

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

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### Abstract

**Introduction:** Ever since the advents of high velocity transport system, there is an alarming increase in road traffic accident (RTA) with increased orthopaedic related morbidity and mortality. Proximal tibia being involved in body weight transmission through knee joint and leg, it plays a vital role in knee function and stability. The aim of surgical treatment of proximal tibial fractures is to restore and preserve normal knee function, which can be accomplished by anatomical restoration of articular surfaces, maintaining mechanical axis, restoring ligamentous stability and preserving a functional pain free range of motion of knee. Treatment of these injuries using minimally invasive percutaneous plate osteosynthesis (MIPPO) techniques may minimize soft tissue injuries and damage to vascular integrity of fracture fragments.

**Materials and Methods:** This study was a hospital based prospective study centered in department of orthopedics at R.L. Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Kolar, from December 2013 to May 2015 in which 30 patients with proximal tibia fractures were treated with locking compression plate (LCP).

**Results:** The assessment of clinical outcome was made according to Rasmussen's functional grading system. End results showed excellent outcome in 26 cases and good outcome in 4 cases. On subjective evaluation, 4 patients had superficial wound infection, 1 patient had deep vein thrombosis and 4 patients had extensor lag of  $10^0$ - $15^0$  at the end of final follow-up.

**Conclusion:** Surgical management of proximal tibial fractures will give excellent anatomical reduction and rigid fixation to restore articular congruity, help to facilitate early mobilization and reducing post-traumatic osteoarthritis and hence to achieve optimal knee function. LCP remains a good choice in comminuted or more severe patterns of fractures.

**Keywords:** Proximal tibia fractures, locking compression plate, minimally invasive percutaneous plate osteosynthesis, Intra-articular fractures.

### 1. Introduction

Ever since the advents of high velocity transport system, there is an alarming increase in road traffic accident (RTA) with increased orthopaedic related morbidity and mortality.

Proximal tibia being involved in body weight transmission through knee joint and leg, it plays a vital role in knee function and stability. Fractures of proximal tibia have historically been difficult to treat because of its subcutaneous location of the anteromedial surface of the tibia. Severe bone and soft tissue injuries are not infrequent and there is high incidence of open fracture compared with other long bones.[1]

The aim of surgical treatment of proximal tibial fractures is to restore and preserve normal knee function, which can be accomplished by anatomical restoration of articular surfaces, maintaining mechanical axis, restoring

ligamentous stability and preserving a functional pain free range of motion of knee.[1]

The incidence of malunion, non-union and infections are relatively high in many reported series, causing significant long term disability. Recently more attention has been paid to the condition of soft tissue envelope. Soft tissue friendly approaches and minimally invasive techniques have improved the outcome. Treatment of these injuries using minimally invasive percutaneous plate osteosynthesis (MIPPO) techniques minimize soft tissue injury and damage to vascular integrity of fracture fragments.

Over the last decade plate fixation has become popular for the treatment of proximal tibial fractures. This coupled with biological advantage of percutaneous insertion has resulted in high union rates.

Locking compression plate device offers potential biomechanical advantage over other methods by,  
– Better distribution of forces along the axis of bone,

- Can be inserted with minimal soft tissue stripping using minimally invasive percutaneous plate osteosynthesis (MIPPO),
- Substantially reduces failure of fixation in osteoporotic bones,
- Reduces the risk of a secondary loss of intraoperative reduction by locking with screws to the plate,
- Unicortical fixation option,
- Better preservation of blood supply to the bone as a locked plating does not rely on plate bone compression,
- Provides stable fixation by creating a fixed angle construct and angular stability and
- Allows early mobilization.

Locking compression plate has added advantage of the ability to manipulate and reduce the small and often osteoporotic fracture fragments directly.

## 2. Materials and Methods

This is a study of proximal tibial fractures treated with locking compression plate (LCP) which was conducted in the Department of Orthopedics at R. L. Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Kolar from December 2013 to May 2015. Clearance was obtained from hospital ethical committee.

