# MANAGEMENT OF DISTAL FEMORAL FRACTURES- A COMPARITIVE STUDY BETWEEN SUPRACONDYLAR NAIL AND DISTAL FEMORAL LOCKING PLATE

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**ABSTRACT**

**BACKGROUND**

Distal Femoral Fracture (DFF) poses a considerable therapeutic challenge in management, despite new fixation options. Anatomic reduction, stabilisation, early weight bearing and mobilisation are the main aims of the fracture management. Operative treatment has become a standardised procedure. Earlier stabilisation was usually achieved by an osteosynthesis with condylar screws and plates.

**MATERIALS AND METHODS**

This is a prospective study, 40 patients with fracture of DFF were treated with retrograde femoral nail and DFLP.

**RESULTS**

The mean age in the two groups was 52.25 years (range 20-60 years) with mean follow-up of 2.1 years (range 1.5-2.0 years). Majority of patients were males in both groups. Mechanism of injury was high energy trauma like RTA in 30 patients and low energy impact in 10 patients. The patients were assessed for fracture union, function and complications at regular follow-up interval.

**CONCLUSION**

LCP plating proved to the better choice than DFN for treating DFF with respect to surgical duration, mobilisation, fracture union, weight bearing, range of movements and complications.

**KEYWORDS**

Supracondylar Fractures, Locking Plate, Retrograde Femoral Nail.

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## BACKGROUND

Distal femoral fracture poses a considerable therapeutic challenge in management. Supracondylar femur fractures are complex injuries, difficult to manage and associated with potential complications.[1] Despitenew fixation options, anatomic reduction, stabilisation, early weight bearing and mobilisation are the main aims of the fracture management. Earlier stabilisation has usually been achieved by a various devices like intramedullary nails or osteosynthesis with Dynamic Condylar Screws (DCS) and DFL plates.

These fractures occur in two different age groups due to different types of injuries. In young patients, these fractures occur due to high velocity injury, e.g. road traffic accidents and sports injuries. While in elderly patients, usually low velocity injury like fall during walking, slippage in bathroom results in supracondylar fractures of the femur.[2,3,4,5,6]

The traditional management of displaced fracture supracondylar of femur was along the principle of Watson Jones and John Charnley.[1,2] This comprised of skeletal traction, manipulation of fracture and external immobilisation in the form of casts and cast bracings. These methods, however, met with problems like deformity, shortening, knee stiffness, angulation, joint incongruity, malunion, quadriceps wasting, knee instability and posttraumatic arthritis. Involvement of the articular surface demands acongruent anatomic reduction to prevent or minimise posttraumatic arthritis.

Although, managed conservatively in the initial era, but with improvement in the available implants and surgical techniques, operative treatment is now[7] considered as a standard treatment option. Internal fixation allows early ambulation and range of motion[8], which avoids knee stiffness. There are number of options available for fixation of these[9] fractures, including distal femur locking plate, Dynamic Condylar Screw (DCS) and retrograde[10] intramedullary supracondylar nail. There has been a changing philosophy towards surgical treatment of supracondylar fractures of femur. The trend of open reduction and internal fixation has become popular in the

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recent years; internal fixation allows early ambulation and range of motion, which avoids knee stiffness. In the management of closed displaced supracondylar fractures with blade plating, there has reported an overall complication rate even up to 35% by Merchan et al. There has been malalignment and pseudoarthrosis, which are proposed to be due to the eccentric lateral location of the plate and less stiffness of the bone stockin the metaphysis. Also, the iatrogenic soft tissue trauma surrounding the fracture site and devascularisation of the periosteum inplacing the extramedullary plate has been suggested to play a role in the development of infection and delayed union.[11]The rotational movement created by dynamic condylar screw or AO blade plate at the fracture site that causes pulling off the blade plate or condylar screws leading to fatigue fracture of the plates. The osteoporotic bone leads to fixation failures with screws and plate. The anatomically precontoured built of locking compression plate, reduces soft tissue problems and acts as internal/external fixator. Aunicortical fixation with a locking compression plate has got advantages of least chance of plate back out as the screw gets locked to the plate. Further, if MIPO technique is used along with closed reduction, soft tissue injury is very less. Locking plates have been developed in conjunction with a minimally-invasive biologically friendly insertion technique, which allows the plate to be placed without excessive soft tissue stripping and with minimal disruption of the bone blood supply.[1,2]

