Original Research Article

Surgical Management Of Supracondylar Femoral Fracture By Locking Compression Plate

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Abstract

Introduction: Supracondylar femur fractures account for 6% of femoral fractures and fractures about the hip were ten times more common than those involving distal metaphysis and the knee. The incidence density rate of supracondylar femoral fractures is 37 per 1,00,000 person years. Supracondylar femoral fractures primarily have a negative influence on the knee function as failure to restore the functional angles of the distal femur directly compromises the motion and stability of the joint.**Aim:** The aim of this study was to evaluate the effectiveness and complications of locking compression plating used in surgical management of supracondylar fractures of lower end of femur among patients reporting to the Department of Orthopaedic Surgery at MIMS Medical College and Hospital, Vizianagaram.**Materials and Methods:** This prospective, quasi-experimental, one group posttest-only design was adopted where 40 subjects with supracondylar femoral fractures were given surgical management by locking compression plates at MIMS medical college and hospital Hospitals, Vizianagaram in the Department of Orthopaedic Surgery during the period from June, 2018 to May, 2019. All the patients underwent thorough preoperative investigations which included: hemogram; blood sugar level; serum creatinine level; blood urea level; serum electrolytes; blood group and Rh typing; bleeding, clotting, and prothrombin times; chest x-ray postero-anterior view; electrocardiography; 2D echo; other tests required in pre anaesthetic evaluation. Patients were reassured to alleviate their anxieties. All patients were evaluated by a physician for fitness to surgery. If associated medical conditions were detected, they were set right preoperatively. **Results:** Of the 40 study participants, 28 were males and 12 were females. The mean age of the study participants was 39.55 years with a standard deviation of 15.27 years. Of the study sample, 25% of the subjects demonstrated associated injuries, with metatarsal injuries being the most common, followed by metacarpal and phalangeal fractures, facial injuries. In majority of the cases, fracture took place on the right side. In 40% of cases, surgery took place within 3 days from the time of injury. There were 3 subjects on whom surgery was performed after more than 15 days from the injury. While 40% of the study subjects were hospitalized for 1-2 weeks, there were 2 subjects who were hospitalized for more than four weeks. Sixty five percentage of the study subjects reported intermittent pain, 55% reported mild restriction; 57.5% demonstrated knee flexion of 100°; 45% could do regular work but with handicap; 52.5% of subjects demonstrated only thickening; 60% subjects shown an angulation of 5° or displacement by 0.5 cm on radiographs. On the whole, 20 subjects were observed to have excellent overall NEER's scores. Subjects with Type A fractures demonstrated better NEER overall scores compared to those with Type C fractures. There was no significant difference between subjects from different age groups in the overall NEER scores.**Conclusion:** It can be concluded from this study that locking compression plate is an ideal treatment option for supracondylar femoral fractures. Compared to type C fractures, type A fractures demonstrated better results as evaluated by the Neer's functional scoring system. Locking compression plates also prevent compression of periosteal vessels. It is ideal to prevent metaphyseal collapse and to preserve limb length in severly comminuted fractures. The technique also demonstrates a lesser chance of complications like plate or screw breakage, however, judicious selection of patients and strict compliance to the basic principles of fracture fixation will go a long way in curtailing the complications of fracture fixation of supracondylar femoral fractures using locking compression plates.

Keywords: Distal injuries, supracondylar femoral fractures, metacarpal and phalangeal fractures, facial injuries.

Introduction

Distal injuries account for 6% of femoral fractures and fractures about the hip were ten times more common than those involving distal metaphysis and the knee[1]. The incidence density rate of supracondylar femoral fractures is 37 per 1,00,000 person years. The distribution of these fractures is classically bimodal, with younger people sustaining high energy injuries from road traffic accidents and sports, while a second spike is seen after 50 years of age as a result of low energy osteoporotic injuries[2].Distal femoral fractures are frequently comminuted and intra-articular, and they often involve osteoporotic bone. It is because of this reason that the reduction of distal femoral fractures, while maintaining joint function and limb alignment, is difficult. Distal femoral fractures commonly present as severe thigh or knee pain, with an inability to bear weight on the injured extremity[3].Supracondylar femoral fractures primarily have a negative influence on the knee function as failure to restore the functional angles of the distal femur directly compromises the motion and stability of the joint[4]. It is for this purpose that the goals of surgical management of distal femoral fractures are in line with any other articular fracture, which includes: restoring articular surface; the bone contact; the metaphyso diaphyseal angle. In order to comply with these objectives in surgical management, a correct classification of the fracture must first be established[5]. Though there are many classifications of the distal femoral fractures, the

