

## A study on surgical management of closed tibial condylar fractures in adults

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### Abstract

**Background:** Tibial plateau fractures are one of the commonest intra-articular fractures. It results from indirect coronal or direct axial compressive forces. It comprises of 1% of all fractures. Being one of the major weight bearing joints of the body, fractures around it will be of paramount importance. **Methods:** 30 cases of tibial plateau fractures treated by various modalities were studied from September 2017 to September 2019 at our institution and followed for minimum of 6 months. **Results:** The selected patients evaluated thoroughly clinically and radiologically, after the relevant lab investigations, were taken for surgery. The indicated fractures treated as per the SCHATZKER'S types, accordingly with CRIF with percutaneous cannulated cancellous screws, MIPPO with LCP/ Butress plate and screw, ORIF with butress plate/ LCP and screw. Early range of motion started soon after the surgery. No weight bearing upto 6 weeks. The full weight bearing deferred until 12 weeks or complete fracture union. Immobilization in insecurely fixed fractures continued for 3-6 weeks by POP cast. The knee range of motion was excellent to very good, gait and weight bearing after complete union was satisfactory. Infection in two cases and stiffness in 2 cases were seen and there was no non-union in our cases. **Conclusion:** Surgical management of tibial condylar fractures will give excellent anatomical reduction and rigid fixation to restore articular congruity, facilitate early motion, hence to achieve optimal knee function and reducing post-traumatic osteoarthritis.

**Keywords:** Fracture, tibial condyle, butress plate, locking compression plate, MIPPO.

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### Introduction

Tibial plateau fractures are one of the commonest intra-articular fractures. It results from indirect coronal or direct axial compressive forces. It comprises of 1% of all fractures. These fractures encompass many and varied fracture configurations that involve medial, lateral or both plateaus with many degrees of articular depressions and displacements. 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 assessed[1]. Advance in mechanization and the acceleration of travel have been associated with increase in the number and severity of fractures. Fractures of the

upper part of the tibia are no exception to this. High velocity injury sustained in automobile disasters and increase in road traffic accidents as a whole is creating an ever-growing problem. Since man has taken to traveling at high speeds in the sitting position with the loading edge composed of flexed hind limbs, when the machine or in which the subject is traveling stops suddenly, most of the impact is taken at first upon the patella, then the tibia and femur in varying proportions and at various positions. The stationary lower limb may be struck by a moving object, this is the common pedestrian injury, the so called "BUMPER FRACTURE", since the bumper of most vehicles being placed roughly at knee height. The exposed knee joint may be subjected to angulation, rotation or shearing strains and when the subject is upright, his body weight assists in the injury and he falls over[2-4]. The twentieth century has seen a lot of changes in medical field, especially in orthopaedic 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

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fixation in fractures as an acceptable mode of treatment. Fractures of the upper tibia are difficult to treat, apart from the usual problems of confining patients to bed. 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, locking compression plates, cancellous screws, etc., to achieve good fracture union and optimal knee function. To study the closed tibial condylar fractures in adults of Schatzker's type 1 to 6 treated by surgery i.e. by reduction, internal fixation and evaluate the results [5].

### Methodology

The cases studied for this dissertation, the surgical management of tibial plateau fractures were included from inpatients of xxxxxxxx. The total number of cases studied were 30. The average age of patient was 38.7 years with the oldest patient 70 years and youngest 20 years. The intention of this dissertation was to study the surgical management of closed tibial condylar fractures to obtain a stable, pain free, mobile joint, and to correlate the radiological findings with the type of fracture and the functional end result [6,7]

### Period of study – two years inclusion criteria:

- Age /sex, Above 18 years, both sex
- Closed Fractures
- Duration – within one week
- Schatzker's type 1,2,3,4,5, and 6 fracture
- Associated ligamentous injuries
- Associated fibular upper end fracture

### Exclusion criteria :

- Age below 18 years
- Compound fractures
- Other limb fractures and diseases
- Pathological Fractures
- Associated neurovascular injury
- Patients who are medically not fit for surgery
- Patients who were selected for the study were evaluated with the following investigations
- Anteroposterior and lateral radiographs of the knee joint
- CT Scan of the knee joint (not mandatory for all)
- MRI of the knee joint (if needed to rule out ligamentous injury)

The Ethical clearance for this study has been obtained from institution. As soon as the surgery was planned, the following procedures were regularly followed

- Preoperative investigations

- Treatment of the co-morbidities of the patient was done with appropriate references to the concerned specialties.

