A CASE SERIES ON COMMINUTED DISTAL FEMUR FRACTURES.

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Abstract

Distal femur fractures have been more common recently, and older women and are more likely to suffer from one. The goal of the current study was to evaluate the functional and radiological results of internal fixation of distal end femur fractures treated surgically with a distal femoral locking compression plate. Additionally, to assess the success and side effects of the locking compression plate treatment of distal end femur fractures based on the rate of union, union time, infection, valgus and varus malalignment, and fixation failures. Ten patients were hospitalised in our dept of orthopaedics at Sree Balaji Medical College & Hospital.

A prospective study was conducted in the Department of Orthopaedics, Sree Balaji Medical College and Hos pital, Tamil Nadu, India, over a period of one year. It included10 patients with distal femur fracture admitted in department. Ages of

the subjects ranged from 19 to 75. Of the n = 10 participants, 8 cases demonstrated radiological union within 20 weeks, with a union period of 16 weeks on average.

In n = 10 patients, painfree weight bearing was accomplished in a mean of 12.2 weeks. There were 8 occurre nces of limb shortening: 1 patient had a reduction of 1 to 2 cm. At the end of a year, the functional outcome was evaluated by acquiring the knee function using NEER's Scoring System, 90% of the n = 10 participants had excellent to fair performance with no significant issues. Excellent (60%) patients had a functioning outcome, followed by Good (26%), Fair (10%), and Poor (4%) cases. The locking compression plate is an advancement in surgical care of these fractures, although it does not entirely resolve the enduring issues of union. It is an affordable and secure fixing method for the treatment of long bone fractures in any location. It is a favourable alternative for treatment because of the rate of union, enhanced range of motion, wound healing, improved articulation and stability, less incidence in re surgery and fast rehabilitation. Therefore, LCP may give great fixation in challenging conditions, presenting a solid treatment alternative, assuming preoperative planning and biomechanical principles are followed.

Keywords: Knee Society Score, Locking Compressive Plate, Distal Femur Fracture

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INTRODUCTION

One of the fractures that orthopaedic surgeons routinely treat is a fracture of the distal femur. Distal femoral fractures are among the most serious injuries, accounting for 4-6% of all femoral fractures and 1% of all fractures [1, 2]. The distal femur fracture in young or middle-aged people can be caused by high energy trauma or low energy trauma in elderly people, Distal femur fractures are complicated wounds with various possible consequences for the surgeon. These fractures present therapeutic challenges for treating fractures because they are typically compound, Comminuted, easily deformed due to muscle forces acting on the distal fragment, likely to cause functional impairment of the knee joint due to injury to the quadriceps mechanism, and frequently occur in Comminuted or intercondylar in "T" or "Y" fashion. Management of these fractures still sparks much debate. For the management of these injuries, there are numerous therapy options available. They are treated surgically stabilise & reduce the articular surface, restore limb alignment, and early ambulation to achieve fast union and good knee function thanks to the development of new procedures and devices by the AO group. Locking Compression plate is a more recent idea for internal fixing. Robert Frigg [5] created a special type of distal femoral "Locking Compression Plate" that combines a standard compression plate with a locked internal fixator to improve plate osteosynthesis [6, 7]. Internal fixation is possible using a mix of regular and locking head screws. The plate is completely separated from the bone in this form of plate screw fixation, which is advantageous for minimally invasive percutaneous osteosynthesis (MIPO). The distal femoral locking compression plate provides for both locking and compression screw fixation of the femur shaft and has a smaller application device [8, 9]. The locked internal fixator technique is based on scientific discoveries about the biology of bones, particularly in relation to its blood supply. The fundamental locked internal fixation technique attempts to induce spontaneous healing, including its induction of callus formation, by flexible elastic fixation. The advantages of LCP include early and active mobilisation in Comminuted fractures and osteoporotic bone, LCP were assessed by how well they function in these fractures, The current objective was to evaluate the outcome and Xray results after surgery by fixing LCP. To assess the success and side effects of locking compression plate treatment for distal end femur fractures based on union rate, healing time, infection rate, malalignment, and fixation failures.