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AO/OTA fracture classification system is the most universally used.Over the years, different treatment options have been proposed for supracondylar femur fracture like conservative management with skeletal traction and surgical management with dynamic condylar screw, retrograde intramedullary nailing. Given the broad soft-tissue covering of the distal femur and its proximity to the knee, management of the distal femoral fracture fragments with casting and cast bracing was proved to be extremely difficult. Though there are benefits like better axial alignment and maintenance of length with conservative management in a closed manner with traction, the rotational and coronal plane alignment are difficult to achieve. Literature suggests that the closed treatment universally yielded poor results. A meta-analysis in 2006 demonstrated 32% reduced risk of poor results with surgical management compared to conservative management. However, it has been recently reported that the functional outcome is not very encouraging even with surgical management using dynamic condylar screws and retrograde intramedullary nailing, in case of comminuted intra-articular fractures.The main aim of the study is to evaluate the effectiveness and complications of locking compression plating used in surgical management of supracondylar fractures of lower end of femur.

Materials and Methods

Study Site: Department of Orthopaedic Surgery at MIMS medical college and hospitals, Vizianagaram, Andhra Pradesh.

Study Population: 40 patients undergoing surgical management of supracondylar femoral fractures with locking compression plates at MIMS medical college and hospitals, Vizianagaram from June, 2018 to May, 2019.

Study Design: A prospective, quasi-experimental, one group posttest-only design was adopted where 40 subjects with supracondylar femoral fractures were given surgical management by locking compression plates at MIMS medical college and hospitals, Vizianagaram in the Department of Orthopaedic Surgery during the period from June, 2018 to May, 2019. The study was conducted after obtaining the ethical committee clearance of our institution as well as informed written consent taken from the patients.

Time Frame: From June, 2018 to May, 2019

Inclusion Criteria:

- All skeletal mature patients (>18years).
- Patients with type I, II and III A open distal femur fractures.
- Patients willing to give consent.
- Patients presenting with distal femoral fractures with or without osteoporotic changes are included in the study.

Exclusion Criteria:

- Patients with open distal femoral fractures Type IIIB &IIIC.
- Patients with associated tibial plateau fractures.
- Children with distal femoral fractures, or in whom growth plate is still open or less than 18 years of age.
- Patient with pathological distal femoral fractures other than osteoporosis.
- Patients managed conservatively for other medical reasons.
- Distal femoral fractures with neurovascular compromise.
- Revision surgery of supracondylar femur fractures.

Materials

Design features of locking compression plates:

The locking compression plates have these LC-DCP features:

500 of longitudinal screw angulation;

140 of transverse screw angulation;

Uniform hole spacing;

Load (compression) and neutral screw positions;

Plates are made of 316L stainless steel;

Tapered end for submuscular plate insertion, improving tissue viability;

Limited - contact plate design reduces plate to bone contact limiting vascular trauma.

Locking screw design: The screw design has been modified from standard 4.5 mm cortex screw design to enhance fixation and facilitate the surgical procedure.

Features include:

- Conical screw - to provide a secure screw plate construct.
- Large core diameter-Improves bending and shear strength and distributes the load over a larger area in the bone.
- Cortical thread profile - The shallow thread profile of the locking screws results from the larger core diameter.
- Locking screws engaged in the plate create a fixed-angle construct that improves fixation in osteopenic bone and multifragment fractures. Multiple screw fixation in the femoral condyles. Low-profile, anatomically-shaped plates designed for left or right femur 316L stainless steel implants.

Plate Head (condylar region): Anatomically-shaped head is contoured to match the distal femur, eliminating intraoperative plate contouring Six threaded screw holes accept locking screws.

Plate Shaft:

- Combi holes combine a dynamic compression unit (DCU) hole with a locking screw hole, providing the flexibility of axial compression and locking capability throughout the length of the plate.
- Straight plates are available with 6, 8, 10, 12, 14, 16 or 18.
- Combi holes in plate shaft to accommodate fracture patterns that include shaft fractures in conjunction with articular fragments.
- Curved plates are precontoured to mimic the anterior bow from the lateral aspect of the femur.

