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Distal Frmoral Fractures Fixation by Locking Compression Plate: Efficacy & Complications

KEYWORDS

Dr. Arvind Kumar Bohra	Dr. DIlip Sharma	Dr.Chetan Shrivastava
Associate Professor, Department of Orthopaedic S.R.G.Hospital & Medical College, Jhalawar;(Rajasthan)	Assistant Professor. Department of Orthopaedic S.R.G.Hospital & Medical College, Jhalawar; (Rajasthan)	Assistant Professor; , Department of Orthopaedic S.R.G.Hospital & Medical College, Jhalawar; (Rajasthan)

ABSTRACT *Locking compression plate (LCP) is a good fixation system for distal end femoral fractures particularly intra-articular type. The device provides good angular stability by its triangular reconstruction principle and thus helps in early mobilization, even in communited fractures where other modes of fixation often tend to delay the process of mobilization because of lack of stability. Preferably can be used in osteoporotic fractures were it provides a solution to the age old problems of screw cut out, late collapse, and misalignments since the stability of the construct does not entirely depend on the quality of the bone. This goes further to say that understanding the basic principles of fixation and the appropriate indications for use of LCP in fractures of distal end femur is a must, before its use. The final flexion achieved also depended on education level, compliance level and the motivation of the patient.*

INTRODUCTION

The incidence of distal femur fractures is approximately 37 per 1,00,000 person-years.[1] Distal femoral fractures mainly arise from two different injury mechanisms. They are often caused by high energy trauma mainly sustained in road traffic accidents. Open injuries with considerable comminution of condyles and metaphysis are frequently seen, as is low energy trauma, relating to elderly patients with severe osteoporosis frequently seen as periprosthetic fracture. In high-energy trauma, the problem of restoring the function in a destroyed knee joint persists. Complex knee ligament injuries frequently occur additionally to extensive cartilage injuries. In elderly patients, extreme osteoporosis represents a particular problem for anchoring the implant.[2]

Most surgeons agree that distal femur fractures need to be treated operatively to achieve optimal patient outcomes.[3] The options for operative treatment are traditional plating techniques that require compression of the implant to the femoral shaft (blade plate, Dynamic Condylar Screw, non-locking condylar buttress plate), antegrade nailing fixation, retrograde nailing, sub muscular locked internal fixation and external fixation.[4]

However, with double plating there is often extensive soft tissue stripping on both sides of the femur, resulting in reduced blood supply and potential non-union and failure of the implants.[2,4,5]

The LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness or pullout resistance as seen in unlocked plates. Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilization, avoidance of stress shielding and induction of callus formation. Further when it is applied via a minimally invasive technique, it allows for prompt healing, lower rates of infection and reduced bone resorption as blood supply is preserved.[6,7,8]

Internal fixation with locking plates creates a toggle free, fixed angle construct. The introduction of plates with the option of locked screws has provided the means to increase the rigidity of fixation in osteoporotic bone or in the presence of periarticular or juxta-articular fractures with a small epiphyseal segment. The implant offers multiple points of fixed-angle contact between the plate and screws in the distal part of femur, theoretically reducing the tendency for varus collapse that is seen with traditional lateral plates.[9]

The purpose of this study is to evaluate the outcome, effectiveness and complications of distal femur fractures, treated by open reduction and internal fixation using distal femoral Locking Compression Plate.

MATERIALS AND METHODS

The study was done in the Department of Orthopaedics, S.R.G. Hospital & Medical College, Jhalawar. This study consisted of 40 patients visiting outpatient department, emergency department of the hospital. Patients diagnosed with distal femur fractures were included in the study who were operated during the period from March 2012 to March 2014 (2 years). The duration of follow up ranged from 6 months to 18 months. All the fractures in this series were post-traumatic. Inclusion criteria was closed and open distal femoral fractures(Grade I & II of Gustillo Andersons classification)[10], AO Classification types A,B and C; exclusion criteria was pathological fractures and Grade III open fractures of distal femur.

Fractures were classified with the help of radiographs (A.P. and Lateral views) according to the AO-ASIF classification[11].

