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Original article

Evaluating Advanced Plate Fixation Techniques for Distal Femoral Fractures in Elderly Patients

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Abstract
Distal femoral fractures are a growing concern among geriatric patients due to osteoporosis and age-related fragility. This study evaluates the effectiveness of LOCKED COMPRESSION PLATES (LCPs) in the surgical management of these fractures. Fifty elderly patients with fractures classified by the AO system underwent LCP fixation at Al-Beida Medical Center. Outcomes included radiological union, functional recovery assessed by the Knee Society Score (KSS), and complication rates. Radiological union was achieved in all cases within an average of 12.7 weeks. Functional recovery was excellent for Type A fractures (KSS 93), satisfactory for Type B (KSS 88), and moderate for Type C (KSS 80). Complication rates were low (10%), with no cases of nonunion or deep infection. LCPs offer biomechanical stability and promote early mobilization, making them effective for managing osteoporotic distal femoral fractures. Further studies are needed to compare their performance with other fixation techniques.
Keywords. Plate Fixation, Femoral Fractures, Elderly Patients.

Introduction

Distal femoral fractures, comprising 4-6% of all femoral fractures, are a significant challenge in geriatric orthopedics. These fractures often occur due to low-energy trauma in osteoporotic bone, making stabilization and healing difficult. Traditional fixation methods, including intramedullary nails and dynamic condylar screws, have limitations in osteoporotic bone [1,2].

Locked compression plates (LCPs) have emerged as a superior alternative due to their angular stability and minimally invasive application [3]. Studies have demonstrated their ability to enhance biomechanical stability and support early mobilization [4]. However, the outcomes of LCP fixation in elderly patients with varying fracture types remain a critical area of investigation. This study evaluates the outcomes of LCP fixation in elderly patients, focusing on radiological and functional recovery, with comparisons to existing literature.

Methods

Study Design and Setting

This prospective case series was conducted between December 2019 and June 2023 at Al-Beida Medical Center. Ethical approval was obtained, and informed consent was secured from all participants.

Patient Selection

We include patients if they were aged 65 years or older, had distal femoral fractures classified as Type A, B, or C per the AO system, had medically fit for surgery. While, we excluded cases with open fractures with extensive soft tissue damage and those with severe comorbidities contraindicating surgery.

Surgical Technique

A lateral approach was used for all cases [5]. This approach provides optimal access to the distal femur while minimizing disruption to soft tissues. For extra-articular fractures, a minimally invasive plate osteosynthesis (MIPO) technique was employed [6], which preserves the periosteal blood supply and promotes healing. Complex fractures were treated with an open lateral approach for direct anatomical reduction and stabilization. Spinal anesthesia was used in most cases, except for one patient who required general anesthesia due to severe kyphosis and positioning challenges.

Postoperative Protocol

Antibiotics: Cefazolin (2g IV) was administered perioperatively to prevent infection. For patients with beta-lactam allergies, clindamycin or vancomycin was used [7].

Anticoagulation: Enoxaparin (40mg subcutaneously) was initiated 12 hours postoperatively and continued for 14 days to prevent venous thromboembolism [8].

Pain Management: A multimodal analgesia regimen included paracetamol (1g every 6 hours) and celecoxib (200mg daily). Oxycodone (5-10mg) was used for breakthrough pain.

Physiotherapy: Passive range of motion exercises began on postoperative day one, with weight-bearing delayed until radiological evidence of union, typically around 6-8 weeks.

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Results

Table 1 presents the distribution of different fracture types among patients, with Type C (complete articular) being the most common (42%). The mean age of patients is relatively consistent across fracture types, ranging from 76 to 78 years.

Table 1. Fracture Type Distribution and Patient Demographics

Fracture Type	Patients (%)	Mean Age (years)
Type A (extra-articular)	13 (26%)	76
Type B (partial articular)	16 (32%)	78
Type C (complete articular)	21 (42%)	77

Table 2 compares the operative parameters for the three fracture types. As the severity of the fracture increases from Type A to Type C, both the operative time and blood loss increase, with Type C fractures requiring the longest operative time and the most blood loss.

