ORIGINAL RESEARCH

To manage a proximal tibia fracture with a locking compression plate

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ABSTRACT

Aim: To manage a proximal tibia fracture with a locking compression plate. **Material and methods:** The total number of cases studied were 70 with the youngest 18 years and oldest 67 years. The intention of this dissertation was to study treatment of proximal tibial fracturewithlockingcompressionplatetoobtainastable, pain free, mobile joint, to prevent the development of osteoarthritis.Inclusion criteria for current study were; adults (18 years and above), closed fracture and type 1 compoundfracture. Exclusion criteria for current study were; type II and III compound fracture and patients with comorbidities. **Results:** Postoperative care protocols were uniform across both groups, with mobilization starting 48 hours post-surgery. The initial range of motion (ROM) was restricted to 0-20 degrees for the first 2-3 days, and by the 5th day, ROM was increased to 90 degrees. Full ROM was allowed after suture removal. External splinting was provided as needed, and continuous passive motion (CPM) exercises were performed daily. This standardized approach to postoperative care and mobilization facilitated early recovery and minimized complications.Radiological healing times averaged 12 weeks for the MIPO group and 14 weeks for the ORIF group, with an overall mean of 13 weeks. The study observed 4 cases of infection (1 in MIPO and 3 in ORIF), 2 cases of loss of reduction (all in ORIF), and 7 other complications (2 in MIPO and 5 in ORIF). The higher incidence of complications in the ORIF group suggests that this technique may carry a slightly higher risk profile compared to MIPO. However, both techniques showed effective fracture healing within a similar timeframe, highlighting their efficacy in treating proximal tibial fractures. **Conclusion:** The study demonstrated that both MIPO and ORIF techniques are effective in treating proximal tibial fractures, with comparable demographic and fracture classifications. Postoperative care and mobilization protocols were standardized across all patients, facilitating early recovery. Weight-bearing and follow-up schedules ensured consistent monitoring and early detection of complications.

Keywords: Tibia fracture, Locking compression plate, Proximal tibia

INTRODUCTION

Proximal tibia fractures present a significant challenge in orthopedic trauma due to the complex anatomy of the knee joint and the functional demands placed on it. These fractures commonly result from high-energy trauma in younger individuals and low-energy falls in the elderly. The primary goals in managing proximal tibial fractures are to restore the articular surface, achieve stable fixation, and facilitate early mobilization to prevent long-term complications such as osteoarthritis and knee stiffness.[1]Locking compression plates (LCPs) have become a preferred method for the surgical management of proximal tibial fractures due to their biomechanical advantages and ability to provide stable fixation in both osteoporotic and comminuted fractures. LCPs combine the principles of conventional plating with locked screw technology, creating fixed-angle constructs that enhance stability, particularly in metaphyseal and periarticular regions.[2,3]The use of LCPs also enables the application of minimally invasive surgical techniques, such as minimally invasive plate osteosynthesis (MIPO), which are associated with reduced soft tissue damage, lower infection rates, and faster recovery times compared to traditional open reduction and internal fixation (ORIF) methods. MIPO involves the percutaneous insertion of plates, preserving blood supply to the fracture fragments and promoting biological healing. This approach has shown promising results in terms of functional outcomes and patient satisfaction.[4,5]The effectiveness of LCPs in managing proximal tibial fractures has been demonstrated through high rates of fracture union and low complication rates in both high-energy and low-energy fractures. Patients treated with LCPs typically experience satisfactory clinical

outcomes, with many regaining pre-injury levels of activity and function.[6,7]Despite these advantages, the choice of surgical approach and the management of associated soft tissue injuries remain critical factors influencing the outcome of proximal tibial fracture treatment. The decision between MIPO and ORIF techniques often depends on the fracture pattern, soft tissue condition, and surgeon experience. Understanding the indications, benefits, and potential complications associated with each technique is essential for optimizing patient outcomes.[8]

MATERIAL AND METHODS

The total number of cases studied were 70 with the youngest 18 years and oldest 67 years. The intention of this dissertation was to study treatment of proximal tibial fracturewithlockingcompressionplatetoobtainastable, pain free, mobile joint, to prevent the development of osteoarthritis.

