

A Study of Management of Fractures of Lower End of Femur with Locking Compression Plate

Abhishek NK saha¹, Anindya Dutt², Aindrila biswas³

¹*Designation: Consultant, Affiliation: Manipal hospitals*

²*Designation: Consultant,*

³*Designation: junior resident, Affiliation: peerless hospital*

Abstract—Background: Fractures involving the distal femur are complex injuries that can lead to long-term disability if not properly managed. With the rising number of high-energy trauma such as road traffic accidents and increased life expectancy contributing to osteoporosis-related injuries, the incidence of distal femur fractures has risen significantly.

Materials and Methods:

This retrospective study involved 30 adult patients with distal femur fractures, treated surgically using Locking Compression Plates (LCP) from January 2008 to January 2024. Patients were assessed based on demographic data, fracture type (classified using AO classification), comorbidities, associated injuries, knee range of motion, and complications. Surgical techniques included MIPPO for extra-articular fractures and TARPO for intra-articular fractures. Functional outcomes were evaluated using the NEER's scoring system.

Results:

The study population had a mean age of 53 years, with the highest incidence in the 51–60 year age group. Males were more frequently affected. The average healing time was 10.3 weeks, delayed in open fractures. Knee flexion ranged from 40° to 130°, with a mean of 100°. According to NEER's criteria, 60% had excellent outcomes, 36.67% good, and 1 patient experienced failure due to implant breakage. Complications included knee stiffness (3 cases), delayed union (5 cases), and one case of shortening >2 cm.

Conclusion:

Locking Compression Plates, especially when used with MIPPO and TARPO techniques, provide stable fixation with favorable outcomes in distal femur fractures. Early mobilization and minimal soft tissue damage contribute to improved functional results, particularly in osteoporotic and intra-articular fractures.

Index Terms—Distal femur fracture, Locking compression plate, MIPPO, TARPO, Functional outcome

I. INTRODUCTION

Fractures of the distal femur represent a significant challenge in orthopedic trauma care due to their proximity to the knee joint and potential for long-term functional impairment. These fractures include supracondylar and intra-articular types and are increasingly seen in both young patients following high-energy trauma and elderly individuals with osteoporotic bones. With the rising incidence of road traffic accidents and increasing lifespan, distal femur fractures are becoming more common.

Management of these fractures has evolved with the development of newer fixation devices such as Locking Compression Plates (LCP), which offer enhanced stability, particularly in osteoporotic bones and comminuted fractures. Surgical techniques like Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) and Transarticular Retrograde Plate Osteosynthesis (TARPO) have further improved outcomes by preserving soft tissue and promoting early mobilization. This study evaluates the functional and radiological outcomes of distal femur fractures treated with LCP over a 16-year period.

II. AIM & OBJECTIVES

Aim:

To evaluate the functional and radiological outcomes of distal femur fractures treated surgically using Locking Compression Plates (LCP) with MIPPO and TARPO techniques.

Objectives:

1. To study the demographic distribution and

- fracture patterns of distal femur fractures.
2. To assess the surgical outcomes and complications associated with the use of LCP.
 3. To evaluate the effectiveness of MIPPO and TARPO surgical techniques in promoting early mobilization and fracture healing.
 4. To analyze the functional outcomes using NEER’s rating system.

III. MATERIALS AND METHODS

Study Design:

A retrospective, observational study.

Study Period and Duration:

From January 2008 to January 2024 (16 years).

Sample Size:

30 adult patients with distal femur fractures.

Inclusion Criteria:

- Adult patients with distal femur fractures (supracondylar and intra-articular types).
- Fractures managed operatively with LCP using MIPPO/TARPO techniques.

Exclusion Criteria:

- Pathological fractures.
- Pediatric fractures (patients <16 years of age).

Fracture Classification:

All fractures were classified using the AO classification system:

- 33C1 – 6 cases (20.69%)

- 33C2 – 12 cases (41.38%)
- 33C3 – 11 cases (37.93%)

Surgical Techniques Used:

- MIPPO (Minimally Invasive Percutaneous Plate Osteosynthesis) for extra-articular fractures.
- TARPO (Transarticular Retrograde Plate Osteosynthesis) for intra-articular fractures.
- All surgeries performed under spinal anesthesia using fluoroscopic guidance.
- Compound fractures initially stabilized with external fixation followed by definitive plating.

