International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(1): 533-536

www.orthopaper.com
Received: 01-11-2019
Accepted: 05-12-2019

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A study on complications of surgical stabilization of supracondylar fracture femur

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DOI: https://doi.org/10.22271/ortho.2020.v6.i1j.1917

Abstract
Modern plating techniques result in the maintenance of vascularity around the fracture site and relatively longer plates are used than in previous decades. In general, 4 to 5 screws should be chosen in each of the distal femur and proximal femur. A plate length should be chosen that allows for an approximately similar number of empty plate holes in the proximal femur. After obtaining approval from institutional ethics committee, 30 skeletally mature patients with distal fracture femur fractures, satisfying the inclusion and exclusion criteria were enrolled. Informed and written consent was taken from the enrolled patients. Data was obtained through structured questionnaires regarding the trauma, detailed clinical examination, relevant investigations, and entered in the case record form (CRF). The complications we encountered include superficial infection in 2 patients, plate lift in one patient and varus malalignments in three patients. Superficial infections were subsided by intravenous antibiotics. Out of three virus malalignments two were of type C3 fracture and one type C2. Factors contributing to malalignments were severe comminution and improper reduction.

Keywords: Complications, surgical stabilization, supracondylar fracture femur

Introduction
For retrograde femoral nailing to achieve adequate fracture stabilization, the fracture should be at least 6 cm from the joint line to achieve distal locking with two transverse screws or a screw and a spiral blade. In contrast, more distal fixation can be achieved with plates, or locked fixators. For example, the distal most screws in a LISS plate, or a condylar plate, may be subchondral [1].

Modern plating techniques result in the maintenance of vascularity around the fracture site and relatively longer plates are used than in previous decades. In general, 4 to 5 screws should be chosen in each of the distal femur and proximal femur. A plate length should be chosen that allows for an approximately similar number of empty plate holes in the proximal femur [2].

The pre-operative x-ray template is useful in determining the required length of the Condylar LCP and the position of the screws. The anatomically shaped plate head is pre-contoured to match the distal femur, eliminating intraoperative plate modification.

Five threaded 5.0 mm peripheral screw holes accept locking screws. The central 7.3 mm screw has an angle of 95° to the plate shaft. Its insertion should therefore be parallel to the tibio-femoral joint surface [3].

Combi-holes combine a dynamic compression unit (DCU) hole with a locking screw hole. This allows the surgeon either to insert a standard bicortical screw, or a locked screw.

The sloping shoulder of the DCP hole has the form of part of an angled cylinder. If a screw is inserted eccentrically so that its head, on final tightening, slides down the sloping profile of the hole, the screw/bone unit will be shifted toward the fracture and the fracture plane will thereby be compressed. Such a screw is often referred to as a load screw [4]. The combination hole of the LCP accepts conventional screws for conventional plating techniques, but also accepts locking head screws to create angularly stable fixations. Conventional screws can be tilted in the non-threaded portions of the combination holes. Locking head screws must not be angled in the threaded portions of the holes. Locking head screws (LHS) must be inserted carefully. The threads of the screw and the plate must match. Optimal angular stability is gained when the screw is inserted at 90° to the plate, using a special guide.

Hence, the importance of the correct use of the LCP drill guide.

Angular stability is greatly reduced if the LHS is not inserted at 90°, screws that lock into threaded plate holes now provide an alternative method of achieving angular stability, as illustrated above. Because the screws in the metaphyseal fragment purchase in the bone, and also lock into the plate holes, the mechanical equivalent of a fixed angle device can be constructed. The LCP used as An- internal fixator‖ to bridge a multifragmentary diaphyseal fracture complex. As locking head screws are used, the plate does not need to be contoured exactly to the bone, the cortical vascularity is not compromised as the plate stands off the bone, and there is angular stability in the metaphyseal zone [5].

LCP used with conventional screws as a traditional plate. The fixation is less stable due to the lack of angular stability with conventional screws. The position is maintained by compressing the contoured plate to the bone surface.

Straight plates are available with 6, or 8, combi-holes. Curved plates are available with 10, 12, 14, 16, 18, 20, or 22 combi-holes, to accommodate fracture patterns that include shaft fractures in conjunction with articular fragments. Curved plates are precontoured to mimic the anterior convexity of the femur. Plate design permits the use of minimally invasive surgical techniques. Limited-contact design provides minimal periosteal disruption [6].

