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Original Research

Comprehensive Analysis of Surgical Management for Supracondylar Femur Fractures using Locking Compression Plates

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ABSTRACT:
Background: Supracondylar fractures of the femur represent a notable surgical complexity. The advent of the locking compression plate (LCP) has introduced a remarkable revolution in the management of distal femoral supracondylar fractures. **Methods**: This study, conducted by the Department of Orthopedics over the course of one year, focused on 120 adult patients with closed supracondylar fractures of the distal femur (Muller Type-A). These patients were treated with a locking compression plate. Various patient-specific factors, such as age, gender, fracture type, injury cause, affected limb, concurrent injuries, surgical timing and duration, hospitalization length (in days), follow-up schedule, complications, and ultimate outcomes, were meticulously documented and subjected to detailed analysis. The patients underwent clinical and radiological assessments at four-week intervals during the first four months, followed by evaluations every two months over the subsequent six months, and then at six-month intervals. **Results**: In this study, the average age of the participants was 24.50 years. Out of the 120 patients, 76 were male, and 44 were female. Regarding the affected femur, the right side was involved in 60 patients, the left side in 56 patients, and both femurs were affected in only 4 patients. Clinical healing was observed in all cases, occurring within a timeframe of 15 to 30 weeks. Radiologically, the formation of bridging callus became evident at the 12th week after the operation, and complete radiological recovery was achieved, on average, at 25.73 weeks, with a range of 20 to 40 weeks. In terms of the final outcomes, 84 patients (85%) achieved excellent results, 20 patients (10%) had good outcomes, and 12 patients (5%) experienced treatment failure. **Conclusion**: Locking compression plate fixation has emerged as a secure and reliable approach for managing supracondylar fractures of the distal femur. It consistently produces excellent functional outcomes and promotes early clinical and radiological healing. This method can be readily integrated into standard practice with minimal risk of complications.
Keywords: Supracondylar femur fracture(MullerType-A),Lockingcompressionplates

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INTRODUCTION

The femur, the body's largest tubular bone, plays a pivotal role in connecting the tibia and the pelvic bone. It is surrounded by an extensive muscular structure and can be divided into three segments: the proximal, middle, and distal thirds[1]. Of particular interest is the distal femur, comprising the lower 10 to 15 centimeters of the femur's total length .Specifically, the supracondylar area is the region between the femoral condyles and the point where the metaphysis meets the femoral diaphysis .The femur is relatively narrow at its mid-shaft, gradually widening as it ascends toward the upper regions and significantly broadening as it nears the lower end of the bone .In the context of fractures, a supracondylar fracture falls into Muller's Type-A category, representing a subset of extra-articular fractures within the spectrum of distal femoral fractures[2].Distal femoral fractures account for approximately 10% of all femoral fractures .These fractures present a wide range of fracture patterns and are often associated with additional injuries, such as open wounds, ligament disruptions, as well as fractures involving other areas like the acetabulum, femoral neck, femoral shaft,

tibia, patella, and more [3,4].Supracondylar femur fractures are particularly significant and can be catastrophic events. They exhibit a bimodal distribution in terms of age and gender. They tend to occur most frequently in young men following high-energy traumatic incidents, and in elderly women after low-energy falls.Significantly, severe trauma, including road traffic accidents (RTAs), falls from substantial heights, and gunshot injuries, stands as one of the primary causes of these fractures. The occurrence of these injuries is increasing, largely driven by the rising frequency of vehicular accidents and the rapid process of urbanization.The management of supracondylar femoral fractures has seen substantial changes over the years, transitioning from non-operative methods as far back as 1962 to the current era marked by biological fixation techniques and the advancement of modern implant technologies .In present times, specific surgical methods have also come to the forefront.[5] The key surgical goals for addressing these fractures involve achieving an anatomical reduction of the fracture, restoring the correct alignment, length, and rotation of the limb, addressing significant bone loss through bone grafting, and ensuring stable fixation that allows for early mobilization.Among the diverse surgical techniques available, the utilization of locking compression plates is distinguished as one of the most efficient methods, especially in situations involving extensively shattered and osteoporotic fractures. This approach shines, particularly when intramedullary fixation is not feasible due to the presence of an extremely short distal fragment.Locking compression plates offer the advantage of utilizing both locking and compression screws for securing the femur shaft. Locking screws possess notably higher pull-out strength compared to conventional screws[6]. Consequently, it is quite challenging for a single locking screw to dislodge or fail, unless all the neighboring screws experience the same problem. This characteristic enhances the stability and strength of the fixation, reducing the risk of implant failure and promoting successful healing of the femur shaft. Importantly, this enhancement in stability is particularly beneficial for bones affected by osteoporosis. These locking plates create a secure fixed-angle structure, allowing for plate placement without direct contact with the bone[7].The objective of this study was to evaluate the rate of union, functional outcomes, and complications associated with fractures treated using open reduction and internal fixation with a locking compression plate.

