



## A prospective study of functional outcome of closed schatzker type V and type VI tibial plateau fractures managed by open reduction and internal fixation

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### ABSTRACT

Knee joints comprised of the distal femur, proximal tibia & patella. Injuries of the knee must be treated properly to maintain a good knee function. Fractures of the tibia plateau represent 1% of all fractures and approximately 8% of fractures occurring in the elderly. The aim was to study the "functional outcome of treatment of closed schatzker type V and type VI tibial plateau fractures using locking compression plate". In this study, twenty patients with tibia plateau fractures who presented to our casualty were studied. All the patients were victims of road traffic accidents. Once they were thermodynamically stable, were clinically examined and assessed for associated injuries. Out of 11 patients with Type VI fractures, 4(36%) had excellent results, 4(36%) had good results, 2(18%) had fair results and 1(9%) had poor results. The poor result was due to the associated pelvic injury, which interrupted the regular post-op rehabilitation. Out of 9 patients with type V fractures, 2(22%) had excellent results and 7(78%) had good results according to Rasmussen Radiologic Assessment. Hence, early mobilization is absolutely essential for preventing the knee stiffness & for quick articular cartilage regeneration. Weight-bearing should be delayed until solid union to prevent the articular collapse.



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### INTRODUCTION

Knee is a major weight-bearing joint of the lower limb; consequently, any fractures involving the proximal tibia will definitely compromise the knee function and stability. They account for only 1% of all fractures and 8% of fractures in the elderly (Ali

*et al.*, 2003). Tibial plateau fractures are frequently caused by high energy trauma and 1 to 3 % of these fractures are open injuries, often associated with other complications. Isolated injuries to lateral condyle occur in 70%, 15% involve medial condyle, and 15% are bicondylar (Burks *et al.*, 1990). Though difficult, the aim of treatment of these fractures is to bring back and conserve normal knee function by an anatomical restoration of joint surfaces, maintaining of mechanical axis and restoring ligamentous stability. Understanding the injury patterns, better implants, and the concept of early surgical fixation and early mobilization of knee joint all have convincingly bettered the functional outcome of these injuries to a great degree (Manidakis *et al.*, 2010). Historically, we have seen immobilization for 6 weeks in traction or plaster immobilization, causing stiffness. If operated with extensive dissection for the purpose of reduction, it resulted in delayed union and infection. This forms the cause of

evolving an in-between approach, [Minimally invasive approach], which not only reduces stiffness but is also biological (Honkonen, 1994; Kenneth *et al.*, 2006).

## MATERIALS AND METHODS

This is a prospective study conducted in Saveetha Medical College & hospital Chennai from June 2017 to November 2018. Twenty patients who satisfied the following criteria were included in the study.

### Inclusion Criteria

1. Closed fractures
2. Schatzker's type V and VI, i.e., bicondylar fractures and bicondylar fractures with diaphyseal-metaphyseal dissociation.

### Exclusion criteria

1. Open fractures
2. Late cases with joint stiffness
3. Late cases with infection
4. Cases of more than 30 days duration
5. Cases with extensive soft tissue injury whose healing period was more than 21 days.

The mean age was 46.75 years. It ranged from 27 years to 62 years. Most cases were between 41-60 years, i.e., in the fifth & sixth decade, about 65%. There was a male preponderance due to more active social lifestyle of males. The number of male patients, 15 (75%) Number of female patients 5 (25%) as shown in Table 1. 13 out of 20 cases were because of high-speed motor vehicle accidents. 7 cases sustained the fracture due to fall from a height, which was mostly in cases of elderly individuals as shown in Tables 2 and 3 Of the 20 patients Right side was fractured in 10 cases and in 10 cases left was involved as shown in Tables 3 and 4. In our study of 20 cases, 9 (45%) were of type V, 11 (55%) were of type VI fractures. 11 (55%) cases were associated with other injuries. Two cases had associated LCL injuries. Two cases had Distal Radius fracture and 2 had an ACL injury, 1 had MCL tear, one had a pelvic injury and 3 had meniscus injury as shown in Table 4.

## PROCEDURE

Sequences in the surgical management of tibial plateau fractures include Restoration of an articular surface, Metaphyseal alignment, Impaction of fracture in osteoporotic patient's early mobilization of the knee.



