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Surgical stabilization of supracondylar fracture femur with locking compression plate: A Study on functional outcome

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Abstract

Fractures of the distal end of femur especially comminuted, intra-articular extension remain some of the most challenging fractures facing orthopaedic surgeons. The present study is justified for the fact that it will be one of the solutions for the age-old complications associated with the treatment of supracondylar fractures with traditional fixed angle plates and nails of, postoperative loss of reduction (varus collapse) and malalignment due to the inherent lack of rigidity and in some cases, eventual implant failure. After the proper preoperative evaluation fitness for surgery was obtained. The limb to be operated was shaved and prepared a day before scheduled surgery. Antibiotic was injected intravenously at least 10 minutes before surgery. Although various approaches like direct lateral-standard approach, minimally invasive lateral approach, medial approach and antero-lateral approach are described however in the current study direct lateral approach was used which is the standard one generally followed by the various previous studies. Out of 30 fractures, 19 fractures accounting for 63.3% were open fractures. Rest of the fractures were closed. In this study majority of the cases 19 (63.3%) were due to road traffic accidents seen in below 50 years of age. Long term results were rated using Neer's rating system. Neer's score was assigned for each patient after 24 to 36 weeks. Using this scale 16 cases (53.3%) shown excellent, 11 cases (36.7%) good and 3 cases (10%) poor result. 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.

Keywords: Supracondylar fracture femur, locking compression plate, neer's score, outcome

Introduction

The supracondylar area of the femur is defined as the zone between the femoral condyles and the junction of the metaphysis with the femoral diaphysis. This comprises approximately the distal 15 cm of the femur, as measured from articular surface. It is important to distinguish extra-articular fractures from intercondylar as well as diaphyseal fractures of the distal femur because the methods of treatment and prognosis are considerably different^[1]. Fractures of the distal end of femur especially comminuted, intra-articular extension remain some of the most challenging fractures facing orthopaedic surgeons. These are serious injuries having the potential to produce significant long-term disabilities. These fractures reportedly account for less than 1% of all fractures and comprise 6% of all femoral fractures^[2, 3]. There is bimodal distribution of these fractures^[4, 5]. Operative treatment is recommended for most of these fractures. The goal of operative treatment is anatomical reduction, stable internal fixation and early rapid mobilization of adjacent joints and early functional rehabilitation of the knee. Locking compression plate has the advantage of combination of conventional compression plating and locked plating techniques which enhances the plate osteosynthesis. The DF-LCP is a further development from the LISS which was introduced in the mid to late 1990's. The shaft holes on the DF-LCP are oval allowing for the options of a compression screw or a locking screw. This leads to a more precise placement of the plate, as it is able to be compressed more closely to the bone. The present study is justified for the fact that it will be one of the solutions for the age-old complications associated with the treatment of supracondylar fractures with traditional fixed angle plates and nails of,

postoperative loss of reduction (varus collapse) and malalignment due to the inherent lack of rigidity and in some cases, eventual implant failure [6-10].

Materials and Methods

This was a prospective longitudinal observational study conducted from November-2012 to October-2014 in the Department of Orthopaedics, at Andhra Medical College with a follow up period of 6 months to 18 months. 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.

Initial stabilization and pre-operative planning

All the patients were initially managed in emergency department according to advanced trauma life support guidelines. The patients were evaluated clinically and proper history of the incident was elicited. General, systemic examination as well as local examination of the patient was done. Thorough assessment was done to rule out head/chest/abdominal/spinal or pelvic injury. Injured limb was assessed carefully as regard to neurovascular status. Primary immobilization of involved limb in Thomas splint with a cotton pad below the distal fragment for transport of patient.

Radiological evaluation

Antero-posterior and true lateral views of injured limb including complete knee joint and distal femur. Antero-posterior view of pelvis with both hips to rule out associated injuries. Patients with open wounds received immediate wound lavage with at least 9 liters of normal saline followed by povidone iodine, padding dressing and were put on intravenous antibiotics, which continued post operatively according to requirement. Upper tibial skeletal pin traction with a Steinmann or Derham pin under local anaesthesia followed by continuous traction given over Bohler-Braun splint. Injection ATS 1500 IU, Injection AGGS 20,000 IV, broad spectrum injectable antibiotics and analgesics were administered for compound injuries. Intravenous Metronidazole was administered in open fractures where anaerobic contamination was suspected.

Instruments and implants used

The instruments and implants used are plate and screws manufactured using 316L stainless steel with gun drilling technique. Locking compression plate (4.5mm) which are available from 4 holed to 22 holed. Anatomically pre-contoured plate head with soft edges. Self-tapping cortical locking screws (5mm) (Figure 1).



Fig 1: DF-LCP Instruments set

Surgical approach

Although various approaches like direct lateral-standard approach, minimally invasive lateral approach, medial approach and antero-lateral approach are described however in the current study direct lateral approach was used which is the standard one generally followed by the various previous studies.