Postoperative Protocol:

- ROM exercises initiated from postoperative day 2.
- Weight-bearing progressed from 8th day (touch-down) to full weight-bearing by 14–16 weeks.
- Radiographic follow-ups were scheduled post-op, at 6 weeks, 12 weeks, 4 months, and every 6 months up to 10 years.

Statistical Analysis:

- Data compiled and analyzed using Microsoft Excel.
- Descriptive statistics including mean, percentage, and frequency were used for demographic variables.
- Functional outcomes were assessed using NEER’s scoring system.
- No inferential statistics or hypothesis testing were used due to the retrospective nature and small sample size.
- Visual representation of results was done using bar charts and tables

IV. RESULTS

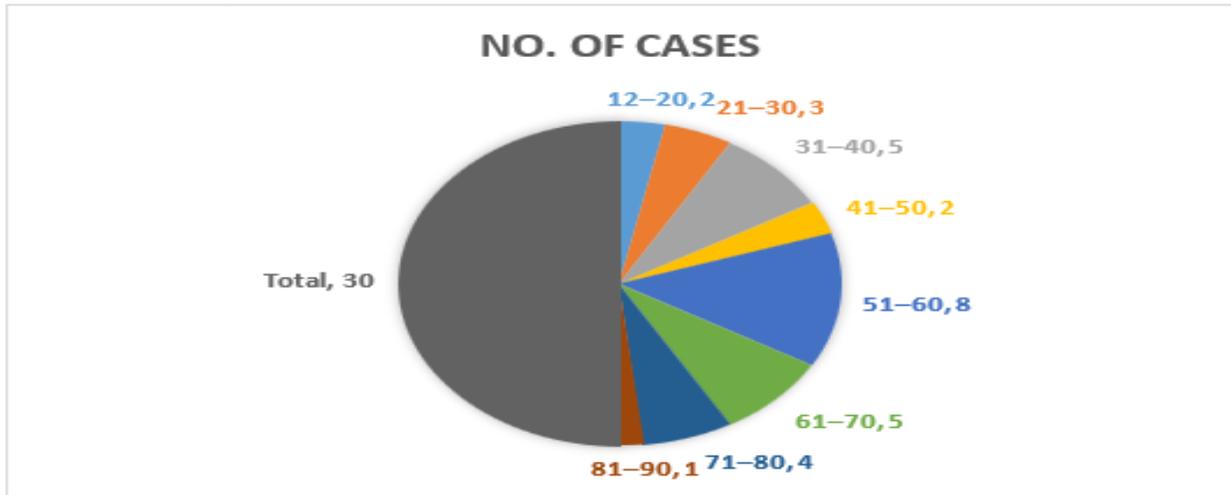
1. Age Distribution

Age Group (Years)	No. of Cases	Percentage (%)
12–20	2	6.67%
21–30	3	10.00%

31-40	5	16.67%
41-50	2	6.67%
51-60	8	26.67%
61-70	5	16.67%
71-80	4	13.33%
81-90	1	3.33%
Total	30	100%

Interpretation:

The highest incidence of distal femur fractures was observed in the 51-60 years age group (26.67%), likely reflecting increased fragility due to age-related osteoporosis. Middle-aged and elderly populations accounted for the majority of cases, emphasizing the need for robust fixation techniques suited for weaker bone quality.



2. Sex Distribution

Sex	No. of Cases	Percentage (%)
Male	18	60.00%
Female	12	40.00%

Interpretation:

There was a male predominance (60%) in the study population. This may be attributed to greater exposure of males to high-energy trauma such as road traffic accidents, particularly in working-age groups.