**Figure 1: Patient position**

Prerequisites - A radio-lucent operating table facilitates the use of an image intensifier during the procedure. Figure 4 shows the LCP instrumentation needed. Using a fracture table is avoided because the resulting muscle tension will make exposure and reduction more difficult. A sterile bolster is placed under the knee to facilitate exposure and reduction. A sterile tourniquet may be used as a part of the procedure. Figure 1 shows a patient position. Figure 2 shows an approach for surgery.

### Reduction techniques

The reduction of the displaced fracture fragments can be done by either direct or indirect methods. The direct method is by open reduction techniques.

The indirect reduction is by using the principles of ligamentotaxis or by creating a cortical window and elevating the articular fragments by using a tamp and filling the defect created with a bone graft or bone substitutes. Indirect reduction techniques have the advantage of minimal soft tissue stripping and fragment devitalization. Figure 5 shows the post LCP fixation.

## PREFERRED TREATMENT

### Type V

Historically, these [bicondylar] fractures were stabilized with medial and lateral plates or with a combination of limited internal fixation and external fixation. With the advent of locking plates, laterally placed plates with screws that lock to the plate creating a fixed angle construct, provide enough stability to counteract forces seen by the medial tibial plateau. This allows for less surgical dissection and a decrease in the incidence of soft tissue complications.

### Type VI

It implies metaphyseal-diaphyseal dissociation. Often there is a split depression fracture of the lat-



**Figure 2: Midline approach**

**Table 1: Age Distribution of the Patients**

Age Group (Years)	No. of patients	Percentage
21 - 30	2	10
31 - 40	3	15
41 - 50	7	35
51 - 60	6	30
>61	2	10

**Table 2: Mode of Injury of the patients**

Mode of Injury	No. of cases	Percentage
RTA	13	65
Fall from height	7	35

**Table 3: Side Involved in patients**

Side	No. of cases	Percentage
Right	10	50
Left	10	50

**Table 4: Fracture Types of the cases**

Schatzker Type	No. of Cases	Percentage
V	9	45
VI	11	55

**Table 5: Kss in Schatzker Type V Fractures**

S. No	Result	No: of Patients
1.	Excellent	7
2.	Good	2
3.	Fair	0
4.	Poor	0

**Table 6: Kss in Schatzker Type VI Fractures**

S. No	Result	No: of Patients
1.	Excellent	4
2.	Good	4
3.	Fair	2
4.	Poor	1

**Table 7: RRA in Schatzker type V fractures**

S. No	Result	No: of Patients
1.	Excellent	2
2.	Good	7
3.	Fair	0
4.	Poor	0

**Table 8: RRA in Schatzker type VI fractures**

S. No	Result	No: of Patients
1.	Excellent	0
2.	Good	8
3.	Fair	3
4.	Poor	0

**Table 9: Complications**

Complication	No. of Cases	
Superficial Infection	3	
Knee Stiffness	2	
Articular Incongruity	6	
Pain	Occasional pain	10
	While Climbing stairs	7
	While Walking	1
	Moderate	1