Methodology

After obtaining approval from institutional ethics committee, 30 skeletally mature patients with distal fracture femur fractures, satisfying the inclusion and exclusion criteria were enrolled. Informed and written consent was taken from the enrolled patients. Data was obtained through structured questionnaires regarding the trauma, detailed clinical examination, relevant investigations, and entered in the case record form (CRF).

Postoperative care

- Patients were kept nil oral for 4 to 6 hours post operatively.
- IV fluids / blood transfusions were given as needed.
- Analgesics were given according to the needs of the patient.
- The operated limb was kept in elevation on a splint with the knee in 10-15 degree of flexion.
- The suction drain was removed after 24 hours and first wound inspection was done on same day.
- Intravenous antibiotics were continued for 72 hrs or according to requirement for more duration and later continued on oral antibiotics for seven days.
- Suture removal was done on post-operative day 10 and patient was discharged.

Physical therapy

Postoperative physiotherapy regimen was tailored according to the fracture pattern, fixation achieved. Static quadriceps exercise with active hip and knee mobilization were started from the next day of surgery. Active assisted ROM along with active quadriceps and hamstring strengthening exercises were added from 5-7th day of surgery.

Early phase (1-3 Weeks)

- The primary goal is full range of motion, started on 2nd day, if fixation is stable, emphasizing extension, normal patella mobility, control of oedema and pain.
- Quadriceps strengthening and hamstring stretching exercises are encouraged. Gentle hip and ankle mobilization exercises are continued.

Continuous passive motion -when started in 1st week has following advantages

- Improves early range of motion of knee.
- Decreases incidence of deep vein thrombosis and pulmonary embolus.
- Faster pain relief and shorter stay at hospital.
- Better results when used at a rate of 1 cycle per minute, with 40 degrees of maximum flexion for first 3 days.
- Continuous passive motion reverses collagen loss, improves cartilage nourishment and prevents joint stiffness.
- Non-weight bearing with crutches or walker support can be initiated in 1st week, if fixation is stable.
- Late Phase (After 3 weeks)
- Continue isometric quadriceps setting exercises, Active and passive Range motion exercises.
- Seated knee extension procedures.
- Partial weight bearing is allowed after 3rd week.
- Full weight bearing is allowed after radiological evidence of healing (6-12 weeks). Patients with type-C fractures are not allowed full weight bearing for at least 12 weeks.

Early complications

1. Iatrogenic fractures especially in osteoporotic bones while reducing the fracture.
2. Damage to surrounding soft tissue (collateral ligaments of knee and menisci).
3. Injury to popliteal vessels, as it winds from medial to posterior compartment.
4. Damage to geniculate vessels and accompanying nerves.

Late complications

1. Failure of Reduction, due to improper surgical technique, poor bone stock, poor patient compliance, poor surgical planning and execution.
2. Infection - following fixation of open fractures approach 20% and for closed fractures approaching 1%.
3. Non-union, Mal-union occurs with distal fragment in varus. The indication for a corrective osteotomy depends on the degree of malalignment and the severity of symptoms. Valgus and varus malalignment greater than 10° and / or rotational deformity greater than 15°, should be corrected [4].
4. Knee stiffness postoperatively.

Results

Table 1: Fracture type in present study

OTA Classification Type	No. of patient	Percentage (%)
A1	5	16.7
A2	4	13.3
A3	4	13.3
C1	6	20
C2	7	23.4
C3	4	13.3

In this study, out of 30 fractures, type A fractures were seen in 13 patients (43.3%) and type C fractures were seen in 17 patients (56.7%).

Table 2: Radiological union of fracture in present study.

Union Time (Weeks)	Number Of Fractures	Percentage (%)
≤12	10	33.3
13-18	16	53.3
19-24	2	6.7
25-30	2	6.7

Average time for fracture union was 15.1 weeks. There was delayed union in 2 patients. There were no non-unions. Most of the fractures were united between 12 to 18 weeks.

Table 3: Time of full weight bearing in present study

Full Weight		
Bearing	**Number**	**Percentage (%)**
Time(Weeks)		
<12	4	13.3
12-16	23	76.7
17-20	2	6.7
>20	1	3.3

Average time taken for full weight bearing in this study was 13.43 weeks.

