International Journal of Research in Orthopaedics
Kommuru DV et al. Int J Res Orthop. 2023 Jan;9(1):47-52
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20223438

Original Research Article

Treatment of proximal tibia fractures with locking compression plate: a prospective study

Devendra V. Kommuru, Shikhar Singh, Sunil Shetty, Sachin Kale, Abhilash Srivastava*

Department of Orthopaedics, D. Y. Patil Hospital and Research Centre, Navi Mumbai, Maharashtra, India

Received: 25 August 2022
Revised: 25 October 2022
Accepted: 31 October 2022

***Correspondence:**
Dr. Abhilash Srivastava,
E-mail: charlie.srivastava009@gmail.com

ABSTRACT

Background: With the rise in the incidence of proximal tibia fractures in India due to road traffic accidents, this prospective study was intended to assess the operative procedure in the management of such fractures using the locking compression plate (LCP).
Methods: 30 subjects attending the study site scheduled to undergo the defined surgery were enrolled as per the study selection criteria.
Results: A total of 30 patients with proximal tibia fractures were enrolled. Majority of cases were due to RTAs, with a higher incidence of types IV, V and VI. Average time for union of fracture ranged from around 16-24 weeks. 23 patients were treated with ORIF and 7 patients were treated with MIPO technique. Three different principles of fixation were done using the LCP, viz. compression, bridging and combined. Functional outcome was evaluated, which revealed excellent results in 53.33% patients, good results in 30% patients, fair results in 13.33% results, while 3.33% had poor outcomes.
Conclusions: Based on the findings of the present study we can conclude that overall Locking Compression plate (LCP) for fractures of the proximal tibia is a useful adjunct in the management of trauma patients. The locking compression plate system with its various type of fixation act as a good biological fixation including difficult fracture situations.

Keywords: Tibia fracture, Locking compression plate, Proximal tibia

INTRODUCTION

The knee joint is one of the major weight bearing joints in the lower extremity. The proximal tibial fractures are one of the commonest intra-articular fractures. Generally, these injuries fall into two broad categories, high energy fractures and low energy fractures. The majority of tibial fractures are secondary to high-speed RTA's and fall from height.[1] The fractures results from direct axial compression which are usually with a valgus or varus moment and indirect shear forces.[2] The aim of surgical treatment is to restore congruent articular surfaces of the tibial condyles thus maintaining the mechanical axis and restoring the ligamentous stability.[3] Eventually it will achieve functional painless limb and also good range of motion in the knee joint.[4] The various clinical studies have proved that bone beneath a rigid conventional plate are thin and atropic and are prone for secondary displacement due to insufficient buttressing and secondary fractures after removal of plate. Fracture site takes longer time to osteosynthesis due to interruption of vascular supply to bone because of soft tissue and periosteal stripping. This gave birth to a new concept of biological fixation using the plates, also called as minimally invasive plate osteosynthesis (MIPO). But this was difficult as conventional plates needed to be

accurately contoured to achieve good fixation, and osteoporosis also posed the same problem of poor fixation with conventional plates.[5] This leads to the development of the internal fixators, PC-fix I and later PC fix II. As more and more concepts about biological fixation become clearer the innovation of plates progressed leading to the development of less invasive stabilizing system (LISS). Thus, Research to combine these two methods has lead to the development of the AO locking compression plate (LCP)6 This new system has been regarded to be technically mature. It offers numerous fixation possibilities and has also proven to be worth in complex fracture situations and in osteoporosis.

METHODS

The study was carried out at D.Y. Patil hospital, Nerul, Navi Mumbai for the period of 24 months. The total number of cases studied were 30 with the youngest 18 years and oldest 67 years. The intention of this dissertation was to study treatment of proximal tibial fracture with locking compression plate to obtain a stable, pain free, mobile joint, to prevent the development of osteoarthritis.

Study design, location and duration

Current study was a prospective study conducted at D. Y. Patil hospital, Nerul, Navi Mumbai for a duration of two years from July 2020 to July 2022.

