National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2018; 2(1): 32-36
Received: 16-11-2017
Accepted: 20-12-2017

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Functional outcome of management of fracture of distal femur

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Abstract
Distal femoral fractures are difficult to treat and ideal treatment of such fractures will include anatomical reduction, rigid fixation of articular surfaces and early mobilization of knee joint. The purpose of the study is to evaluate the end results of surgical management of fracture of distal end of femur using the D.C.S, L.C.D.C.P, L.C.P, Nail and other surgical modalities and anlayse the complications and the causes of fractures.
Materials and methods: A Retrospective Study of 30 patients were evaluated from tertiary hospital for a period of Dec 2014 to June 2017. There were 30 fractures in 30 patients involving the distal femur, which were treated either surgically by internal fixation or conservatively by POP application or skeletal traction, 26 cases were treated surgically and 4 were treated conservatively.
Results: At the end of study, the cases were followed up for an average period of 7.4 months (range of 6-22 months) and functional results were evaluated using Neer's *et al* [1]. rating system. Overall 9 cases (30%) had excellent rating, 14 cases (45%) had satisfactory rating and 7 cases (25%) had unsatisfactory.
Conclusion; Fractures of distal femur can be very effectively treated by surgical methods. The satisfactory osteosynthesis of fractures and stable osteosynthesis is achieved by the right approach and correct surgical technique.

Keywords: distal femur fracture, internal fixation, conservative methods, Neer's scoring system, dynamic condylar screws

Introduction
Since man has taken to travelling at high speed in the position of flexed knee joints, when the machine in which the subject is travelling stops suddenly, much of the impact is taken first upon the patella, then the condyles of the femur and then the tibia in varying proportions and positions. The knee has become the most vulnerable of all joints. No simple method of management has overcome all the problems associated with these fractures. Although closed treatment methods have improved, difficulties were often encountered, including persistent angulatory deformities, knee joint incongruity, loss of knee motion and delayed mobilization (especially in patients with multiple injuries) [2].
During the past two decades as technology and implants have improved the concepts of treatment of these fractures has changed significantly Better methods of fixation have improved clinical results and allowed immediate mobilization of the patient and extremity, sparing the cardio pulmonary and other multisystem sequelae of long immobility.
Femur fractures are fractures within the articular and non-articular metaphyseal region of the distal femur. For a fracture to be included in this series, part of the fracture line had to extend distal to a horizontal line draw on the antero-posterior roentgenogram 9 cm above the distal articular surface of the femoral condyles
The purpose of the study is to evaluate the end results of surgical management of distal end of femur using the dynamic condylar screw, retrograde supracondylar nail, Limited contact dynamic compression plates, Locking compression plate and other surgical modalities and analayse the complications and the causes of fractures. The rating system of Neer *et al*. was employed to determine the functions of outcome. The results were compared with each other, and to that of conservative treatment.

Literature of survey
Watson-Jones [3]. In 1966, Stewart *et al*. Two-pin traction was recommended as the treatment

of choice [4[. In 1967, Neer *et al*. Closed treatment yielded satisfactory results in 84% of the patients [5].

Schatzker and Lambert (1979) I noted common errors, including in accurate reduction, failure to achieve inter fragmentary compression with lags screws, medial protrusion of the blade plate, and the blade plate being introduced too proximal from the knee joint[6]. In 1982, Mize *et al*. [7-8] reported on ORIF of distal femoral fractures using AO technique. They also recommended the use of extensile surgical approach for complex intraarticular fractures.

In 1987, Kenneth D. Johnson, compared the results of non operative treatment with that of operative treatment with various implants ranging from condylar buttress plate, DCS, Angle blade plate, interlocking nail, Zickel device depending on the age of patient and type of the fracture. Good results were obtained with operative treatment [9].

Kretteck C *et al*., in 1997, reported results with DCS, using the MIPPO technique. There was one implant failure (plate screw breakage), 2 varus deformities above 5°, 2 shortenings over 20 mm, and one rotational deformity of 20°, according to Neer score, there were 6 excellent, one satisfactory, 3 unsatisfactory results and no failures [10].

In 2000, Kumar *et al*., reported the results with AIM titanium supracondylar nails. They concluded that this device is a useful alternative implant for the management of osteoporotic fractures, particularly the extra articular AO type A in elderly population [11].

In 2001, Lamraski G. *et al*., evaluated retrospectively 47 fractures of distal femur treated with blade plates and DCS. Blade plates were used for all fracture types until 1992, subsequently restricted to simple supracondylar fractures, whereas DCS was preferred for other type of fractures [12].

Philip J Kregor, in 2002, reviewed the past experience with treatment of supracondylar femur fractures, in particular the C3 distal femur fracture. He stressed on a lateral per patellar approach for optimal visualization of the articular surface, followed by soft tissue preservation around the metaphysical component of the fracture, and sub muscular fixation [13].

Armstrong R. *et al*., in 2003 reported good results with retrograde intramedullary nail after intercondylar fracture extension being reduced and treated with lag screws. Weight bearing was not allowed until clinical union [14].