Table 2: Operative Parameters by Fracture Type

Parameter	**Type A**	**Type B**	**Type C**
Operative Time (min)	80	109	120
Blood Loss (mL)	200	400	500

In table 3, the radiological union time and functional outcomes, including the Knee Society Score (KSS) and Range of Motion (ROM), for different fracture types were reported. Type A fractures heal the fastest, with the highest KSS and ROM, suggesting better functional recovery. In contrast, Type C fractures have the longest healing time and the lowest functional scores, indicating poorer outcomes

Minor complications were observed in 10% of patients, including transient pain during ambulation. These issues resolved with physiotherapy and analgesics. No cases of nonunion, malunion, or deep infections were reported.

Table 3: Radiological Union and Functional Outcomes by Fracture Type

Fracture Type	**Union Time (weeks)**	**Knee Society Score (KSS)**	**Range of Motion (ROM) (Degrees)**
Type A	11	93	105
Type B	13	88	90
Type C	15	80	80

Discussion

This study highlights the effectiveness of locked compression plates (LCPs) in managing distal femoral fractures in elderly patients. The outcomes observed, with radiological union times ranging from 11 to 15 weeks and functional recovery scores (Knee Society Score, KSS) ranging from 80 to 93, suggest that LCP fixation provides significant biomechanical stability to fractures in osteoporotic bone. The success of LCPs in this cohort is in line with previous studies that have demonstrated the benefits of LCPs in distal femoral fractures, particularly in osteoporotic bone, which is prone to poor healing with traditional fixation methods such as dynamic condylar screws or intramedullary nails [1,2,5].

One of the key advantages of LCPs is their angular stability. In osteoporotic bone, where bone quality is compromised, the ability of LCPs to resist rotational forces is crucial in preventing fixation failure. The locking mechanism of the plates offers resistance to shear forces, which is especially important in elderly patients who may have reduced bone density and strength. These plates provide strong fixation even in fractures where traditional plating methods might have failed. The results observed in this study, particularly the high rate of radiological union (100% union in all patients) and the relatively short union times, support the efficacy of LCPs in these challenging cases.

In terms of functional recovery, Type A fractures, which are extra-articular and generally simpler in nature, showed the best outcomes, with an average KSS of 93 and a range of motion (ROM) of 105 degrees. This suggests that patients with Type A fractures, who have fewer complex fractures, recover more quickly and achieve near-normal knee function after LCP fixation. Conversely, Type B and C fractures, which are more complex (partial or complete articular fractures), had slightly lower KSS scores (88 and 80, respectively), indicating that more complex fractures may take longer to heal and may result in less optimal functional recovery. These findings are consistent with previous studies indicating that more complicated fractures, particularly those with joint involvement (Type B and C), may have a higher risk of functional impairment due to the complexity of the injury and the potential for joint surface involvement, which can impact knee mobility [3,7].

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The functional outcomes observed in this study are further supported by the early mobilization encouraged by LCP fixation. Early mobilization is crucial in elderly patients as it helps reduce complications associated with prolonged immobilization, such as joint stiffness, thromboembolic events, and muscle atrophy. The ability to initiate early passive range of motion exercises in the postoperative period, starting from day one, has been a notable benefit of LCP fixation. Early mobilization not only accelerates functional recovery but also reduces the risk of postoperative complications, particularly in elderly patients who are at an increased risk of complications due to comorbidities and frailty.

In terms of complications, the 10% complication rate observed in this cohort is relatively low, especially considering the elderly age group and the osteoporotic nature of the fractures. The minor complications that occurred, including transient pain during ambulation, were manageable with physiotherapy and analgesic interventions. No cases of nonunion, malunion, or deep infections were reported, which is a significant achievement considering the challenges of managing fractures in osteoporotic bone. This supports the notion that LCPs not only provide biomechanical stability but also reduce the risk of complications associated with poor bone quality and complex fractures [6]. The absence of major complications is particularly notable in elderly patients, who are often at higher risk for infection, nonunion, and delayed healing due to comorbidities such as diabetes, vascular disease, or impaired immune function.