AO Classification(A,B and C):-
TYPE A: Fractures are extra-articular
A1 Simple fractures

A.1.1 Avulsion fracture of the medial or lateral epicon dyle.
A.1.2 Fracture of metaphysis oblique or spiral
A.1.3 Fracture of metaphysis transverse

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A2 Metaphyseal wedge fractures
A.2.1 Wedge intact
A.2.2 Lateral comminuted wedge
A.2.3 Medial comminuted wedge

A3 Complex metaphyseal fracture
A.3.1 With a split intermediate segment
A.3.2 Irregular but limited to the metaphysis
A.3.3 Irregular and extending into the diaphysis

TYPE B: Fractures are partially articular
B1 Lateral condylar fractures in the sagittal plane
B.1.1 Simple through intercondylar notch
B.1.2 Simple through weight bearing surface
B.1.3 Comminuted

B2 Medial condylar fracture in sagittal plane
B.2.1 Simple through intercondylar notch
B.2.2 Simple through weight bearing surface
B.2.3 Comminuted

B3: Coronal fracture of femoral condyles

TYPE C: Fractures which are intra-articular
C1 Simple fractures of both articular surface and metaphysis
C.1.1 Slightly displaced T or Y shaped fractures
C.1.2 Markedly displaced T or Y shaped fractures
C.1.3 Distally situated T fractures with horizontal ele ment involving the epiphysis.

C2 Simple fractures of articular surface and comminution of metaphysis.
C.2.1 With intact wedge
C.2.2 Comminuted wedge
C.2.3 Complex

C3 Comminuted of articular surface
C.3.1 Metaphyseal simple
C.3.2 Metaphyseal comminuted
C.3.3 Metaphyseal comminuted extending into the shaft

Preoperative calculation was done on radiographs to ascertain the size of the plate, accurate size of locking, cortical and cancellous screws after subtraction of the magnification factor.

Locking Compression Plate
We have used an Indian made LCP in treatment of fracture lower end of femur. It is a prebent fixed angle plate with dual function of achieving compression at fracture site when required and obtaining rigid fixation by locking screw to the plate in turn reducing the plate back out, providing angular stability. The locking screws are self - tapping available in 4mm and 4.5 mm thickness.

SURGICAL PROCEDURE-LCP[12,13]
Patient is placed supine on a radiolucent table with a pillow below the knee, the entire injured extremity and ipsilateral iliac crest are prepared and draped. Lateral incision is made parallel to the shaft of the femur, beginning at the Gerdy tubercle and extending proximally far enough to permit application. Longitudinal incision is made through the fascia lata, and extended distally into the iliotibial band. The distal part of the incision is extended through the lateral joint capsule and synovium, avoiding injury to the meniscus.

More proximally, the fascia overlying the vastus lateralis muscle is incised and the muscle reflected anteriorly off the intermuscular septum and perforating vessels are identified and ligated or coagulated. Minimal Stripping of soft tissue necessary for application of the plate and reduction of the articular surface is done. To preserve their vascularity, attempt is not made to expose and anatomically reduce comminuted anterior and metaphyseal fragments.

Often the shaft of the femur is wedged between two condyles; if so, by applying traction to the leg with the knee flexed, wedged shaft of femur is displaced. Quadriceps mechanism and the patella are reflected medially to expose the entire lower end of the femur. To aid in reduction of the condyle, a Steinmann was drilled into the lateral surface of the lateral condyle, if needed, a similar pin was placed in the medial condylar fragment. Using these pins as levers, manipulation and reduction of the two major condylar fragments was done to restore the articular surface and patellofemoral groove.

Two condyles were fixed together with multiple 2-mm Kirschner wires. Medial and lateral condyles together were fixed with 6.5-mm cancellous screws directed lateral to medial, taking care not to interfere with the subsequent path of other cancellous screws of locking compression plate. Second screw was placed without a washer, slightly anterior and proximal to the first. Kirschner wires used for temporary fixation was remove The next step is reduction of the condyles to the femoral shaft. When using the plate as a reduction aid, the compression screw draws the bone towards the plate and uses the contour of the plate to reduce the fracture in the coronal plane. The plate does not aid in the sagittal plane reduction or restoration of limb length. Reduction of the fracture was assisted keeping folded pillow below the knee which prevented posterior angulation of distal fragment with manual traction. Once the fracture is reduced, supplemental locking screws were then added to create a fixed-angle construct. The compression mode can also be used to address reduced articular fractures through the plate, or can be used in simple fracture patterns.

Post-operatively Patient's vitals were monitored. Foot end elevation was given overnight, drain was monitored. Antibiotics were given as per the hospital protocol. Analgesics were given as per the patient compliance. Splints were removed and mobilization of the limb started on the 3rd or 4th day postoperatively. Mobilization with Non weight bearing was started from the first post operative week till 6-8 weeks depending on the fracture pattern and then partial weight bearing after confirmation of beginning of healing process till fracture union.

