

ORIGINAL RESEARCH

A Comprehensive Analysis of Supracondylar Femur Fracture Management through Locking Compression Plate Surgery

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Received: 22 December, 2016

Accepted: 27 January, 2017

ABSTRACT

Background: Supracondylar femur fractures pose a significant surgical challenge. The introduction of the locking compression plate (LCP) has ushered in a remarkable transformation in the treatment approach for distal femoral supracondylar fractures. **Aim:** The objective of this research was to assess the union rate, functional outcomes, and complications associated with fractures treated using open reduction and internal fixation via a locking compression plate. **Material and method:** This study involved the inclusion of 60 adult patients who had closed supracondylar fractures of the distal femur (Muller Type-A) and were treated with a locking compression plate. Various patient-related variables, including age, gender, fracture type, injury mechanism, affected limb, associated injuries, timing and duration of the operation, length of hospital stay (in days), follow-up schedule, complications, and ultimate outcomes, were meticulously recorded and subjected to analysis. These patients underwent clinical and radiological evaluations at four-week intervals for the initial four months, followed by assessments every two months for the subsequent six months, and subsequently, at six-month intervals. **Results:** The average age of the patients in this study was 26.50 years. Among the 60 patients, 38 were male, and 22 were female. Among the fractures, the right femur was affected in 30 patients, the left in 28 patients, and both femurs were involved in only 2 patients. Clinical union was observed in all cases within a range of 15 to 30 weeks. Radiologically, the formation of bridging callus was evident at the 12th post-operative week, with complete radiological union achieved at an average time of 25.73 weeks (ranging from 20 to 40 weeks). In terms of final outcomes, 42 patients (85%) achieved an excellent result, 10 patients (10%) had a good outcome, and 6 patients (5%) experienced failure in their treatment. **Conclusion:** Locking compression plate fixation emerges as a secure and dependable procedure for treating supracondylar fractures of the distal femur. It consistently yields excellent functional outcomes, facilitating early clinical and radiological union. This method can be readily employed as a routine practice, bearing minimal risk of complications.

Keywords: Supracondylar femur fracture (Muller Type-A), Locking compression plates

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INTRODUCTION

The femur, which is the body's largest tubular bone, serves as a crucial connection between the tibia and the pelvic bone. It is enveloped by an extensive muscle mass and can be divided into three segments: the proximal, middle, and distal thirds. In particular, the distal femur, encompassing both the supracondylar and intercondylar regions, constitutes the lower 10 to 15 centimeters of the femur's length [1]. The supracondylar area, specifically, is defined as the region situated between the femoral condyles and the junction where the metaphysis meets the femoral diaphysis [2]. The femur exhibits a relatively narrow width at its mid-shaft, gradually expanding as it ascends towards the upper regions and significantly

widening as it approaches the lower end of the bone [4]. Within the context of fractures, a supracondylar fracture falls under the category of Muller's Type-A, representing a subgroup of extra-articular fractures within the spectrum of distal femoral fractures [5]. Distal femoral fractures make up approximately 10% of all femoral fractures [6]. These fractures manifest in a diverse range of fracture patterns and are frequently linked to additional injuries, including open wounds, ligament disruptions, as well as fractures involving areas such as the acetabulum, femoral neck, femoral shaft, tibia, patella, and more [7]. Supracondylar femur fractures represent a significant and often catastrophic event, displaying a bimodal distribution with regard to 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 [1, 4]. Notably, severe trauma, such as road traffic accidents (RTAs), falls from significant heights, and gunshot injuries, ranks among the leading causes of these fractures. The incidence of these injuries is on the rise, primarily due to the increasing frequency of vehicular accidents and the rapid pace of urbanization.

The management of supracondylar femoral fractures has undergone a significant transformation over the years, transitioning from non-operative approaches as early as 1962 to the present era characterized by biological fixation techniques and the evolution of modern implant technologies [8]. In contemporary times, specific surgical techniques have also emerged. The primary surgical objectives in treating these fractures include achieving an anatomical reduction of the fracture, restoring proper limb alignment, length, and rotation, addressing extensive bone loss through bone grafting, and achieving stable fixation that enables early mobilization. Among the various surgical approaches, the use of locking compression plates stands out as one of the most effective methods, particularly in cases involving highly comminuted and osteoporotic fractures. This approach excels, especially when intramedullary fixation cannot be employed due to the presence of an exceedingly short distal fragment [9-11].

Locking compression plates enable the utilization of both locking and compression screws for femur shaft fixation. Locking screws possess significantly greater pull-out strength compared to conventional screws. As a result, it is challenging for a single locking screw to dislodge or fail unless all adjacent screws experience the same issue. This feature enhances the stability and strength of the fixation, reducing the risk of implant failure and promoting successful femur shaft healing. This improves stability in bones affected by osteoporosis. These locking plates create a stable fixed-angle structure, allowing for plate placement without direct contact with the bone [12-15]. The aim of this study was to assess the union rate, functional outcomes, and complications associated with fractures treated using open reduction and internal fixation with a locking compression plate.

MATERIALS AND METHODS:

A prospective study was carried out within the Department of Orthopedics. The study involved 60 patients, ranging in age from 25 to 72 years, with supracondylar femur fractures, regardless of gender. These patients underwent locking compression plate fixation following the acquisition of written informed consent.

