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Functional outcome of displaced proximal tibia fracture treated with plate osteosynthesis

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Abstract
Introduction: Fractures of tibial plateau disrupts knee alignment, stability and motion. Incidence of proximal tibia fractures is increasing due to increasing incidence of road traffic accidents. The recent development of locking compression plate (LCP) has revolutionized the treatment of proximal tibia fractures by overcoming the drawbacks of conventional buttress plate. The aim of the study is to evaluate the functional outcome of proximal tibial fractures fixed with locking compression plate.
Materials and Methods: This retrospective study is of 30 patients involving proximal tibia fracture managed using LCP [20 patients with minimally invasive percutaneous plate osteo-synthesis, (MIPPO) technique and 10 patients with Open reduction and internal fixation (ORIF) technique]. We followed up all the patients until complete union of fractures & desirable functional outcome. (Figure no 4, 5 & 6)
Results: The average time for union of fracture was 16 weeks (range: 12-24 weeks). Overall, 80% patients had acceptable functional outcome. Patients treated with MIPPO technique healed earlier and more frequently had excellent results than those treated with ORIF.
Conclusion: Locking compression plate system acts as a good biological fixation for proximal tibia fractures even in difficult fracture situations. MIPPO technique offers short duration of procedure, less blood loss, less soft tissue injury and wound healing was better and faster healing, and better clinical outcome than ORIF in patients with proximal tibia fracture.

Keywords: Tibia plateau, osteosynthesis, locking compression plate (LCP), ORIF, MIPPO

Introduction
The knee joint is a complicated synovial joint that regulates the centre of body mass and posture, and it requires a wide range of motion in three dimensions as well as the ability to withstand considerable stress. It's needed for daily activities including standing, walking, and stair climbing, as well as running, leaping, kicking, and changing directions [1].
For both range of motion and stability, the interplay of the articular surfaces, passive stabilisers, and muscles that traverse the joint is vital [2]. The majority of proximal tibia fractures (Fig. no. 1) are produced by articular extension and can happen as a result of high-speed accidents or falls from great heights, respectively, when fractures are generated by indirect shear forces and direct axial compression [3].
The main goals of surgical therapy for proximal tibial fractures are to restore articular congruity and mechanical axis to and re-establish ligamentous stability; all of these can lead to a fully functional, pain-free knee with a fair range of motion [4]. The process of repairing a bone is known as osteosynthesis. It is a surgical procedure in which bone pieces are fused together by screws, plates, nails, or wires to repair bone fractures [5].
Osteosynthesis is best suited for open bone fractures with concomitant skin or soft tissue injury. It is also the preferred method of treatment for bone fractures with multiple fragments, leg fractures, and osteoporosis-related bone fractures [6].
Plate osteosynthesis is a surgical procedure that uses a plate to repair broken bone fragments. The broken bone is exposed and a suitable plate is screwed over the fracture line by the surgeon. This is secured to all of the fragments with bone screws. During the process, the broken parts are securely connected to one another.

Open reduction and internal fixation (ORIF) techniques allow for the restoration of joint congruency. Other treatment options are plate fixation using a minimally invasive technique (MIPPO). The development of locking compression plates has enabled the use of the MIPPO technique for single column tibial plateau fractures, with improved soft tissue healing.

Appropriate management of fracture will be of paramount importance in maintaining mobility. The aim of the study is to evaluate the functional outcome of proximal tibial fractures fixed with locking compression plate.

Materials and Methods

We retrospectively studied 30 patients involving proximal tibia fracture managed using LCP 20 patients with minimally invasive plate osteosynthesis, (MIPPO) technique and 10 patients with Open reduction and internal fixation (ORIF) technique.

Total 30 patients were involved in this study with inclusion criteria of age more than 18 years and patients having closed intra articular and extra articular fractures of proximal tibia. Patients which were excluded was age less than 18 years, open fractures (any grade) and pathological fractures.