In 2015 Nagamuneendrudu *et al*. [15]. The MIPO-Minimally Invasive Plate Osteosynthesis, LISS less invasive stabilization system is preferred. In the elderly patients with a thin metaphysical cortex and osteoporotic bone, and wherever one expects to find osteopenic bone, LCP is preferred.

Aim

1. To determine suitable method of treatment for a particular type of fracture.
2. To analyse outcome of management of fractures of distal femur.
3. To analyse complications of distal femoral fractures.

Materials and Methods

A Retrospective Study of 30 patients were evaluated from tertiary centre, Mangalore from period of Dec 2014 to June 2017. The approval was given by institutional ethics committee. There were 30 fractures in 30 patients involving the distal femur, which were treated either surgically by internal fixation or conservatively by POP application or skeletal traction. 26 cases were treated surgically and 4 were treated conservatively.

The following observations were made and final results were assessed on the basis of *Neer's* knee score rating.

Sex Distribution

In 30 patients, 23 were males and 7 were females.

Age Distribution

The age range was 18 to 62 years with an average of 40 years. 83% of cases (25 cases) were in age group of 20-49 years.

Table 1: Mode of injury

Mode of injury Cases		Cases	Percentage
R.T.A	Pedestrian	3	9.9%
	Two wheeler	12	40%
	Three wheeler	2	6.7%
	Four wheeler	6	20%
Fall		5	16.7%
Assault		2	6.7%
Total		30	100%

Fractures were classified according to Muller's classification based on X-ray findings.

Table 2

Type of fracture	Cases	Percentage
A_1	7	46.7%
A_2	3	
A_3	4	
B_1	3	
B_2	1	13.3%
C_1	5	
C_2	5	
C_3	2	40%

Intraoperative grading of fractures

The fractures were graded intraoperatively and compared to preoperative classification. In 4 cases, X-rays did not correlate well with intra operative findings.

Surgery

Patients underwent surgery after an average duration of 3 days with a range of 1-24 days after admission. All the patients were operated under spinal anaesthesia. Average duration of surgery was 100 minutes with a range of 140 to 600 min. Tourniquet was used in all cases. Different implants were used as based on the fracture type and surgeon's preference. Bone grafts were used in 1 case for metaphyseal defects. They were taken from ipsilateral iliac crest.

Table 3: Implants used in different types of fractures

Implant	Types of fracture									Total
	A1	A2	A3	B1	B2	B3	C1	C2	C3	
DCS	1	1	0	0	0	0	3	1	1	7
CBP	5	0	0	0	0	0	1	0	0	6
IL-NAIL	1	1	1	0	0	0	0	0	0	3
DCP	0	0	0	0	0	0	0	1	0	1
CCS	0	0	0	3	1	0	0	0	0	4
Butteress plate	0	0	1	0	0	0	1	1	0	3
Locking compression plate	0	0	1	0	0	0	0	0	1	2
Total	7	2	3	3	1	0	5	3	2	26

Complications during Surgery
No difficulties were encountered intraoperatively

Postoperative complications
Infection was seen in 2 cases. Superficial infection was seen in one case and deep infection was seen other case.
In the patient with deep infection, implants were removed and infection controlled. Superficial infection was treated with antibiotics and healing attained in 3 weeks. Patient had a final satisfactory functional result.

Delayed complications
Failure of implant was seen in 2 cases. In 1 case, the distal screws of locking compression plate was broken on the 6th post operative week. In the second case, there was a break in the distal screws of interlocking nail. There were no functional or healing complications and patient had a satisfactory functional result. One patient required bone graft after 12 weeks.

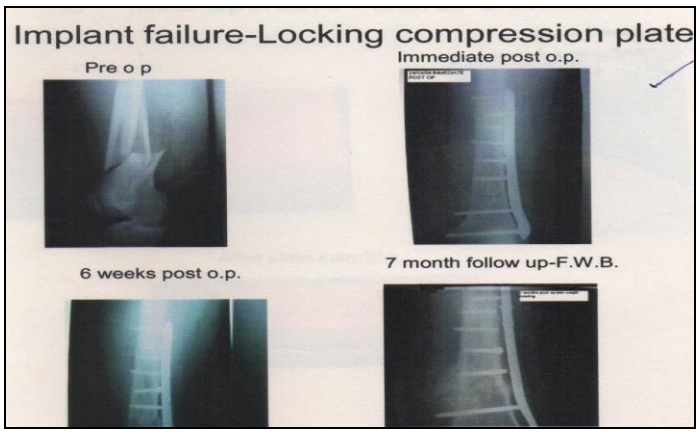


Fig 1

Time of discharge
Patients were discharged at an average of 18.2 days with a range of 10-34 days.

Follow up
The average duration of follow up was 7.4 months with a range of 6 month to 22 months.

Radiological Union
Early callus was seen by an average of 8 weeks, most of the patients had good callus formation by 20th week.

Range of knee movements
Average range of movement of knee was found to be 87 degrees. With a range of 20 to 130 degrees. One (no. 26) had a fixed flexion deformity of 10 degrees.