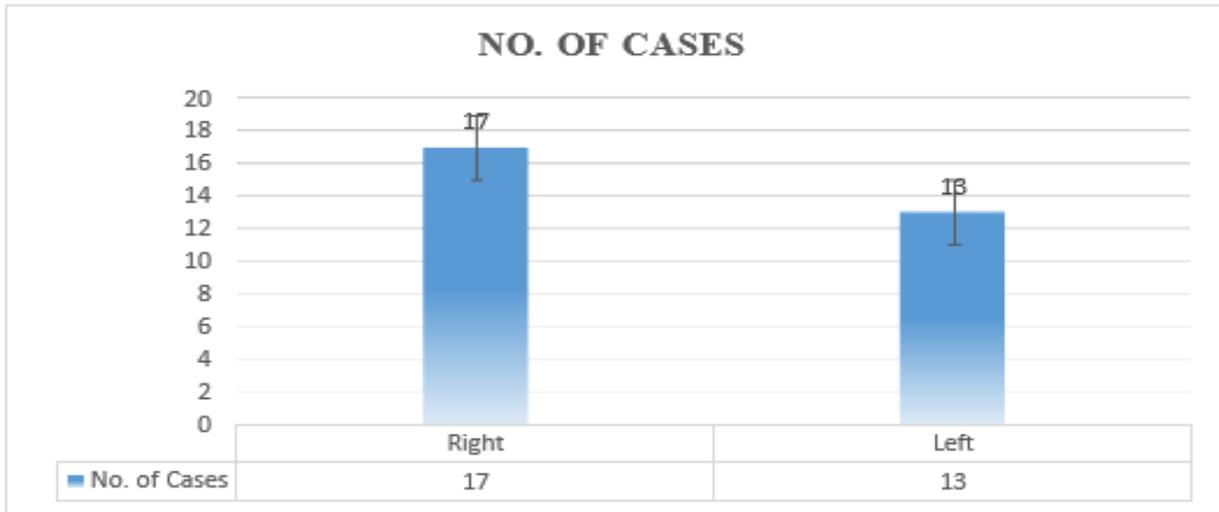


3. Side of Injury

Side	No. of Cases	Percentage (%)
Right	17	57%
Left	13	43%

Interpretation:

Right-sided femur fractures were slightly more common (57%). No significant clinical implication is associated with laterality, though this may reflect common injury mechanisms or dominance-related activity patterns.

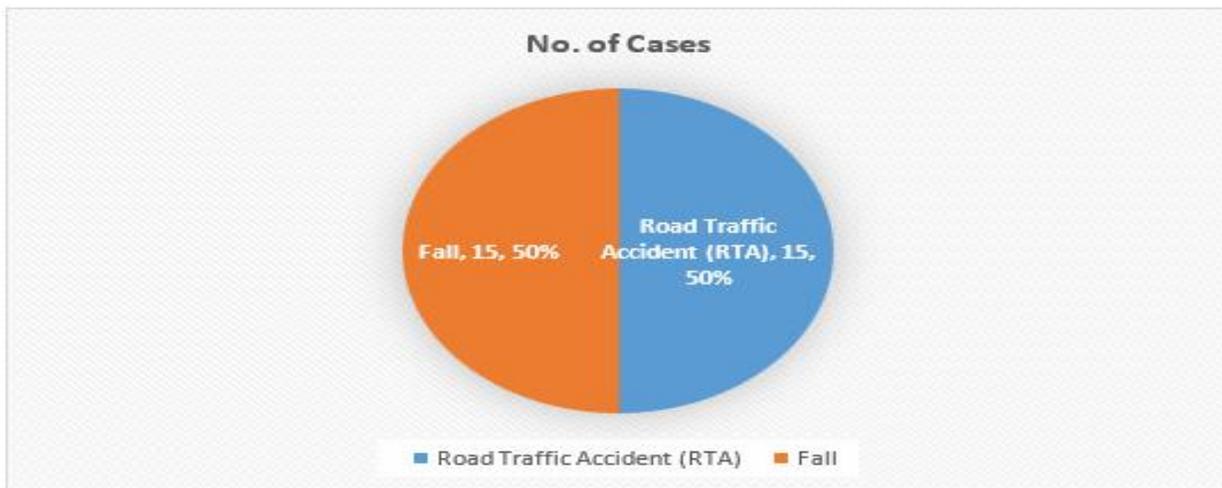


4. Mode of Injury

Mode of Injury	No. of Cases	Percentage (%)
Road Traffic Accident (RTA)	15	50%
Fall	15	50%

Interpretation:

Both RTA and falls were equally responsible (50% each) for fractures. This underlines the dual nature of injury mechanisms: high-energy trauma in younger adults and low-energy falls in elderly individuals with osteoporotic bones.