Fig 1: Locking Compression Plate & Instruments

Methodology: Due approval was taken from Institutional Ethical Committee before undertaking the study. The selected patients were then informed about the procedure and written informed consent was taken.All the patients underwent thorough preoperative investigations which included: hemogram; blood sugar level; serum creatinine level; blood urea level; serum electrolytes; blood group and Rh typing; bleeding, clotting, and prothrombin times; chest x-ray postero-anterior view; electrocardiography; 2D echo; other tests required in pre anaesthetic evaluation. Patients were reassured to alleviate their anxieties.

Investigations: Hemogram, Serum creatinine, Serum electrolytes, Random blood sugar, Blood urea level, Blood group and Rh typing, Bleeding time, clotting time, prothrombin time, ECG and Chest x-ray PA view, X-ray Knee AP&LAT view, x-ray femur AP&LAT view 2D Echo.

Surgical Procedure:

Although various approaches like

- Lateral approach
- Minimally invasive lateral approach
- Medial Approach

- Antero-lateral approach are described.

Most surgeons prefer to use the Lateral approach-standard.

Under appropriate anaesthesia, we used the standard lateral approach to distal femur, with patient in supine position and a sand bag was kept below the operating knee and one below the ipsilateral hip.

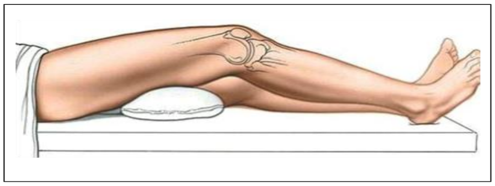

Fig 2: Position of patient to approach distal femur

Through lateral approach to distal femur, Skin and subcutaneous tissue were cut.

- Superior geniculate artery was identified and ligated.
- Care was taken not to incise the lateral meniscus at the lateral joint margin.
- The vastuslateralis muscle was carefully elevated from intermuscular septum and retracted anteriorly and medially.
- Osteotomy of tibial tubercle was done and lifted along with patellar tendon, which improved anterior exposure to the condyles of femur.
- The articular fragments were reduced and temporarily secured with pointed reduction foreceps and/or K wires. If a posterior Hoffa fragment is present, it must be reduced and provisionally stabilized with k-wire inserted from anterior to posterior.
- The condyles were secured with 6.5mm 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 place placement.
- A K wire was placed across the femoral condyle, at the level of knee to indicate the joint axis and a second K wire was placed across the patella-femoral joint on the trochlear surface.
- Using anatomic landmarks and C-arm imaging, the plate was mounted on the intact / reconstructed condyle without attempting to reduce the proximal portion of the fracture.
- The position of guide wire, which was inserted in through the central hole, parallel to both distal femoral joint axis and patella femoral joint was ensured.
- The length was measured and screws were inserted starting from central hole in the condylar portion and checked under image control.
- Predrilling / pretapping were not considered owing to the self drilling, self tapping flutes of the screws. However, lateral cortex was predrilled in dense bone.
- Once satisfactory reduction was achieved, the plate was loaded in tension using articulated tension device. The plate shaft was fixed with appropriate screws after confirming final reduction of the fractures. The wound was closed in layers over a suction drain.

Post–Operative Protocol: Antibiotic prophylaxis was given in the form of iv for 5 days then converted to oral for 5 days. Thrombo prophylaxis for most patients in our study was done with physical methods such as early mobilization, manual compression of the calf & elastic stockings. All drains were removed once the drainage stopped. Most drains were removed by 48 hours. The wounds were inspected on the 3rd& 7th post-operative days. Stitches were removed on the 12th or 13th day after ensuring healthy wound margins. Wounds showing any suspicious signs of infection were treated with higher antibiotics & subsequently by debridement.

Mobilization & Rehabilitation: Proper postoperative rehabilitation is essential to ensure the attainment and maintenance of satisfactory range of motion, strength and function of the knee joint. Rehabilitation was custom made to the patient and the fracture type. If fracture fixation was stable, then therapy was started early with the understanding that the most useful range of motion could be achieved, in the first few weeks of postoperative period. Post operatively physiotherapy in bed was started on the second post-operative day or according to the tolerance of patient and associated injuries. The patients were started with quadriceps strengthening exercises, knee and ankle mobilization exercises. Partial weight bearing was started after 6 weeks and full weight bearing was started according to signs of union on followup.

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 edema 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:

1. Improve early range of motion of knee.
2. Decreases of incidence of deep vein thrombosis and pulmonary embolism.
3. Faster pain relief and shorter stay at hospital.
4. It reverses collagen loss, improves cartilage nourishment, prevents joint stiffness.

