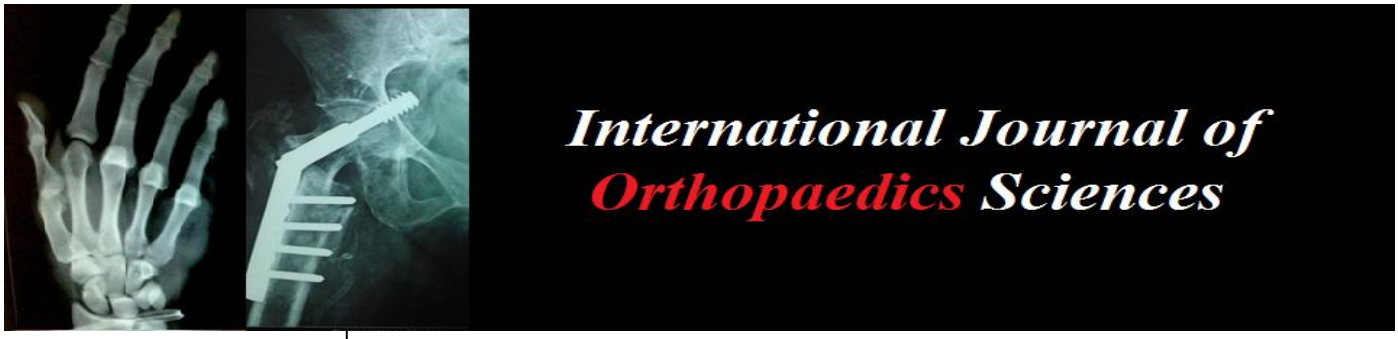

ISSN: 2395-1958
IJOS 2017; 3(4): 871-875

www.orthopaper.com
Received: 15-08-2017
Accepted: 16-09-2017

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Efficacy of distal femoral locking plate in treatment of distal femoral fractures

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DOI: https://doi.org/10.22271/ortho.2017.v3.i4l.120

Abstract
Aim: To evaluate the efficacy of distal femoral locking plate in treatment of distal femoral fractures.
Background: Distal femur fractures are one of the common fractures and constitute 1.6% of all fractures. Different treatment modalities with varying outcomes are seen in literature in the management of these fractures.
Materials & methods: The study was conducted in the department of orthopaedics at tertiary Institute of Punjab. Patients treated for distal femur fractures with ORIF using distal femoral locking compression plates were evaluated to assess their clinical and functional outcome and compared with the available literature.
Results: The mean time for union was less than 26 wks.
Conclusion: Surgery in the form of ORIF with distal femoral locking compression plate for Distal femur fracture is a comparatively good treatment option for better out come and early mobilization with minimum complications.

Keywords: Distal femur, locking plate

Introduction

Fractures of distal one third of femur supposedly are less than 1% of total fractures and stuck between 4%–6% of all femoral fractures. Supra condylar femoral fractures universally have bimodal distribution, younger generation caught up in high-energy trauma (including vehicular and motor-bike accidents and sports injuries) and senior citizens, often osteopenic or osteoporotic, sustaining trivial low-energy fall at home and ending up with femoral fractures [1]. Intra-articular fractures of distal femur present a tight spot to the orthopaedicians as these are easier said than done. Surgical management is usually prudent & carried out most of the times to have an advantageous end result because these are often comminuted and have their extension into the joint [2]. As orthopedic surgery has improvised over the years, methods in handling of supracondylar and intercondylar (intra articular) femur fractures now by and large engross varied surgical techniques. The aim of surgical management are to have a anatomical or near anatomical reconstruction of the articular surfaces and also to have reduction of the metaphyseal component to the diaphyseal one, restitution of normal axial alignment, length and rotation, in the last but not the least a stable internal fixation followed by early mobilisation and functional rehabilitation of the limb [3]. Internal fixation devices that used in the past and present to treat these fractures comprise of 95° angled blade plate, dynamic condylar screw plate (DCS), condylar buttress plate and retrograde supracondylar inter-locking nail. As the intricacy of these fractures has altered from simple extraarticular supracondylar types to intraarticular (inter condylar) and metaphyseal comminuted types, implants used till now may not meet the requirements. Double plating, and/or of late, locked plating (LP) technique have been advocated. But in double plating, there is often extensive soft tissue stripping on both medial & lateral sides of the femur, resulting in decreased blood supply and impending non-union and/or failure of the implant. The Less Invasive Stabilization System (LISS) allows for fixed angle fixation of the distal femur and minimally invasive percutaneous osteosynthesis (MIPO) of the femoral fracture. On the other hand, there has been apprehension that the implant may be too stiff, and when coupled with non-compliant premature weight

