



## Outcomes of Open Proximal Tibia Fractures Managed by Primary Plating with Mippo Technique in Terms of Stability, Union and Complications

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### Abstract

**Background:** Periarticular fracture of tibia management had main challenges because these are high energy fractures associated with soft tissue damage leading to increased chance of complex injuries. The purpose of this study, on patients of open proximal tibia fractures managed by primary plating with MIPPO technique, were to assess the functional outcome in terms of functional Stability, union, range of motion, early mobilization and complications.

**Methodology:** In this study, 55 patients of open fracture of upper third tibia were managed by primary locking compression plate using MIPPO method. Cases were followed up at 4th week, 8th week, 14th week, 20th week, 26th week, 38th week and 50th week. At all visit cases were evaluated by using radiograph of knee and Knee-Society score.

**Results:** More than 90% patients had an Excellent to good Knee Society Score ( $p \leq 0.005$ ) and Fracture united in less than 20 weeks duration.

**Conclusion:** MIPPO has leverage over traditional plating by conserving periosteal blood supply. The patient compliance is good and it is cosmetically better than different types of fixators. Thus, Primary MIPPO using locking plates is an acceptable method of managing Compound proximal tibia fractures.

**Keywords:** Proximal Tibial Fractures; Mippo Technique; Knee Society Score; Gustilo Anderson Classification

### Introduction

The knee joint is typical weight bearing joint. It helps in running, load bearing, walking, squatting, sitting etc. To maintain good knee function, we must treat knee injuries accurately. Direct bending forces applied to the meta-diaphyseal region of proximal tibia leads to extraarticular upper third tibia fracture. About 1%

of all fracture and 8% of the fracture in older people comprised by proximal tibial fracture. Lateral tibial condyle (55 to 70%) is more prone than medial condyle fracture (10 to 23%) whereas bicondylar involvement found in 10 to 30% cases [1]. Main problem faced in the management of upper third fracture of tibia (extra articular) are these high velocity fractures (higher kinetic energy) associated

with compounding which results in increased complexities following open reduction and internal fixation. Multi-fragmented fracture create problem in accomplishing rigid fixation because of poor hold of screws and weight bearing or even early joint mobilization not allowed. With recent advancements there is improvement in surgical techniques and implants, which is evident towards surgical management of these injuries. As there is so many varieties and complexity in intraarticular tibia fracture so there is no uniform successful method of treatment. There was a great development in the treatment of open fracture of any bone from plaster of Paris (POP) with window, pin and plaster, continuous traction, external fixation, ring fixation, and hybrid fixation to primary locked intramedullary (IM) nailing. The main problem in open fracture is soft tissue damage and its treatment [2]. Nowadays, Primary fracture fixation is considered without Insulting the already damaged soft tissues because of good understanding of soft tissue management [3]. However, Primary locked IM nailing with soft tissue treatment simultaneously have better results in tibia middle third open fracture [3]. In Orthopedics, upper third tibia open fractures are still the area of concern. Joint stiffness and immense need of others are associated with calcaneal traction which is used to manage open metaphyseal fracture. Other method includes ilizarov's [5], tubular [6] OR hybrid fixator [7] which is then followed by procedures [8] either IM nailing or MIPPO in later stage [9]. External fixators have variable results with poor patient compliance, pin-tract infection, pin loosening and prime of all is non-union (also known as non-union machine [10]. Some also advocate [11] early i/m nailing or MIPPO for compound fracture. The introductions of locking plates have added a new dimension in the treatment of these injuries. Traditional open plating presents complications, such as, infection and delayed soft tissue breakdown. As the emphasis is now placed on soft tissue care, minimal invasive plate osteosynthesis using a locking plate has become alternative technique for tibial plateau fractures. MIPPO offers advantage over traditional plating as it secures periosteal blood supply and also reduces iatrogenic damage. Aims and Objectives of the present study, on patients of open proximal tibia fractures managed by primary plating with MIPO technique, were to assess the functional outcome in terms of functional Stability, malunion and rotation, pain and range of motion, early mobilization and rehabilitation and Complications (Infection/Deformity).