Inclusion and exclusion criteria

Inclusion criteria for current study were; adults (18 years and above), closed fracture and type 1 compound fracture. Exclusion criteria for current study were; type II and III compound fracture and patients with comorbidities.

Procedure

On admission demographic data was recorded and thorough history and clinical examination done. We assessed the soft tissue injuries even in closed fractures followed by radiological assessment of the fracture with Schatzkers classification. As soon as the operation was planned, certain routine procedures like; use of preoperative antibiotics and continued till removal of suture, stabilize patient haemodynamically and physical fitness for surgery was obtained, preoperative planning for selection of plate. Approach MIPO technique or open reduction and internal fixation, in our series, all fractures reduced with traction in fracture table with C-arm guidance, to check for any associated fracture, we treated 7 patients with minimally invasive plate osteosynthesis and 23 patients with open reduction and internal fixation. The approach either was anteromedial parapatellar or anterolateral parapatellar incision. The primary difference with locking compression plate is the method of locking head screw insertion. Here since the locking head of the screw has to get locked in locking part of the combihole. The direction of drilling has to be perfect. Hence drilling for all locking head screws has to be after fixing screw in drill sleeve. We also made sure that whenever using the non-locking regular screw in fixation. They were inserted prior to insertion of the locking screws.

Postoperative

In the immediate postoperative period. Care was given to general condition, fluid balance, IV antibiotic and analgesics as per the protocol. This helped us to mobilize patient faster.

Mobilization

Whenever stable internal fixation was achieved, the patient was mobilized after 48 hrs after removal of drains, for 2-3 days range of motion allowed was 0-20 degrees from 5th day range of motion was gradually allowed to be increased to 90 degrees more after suture removal full range of movement was allowed. Whenever there was doubt about stable fixation. External splinting in the form of plaster of Paris slab was given for support and advised to do static quadriceps exercises. Continue passive motion exercise (CPM) done daily with temporarily removal of slab under carefully supervision and splint reapplied. Partial weight bearing delayed until 6 weeks and full weight bearing allowed after 12-16 weeks.

Follow up

The first follow up usually between 6-8 weeks and later on patients followed up at regular interval of 6-8 weeks till complete fracture union. During follow up, the course of fracture healing documented radiologically with minimum 6 weeks interval. The moment of complete healing defined as radiologically complete bone regeneration at fracture site. Evaluation of any possible loss of reduction. Assessment and analysis of any complication. Follow up of out patients ranged from 16 weeks to 64 weeks.

RESULTS

Most of the patients belonged to 31-50 years of age group, who are more prone for RTA. Most of the patients were male. It reflects the general population which visit our both outpatient as well as the emergency trauma section. The tabular column clearly shows that the major preponderance of proximal tibia fracture is seen in people with a high level of activity and also, who indulge themselves in travelling because majority of the morbidity is due to RTA. Few of them sustain fracture through fall from height when they are climbing up ladder or stool to pick up object from the shelves. In our series, there is slight right sided predominance as compared to the left side. In our series majority of fractures were found to be of type IV, V and VI fracture types which are usually associated with high velocity

road traffic accident. We used MIPO technique in 7 patients both duration of procedure and soft tissue injuries are less compared to ORIF technique.

Table 1: Age wise distribution.

Age (in years)	N	%
18-20	4	13.33
21-30	4	13.33
31-40	8	26.67
41-50	7	23.33
51-60	4	13.33
>60	3	10
Total	30	100

Table 2: Sex wise distribution.

Sex	N	%
Male	23	76.67
Female	7	23.33
Total	30	100

Table 3: Occupation wise distribution.