The findings of this study also emphasize the importance of surgical technique in optimizing outcomes. The minimally invasive plate osteosynthesis (MIPO) technique, used in extra-articular fractures, contributed to minimizing soft tissue disruption, which is critical in preserving the periosteal blood supply and promoting bone healing. Additionally, for more complex fractures, the open approach allowed for direct anatomical reduction and stabilization, which is essential for achieving optimal outcomes in fractures with significant displacement or joint involvement [5]. The surgical technique, in combination with the stable fixation provided by LCPs, is a key factor in the successful healing of these fractures.

However, this study also highlights some limitations. One major limitation is the relatively small sample size, which limits the generalizability of the findings. Larger cohort studies or randomized controlled trials (RCTs) comparing LCP fixation to other fixation methods, such as dynamic condylar screws or intramedullary nails, would provide stronger evidence for the superiority of LCPs. Moreover, the lack of a control group makes it difficult to draw definitive conclusions about the relative efficacy of LCP fixation compared to other methods. Future studies with larger sample sizes, longer follow-up periods, and control groups are needed to confirm the long-term benefits and outcomes of LCP fixation in elderly patients with distal femoral fractures. Another limitation of the study is the heterogeneity of fracture types, as Type A, B, and C fractures were all included in the analysis. While this reflects the diversity of distal femoral fractures in the elderly population, it also means that outcomes for different fracture types may not be directly comparable. Future studies could benefit from subgroup analyses that separately evaluate outcomes for each fracture type to provide a clearer understanding of how LCP fixation performs in the context of different fracture severities.

Conclusion

Locked compression plates (LCPs) prove to be a reliable and effective option for managing distal femoral fractures in elderly patients. The study highlights the biomechanical stability provided by LCPs, which allows for early mobilization, reduced complications, and favorable outcomes in terms of radiological union and functional recovery. Particularly in osteoporotic bone, where traditional fixation methods may fall short, LCPs offer enhanced angular stability and provide a superior solution to managing these fractures. Although the study shows positive results, including low complication rates and no nonunion or deep infections, the limitations of a small sample size and lack of control group suggest the need for further randomized controlled trials with larger cohorts to compare LCP fixation with other techniques. Future research should also focus on long-term follow-up to fully assess the durability and success of LCPs in elderly patients with distal femoral fractures.

Conflict of interest. Nil

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المستخلص

تعد كسور الفخذ السفلي من القضايا المتزايدة بين المرضى كبار السن بسبب هشاشة العظام وضعف العظام المرتبط بالعمر. تقيّم هذه الدراسة فعالية الألواح المثبتة بالضغط المغلق في العلاج الجراحي لهذه الكسور. خضع خمسون مريضاً مسناً مصاباً بكسور مصنفة وفقاً لنظام جمعية دراسة التثبيت الداخلي للتثبيت بالالواح المثبتة بالضغط المغلق في مركز البيضاء الطبي. شملت النتائج إلتحام الكسور شعاعيا، والتعافي الوظيفي المقيم باستخدام مقياس جمعية الركبة و معدلات المضاعفات . تم تحقيق التحام شعاعي في جميع الحالات في غضون متوسط قدره 12.7 أسبوعًا. كان التعافي الوظيفي ممتازًا للكسور من النوع , A ، ومرضياً للنوعB، ومتوسطًا للنوع C . كانت معدلات المضاعفات منخفضة (10%)، مع عدم وجود حالات فشل التئام أو إصابة عميقة. توفر الألواح المثبتة بالضغط المغلق استقرارًا بيوميكانيكيًا وتعزز التحرك المبكر، مما يجعلها فعالة في إدارة كسور الفخذ السفلي الناتجة عن هشاشة العظام. هناك حاجة إلى دراسات إضافية لمقارنة أدائها مع تقنيات التثبيت الأخرى.

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