Operation table

Radiolucent top fracture table was used.

Position of the patient

Supine position with a sand bag placed below the operating knee and another one below the ipsilateral hip.

Operative steps/technique (Figure 2)

- Skin and subcutaneous tissue were cut, superior geniculate artery is identified and ligated.
- Care was taken not to incise the lateral meniscus at the lateral joint margin.
- The vastus lateralis muscle was carefully elevated from intermuscular septum and retracted anteriorly and medially.

- Reduce and temporarily secure the articular fragments with pointed reduction forceps and/or K-wires.
- Condyles were secured with 6.5 mm cancellous screws. A condylar plate guide or plate itself may be held laterally on the condyle to select an area, where screws will not interfere with plate placement.
- K-wire was passed across the femoral condyle, at the level of the knee, to indicate the joint axis and second K wire was passed across the patella femoral joint on the trochlear surface.
- Using anatomic landmarks and C-arm imaging, plate was mounted on the intact / reconstructed condyle without attempting to reduce the proximal portion of the fracture.
- Whether the guide wire inserted in through the central hole is parallel to both distal femoral joint axis and patella femoral joint was checked.
- Screw length was measured using measuring device.
- Screws were inserted starting from central hole in the condylar portion under image control.
- Once reduction is satisfactory, the plate was loaded in tension using articulated tension device.
- The plate shaft was fixed with appropriate cortical screws after confirming final reduction of the fracture.

- In case of 33A type fractures closed reduction was achieved using various instruments like clamps or Steinmann pins using as joy stick to manipulate fracture fragments and fixation done by MIPO technique with DF-LCP.
- In cases of 33C type fractures closed reduction was attempted and if anatomically reduced, fixation was done with MIPO technique, otherwise direct lateral approach was used to expose fracture fragments and are anatomically reduced.
- In cases of medial wall comminution, medial side also was augmented with screws to prevent Varus collapse.



Fig 2: Intra operative images of direct lateral approach to distal femur fracture

Postoperative care was performed to the patient.

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 was conducted for 1-3 weeks and late phase after 3 weeks.

Early complications

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

Late complications

Failure of Reduction, due to improper surgical technique, poor bone stock, poor patient compliance, poor surgical planning and execution. The results were evaluated by taking into consideration the following pain, function, motion, work, gross anatomy and Roentgenograms

Follow up protocol

After discharge from the hospital, these patients were called for the first follow up after 2 weeks and subsequent follow up were done at 1 month, 3 months, 6 months and at 9 months. Patients were educated to report earlier for follow up if required. Patients were assessed by NEER'S functional scoring in follow-up visits by assessing the following:

Neer's functional scoring was used to assess the outcome of surgery, for adult distal femoral fractures. It consists of: Functional (70 units) and Anatomic (30 units) (Table 1).

Table 1: Neer's Functional scoring

Neer's score-pain	
Pain (20 units)	Unit value
5- No pain	20
4- Intermittent	16
3- With fatigue	12
2- Restrict function	8
1- Constant or at night	4
Neer's score - function	
Function (20 units)	Unit value
5- As before injury	20
4- Mild restriction	16
3- Restricted, stairs sideways	12
2- Cane or severe restriction	8
1 - Crutches or brace	Apr-00
Neer's score - knee flexion	
Motion (20 units) Knee Flexion	Unit value
5 - Normal or 135 degrees	20
4 - 100 degrees	16
3 - 80 degrees	12
2 - 60 degrees	8
1 - 40 degrees	4
0 - 20 degrees	0
Neer's scoring - work capacity	
Work (10 units)	Unit value
5- As before injury	10
4- Regular but with handicap	8
3- After work	6
2- Light work	4
1- No Work	Feb-00
Neer's score - Roentgenogram	

Neer's score - Roentgenogram	
Roentgenogram (15 units)	Unit value
5. Near Normal	15
4. 5° angulation or 0.5 cm displacement	12
3. 10° angulation or 1.0 cm displacement	9
2. 15° angulation or 2.0 cm displacement	6
1. Union but with greater deformity; spreading of condyles; osteoarthritis.	3
0. Non-union or chronic infection	0
Neer's score-overall rating	
Parameter	Unit value
Excellent	Above 85 units
Satisfactory / good	70-85 units
Unsatisfactory / fair	55-69 units
Failure	Below 55 units

Results

The results of the present study was depicted in the Table 2. Age of the patients ranged from 21 to 71yrs with an average age of 41.9 years. Majority of the patients (63.3%) were in the age group of 21-40 years. Out of 30 patients treated with locking compression plate, 19 (63.3%) were male patients and 11 (36.7%) were female patients. Supracondylar fracture of right femur was seen in 17 patients making up to 56.7% of fractures and left sided femur was seen in 13 patients accounting for 43.3% of the fractures. None had bilateral fractures. Out of 30 fractures, 19 fractures accounting for 63.3% were open fractures. Rest of the fractures were closed. 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%). Average time for fracture union was 15.1 weeks. In this study 50% of the patients had knee flexion of more than 110 degrees, 40% had 91-110 degrees and 10% had less than 90 degrees. Average knee flexion in type A fractures was 118.66 degrees and type C was 110.27 degrees. Overall average knee flexion in 30 patients in this study was 114.47°. Long term results were rated using Neer's rating system. Neer's score was assigned for each patient after 24 to 36 weeks. Using this scale 16 cases (53.3%) shown excellent, 11 cases (36.7%) good and 3 cases (10%) poor result. 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 (Figure 3).