Patient placed in supine and under Spinal anaesthesia, and Pneumatic tourniquet was applied after exsanguinations and time noted. Painting and draping was 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 in situ.

Postoperatively, the patients were mobilized after removal of drains, for 2-5 days 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 or more.

After suture removal on 12-14th 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.

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. (Fig. no 2) 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. (Fig. no.3)

Results

In our study a total of 30 patients with proximal tibial fracture were studied after meeting the inclusion criteria.

In our study majority of the patients around 66% belonged to the 20 to 40 years age group followed by 20% in more than 40 years age group. A total of 14% were belonged to the age group of less than 20 years.

Fractures were classified based on Schatzker's Classification [7]. Type VI tibial fracture was the most common fracture seen in 23.33% of the cases. Followed by Type IV and Type I fracture which were seen in 20% of the cases each. Type V Fracture was seen in 16.67%, Type II fracture was seen in 13.33% of the cases and Type III fracture was seen in 6.67%.

In 67% of the cases minimally invasive percutaneous plate osteosynthesis (MIPPO) technique was used which in terms of duration of procedure and soft tissue injuries were less compared to ORIF. Wound healing with MIPPO was also better and faster. In 90% of the cases open reduction and internal fixation (ORIF) technique was used.

The average time for proximal tibia fracture union was 16 weeks (range from 12-24 weeks). In majority of the cases, around 33.33% had union of proximal tibia fracture by 16th weeks, 30% had fracture union by 18th week. 10% had fracture union by 20th and 22nd week, 6.67% had fracture union by 14th and 24th week and 3.33% had fracture union by 12th week. (Acc. To table 1)

Infection occurred in 7% of cases at the post-operative site. As a result, the plate was removed, the patient was given intravenous antibiotics, and an above-knee pop cast was applied. At 26 weeks, the fracture was eventually united. Approximately 20% of the cases developed knee joint stiffness. (Acc. To table 2)

Out of 30 Cases, according to Ramussen score 66% had an excellent functional outcome, 14% had good functional outcome, 16.67 had fair functional outcome and 3.33% had poor functional outcome. (Acc. To table 3)

Discussion

Tibial plateau fractures are one of the commonest intra articular fractures that usually occur as a result of road traffic accident, fall from height, violence etc. For many years, treating proximal tibial fractures has been the subject of much controversy regarding both the indications for surgical intervention and the specific type of intervention to be employed. Especially in intra-articular fractures, inadequate treatment may result in joint instability and deformity coupled with a restricted range of motion [8, 9].

Open reduction and rigid internal fixation, according to the principles of Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF), has been the treatment of choice for decades. This treatment modality has yielded satisfactory short- and long-term results in many series. Recently, locking plates, or internal fixators, have been designed to allow for less plate to bone contact without compromising stability.

The screw holes are modified to allow the screw to "lock" into the plate, thus converting a plate/screw construction into a fixed-angle device with multiple points of fixation [10].

This design allows for minimal vascular damage to the periosteum.

Moreover, locking plates can be particularly effective in treating osteoporotic bones [11]. In our study, we have used Schatzker classification [7] for the proximal tibial plateau fractures type I to VI with the incidence of type-I (20%), type-II (13.33%), type-III (6.67%), type-IV (20%), type - V (16.67%) and type-VI (23.33%).

In Girish H V and co-workers' study [12], Schatzker type I and II dominated the total fractures making 50%, with type V and VI having 18.8% and 12.5% involvement, respectively. Similarly, Rademakers *et al.* [13] reported that 64% of patients sustained a lateral condyle fracture (Schatzker type I and II). In MRI analysis of 103 patients, Gardner *et al.* [14] reported that the most frequent fracture pattern was a lateral plateau split-depression (Schatzker type II).

Barei *et al.* [15] showed that the average time interval from injury to definitive surgical treatment was nine days. Manidakis *et al.* [16] showed that the average time interval from injury to definitive surgical treatment was three days.