Inclusion and exclusion criteria

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

Methodology

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 planningfor 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 20 patients with minimally invasive plate osteosynthesis and 50 patients with open reduction and internal fixation. The approach either was anteromedial parapatellar or anterolateralparapatellarincision.Theprimarydifferenc e with locking compression plate is the method of locking headscrewinsertion.Heresincethelockingheadofthescre w 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 infixation. Theywereinserted 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 patientwasmobilizedafter48hrsafterremovalofdrains, for 2-3 days range of motion allowed was 0-20 degrees from 5th day range of motion was gradually allowed tobe 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 passivemotion 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.

Followup

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

Table 1: Demographic Data and Fracture Classification

The study included 70 patients, with a mean age of 37 years. The MIPO group had a mean age of 35 years, while the ORIF group had a mean age of 38 years. Gender distribution showed a higher number of males (42) compared to females (28). Fractures were classified using Schatzker's classification, with Type III fractures being the most common (18 cases), followed by Type II (16 cases), and Type V (11 cases). The distribution of fracture types was similar between the MIPO and ORIF groups, indicating a comparable range of fracture severity in both groups.

Table 2: Surgical Approach and Techniques

In terms of surgical approach, 30 patients underwent an anteromedial parapatellar incision, and 40 had an anterolateral parapatellar incision. Both surgical techniques, MIPO and ORIF, involved the insertion of locking head screws and non-locking screws. All 70 cases had both types of screws inserted to ensure proper fixation of the locking compression plates. The distribution of incision types and the consistent use of locking and non-locking screws across all cases

reflect the standardized surgical approach employed in the study.

Table 3: Postoperative Care and Mobilization

Postoperative care protocols were uniform across both groups, with mobilization starting 48 hours post-surgery. The initial range of motion (ROM) was restricted to 0-20 degrees for the first 2-3 days, and by the 5th day, ROM was increased to 90 degrees. Full ROM was allowed after suture removal. External splinting was provided as needed, and continuous passive motion (CPM) exercises were performed daily. This standardized approach to postoperative care and mobilization facilitated early recovery and minimized complications.

Table 4: Weight Bearing and Follow-up

Partial weight-bearing was delayed until 6 weeks post-surgery for all patients, and full weight-bearing was permitted between 12-16 weeks. Follow-up visits were scheduled at 6-8 week intervals, with the follow-up duration ranging from 16 to 64 weeks. These consistent follow-up intervals allowed for regular monitoring of fracture healing and early detection of any complications. The structured weight-bearing and follow-up protocols ensured that all patients received comparable post-surgical care and monitoring.

Table 5: Fracture Healing and Complications

Radiological healing times averaged 12 weeks for the MIPO group and 14 weeks for the ORIF group, with an overall mean of 13 weeks. The study observed 4 cases of infection (1 in MIPO and 3 in ORIF), 2 cases of loss of reduction (all in ORIF), and 7 other complications (2 in MIPO and 5 in ORIF). The higher incidence of complications in the ORIF group suggests that this technique may carry a slightly higher risk profile compared to MIPO. However, both techniques showed effective fracture healing within a similar timeframe, highlighting their efficacy in treating proximal tibial fractures.

Table 1: Demographic Data and Fracture Classification

Parameter	MIPO Group (n=20)	ORIF Group (n=50)	Total (n=70)
Mean Age (years)	35	38	37
Gender Distribution (M/F)	12/8	30/20	42/28
Schatzker Classification			
Type I	3	5	8
Type II	4	12	16
Type III	5	13	18
Type IV	2	6	8
Type V	3	8	11
Type VI	3	6	9

Table 2: Surgical Approach and Techniques

Parameter	MIPO Group (n=20)	ORIF Group (n=50)	Total (n=70)
Surgical Incision Approach			
Anteromedial Parapatellar Incision	8	22	30
Anterolateral Parapatellar Incision	12	28	40
Locking Compression Plate			
Locking Head Screw Insertion	20	50	70
Non-Locking Screw Insertion	20	50	70

Table 3: Postoperative Care and Mobilization

Parameter	MIPO Group (n=20)	ORIF Group (n=50)	Total (n=70)
Mobilization Start (hours)	48	48	48
Initial ROM (0-20 degrees)	2-3 days	2-3 days	2-3 days
ROM Increase (90 degrees)	5th day	5th day	5th day
Full ROM Allowed	After suture removal	After suture removal	After suture removal
External Splinting	As needed	As needed	As needed
CPM Exercises	Daily	Daily	Daily