The technique of retrograde intramedullary nailing has been developed to avoid some of the problems associated with condylar plating. In distal femoral plate, the shaft of femur is often pulled laterally displacing the line of weight bearing lateral to the anatomical axis of condyle. The advantage of an intramedullary device is that it maintains the anatomical axis; failure of fixation in osteoporotic bone should be less.[12,13] Haematoma at fracture site is preserved by the intramedullary nail. Also, it reduces chances of blood loss and lessens soft tissue dissection, retrograde nailing reduces time and also rate of infection.

## MATERIALS AND METHODS

This is a prospective study of 40 patients in KIMS Hubli. We studied our patients who fitted the criteria for the study. A written consent was obtained from all the patients. Extra-articular fractures are operated with RN and intra-articular fractures with LCP. Plating group included 23 patients whereas nailing group included only 17.

The study consists of 40 patients of distal femoral fractures treated either with intramedullary nails or minimally-invasive plate osteosynthesis techniques. Biplanar radiography was evaluated to determine the nature and geometry of fracture. Patients were classified according to AOMuller classification. CT was done in few patients to study the correct fracture geometry. The majority of patients (80%) were within 0-2weeks. 20% were operated after 2 weeks because of comorbid medical conditions, which should be controlled first and then operated. All the open fractures are thoroughly washed and debrided within 5-6 hours of injury. Patients were given a course of antibiotics having broad-spectrum coverage. In our study, 8 patients had open fracture (type1-2).The patients were taken to surgery once the wounds healed.

There are 2 groups of patients. Group A includes patients managed by closed reduction and reamed retrograde intramedullary nailing. Group B includes minimally-invasive techniques (MIPPO) by locked plates. Both groups are matched for age, sex, fracture type, associated fractures and comorbid conditions. Patients are followed up every 2 months till fracture union at 6 months and at 1 year. Patients are evaluated for functional and radiological criteria. Fractures were classified with the help of radiographs according to the AO-ASIF classification.

Primary treatment was given in the form of splintage or traction, antiseptic dressing done, antibiotics, analgesics, anti-inflammatory drugs and intravenous fluids. Preoperative preparation like routine blood investigations were done and initial radiographs taken in anteroposterior and lateral views. Fractures were classified according to AO classification.

### Inclusion Criteria

1. Distal femoral fractures-TYPE A,TYPE B and TYPE C
2. Patients older than 18 years of age.
3. Fresh fractures up to 2 weeks.

### Exclusion Criteria

1. Pathological fractures.
2. Periprosthetic fractures in TKR.
3. Open type 3 C.

The decision to fix with either SC nail or DFLP was taken based on type of fracture, geometry of fracture, extensive comminution, osteoporosis and decision of surgeon. Majority of fracture fixation was done within 0-2 weeks of injury. Few were operated after 2 weeks due to comorbid medical conditions or healing of wound.

### Operative Technique-DFLP

Under all aseptic precautions and tourniquet control, the patients were operated under either epidural or spinal anaesthesia. Patient in supine position with knee on sterile bolster, a pillow is kept under knee, so that knee is in 40-50 degrees flexion. Cotton padding was always placed beyond kneeto prevent neurovascular insult. An image intensifier was used intraoperatively via standard lateral approach skin incision was made and vastuslateralis was elevated from lateral intermuscular septum anteriorly to expose the distal femur. Intraarticular fracture reduction was achieved and fixed temporarily with multiple K wires and indirect reduction of articular surface with femoral diaphysis was done under C-arm. Proper-sized DFCP is inserted in distal to proximal direction submuscularly over distal femur. A guide is inserted into guidewire hole on plate. Minimum 5 locking screws were inserted in distal femur, it's always best to insert 7.3mm followed by 5.0mm

cannulated screws. One or more threaded cancellous screws were used in condylar region whenever intercondylar compression was required to achieve compression. Proximal plate fixation was done by either 4.5 mm cortical screws or 5.0mm locking cortical screws. A minimum of 8 cortices must be used in proximal part of plate. Final position of plate was confirmed on C-arm. Wound was closed in layers with suction drain. Dressing done.