Late Phase (After 3weeks)

- Continue isometric quadriceps setting exercises, Active and Passive range motion exercises.
- Seated knee extension procedures.
- Partial weight bearing was allowed after 3rdweek.
- Full weight bearing was allowed after radiological evidence of healing (6- 12 weeks).

Follow Up Protocol

All patients were followed up for a period of six months; the follow up visits were done at: 1,3,6 months clinically for wound condition, functioning, anatomically for shortening, and radiologically for union and amount of collapse.

Parameters: Type of fracture, Associated injuries, Gap between injury and surgery, Duration of hospitalization, Time for union, Neer's Pain score, Neer's walking capacity score, Neer's knee flexion (Joint movement) score, Neer's work capacity score, Neer's gross anatomy score, Neer's radiographic score, Neer's overall score.

Definition of Outcome Measures: Neer's scoring was used to assess the outcome of surgery, for adult distal femoral fractures.10It consists of functional (70 units) and anatomic (30 units) components. A clear description of the scoring system is presented in Table 2.

Statistical Methods: Data were analysed using the Statistical Package for Social Sciences (IBM SPSS statistics for windows version 20, Armonk, NY, USA). Descriptive statistics, Chi square test, Fisher's exact test were done to analyse the data. Alpha for significance for all inferential statistics was set at 5% (i.e. $p \leq 0.05$ was considered statistically significant).

Results

Of the 40 study participants, 28 were males and 12 were females. The mean age of the study participants was 39.55 years with a standard deviation of 15.27 years. Majority of the study participants belonged to 21-30 years and 31-40 years age groups. Study participants were categorized based on the type of fractures. 14 subjects had extra articular fractures, while 26 subjects had complete articular fractures. According to AO/OTA classification, of the 14 subjects with extra articular fractures, 3 had simple (A1), 4 had metaphyseal wedge (A2), and 7 had metaphyseal complex fractures (A3). Ofthose with complete articular fractures, 11 had articular simple, metaphyseal simple (C1), 8 had articular simple, metaphyseal multifragmentary (C2), and 7 had articular multifragmentary fractures (C3). According to Gustilo-Anderson classification, 21 subjects were categorized as Type I (an open fracture with a wound less than 1 cm long and clean), 11 as Type II (an open fracture with laceration greater than 1 cm long without extensive soft tissue damage, flaps, or avulsions), and 8 as Type III (either an open segmental fracture, an open fracture with extensive soft tissue damage, or a traumatic amputation).

Of the study sample, 25% of the subjects demonstrated associated injuries, with metatarsal injuries being the most common, followed by metacarpal and phalangeal fractures, facial injuries. In majority of the cases, fracture took place on the right side. In 40% of cases, surgery took place within 3 days from the time of injury. There were 3 subjects on whom surgery was performed after more than 15 days from the injury. While 40% of the study subjects were hospitalized for 1-2 weeks, there were 2 subjects who were hospitalized for more than four weeks. 65% of the study subjects reported intermittent pain, 55% reported mild restriction; 57.5% demonstrated knee flexion of 100°; 45% could do regular work but with handicap; 52.5% of subjects demonstrated only thickening; 60% subjects shown an angulation of 5° or displacement by 0.5 cm on radiographs.

On the whole, at 6 months, 20 subjects were observed to have excellent overall NEER's scores. Subjects with Type A fractures demonstrated better NEER overall scores compared to those with Type C fractures. There was no significant difference between subjects from different age groups in the overall NEER scores.

Table 1: Gender distribution among study subjects

Gender	Number	Percentage
Male	28	70%
Female	12	30%

Table 2: Descriptive statistics relating to age of the study population

Number	Mean age	Standard deviation	Median	Inter quartile range
40	39.55 years	15.27	35.5	19.5

Table 3: Age distribution of study subjects

Age group	N (%)
21-30 years	13 (32.5)
31-40 years	13 (32.5)
41-50 years	4 (10)
51-60 years	2 (5)
61-70 years	6 (15)
71-80 years	2 (5)

Table 4: Fracture classification (AO/OTA classification)

Fracture classification	N (%)
Extra-articular, simple (A1)	3 (7.5)
Extra-articular, metaphyseal wedge (A2)	4 (10)
Extra-articular metaphyseal complex (A3)	7 (17.5)
Complete articular, articular simple, metaphyseal simple (C1)	11 (27.5)
Complete articular, articular simple, metaphyseal multi fragmentary (C2)	8 (20)
Complete articular, articular multi fragmentary(C3)	7 (17.5)