Table 4: Weight Bearing and Follow-up

Parameter	MIPO Group (n=20)	ORIF Group (n=50)	Total (n=70)
Partial Weight Bearing	6 weeks	6 weeks	6 weeks
Full Weight Bearing	12-16 weeks	12-16 weeks	12-16 weeks
Follow-up Intervals (weeks)	6-8 weeks	6-8 weeks	6-8 weeks
Follow-up Duration (weeks)	16-64	16-64	16-64

Table 5: Fracture Healing and Complications

Parameter	MIPO Group (n=20)	ORIF Group (n=50)	Total (n=70)
Complete Fracture Healing			
Radiological Healing (weeks)	12	14	13
Complications			
Infection	1	3	4
Loss of Reduction	0	2	2
Other Complications	2	5	7

DISCUSSION

In this study, the mean age of the patients was 37 years, with the MIPO group averaging 35 years and the ORIF group 38 years. This age distribution is consistent with other studies such as Koval et al. (1995) and Tscherne and Lobenhoffer (1993), which reported that tibial plateau fractures are common in adults aged between 30 and 50 years. The gender distribution in our study (42 males and 28 females) also aligns with previous research indicating a higher incidence of tibial fractures in males due to higher exposure to trauma-related activities.[9,10]The Schatzker classification in our study revealed a predominance of Type III fractures (26%), followed by Type II (23%) and Type V (16%). This is in agreement with the findings of Ali et al. (2007), who reported similar distributions of fracture types in a large cohort of tibial plateau fractures. This classification system remains crucial for determining treatment approaches and predicting outcomes.[11,12]In our study, the surgical approach involved either anteromedial or anterolateral parapatellar incisions, with 40 cases using the anterolateral approach. Previous studies, such as the one by Gosling et al. (2005), have demonstrated the efficacy of the anterolateral approach in providing better access and visualization of the fracture site, which is critical for proper fixation.[13] The use of locking compression plates with both locking and non-locking screw insertions was consistent across all cases. This method has been shown to enhance the stability of the fixation, as supported by the biomechanical study by Lobenhoffer et al. (2004).[14]Postoperative care in our study was standardized, with mobilization starting 48 hours post-surgery and initial ROM restricted to 0-20 degrees for the first 2-3 days. This protocol is in line with the accelerated rehabilitation programs advocated by Egol et al. (2004), which emphasize early mobilization to prevent stiffness and improve functional outcomes.[15] Continuous passive motion (CPM) exercises were performed daily, aligning with the findings of McNamara et al. (1996), who reported that CPM can help maintain joint mobility and reduce postoperative complications.[16]Our weight-bearing protocol, which delayed partial weight-bearing until 6 weeks and full weight-bearing until 12-16 weeks, reflects the recommendations by Rademakers et al. (2007), who emphasized the importance of gradual weight-bearing to prevent displacement and ensure proper healing . Regular follow-up intervals of 6-8 weeks allowed for continuous monitoring of the healing process, consistent with the follow-up schedules recommended in previous studies.[17]Radiological healing times averaged 12 weeks for the MIPO group and 14 weeks for the ORIF group, with an overall mean of 13 weeks. These healing times are comparable to those reported by Higgins et al. (2009), who found that most tibial plateau fractures heal within 12-16 weeks when appropriately managed.[18]The incidence of complications was slightly higher in the ORIF group, with 3 infections and 2 cases of loss of reduction, compared to 1 infection in the MIPO group. This is consistent with the findings of Krupp et al. (2009), who noted a higher complication rate associated with more invasive surgical techniques like ORIF.[19] The overall complication rate, including infections and other issues, was within the expected range based on prior research by Mallik et al. (2003).[20]

CONCLUSION

The study demonstrated that both MIPO and ORIF techniques are effective in treating proximal tibial fractures, with comparable demographic and fracture classifications. Postoperative care and mobilization protocols were standardized across all patients, facilitating early recovery. Weight-bearing and follow-up schedules ensured consistent monitoring and early detection of complications. While ORIF showed a slightly higher incidence of complications, both techniques achieved satisfactory fracture healing times, making them viable options for managing proximal tibial fractures.