- Fitness for the surgery was taken from the physicians.

- Use of antibiotics pre-operatively and continued till the removal of sutures.

- Preparing the part for surgery.

- Selection of proper size of buttress plate, condylar screws and cortical screws.

- Assessment of the joint instability under anesthesia.

- To check for any associated fractures.

- To verify if any other associated procedures might be required like bone grafting.

- In our series, we have used image intensifier for most of the patients. Instruments and implants used in proximal tibial fractures:

The various instruments required are

- Reduction clamps (pointed) for reducing the fracture site.

- Periosteum elevator : for elevation of periosteum

- Screw drivers for 4.5mm cortical screws 4mm and 6.5mm cancellous screws (hexagonal drivers preferred)

- Hand drill, power drill.

- Drill bit of 3.2mm for drilling the bone [8]

- Tap of different sizes i.e., 4.5mm and 6.5mm tap.

- Depth gauge for measuring the appropriate size of screws.

- Bone grafting set with (mallet, osteotomes)

- Bone impaction set

### Implants :

#### Cancellous bone screws :

- 5.0 mm cancellous bone screw with 8mm spherical head and 3.5 mm hexagonal recess, thread length 16mm and 32mm in the partially threaded screws, with 4.5mm shaft, 3mm core, 3.2 mm drill bit and 6.5 mm tap.

- 4.5 mm cortical bone screw, with 4.5mm shaft, 3mm core, 3.2mm drill bit and 4.5mm tap.

- 4mm cancellous bone screw, with 6mm head, 2.5 mm hexagonal recess, core diameter 1.9mm, 1.7mm pitch, 2.5mm drill bit and 4mm tap.

### K-wires

#### Buttress plates :

T plate

L buttress plate with right and left offset.

Locking compression plate

Preoperative instructions:

- Consent of the patient for anaesthesia and surgery

- NBM 8 hours prior to surgery

- Injection TT 0.5cc IM stat

- Preoperative antibiotic

- Preparation of the part of surgery

**Post operative instructions:**

- BP and TPR hourly
- Postoperative analgesia
- To watch out forbleeding
- Postoperative antibiotics for 7-10days
- Foot end elevation (as the surgeries are performed under spinal anaesthesia).
- Postoperative X-ray preferably the next day[9].

**Results**

Observation and analysis of results was done in relationship to age, sex, occupation, laterality of fracture, type of fracture, method of treatment, duration of immobilisation, complications and the remarks of

different age groups in details as follows. The youngest being 20 years and the eldest being 70years.

**Age distribution:**This study was done to find out the age incidence in our Indian set up and to know the type of fracture incidence and outcome as different age groups present and different response to fracture healing.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. The type of fracture and fracture pattern depends on many factors like amount of force, age, degree of knee flexion, direction of loading force, valgus/varus stresses, etc. The graphs shows patient age groups Vs number ofcases

**Table 1: Age incidence**

Age in years	Number of patients(n=30)	Percentage %
20-30	12	40.0
31-40	3	10.0
41-50	10	33.3
51-60	3	10.0
61-70	2	6.7
<b>Total</b>	<b>30</b>	<b>100.0</b>

In our series, the majority of the patients are found to be between the age group of 20-30 years (12) and 41-50 years[10].The least number of cases are found in the age group between 61-70years.The mean age of the patients was 38.7 years.

**Table 2: sex incidence**

Gender	Number of patients(n=30)	Percentage %
Male	21	70.0
Female	9	30.0
Total	30	100.0

This incidence of sex versus upper tibial fractures can be attributed to an overwhelming large proportion of male patients, because in our Indian setup, the female population largely working indoors or in the agricultural fields and do not indulge themselves in travelling or out door activities.

**Table 3: Occupation**

The relationship of fractures to different occupations is shown below

Occupation	Number of patients (n=30)	Percentage %
House wife	8	26.7
Labourer	11	36.7
Employee	3	10.0
Businessman	3	10.0
Student	5	16.7

The tabular column clearly shows that the major preponderance of upper tibial fracture is seen in people

with a high level of activity,(labourer) who indulge themselves in travelling , because majority of the

injuries is due to R.T.A. The groups like employee, businessman have a comparatively lesser fracture rate as they do not indulge in high level of activity, but if these group were to sustain a fracture, it is mainly due to automobile accidents. Housewives tend to have violent injuries commonly due to automobile accidents, fall

from height, when they climb up ladder or stool to pickup objects from the shelves.

**Mode of violence** :In this series, the majority of the patients treated are due to road traffic accidents or automobile accidents, to the extent of 70%.

