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A prospective study of treatment of distal femur fractures with locking condylar plate

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ABSTRACT

Background: Multiple implants are available to treat distal femoral fractures. The recent addition is the locking plate contoured to the distal femur with combiholes in the proximal portion. Though it is established that locking plates offer higher stability than the previous implants like dynamic compression screw or condylar buttress plate, some studies showed higher incidence of delayed union. We evaluated 30 type A and type C distal femoral fractures treated with locking condylar plate in our institutes.
Methods: We conducted a prospective study on 30 consecutive patients with fractures of distal femur operated with locking condylar plate from December, 2015 to February, 2017. Patients were regularly followed up with x-rays and clinical examination. At the end of one year follow-up, patients were evaluated with Pritchett score.
Results: Fracture union was seen in all patients. Union was faster in type A fractures than in type C intra articular fractures. 67% of patients achieved excellent to good grading according to Pritchett rating system.
Conclusions: Locking condylar plate is effective in treating distal femoral fractures with minimal complications.

Keywords: Distal femur locking plate, Distal femur fractures, Intra articular fractures

INTRODUCTION

Distal femoral fractures cause considerable morbidity to the patients. They are frequently comminuted and extend into the knee joint. They follow bimodal distribution.[1] A low velocity injury like fall at home can cause comminuted distal femoral fracture in osteoporotic bone. Motor vehicle accidents are the usual cause of these fractures in young individuals. If not properly treated, they accelerate osteoarthritis of knee joint, apart from multiple early complications like knee stiffness and shortening.

Distal femoral fractures were used to be fixed with condylar blade plate, dynamic condylar screw and condylar buttress plate. The complications like delayed union and non-union were shown to be frequent with dynamic condylar screw.[2] Locking compression plate for distal femoral fractures is a relatively recent innovation. Locked plates act as internal fixators. Because the screws are locked into the plate, all the screws and plate act as single construct and this decreases varus collapse. In contrast to compression plating, locked plates facilitate callus formation and secondary bone healing.[3] Locked plates were consistently shown to have less failure rates than compression plates in osteoporotic fractures.[4,5]

We studied 30 fractures of distal femur operated with locking compression plate in our institutes from December, 2015 to February, 2017.

METHODS

30 patients with fractures of distal femur who were operated with locking compression plate in Kamineni Institute of Medical sciences, Narketpally and GSL Medical College, Rajahmundry, from December, 2015 to February, 2017 were prospectively taken into study

Inclusion criteria

Inclusion criteria were distal femur fractures within 15 cm from the articular surface; femoral Shaft fractures extending to the supracondylar region; Grade I, II and IIIA Gustilo-Anderson compound injuries; AO types I and III fractures.

Exclusion criteria

Exclusion criteria were Gustilo-Anderson Grade IIIB and IIIC compound injuries; isolated AO type B fractures; pathological fractures; periprosthetic fractures.

All patients were operated on a standard radiolucent table under C-arm guidance. Lateral approach was used for type A fractures and anterolateral approach was used for type C fractures. If intercondylar component was present, it was reduced through open method and was fixed with two k wires. In minimally invasive method, metaphyseal fracture was reduced with closed manipulation. A five cm long incision was given on lateral aspect of the thigh proximal to the fracture. Plate was slid along the bone from the distal incision and was positioned accurately on the shaft with k-wires proximally and distally. Distal locking screws on condyles were placed first. Proximally, the plate was firmly fixed to the bone with compression screws and then locking screws were applied. The holes over comminution were left empty. Plate was applied with minimally invasive technique in 20 patients and through open approach in 10 patients. Open reduction was done for fractures which were more than two weeks old. Fractures were fixed with 4-5 screws on either side.

Stainless steel plate was used in all cases. Primary bone grafting was done in five cases with bone graft substitute. After procedure, fracture stability was checked with flexion and extension of knee.

All surgical wounds healed primarily. Quadriceps and hamstring strengthening exercises and knee range of motion exercises were started on second post-operative day. Weight bearing was delayed up to 12-16 weeks, depending on the callus seen on check x-rays.