Patients were started on static quadriceps on 1st postoperative day and active or active assisted bedside knee mobilization was started from second postoperative day. Suture removal was done on 11th postoperative day.

Further, weight bearing was allowed depending on the clinical and radiological picture. The initial fracture geometry, comminution, stability of fixation were the major factors considered while advising progressive weight bearing.

All patients were followed up at 4th, 8th, 12th weeks and subsequently, at 6th month, 9th month, 12th month and 18th months .

During follow up patients were assessed clinically, radio-

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logically and functionally by Knee society score.

Knee Score (Insall Modification - 1993)[14]
The maximum Knee Score is 100 points and the maximum Functional Score is 100 points.

Knee Findings
Pain 50 (Maximum)
WALKING

None	35
Mild or occasional	30
Moderate	15
Severe	0
Stairs	
None	15
Mild or occasional	10
Moderate	5
Severe	0

R.O.M. 25 (Maximum)
8° = 1 point
Stability 25 (Maximum)
Medial/Lateral

0-5 mm	15
5-10 mm	10
> 10 mm	5

Anterior/Posterior

0-5 mm	10
5-10 mm	8
> 10 mm	5

Deductions
Extension lag

None	0
<4 degrees	-2
5-10 degrees	-5
>11 degrees	-10

Flexion Contracture

< 5 degrees	0
6-10 degrees	-3
11-20 degrees	-5
> 20 degrees	-10

Malalignment

5-10 degrees	0
(5° = -2 points)	

Pain at rest

Mild	-5
Moderate	-10
Severe	-15
Symptomatic plus objective	0

Knee Score 100 (Maximum)

1. **Case 1: 39 Yrs / Male**

Postop 6th week 12th week

2. **Case 2: 19Yrs / Male**

Preop

Postop 6th week 12th week

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OBSERVATIONS AND RESULTS

An observational prospective orthopaedic study with 40 patients was undertaken to study the functional outcome of distal femur fractures treated with LCP in terms of fracture union time (radiologically and clinically), immediate, late and delayed post op complications, functional outcome with respect to range of movement achieved after union. Advantages and disadvantages of the procedures was evaluated

Table : Distribution of age and Sex of patients studied

Age in years	Patients	Sex	
	No.	Male	Female
≤30	11	9	2
31-40	15	11	4
41-50	6	5	1
51-60	3	2	1
61-70	2	2	0
>70	3	3	0
Total	40	32	8

Table : Distribution of Knee score in patients studied

Knee score	LCP	
	No.	%
80-100	31	77.5
70-79	7	17.5
60-69	2	5
Below 60	0	0.0
Total	40	100.0

Table: Distribution of nature of complications in patients studied

Nature of Complications	LCP	
	No.	%
Delayed Union	1	2.5
Non-Union	1	2.5
Superficial Infection	2	5.0
Shortening	0	0.0

DISCUSSION

In our study, mean age was 40.22 years with range of age group 19-71. Commonest mode of injury was RTA in 81.8% patients, respectively.

Time period for radiological union in most cases was 16-20 weeks. One patient in went for delayed union(2.5%), one presented with non-union(2.5%)[15] and 2 cases of superficial infection(5.0%) which were managed by regular dressing. Most patients had knee flexion in range of 105-120 degree with a mean of 111 degree. Majority of patients borefull weight in 20-24 weeks. 4 patients had extension lag of 5 degree.

Knee Score

In our study, 77.5% patients treated with LCP had excellent knee score. Yeap EJ and Deepak[16] conducted a retrospective review on eleven patients who were treated for Type A and C distal femoral fractures (based on AO classification) between January 2004 and December 2004. All fractures were fixed with titanium distal femoral locking compression plate. The patient's ages ranged from 15 to 85 with a mean of Clinical assessment was conducted atleast 6 months postoperatively using the Schatzker scoring system[17]. Results showed that four patients had excellent results, four good, two fair and one poor.

Conclusion

Locking compression plate found to be a good fixation system for distal end femoral fractures particularly intra-articular type. The device provides good angular stability by its triangular reconstruction principle and thus helps in early mobilization, even in communited fractures where other modes of fixation often tend to delay the process of mobilization because of lack of stability. Preferably can be used in osteoporotic fractures were it provides a solution to the age old problems of screw cut out, late collapse, and malalignment since the stability of the construct does not entirely depend on the quality of the bone. Understanding the basic principles of fixation and the appropriate indications for use of LCP in fractures of distal end femur is a must, before its use. .

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