustilo Anderson type IIC and type III] /patients who are unfit for surgery.

MANAGEMENT: After initial stabilization of the patients. Suspected tibial plateau fractures were confirmed radiologically and classified. After obtaining a proper consent patient were enrolled in the study. All were assessed by an established proforma. Basic laboratory investigations were done for each case, associated co morbid medical conditions was duly attended and made sure that they medically fit for surgery.

The Scharzker's classification was used to classify these fractures. The patients were followed up for an average period of 6 months. Condylar depression was measured from reference line in level with uninjured plateau. Condylar widening was obtained by measuring the width of the tibial plateau just below the joint line and width of femoral condyle above the joint line. These two lines are normally equal.

Surgical treatment was based on the type of fracture and amount of displacement or depression and degree of instability. The patients were taken for surgery at the earliest possible time depending on their medical condition, skin condition and amount of swelling. All surgeries were done under C-arm image intensifier control. Fractures were fixed either with percutaneous technique or by open reduction and internal fixation. The fixation devices consisted of T Buttress plate, Buttress plates, 4.5 mm cortical screws and 6.5 mm and 7.0mm cannulated and non cannulated cancellous screws. Bone grafts were used in depressed and comminuted fractures. The source of bone graft was ipsilateral iliac crest.

Postoperatively patients were immobilized with an above knee posterior slab or a compression bandage. The sutures were removed on the 10th postoperative day. IV Antibiotics were for 72 hrs and then switched to oral antibiotics till suture removal. The patients were advised quadriceps exercises, knee mobilization and non weight bearing crutch walking, on discharge. An immediate postoperative X-ray was also done.

FOLLOW UP: First follow up-2 weeks, during which the surgical scar was inspected and range of movements noted.

Second follow up-3 months, X-ray and clinical evaluation of union was done. Based on the clinical and radiological signs of union patients were allowed partial weight bearing and gradually progressed to full weight bearing. The patients were followed up at 6 months and 1 year

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respectively.

GRADE 0	NO OSTEOARTHRITIS
GRADE 1	DISCREET NARROWING OF JOINT SPACE
GRADE 2	MARKED NARROWING OF JOINT SPACE WITH OSTEOPHYTES
GRADE 3	MARKED NARROWING OF JOINT SPACE , OSTEOPHYTES, SUBCHONDRAL CYSTS AND SCLEROSIS
GRADE 4	SEVERE JOINT DESTRUCTION

TABLE 1 – OSTEOARTHRITIS SCALE 2

Grade	Lack extension (degrees)	Range of Movements (degrees)	Varus or Valgus Instability (degrees)	Walking Distance (m)	Pain
Excellent All of the Following	0	. >120	<5	<3000	None
Good Not More than One of the following	<10	<90	>5	<1000	Mild On Activity
Fair not More than Two of the following	>10	<75	>10	<100	Moderate on Activity Intermittent at rest
Poor	All results worse than fair				

TABLE 2 - MODIFIED HOHL AND LUCK EVALUATION METHOD

GRADE	Valgus/Varus Deformity (Degree)	Depression of articular surface (mm)	Osteoarthritis
Excellent (All of The following)	_ \leq 5	<5	None
Good (Not more than One of the following)	>5	>5	Minimal
Fair (not more than two of the following)	>10	>5	Moderate

TABLE 3 - RADIOGRAPHIC GRADING IN EVALUATION

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Observation	No. of subjects	Percentages
Age		
20-29	15	25%
30-39	18	30%
40-49	15	25%
50-59	6	10%
60-69	6	10%
Sex		
Male	42	70%
Female	6	30%
Occupation		
Student	9	15%
House Wife	9	15%
Agriculturist	21	35%
Driver	3	5%
Teacher	3	5%
Businessman	15	25%
Mode of injury		
RTA	42	70%
Fall from H/L	15	25%
Sports	3	5%
Laterality		
Right	45	75%
Left	15	25%
Type		
Pure cleavage	12	20%
Cleavage depression	21	35%
Central depression	3	5%
Medial condyle fracture	6	10%
Bicondylar fracture	6	10%
Metaphysio diaphyseal dissociation	12	20%
Method		
Percutaneous cancellous screw fixation	33	55%
ORIF with buttress plate and screws	3	5%
ORIF with buttress plate and bone graft		
External fixator	21	35%
	3	5%
Period		
< 10 days	42	70%
Upto 3 wks	15	25%
Upto 8 wks	3	5%
Complications		

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Post Traumatic OA	3	5%
Knee Stiffness	6	10%
Infection and Wound Dehiscence	12	20%
Extensor Lag	3	5%
Types		Avg Condylar Depression
I	12	3mm
II	21	5mm
III	3	4mm
IV	6	3.5mm
V	6	4.5mm
VI	12	5mm
Types	No. of subjects	Avg Condylar Widening
I	12	5.57cm
II	21	6.58cm
III	3	6.4cm
IV	6	6.12cm
V	6	6.4cm
VI	12	6.62cm