**Table 4 :Mode of injury**

Mode of Injury	Number of patients(n=30)	Percentage %
Fall	9	30.0
RTA	21	70.0

**Table 5 : Laterality of fractures**

In our series, there is right sided predominance, compared to the left side.

Side involved	Number of patients(n=30)	Percentage %
Right	20	66.7
Left	10	33.3

**Table 6: Type of fracture**

**Schatzker's classification** :In our series, the majority of the fractures were found to be of type II and type V fracture types ie. Cleavage with depression fractures and bicondylar fractures respectively.

Type of fracture	Number of patients(n=30)	Percentage%
Type I	5	16.7
Type II	9	30.0
Type III	1	3.3
Type IV	5	16.7
Type V	8	26.7
Type VI	2	6.7

**Table7:Methods of treatment**

Treatment	Number of patients(n=30)	%
MIPPO with BP	10	33.3
MIPPO with LCP	2	6.7
ORIF with BP	5	16.7
ORIF with LCP	5	16.7
ORIF with BP & LCP	1	3.3
CRIF with cancellous screw	7	23.3

The ultimate objective of the surgery was to achieve accurate articular alignment, axial alignment and rigid fixation of the fracture fragments.

#### Associated injury

- Medial collateral ligament (2) The ligament was surgically repaired during fracture treatment.

- Anterior cruciate ligament (2) patient refused ACL Reconstruction surgery yet he did not show functional disability but only the clinical instability. We did not come across any other ligament injuries around the knee joint

**Table 8: Associated injury**

Associated Injury	Number of patients(n=30)	Percentage %
YES	4	13.3
• ACL	2	6.7
• MCL	2	6.7
NIL	26	86.7

**Table 9:Period of immobilisation in weeks**

Immobilization period in weeks	Number of patients(n=30)	Percentage %
1-2 weeks	19	63.3
3-4 weeks	11	36.7
> 4 weeks	1	3.3

None of the patients were immobilized when secure, rigid fixation was done. When there was doubt about rigidity of fixation, associated ligament injury or osteoporosis, the immobilization extended preferably in above knee cast upto 3 weeks. Two cases of infection

and one case of severe metaphyseal comminution had to immobilize 3-6 weeks. Most of the cases had good range of painless knee motion (0-130°), except for the two patients who developed knee stiffness.

**Table 10: Complications**

All fractures united within expected time . There was not a case of nonunion noted in our series. Average time for union was 14 weeks (range 10-22 weeks).

There were two cases of wound infection which were associated with stiffness of the knee joint.

Complications	Number of patients(n=30)	Percentage %
Absent	28	93.3
Present	2	6.7

**Clinical results :**

**Outcome**

Out of 30 cases treated with surgical procedure, 20 cases had excellent result, 6 cases had with good

result, fair in 2 cases and 2 cases of poor result. In our study it was found that high velocity injuries (type IV – VI) have poorer outcome than low velocity injuries (type I-III)

**Table 11: Clinical results**

Outcome	Number of patients(n=30)	Percentage %	95% CI
Excellent	20	66.7	48.78-80.77
Good	6	20.0	9.51-37.31
Fair	2	6.7	1.86-21.32
Poor	2	6.7	1.86-21.32

**Discussion**

Tibial plateau fractures, one of the commonest intra articular fractures, are major traumatic injury occurring

as a result of RTA, fall from height, violence etc. It is sometimes associated with other bony or soft tissue injuries. Any fracture around the joint (especially weight bearing knee joint in the lower limb) is of paramount importance as would result in significant morbidity and quality of life. Hence the treatment of upper tibial fractures with intra articular extension have become a challenge for the orthopaedic surgeons. Keeping our aims of the study at high, we presented the clinical study of surgical treatment of 30 closed tibial plateau fractures. The analysis of the results were made in terms of - age of the patient, sex distribution, occupation, mode of violence, laterality of the fracture, analysis of the types, modalities of treatment, complications associated injuries and the functional outcome. We have endeavoured to present the various types of tibial plateau fractures in our Indian setup. It is found that the zeal for modernisation, mechanisation and industrial development made more automobile accidents due to increase in the number of population and automobiles. The majority of fractures occur between the age of 20 and 50 years with maximum incidence being involving the productive age group 20-30 years (40%). The mean average of the patient was 38.7 in our study. Boune in 1981 also found that the majority of the patients are aged between 15-55 years with an average of 38.5 years, correlates well with the study. Seppo also showed age incidence 20-60 years with an average of 39.8 years which correlates with the present study[2]. In our series majority of the patients were males 70%. This can be attributed to our Indian setup where the female population largely work indoor or in agricultural fields