MATERIALS AND METHODS

Over a period of one and a half years, a prospective study was conducted in the Department of Orthopedics. The study involved 120 patients, ranging in age from 24 to 72 years, who had supracondylar femur fractures, irrespective of their gender[8]. These patients underwent locking compression plate fixation following the procurement of written informed consent.

Exclusion Criteria for Study Participants: Patients under the age of 16 were excluded from the study. Also excluded were individuals with compound fractures of the distal femur, closed distal femur fractures falling under types B and C based on the AO/OTA classification, those with pathological fractures unrelated to senile osteoporosis, pregnant patients, individuals with peri-prosthetic fractures, and those determined to be medically unfit for surgery.

OPERATIVE AND SURGICAL TECHNIQUE

The patients were positioned in a supine posture with a slight tilt toward the affected limb, rendering it in a lateral position with support from a sandbag under the buttock on the same side[9]. Following this, the skin covering the affected limb was meticulously cleaned and prepared using a solution comprising 10% povidone iodine and spirit. A sterile surgical field, extending from the buttock to the knee, was then established. To access the fracture site, a postero-lateral incision was made. After the skin incision, the vastus lateralis muscle was carefully separated from the intermuscular septum to expose the fracture site. Both fracture fragments were then attentively repositioned into their anatomical alignment through an open procedure[10]. An appropriately sized plate was selected and securely positioned using a bone clamp or reduction forceps. For achieving stable fixation, a combination of locking and conventional screws was inserted. These screws were placed after drilling through both the plate and the bone surface, using either a motorized power drill or a hand-held drill. After a thorough cleansing with a generous amount of sterile saline solution, the skin wounds were sealed using a negative suction drain, and sterile dressings were applied to the limb.[11] The operated limb was kept elevated, with both the hip and knee partially flexed at an angle of 10 to 15 degrees. The drainage tube was removed after 48 hours, and the skin sutures were taken out on the twelfth day post-surgery, at which point the patients were discharged.

RESULTS

The present study was conducted within the orthopedics department over a one-year period. It focused on analyzing treatment approaches, union rates, functional outcomes, and complications related to the treatment of 60 adult patients who had sustained closed supracondylar fractures of the distal femur, classified as Muller Type-A fractures. Among the 120 patients included, 76 were male, and 44 were female. The age range within the study cohort varied from a minimum of 18 years.

A majority of the patients, comprising 70%, had been involved in road traffic accidents (RTAs), while 30% of cases resulted from falls. Notably, there were no reported instances of sports or industrial accidents during this period. The average length of

hospitalization was 40 days, with a range from 10 to 30 days. The mean duration from injury to surgery was 15 days, with a range spanning from 10 to 28 days. The surgical procedure typically lasted between 50 and 80 minutes, and it's important to note that no intraoperative or immediate post-operative complications were encountered during the treatment process[12]. There were two cases of superficial infection, which were effectively treated with antibiotics and local wound dressings.

Patients were closely monitored over a follow-up period ranging from 1 to 18 months. Based on the parameters used to determine the final results, it was observed that 84 patients (85%) achieved excellent outcomes, 20 patients (10%) had good outcomes, and 12 patients (5%) unfortunately experienced treatment failures.