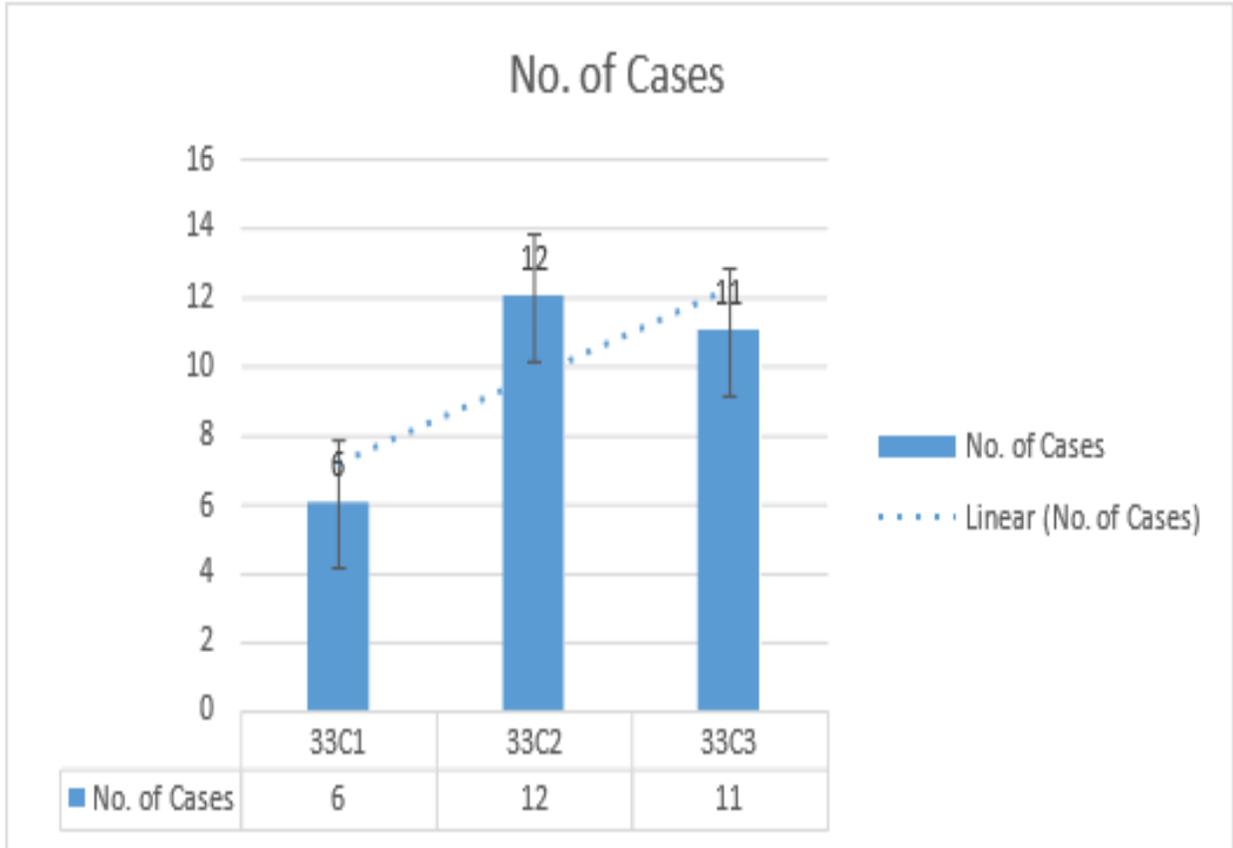


5. AO Fracture Classification

AO Type	No. of Cases	Percentage (%)
33C1	6	20.69%
33C2	12	41.38%
33C3	11	37.93%

Interpretation:

Majority of the cases (over 79%) were severely comminuted intra-articular fractures (33C2 & 33C3). These types of fractures often require rigid fixation and careful reconstruction, justifying the use of LCP with MIPPO/TARPO techniques.