bearing, may lead to breakdown of the implant. Distal femoral locking compression plate (DF-LCP) has a smaller hybrid appliance and permits both locking and compression screw fixation of the femoral shaft. This present study was conducted to examine the short term results of clinical, Radiological, functional and union rate of distal femoral fractures treated with distal femoral locking compression plate (DF-LCP). The prologue of fixed-angle locking plates with has enhanced the fixation might of plate constructs and now are often practiced [4].

Classification

AO classification is still the most extensively used system to categorize distal femur fractures. Other classifications by Neer, Seinsheimer, and Egund and Kolmert have also been proposed. AO classification however has unanimously gained acceptance for distal femoral fractures in preceding few years. According AO classification,

Type A: fractures are extra-articular.

Type B: fractures are partial articular, which means that parts of the articular surface remain in contact with the diaphysis. It is further subdivided into

- B1 (sagittal, lateral condyle),
- B2 (Sagittal, medial condyle),
- B3 (Frontal, Hoffa type).

Type C: fractures are complete articular fractures with detachment of both condyles from the diaphysis. It is further subdivided into

- C1 (Articular simple, metaphyseal simple),
- C2 (articular simple, metaphyseal multifragmentary),
- C3 (Multifragmentary) [6]. indicated for bridge plating of comminuted fractures [4].

Aim and objectives

To evaluate the clinical and radiological outcome of the treatment of distal femur fractures by distal femoral locking compression plate (DFLCP).

Material and Methods

The present study was conducted in the Department of Orthopaedics of a tertiary hospital of Punjab in a period of one year from June 2016 to June 2017.

STUDY DESIGN: Prospective study

SAMPLE SIZE: 25 patients with distal femur fractures (with supracodylar and intra-articular extension) who underwent operative procedure from June 2016 to June 2017 were selected.

Selection criteria

Inclusion Criteria

- All patients with > 18 years of age having supracondylar and intercondylar fractures of femur.
- All fresh fractures (gustilo type I and II) i.e. less than 2 weeks with willingness for surgical management and
- Patients without any proposed contraindications for surgical management.

Exclusion criteria

- Patients unfit for the surgery or having pre-existing hip/femoral deformity.
- Patients with polytrauma.
- Open / pathological/ bilateral fractures.
- Patients with less than 01years of follow-up.
- Compound fractures.
- Patients who were bed ridden or non-ambulatory.

All Patients were operated under general / spinal and/or epidural anaesthesia. Patients were placed in supine position on operating table slightly elevating the affected side with a sandbag under ipsilateral hip joint. Skin at the operating site was cleaned & prepared by povidone iodine (10% w/v) solution and spirit and the operating field from the hip to the knee was draped. Fracture site was opened through a lateral approach. After skin incision deep fascia, illiotibial band and vastus lateralis was split in layers till the fracture site was exposed and reduction of fracture is maintained with the help of bone clamps bone reduction forceps.

The appropriate chosen sized plate depending upon fracture pattern was placed into position and stabilized with bone clamp or reduction forceps. Then rigid fixation was achieved by insertion of variable number of locking screws which were inserted after drilling the bone through the plate and bone surface by motorized drill under c-arm guidence. Compression screws were placed as and when needed before the placement of locking screws. The wound was closed in layers over a negative suction drain after thorough washing with copious amount of sterile saline solution and sterile antiseptic dressings applied over the wound. Postoperatively passive and active movements of toes were encouraged. Patients received prophylactic intravenous antibiotics were administered as per protocol. Anti-inflammatory analgesics and other supportive measures were also given as per individual requirements. The suction drain was removed after 24-48 hrs and check x-ray (AP/Lat) of the thigh with knee was taken.

Patients were allowed to sit out of bed once the drain was removed. Knee range of movements and active quadriceps and hamstring exercises were put into action, as soon as patient could tolerate pain from immediate post-operative day and non-weight bearing started with help of walker. Alternate skin suture were removed on the 10th post-operative day and the remaining on 12th post-operative day. Patient discharged thereafter with appropriate post- operative instructions in black and white

Pre- Operative X-Ray

Post Operative X-Ray

Results and observations

Table 1: Age Distribution

Age	Cases	Percentage (%)
31-40	07	28.0%
41-50	05	20.0%
51-60	06	24.0%
61-70	04	16.0%
71-80	03	12.0%

❖ 88% of the patients were in age group of 31-70 years
48% of the patients in the present study were in age group of 31 -50 years while 40% were in 51-70 years of age.