During this period 30 patients were treated for proximal tibial fractures by LCP fixation and all the required data was collected from the patients during their stay in the hospital and during follow up at regular intervals.

### The Inclusion Criteria

1. Age above 18 years.
2. Closed / Open Gustilo-Anderson Type I, II and IIIA.
3. Intraarticular / Extraarticular proximal tibial fractures (AO 41A and 41C).

### The Exclusion criteria

1. Pathological fractures.
2. Patients medically unfit for surgery.

### Classification system

The AO classification was used to classify these fractures. The patients were followed up for a minimum period of 6 months.

### 2.1 Management

The patients were first seen in the casualty/ OPD. The history was taken followed by general and local examination of the patient. Concerned specialists undertook appropriate management of any associated injuries. Intensive care was given to those patients who presented with shock following head injuries and immediate resuscitative measures were taken. Once the patient's general condition was fit, relevant x-rays were taken. Higher investigations such as CT scan were done if indicated.

The patients were taken for surgery at the earliest possible time depending on their medical condition, skin condition and the amount of swelling. If definitive surgery was delayed, fracture was immobilized with an above knee posterior splint. All surgeries were done under C-arm image intensifier control. Fractures were fixed either with MIPPO

technique or by open reduction and internal fixation with LCP.

### 2.2 Preoperative planning

- Consent of the patient/ patient attenders was taken prior to the surgery.
- Appropriate length of the plate to be used was assessed with the help of radiographs.
- A dose of tetanus and antibiotic was given preoperatively.
- Preparation of the part was done before the day of surgery.
- The injured leg was immobilized in a plaster of paris slab during preoperative period.
- Instruments to be used were checked and sterilized.

### 2.3 Position

- Patient supine on radiolucent operating table.

### 2.4 Operative Procedure

- Type of anaesthesia: Spinal anaesthesia.
- Betadine scrub was given to the limb.
- Pneumatic tourniquet was applied after exsanguinations and time noted.
- Painting and draping of the part done.
- Through anterolateral approach, intraarticular fractures were exposed and reduced anatomically, whereas extraarticular fractures were treated through MIPPO technique.
- After achieving reduction, appropriate sized plate was taken and fracture was stabilized using cortical and locking screws. Cortical screws were put before putting locking screws.
- The average time taken for surgery in case of MIPPO technique was 50 minutes (range, 40-60 minutes) and 75 minutes (range, 60-90 minutes) in case of open reduction and internal fixation.
- The major intra-operative problems encountered were in case of comminuted fractures that were tried to reduce by MIPPO technique and later converted to open reduction after unsuccessful attempts.
- Tourniquet was released and haemostasis secured.
- Wound closed leaving suction drain insitu.

### 2.5 Postoperative

Postoperatively after obtaining rigid internal fixation, the patients were mobilized after removal of drains, for 2-5 days the range of motion allowed was 0-20°, from the 5th day the range of motion was gradually allowed to be increased to 90° or more. After suture removal on 12-14<sup>th</sup> day if no complications, full range of movement was allowed. An immediate postoperative x-ray was also done. Intravenous antibiotics were given for 48 hours in case of closed fractures and more as required in case of open fractures. Analgesics were given till adequate pain relief was obtained. The patients were advised quadriceps exercises, early active knee mobilization and non-weight bearing crutch walking, on discharge. In case of comminuted fractures with unstable fixation, external support was given in the form of slab and mobilization was started after confirming the healing process clinically and radiologically.

### 2.6 Follow up

After suture removal, follow up was done at 6 weeks during which patient were clinically evaluated and an x-ray was taken to look for signs of fracture union and loss of

reduction if any. The second follow up was done at 3 months during which one more x-ray was done and a clinical evaluation of union done. Based on the clinical and radiological signs of union patients were allowed partial weight bearing and gradually progressed to full weight bearing. Partial weight bearing was delayed until 6 – 8 weeks and full weight bearing allowed after 12-16 weeks if fracture union seen. The patients were then followed up at 6 months during which time the anatomic and functional evaluation was done using the Rasmussen's functional grading system.