TABLE-4: RESULTS

Treatment	Results	I	II	III	IV	V	VI	Total/%
Percutaneous cancellous screw fixation	Excellent	27	-	-	-	-	-	27(45%)
	Good	3	3	-	-	-	-	6(10%)
	Fair	-	-	-	-	-	-	-
ORIF with buttress plate and screws	Excellent	-	-	-	-	-	-	-
	Good	-	-	3	-	-	-	3(5%)
	Fair	-	-	-	-	-	-	-
ORIF with buttress plate and bone graft	Excellent	-	-	-	-	3	-	3(5%)
	Good	-	-	-	3	3	9	15(25%)
	Poor	-	-	-	-	-	3	3(5%)
External fixator	Excellent	-	-	-	-	-	-	-
	Good	-	-	-	-	-	-	-
	Poor	-	-	-	-	-	3	3(5%)

TABLE-5: CLINICAL OUTCOME

Observation and analysis of results were done in relationship to age, sex and occupation, laterality of fracture, and type of fracture, condylar depression/widening method of treatment, complications and the remarks of different age groups in details as follows.

The tibial plateau fractures are commonly seen in the active and productive age group in our setup as they engage in more activities and travels. In our series the majority of the patients were found to be between the group of 30-39 years [18] and between 20-29 [15] and 40-49 years [15]. Less numbers were noted in above 50 years and none above 70 years.

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The incidence of sex versus tibial plateau fractures can be attributed to an overwhelming large proportion of male patients [70%] directly correlates with their travel in day to day activities. The major preponderance of tibial plateau fracture is seen in people with a high level of activity, who indulge themselves in high level work [Agriculturalists] and [businessmen], because majority of the morbidity is due to R. T. A. The groups like house wives, teachers have lesser fracture rate as they do not travel very frequently. The mechanism of injury was grouped into 3 categories. Road traffic accidents fall from level a surface/height and Sports related injuries. In our study the majority of the patients were victims of road traffic accidents or Automobile accidents (70%). Fall from height/level surface constituted 25%. Sports related injury constituted 5%.

We intended to study the predominance of side Tibial Plateau fractures. Our study pool constituted 75% of right sided insult and 25% of left sided injury. In our study majority of patients had a right sided insult, probably because of right dominance.

All the fractures in the study are classified according to Schatzker's classification system. Treatments of tibial plateau were individualized case to case. 55% of patients underwent PCCS under fluoroscopic guidance, one patient underwent ORIF with BP, 7 were treated by ORIF with BP and bone grafting and 3 were treated with BP and external fixator. None of the patients were immobilized when secure, rigid fixation was done. When there was doubt about rigidity of fixation, associated ligament injury, Osteoporosis infection and wound dehiscence, then immobilization was extended preferably in above knee slab upto 3 weeks. Twelve cases of infection and three case of severe metaphyseal comminution had to immobilize for 6-8 weeks.

In this study we intended to measure condylar depression with respect to different types of fractures. Here uninvolved articular surface was reference, if both articular surfaces were involved then opposite knee was used as reference. We found that the average Type I condylar depression was 3mm, Type II measured 5mm, Type III 4mm, Type IV 3.5mm, Type V 4.5mm and Type VI average depression was 5mm.

In this study we intend to measure condylar widening with respect to different types of fractures. Here uninvolved femoral condyle was used as reference, if there was an associated femoral condylar fracture, then opposite knee was used as reference. Type I condylar depression was 5.57cm, Type II measured 6.58cm, Type III 6.4cm, Type IV 6.12cm, Type V 6.41cm and Type VI average condylar depression was 6.62cm.

All fractures united within expected time. Not a single case of nonunion noted in our series. Average time for union was 14 weeks (range 10-22 weeks). The six cases of wound infection were also having stiffness of the knee joint. Out of 33 patients treated with PCCs 27[45%] showed excellent result, 6[10%] showed good result. Three patients [5%] underwent ORIF with BP which gave a good result. 21 patients underwent ORIF with BP and bone graft 5% gave excellent result, 25% showed good result and 3 patients [5%] showed a poor result.

DISCUSSION: Fractures of tibial plateau are serious injuries that result in functional impairment. the emphasis in treating these fractures are anatomical restoration of fracture surface, repair of soft tissue injury, rigid fixation to obtain a stable painless knee with normal range of motion⁴, the management of tibial plateau has always been a subject of debate. In quest of perfection any treatment modality that has varied opinion is a subject for research and study. High energy intra-articular tibial fractures are still a major concern among orthopaedic surgeons⁵.