Patients were reviewed at six weeks, three months, nine months and one year intervals. The average follow-up was ten months. At the end of one year or at the last follow-up, patients were evaluated for union of the fracture, malunion, shortening, pain on walking and knee stiffness. Malunion was defined as angulation of more than 10^{o} in coronal or sagittal planes. The functional status was assessed with Pritchett rating system.

We compared types A and C fractures in terms of time required for union and knee range of motion attained at three months. Statistical analysis was done with unpaired 't' test and p values were calculated to check the significance in variation.

RESULTS

20 fractures were closed injuries and 10 were compound fractures. There were 21 males and nine females on our study with an average age of 50 years.

Table 1: Distribution of the patients by sex.

Sex	Incidence	Percentage (%)
Male	21	70
Female	9	30

Table 2: Distribution of the fractures by mechanism.

Mechanism of injury	No. of fractures	Percentage (%)
Road traffic accident	22	73
Injury at home	8	27

Table 3: Distribution of compound fractures.

Type of compound fracture	No. of fractures	Percentage (%)
Grade I	5	50
Grade II	2	20
Grade IIIA	3	30

According to AO classification, 16 were extraarticular type A fractures and 14 were intraarticular type C injuries. The classification was shown in Table 4.

Table 4: Distribution of cases according to AO classification.

Fracture type	Number of cases	Percentage (%)
A1	2	6.7
A2	4	13.3
A3	10	33.3
C1	3	10
C2	9	30
C3	2	6.7

All fractures united with an average union time of 18 weeks. Union in six patients was delayed up to 24-28 weeks. Delayed union was seen in patients who developed infection or who were smokers.

Out of 30 patients, 12 patients were individuals aged more than 60 years. 10 of these patients had pre-existent osteoarthritis of knee joint which limited their pre injury knee flexion. The knee range of motion was measured in all patients at three months follow-up. In patients below 50 years, average range of 115^{o} was achieved. In older population with osteoarthritis of knee joint, the average arc of motion was 95^{o}.

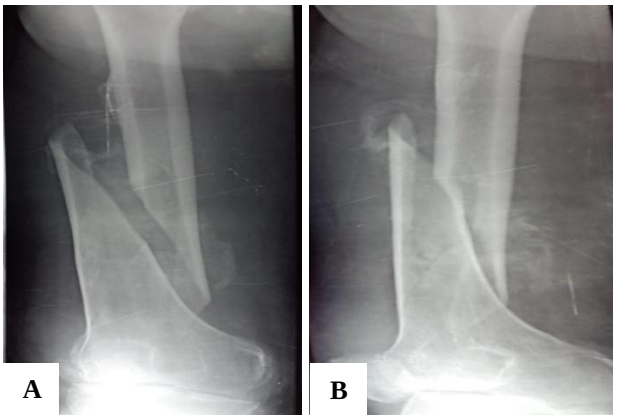

Figure 1 (A and B): Three months old spiral fracture from supracondylar area to mid shaft.

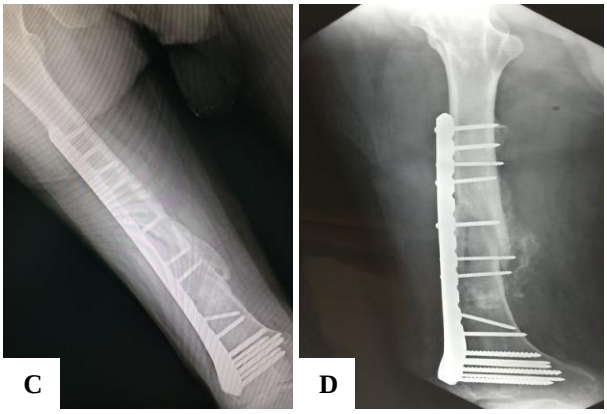

Figure 1 (C and D): Union of the fracture four months after open reduction and fixation.

