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RESEARCH ARTICLE
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"COMPREHENSIVE ANALYSIS OF LOCKING COMPRESSION PLATE (LCP) TREATMENT FOR PROXIMAL TIBIA FRACTURES: UTILIZING MINIMALLY INVASIVE PERCUTANEOUS PLATE OSTEOSYNTHESIS (MIPPO) TECHNIQUE AND ASSESSING CLINICAL OUTCOMES, COMPLICATIONS, AND FIXATION STRATEGIES"

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Abstract
This study investigates the application of the locking compression plate (LCP) in conjunction with the minimally invasive percutaneous plate osteosynthesis (MIPPO) technique for the treatment of proximal tibia fractures. Analyzing a cohort of 25 patients, the research explores age distribution, gender, fracture types, plate sizes, fixation principles, and clinical outcomes. Bridging fixation predominates (52%), and excellent/good clinical outcomes are observed in 88% of cases. Complications, including knee joint stiffness and infections, are limited. However, the study acknowledges limitations such as the small sample size. Overall, the findings contribute valuable insights into the efficacy and challenges of LCP and MIPPO in managing proximal tibia fractures.

Keywords- Proximal Tibia Fractures, Locking Compression Plate (LCP), Minimally Invasive Percutaneoos Plate Osteosynthesis (MIPPO)

Introduction:

Proximal tibia fractures, specifically those involving the plateau, present intricate challenges necessitating a nuanced approach to treatment. Understanding the historical context and advancements in the management of these fractures is paramount to devising effective strategies. Perry CR's foundational work (1) laid the groundwork for comprehending the complexities of tibial plateau fractures. While non-surgical interventions have been explored, such as the cast brace treatment advocated by George A. Brown and Spraque (2), a comprehensive understanding of both osseous and soft tissue considerations, as emphasized by Bennett WF and Browner B (3), is imperative. Apley A's early exploration (4) into fractures of the lateral tibial condyle provides historical insights into mobilization techniques. The evolution of fracture management includes the

standardized principles for Locking Compression Plate (LCP) application proposed by Wagner M (5). Biomechanical studies, like Westmoreland GL et al.'s work (6), contribute crucial insights into the mechanical aspects of fixation, guiding the selection of appropriate hardware. Ali AM et al.'s examination of failure of fixation in tibial plateau fractures (7) informs potential pitfalls, and Mallik AR et al.'s study on internal versus external fixation (8) adds evidence to the ongoing debate. Moore TM et al.'s extensive review (9) outlines historical perspectives, and Sommer C et al.'s work on the clinical application of the LCP (10) bridges theory and practice. Synthesizing these foundational studies, our research aims to contribute new insights into the treatment of proximal tibia fractures using the LCP and Minimally Invasive Plate Osteosynthesis (MIPPO) technique.

Objective:
To study the treatment of proximal tibia fractures using the locking compression plate and MIPPO technique.
Aimed to achieve a stable, pain-free, and mobile joint to prevent osteoarthritis development.

Materials and Methods:
Study Setting:
Conducted at the Department of Orthopaedics and Rehabilitation at Tertiary Centre Hospital of Southern Rajasthan.
Duration: July 2020 – June 2021
Total cases studied: 25.

Inclusion Criteria:
- Adults aged over 18 years (both genders).
- Fractures of less than 3 weeks duration.

Exclusion Criteria:
- Patients aged below 18 years.
- Type IIIb compound fractures.
- Pathological fractures.
- Fractures not reducible by MIPPO technique.

Data Collection:
- Recorded demographic data and conducted thorough history and clinical examinations.
- Assessed soft tissue injuries, even in closed fractures.
- Utilized Schatzker’s classification for radiological assessment.

Preoperative Procedures:
1. Administered preoperative antibiotics (continued for 5 days postoperatively).
2. Stabilized patients hemodynamically for surgery.
3. Conducted preoperative planning for plate selection, MIPPO technique, and surgical approach based on fracture displacement.
4. Manual traction and/or reduction clamp used for reduction with c-arm guidance.
5. Checked for associated fractures.
6. Obtained informed consent from study subjects.

Surgical Technique (MIPPO):
- Aligned fractures by indirect reduction.
- Introduced plate through a short incision beneath the skin, pushed distally on the lateral aspect of the proximal tibia.

- Bridging plate fixed proximally, alignment checked using fluoroscopy, and then fixed distally.

Instrumentation:
- Used locking compression plate with a specific technique for locking head screw insertion.
- Non-locking regular screws inserted prior to locking screws.

Postoperative Care:
- Monitored general condition, fluid balance, and provided IV antibiotics and analgesics.
- Initiated mobilization after 72 hours post-op, gradually increasing range of motion.

Follow-up:
- First follow-up at 4-6 weeks, followed by regular intervals of 6-8 weeks until complete fracture union.
- Radiological documentation of fracture healing, assessment of reduction loss, analysis of complications, and knee score calculation at each follow-up.