Occupation	N	%
Agriculturist	8	26.67
Businessman	6	20
House wife	5	16.67
Labourer	7	23.33
Students	4	13.33
Total	30	100

Wound healing was also observed to be better and faster compared to ORIF technique. It demands more surgical techniques and we found as study progressed that the operative time need for MIPO decreased as we matured more in this technique. We used compression type for 6 patients were both rigid fixation and buttress effect were needed. We used bridging type for 10 patients with fracture extending into metaphyseal region and lack of purchase to the screw due to communition in metaphysial region. Combined type was used in 14 patients were articular reconstruction is essential and need protection from collapsing in postoperative period. We preferred anteromedial approach for 16 patients for fractures with medial condylar displacements and MIPO technique of reduction and fixation is essential. This approach needs less soft tissue stripping from bone and can contour plate appropriately. Anterolateral approach was done for 14 patients with lateral condylar displacement fractures and soft tissue injuries on medial side of proximal tibial. We had no cases of any purely implant related complication like screw loosening, screw breakage, or implant failure. Average time for union of fracture ranged from around 16-24 weeks. One patient with knee joint stiffness has been associated with ipsilateral inter condylar fracture of femur. Two patients with knee joint stiffness due to lack of postoperative mobilization. Two patients with knee instability due to associated anterior cruciate ligament injury. One patient developed deep infection of operative site. The plate was removed and treated with antibiotic and above knee pop cast applied later, fracture united at 24 weeks.

Table 4: Laterality of fracture.

Laterality of fracture	N	%
Right	17	56.67
Left	13	43.33
Total	30	100

Table 5: Type of fracture.

Type of fracture	N	%
I. Pure cleavage	6	20
II. Cleavage with depression	0	0
III. Central depression	0	0
IV. Medial Condyle fracture	8	26.67
V. Bicondylar fracture	7	23.33
VI. Metaphysio diaphyseal dissociation	9	30
Total	30	100

Table 6: Method of reduction.

Method of reduction	N	%
MIPO	7	23.33
ORIF	23	76.67
Total	30	100

Table 7: Principle of fixation.

Principle	N	%
Compression	6	20
Bridging	10	33.33
Combined	14	46.67
Total	30	100

Figure 1: Case 1-pre operative and post operative X-rays.

One patient developed varus deformity due to postoperative collapse of medial condyle. In one patient medial condyle collapse occurred in post operative period

due to toggling of cancellous screw applied to condyles. We studied 30 patients with 30 proximal tibial fractures who were treated with locking compression plate (buttress type). Grading of results was based on paarameters like; Clinical ssymptoms: pain/swelling stiffness, disfigurement and walking capacity. Clinical signs like: tenderness, deformity range of motion, shortening and stability. Clinical radiology signs: presence/absence of callus and ligament of fracture angulation.

Table 8: Approach to fractures.

Side	N	%
Anteromedial	16	53.33
Anterolateral	14	46.67
Total	30	100

Table 9: Complications of fractures.

Complications	N
Knee joint stiffness	3
Post operative loss	1
Infection	1
Varus deformity	1
Knee instability	2
Total	8

Figure 2: Case 2-pre operative and post operative X-rays.

Criteria for evaluation of results of pain

No pain-6, occasional pain-5, Stabbing pain in certain position, moderate pain-4, Severe pain-2, constant pain around knee after activity, night pain, at rest-0. Walking capacity: normal walking capacity in relation to age-6, walking capacity out doors for atleast one hour-4, walking capacity out door >15 minutes-2, walking capacity- walking indoor only-1, wheel chair bound/bed ridden-0. Extension of leg (extensor lag): normal extension-6, lack of extension (0-10 degrees)-4, lack of extension (>10 degrees)-2, range of motion: at least 135 degrees-6, at least 120 degrees-5, at least 90 degrees-4, at least 60 degrees-2, at least 30 degrees-1, 0 degrees-0. Stability: normal in extension and 20-degree flexion-6, abnormal in 20-degree flexion-5, unstable in extension (>10 degree)-4 and unstable in extension (>10 degree)-2. Excellent results-total minimum of 27 points, good results-total minimum of 20 points, fair results-total minimum of 10 points, poor results-total minimum of 06 points.

Clinical results

Out of 30 cases treated, 16 cases gave excellent result, 9 cases came out with good result, fair in 4 cases, and 01 case of poor results.

Figure 3: Complete ROM in 2 months.