MATERIALS AND METHODS

The Department of Orthopaedics at the Sree Balaji Medical College and Hospital in Tamil Nadu, India, conducted a prospective study with n = 10 individuals over the course of a year. The participants in the current study were those who had been hospitalised to the Department of Orthopaedics, Sree Balaji Medical College and Hospital, Tamil Nadu, with distal femur fractures (supracondylar & intraarticular extension). All patients received thorough information about the trial, and their written informed consent to participate in it was obtained. The same surgical team operated on each patient. The College Ethical Committee Board granted the Ethical Committee's permission. The duration of the follow-up period ranged from 12 to 36 months, with 12 months on average.

Every month, the patients' functional ability and radiographic fracture healing were evaluated. This series contains only post-traumatic fractures. The investigation excluded any fracture with a pathological origin. Children's supracondylar fractures were not taken into consideration either. When patients with lower end femur fractures arrived, the follow-up procedure was followed, which included examination of the patient as well as a local evaluation of the patient in accordance with ATLS standards. a complete evaluation of the patient was done to r/o injuries to the skull, brain, chest, abdomen, pelvis, or spine, as well as an assessment of the patient's age, sex, mode of injury, and time between the accident and arrival. Patients get a musculoskeletal assessment to rule out any related fractures. Patient stabilisation by the administration of IV fluids, O2, and blood transfusions as necessary. careful examination of the neurovascular condition of the damaged limb. A cotton pad was placed beneath the distal fragment of the affected limb's Thomas splint for initial immobilisation, and the patient was then transported to the Department of Radiodiagnosis. AP and lateral images of the damaged limb, comprising the entire knee joint and complete leg, were included in the radiological assessment. Povidone iodine padded dressings are applied after thorough hydrogen peroxide and normal saline irrigation and lavage of any related compound injuries. Broad spectrum injectable antibiotics, analgesics, and injections ATS 1500 IU and AGGS 20,000 IV were given as needed for compound damage to other parts.

Selection criteria

Patients over the age of 19 with supracondylar and intercondylar femur fractures who were willing to undergo surgery, patients who had distal femoral

fractures, all with recent (Gustilo types I and II, meaning less than two weeks), and surgically fit patients were all included in the study.

Patients with distal femoral fractures in children, multiple trauma patients, open wound, pathological fractures, Comminuted fractures, patients with neuro-vascular damage, patients with less than 12 months of follow-up, and patients who were bedridden were all excluded from the study.

The implants were made of plate and screws from 316L stainless steel alloy providing gun drill technique. Self-tapping locking screws measuring 4.0 mm and 5.00 mm with threaded drill sleeves and 3.2 mm and 4.3 mm drill bits, respectively, patients were given initially advance life support in Emergency room. Each case had a clinical evaluation, and the incident's history was noted or elicited. Patients with open wounds were given intravenous antibiotics during debridement and lavage under anaesthesia and continued them postoperatively as necessary. AP and lateral X-rays of the femur, as well as a pelvic X-ray to rule out proximal femur fractures, were taken as part of the radiological evaluation to determine the kind of fracture. As needed, a CT scan was performed. CBC, serum electrolytes, RFT, PT, aPTT, INR, blood sugar, blood group and Rh typing, BT/CT, serology was done.

Anaesthetic fitness was obtained, cardiac fitness was obtained.