Table 5: Side of fracture among the study subjects

Fracture side	Number	Percentage
Right	27	67.5%
Left	13	32.5%

Table 6: Associated injuries among the study subjects

Associated injury	Number	Percentage
Metacarpal and phalangeal fractures	3	7.5%
Facial injuries	2	5%
Metatarsal injuries	4	10%
Humerus fractures	1	2.5%

Table 7: Gap between injury and surgery among the study subjects

Gap between injury and surgery	Number	Percentage
< 3 days	16	40%
4-7 days	12	30%
8-14 days	9	22.5%
>15 days	3	7.5%

Table 8: Details of duration of hospitalization of the study subjects

Duration of hospitalization	Number	Percentage
1 week	5	12.5%
1-2 weeks	16	40%
2-3 weeks	11	27.5%
3-4 weeks	6	15%
>4 weeks	2	5%

Table 9: Distribution of NEER Pain scores among the study subjects

NEER Pain score	Number	Percentage
No Pain	6	15%
Intermittent Pain	26	65%
Causing fatigue	8	20%
Restricting function	0	0%
Constant pain or pain at night	0	0%

Table 10: Distribution of NEER walking capacity scores among the study subjects

NEER walking capacity score	Number	Percentage
As before injury	6	15%
Mild restriction	22	55%
Restricted, stair sideways	9	22.5%
Cane or severe restriction	3	7.5%
Crutches or brace	0	0%

Table 11: Distribution of NEER knee flexion scores among the study subjects

NEER knee flexion score	Number	Percentage
Normal or 135°	4	10%
100°	23	57.5%
80°	13	32.5%
60°	0	0%
40°	0	0%

Table 12: Distribution of NEER work capacity scores among the study subjects

NEER work capacity score	Number	Percentage
As before surgery	12	30%
Regular but with handicap	18	45%
Alter work	7	17.5%
Light work	3	7.5%
No work	0	0%

Table 13: Distribution of NEER Gross anatomy scores among the study subjects

NEER gross anatomy score	Number	Percentage
Thickening only	21	52.5%
5° angulation or 0.5 cm short	16	40%
10° angulation or rotation, 2 cm short	3	7.5%
15° angulation or rotation, 3 cm short	0	0%
Union but with great deformity	0	0%
Non union or chronic infection	0	0%

Table 14: Distribution of NEER radiograph scores among the study subjects

NEER radiograph score	Number	Percentage
Near normal	9	22.5%
5° angulation or 0.5 cm displacement	24	60%
10° angulation or 1 cm displacement	7	17.5%
15° angulation or 2 cm displacement	0	0%
Union but with great deformity; spreading of condyles; osteoarthritis	0	0%
Non union or chronic infection	0	0%

Table 15: Distribution of NEER overall scores among the study subjects

NEER overall score	Number	Percentage
Excellent	20	50%
Good	16	40%
Fair	3	7.5%
Poor	1	2.5%

Table 16: Association between type of fracture and NEER walking capacity score

NEER walking capacity score	Type A	Type C	P value
As before injury	5 (35.7%)	1 (3.8%)	0.001*
Mild restriction	7 (50%)	15 (57.7%)	
Restricted, stair sideways	2 (14.3%)	7 (26.9%)	
Cane or severe restriction	0	3 (11.6%)	
Crutches or brace	0	0	

Fisher's exact test; p≤0.05 considered statistically significant; * denotes statistical significance

Table 17: Association between type of fracture and NEER Knee flexion score

NEER knee flexion score	Type A	Type C	P value
Normal or 135°	3 (21.4%)	1 (3.8%)	0.001*
100°	9 (64.3%)	14 (53.8%)	
80°	2 (14.3%)	11 (42.4%)	
60°	0	0	
40°	0	0	

Fisher's exact test; p≤0.05 considered statistically significant; * denotes statistical significance

Table 18: Association between type of fracture and NEER work capacity score

NEER work capacity score	Type A	Type C	P value
As before surgery	4 (28.6%)	8 (30.7%)	0.001*
Regular but with handicap	7 (50%)	11 (42.3%)	
Alter work	2 (14.3%)	5 (19.2%)	
Light work	1 (7.1%)	2 (7.8%)	
No work	0	0	

Fisher's exact test; p≤0.05 considered statistically significant; * denotes statistical significance

