

# Management of Proximal Tibial Fractures by Locking Compression Plate

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## ABSTRACT

**Introduction:** 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. Study aims and objectives were to evaluate proximal tibia fracture union treated by Locking compression plate and to evaluate clinical outcome of fracture treated by Locking compression plate in regards to Knee range of movements and complications of Locking compression plate.

**Material and methods:** A prospective study was done on thirty patients of proximal tibial fractures treated by locking compression plate in Orthopaedic Department of Dr. R. N. Cooper Municipal General Hospital, Mumbai. Duration of study was from February 2015 to September 2016. 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 (30%) were in the age group of 31-40 years. There was male preponderance (80%) in the study while female patients constituted 20% of the study group. Road Traffic Accident was found to be the most common cause of fracture. 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. ORIF technique was used in 23 (76.7%) patients while MIPPO was used in 7 (23.3%) patients. Most of the fractures (83.4%) were united by 12-15 weeks while 1 (3.3%) fracture was united in less than 12 weeks and 4 (13.3%) fractures were united in more than 15 weeks. 26 (86.7%) patients had excellent results with full, pain-free function and 4 (13.3%) patients had good result.

**Conclusion:** From this study, we concluded that ORIF with LCP seems to be good implant choice in proximal tibia fractures including difficult fracture situations.

**Keywords:** Proximal Tibial, Fractures, Locking Compression Plate

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<sup>2</sup> where fractures results from direct axial compression, usually with a valgus (more common) or Varus moment and indirect shear forces.<sup>3</sup> Elderly patients with osteoporotic bone are likely to sustain depressed type fracture.<sup>4</sup> 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.<sup>5</sup> 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.<sup>6</sup> 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

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**How to cite this article:** Rajesh Sethiya, Vivek Dubey, Pradeep Sangnod, Ashish Gupta, Sunil M. Shahane, Ashwin Samant. Management of proximal tibial fractures by locking compression plate. International Journal of Contemporary Medical Research 2018;5(11):K1-K5.

**DOI:** <http://dx.doi.org/10.21276/ijcmr.2018.5.11.12>

## 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.<sup>1</sup> The incidence of malunion, non-union and infections are relatively high in many reported series, causing

AO locking compression plate (LCP).<sup>7</sup> 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. Figure -1 represents Fracture Classification (AO/ASIF).

## MATERIAL AND METHODS

A prospective study was done on 30 patients of proximal tibial fractures treated by locking compression plate in Orthopaedic Department of Dr. R. N. Cooper Municipal General Hospital, Mumbai. Duration of study was from February 2015 to September 2016. 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 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. 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 using anteromedial or anterolateral incision. Post operatively, patient was managed with analgesics, anti-inflammatory drugs and antibiotics. This helped in mobilising the patient faster. Post operative x-rays were done at required intervals at 3, 6, 9, 12 months.

### Mobilization

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.<sup>8</sup>

## 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

A prospective study was performed to evaluate surgical management of proximal tibial fractures by locking compression plate. Majority of the patients (30%) were in the age group of 31-40 years. There was male preponderance (80%) in the study while female patients constituted 20% of the study group. Road Traffic Accident was found to be the main cause of fracture (80%) whereas 20% of fractures were due to fall from height (13.4%). In the study, there is a slight right sided predominance compared to the left side (56.7% vs. 43.3%). 20 (66.7%) patients sustained closed fractures and 10 (33.3%) patients sustained open 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. ORIF technique was used in 23 (76.7%) patients while MIPPO was used in 7 (23.3%) patients. The average injury – surgery interval was 2.8 days. Infection was seen in 4 (13.3%) patients and deep vein thrombosis (DVT) was seen in 1 (3.3%) patient. Late complication of extensor lag (100-150) was seen in 4 (13.3%) patients. Most of the fractures (83.4%) were united by 12-15 weeks while 1 (3.3%) fracture was united in less than 12 weeks and 4 (13.3%) fractures were united in more than 15 weeks. 26 (86.7%) patients had excellent results with full, pain-free

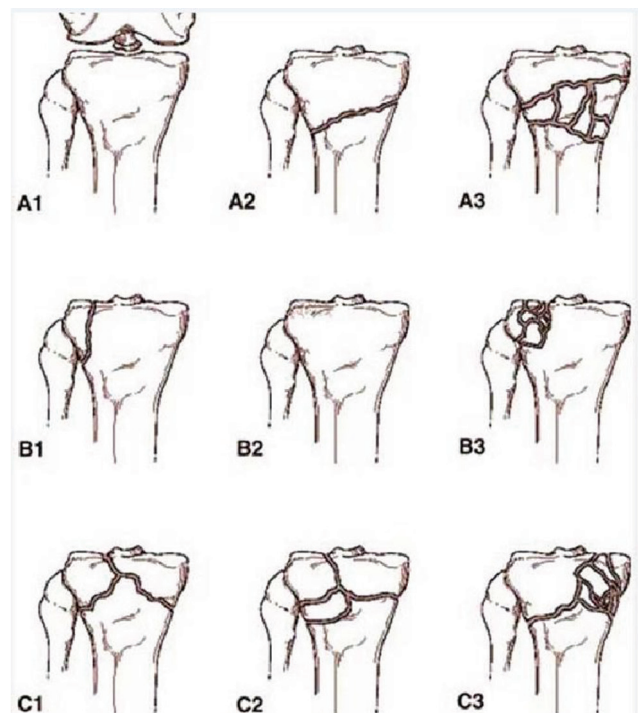


Figure-1:

function and 4 (13.3%) patients had good result. In our study, one patient with A1 AO type fracture of proximal tibia had an excellent outcome. All the four patients with A2 type fracture had excellent outcome. Out of the 10 patients with A3 type fracture, nine had excellent outcome and one had a good outcome. Three patients with C1 type fracture had excellent outcome while, two had good outcome. All the ten patients with C2 type fracture had excellent outcome. While, out of the two patients with C3 type fracture, one had a good while the other had an excellent outcome. There was no significant association of Type of fracture and Functional Outcome ( $p=0.651$ ). This suggests that the fracture types A1, A2, A3, C1, C2 and C3 are suitable for fixation with lateral locking plate. Two patients with C1 type fracture had infection while, four patients with C2 type fracture had extensor lag as the complication. Hence, post-operative complications are more in C type fracture as compared to other types.

## DISCUSSION

Proximal tibia fractures present a spectrum of soft tissue and bony injuries that can produce permanent disabilities. Their treatment is challenging due to the fracture comminution, instability, displacement and extensive soft tissue injuries. The aims of treatment are restoration of joint congruity, limb alignment, knee stability and a functional range of knee motion. The major limitations of nonoperative 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. The proximal tibial fractures, one of the commonest intra articular fractures, incidence of this fractures are increasing regularly due to RTA and at the same time surgical treatment options for the same are also being changed continuously. Any fracture around the knee joint is of paramount importance as it would result in significant morbidity and affect quality of life. Ergo, the treatment of proximal tibial fractures is a challenge for the orthopaedic surgeons.

To overcome these difficulties, the researchers developed new technologies called MIPO and locking compression plate system.

A prospective study was carried out to evaluate surgical management of proximal tibial fractures by locking compression plate. Thirty patients were enrolled in the study.

### Preoperative factors

The preoperative factors that were studied include age of the patient, gender, mode of injury, mode of injury and the type of fracture. We tried to find out whether these preoperative factors had any influence on the functional outcome following surgery. In our study, majority of the patients (30%) were in the age group of 31-40 years followed by 23.3% and 20% in the age groups of 41-50 years and 21-30 years respectively. 13.4% patients were in the age group of 18-20 years, 10% patients were in the age of 51-60 years and 3.3% patients were in >60 years. However, the age of the patient did not influence the functional outcome. Reddy JPK et al.<sup>9</sup> in a similar hospital based prospective study observed that

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. Reddy JPK et al<sup>9</sup> observed that the incidence of fractures in their 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. The study is similar to our study which had male preponderance (80%) while female patients constituted 20% of the study group. But, the gender of the patient did not affect the functional outcome In our study Road Traffic Accident was observed to be the main cause of fracture (80%) whereas 20% of fractures were due to fall from height (13.4%). But, the mode of injury did not affect the functional outcome post operatively. Studies done by Dendrinis GK et al<sup>10</sup>, Barei DP et al<sup>11</sup> and Patil DG et al<sup>12</sup> observed that among modes of injury, road traffic accidents are the most common (93.3%) with more (73.3%) fractures on right side. There was a slight right sided predominance compared to the left side (56.7% vs. 43.3%) in our study of thirty patients who sustained proximal tibia fractures. However, the side (left or right) at which the patient sustained injury had no effect on functional outcome. Twenty (66.7%) patients sustained closed fractures and 10 (33.3%) patients sustained open 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. This is in agreement to the study of Reddy JPK et al<sup>9</sup> where 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 injury to surgery interval for 10 (33.3%) patients was less than 2 days, 2-5 days for 16 (53.3%) patients and 4 (13.4%) patients had to wait for more than 5 days before getting operated. The average injury to surgery interval was 2.8 days. This preoperative factor also did not affect the functional outcome of the patient. The study of Reddy JPK et al<sup>9</sup> had 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. Hence, the preoperative factors mentioned above did not influence the final functional outcome.

### Intraoperative factors

The factors studied was the method used for reduction and fixation.