DISCUSSION

Proximal tibial fractures are one of the commonest intra articular fractures. The incidence of this fractures are increasing regularly due to RTA.[7] At the same time the surgical treatment options for the same are also being modified continuously. Any fracture around the weight bearing joint like knee joint is of paramount importance as it would result in significant morbidity and quality of life. Hence it has become a challenge for the orthopaedic surgeons to treat the proximal tibial fractures. The innovators thus developed new technologies called MIPO and locking compression plate system to overcome these difficulties and for early restoration of strength of bone and function of knee joint with minimal injury to soft tissue.[8] Keeping our aims of the study at high, we presented the clinical study of surgical treatment of 30 proximal tibial fractures. We analysed the results in terms of age of patients, sex distribution. Also, the Occupation of patient, laterality of fracture, mode of violence, analysis of the types, method of reduction and fixation, principle of LCP fixation, surgical approach and complications were analysed. The majority of fracture occur between the age of 18-67 yrs with maximum incidence being involving the productive age group 31-50 yrs (50%). In our series majority of the patients were males around 80%, this can be attributed to our Indian setup whereas the female population largely work indoor and do not travel much. Proximal tibial fractures were seen in people with high level of activity, movement and travel occupationally. Most commonly seen with people who travel more like businessmen, agriculturist. In our series majority were agriculturists 26.67% followed by labourer 23.33%. Businessman 20.00%, housewife 16.67% and students 13.33% respectively. In our study

the commonest mode of injury was the road traffic accident, other being fall from height.

The right tibia was affected in 57% and the left tibia was affected in 43% of cases. Thus, there was not much difference in the laterality of the fracture. In this series we studied 30 cases of out of them most of the patients fall into type IV, type V and type VI schatzkers classification. Different criteria are being used by different authors for the surgical management of these fractures. Honkonen et al conducted 130 tibial plateau fractures taking into consideration of condylar widening of >5 mm, lateral condyle step off >3 mm, all medial condylar fracture. In our series the indications for surgery were the same standard indications as for the tibial plateau fractures. 3 mm depression was considered as a indication for surgery in our series.[9] In our series we used MIPO technique for reduction and fixation in 7 patients 23.33%. In which both duration of procedure and soft tissue injuries were less compared to ORIF technique, wound healing also better and faster compared to ORIF technique but it demands more surgical techniques. In our series we used combined principle of fixation in 14 patients 46.67% and achieved good articular reconstruction and protection from collapse during post operative period. We used bridging type of principle of fixation in 10 patients 33.33% in metaphyseal comminution fractures and osteoporotic patient where bone graft was needed, we have not done bone graft in these patients as LCP implant system provide good fixation and prevent collapse of fracture during postoperative period. We used compression type principle of fixation in 6 patients 20.00% were both rigid fixation and buttress effect were needed, but postoperatively due to toggling of condylar screws (non locking screws) there was an collapse of condyle in two patients. In our series we approached with anteromedial incision in 16 patients this approach needs less soft tissue stripping from bone can contour plate to bone appropriately and easy to perform MIPPO technique and we preferred antero-lateral approach in 14 patients with lateral condylar displacement fracture and soft tissue injury on medial side of proximal tibia. In our series we had no cases of any purely implant related complications and average time for union of fracture was around 16-24 weeks. In our series three patients developed knee stiffness. One developed due to associated ipsilateral fracture of femoral condyle and the other two developed knee joint stiffness due to lack of postoperative mobilization. They were treated with physiotherapy and thus regained considerable range of motion. In our series one patient developed deep infection by 7th postoperative day secondary to uncontrolled diabetes and skin infection in the thigh region. He was then treated with IV antibiotics (ceftriaxone and amikacin), implant removal and above knee pop cast application. Subsequently infection was controlled and fracture union occurred at end of 24 weeks postoperatively. In our series one patient developed loss of reduction with collapse of medial condyle at end of eight eeks of postoperative period. It was treated with above knee pop cast for 12 weeks subsequently fracture united with minimal depression of medial condyle. Another patient developed varus deformity due to collapse of medial condyle at 9 weeks of postoperative period due to early weight bearing. He was treated with application of above knee pop cast for 2 weeks and was advised to wear knee brace while walking. In our series two patients had associated anterior cruciate ligament injury. They were treated with above knee pop cast till fracture unite and to wear knee support while walking and to undergo ACL repair in subsequent days. The period of immobilization was again individualized depending on security of stable fixation. The benefits of early knee motion include reduction of knee stiffness and improved cartilage healing (regeneration) with promotion of good callus formation and remodeling.[9] Inspite of all these complications we were able to achieve 53.33% excellent result and 30% good result (over all 83.33%, acceptable results) with our standard surgical care. In addition, we have 13.33% fair and 3.33% poor results in term of functional outcome. These results are comparable and on par with other documented standard studies.[10] Current study was limited to 30 patients.