Table 19: Association between type of fracture and NEER gross anatomy score

NEER gross anatomy score	Type A	Type C	P value
Thickening only	6 (42.8%)	15 (57.7%)	0.04*
5° angulation or 0.5 cm short	7 (50%)	9 (34.6%)	
10° angulation or rotation, 2 cm short	1 (7.2%)	2 (7.7%)	
15° angulation or rotation, 3 cm short	0	0	
Union but with great deformity	0	0	

Fisher's exact test; p≤0.05 considered statistically significant; * denotes statistical significance

Table 20: Association between type of fracture and NEER radiographic score

NEER radiographic score	Type A	Type C	P value
Near normal	4 (28.6%)	5 (19.2%)	0.08
5° angulation or 0.5 cm displacement	8 (57.1%)	16 (61.5%)	
10° angulation or 1 cm displacement	2 (14.3%)	5 (19.3%)	
15° angulation or 2 cm displacement	0	0	
Union but with great deformity; spreading of condyles; osteoarthritis	0	0	

Fisher's exact test; p≤0.05 considered statistically significant; * denotes statistical significance.

Table 21: Association between type of fracture and NEER overall score

NEER overall score	Type A	Type C	P value
Excellent	9 (64.2%)	11 (42.3%)	0.009*
Good	4 (28.6%)	12 (46.1%)	
Fair	1 (7.2%)	2 (7.6%)	
Poor	0	1(4%)	

Fisher's exact test; p≤0.05 considered statistically significant; * denotes statistical significance

Table 22: Association between age and NEER overall score

NEER overall score	21-30 years	31-40 years	41-60 years	61-80 years	P value
Excellent	8(53.3%)	6 (50%)	4 (66.7%)	2 (28.6%)	0.083
Good	7 (46.7%)	5 (41.7%)	2 (33.3%)	2 (28.6%)	
Fair	0	1 (8.3%)	0	2 (28.6%)	
Poor	0	0	0	1 (14.2%)	

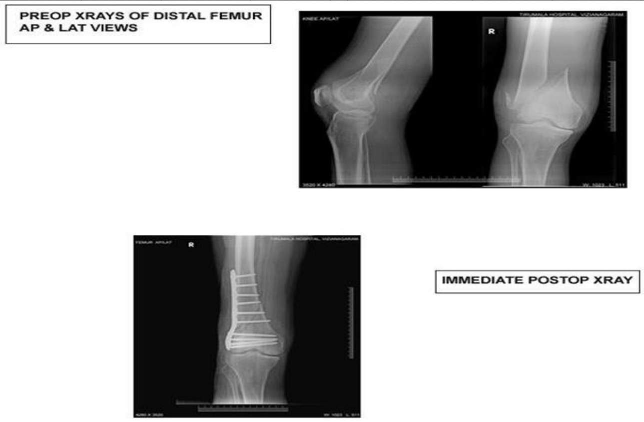

Fig 3: Pre-OP Xrays of distal femur AP and Lateral views; immediate post-OP X Ray

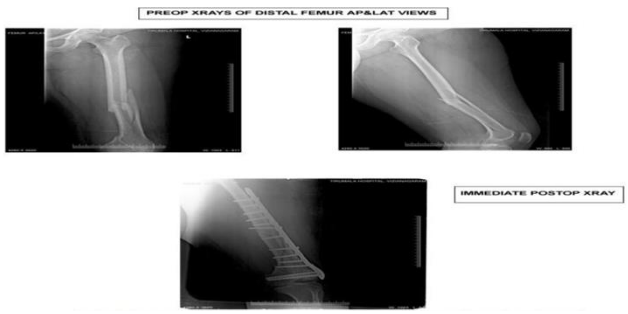

Fig 4: Pre-op Xrays of distal femur AP and Lateral views; immediate post-op X ray

Fig 5: Pre-op Xrays of distal femur AP and Lateral views; immediate post-op X ray

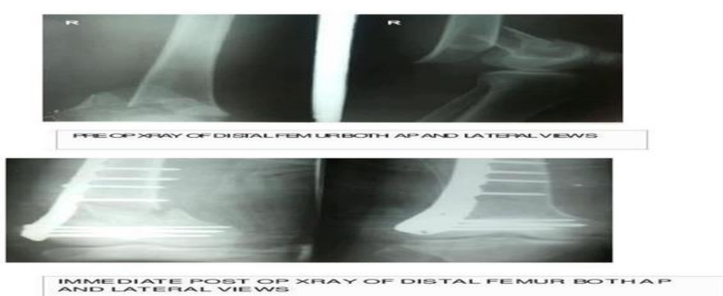

Fig 6: Pre-op Xrays of distal femur AP and Lateral views; Immediate post-op X ray