**Retrograde Nailing procedure**

Patient positioned supine on radiolucent operation table. Leg is placed on sterile bolster with knee flexed to 20-30 degrees.

A midline incision of 4 cm was taken from inferior pole of patella up to tibial tuberosity. A straight bone awl was inserted into the joint through the split tendon and positioned against the intercondylar notch. The femoral attachment of posterior cruciate ligament is palpated and the bone awl is kept just anterior to the posterior cruciate ligament attachment. The bone awl was then removed and guidewire passed through the entry point. The fracture was reduced under image intensifier control and guidewire passed in proximal fragment. Medullary canal reamed by serial reamers. The nail was then inserted over the guidewire through the entry point made previously through distal and then proximal fragment. Distal locking done using jig/guide. When final reduction and length are acceptable, proximal locking done. Thorough wound wash given, wound closed in layers and sterile dressing done.

**Postoperative Protocol/Follow Up**

Postoperatively, antibiotics were given, limb was elevated with knee in 20-30degrees of flexion. Static quadriceps exercises, straight leg raise exercises and ankle foot exercises were started within 2 days of surgery. Non-weight bearing mobilisation was started between 10 days to 2 weeks depending upon on type of fracture, nature of fixation either nails or DFLP. Graded weight bearing was started based on the evidence of bridging callous on follow-up radiographs and clinical assessment. Follow-up done at 2weeks, 6weeks, 8 weeks, 12weeks,6 months,9 months and one year. During each follow-up visit, patients were assessed clinically for any operative site wound infection, pain at fracture site, tenderness over distal femur and range of movements. Clinically, fracture was considered united if there is no pain at fracture site during palpation and attempted movements of knee, no local increase in warmth at fracture site and no pain during weightbearing. Radiologically, the fracture was considered united when serial x-ray shows bony trabecular crossing the fracture site (Figure 1 and Figure 2).

**RESULTS**

| Sex | LCP | RN | Number of Cases |
|---|---|---|---|
| Male | 15 | 13 | 28 |
| Female | 08 | 04 | 12 |
| ***Table 1. Sex Distribution*** | | | |

| Mode of Injury | Number of Cases |
|---|---|
| RTA | 23 |
| Self-Fall | 17 |
| Open fractures | 08 |
| ***Table 2. Mode of Injury*** | |

| | |
|---|---|
| A1 | 10 |
| A2 | 04 |
| A3 | 12 |
| C1 | 03 |
| C2 | 07 |
| C3 | 04 |
| ***Table 3. Classification of Muller*** | |

| | |
|---|---|
| LCP | 23 |
| Retrograde nail | 17 |
| ***Table 4. Operative Technique*** | |

| | |
|---|---|
| LCP | 20 weeks |
| Retrograde nail | 18 weeks |
| ***Table 5. Full Weightbearing Allowed*** | |

| | |
|---|---|
| Infection | 07 |
| Delayed union | 03 |
| Severe restriction of ROM | 03 |
| Anterior knee pain | 04 |
| Varus or valgus deformity | 00 |
| ***Table 6. Complications*** | |

| Results | LCP | RN |
|---|---|---|
| Excellent | 08 | 06 |
| Good | 10 | 08 |
| Fair | 01 | 03 |
| Poor | 02 | 00 |
| ***Table 7. Evaluation of Results*** | | |

| Percentage | 60-94° | 95-104° | >104° |
|---|---|---|---|
| Number of cases | 3 | 18 | 14 |
| ***Table 9. Clinical Outcome of Range of Movements- Kristensen*** | | | |

40 patients included on the study were divided into two groups as nailing group and plating group.

Plating group included 23 patients whereas nailing group included 17 patients. There were 28males (LCP=15, RN=13) and 12 females (LCP=8, RN=4). Mode of injury as high velocity in 23 patients and 17 had low velocity injury. With mean age of 35 years range (range 20-72). 26 patients had type A fractures and 14 had type C fractures.