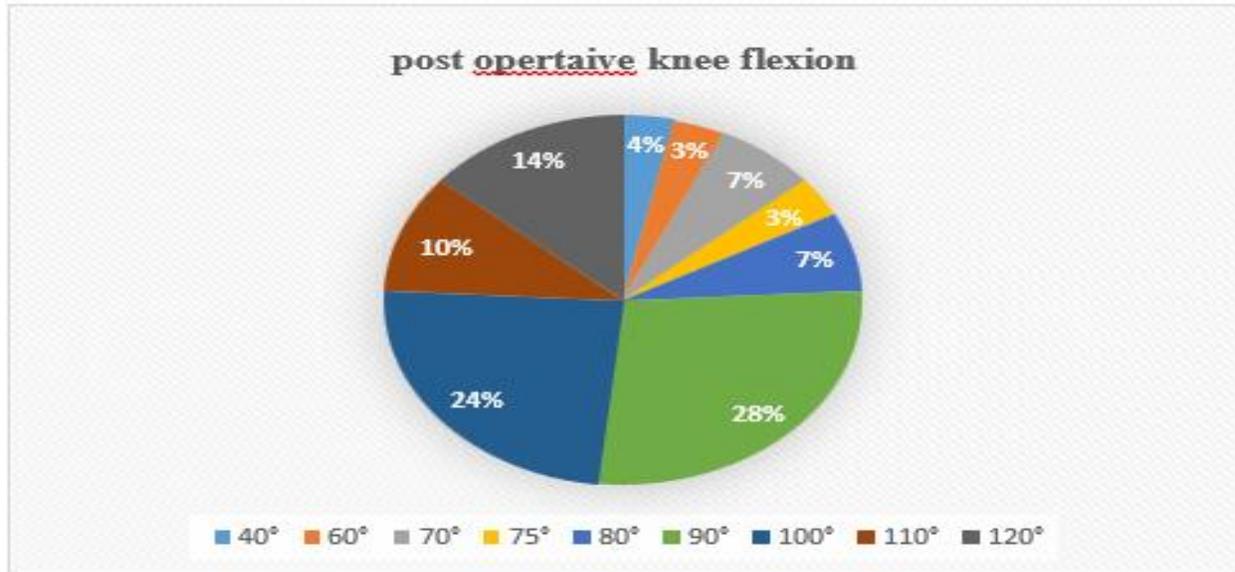


6. Postoperative Knee Flexion

Knee Flexion (°)	No. of Cases
40°	1
60°	1
70°	2
75°	1
80°	2
90°	8
100°	7
110°	3
120°	4

Interpretation:

Postoperative knee flexion was acceptable to good in most patients, with a mean flexion of 100°. This highlights the importance of early physiotherapy and stable fixation allowing knee mobilization. Only a few patients had flexion <80°, often due to poor compliance or more severe fracture types.

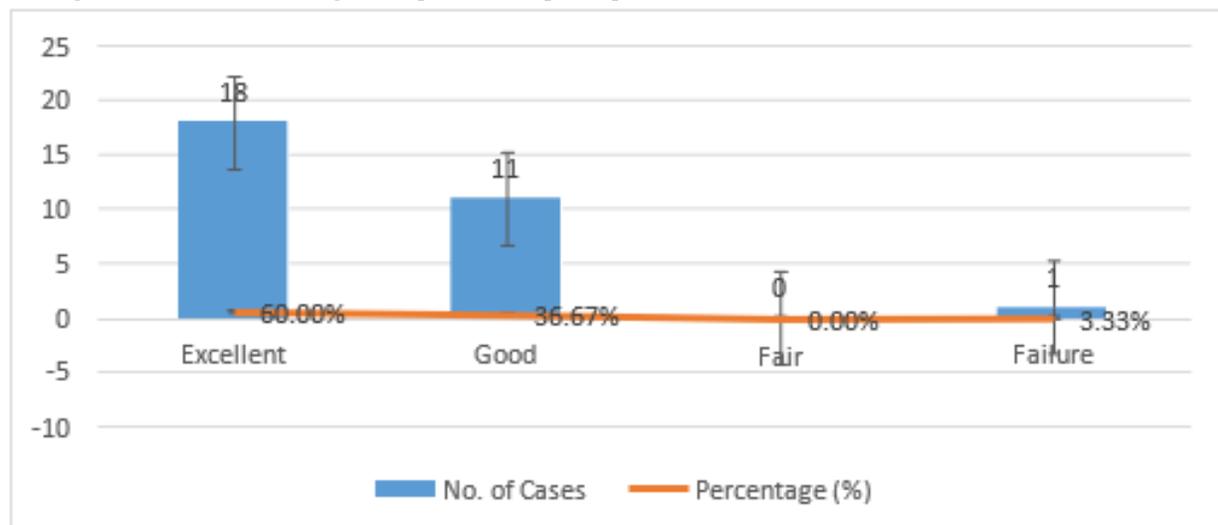


7. Functional Outcome Based on NEER's Scoring

Outcome Grade	No. of Cases	Percentage (%)
Excellent	18	60.00%
Good	11	36.67%
Fair	0	0.00%
Failure	1	3.33%

Interpretation:

The majority of patients (96.67%) had Excellent or Good outcomes as per NEER's rating, indicating the effectiveness of LCP fixation with MIPPO/TARPO. One failure case was linked to non-compliance with weight-bearing restrictions, underlining the importance of post-operative instructions.