**Figure 3: Buttress plating**

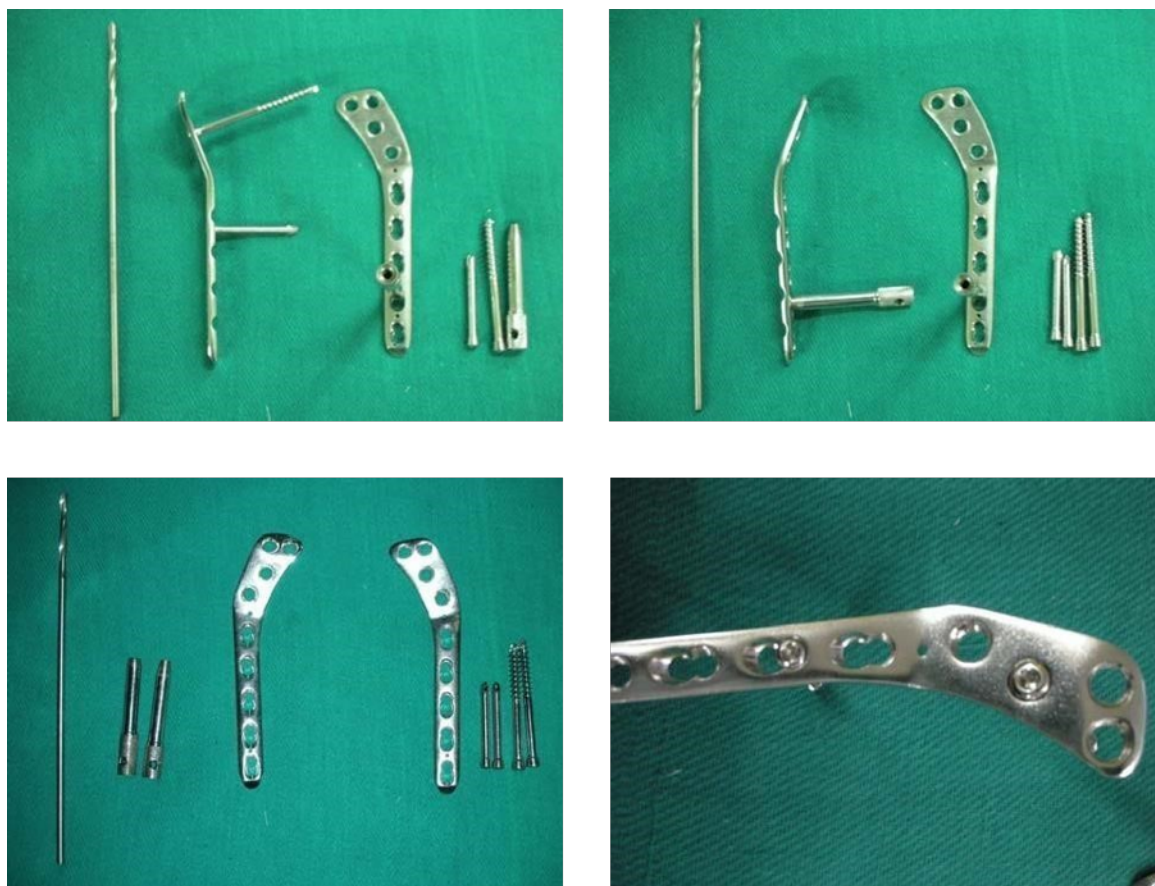
eral plateau or a fracture of the medial side, which is either a coronal split or the entire condyle. Following articular reconstruction, the articular segment

is stabilized to the tibial shaft using a single plate, double plates, a single plate, and a contralateral two-pinn external fixator, or a thin-wire fixator. If the fracture is transverse, a single plate will suffice. Oblique fracture lines exiting the opposite cortex require a second plate or external fixator to resist shearing forces.

**IMPLANT OPTIONS**

**Screws**

(Kemp *et al.*, 1988) Usually, large fragment cancellous screws are used in cases of simple split fractures that are anatomically reduced by closed means or in the cases of depression fractures that are elevated percutaneously. In certain cases, when joint fragments are avulsed by soft tissue attachments, lag



**Figure 4: LCP Instrumentation**

screw fixation alone may be used.

**Buttress plate**

Function as a buttress against shear forces or to neutralize rotational forces. Due to the thin, soft tissue envelope around the proximal tibia, the use of thinner plates has been advocated. L plate allows more buttressing without getting in the way of the proximal fibula. DCP holes in the shaft accept 4.5 mm cortex screws, round holes in the slightly thinner head accommodate 6.5 mm cancellous bone screws. [Figure 3], (Koval and Helfet, 1995).