Figure 1 (E and F): Complete extension and flexion up to 105^{o} in the same patient.

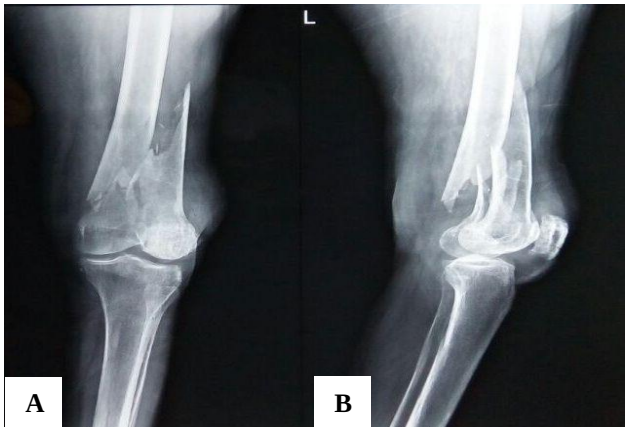

Figure 2 (A, B): Type C2 fracture.

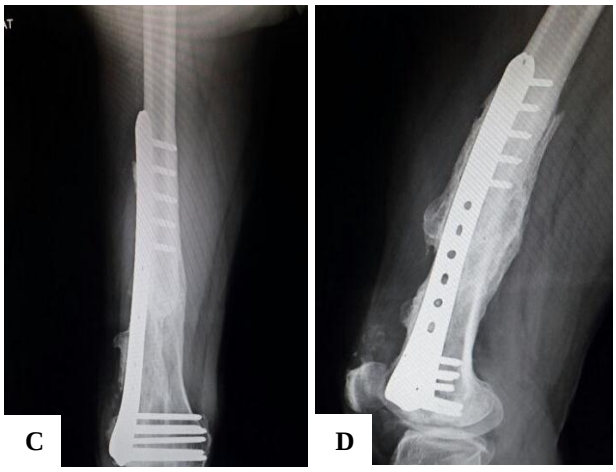

Figure 2 (C and D): Union of the fracture.

Fixation of three months old non union of long spiral fracture of femur through open reduction, its subsequent union and patient's range of motion were shown in Figures 1. Union of type C2 fracture was shown in Figure 2.

The knee flexion achieved by the patients was shown in the Table 2.

Table 5: Knee flexion at three months after surgery.

Degrees of knee flexion	No. of patients
<90	2
91-119	20
>120	8

Superficial infection was encountered in five cases which subsided with appropriate antibiotics. Union in these patients was delayed up to 28 weeks. Shortening of more than 1.5 cm was present in three patients. Two patients had varus deformity of more than 10^{o}. This may be due to early weight bearing by the patients.

At one year follow-up, four patients (13%) were complaining of moderate pain on walking. They were

confined to home. The rest of the patients were pain free. 20 patients returned to pre injury profession.

On an average, the time required for union in type A fractures was 13±0.83 weeks and in type C fractures was 18±1.55 weeks. The 't' value was 15.57 with a significant p value of 0.00.

The average range of motion attained in type A fracture was 111.33±11.59^{o} and in type C fractures was 100.33±10.08^{o}. The 't' value was 3.92 with a significant p value of 0.0002.

The outcome was graded according to Pritchett rating. It is shown in Figure 2. The two patients whose results were graded as poor were about 70 years old and had severe osteoarthritis in the opposite knee.

Table 6: Grading of results according to Pritchett rating system.

Grade	No. of patients (%)
Excellent	8 (27)
Good	12 (40)
Fair	8 (27)
Poor	2 (6)

80% of type A fractures had excellent to good result, while 50% of type C fractures had the same result.

DISCUSSION

Distal femoral fractures constitute 4-6% of total fractures of femur. Since they are close to the knee joint, complications like knee stiffness and secondary osteoarthritis cause considerable disability to the patients.