and less prone for injuries . So the significant proportion of tibial plateau fractures related sex distribution were not available to comment on them. Occupationally tibial plateau fractures were seen in people with high level of activity, movement and travel. It is most commonly seen with people who do high level of activity like labourers . In our series majority were labourers (36.7%), followed by housewives (26.7%), student (16.7%), employee (10%) and businessman (10%). In our study the commonest mode of injury being the road traffic accident (70%), next common being fall (30%). There was significant preponderance to right side in the laterality of the fracture. The right tibia was affected in 66.7% and left tibia in 33.3% of cases. In this series we studied 30 cases of simple tibial plateau fractures treated only by surgical methods. Different authors use different criteria for the surgical management of these fractures. SEPPO E. HONKONEN conducted 130 tibial plateau fractures taking into consideration of [3]

- Condylar widening of >5mm
- Lateral condyle step off >3mm
- All medial condylar fractures for the surgical management.

In our study, the indications for the surgery were the same standard indications as for those tibial plateau fractures. 3mm depression was considered as an indication for surgery in our series .

In our series, Schatzker's type II and type V dominated the total fractures making 56.7%. It is also to be noted that bicondylar fracture was common.

**Table 12: Type of fracture and its cases**

Type of fracture	Tampere hospital Finl and % of cases	Wellesley hospital Toronto % of cases[4]	Our study % of cases
TYPE 1	11.5	6	16.7
TYPE 2	30.5	25	30
TYPE 3	9.9	36	3.3
TYPE 4	9.2	10	16.9
TYPE 5	21.3	3	26.7
TYPE 6	17.5	20	6.7

The method of fixation for particular type of fracture were formulated depending on the morphology of the fracture and quality of the bone. . So each case was individualized and treated accordingly to achieve the articular alignment , axial alignment and rigid fixation of the fracture. Most of the type I, some type II were treated with percutaneous cancellous screw fixation. The split fracture, of >3mm displacement was treated by MIPPO with buttress/ locking compression plate

and screws. All the medial plateau fractures were treated surgically as illustrated by Seppo E. in 1993[3]. The patients with collateral ligament injuries were managed intraoperatively by suturing when required or POP cast immobilization for 3-4 weeks[5-7]. The period of immobilization was again individualized depending on the security of rigid fixation and associated ligamentous injuries. The problem faced by us during the study in two of the cases were infection

and wound dehiscence, hence immobilization was more in these patients. The infection might be attributed to nosocomial infection. In spite with all the ligament injuries and complications, we are able to achieve 66.7% excellent result 20%, good results (overall 86.7% acceptable results) with our surgical care using various standard fixation methods. In addition we have 6.7% fair and 6.7% poor results in terms of functional outcome. These results are comparable and on par with other documented standard studies. Recent trend is to do minimal invasive surgeries possible. Many centers have shown good results with arthroscopic assisted internal fixation[8], hybrid external fixator[1], minimal internal fixation supplemented with external fixation[9], Ilizarov ring fixation and most recently the MIPPO [10] (Minimal Invasive Percutaneous Plate Osteosynthesis). We have employed the MIPPO technique and had satisfactory results with the method, proving that minimal invasive surgery leads to less operative trauma to the soft tissues thereby reduction in the period of immobilization and less chances of infection, stiffness leading to excellent functional outcome of the knee joint. Hence, to conclude, the surgical management of tibial plateau fractures is challenging, gives excellent anatomical reduction, rigid fixation to restore articular congruity, facilitate early knee motion, thus achieving optimal knee function and thereby preventing post-traumatic osteoarthritis.

### Conclusion

At the end of our study, following conclusions could be drawn from the surgical management of closed tibial condylar fractures. Tibial condylar fractures are increasing in their incidence (especially the high velocity injuries) with the increase in the number of road traffic accidents. These fractures need optimum treatment as they involve the productive age groups. Anatomic reduction, accurate axial and articular alignment with rigid fixation should be the objective of the treatment to achieve a stable and functional knee joint. Preoperative soft tissue status and associated ligamentous injuries and their repair at right time,

significantly changes the functional outcome. Hence, to conclude, the surgical management of tibial plateau fractures is challenging, gives excellent anatomical reduction, rigid fixation to restore articular congruity, facilitate early knee motion, thus achieving optimal knee function and thereby preventing post-traumatic osteoarthritis.

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