Table 2: Overall results of the study

Age	Number of patients	Percentage (%)
21-30	9	30
31-40	10	33.3
41-50	3	10
51-60	4	13.3
Above 60	4	13.3
Sex	Number of patients	Percentage (%)
Male	19	63.3
Female	11	36.7
Nature of injury	Distal femur fractures	Percentage (%)
RTA	22	73.3
FALL	8	26.7
TOTAL	30	100
Side affected	Number of fractures	Percentage (%)
RIGHT	17	56.7
LEFT	13	43.3
Type of injury	Number of fractures	Percentage (%)
Open	19	63.3
Closed	11	36.7
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
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
Full weight bearing time(weeks)	Number	Percentage (%)
<12	4	13.3
16-Dec	23	76.7
17-20	2	6.7
>20	1	3.3

Knee flexion (degrees)	Number of patients	Percentage (%)
>110	15	50
91-110	12	40
≤90	3	10
Type of Fracture OTA Classification	Number of Fractures	Average Knee Flexion (Degrees)
Type A	13	118.66
Type C	17	110.27
Total	30	114.47
Pain	Number of patients	Percentage (%)
No pain	4	13.3
Intermittent	22	73.4
With fatigue	4	13.3
Restrict function	0	0
Constant or at night	0	0
Neer's Function score of the study	Number of patients	Percentage (%)
As before injury	4	13.3
Mild restriction	22	73.4
Restricted, stairs sideways	4	13.3
Cane or severe restriction	0	0
Crutches or brace	0	0
Neer's scoring for work capacity in present study	Number of patients	Percentage (%)
Same As before injury	7	23.3
Regular but with handicap	20	66.7
Alter work	3	10
Light work	0	0
No Work	0	0
Neer's score gross anatomy	Number of fractures	Percentage (%)
Thickening only	20	66.7
5° angulation or 0.5 cm short	10	33.3
10° angulation or rotation, 2.0 cm short	0	0
15° angulation or rotation, 3.0 cm short	0	0
Union but with greater deformity	0	0
Non-union or chronic infection	0	0
Neer's score Roentgenogram	Number of fractures	Percentage (%)
Near Normal	12	40
5° angulation or 0.5 cm displacement	15	50
10° angulation or 1.0 cm displacement	3	10
15° angulation or 2.0 cm displacement	0	0
Union but with greater deformity; spreading of condyles; osteoarthritis	0	0
Non-union or chronic infection	0	0

X-ray findings and functional outcome of Supracondylar fracture femur with locking compression plate





Fig 3: X-ray findings of the cases and functional outcome of the study

Discussion

The study was particularly relevant as supracondylar fracture of femur historically has been difficult to treat. Problems such as knee stiffness, varus collapse, mal-union and non-union frequently resulted. These limitations have encouraged surgeons to resort to definitive operative management of the fractures by internal fixation using distal femoral locking compression plates. High energy trauma in 73.3% of our patients of which most of whom were younger. In Yeap *et al.* (2007)^[18] study, patients ranged from 15 to 85 years with a mean age of 44 years. According to the OTA supracondylar fracture femur classification, intra articular (type C) fractures were seen in 17 (56.7%) patients and rest 13 (43.3%) had extra articular (type A) fractures. This indicates that type C fractures occur more than type A. In our study the average time interval between injury and surgery was 6 days. This was in accordance with the study conducted by Yeap *et al.* (2007)^[11]. In Bachu *et al.* (2017)^[12] study bony union was achieved on average in 16.6 weeks. In Weight *et al.* (2004)^[13] in their study all fractures healed at a mean of 13 weeks (range 7-16 weeks). However, the early union in our study in compression with others might be due to early intervention, less soft tissue handling and early mobilization. In this study group, overall average knee flexion in 30 patients was 114.47 degrees. It was attributed to the stable and study construct and the early range of motion achieved with DF-LCP. We conclude ROM around knee is better in patients treated with DF-LCP. Post-operative ROM is less in type C fractures compared to type A. All the patients in our study were followed for an average of 11.83 months (ranging from 6-18 months). All fractures were united eventually and there were no non-unions.

Conclusion

DF- LCP has combi-hole, based on need of surgeon can use either locking or standard bicortical screw. 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.

Conflict-of-interest statement

The author declares no conflicts-of-interest related to this article.

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