Fig 7: Pre-OP Xrays of distal femur AP and Lateral views; immediate post-OP X ray

Fig 8: Pre-op Xrays of distal femur AP and Lateral views; Immediate post-op X ray

Fig 9: Pre-OP Xrays of distal femur AP and Lateral views; immediate post-OP X ray

Fig 10: Pre-OP Xrays of distal femur AP and Lateral views; Immediate post-OP X ray

Discussion

Recent epidemiological surveys suggest an increasing incidence of distal femoral fractures. Advance in mechanization and acceleration of travel have resulted in increased incidence of such comminuted, unstable fractures. Increasing geriatric population and osteoporosis has added to the problem. Supracondylar fracture of femur, reportedly has been a difficult traumatic event to treat, one of the many reasons for which is its proximity to the knee bone[6]. These fractures pose the risk of long term disability as most of the cases are unstable and comminuted. In the management of supracondylar femoral fractures, the fundamental concern is restoration of the axis and rotation of femur, maintain limb length and articular congruity. These fractures are frequently comminuted and intra-articular, and they often involve osteoporotic bone. Implant selection occupies a pivotal role in the management of these fractures. The selected implant must have the properties to ensure high stability with optimum flexibility for maintenance of dynamic osteo-synthesis; it should allow application in an angular stable manner, and must demonstrate substantivity in maintaining reduction till union. LCP is one such implant with all the aforementioned features. In this study 40 fractures of distal femur were treated with LCP. Overall outcome of the surgical management of supracondylar femoral fractures using LCP was assessed using Neer's Score. 70% of subjects in the present study sustained fractures in road traffic accidents and the remaining 30% of the subjects had accidental falls or falls from a height. This observation is consistent with the previous literature and is also in line with the age distribution of the study participants, with 75% of the study subjects aged less than 50 years sustaining high energy trauma. Majority of the participants in the younger age groups from previous studies had road traffic accidents as follows: 70% reported by Dasaraiah CV et al.; 70% by Gupta GK et al.; 87.5% by Krishna C and Shankar RV; 66% in the study conducted by Babu SK, Pardhasaradhi; 80% reported by Bachu S and Ramulu L; 81% by Biju S and SabariSree M; 76.5% reported by Gyanendra Kumar et al[6]. The study participants in the present study included 70% males and 30% females. This gender distribution is similar to that reported by Dasaraiah CV et al, Gupta GK et al, Babu SK and Pardhasaradhi, Bachu S and Ramulu L, Biju S and SabariSree M, Saini RA et al[7]. In the present study, 35% of the fractures were AO type A and 65% were type C. These results are comparable to those reported by Dasaraiah CV et al, where 66.7% of the fractures were type C. 10% of subjects in this study had metatarsal injuries followed by metacarpal and phalangeal fractures to 7.5% of study subjects. In the study conducted by Dasaraiah CV et al, 3.34% of subjects had metacarpal and phalangeal fractures.

While intramedullary nails are well suited to fix extraarticular and simple articular fractures (C1), plates can also be used to treat complex articular fractures. Nevertheless, any displaced articular fracture component must still be anatomically reduced by an open approach and fixed with absolute stability. Fracture fixation was predominantly with anatomical periarticular locking plates, and a smaller number of retrograde intramedullary nails. Whilst this reflects the current literature, with the role of locking plates expanding as the technology evolves, studies supporting both methods of fixation have been published.

The LCP is a single beam construct where the strength of its fixation is an additive function of all screw-bone interfaces rather than a single screw's axial stiffness and pull out resistance as seen with the 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. Locking compression plate acts as load bearing device, stabilizing fracture fragments and ensuring early bony union. It acts as an 'internal fixator' and functions by splinting the fracture rather than compression and hence allows a flexible stabilization, avoidance of stress shielding and induction of callus formation. Vascular compromise was minimal due to the fact that the plate does need to be in contact with the bone. With minimal invasive applications, LCP allows for substantially quick healing, reduces the incidence of infections, and curtails resorption of the bone by preserving the blood supply. The DF-LCP is a further development from the LISS, which was introduced in the mid to late 1990's. The main difference between the DF-LCP and the LISS is that the LISS utilizes an outrigger device for shaft holes, functioning essentially as a locking guide jig, which is attached to the distal part of the plate and guides the placement of the proximal locking screws. The oval shaft holes on the DF-LCP allow the choice of a compression screw or a locking screw, which results in the exact and accurate placement of the plate with a provision to be compressed further close to the bone.