EXCLUSION CRITERIA FOR SUBJECTS

Excluded from the study were patients under the age of 17, those with compound fractures of the distal femur, closed distal femur fractures falling under

types B and C as per the AO/OTA classification, individuals with pathological fractures not related to senile osteoporosis, pregnant patients, individuals with peri-prosthetic fractures, and those deemed medically unfit for surgery.

OPERATIVE AND SURGICAL TECHNIQUE

The patients were placed in a supine position, with a slight tilt to the affected limb, placing it in a lateral position with support from a sandbag under the ipsilateral buttock. Following this, the skin over the affected limb was cleaned and prepared using a solution of povidone iodine (10% v/v) and spirit. The surgical field, spanning from the buttock to the knee, was then draped. To access the fracture site, a posterolateral incision was made. After making the skin incision, the vastus lateralis muscle was carefully separated from the intermuscular septum, exposing the fracture site. Both fracture fragments were then meticulously repositioned into their anatomical alignment through an open procedure.

The selected appropriately sized plate was carefully positioned and secured in place using a bone clamp or reduction forceps. To achieve 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 thorough cleansing with a generous quantity of sterile saline solution, the skin wounds were sealed using a negative suction drain, and sterile dressings were placed on the limb. The operated limb was maintained in an elevated position, with both the hip and knee partially flexed at an angle of 10 to 15 degrees. The drainage tube was taken out after 48 hours, and the skin sutures were removed on the twelfth day following the surgery, at which point the patients were discharged.

RESULTS

The current investigation took place within the orthopedics department from July 2015 to November 2016. It involved an analysis of treatment approaches, union rates, functional outcomes, and treatment-related complications in a group of 60 adult patients who had experienced closed supracondylar fractures of the distal femur (classified as Muller Type-A). Among these 60 patients, 38 were male, and 22 were female. The age range within the study cohort spanned from a minimum of 18 years.

The majority of patients, constituting 70%, were involved in road traffic accidents (RTA), while 30% of cases resulted from falls. There were no reported instances of sports or industrial accidents during this period. The average duration of hospitalization was 40 days, with a range varying between 10 and 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 took anywhere from 50 to 80 minutes to complete. Notably, no intraoperative or

immediate post-operative complications were encountered during the treatment process. Two cases of superficial infection were effectively treated with antibiotics and local wound dressings. Patients were meticulously monitored over a follow-up period ranging from 1 to 18 months. As evaluated based on

the parameters used to determine the final results, it was found that 42 patients (85%) experienced excellent outcomes, 10 patients (10%) achieved good outcomes, and 6 patients (5%) unfortunately had treatment failures.

Table 1: Showing age and sex distribution of the patients

Age range (yrs.)	Male		Female		Total	
	No.	%	No.	%	No.	%
<20	01	7.69	01	7.34	02	7.5
21-30	24	53.84	04	21.73	28	42.5
31-40	05	15.38	02	14.29	07	15
41-50	01	3.85	00	00	01	2.5
51-60	02	7.69	09	21.98	11	12.5
>60	05	11.54	06	36.61	11	20
Total	38	100	22	100	60	100

Table 2: Showing Mode of Injury

Mode of injury	No. of patient(N=40)	Percentage(%)
RTA	29	70
Fall	11	30

Table 3: Showing final outcome

Outcome	Number of patient(N=40)	Percentage(%)
Excellent	42	85
Good	10	10
Failure	6	5

DISCUSSION

Historically, treating supracondylar fractures of the femur has posed considerable challenges. These fractures tend to be unstable, comminuted, and carry the risk of causing long-term disability. A review of existing literature highlights the diverse array of implants and techniques employed in managing these fractures. However, the applicability of these devices is contingent on the presence of a sufficient amount of available bone stock, limiting their use in specific fracture types. Biomechanical studies have further illuminated issues related to implant stability, particularly concerning the loosening observed at the screw-plate interface. Additionally, the rising geriatric population and the prevalence of osteoporosis have compounded the complexity of addressing these fractures [18].

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. 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. 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 [19]. 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 60 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 total 60 patients included in the study, 38 were male, and 22 were female. The age range of the patients varied, 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 29 patients, accounting for 70% of cases, while falls accounted for 11 patients (30%). These findings align with observations made by other researchers as documented in references [21-26]. Regarding hospitalization, the study revealed an average length of 40 days, with a range spanning from 10 to 30 days. In terms of the time interval between injury and surgery, the average was 15 days, with a range of 10 to 28 days. Similar results were also reported by Bipul et al. in 2016 [27] and Rajaiah D et al. in 2016 [25]. In all cases, clinical union was observed at an average time of 14.65 weeks, with a range spanning from 10 to 30 weeks. This finding is consistent with the observations made by Weight et al.

[29], where the mean time for clinical union was 11 weeks (with a range of 6 to 28 weeks), and by Bae SH et al. [30], who reported a mean time to union of 16.3 weeks. The assessment of final outcomes, utilizing the Modified Sanders criteria as a reference, revealed that the majority of patients, 42 in total, achieved an excellent outcome. Additionally, 10 patients had a good outcome, while only 6 patients experienced treatment failure. This outcome distribution aligns with the findings of Bae SH et al. [30], who also observed excellent to good outcomes in 16 patients, fair outcomes in 4 patients, and only 1 patient with treatment failure in their study.

CONCLUSION

The locking compression plate serves as an external load-bearing device, effectively stabilizing fracture fragments and promoting early bony union. The system of locked plates and screws creates a rigid screw-bone fixation, preventing issues like malrotation or shortening. To fully assess the utility of this implant, further randomized controlled studies are necessary in various clinical scenarios.

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