## Methodology

This study (prospective) was carried out on 55 cases. The intent of this paper was to study the management of open upper tibia

fracture with MIPPO technique to provide a stable, painless and mobile joint and to assess complications of plating and infection rates in open fractures. Between September 2018 to November 2021, 55 patients of upper third tibia open fracture presented in OPD and emergency were selected for plating using MIPPO method. The study includes fresh open upper third tibia open fracture (both intra and extra articular) up to GUSTILO ANDERSON grade 3A with minor periosteal stripping. Wound without any discharging sinus/deep-seated infection at fracture site and person with mature skeleton.

Exclusion criteria 1. GUSTILO ANDERSON more than grade 3A, 2. Severely contaminated fracture, 3. Fracture without decent soft tissue coverage, 4. Malnourished and Immuno-compromised patients. Consent both written and informed is must for Ethical clearance from Institutional Ethical Committee. Out of 55 upper third tibia open fracture, 28 cases were extra-articular (41A), 5 cases were partial articular (41B), 22 cases were intra-articular (41C). Initially they all were managed by wound debridement and washed with at least 9L of normal saline then traction applied over affected site. After 5-15 days patients were posted for primary plating with average duration of injury about 7 days. All surgeries were done in supine position with knee support under spinal anesthesia. Proximal tibia locking plate of 4.5mm of 5 to 11 holes were used. MIPPO method is used to avoid further damage of soft tissue. Addition C.C. Screw was used in some cases to fix the intercondylar fractures. Indirect method using K-Wires and Steinman pin to achieve under C-ARM machine. Calcaneal pin is not removed till the plate application and used during operation for traction if required. According to fracture, length of plate is selected so that at least three locked screws with fair purchase can be placed proximally and distally respectively. During operation, fixation of plate is assessed by gently moving knee joint. Bone and plate are covered with soft tissue with every measure taken without tension. Six of them needed lateral release incision which is left for secondary healing.

Compounding's were healed by secondary healing or skin grafting later on and skin incisions were closed layer by layer given during operation. Only 2 out of 55 needed skin grafting for complete coverage of bone. Calcaneum traction is removed and well-padded dressing was done at the end of surgery and limb is elevated. All patients were given IV antibiotics during post-op period. 5 out of 55 needed extended IV antibiotics coverage and repeat cultures were taken to ensure antibiotics accordingly. Wound dressing done



**Figure 1:** pre op x-ray of patients showing proximal tibia fractures.



**Figure 2:** immediate post op x-ray of patient fix with locking plate and c-c screw by MIPPO technique.

on daily basis to ensure skin condition and any potential exposure of plate for the next few days. Later on, dressing done on alternate days. Gradually knee bending started depending upon comminution and recovery from pain over the period of next 5-7 days. X-

rays was taken on post-op day 2 or 3. Weight bearing not allowed and quadriceps exercise and active finger movement allowed. Discharge given after 10-20 days depending upon wound condition. Cases were followed up at 4<sup>th</sup> week, 8<sup>th</sup> week, 14<sup>th</sup> week, 20<sup>th</sup> week, 26<sup>th</sup> week, 38<sup>th</sup> week and 50<sup>th</sup> week. Weight bearing started partially after radiological signs of callus formation is seen. When solid bridging callus is seen on radiograph there after complete weight bearing is allowed. In follow-up, patients assessed by examining skin condition, sign of any infection, any exposure of plate or bone or both, knee movement and pain during rest or activity. 6 weekly x-ray was obtained for follow-up till bridging callus was observed. On X-RAY examination, change in angulations were assessed in AP and Lateral position. Knee society clinical rating score of 85-100 is excellent, 70-84 is good and 60-69 is fair and this is going to be used in the final outcome.