Preoperative workup

Patients were operated on using a distal femoral locking compression plate following preoperative examination and fitness for surgery (DF-LCP). Based on the radiographs, fractures were classified using the AO-ASIF system. Pre-operative calculations were made based on the radiographs to determine the size of the plate and the precise sizes of the locking, cortical, and cancellous screws. The leg that would be operated on was ready. 10 minutes before to the surgery, 1 gram of cephalosporin was injected. The patients were positioned supine on an operating table with the affected side slightly elevated and a sandbag put beneath the ipsilateral hip joint. At the surgical site, a solution of povidone-iodine solution and spirit was used to clean, the working area was covered from the hip to the knee. A lateral technique was used to open the fracture location. Following a skin incision, the deep fascia, iliotibial band, and vastus lateralis were divided into layers until exposing surgical area, and under the supervision of an IITV, the articular surface was reduced. The fracture was compressed directly, and the proper size and shape of the plate were fixed. Conventional screws were also used to apply compression to some extent through the LCP's dynamic compression unit. The LCP's locking unit was then used to fix the locking screws. A minimum of three screws were inserted on each side of the fracture. The size and positioning of the screws were evaluated under image intensifier reduction. All the patients had suction drains, which were removed after 24 to 48 hours. The tourniquet was deflated and the incision was stitched shut in layers. Two weeks following surgery, the sutures were removed. On the third post-operative day, the suction drain was removed after 48 hours and the incision was examined. Cephalosporin, an intravenous antibiotic, was regularly administered for three days following surgery. From the second to the third post-operative day, the patients were encouraged to perform exercises for the relevant joints. On the second post-operative day, range-of-motion exercises for the hand and wrist were begun. Exercises for the elbow and shoulders were also suggested.

During follow-up visits in the immediate post-operative period, check X-rays were performed in order to look for any potential issues, In order to monitor the patients' progress, clinical and radiological evaluations were performed every three weeks for 12 weeks, every six weeks until evidence of fracture union, and then every three months after that. ROM, Xray union, complications and re surgery were the variables assessed at the 1-year follow-up. For the first six weeks, non-weight bearing crutch walking was permitted for the patients. On the basis of the follow-up radiographs' evidence of bridging callus, gradual weight bearing was initiated. Clinical examinations determined that a fracture had sufficiently healed if the location was stable and pain-free during full weight bearing. Patients were labelled completely healed when they could weight bear on the treated limb without any pain.

Failure to heal the fracture at the 9-month mark was deemed non-union; shortening of more than 2 cm or valgus/varus of more than 5° was deemed mal-union. Return to work was also assessed. At one year, all patients underwent their final evaluation. There were no unfollowed patients. Using Neer's Score System [10], clinical and functional results were assessed. Neer's criteria were utilised to rate the knee's overall functional status, and the Knee Society Scoring System [11] was employed to quantify that status.

THE RESULT AND DISCUSSION

10 participants with supracondylar femur fractures who had surgical treatment in the current study were assessed for outcomes following fixation with a locking compression plate (LCP). All of the

study participants were seen on a regular basis for clinical and radiological examination, and the follow-up period was between 12 and 36 months. The age range of the subjects in the current study was 19–74 years, with a mean age of 44 years (Table 1). In a related study, Lee et al. [12] discovered that the average age was 42 years, with a range of 18 to 82 years. According to these findings, distal femoral fractures at the knee are common in young adults because they participate in sports activities. The most common cause of distal femur fractures in adolescent age people is high-speed auto accidents.

Table:1 Age distribution

Age in years	Lower end femur	Percentage%
19-30	3	30
31-40	2	20
41-50	2	20
51-60	1	10
Above 60	2	20
Total	10	100

Male: female ratio was 3:1 among the entire n = 10 individuals, with n = 6 (60%) male cases and n = 4 (40%) female cases (Table 2). Similar to past study reports [13, 14], a 75% male predominance was seen in the current study series. Because men participate in more outdoor activities than women do, they may be more exposed to high-energy trauma

Table 2: Distribution of gender

Gender	Distal femur fracture	%
Female	4	40%
Male	6	60%

N = 7 (70%) participants had fractures on the right side, while N = 3 (30) subjects had fractures on the left side (Table 3). Because most persons are right-handed and the most active limb takes the brunt of injuries in car accidents, right side involvement outweighed left side involvement.