The implants for fixation of distal femoral fractures evolved through condylar blade plate, dynamic condylar screw (DCS), condylar buttress plate (CBP) and locking condylar plate (LCP). Dynamic condylar screw and condylar blade plate cause considerable defect in the condyles because of the size of the blade and lag screw. Condylar buttress plate cannot effectively stabilize distal femoral comminuted fractures or fractures in osteoporotic bone. To counteract these problems, nowadays locking condylar plate has become a preferred implant in treating distal femoral fractures.

We treated all type A and type C fractures exclusively with locking condylar plate in our institutes during our study period. We observed substantial variation of union time between type A and type C fractures. While supracondylar fractures united in 12-14 weeks, intercondylar fractures required 16-20 weeks for union. This is in contrast to the results obtained with condylar buttress plate or DCS in intercondylar fractures with CBP and DCS, which we used earlier. The union time was considerably less, but incidence of malunion was high. We do not have any experience with condylar blade plate.

In type C fractures, we reduced articular fragments initially, and fixed them with two k-wires. After reducing the metaphyseal portion to the condylar block, we fixed LCP to the lateral aspect of femur. We did not use any lag screw in the condylar region as it may interfere with the rest of the locking screws. We noticed that there was no intercondylar compression with LCP, as opposed to fixation with DCS or CBP. We think this lack of compression to be the main reason for longer periods required for union of type C fractures. But LCP provided definite advantage in osteoporotic bones where the risk of pulling out of screws is high and also in comminuted fractures, where it provides greater stability.

Shortening was present in 10% and varus deformity in 7% of our patients. Excellent to good result was obtained in 67% of patients.

An evaluation of 111 distal femoral fractures including 35% open fractures treated with LCP in two trauma centers was done by Hoffmann et al[6]. 18% of patients developed non-union or delayed union, out of which hardware failure was seen in 10%. But they found that non-union rate was significantly higher in open reduction group (32%) compared to minimally invasive group (10.7%). The higher number of non unions may be due to more number of high energy compound injuries.

80% excellent to satisfactory result was obtained by Virk et al in 25 patients with distal femoral fractures treated with LCP.[7] Their study included 52% compound injuries, but Grade IIIB and Grade IIIC compound fractures were excluded. Bone grafting was done in 36% of cases, which was higher than in other studies. The average union time of 19 weeks was similar to our series.

Kumar et al reported excellent results in intraarticular fractures treated with LCP.[8] Out of 46 cases, only one case of implant failure was seen, with an average radiological union time of 14 weeks in rest of the cases. Similar results were attained by Viswanath et al in 78% of their cases, of which 44% were compound. They observed delayed union in 8% of cases.[9]

Shriharsha et al opined that fractures of distal femur united early in closed fractures and where bone grafting was done.[10] But the difference in time for union in their study was only two weeks in closed vs. open fractures and also in simple vs. compound fractures. 48% of fractures were bone grafted in this series. They also observed that excellent result was obtained in 80% of closed fractures, while it was 20% in open fractures.

Menon et al studied 25 distal femoral fractures operated with LCP through minimally invasive technique.[11] They obtained good result in 88% of patients with varus angulation in two patients and shortening in two patients.

They attributed these to premature weight bearing. Similar result was achieved by Rajaiah et al.[12] They noted that type C fractures took longer time to unite compared to type A fractures.

60 patients treated with LCP for distal femoral fractures were evaluated with Pritchett rating system by Ashok Reddy et al.[13] Half of the injuries were type C fractures and two-thirds were compound injuries. 83% achieved excellent to good result with 3% non-union rate.

CONCLUSION

Locking condylar plate is effective in treating distal femoral fractures. They should be especially considered for comminuted fractures and fractures in osteoporotic bones. The main disadvantage is the lack of intercondylar compression in intra articular fractures, unless LCP is supplemented with cancellous screws. Since condylar part of LCP is usually provided with six locking holes, it is our opinion that one or two holes can be redesigned to accommodate cancellous screws.

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Ethical approval: The study was approved by the institutional ethics committee

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