8. Complications Observed

Complication	No. of Cases	Management
Knee stiffness	3	Physiotherapy, ROM exercises
Delayed union	5	Physiotherapy, longer non-weightbearing
Implant failure	1	Reoperation (non-compliance)
Malunion	1	No surgical correction; functional result
Limb shortening <1cm	8	Well tolerated; no intervention needed
Limb shortening = 2cm	1	No surgical correction; good function
Infection	0	None reported

Interpretation

The complication rate was low. The most common issue was stiffness, managed successfully with rehabilitation. Delayed union was noted in compound cases but eventually united without reoperation. Only one case of implant failure occurred due to premature weight bearing. Importantly, no infections were recorded, demonstrating good surgical technique and sterile protocols.

V. DISCUSSION

Fractures of the distal femur are complex injuries that often require careful surgical intervention to restore limb alignment, preserve joint function, and ensure early mobilization. In our retrospective study of 30 patients managed with Locking Compression Plates (LCP) using MIPPO and TARPO techniques, we observed a high rate of excellent to good functional outcomes, particularly when early mobilization and physiotherapy protocols were followed. The age group most affected was 51–60 years, followed by the 61–70 age group, indicating a bimodal age distribution often seen in literature—young males with high-velocity trauma and elderly females with osteoporotic bones. This matches with previously reported patterns by authors like Martinet et al. and Kregor PJ et al., where similar demographics were involved. Males (60%) were more affected than females, possibly due to increased exposure to road traffic injuries.

The AO classification showed a predominance of type 33C fractures (96.67%), with over 70% involving severe comminution (33C2 and 33C3). These fracture types require stable fixation and precise reduction of the articular surface. Our

approach with TARPO for intra-articular and MIPPO for extra-articular fractures allowed anatomical realignment with minimal soft tissue disruption, supporting principles of biological fixation as emphasized by Perren SM. Using the NEER’s scoring system,

60% of patients achieved excellent and 36.67% good outcomes. Only one case was classified as failure (implant breakage due to premature weight bearing). This is consistent with studies such as Kregor PJ et al. (2005), where early results with LCP showed favorable union rates and functional outcomes in 103 cases. Their reported mean knee ROM of 105° closely mirrors our study’s average flexion of 100°. The MIPPO technique, as supported by Gautier and Sommer, is advantageous in preserving periosteal blood supply and minimizing soft tissue damage. Our use of long plates with minimal screw insertion allowed for elastic fracture fixation, enhancing bone healing. We avoided tourniquets and carefully handled soft tissues to prevent devascularization, especially in osteoporotic patients. The overall complication rate was low. Knee stiffness occurred in 3 cases and was effectively managed with ROM exercises. Delayed union was observed in compound injuries but none required bone grafting. No infections were noted—remarkable given that 4 cases were open fractures. One implant failure resulted from early unadvised weight bearing. Malunion was minimal, with varus collapse in 1 case and shortening <1 cm in 8 cases, all well tolerated. Compared to Schütz and Südkamp, who reported higher rates of complications in distal femur fractures, our findings suggest that strict adherence to postoperative protocols and meticulous intraoperative technique play a vital role in

reducing adverse outcomes. Initiating ROM exercises by day 2, touch-down weight bearing by week 2, and full weight bearing by weeks 14–16 helped restore early function without compromising union. This progressive rehabilitation aligns with modern protocols suggested by the AO Foundation and Court-Brown CM for complex femoral fractures.

VI. CONCLUSION

Fractures of the distal femur remain a significant orthopedic challenge, particularly in the elderly osteoporotic population and in high-energy trauma among younger individuals. In our retrospective study of 30 patients treated with Locking Compression Plate (LCP) using MIPPO and TARPO techniques, we observed consistently favorable outcomes. The application of biological fixation principles, minimal soft tissue dissection, and careful surgical planning led to early fracture union, low complication rates, and good-to-excellent functional recovery in the majority of patients. Postoperative rehabilitation protocols that emphasized early mobilization and progressive weight bearing played a crucial role in achieving these outcomes. The NEER's scoring system revealed excellent results in 60% of cases and good results in 36.67%, with only one failure due to non-compliance. Knee stiffness, the most common complication, was effectively managed with physiotherapy. There were no infections noted, and implant-related complications were minimal.