Table 1: Showing age and sex distribution of the patients

Age range(yrs.)	Male		Female		Total	
	No.	%	No.	%	No.	%
<20	02	7.69	02	7.34	04	7.5
21-30	48	53.84	08	21.73	56	42.5
31-40	10	15.38	04	14.29	14	15
41-50	02	3.85	00	00	02	2.5
51-60	04	7.69	18	21.98	22	12.5
>60	10	11.54	12	36.61	22	20
Total	76	100	44	100	120	100

Table 2: Showing Mode of Injury

Mode of injury	No. of patient	Percentage(%)
RTA	58	70
Fall	22	30

Fig 1: Mode of Injury

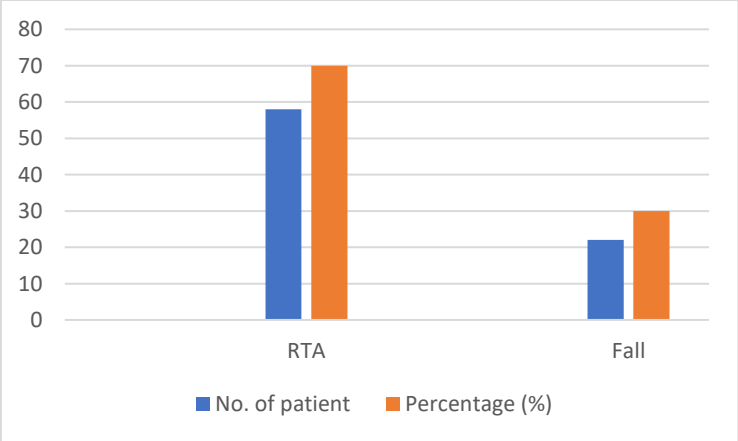

Table3: Showing final outcome

Outcome	Number of patient	Percentage(%)
Excellent	84	85
Good	20	10
Failure	12	5

DISCUSSION

Treating supracondylar fractures of the femur has historically been a significant challenge. These fractures are often unstable, comminuted, and carry the risk of causing long-term disability. A review of the existing literature reveals a wide range of implants and techniques used to manage these fractures[13]. However, the suitability of these devices depends on the presence of an adequate amount of available bone stock, which limits their use in specific types of fractures. Biomechanical studies have also shed light on issues related to implant stability, particularly concerning the loosening observed at the screw-plate interface. Furthermore, the increasing geriatric population and the prevalence of osteoporosis have added to the complexity of addressing these fractures.The locking compression plate serves as a load-bearing device, playing a crucial role in stabilizing fracture fragments and promoting the prompt attainment of bony union[14]. The Locking Compression Plate (LCP) is designed as a single-beam construct, and its fixation strength is determined

by the collective contribution of all screw-bone interfaces, rather than relying solely on the axial stiffness and pull-out resistance of individual screws, as seen in non-locking plates[15,16]. This design concept transforms the LCP into an "internal fixator." Its primary function is not compression but rather splinting the fracture, offering a more flexible form of stabilization. This approach helps in avoiding stress shielding and encourages the formation of callus at the fracture site. Importantly, the risk of vascular compromise is minimized because the plate doesn't need to be in direct contact with the bone. The conclusions drawn in this study were derived from the analysis of 120 adult patients who had sustained supracondylar fractures of the femur, specifically categorized as Muller's Type A. These patients underwent treatment through open reduction and internal fixation (ORIF) employing a locking compression plate.Out of the 120 patients included in the study, 76 were male, and 44 were female. The patients' ages spanned a wide range, with the oldest participant being 66 years old and the youngest being 18 years old. The fractures in this study were primarily attributed to road traffic accidents (RTA) in 70% of cases, accounting for 58 patients, while falls accounted for 30% of cases, involving 22 patients. Regarding hospitalization, the study revealed an average duration of 40 days, with a range from 10 to 30 days[17].

In terms of the time interval between injury and surgery, the average was 15 days, with a range of 10 to 28 days. Clinical union was observed in all cases at an average of 14.65 weeks, with a range from 10 to 30 weeks. This finding is consistent with observations made by Weight et al., where the mean time for clinical union was 11 weeks (ranging from 6 to 28 weeks), and by Bae SH et al., who reported a mean time to union of 16.3 weeks.[18]The assessment of final outcomes, utilizing the Modified Sanders criteria as a reference, revealed that the majority of patients, a total of 84, achieved an excellent outcome. Additionally, 20 patients had a good outcome, while only 12 patients experienced treatment failure. This outcome distribution aligns with the findings of Bae SH et al., who also observed excellent to good outcomes in 32 patients, fair outcomes in 8 patients, and only 2 patients with treatment failure in their study.

CONCLUSION

The locking compression plate functions as an external load-bearing device, efficiently stabilizing fracture fragments and facilitating early bony union. The combination of locked plates and screws establishes a robust screw-bone fixation, effectively preventing problems such as malrotation or shortening. However, to comprehensively evaluate the effectiveness of this implant, additional randomized controlled studies are required in diverse clinical situations.

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