In our study, the average duration from injury to operation was five days. This means that a number of patients had to stay longer before the definitive procedure for:

1. General condition stabilisation.
2. Oedema to resolve.
3. Treatment of compartment syndromes.
4. Open wounds to heal.

In our study of proximal tibia plateau fracture, mean union time was 16 weeks which is comparable to Manidakis *et al.* [16] which showed that average time of union was 13 weeks and Jain *et al.* [17] which showed a series of 34 cases having mean union time of 17.6 weeks.

The most frequently used approach was lateral approach with incidence of 67.92% and the most frequently used implant was lateral anatomical plate (proximal tibial locking plate) which was used in 62.26% of the patients with or without cannulated cancellous screw.

In the series by, Pasa *et al.* [18] out of 114 patients with proximal tibial fractures he fixed the fracture with cannulated cancellous screw and washer in 25, and a buttress plate in 27 patients. In the series by Vasanad *et al.* [12] showed that 46.8% of the patients needed ORIF with buttress plate along with cannulated cancellous screw.

In our study, we achieved 66% excellent result and 14% good result with our standard surgical care using periarticular proximal tibia plating and allowing mobilisation of the knee. Vasanad *et al.* [12] had 44% excellent result and 44% good results (overall 88% acceptable results) (Table No.3).

Kugelman *et al.* [19] showed in their study that out of 279 tibial plateau fractures 10 patients (3.6%) sustained a deep infection. Six patients (2.2%) developed a superficial infection. One patient (0.4%) presented with early implant failure. Two patients (0.7%) developed a fracture non-union.

Eight patients (2.9%) developed a venous thromboembolism. Seventeen patients (6.2%) went on to re operation for symptomatic implant removal. Nine patients (3.3%) underwent a lysis of adhesions procedure.

Vasanad *et al.* [12] also showed knee stiffness in three patients, mal-union in two patients, infection and wound dehiscence in three patients, extensor lag in one patient and loss of reduction in one patient. Our study also showed superficial infection in (7%) patients which were controlled by antibiotics and dressing. Knee stiffness was developed in (20%) of patients.

Table 1: Time of union

Duration in weeks	No. of patients	Results
12	1	3.33%
14	2	6.67%
16	10	33.33%
18	9	30%
20	3	10%
22	3	10%
24	2	6.67%

Table 2: Complications

Complications	No. of patients	Results
None	22	73%
Knee stiffness	6	20%
Implant failure	0	0%
Non union	0	0%
Infections	2	7%
Total	30	100%

Table 3: Functional outcome and Ramussen score

Clinical results	No. of patients	Results
Excellent	20	66%
Good	4	14%
Fair	5	16.67%
Poor	1	3.33%
Total	30	100%