Table 3: right side/left side affected

	right	**left**
Distal femur fracture	7(70%)	3(30%)

In n = 6 (60%) instances, motor vehicle accidents were the cause of fractures, whereas n = 4 (40%) cases were home falls (Table 4). According to past studies [13–15], similar pattern observations were made, which shows that high velocity trauma has sharply increased with modernization. Both the frequency and complexity of distal femoral fractures are increased by high velocity trauma.

Table 4: Mode of injury

Mode	**Distal femur fracture**	**%**
RTA	6	60%
Domestic	4	40%
Total	10	100%

In a related study, Lee et al. [12] found that the majority of the participants had acute, new fractures, and that RTA occurred in 80% of cases, with the most common causes being falls from heights (11.4%), blows (5.7%), and shotgun injuries (2.8%). n = 1 (10%) fractures were Muller's Type A1 according to the AO/ Mullers classification of distal femur, n = 2 (20%) were Type A2, n=2 (20%) were Type A3, n = 1(10%) were Type C1, Type C2 were n=3 (30%), and Type C3 were n=1 (10%). (Table 5). In 8 (80%) of the individuals, the fractures were closed, while in 2 (20%), they were open.

Similar to the findings in the study conducted by Rajaiah and his colleagues [13], the majority of the fractures in the current series are of Type C in n = 5 (50%) and n = 4 (40%) of Type A. This shows that type C fractures occur more frequently than type A fractures, indicating that high energy trauma accounts for the majority of distal femoral fractures. They are unstable and linked to severe comminution.

Table 5: Fracture type accordance to AO/ muller classification.

Supracondylar fractures	No. of patients	Percentage (%)
Mullers' A1	1	10%
A2	2	20%
A3	2	20%
B1	-	-
B2	-	-
B3	-	-
C1	1	10%
C2	3	30%
C3	1	10%

The average duration from injury and operation date in the current study was 3.5 days (1 – 7 days). Nine patients (90%) had surgeries during the first three days of their injuries, while one patient (1%) underwent surgery within seven days. Short hospital stays, enhanced muscular strength, early mobilisation, better union, and adequate mobility are all benefits of early fracture treatment. In a related study by Gosling and his co-workers [16], the typical wait time before surgery was 7.5 days from 1-28days. However, according to Lee et all investigations' [12], all patients had surgery within a mean of 12 days, with a range of 1 to 30 days.

Because patients experienced less swelling and small knee abrasions at the time of presentation in our trial, there may not have been as much delay in the procedure.

Table: 6: Injury to surgery duration

Duration between injury to surgery (days)	Nos	(%)
1-3	9	90%
4-7	1	10%

Bridging callus across three cortices was used to define radiological union. In the current investigation, the average time for union was 16 weeks, and 8 (80) of the 10 participants displayed radiological union within 20 weeks (Table 9). In their investigation of 25 fractures, Lee et al. [12] discovered that the average duration for union - 4.2 months (range 3 - 7 months). In their comparative analysis, Ryan et al. [17] found that the external fixation group required an average of 7 months (range 3–15 months) compared to 6 months (range 3–14 months) for union with locking plating.

These findings suggest that various fixation techniques take longer to heal peri-articular fractures (around the knee joint) with metaphyseal extension than locking plate fixation Kim and his collaborators [18] has reported period of 13–20 weeks' time for the union, which is similar to the findings of the current study. Rajaiah et al. [13] has reported 14–25 weeks. Primary bone grafting was performed on 4 (12.5%) patients at the time of surgery, with one patient (n = 1) receiving an allogeneic bone graft. Secondary bone grafting was performed on 1 (3.13%) of the patients who experienced non-union.

Table 7: Union Time

Union (weeks)	Number	Percentage (%)
<16	5	50%
16-18	2	20%
18-20	1	10%
>20	2	20%

With n = 7 (70%) participants having knee range of motion more than 110o, the average range of flexion in the current study series was 115o (Table 10). The patient's range of the motion, which was required to permit sitting cross-legged, was given a great deal of thought in light of Indian living style and working patterns. Stannard and others [19] In their separate studies, Lee et al. [12] and Cole et al. [20] has reported the average ranges of motion of 127° (range: 90–145°), 105° (range: 0–135°), and 122°.