### 3. Results

The results were analyzed under various terms - youngest patient in this study was 21 years and the oldest was 60 years. The average age was 41 years. The majority of patients, 30% were in 18- 30 years age group, 23.3% in 31-40, 41-50 and above 50 years age groups. 86.7% patients were male and 13.3% were females. The mechanism of injury was grouped into 2 categories, road traffic accidents and fall from a height. 93.3% of the patients sustained injury secondary to RTA and the rest 6.7% due to fall from a height. 73.3% of the patients sustained injury on the right side and

26.7% on the left side. 66.7% of the patients sustained closed fractures, 23.3% sustained open type I fractures and 10% of the patients sustained open type II fractures.

As per AO classification system 3.3% of the patients were type A1, 13.3% type A2, 30% type A3, 16.7% type C1, 30% type C2 and 6.7% type C3. The average duration between injury and surgery was 2.8 days. 33.3% of the cases were operated within 1 day, 53.3% of the cases were operated within 2-5 days and 13.4% of the cases were operated in more than 5 days. The average range of motion was 114 degrees. Only 1 patient (3.3%) had final knee flexion of 90 degrees.

The early complication which includes infection was seen in 4 cases (13.3%) and deep vein thrombosis (DVT) was seen in one case (3.3%) and late complication of extensor lag ( $10^0$ - $15^0$ ) was seen in 4 cases (13.3%). Most of the proximal tibia fractures were united by 12-15 weeks ranging from 12-20 weeks with an average union time of 13.75 weeks. Based on Rasmussen's functional grading system 86.7% of the patients had excellent outcome and 13.3% of the patients had good outcome at the end of 6 months follow up.

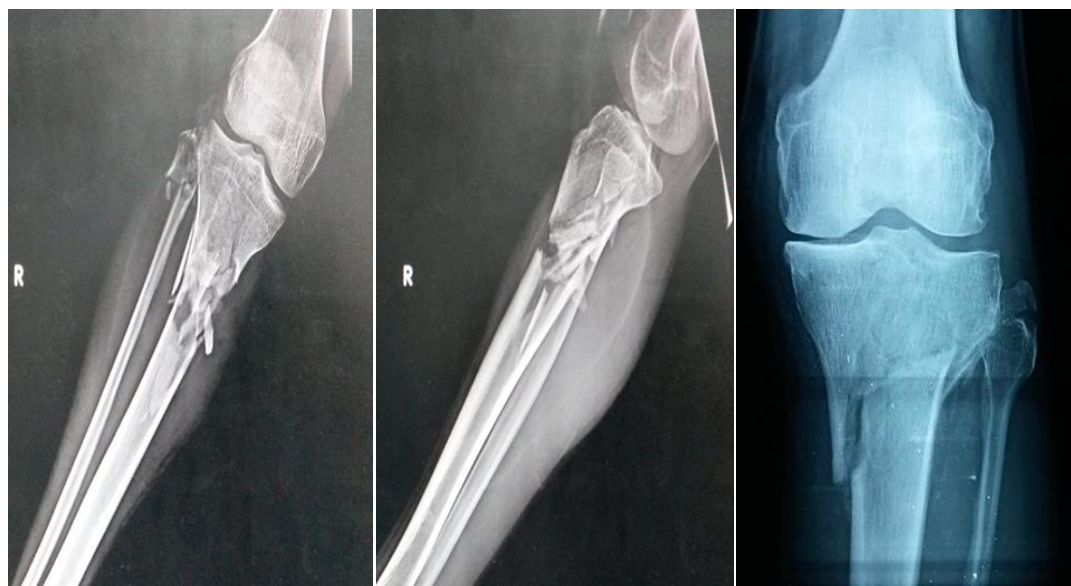


Fig.1: Pre-op X-rays.



Fig.2: Post-op X-rays.