### Results

Between September 2018 to November 2021, 55 patients of upper third tibia open fracture were treated by plating using MIPPO method. Out of 60 cases, 5 cases were left in the follow up. Out of 55 cases, 41 were male whereas just 14 were female. Age between 18 to 70 years were the candidates with average being 36 years. The mechanism of injury was predominantly a road traffic accident (38 patients) but some sustained injuries due to a fall from height (10 patients) and agricultural or farm injuries (7 patients). According to AO-OTA classification of proximal tibia fractures, 28 patients fell in 41A, 5 in 41B and 22 in 41C categories. As per Gustilo Anderson's classification of open injuries, 12 had grade I wounds. Patients presented to us on average 3<sup>rd</sup> day of injury but ranged from 1<sup>st</sup> day to 15<sup>th</sup> day. The average duration of stay in the hospital was 10 days ranging from 7 to 19 days. The average follow-up was 60 weeks with lowest being 43 weeks and highest being 102 weeks. All patients showed complete bony union in follow-up radiographs. The radiological union time in proximal compound fracture cases varied from 15 weeks to 21 weeks with average being 17.6 weeks. Out of 55 cases, one case showed loss of reduction and marked varus angulation due to deep infection at fracture site. This case fell in 41C3 category of AO-OTA classification and had a Gustilo Anderson Grade IIIA wound. It was managed by removal of plate and external fixator application. Low grade infection with uninterrupted discharging sinus causes late removal of plate after attaining bony union in TWO cases. One of them is of grade 3A and one from grade 2 group of GUSTILO ANDERSON CLASSIFICATION. 46 Out of 55

cases, have achieved full range of movement. 9 of them shows restricted movement with extension lag of 5-15° or flexion less than 90°. 51 out of 55 were having no sign of infection in follow-up. 4 cases show signs of infection out of which 3 were superficial and 1 were deep infections. With deep infection; patient undergo an early implant removal with application of external fixator. As far as functional results in Compound Grade 3A group patients are considered, 5 out of 8 cases showed good to excellent results (62.5%), 2 out of 8 cases (25%) were in fair group, 1 out of 2 needed delayed plate removal and 1 patient (12.5%) who had to undergo an early implant removal with application of external fixator, fell in poor outcome group. This patient also achieved union but much later and finally had poor knee society score of 55. Above 95% had more than 90° of range of motion.

Knee Society Score functional outcomes- More than 90% patients had an Excellent to good Knee Society Score. Only 1 patient had poor outcome.

Knee Society Score	No. Of Patients
Excellent (85-100)	27
Good (70-84)	15
Fair (60-69)	03
Poor (< 60)	01

Table 1

Complication	No. of patients
Infection	6
Malunion	5
Wound dehiscence	1
Stiffness	2
Early implant removal	1

Table 2: Complications showed in our study mentioned in following.

Discussion

Now a days, Open fracture of tibia is one of the commonest injuries. Soft tissue management is one of the prime concerns. Soft tissue injury requires time (weeks to months) to settle. For open fracture management there are various methods ranging from con-