In their comparative analysis, Ryan et al. [17] discovered that patients handled with locked plating had an average knee flexion of 109° (range: 75–150°) as opposed to 104° in patients with external fixation. Early knee mobility can be credited for the good range of motion (average 124o) at the knee. With less intrusive techniques like LCP fixation, this problem is barely noticeable. Open reduction causes fibrosis, which in turn reduces the resulting range of motion.

Table 8: Range Of Motion

Knee flexion (degrees)	Number	Percentage
<90	1	10%
91-109	2	20%
110 & more	7	70%

In this study, 18.1 weeks on average were spent fully bearing weight (range from 9 - 34 weeks). In all cases, pain-free weight bearing was accomplished within the average period of 12.2 weeks (range 8 – 19 weeks). The average period to allow for full weight bearing, according to Cole et al. [20] that 12.5weeks (duration from 6 to 21 weeks). In the current study, n = 1 (10%) instance showed a delay in weight bearing, which may be related to concomitant injuries like patella fractures and leg bone fractures.

Table 9: Time For Full Weight Bearing

Achieved time (months)	Number	Percentage (%)
2-3	1	10%
4-5	8	80%
>5	1	10%
Total	10	100

Out of 10 participants, 7 (70%) instances experienced shortening of the limbs; these cases ranged from 1 cm to 1=2 cm in 2 (20%) cases to 1–2 cm in 1 (10%) patients (Table 12). In n = 4 (12.5%) cases, a shortening of more than 2 cm was seen.

Table 12: limb shortening (n = 10)

Shortening (cm)	Number	(%)
No discrepancy	7	70%
0.5 – 1	2	20%
1 – 2	1	10%

Using NEER's Scoring System, the functional outcome was evaluated at the end of a year in terms of restoring the lost knee function. Nine (90%) of the n = 10 individuals achieved excellent to fair results without any significant problems. Excellent (n = 6; 60% of subjects), Good (n = 2; 20%), Fair (n = 2; 20%), and Poor (n = 10; 10% of cases) were the functional outcomes (Table 13).

Table 13: radiological and functional outcome of patients (n = 10)

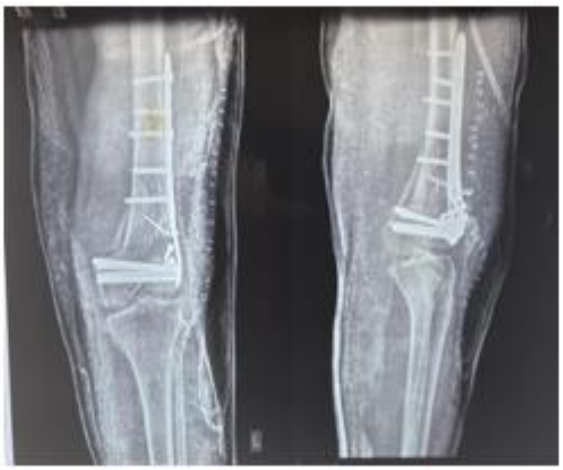
Grades	Number	Percentage (%)
Excellent	6	60%
Good	2	20%
Fair	2	20%
Poor	1	10%