Table 2: Sex distribution

Sex of The Patient	No. of Patients	Percentage (%)
Male	20	80.0%
Female	5	20.0%
Total	25	100%

- Males were affected more than females

80% of the patients in our study were male patients and 20% were female patients.

Table 3: Mechanism of Injury

Mechanism of Injury	No. of Cases	Percentage %
Road traffic accident (RTA)	22	88.0%
Falls from stairs, height or slippage etc.	03	12.0%
Total	25	100%

- RTA was the common (88%) cause.

Major trauma was due to road traffic accidents (88%) whereas 12% fractures occurred due to accidental falls in elderly population.

Table 4: Side affected

Side Affected	No. of Patients	Percentage
Right	17	68.0%
Left	08	32.0%
Total	25	100%

- Fracture occurance was more on right side.

Right side was affected more commonly (68%) and left side was affected in (32%).

Table 5: Fractures type as per AO classification

Type of Fracture	No. of Patients	Percentage (%)
Type A	03	12.00%
Type B	13	52.00%
Type C	09	36.00%
Total	25	100.00%

In our study, we used AO classification, majority(88%) were classified as having type 2 and type 3, making this the commonest type in our study followed by 12% of type I fractures.

Table 6: Associated injuries

Type of Injury	No. of Patients	Percentage %
Head injuries (Concussion)	01	04%
Chest Injury	NIL	NIL
Fracture Both Bones Leg	02	08%
# Metatarsals Ipsilateral foot	01	04%
Ipsilateral Colle's Fracture	01	04%
Ipsilatateral Clavicle #	01	04%
Total	06	24%

- Patient with Head injury had no complications pre or post operatively

In our study 24% of the patients had associated injuries. 04% had fractures of metatarsals, another 04% had ipsilateral colle"s fracture and clavicle fracture, 08% had fracture of both bone leg. 04% patients had concussion injury of head.

Table-7: Trauma – surgery interval

Trauma-Surgery Interval	No. of Patients	Percentage %
< 2 Days	20	80.0%
3-5 Days	03	12.0%
>5 Days	02	08.0%

- 80% of patients were operated within 2 days of injury

80% of patients were operated within 2 days of injury, 12% within 3-5 days and 08% were operated more than 5days after injury.

Table 8: Average duration of surgery

Average Duration (Minutes)	No. of Patients	Percentage (%)
<60	13	52.0%
60-90	09	36.0%
90-120	03	12.0%
Total	25	100.0%

- Average duration of surgery was 65,7 minutes

In 52% of cases surgery was done in less than 60 minutes and in 36%, lasted between 60-90minutes.

Table 9: Blood transfusion

No. of Unit	No. of Cases	Percentage (%)
1	03	12.0%
2	01	04.0%
Total	04	16.0%

- 12.0% cases each required one unit of blood.per operatively

16% cases required blood transfusion out of which 12.0% cases required only one unit of blood.

Table 10: Post-operative complications

Complications	No. of Patients	Percentage (%)
Early		
Superficial Wound Infection	02	08.0%
Shortening	01	04.0%
Mortality	Nil	Nil
Late		
Malunion	01	04.0%
Deep wound infection	01	04.0%
Delayed union	02	08.0%
Non union and implant failure	Nil	Nil
Knee stiffness	01	04.0%

08% had superficial wound infection, were cured after proper I/V antibiotics and sterile dressing. 04% had deep wound infection, 04% patient had varus malunion and 08% went into delayed union. Only 04% developed knee stiffness.

Table 12: Radiological union time

Time For Radiological Union	No. of Patients	Percentage (%)
< 26 weeks	20	80.0%
20-28weeks	04	16.0%
>28 weeks	2	08.0%

- The average radiological union time was < 26 weeks

Successful fracture union was defined as complete bridging callus in 3 cortices along with painless full weight bearing. Above table shows that in our study 80% of patients showed fracture union within < 26weeks followed by 16% of patients in 26-28weeks and remaining 28% in more than 28 weeks.