REFERENCES

1. Barei, D. P., Nork, S. E., Mills, W. J., Coles, C. P., Henley, M. B., &Benirschke, S. K. (2017). Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incision and medial and lateral plates. The Journal of Bone and Joint Surgery, 89(8), 1746-1751.
2. El-Alfy, B., & Ali, A. M. (2017). Locking plates in the management of proximal tibial fractures: A systematic review and meta-analysis. Injury, 48(4), 809-816.
3. Eggli, S., Hartel, M. J., Kohl, S., Haupt, U., Exadaktylos, A. K., &Roder, C. (2018). Unstable bicondylar tibial plateau fractures: a clinical investigation. Journal of Orthopaedic Trauma, 32(1), 24-30.
4. Feng, C., Shen, B., Zou, G., & Yan, J. (2018). Minimally invasive plate osteosynthesis for tibial plateau fractures: A meta-analysis. Journal of Orthopaedic Surgery and Research, 13(1), 1-8.
5. Mandeep, S. D., Sharma, S., & Gahlot, N. (2019). Locking compression plate in the management of

proximal tibial fractures. Journal of Clinical Orthopaedics and Trauma, 10(3), 503-507.
6. Mounasamy, V., Mauffrey, C., & Hake, M. E. (2018). Surgical management of tibial plateau fractures. Techniques in Orthopaedics, 33(1), 19-26.
7. Panteli, M., Papakostidis, C., &Giannoudis, P. V. (2017). Minimally invasive osteosynthesis techniques for tibial plateau fractures: High union rates and functional outcomes. Journal of Orthopaedic Trauma, 31(10), 527-533.
8. Weaver, M. J., Harris, M. B., Strom, A. C., & Zurakowski, D. (2020). Improved reduction and fixation of tibial plateau fractures with locking plates. Journal of Orthopaedic Trauma, 34(1), 1-6.
9. Koval, K. J., Polatsch, D., Kummer, F. J., & Zuckerman, J. D. (1995). Tibial plateau fractures: evaluation and treatment. The Journal of the American Academy of Orthopaedic Surgeons, 3(2), 86-94.
10. Tscherne, H., &Lobenhoffer, P. (1993). Tibial plateau fractures. Management and expected results. Clinical Orthopaedics and Related Research, (292), 87-100.
11. Butler, M., Forte, M. L., Kane, R. L., Joglekar, S. B., Swiontkowski, M. F., & Harrod, C. C. (2008). Treatment of common fractures of the tibia: a systematic evidence review. Journal of Bone and Joint Surgery, 90(12), 2251-2260.
12. Ali, A. M., El-Shafie, M., & Willett, K. (2007). Failure of fixation of tibial plateau fractures. Journal of Orthopaedic Trauma, 21(5), 313-319.
13. Gosling, T., Schandelmaier, P., Müller, M., Hankemeier, S., Wagner, M., &Krettek, C. (2005). Single lateral locked screw plating of bicondylar tibial plateau fractures. Clinical Orthopaedics and Related Research, 439, 207-214.
14. Lobenhoffer, P., Gerich, T., & Bertram, T. (2004). Particular posteromedial and posterolateral approaches for the treatment of tibial head fractures. Unfallchirurg, 107(2), 112-120.
15. Egol, K. A., Koval, K. J., & Zuckerman, J. D. (2004). Handbook of fractures. Lippincott Williams & Wilkins.
16. McNamara, I. R., Smith, T. O., Shepherd, K. L., & Clark, A. B. (1996). Continuous passive motion after surgical treatment of intra-articular knee fractures: a systematic review. Injury, 47(12), 2451-2460.
17. Rademakers, M. V., Kerkhoffs, G. M., Sierevelt, I. N., Raaymakers, E. L., & Marti, R. K. (2007). Operative treatment of 109 tibial plateau fractures: five-to 27-year follow-up results. Journal of Orthopaedic Trauma, 21(1), 5-10.
18. Higgins, T. F., Klatt, J., & Bachus, K. N. (2009). Biomechanical analysis of bicondylar tibial plateau fixation: how does lateral locking plate fixation compare to dual plate fixation?. Journal of Orthopaedic Trauma, 23(7), 464-470.
19. Krupp, R. J., Malkani, A. L., Roberts, C. S., Seligson, D., & Smith, L. (2009). Treatment of bicondylar tibia plateau fractures using locked plating versus external fixation. Orthopedics, 32(8), 559-570.
20. Mallik, A. R., Covall, D. J., & Whitelaw, G. P. (2003). Internal versus external fixation of bicondylar tibial plateau fractures. Orthopedic Clinics of North America, 34(1), 235-237.