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## Study of surgical management of tibial plateau fractures using locking compression plate

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### Abstract

**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 for 1% of all fractures and 8% of fractures in the elderly. Fractures of proximal tibia have always been difficult to treat because of the subcutaneous location of its anteromedial surface. These days significant attention has been paid to the condition of soft tissue envelope. With the advent of newer implants and minimally invasive techniques, complex tibial plateau fractures which were once considered difficult to treat, are now having successful outcomes.

**Aim:** The aim of the present study is to evaluate the results of Surgical Management of tibial plateau Fractures with Locking Compression Plate.

**Methods:** A prospective study was done on thirty patients of proximal tibial fractures treated by locking compression plate in Orthopaedic Department of Medici institute of medical sciences, Medchal. Duration of study was from October 2017 to March 2019. We included patients of both the genders from 18 to 70 years of age, those were treated with locking compression plates for intra-articular and extraarticular fractures of proximal tibia. However, type II and Type III open fractures (Gustilo Anderson), pathological fractures and patients with severe comorbidities were excluded from the study. Ethics committee approval was obtained. Informed written consent was taken. Data was collected from the patients.

**Results:** Majority of the patients with Tibial plateau fractures i.e., 8 patients (40%) were in the age group of 30-39 years. The youngest patient was 19 years and oldest patient was 58 years. Mean age in this study was 34 years. Road traffic accident was the cause for this fracture in most of the patients. All our patients were operated under spinal anesthesia with LCP for Tibial plateau fractures. MIPPO approach was used in 14 patients and open reduction was done in 6 patients. 14 patients (70%) were placed a single plate and 6 patients (30%) were done dual plating. In 1 patient (5%) delayed union occurred. 15 patients (75%) had excellent functional outcome, good functional outcome in 3 patients (15%) and fair functional outcome in 2 (10%) patient.

**Conclusion:** From this study, we concluded Tibial plateau LCP system is an exciting new method of osteosynthesis for complex tibial plateau fractures allowing early mobilization and good functional outcome with limited number of complications.

**Keywords:** Proximal tibial, fractures, locking compression plate

### Introduction

Fractures of proximal tibia have always been difficult to treat because of the subcutaneous location of its anteromedial surface. Severe bone and soft tissue injuries are not infrequent and there is high incidence of open fractures compared with other long bones [1]. The incidence of malunion, non-union and infections are relatively high in many reported series, causing significant long term disability. Recently significant attention has been given to the condition of soft tissue envelope.

Soft tissue friendly approaches and minimally invasive techniques have improved the outcome. The fractures of proximal tibia are common intraarticular fractures. These injuries can be divided into two broad categories, high energy fractures and low energy fractures. Majority of these fractures are due to high speed velocity accidents or fall from height [2]. Where fractures results from direct axial compression, usually with a valgus (more common) or Varus moment and indirect shear forces [3]. Elderly patients with osteoporotic bone are likely to sustain depressed type fracture [4].

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The goal of surgical treatment of proximal tibia fracture is to restore congruent articular surfaces of the tibial condyles so that eventually patient can achieve a functional and painless range of motion in the knee joint [5].

The various clinical studies established that bone beneath a rigid conventional plate are thin and atrophic making them prone for secondary displacement due to insufficient buttressing and secondary fractures after removal of plate, fracture site take longer period to unite due to interruption of vascular supply. This gave rise to a new concept of biological fixation using the plates, otherwise called minimally invasive plate osteosynthesis (MIPO). But this was difficult as conventional plates were to be accurately contoured to achieve good fixation, at the same time osteoporosis also posed the same problem of poor fixation with conventional plates [6]. This directed the development of the internal fixators, PC-fix I later PC fix II. As the concepts about biological fixation become clearer, the innovation of plates progressed leading to development of less invasive stabilizing system (LISS). Research to combine the two methods led to the development of the AO locking compression plate (LCP) [7]. It offers numerous fixation possibilities and has proven its worth in complex fracture situations and in osteoporosis. In this study, we have made an attempt to study the functional outcome of proximal tibial fractures treated with Locking Compression plate