**Hybrid external fixator**

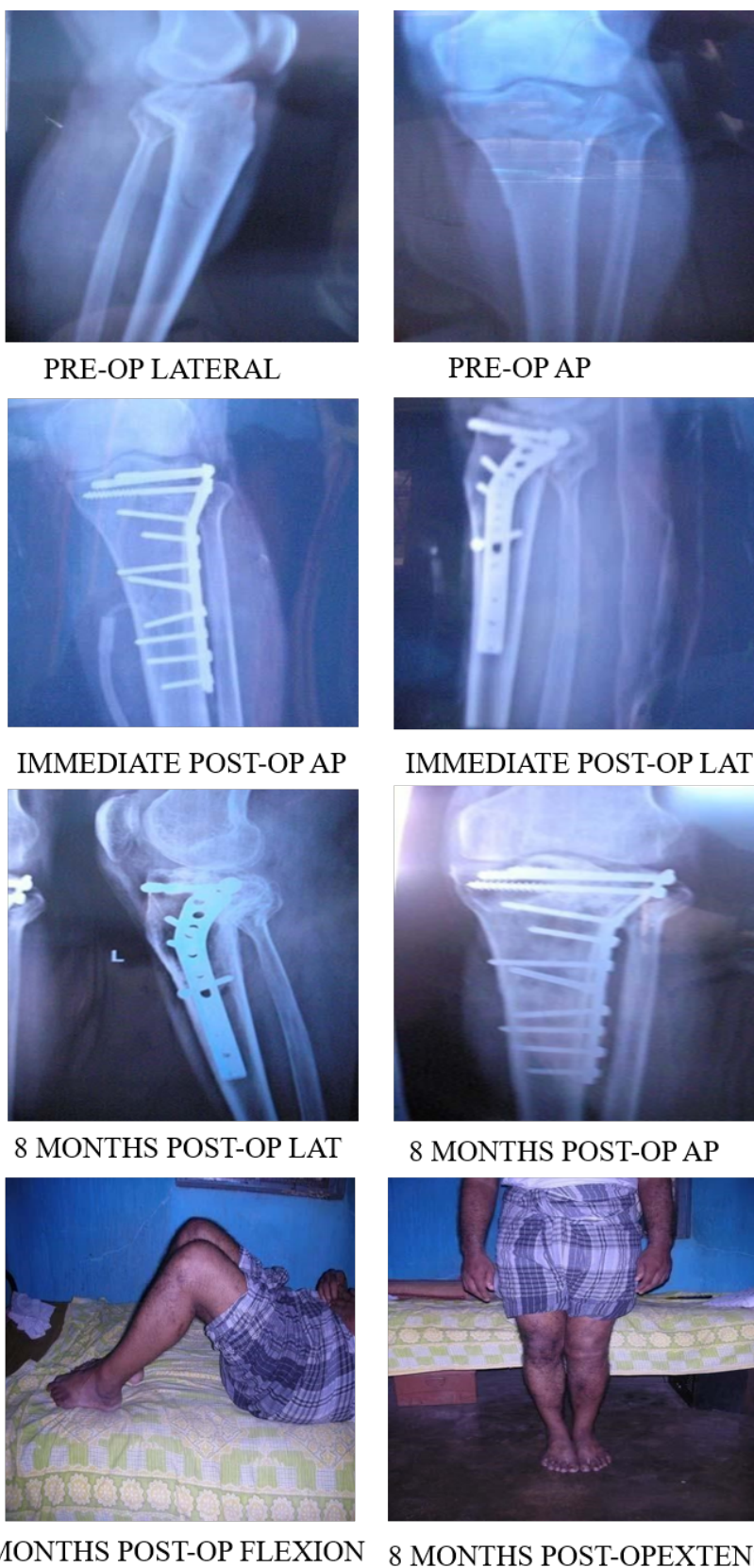
Hybrid external fixation of proximal tibia fractures has 2 or 3 tensioned transfixion wires on a single ring stabilizing the periarticular segment and 3 half pins in the diaphyseal segment, with the ring connected to the half pins through a variety of frame options. This combines the advantage of thin wire control in the limited space near the joint with the ease of application of unilateral half pin fixation in the shaft. This is mainly used in fractures associated with significant soft tissue injuries and compound fractures. The advantages are that it allows early mobilization and weight-bearing (Lansinger et al., 1986; Muller et al., 1979).

**Ilizarov external fixator**

These are generally knee spanning fixators using thin wires with or without olive beads. That makes use of indirect reduction techniques using the principle of ligamentotaxis. It is indicated primarily in open fractures, fractures with compartment syndrome, also in severely comminute fractures with diaphyseal extension. The key is to place the pin or wire 10 to 14 mm below the articular surface to avoid penetration of the synovial recess posteriorly. It helps to minimize the development of septic arthritis from a pin tract infection. Advantages: No soft tissue dissection. These frames can be dynamized during fracture healing, which may help if delayed or non-union occurs in the metaphyseal regions. It provides excellent stability in cases where there is severe soft tissue or bony defect. It allows for correction if there is a mal alignment or deformity. Arthroscopy assisted fixation of depressed tibial plateau fractures is now on the rise, even this relatively newer technique has its own advantages and disadvantages (Rasmussen, 1972).