REFERENCES

- [1] Martinet O, Cordey J, Harder Y, Maier A, Buhler M, Barraud GE. The epidemiology of fractures of the distal femur. *Injury*. 2000;31(Suppl 3):C62-C63.
- [2] Zlowodzki M, Bhandari M, Marek DJ, Cole PA, Kregor PJ. Operative treatment of acute distal femur fractures: systematic review of 2 comparative studies and 45 case series (1989 to 2005). *J Orthop Trauma*. 2006;20(5):366-71.
- [3] Kregor PJ. Distal femur fractures with complex articular involvement: management by articular exposure and submuscular fixation. *Orthop Clin North Am*. 2002;33(1):153-175.
- [4] Schutz M, Muller M, Krettek C, et al. Minimally invasive fracture stabilization of distal femoral fractures with the LISS: a prospective multicenter study. *Injury*. 2001;32(Suppl 3):SC48-54.
- [5] Frigg R. Locking Compression Plate (LCP): an osteosynthesis plate based on the dynamic compression plate and the point contact fixator (PC-Fix). *Injury*. 2001;32(Suppl B):63-66.
- [6] Bolhofner BR, Carmen B, Clifford P. The results of open reduction and internal fixation of distal femur fractures using a biologic (indirect) reduction technique. *J Orthop Trauma*. 1996;10(6):372-377.
- [7] Krettek C, Schandelmaier P, Miclau T, Tscherne H. Minimally invasive percutaneous plate osteosynthesis (MIPPO) using the DCS in proximal and distal femoral fractures. *Injury*. 1997;28(Suppl 1):A20-30.
- [8] Wagner M. General principles for the clinical use of the LCP. *Injury*. 2003;34(Suppl 2):B31-42.
- [9] Markmiller M, Konrad G, Südkamp N. Femur-LISS and distal femoral nail for fixation of distal femoral fractures: are there differences in outcome and complications? *Clin Orthop Relat Res*. 2004;(426):252-257.
- [10] Button G, Wolinsky P, Hak D. Failure of less invasive stabilization system plates in the distal femur: a report of four cases. *J Orthop Trauma*. 2004;18(8):565-570.
- [11] Vallier HA, Hennessey TA, Sontich JK, Patterson BM. Failure of LCP condylar plate fixation in the distal part of the femur. *J Bone Joint Surg Am*. 2006;88(4):846-853.
- [12] Henry SL. Supracondylar femur fractures treated percutaneously. *Clin Orthop Relat Res*. 2000;(375):51-59.
- [13] Farouk O, Krettek C, Miclau T, Schandelmaier P, Tscherne H. Effects of percutaneous and conventional plating techniques on the blood supply to the femur. *Arch Orthop Trauma Surg*. 1998;117(8):438-441.
- [14] Ricci W, Yue JJ, Taffet R, et al. Less Invasive Stabilization System for treatment of distal femur fractures. *Am J Orthop*. 2004;33(5):250-255.

- [15] Wong MK, Leung F, Chow SP. Treatment of distal femoral fractures in the elderly using a less-invasive plating technique. *Int Orthop*. 2005;29(2):117-120.
- [16] Krettek C, Muller M, Miclau T. Evolution of minimally invasive plate osteosynthesis (MIPO) in the femur. *Injury*. 2001;32(Suppl 3):SC14-23.
- [17] Sanders R, Swiontkowski M, Rosen H, Helfet D. Double-plating of comminuted, unstable fractures of the distal part of the femur. *J Bone Joint Surg Am*. 1991;73(3):341-346.
- [18] Gardner MJ, Griffith MH, Demetrakopoulos D, et al. Hybrid locked plating of osteoporotic fractures of the humerus. *J Bone Joint Surg Am*. 2006;88(9):1962-1967.
- [19] Ahmad M, Nanda R, Bajwa AS, Candal-Couto JJ, Green S. Biomechanical evaluation of locking compression plates. *Injury*. 2007;38(3):358-364.
- [20] Campbell WC, Canale ST, Beaty JH. *Campbell's Operative Orthopaedics*. 11th ed. Philadelphia: Mosby Elsevier; 2007.