Knee Score (Insall Modification - 1993):
- Evaluated pain, range of motion, stability, extension lag, flexion contracture, malalignment, and pain at rest.
- Calculated total knee score for each patient.

Results Evaluation:
- Categorized knee scores as excellent, good, fair, or poor based on the total score.




Figure 1: Patients Treated with LCP and MIPPO for Proximal Tibia Fractures"

Observation

Table 1: "Age Distribution of Patients Undergoing Locking Compression Plate (LCP) Treatment for Proximal Tibia Fractures Using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Age Group (Years)	Number of Patients	Percentage (%)
18-20	1	4
21-30	8	32
31-40	7	28
41-50	2	8
51-60	6	24
>60	1	4
Total	25	100

The table illustrates the age distribution of 25 patients undergoing treatment for proximal tibia fractures with the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique. The majority of patients (64%) fall within the age range of 21-60 years, with a notable representation across various age groups.

Table 2 : "Gender Distribution of Patients Undergoing Locking Compression Plate (LCP) Treatment for Proximal Tibia Fractures Using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Sex	Number of Patients	Percentage (%)
Male	20	80
Female	5	20
Total	25	100

The table presents the gender distribution of 25 patients treated for proximal tibia fractures with the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique, demonstrating a predominance of males (80%) in the study cohort.

Table 3: "Laterality Distribution of Proximal Tibia Fractures Treated with Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Laterality of Fracture	Number of Patients	Percentage (%)
Right	20	80
Left	5	20
Total	25	100

The table delineates the laterality distribution of proximal tibia fractures in 25 patients treated with the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique, with the majority of fractures occurring on the right side (80%).

Table4: "Distribution of Proximal Tibia Fracture Types in Patients Treated with Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Type of Fracture	Number of Patients	Percentage (%)
Intraarticular	16	64
Extraarticular	9	36
Total	25	100

The table delineates the distribution of proximal tibia fractures in 25 patients undergoing treatment with the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique. It reveals that 64% of the fractures are intraarticular, emphasizing the prevalence of articular involvement in the study cohort.

Table5 : "Utilization of Different Plate Sizes in Locking Compression Plate (LCP) Treatment for Proximal Tibia Fractures Using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Plate	Number of Patients	Percentage (%)
3.5mm	12	48
4.5 mm	13	52
Total	25	100

The table illustrates the distribution of plate sizes in the treatment of proximal tibia fractures with Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique. It shows that 52% of patients received 4.5mm plates, emphasizing variability in plate selection.

Table 6: "Application of Fixation Principles in Locking Compression Plate (LCP) Treatment for Proximal Tibia Fractures Using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Principle of fixation	Number of Patients	Percentage (%)
Bridging	13	52
Combined	12	48
Total	25	100

The table presents the distribution of fixation principles applied in the treatment of proximal tibia fractures using the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique. It indicates that 52% of patients underwent bridging fixation, emphasizing the prevalent use of this method, while 48% received combined fixation, showcasing the variability in fixation approaches within the study cohort.

Table 7: "Clinical Outcomes of Patients Undergoing Locking Compression Plate (LCP) Treatment for Proximal Tibia Fractures Using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Clinical result	Number of Patients	Percentage (%)
Excellent	12	48
Good	10	40
Fair	2	8
Poor	1	4
Total	25	100

The table delineates the clinical outcomes of 25 patients treated for proximal tibia fractures with the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique. Results indicate that 48% achieved excellent outcomes, 40% demonstrated good outcomes, 8% had fair outcomes, and 4% exhibited poor outcomes, reflecting the varied clinical responses within the study cohort.

Table 8: "Complications Arising in Patients Undergoing Locking Compression Plate (LCP) Treatment for Proximal Tibia Fractures Using Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) Technique"

Complication	Number of Patients
Knee joint stiffness	3
Postoperative loss of reduction	0
Varus deformity	0
Knee instability	1
Infection	2

The table enumerates complications observed in patients treated for proximal tibia fractures using the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique. Three patients experienced knee joint stiffness, one exhibited knee instability, and two patients encountered postoperative infections. Notably, postoperative loss of reduction and varus deformity were absent, highlighting the overall effectiveness of the employed surgical approach in mitigating specific complications.

Conclusion

In conclusion, the utilization of the Locking Compression Plate (LCP) and Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) technique for proximal tibia fractures demonstrated favorable clinical outcomes in our study. The majority of patients achieved excellent or good results, highlighting the efficacy of this approach. Complications were relatively low, with knee joint stiffness being the most prevalent issue. Bridging fixation was the predominant fixation principle employed, and the choice of plate sizes varied. These findings underscore the feasibility and versatility of LCP and MIPPO in treating proximal tibia fractures, providing valuable insights for orthopedic practitioners.

Limitations

A limitation of this study is the relatively small sample size of 25 patients, which may impact the generalizability of findings. Additionally, the absence of a comparative group or long-term follow-up limits a comprehensive assessment of the treatment's efficacy and potential complications.

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