## Methods

A prospective study was done on 20 patients of proximal tibial fractures treated by locking compression plate in Orthopaedic Department of Medciti institute of medical sciences, Medchal. Duration of study was from October 2017 to March 2019

Selected patients were followed up regularly by clinical examination and X-rays which were taken immediately after operation followed by regular intervals till fracture union and once at one year after surgery. We included patients of both the genders from 18 to 70 years of age, those were treated with locking compression plates for intra-articular and extra articular fractures of proximal tibia. However, type II and Type III open fractures (Gustilo Anderson), pathological fractures and patients with severe comorbidities were excluded from the study. Ethics committee approval was obtained. Informed written consent was taken. Data was collected from the patients. On admission, data was recorded and thorough history and clinical examination was done. We assessed the soft tissue injuries even in the all fractures followed by radiological assessment of the fracture. Base line blood investigations and X-rays was done prior to surgery. X-ray knee joint Anteroposterior, lateral and oblique views was obtained. C.T. and M.R.I was done if required. After obtaining anaesthesia fitness surgery was performed. 11 cases were treated with minimally invasive technique through standard lateral approach and 9 cases with Open Reduction and Internal Fixation. These cases were taken for surgery from minimum of 7 days to maximum of 30 days after the injury. For all cases a minimally invasive approach was preferred, open reduction was done only for fractures where it was felt that accurate reduction was not possible through a minimally invasive technique, the primary reason for which being delay in taking up of cases for surgery.

Post operatively, patient was managed with analgesics, anti-inflammatory drugs and antibiotics. This helped in mobilizing the patient faster. Post-operative x-rays were done at required intervals at 3, 6, 9, 12 months. Where stable internal fixation was achieved, the patient was mobilized after 48 hours after removal of the drains. For 2-3 day, the range of motion allowed was 0-20 degree from the 5th day the range of motion

was gradually allowed to be increased to 90 degree after suture removal. Whenever there was doubt about the stable fixation, external splinting (Plaster of Paris slab) was given for support and advised to do static quadriceps exercises. Continue passive motion exercise (CPM) were done daily with temporarily removal of slab under carefully supervision and splint reapplied. Partial weight bearing was delayed till 6 weeks and full weight bearing allowed after 12-15 weeks.

Follow up: The first follow up was at 6 weeks and later on patients were followed up at regular interval of 6-8 weeks till complete fracture union. Any possible loss of reduction was evaluated and assessment was done for any possible complication.

Final Outcome was done according to Rasmussen's score [8].

## Statistical Analysis

Quantitative data was presented with the help of Mean and Standard deviation. Comparison among the study groups was done with the help of unpaired t test. Qualitative data is presented with the help of frequency and percentage table. Association among the study groups is assessed with the help of Fisher test, student 't' test and Chi-Square test. 'p' value less than 0.05 is taken as significant.

## Results

Twenty patients with Tibial plateau fractures were treated surgically, with locking compression plate from October 2017 to March 2019 at Medciti institute of medical sciences. Majority of the patients with Tibial plateau fractures i.e., 8 patients (40%) were in the age group of 30-39 years. The youngest patient was 19 years and oldest patient was 58 years. Mean age in this study was 34 years. Road traffic accident was the cause for this fracture in most of the patients. Males are more commonly affected. Majority of the fractures were bio-condylar with meta-diaphyseal dissociation (type-VI) and cleavage combined with Depression (type -II) fractures, in our series. 5 patients (25%) had associated injuries among them 2 patients (10%) had patella fracture, 1 patient (5%) had shaft of femur fracture, 1 patient (5%) had multiple ribs fracture and 1 patient (5%) had distal end of radius fracture. In 9 patients (45%) surgery was done within the 1st week and in 11 patients (55%) were operated in the second week due to compromised soft tissue status. All our patients were operated under spinal anesthesia with LCP for Tibial plateau fractures. MIPO approach was used in 14 patients and open reduction was done in 6 patients. 14 patients (70%) were placed a single plate and 6 patients (30%) were done dual plating. types. All operated patients were mobilized postoperatively as soon as possible, mostly on the 3rd post-operative day. Partial weight bearing was allowed after 10 to 12 weeks. Full weight bearing was allowed usually after 14 weeks (3.5 months). 14 patients (70%) united at the end of 12-16 weeks. In 4 patients (20%) delayed union occurred at 16-20 weeks. In 1 patient union took more than 20 weeks. Postoperatively 1 patient (5%) had infection and in 2 patients (10%) plate prominence occurred. In 1 patient (5%) delayed union occurred. 15 patients (75%) had excellent functional outcome, good functional outcome in 3 patients (15%) and fair functional outcome in 2 (10%) patient.