The present study showed that the right femur was involved in majority patients, which is commensurate with the findings reported by Abhijit Sarkar and Sachlang Debbarma. In the present study the average length of hospitalization was 20.13 days with a range of 9 to 38 days. Similar findings were reported by Nalo T et al. where the average length of hospitalization was 18.77 days and higher compared to the findings reported by Mahesh DV et al. where the length of hospitalization was 9 days with a range of 3 to 15 days. In the present study, the average number of days from injury to surgery was 6.54 days with a range of 2 to 19 days. Similar observations were made by Bipulet al and Rajaiah D et al[8]. Clinical union was seen at a mean time of 16.21 weeks (18 -56 weeks) in all cases. Similar observation was made by Weight et al, where the clinical union mean time reported was 12 weeks (8-26 weeks) and Bae SH et al. where the time to union was 14.3 weeks. There were no cases of non union in this study. 100% union was reported earlier by Dasaraiah CV et al, Yeap and Deepak, Bolhofner et al[9].

- In the present study, distal femur locking compression plates were used to manage the distal femoral fractures. Markmiller et al. prospectively compared the outcome of condylar blade plate and retrograde intramedullary nail. At 12 months, no statistically significant differences were noted with non-union, fixation failure, infection and secondary surgical procedure. Hierholzer et al. confirmed these results in a retrospective series of 115 fractures comparing retrograde nailing (n = 59) and mini-invasive locking plate (n = 56).The authors describe the indications for each technique: the plate can be adapted to all fractures, while retrograde nailing is better adapted to extra-articular fractures. They emphasize that high quality results are more dependent upon the surgical technique than the choice of implant. Hartin et al did not observe any difference in functional recovery in a randomized comparison of the treatment of extra-articular fractures by retrograde intramedullary nailing and blade plate[10]

Conclusion

It can be concluded from this study that locking compression plate is an ideal treatment option for supracondylar femoral fractures. Compared to type C fractures, type A fractures demonstrated better results as evaluated by the Neer's scoring system. Locking compression plates also prevent compression of periosteal vessels. It is ideal to prevent metaphyseal collapse and to preserve limb length in severely comminuted fractures. The technique also demonstrates a lesser chance of complications like plate or screw breakage, however, judicious selection of patients and strict compliance to the basic principles of fracture fixation will go a long way in curtailing the complications of fracture fixation of supracondylar femoral fractures using locking compression plates.

References

1. O, Cordey J, Harder Y, Maier A, Buhler M, Barraud GE. The epidemiology of fractures of the distal femur. Injury. 2000; 31(Suppl):C62-C63.
2. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006; 37:691-697.

3. Kanakeshwar RB, Perumal R, Kamal AC, Dheenadhayalan J. Decision making in Acetabulum fractures – When to operate and when not to? Trauma International. 2017; 3(1):6-9.
4. Gwathmey FW Jr, Jones-Quaidoo SM, Kahler D, Hurwitz S, Cui Q. Distal femoral fractures: current concepts. J Am Acad Orthop Surg. 2010; 18(10):597-607.
5. Lupescu O, Nagea M, Patru C, Vasilache C, Popescu GI. Treatment Options for Distal Femoral Fractures. Maedica (Buchar). 2015; 10(2):117–122.
6. Marsh JL, Slongo TF, Agel J et al. Fracture and dislocation classification compendium - 2007: Orthopaedic Trauma Association classification, database, and outcomes committee. J Orthop Trauma 2007; 21(10 suppl):S1-S133.
7. Butt MS, Krikler S, Ali MS. Displaced fractures of thedistal femur in elderly patients. J Bone Joint Surg Br. 1996; 78:110-114.
8. Connolly JF, Dehne E, Lafollette B. Closed reduction andearly cast-brace ambulation in the treatment of femoralfractures. II. Results in one hundred and forty-three fractures. J Bone Joint Surg Am. 1973; 55:1581-1599.
9. Healy WL, Brooker AF Jr. Distal femoral fractures comparisonof open and closed methods of treatment. Clin Orthop Relat Res. 1983; 174:166-171.
10. Neer CS II, Grantham SA, Shelton ML. Supracondylar fracture of the adult femur. A study of one hundred andten cases. J Bone Joint Surg Am. 1967; 49:591-613.

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