CONCLUSION

From the conducted study, we are convinced that open reduction and internal fixation with LCP is an excellent technique for treatment of proximal tibia fractures. We recommend this modality of treatment for the same. We conclude that the locking compression plate system with its various type of fixation act as a good biological fixation including difficult fracture situations. But this also involves the risk that may occur unless properly planned preoperatively and follow guided principles intraoperatively.

Recommendations

We thus recommend the following guidelines to achieve excellent results; there should not be an undue delay in treating these fractures, from the time of injury. For pre-operative planning, CT scan with 3D reconstruction of proximal tibia would be of great help. Open reduction is preferred and should be performed after a thorough study of the fracture geometry and planning of the reduction technique. During open reduction and internal fixation, sound surgical principles should be followed. Faster rehabilitation is produced by early mobilization. Supervised physiotherapy program is important to achieve better function. Post operative physiotherapy is also important. Further study on the subject to be conducted with large sample size along with comparison to other standard methods for treatment of such injuries.

ACKNOWLEDGEMENTS

Authors are thankful to Dr. Sanjay Dhar and Dr. Prakash Samant for guidance and motivation. Authors are also

thankful to Dr. Prasad Chaudhari, Dr. Shikhar Singh, Dr. Aditya Gunjotikar, Dr. Arvind Vatkar, Dr. Sachin Kale, Dr. Rajendra Butala, Dr. Bhushan Patil, Dr. Tushar Singhi, Dr.Sachin Gujrathi and Dr.Gaurav Kanade, Dr. Ravindra Khedekar, Dr. Sunil Shetty, Dr. Amit Dhond, Dr. Atul Kharat and Dr. Ajit Chalak for their advice and support at every stage of study. Authors would also like to thank all the subjects who participated in the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Schulak DJ, Gunn DR. Fracture of the tibial plateaus. Clin Orthop. 1975;109:166-77.
2. Koval KJ, Hulfut DL. Tibial plateau fracture: evaluation and treatment. J Am Acad Orthop Surg. 1995;3(2):86-94.
3. Biyani A, Reddy NS, Chaudhary. The results of surgical management of displaced tibial plateau fracture in the elderly. Injury. 1995;26(5):291-7.
4. Wagner M. General principles for the clinical use of the LCP. Injury. 2003;34(2):B31-42.
5. Sommer C, Gautier E, Muller M. For clinical application of the LCP. Injury. 2003;34(2):B43-54.
6. Stoffel K, Dietaru. Biomechanical testing of the LCP how can stability in locked internal fixator be controlled. Injury. 2003;34(2):B11-9.
7. Koval KJ, Hulfut DL. Tibial plateau fracture: evaluation and treatment. J Am Acad Orthop Surg. 1995;3(2):86-94.
8. Muller M. For clinical application of the LCP. Injury. 2003;34(2):B43-54.
9. Moore TM, Harvey JP. Roentgenographic measurement of tibial plateau depression due to fracture. J Bone Joint Surg. 1974;56(2):155.
10. Bowes DN, Hohl M. Tibial condylar fractures evaluation of treatment and outcome. Clin Orthop. 1982;171:105-8.

Cite this article as: Kommuru DV, Singh S, Shetty S, Kale S, Srivastava A. Treatment of proximal tibia fractures with locking compression plate: a prospective study. Int J Res Orthop 2023;9:47-52.