**Fig.3: Range of motion at follow-up**

#### 4. Discussion

Proximal tibia fractures present a spectrum of soft tissue and bony injuries that can produce permanent disabilities. Their treatment is challenged by fracture comminution, instability, displacement and extensive soft tissue injuries. The goals of treatment are restoration of joint congruity, normal limb alignment, knee stability and a functional range knee motion. The major limitations of non-operative treatment include inadequate reduction of articular surface and ineffective limb alignment control. Furthermore the extended period of hospitalization and recumbence are not cost-effective in today's health care environment.

It must be emphasized that this study is only short term follow up of six months and the discussion that follows is essentially a preliminary assessment. The aim of this study is to evaluate the clinical outcome of fracture of proximal tibia treated with locking compression plate and its complications.

The age of the patients in the study ranged from 18 and 30 years (30%) with average age of 41 years. Higher incidence in this age is mostly due to active life style and prone for accidents resulting in high velocity injuries. The incidence of fractures in our study was more common in males (86.7%) which can be attributed to the risk of injury due to occupational and ambulant life led by them. Among modes of injury road traffic accidents are the most common (93.3%) with more (73.3%) fractures on right side. These are comparable to the studies made by Dendrinios *et al* [2], Barei *et al* [3] and Patil *et al* [4].

Among the 30 patients classified according to AO classification system 3.3% of the patients were type A1, 13.3% type A2, 30% type A3, 16.7% type C1, 30% type C2 and 6.7% type C3. We had an average union time of 13.75 weeks with range of 12 to 20 weeks. The rate of infection was 13.3%. Infections were treated with prolonged continuation of antibiotics and healed over time. All these patients had a final fair outcome. None of the implants had to be removed due to infection. One case developed deep vein thrombosis (3.3%) which was treated conservatively. Four

cases had extensor lag of  $10^0$ - $15^0$  (13.3%) at the final follow-up.

The results of functional evaluation showed 86.7% excellent results and 13.3% good results. Rambold[5] in 1960 reported that internal fixation of tibial plateau fractures and early mobilization contributes to good anatomical and functional results. Dennis Jensen [6] in 1990 got good results by surgical treatment of proximal tibia fractures. Chaix *et al*[7] reported 86% good to excellent results by surgical means of treatment. Lee *et al* [8] reported good to excellent results by surgical means of less invasive stabilization system treatment. Feng *et al* [9] reported good results when fixed with LCP in comparison with dynamic compression plate (DCP) with an additional benefit of minimally invasive surgery. Kim *et al* [10] reported good results with MIPPO technique in treatment of open proximal tibial fractures with adequate soft tissue coverage.

The period of immobilization was again individualized depending on the security of rigid fixation and other circumstances demand. The benefits of early knee motion include - reduce knee stiffness and improved cartilage healing (regeneration). However, these benefits are to be cautiously balanced by risks, including loss of fracture reduction, failure of internal fixation and compromised ligament and soft tissue healing. Several studies stated that the prognosis is given by the degree of displacement, type of fracture, method of treatment and quality of postoperative care.

#### 5. Conclusions

At the end of our study, following conclusions were drawn from the surgical management of proximal tibial fractures.

- Road traffic accidents or high velocity injuries are the most common cause of these fractures (93.3%). These high velocity injuries are associated with more severe or comminuted fracture patterns.
- Most of these injuries occur in younger and active age groups (53.3% in 18-40 years age groups).

- These fractures have a predominance of male sex (86.7%) and right side (73.3%).
- The main aim of surgical treatment includes precise reconstruction of the articular surface with elevation of the depressed bone fragment in case of intraarticular fracture, bone grafting in case of bone loss and stable fragment fixation allowing early range of movement.
- Preoperative soft tissue status and their repair at right time, significantly changes the outcome.
- All fracture united well in time (before 6 months). No non-union.
- Infection plays a vital role in influencing the result of the surgical outcome.
- Period of joint immobilization plays a major role in the end result.
- ORIF with LCP seems to be good implant choice in proximal tibia fractures including difficult fracture situations.

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