Table 4: Complications in present study

Complications	Number
Superficial Infection	2
Plate Lift	1
Varus Malalignment	3

The complications we encountered include superficial infection in 2 patients, plate lift in one patient and varus malalignment in three patients. Superficial infections were subsided by intravenous antibiotics. Out of three varus malalignments two were of type C3 fracture and one type C2. Factors contributing to malalignments were severe comminution and improper reduction.

Discussion

The complications we encountered include superficial infection in 2 patients, plate lift in one patient and varus malalignment in three patients. Superficial infections were subsided by intravenous antibiotics. Out of three varus malalignments two were of type C3 fracture and one type C2. Factors contributing to malalignment were severe comminution and improper reduction.

In Sanders *et al*. [7] (1991) and Ostrum and Geel8 *et al*. (1995) reported 5.8% and 3% mal-union respectively.

In Wong *et al*. [9] (2005) there was no infection. However, there were two cases with failure of fixation, which occurred early in our series. Both were loosening of the proximal fixation of LISS.

In Weight *et al*. [10] (2004) there were no cases of failed fixation, implant breakage, or infection.1 mal-union where the fracture was fixed in 8° of valgus and 2 cases of external rotation between 10° and 15°. Painful hardware occurred in 4 patients.

In Schütz *et al*. [11] (2001) deep infection requiring several debridement's occurred in 2 patients.

In present study, extensor lag was seen in 3 cases. Two were with 10 degrees and one with 5degrees. The average being 8.33 degrees.

In Schütz *et al*. [11] (2001) an extension deficit of more than 5° was measured in 3 cases.

In 2014, G. N. Kiran Kumar reviewed 46 distal femoral fractures treated with distal femoral locking compression plates between 2009 to 2012.

More than half of the patients were of type C3 (AO classification) and had been caused by high energy trauma with associated injuries. The mean time for radiological union was 12 weeks (range 10–18) except 2 patients which had gone non-union. ROM >120 degrees was noted in 32 patients, 90–120 degrees in 10 patients, and 70–90 degrees in 2 patients. 38 patients (86%) had good/excellent outcome. The study concluded that use of standard lateral approach for simple intra-articular distal femoral fractures (C1) and trans articular / minimally invasive techniques for complex intra-articular fractures (C2/C3) resulted in improved exposure of the knee joint and better union rates with lower incidence of bone grafting [12].

In 2014, Rajnish R Menon conducted a study on functional outcome of distal femoral fractures treated by minimally invasive surgery using locking condylar plate in 25 patients. The mean radiological fracture union time was 18 weeks. The final functional outcome of knee according to Neer's criteria was excellent in 10 patients (40%), satisfactory in 12 patients (48%) and unsatisfactory in 2 patients. One case was a failure. The study concluded that minimally invasive LCP fixation of distal femoral fractures is a good option with better functional outcome [13].

In 2015, Gajendra R, Aggarwal Sumit S conducted study on use of locking compression plates in supracondylar femur fracture and concluded that good clinical outcomes are to be achieved and maximum benefit is to be attained from the options offered by the LCP system [14]

In 2016, Vishwanath C evaluated that, the DF-LCP is a good implant to use for fractures of the distal femur. They concluded that accurate positioning and fixation are required to produce satisfactory results. The study recommended the use of this implant in Type A, B, C and osteoporotic fractures. Early results were encouraging but long-term studies were not done to prove definitively acceptable outcomes so that the technique can become part in the armamentarium of the orthopaedic trauma surgeon [15].

In 2016, Pradip B. Patil studied the functional outcome of distal end femur fractures operated with locking compression plate in 30 patients with closed fracture lower end of femur. The method used for fracture fixation was closed or open reduction and internal fixation with locking compression plate. Post operatively, they were evaluated for knee stability, subjective knee function, patient satisfaction and range of motion. This assessment was done based on Neer Knee Scoring Scale. The study concluded that Locking plate is the choice of implant for the distal end femur especially with Metaphyseal comminution and Complex intra-articular fracture geometry (33:C3 Type) [16].

Conclusion

This technique has a lesser chance of complications like plate or screw breakage, but careful selection of patients and strict adherence to the basic principles of fracture fixation will go a long way in reducing the complications of fracture fixation using locking compression plates.

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