Pre Op Xray – Case1

6 Weeks Follow up – Case1

12 weeks – case 1

Pre op Xray – Case 2



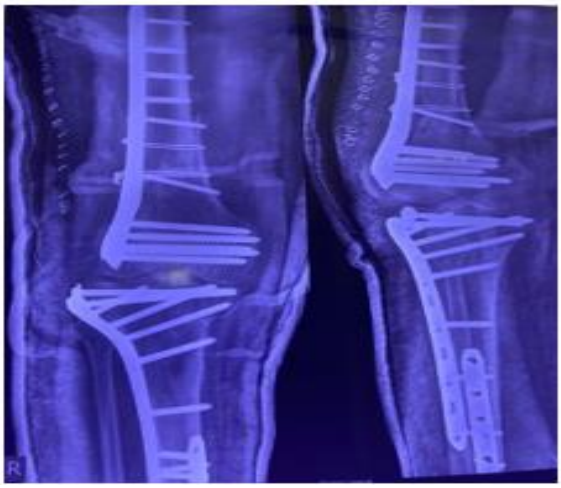
Post op Xray – Case2

Pre OP Xray – Case3

Post op Xray – Case3

Pre op Xray-case 4

Post Op Xray Case 4



Pre & Post OP Xray Case 5

COMPLICATIONS

Not a single patient had a surface infection. One patient experienced a deep infection, which required extensive wound debridement, washing, implant removal, sharpening of edges, installation of a external fixator, and bone grafting. One patient had valgus and varus misalignment, respectively.

Analysis was done on the outcomes of locking compressive plating in different kinds of distal femur fractures. These plates are made to be applied in the least invasive way possible in order to protect local biology, prevent difficulties with fracture healing and infection, and achieve high union rates with positive functional outcomes [21, 22]. The purpose of the current study was to assess the clinical and functional outcomes of distal femur fractures in patients who had open reduction and internal fixation with a distal femur (LCP, the best tool for femur supracondylar fractures is Locking compression plates. It offers firm fixation in the femur region, where fixation is challenging because to a widening canal, narrow cortices, and typically low bone stock. Compared to placing regular plates, surgical exposure for placing plates involves a lot less periosteal stripping and soft tissue exposure. To prevent issues like the creation of non-union, careful comprehension of its fundamental concepts and identification of suitable fracture patterns are crucial. The mean knee range of motion in this cohort was 0 - 1150 at a average follow-up of 12 months. The current study's findings are consistent with those of previously reported studies.

The findings reported by Rajaiah et al. [13] were similar in that there was no implant failure in this trial. One example of implant failure was reported by Yeap and Deepak [14]. In osteoporosis of bone or any periarticular fractures, locking compression plates with the option of locked screws have made it possible to increase the rigidity of fixation. Soft tissue injury was significantly reduced in this study when plating was done using the open reduction approach because less periosteal stripping and soft tissue exposure was required than with other methods. The degree of soft tissue trauma would likely be further reduced by the use of locking compression plates using minimally invasive percutaneous plate osteosynthesis and less invasive stabilisation systems.

Alignment restoration in all planes needs to be given careful intraoperative consideration. To avoid complications, the medial and lateral columns must be restored. Technical mistakes in plate installation and early ambulation in the presence of non-union fracture are two possible causes of implant failure. The healing response would be improved and the risk of mechanical failure and varus collapse would be reduced with the prudent use of bone grafts or bone-graft substitute.

The gold standard of surgical treatment has been open reduction and internal fixation with plate and screws since the late 1970s. They bridge meta-physeal comminution by acting on the internal fixator principle [23, 24]. Surgery involving locking plates aims to accomplish union with bridging callus by allowing mobility at the fracture gap while maintaining relative stability, even in

cases of poor bone quality, locking plates offer several points of fixation because, once the screws are fastened to the plate, they no longer move the fragments in the direction of the implant [27, 28].

CONCLUSION

LCP represent an advancement in how distal femoral fractures are surgically managed, although they do not entirely address the enduring issues of non-union and mal-union. It is a cost-effective and secure fixing method for the treatment of long bone fractures in any location. It is a favourable alternative for treatment because of the rate of union, enhanced mobility, better wound healing, improved articulation and stability, less incidence in re surgery and fast rehabilitation, LCP is crucial in the treatment of distal end femur fractures, particularly when the fracture is substantially Comminuted and in cases of osteoporosis. To shed additional light on the benefits, drawbacks, and potential drawbacks of using LCP, with a particular focus on the long-term effects, a more thorough study with longer follow-up periods is necessary. Therefore, LCP may give great fixation in challenging conditions, presenting a solid treatment alternative, assuming preoperative planning and biomechanical principles are followed.

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