tinuous skeletal traction with regular sterile dressing, slab with window and left the fracture to unite conservatively, tubular external fixation, hybrid external fixator, Ilizarov’s fixator and IM nailing for diaphyseal fracture. Open fracture managed by plaster immobilization is least preferred method because of its poor patient compliance, higher chances of joint stiffness, higher chances of malunion and prolonged morbidity. Open fracture with bone loss is very well managed Ilizarov’s ring. It had some limitations such as pin loosening and loss of reduction in fractures without bone loss and metaphyseal fractures. It also has bad compliance due to bulky ring and difficulty in dressing through Ilizarov’s fixator. Recently IM nailing gains trend in the management of open fractures. IM nailing gives good to excellent results in fixation of open tibia fracture without any further deterioration to surrounding tissues but this cannot be used in intra and juxta-articular fractures. Proximal and distal open tibia fracture are well managed with traditional plating by using MIPPO technique without damaging the vascular supply of underlying bone. Under C-ARM machine, locking compression plate can be applied to metaphysis area percutaneously with minimal exposure giving advantages of nailing and plating. For this study, we selected patients up to Grade 3A for plating in metaphyseal fracture by using MIPPO technique. For this study, 41 out of 55 were male rest female. It reflects that outdoor population, which is predominantly male in India, were more prone for the proximal tibial fractures. Even similar was the distribution from western studies, when Stannard., *et al.* [12] studied 52 patients out of which 41 were male and 11 were female and 24 males out of 30 patients in Kim., *et al.* study [13]. The mode of trauma was predominantly (63%) Road traffic accident in our study and correlated with others (Stannard-65%, Kim-80%). In our study the patients were of age group 18-70 years with average age being 36 yrs. There was similar age distribution of 18 to 69 years was reported by James S Starman., *et al.* [14] with average age being 38 years. GUSTILO ANDERSON CLASSIFICATION is used in compound fractures. We had 22 Grade I patients, 16 Grade II patients and 8 Grade IIIa patients whereas Stannard., *et al.* [12] reported 3, 7 and 26 patients in respective grades. Knee motion in their study ranged from a mean of 1 degrees (range, 0 degrees to 5 degrees) to 125 degrees of flexion (range, 100 degrees to 145 degrees) Final outcome of these patients was assessed using Knee society score (KSS). 27 showed excellent results and 15 showed good result. 42 out of 55 showed good to excellent results. 3 cases had fair results out of which 2 were from compound Grade IIIA category and 1 was from Grade II. Whereas 1

patient with Grade IIIA wound had poor score. The minimum score was 55 whereas maximum was 95, with average knee society score being 81.6 in our study. In Kim., *et al.* study [13] average KSS was 89 in which 23 patients (76%) had Excellent scores whereas 7 patients (24%) had good scores. In our series, Malunion occurred in 4 patients (8.6%) mainly in form of varus deformity. Infection was the most important complication to be assessed as we were doing primary plating in compound fractures. According to Whittle., *et al.* [15] there is 3-8% chances of infection in open fracture of tibia with 12% for Grade 3A and 25% for Grade 3B. However, IM nailing fails in metaphyseal and intra-articular fracture of tibia due to raised chances of instability and mal reduction. Moreover, nailing is prohibited in intra-articular fracture. According to Pal., *et al.* [16] plating osteosynthesis in compound fracture in 12 patients with satisfactory results. 90% reported with good to fair results and 6.5% resulted in deep infection. Chances of infection reduced with lower grade compound fractures. Our infection rates were comparative or in many cases better than these studies. Total 5 cases show signs of infection out of which 2 were superficial and 3 were deep infections. In grade 3A group, out of 8 cases, good to excellent results seen in 5 cases, fair results seen in 2 cases, one out of 2 requires delayed plate removal and 1 out of 8 requires early plate removal with fixator application tumbles in poor outcome group. This patient also achieved union but much later and finally had poor knee society score of 55. Overall, our results with primary minimally invasive plate osteosynthesis in open fractures of Proximal Tibia are consistent with other studies and other modalities of management. More number of randomized control trials with larger sample size should be carried out to validate the results.

### Conclusion

High energy injuries lead to proximal tibia fracture and open fractures are common due to its subcutaneous presentation. Soft tissue damage is primary concern in this fracture. Various modalities including nails and external fixators have been used but they may be associated with higher risks of malunion or non-union. Plating in open fracture of metaphysis and intra-articular fracture is good alternative with less complications. In Grade 2 fractures, plating with MIPPO technique can be used with excellent results with less chances if infection and delayed union. In Grade 3A fractures, most patients can be managed with plating with proper selection of patients. MIPPO technique in open upper third tibia fracture is an excellent method of treatment of these cases. MIPPO technique

is preferred over classical plating because it saves periosteal blood supply. The patient compliance is good and it is cosmetically better than different types of fixators. It uses minimally invasive approach without causing iatrogenic harm to the already damaged soft tissue. Thus, primary MIPPO using locking plates is an acceptable method of managing compound proximal tibia fractures.

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