Functional and Anatomical Grading According To Rasmussens' Criteria.

The results obtained were analysed as excellent, good, fair and poor according to criteria given by Rasmussen. Based on functional criteria we recorded excellent results in 15 cases (60%), good in eight cases (32%), fair result in two cases (8%) with no poor result (table 13).

Table 13: Distribution of Cases According To Functional Grade

Functional grade	Number of cases	Percentage
Excellent	15	60
Good	8	32
Fair	2	8
Poor	0	0
Total	25	100

Based on anatomical criteria we recorded excellent results in nine cases (36%), good in 16 cases (64%) with no fair and poor result (table 14).

Table 14: Distribution of Cases According To Anatomical Grade

Anatomical grading	Number of cases	Percentage (%)
Excellent	9	36
Good	16	64
Fair	0	0
Poor	0	0
Total	25	100

Discussion

In the present prospective study, 25 cases with distal femoral fractures around knee joint were evaluated for results after fixation with locking compression plate. The average age in the present study was 40.96 years (ranging from 31 to 70 years). Horesh Z *et al* in their study found an average age to be 40.6 year (range from 30 to 70 years) [5]. Lee JA *et al* in a similar study found the average age to be 42 years ranging from 18 to 82 years [6]. This reflects that distal femoral fractures around knee joint are common in young adult age group who are involved in outdoor activities. In our series 20 cases were male and 5 cases were female. The male to female ratio were 4:1. Blocker CP *et al* in their study on 64 patients had 34 male and 30 female with male to female ratio of 1.13:1 [7]. The high male to female ratio in our study is probably because males are more involved in outdoor activities especially in our Indian scenario. In our study 17 cases had right sided injury and 08 cases had left sided injury. The ratio of right: left lower limb involvement was 2.1:1. Ryan *et al* noted right to left leg ratio of 1.4:1 [8]. The more involvement of right leg in our study is probably because right side is the dominant side in most of the people and during road traffic accidents the brunt of injury falls on the most active limbs. We had maximum number of 22 cases due to RTA (88%), followed by fall from height 3 cases (12%). Lee JA *et al* in a similar study reported an incidence of 80% due to RTA, 11.4% due to fall from height, 5.8% due to blow and 2.8% due to shotgun injury [6]. This suggests that distal femoral factures around knee joint commonly occurs due to high energy trauma. In our study out of 25 cases of fractures of distal end femur, three cases were Type A (12.0%), 13 were Type B (52.0%), nine was Type C(36.0%), as per A.O classification. This suggests that with modernization there has been a steep increase in high velocity trauma. In our study there were 17 simple fractures (68%) and eight open fractures (32%). Of open fractures according to Gustilo and Anderson classification three were of grade II (12%), one was grade III A (4%), two were grade III B (8%) and two were grade III C (8%). Ali *et al* in their study of 20 patients found five cases (25%) of open fractures, of which three cases (15%) were Gustilo grade IIIA and two cases (10%) were grade IIIB [9]. This suggests that with increasing incidence of high velocity trauma, the cases of open fracture are on the rise. In our study, Polytrauma was present in 06 cases (24%) (one case of head injury, two cases of contralateral fractures of both bone leg, one case of fracture metatarsal, one case of clavicle and one case of colle's fracture). This suggests that high velocity trauma is often associated with multiple injuries. In our study the average interval between injury and surgery was 3.36 days (ranging from 1 to 8days). 80% of cases (20 cases) were operated within first two days of injury. Gosling T, Schandelmaier P, Mullar M in their similar study found average time to surgery was 7.5 day (range 0 to 28 days) [10]. Lee JA *et al* found that all patients underwent operation within a mean time of 12 days (range 1 to 30 days) [6]. The lesser delay in surgery in our study could be because our institute is tertiary care centre where patients came after primary management outside. Secondly, at the time of presentation patients had less swelling and minor abrasions around knee. In our study the average period of hospital stay after surgery was 14.4 days (ranging from 4 to 36 days). Sangwan SZ *et al* found the average duration of hospitalization were six days (ranging from 2 to 17 days) [11]. Thimmegowda M *et al* found average hospital stay was 10 days (ranging from 7 to 21 days) [12]. The long duration of hospitalization was due to fact that our institute is located in a metrocity, at away from rural areas. Patients prefer to get their stitches removed before being discharged. In our study, the mean time of full weight bearing was 19.2 weeks (range from 12 to 32 weeks). Cole PA, *et al* found the mean time to allowance for full weight bearing was 12.6 weeks (ranging from 6 to 21 weeks) [13]. The delay in weight bearing in our study is because patient had associated injuries like fracture both bones leg, fracture metatarsals. In our study the average time to union was 20.32 weeks (range from 14 to 26 weeks). Lee JA *et al* in their similar study found average time to healing of the 25 fractures as 4.2 months (range 3 to 7 months) [6]. Ryan JK *et al* in their comparative study found that average time to union with locking plating was six months (range 3 to 14 months) versus seven months (range from 3 to 15 months) in external fixation group [8]. This suggests that periarticular fractures (around knee joint) with metaphyseal extension take longer with other methods of fixations when compared with locking plate fixation. In our study the overall range of motion at knee joint averaged 124 deg. (range 30-150 deg). Stannard JP *et al* [14] in their similar study measured average range of motion of 127 deg. (range 90-145deg) [14]. Lee JA *et al* in their similar study found overall range of motion averaged 105 degree (range 0-135 deg) [6]. Cole PA *et al* in their study found mean range of final knee motion of 122 d eg [13]. Ryan JK *et al* in their comparative study found that the average knee flexion in locked plating patients was 109 deg. (range 75-150 deg) versus 104 deg. in external fixation patients [8] Good range of motion (average 124 deg) at knee can be attributed to early