## Discussion

Locked plate technology has evolved in an effort to overcome the limitations associated with conventional plating methods, primarily for improving fixation in osteopenic and metaphyseal bone. The development of screw torque and plate-bone interface friction is unnecessary with locked plate designs, significantly decreasing the amount of soft tissue dissection required for implantation, preserving the periosteal

blood supply, and facilitating the use of minimally invasive percutaneous bridging fixation techniques. The locked plate is a fixed-angle device because angular motion does not occur at the plate screw interface. The use of locked plate technology allows the orthopaedic surgeon to manage fractures with indirect reduction techniques while providing stable fracture fixation<sup>51</sup>.

High energy, complex bicondylar tibial plateau fractures, however, typically present with an associated severe soft-tissue injury. Extensive dissection through the tenuous soft-tissue envelope to achieve reduction and apply conventional stabilizing implants, particularly through a midline incision, may significantly increase postoperative infection rates and implant failure leading to loss of fracture reduction, hindering long-term successful outcome<sup>4-6</sup>.

There are two major problems for the operative treatment of tibial plateau fractures:

On the one hand there is a highly elevated infection rate for the treatment of bicondylar tibial plateau fractures, caused by the frequently necessary vast exposition of the fracture and its fragments for the placement of double-plate osteosynthesis. These double-plate osteosynthesis are affiliated with an overall infection rate of up to 50%. Therefore many authors point out that, if possible, only one plate should be used. Separate screws from the opposite side can help to provide sufficient stability.

If double-plate osteosynthesis cannot be avoided it is strictly recommended to use two separate skin incisions. The Y-shaped approach is not used and recommended anymore, due to the high rate of skin necrosis<sup>6, 17</sup>. Wolter<sup>17</sup> and Seide<sup>21</sup> reported in detail about the advantages of angular stability. In not angular stable connections the stabilization depends on the pressure of the plate against the bone by screws.

In case of a locked plate-to-screw connection, the connection is built in the sense of a side clamped bar, which transfers the load from the bone to the plate. Applying pressure on the plate to the bone is not necessary and the blood circulation of the bone surface is less impaired.

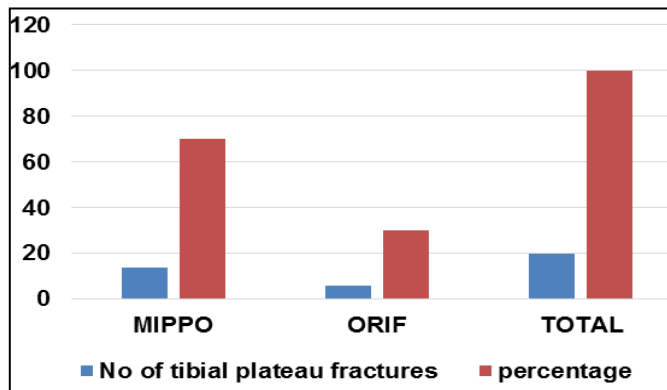
Our results show, that a unilateral plate fixation of the bicondylar tibial fracture is sufficient. With the use of locked-screw plates also the contralateral tibial head fragment can be held in position. We did not observe severe complications like deep wound necrosis or osteitis, which are well known after bilateral incisions. Rasmussen-score of our group showed a result comparable to the results of other authors treating bicondylar tibial head fractures.