Average age of nailing group was 46 years (25-64) and for plating it was 48 years (range 34-62), whereas plating group had 4open cases, all are type 1-2.The mode of injury was RTA in 23 cases followed by self-fall in 17cases.The average duration of surgery in nailing group was 90 minutes (range 60-120minutes) and that of in plating group was 65 minutes (range 70-130minutes). The average time for union was 20 weeks in closed fractures in plating group and 18 weeks in nailing group. Bone grafting was done in 5 patients in plating group. The average range

of motion for nailing group was 79 degrees against plating group, which had 99 degrees. Average knee flexion in this study was 104 degrees. More than 50% patients had knee range of motion more than 110°.

Out of 40 patients, 7 patients had superficial infection, 3 patients had delayed union and 3 patients had severe loss of motion at knee. No valgus or varus deformity more than 5 degrees was seen.

**Retrograde Nailing**

***Figure 1A. Preop X-Ray***

***Figure 1B. Postop X-Ray***

**Distal Femoral Locking Plate**

***Figure 2A. Preop X-Ray***

***Figure 2B. Postop X-Ray***

**DISCUSSION**

Supracondylar fractures of the femur are often difficult to treat and remain a surgical challenge even for the experienced surgeons since it requires careful management to obtain good cosmetic and functional results. In the younger age group, the injury is usually a result of high velocity vehicular crashes. In older patients with osteoporotic bone, it is often due to low energy injuries, especially falls. In either case, the fracture is usually comminuted. It is difficult to compare the results of treatment of distal femur fractures. Different fracture types and differences in demographic characters make it very difficult to compare the results of different series in literature. It is also complicated by the use of different classification systems and functional rating systems. We have used Neer scores because it emphasises on important patient outcome variables like pain, ADL activities, functions, range of movements, return to work, anatomic alignment and x-ray finding of union.

**Locking compression plate(LCP)**

Locking plate fixation gives rigid construct is anatomically and biomedically superior to distal femoral nailing (DFN). It is extramedullary, anatomically countered internalfixator. It provides good and stable fixation in osteoporotic bones in elderly patients. It can be universally applied to all types of distal femoral fractures AO type A to C with the exception of AO type B Hoffa fractures.[12,13] Main advantages of LCP are highest average range of movements, unionrate and time to full weightbearing. It maintains fracture biology and minimises the soft tissue trauma.

In a series by Micalu et al, the bone grafting rate of distal femoral fractures ranged between 0% and 87%. Low rate of bone grafting in our study can be attributed to improved surgical techniques and better soft tissue handling and absence of incidence of valgus or varus deformity of greater than 5 degrees.

Various studies have shown reduced non-union rate for locking plate in distal fractures when compared to non-locked plates.[5]But, recent studies shows non-union rates up to 20%. Higher stiffness of LCP have been related to suppressing the inter fragmentary movements and callus formation.[13]

The concept of bridging osteosynthesis indicates that final fractures construct should be elastic and not too stiff to prevent non-union. Therefore, screws should not be inserted very close to fracture line in order to allow elastic deformation of the plate screw construct. Sub muscular plate insertion reduces non-union formation significantly.

LCP had better outcome in both extra-articular and intra-articular group.

**DFN**

Advantage of DFN includes minimum invasive method, small incision, decreased blood loss, percutaneous joint fixation, better fixation and alignment. Maintaining this alignment is critical to the function and durability of the limb. It is indicated in type A, C1 and C2, severe obesity, ipsilateral segmental fracture. Better alignment can be achieved with locked DFN. Patient is mobilised early.

Disadvantages of DFN are surgical technical expertise required, posterior angulation, cartilage damage and painful knee movements and joint infection.

**CONCLUSION**

1. Both modalities of fixation deserve place in management of distal femoral fractures.
2. Overall, results were comparable in both groups.
3. Locked DFN has advantage of restoring the patient early, union time was shorter, better alignment of knee axis and reduced wound complication.
4. Main disadvantage of DFN is persistent knee pain.
5. Protected weightbearing and wound problem are drawbacks of plating.

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