**Locking compression plate**

These implants combine the principles of angular stable construct and compression plating. Its



**Figure 5: CASE I**

design and characteristics allow it to be used by a minimally invasive approach by using the principles of biological osteosynthesis. Now frequently being used in the treatment of complex tibial plateau fractures. Reduces the need for compressing the plate directly to a bony surface, preserves blood supply and reduces the need for plate contouring (Schatzker et al., 1968).

## RESULTS AND DISCUSSION

Fractures of the tibial plateau have the potential to be devastating injuries, especially when they have significant bony and soft tissue involvement along with knee instability and incongruity as in type V and VI injuries. In this study, male: female ratio was 3:1 (Waddell et al., 1981). The majority of tibial plateau fractures reported in the recent literature have resulted from high-speed motor vehicle accidents and fall from height (Manidakis et al., 2010). In our study, 65% of the fractures occurred as a result of high-energy motor vehicle accidents, and the rest 35% due to falling from a height. Right side & left side had equal involvement 50:50%. 65% of cases were between 40 to 60 years, i.e., 13 out of 20 cases in our study. 2 cases, both above 60 years, sustained this complex fracture due to minor injury because of the osteoporotic nature of the bone (Lansinger et al., 1986). Bone grafting was done in 13 of our 20 cases to maintain the articular congruity and most of our cases were taken up for fixation within 10 days of sustaining the fracture. The average time required for a union was 15 weeks in our study and the weight-bearing was delayed to around 12–16 weeks (Rasmussen, 1972). Superficial infection occurred in 3 cases of our study, which settled with appropriate antibiotics, debridement & regular dressing (Honkonen, 1994). Occasional pain was present in 10 cases, 7 had mild pain during climbing stairs alone; one had mild pain during walking and 1 had moderate pain. Radiologically 2 cases had articular incongruity ranging between 5–10 mm. Knee stiffness and ROM < 90 degree was noted in 2 cases. One patient had malunion (Kemp et al., 1988). In our study, we found that 85% of patients with type V and type VI Tibial Plateau Fractures, who were treated with ORIF with plate osteosynthesis had excellent or good clinical results by Knee Society Score of Hospital for Special Surgery (Burks et al., 1990). Out of the 20 patients 11 had excellent, 6 well and 2 had fair results determined by KSS scoring. According to Rasmussen radiological system, in our study, we had 85% excellent to good results and 15% fair results. We found no correlation between radiographic and clinical results, similar to two previous studies. This

is because Rasmussen radiologic score does not take into account the location of articular depression or the amount of the joint surface involved. (Walker and Erkiuan, 1975), Table 5 shows Out of 9 patients, 7(78%) had excellent results and 2(22%) had good results. Table 6 shows Out of 11 patients with Type VI fractures 4(36%) had excellent results, 4(36%) had good results, 2(18%) had fair results and 1(9%) had poor results. The poor result was due to the associated pelvic injury, which interrupted the regular post-op rehabilitation. Table 7 shows Out of 9 patients with type V fractures 2(22%) had excellent results and 7(78%) had good results according to Rasmussen Radiologic Assessment. Table 8 shows Out of 11 patients with type VI fractures, 8(73%) patients had good results and 3(27%) patients had fair results. In our study, we had 2 patients in 20–30 age group: Their mode of injury was RTA and the injury for both were on the left side (Schatzker et al., 1968). One was type V fracture the other being type VI fracture. Type VI fracture patient had an ACL tear. For type V fracture, we used MBP with BG and for type VI, we used MBP. Type VI patient had Fair results in both KSS scoring and RRA scoring. Type V patient had Excellent KSS and Good RRA scoring. Complications were identified as in (Kenneth et al., 2006), Table 9.

## CONCLUSION

Open reduction and internal fixation of closed type V and VI tibial plateau fractures is an effective method of treatment even with moderate soft tissue injury when an adequate healing period is given. ORIF can restore maximal joint stability and congruity, which are essential for articular cartilage regeneration. Early mobilization is absolutely essential for preventing the knee stiffness & for quick articular cartilage regeneration. Weight-bearing should be delayed until solid union to prevent the articular collapse. We found only a mild difference in the average scores both clinically and radiologically, in assessing the type V and VI fracture patterns.

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