ORIF technique was used in 23 (76.7%) patients while MIPPO was used in 7 (23.3%) patients. Kancherla NR et al<sup>13</sup> did a prospective study on 20 patients with proximal tibial fractures. Most of the patients belonged to the age group of 20-40 years (75%), which were highly active and mobile age similarly in our study only 7 (23.3%) were treated with MIPPO technique.

### Post Operative factors

The post operative factors that were studied include time for fracture union, post operative complications and functional

outcome. Most of the fractures (83.4%) were united by 12-15 weeks while 1 (3.3%) fracture was united in less than 12 weeks and 4 (13.3%) fractures were united in more than 15 weeks. The patients in the study by Kumar Reddy JP et al<sup>9</sup> had an average union time of 13.75 weeks with range of 12 to 20 weeks. Kancherla NR et al<sup>13</sup> observed that the average time for union of fractures was 19 weeks ranging from 16 to 24 weeks. An average of 120 degrees knee joint range of motion was achieved. The authors concluded that soft tissue damage, intraarticular fracture, severity of fracture and physiotherapy determined knee range of motion. Both Cole PA et al<sup>14</sup> and Egol KA et al<sup>15</sup> reported similar range of movement results. Infection was seen in 4 (13.3%) patients and deep vein thrombosis (DVT) was seen in 1 (3.3%) patient. Late complication of extensor lag (100-150) was seen in 4 (13.3%) patients. Lachiewicz PF et al<sup>16</sup> in a case study observed that conventional open reduction and internal fixation of high energy unstable proximal tibial fractures frequently results in high incidence of complications like infection, skin necrosis, and wound dehiscence. Lansinger O et al<sup>17</sup>, Young MJ et al<sup>18</sup>, Schatzker J et al<sup>19</sup>, Papagelopoulos PJ et al<sup>20</sup> found that the incidence of proximal tibial fractures has not only increased with increase in RTA but also the complexity of fracture has altered due to high velocity of direct impact causing more comminution at fracture site. The authors concluded that any fracture around the knee joint is of paramount importance as these would result in significant morbidity and compromised quality of life. Additionally, the management of high energy proximal tibia fractures is a challenging task, as they are often associated with a number of complications. Amongst the complications observed in the study of Kancherla NR et al<sup>13</sup>, 1 patient (5%) developed infection within 2 weeks postoperatively. Our results were comparable to the studies conducted by Egol KA et al<sup>15</sup> who reported no infection, Stannard JP et al<sup>21</sup> who reported 5.9% rate of infection and Cole PA et al<sup>22</sup> with infection rate of 4%. The malalignment rate was 5% in our study as compared to 2.6% in the study conducted by Cole PA et al<sup>14</sup> and 22% in the study by Phistikul P et al.<sup>23</sup> In the study of Reddy JPK et al<sup>9</sup>, 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 100-150 (13.3%) at the final follow up. Two patients with C1 type fracture had infection while, four patients with C2 type fracture had extensor lag as post-operative complication. Hence, post operative complications were more in C type fracture as compared to other types. Twenty six (86.7%) patients had excellent results with full, pain-free function and 4 (13.3%) patients had good result. Kancherla NR et al<sup>13</sup> concluded that based on modified Rasmussen criteria excellent clinical and radiological outcome was noted in 50% of the cases and in 35% of the cases, it was good. In one (5%) patient, the result was poor. Similar results were observed by Yu Z et al<sup>24</sup>, Prasad GT et al<sup>25</sup>, Zhang Y et al<sup>26</sup>,

Oh CW et al<sup>27</sup>. Reddy JPK et al<sup>26</sup> found an excellent result in 86.7% of the cases and 13.3% had good results. In a study by Rohra N et al<sup>28</sup>, 85.29% of the patients had excellent and 14.71% had good results. In our study, one patient with A1 AO type fracture of proximal tibia had an excellent outcome. All the four patients with A2 type fracture had excellent outcome. Out of the 10 patients with A3 type fracture, nine had excellent outcome and one had a good outcome. Three patients with C1 type fracture had excellent outcome while, two had good outcome. All the ten patients with C2 type fracture had excellent outcome. While, out of the two patients with C3 type fracture, one had a good while the other had an excellent outcome. There was no significant association of Type of fracture and Functional Outcome ( $p=0.651$ ). This suggests that the fracture types A1, A2, A3, C1, C2 and C3 are suitable for fixation with lateral locking plate. Reddy JPK et al<sup>9</sup> hospital based prospective study reported 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 range of motion was 114 degrees. Only 1 patient (3.3%) had final knee flexion of 90 degrees. Most of the proximal tibia fractures united by 12-15 weeks with an average union time of 13.75 weeks.

## CONCLUSION

From this study, we concluded that ORIF with LCP seems to be good implant choice in proximal tibia fractures including difficult fracture situations. Nevertheless, one should be prepared with the armamentarium for revision surgery, should the need arise.

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 12-08-2018; **Accepted:** 04-11-2018; **Published:** 15-11-2018