Fig 1: Pre op Xray

Fig 2: 6 Weeks follow op

Fig 3: 6 month follow up

Fig 4: Flexion

Fig 5: Extension

Fig 6: Crossed leg sitting

Conclusion

Locking compression plate system acts as a good biological fixation for proximal tibia fractures even in complex fracture situations. MIPPO technique offers short duration of procedure, less blood loss, less soft tissue injury excellent, early wound healing and faster and better functional outcome than ORIF in patients with proximal tibia fracture. However, MIPPO demands more learning curve.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Bedi A, Le TT, Karunakar MA. Surgical treatment of nonarticular distal tibia fractures. Journal of the American Academy of Orthopaedic Surgeons. 2006 Jul 1;14(7):406-16.
2. Himanshu H, Prasad MB, Verma AK. Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) A Technique for Treatment of Distal Tibia Fractures. International Journal of Current Microbiology and Applied Sciences. 2016 Dec;15(12):31-38.
3. Collinge C, Kuper M, *et al*. Minimally invasive plating of high-energy metaphyseal distal tibia fractures. Journal of Orthopaedic Trauma. 2007;21:355-361.
4. Paluvadi SV, *et al*. Management of fracture of the distal third tibia by minimally invasive plate osteosynthesis: A prospective series of 50 patients. Journal of Clinical Orthopaedics and Trauma. 2014;5:129-136.
5. Dhakar A, *et al*. Minimally invasive plate osteosynthesis with locking plates for distal tibia fractures. Journal of Clinical and Diagnostic Research. 2016 Mar;10(3):RC01-RC04.
6. Ali SKI, *et al*. Evaluation of the functional outcome in distal tibia fractures managed by MIPPO technique using distal tibia locking plate. Indian Journal of Orthopaedic Surgery. 2017;3(2):441-444.
7. Campbell's Operative Orthopaedics 14th edition, Fracture patterns as classified by Schatzker, Chapter no 54, Page no 2861.
8. Yu B, Han K, Ma H, Zhang C, Su J, Zhao J, *et al*. Treatment of tibial plateau fractures with high strength injectable calcium sulphate. International Orthopaedics. 2009;33(4):1127-1133.
9. Stevens DG, Beharry R, McKee MD, Waddell JP, Schemitsch EH. The long-term functional outcome of operatively treated tibial plateau fractures. Journal of Orthopaedic Trauma. 2001;15(5):312-320.
10. Greiwe RM, Archdeacon MT. Locking plate technology: current concepts. Journal of Knee Surgery. 2007;20(1):50-55.
11. Fulkerson E, Egol KA, Kubiak EN, Liporace F, Kummer FJ, Koval KJ. Fixation of diaphyseal fractures with a segmental defect: a biomechanical comparison of locked and conventional plating techniques. Journal of Trauma. 2006;60(4):830-5.
12. Vasanad GH, Antin SM, Akkimaradi RC, Policepatil P, Naikawadi G. Surgical management of tibial plateau fractures: A clinical study. Journal of Clinical and Diagnostic Research. 2013;7(12):3128-30.
13. Rademakers MV, Kerkhoffs GM, Sierevelt IN, Raaymakers EL, Marti RK. Operative treatment of 109 tibial plateau fractures: Five-to 27-year follow-up results. Journal of Orthopaedic Trauma. 2007;21(1):05-10.
14. Gardner MJ, Yacoubian S, Geller D, Suk M, Mintz D, Potter H, *et al*. The incidence of soft tissue injury in operative tibial plateau fractures: a magnetic resonance imaging analysis of 103 patients. Journal of Orthopaedic Trauma. 2005;19(2):79-84.
15. Barei DP, Nork SE, Mills WJ, Coles CP, Henley MB, Benirschke SK. Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incisions and medial and lateral plates. Journal of Bone and Joint Surgery. 2006;88(8):1713-21.
16. Manidakis N, Dosani A, Dimitriou R, Stengel D, Matthews S, Giannoudis P. Tibial plateau fractures: functional outcome and incidence of osteoarthritis in 125 cases. International Orthopaedics. 2010;34(4):565-70.
17. Jain D, Selhi H, Mahindra P, Kohli S, Yamin M. Results of proximal tibial fractures managed with periarticular locking plates: A series of 34 cases. Indian Journal of Research Reports in Medical Sciences. 2012.
18. Pasa L, Kelbl M, Suchomel R, Procházka V, Filipínský J. Výsledky léčby niktrokloubních zlomenin proximální tibie v UN Brno v letech 1997 az 1999: hodnocení po 5-7 letech od terapie [Treatment of intra-articular proximal tibial evaluation of two- to seven-year follow-up]. Acta Chirurgiae Orthopaedicae et Traumatologiae Čechoslovaca. 2007;74(5):336-41.
19. Kugelman D, Qatu A, Haglin J, Leucht P, Konda S, Egol K. Complications and unplanned outcomes following operative treatment of tibial plateau fractures. Injury. 2017;48(10):2221-9.

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