The indications and uses for locking plate technology continue to be defined. One important problem to avoid is the creation of an overstiff construct by placing locked screws when not needed (or more than what is needed). The resultant relative lack of motion at the fracture site can, in some situations, be too stiff to allow fracture healing. This has led some to refer to locking plates as “nonunion generators.”

Thus, the indications and correct utilization of locking plates is important to understand so they are not used inappropriately and compromise fracture healing. In addition, newer techniques such as “hybrid” plating (use of both locking and nonlocking screws in a single construct) and far cortical locking (obtaining purchase in far cortex while bypassing proximal cortex) have evolved to combat these problems sometimes seen with locking plate<sup>52</sup>.

Table 1: Technique

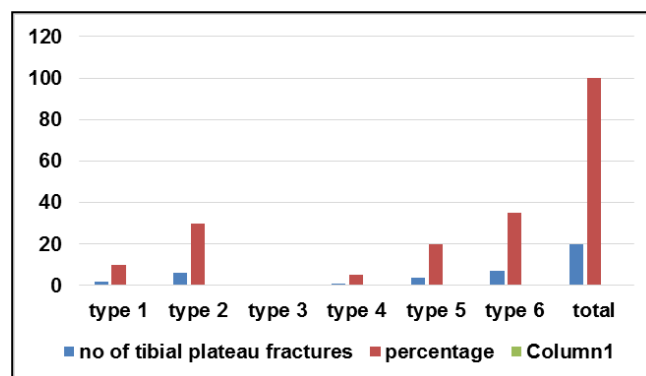
Technique	No. of Tibial plateau fractures	percentage
MIPPO	14	70
ORIF	6	30
Total	20	100



Graph 1: Technique

Table 1: Classification

Type of Fracture	No. of Tibial plateau fractures	Percentage
1. Type I	2	10
2. Type II	6	30
3. Type III	0	0
4. Type IV	1	5
5. Type V	4	20
6. Type VI	7	35
Total	20	100



Graph 2: Classification



Fig 1: Preoperative and immediate post-operative radiograph of intra-articular proximal tibia fracture in anteroposterior and lateral views.

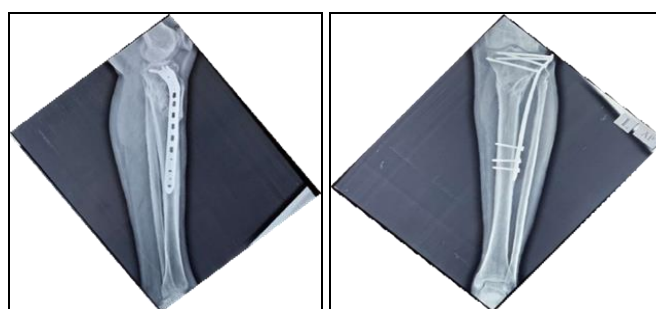


Fig 2: One year follow up radiograph of intra-articular proximal tibia fracture in anteroposterior and lateral views showing fracture union



**Fig 3:** Clinical picture showing full rom of knee joint



**Fig 4:** Preoperative and immediate postop radiograph of Intra-Articular proximal tibia fracture in anteroposterior and lateral views with LCP Osteosynthesis



**Fig 5:** Follow up radiograph of intra-articular proximal tibia fracture in anteroposterior and lateral views showing fracture union



**Fig 6:** Clinical picture showing full flexion at knee joint and extension against gravity

### Conclusion

With emphasis now shifting from perfect reduction and rigid fixation to biological means of fixation by minimally invasive approaches, we need an implant which provides stability at the same time respects biology, for which locking compression plate is the answer. Tibial plateau LCP system is an exciting new method of osteosynthesis for complex tibial plateau fractures allowing early mobilization and good functional outcome with limited number of complications.

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#### Declarations

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**Conflict of interest:** None Declared

**Ethical approval:** Not required

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