knee motion. Open reduction increases fibrosis and thus decreases subsequent range of motion, but this difficulty is minimally seen with less invasive methods like LCP fixation. In our study, primary bone graft was used in 20% of cases in severely comminuted fractures of distal end femur. Gosling T, Schandelmaier P, Muller M in their study used primary bone grafting in 19% of patients [10]. The mechanical principle of plates with locking head screws is similar to external fixation. For external fixation, non union rates of 0-4% without bone grafting have been reported [9, 10]. This suggests that routine primary bone grafting of the metaphyseal defect is not necessary with locking head screw plates. To achieve union in one case of fracture of distal end of femur, secondary bone grafting had to be done at shaft fracture site. This suggests that in such cases with segmental fractures, primary bone grafting should be done at shaft fracture site. In our series, deep infection occurred in one case (4%), a case of open fracture (according to Gustillo Anderson classification, it was of grade III). It was treated with irrigation and debridement followed by antibiotic therapy and infection resolved with four weeks" of antibiotic treatment. These finding are supported by studies by Egol *et al* [12] with no reported infection, Stannard *et al* with a 5.9% rate of infection[14], Cole *et al* with an infection rate of 4% [13]. Ryan *et al* with an infection rate of 7% in locking group and 13% in external fixator group [8] and Lee *et al* with deep infection of 8% [6]. The infection rate seen in their study (4%) could be expected as distal femoral fractures are high energy injuries with high rate of soft tissue complications. The less incidence of infection in locking plate using minimal invasive technique is due to aseptic technique, minimal soft tissue handling, small invasion and minimal duration of surgery. This gives this method an edge over open methods where extensive exposure is made and a lot of hardware is used especially in bicondylar fractures. In our study, the postoperative malalignment occurred in a total of 12 cases (48%), although it was believed to be of clinical significance (i.e>5 degree) only in 5 cases (20%). In three cases, there were coronal plane malreduction (valgus/varus) and in two patients there were sagittal plane malreduction. The articular malreduction was seen in eight patients (32%) but it was of clinical significance (i.e >4mm of step) in only two patients (8%). Lee *et al* in a similar study noted malalignment of eight fractures (32%) postoperatively, in one case fracture healed in six degree of varus and in seven cases fractures had an articular angulation (in the sagittal plane) of six degree. There was no case of secondary loss of reduction [6]. Cole *et al* cited 3.9% of incidence of Malalignment [13]. Ryan *et al* in their comparative study reported malunion (angulation and articular depression) in 14% of cases in locking group compared to 43% in cases of external fixator group [8].

Conclusions

It is concluded that Locking Compression Plate offers a good treatment option for periarticular fractures of distal end of femur without any need for additional medial stabilization, as it provides

- Improved healing rate,
- Restoration of articular surface,
- Better biomechanical stability,
- Increased range of motion,
- Decreased complication rate,
- Decreased incidence of re-operation,
- Early rehabilitation.

Long term follows up and prospective randomized study would certainly add to validity of these conclusions.

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