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While reviewing previous studies, it is apparent that the results are reported collectively without regard to severity of fracture type. Comparison of a contemporary retrospective study is difficult. However it is possible to separate out these injuries as severe or complex. The results of non operative treatment of these fractures had been historically unsatisfactory⁶

In patients with undisplaced, stable fractures and in those patients who are strongly contraindicated for surgery may be treated by conservative means. With careful patient selection a fairly satisfactory percentage of excellent to good result can be obtained by conservative line of treatment. Severe or complex tibial plateau fractures are more commonly seen in younger people due to high velocity injuries. Closed treatment of these injuries has had little success in reducing depressed or displaced fracture fragment. This necessitates open treatment in most displaced and unstable fractures. It is extremely important to do a stable fragment fixation and ligament repair in order to regain complete range of motion.

We have endeavored to present the various types of tibial plateau fractures in our semi urban Indian set up. It is found that the zeal for modernization, mechanization and industrial development made more automobile accidents due to increase in population and automobiles. In this we operated upon 60 tibial plateau fractures and analyzed the results with respect to age of the patient, sex distribution, occupation, mode of violence, laterality of fracture, fracture type, condylar depression, modalities of treatment, complications, associated injuries and the functional outcome.

The majority of fractures occurred between the age of 20 and 60 years with maximum incidence in productive age group 20-50 years (80%). Boune in 1981 also found that the majority of patients are aged between 15- 55 years with average of 38. 5 years, correlate well with the study. Seppo also showed age incidence 20-60 years with average of 39. 8 years. This correlates with the present study⁷.

Our study showed 70% male preponderance. Most of the previous studies by Bowles⁸, Duvelius⁹ and Rinonpoli⁵ emphasised the male dominance in tibial plateau fractures. In our study male being the bread winner of the family in majority of our population, which requires him to commute more and the consequence of it, Trauma very well correlates it with our study.

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, agriculturist. In our series majority was agriculturist [35%] businessmen [15%] and student [15%]. In our study the commonest mode of injury is the automobile accident (70%). Common being fall from height / Level surface (20%) and followed by sports related injury (5%). Majority of the subject had right side laterality (70%) probably because of the right dominance.

In our study, the majority of the fractures were found to be of type II [35%] and type I [20%] ;i. e. Pure cleavage fractures and cleavage combined with depression, followed by type VI [20%] type VI[10%], type V[10%] and type III [5%] respectively. This had certain similarities with Wesley hospital series¹⁰were type I & II predominated [31%] followed by type III [35%]. But in our series we had only 1 subject who presented with type III. The difference might be attributed to stringent inclusion criteria and small subject pool.

In this series we studied 60 cases of both simple and high energy tibial plateau fractures treated we studied only by surgical methods. Different authors used different criteria for the surgical management of these fractures. Hohl⁸ and David ¹⁰ considered 5mm depression as a surgical cutoff. Seppo E. Honkonen conducted 130 tibial plateau fractures taking into consideration

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of condylar widening of >5mm. lateral condyle step off > 3mm, all medical condylar fractures for the surgical management⁷

In our study we considered 3mm depression as an indication for surgery. Each case was individualized and treated accordingly as it required. Most of the type I and type II fractures were treated with percutaneous cancellors screw fixation. The split fracture, of >3mm displacement was treated by ORIF. Bone grafting was included along with ORIF with buttress plate and screws in type II, III, V and VI Wherever necessary.

The period of immobilization was again individualized depending on the rigidity of fixation and other circumstances which demands the benefits of early knee motion include – reduce knee stiffness and improved cartilage healing (regeneration). However, these benefits have to be cautiously balanced by risks, including loss of fracture reduction, failure of internal fixation and compromised ligament and soft tissue healing. Schatzker, Robert Mc Broom in 1978, Magonhobi, Steven and Gauschwitz in 1984 stated that the Prognosis is given by the degree of displacement, type of fracture, method of treatment and quality of postoperative care ¹¹

In spite of all these associated bony fractures, ligament injuries and others Complications. We were able to achieve 50% of excellent result 40% of good result (overall 90% acceptable results) with our standard surgical care using various fixation methods. In addition we had 10% poor results in terms of functional outcome. These results are comparable and par with other documented standard studies of Seppo. E 1993⁵⁷ Joseph Schatzkar 1986 who had 86% satisfactory results against 90% of our results, taking into account that ours is solely a surgical outcome

CONCLUSION: The correct method of management of tibial plateau fracture depends on good clinical judgement. If rational treatment is to be instituted the surgeon must have a sound knowledge of type of injury and a clear understanding of the knee examination, imaging studies and different modalities of treatment of these fractures.

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