Shortening
Shortening was seen in 11 cases. Average shortening of 0.75 cm was found with a range from no shortening to 2 cm. Even with 2 cm shortening, no significant functional alternation was seen.

Angulations
Angulation was noted in 2 cases. 1 had varus and 1 had valgus deformity of 10 and 12 degrees respectively. No rotational deformity was seen.

Functional result
At the end of study, the cases were followed up for an average period of 7.4 months (range of 6-22 months) and functional results were evaluated using *Neer's et al.* [1] rating system. This rating is specifically used for distal femoral fractures. Overall 9 cases (30%) had excellent rating, 14 cases (45%) had satisfactory rating and 7 cases (25%) had unsatisfactory rating. The results were also analyzed based on the fracture types and are summarized in table as given below.

Table 4

Results	Cases	Percentage
Excellent	9	30%
Satisfactory	14	46.7%
Unsatisfactory	7	23.3%
Failure	0	0
Total	30	100%

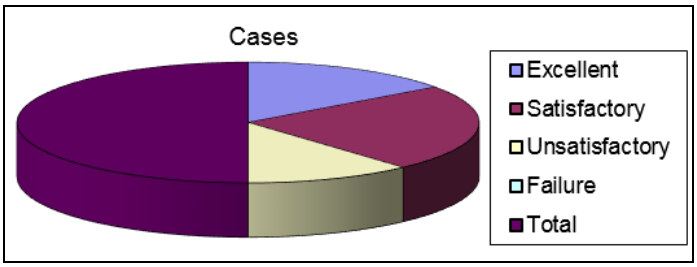


Fig 2

Discussion
Distal femoral fractures are always regarded with great concern because they are difficult to treat and are often associated with temporary disablement. These facts have encouraged surgeons to opt for operative treatment with internal fixation. Successful treatment of distal femoral fractures especially intra articular fractures requires operation and maintenance of the congruence of the articular surfaces. Traction or conservative treatment can hardly guarantee restoration of such congruence. In principle, therefore, all intra – articular distal femoral fractures should be treated surgically. An essential prerequisite for the success of any treatment, however is effective implant for stable osteosynthesis.

Theoretically, for fractures, operation should be performed in acute stages. The tissues are then at their best. From the present series it would appear that the risk of infection is not high. One of the main advantage of an immediate operation is that earlier and more complete mobilization of the patient's knee is made possible by decreasing the hematoma and edema.

The literature over the past five decades has shown the increasing trend towards satisfactory results with surgical management of distal femoral fractures. Improvements of surgical techniques have brought the surgical fixation of distal femoral fractures into the realm of respectability. The technique demands superb skill and sound judgement on the part of the surgeon. The entire patient as well as the fracture pattern and bone density should be carefully reviewed to allow correct implant selection and use. There is no one surgical implant that will lead to excellent surgical results in every case. Caring distinction, open reduction and internal fixation of distal femoral fractures can be performed reliably with excellent results and a low rate of complication.

The present study of 30 cases indicates road traffic accidents as the predominant cause of fractures (76%) and other cause being falling from height and assault. 76.7% of the fractures were seen in male, with predominance in age group of 18-49 (83%). This reflects that young and active individuals are prone to this fracture due to high velocity injuries. There was no biphasic age distribution as seen in other studies (Bell *et al*. 1992) [16]. Also the average age was less (40 years) compared to other reported series; (Healy *et al*. 48 years) [17].

In reference to mode of injuries, the main reason was found to RTA involving two wheelers (40%). This is because of susceptibility of knee joint in these injuries.

Six of the patients had associated injuries, which included 2 major fractures, thus indicating that these distal femoral fractures are components of polytrauma. Most of our patients were seen on the day of injury.

In our series, 4 patients were treated conservatively, out of which 2 were polytrauma which healed over a period of time. The other 2 cases were in the elderly age group with severe osteoporosis, both of which had fair results at the end of treatment. All of them were initially immobilized with Thomas splint for 5 weeks and then with above knee cast for 4 weeks.

The *Muller's* comprehensive classification was used to classify the fractures and for deciding on implants. On intraoperative evaluation of fracture, it was found that in 4 cases (13.33%) X-ray findings were inconsistent when compared to operative findings. So 3-D CT evaluation of fracture is recommended when the facilities are available.

It was also found that it is easier to classify the fractures into A, B or C groups. But sub – classification is likely to have many individual variations when classified by different persons.

The average duration of time for surgery was 3 days. The chief reasons for delay in surgery were increased patient input, inadequate O.T. facilities, delay in getting implants and adequate blood. In type C fractures, there was found to be difficulty in reducing intra – articular fractures and giving a congruent articular surface. The bone grafts were rarely required in spite of commination in type C1 fracture.

Implants and instruments were found to be the key to successful reduction. Any compromise in implants will have undesirable results. It is recommended to use alternative implants when needed.

The average hospitalization time in our study was 18.2 days. This is also reported in other series, Muller *et al*. [18, 9, 16] (20 days) Stewart *et al*. [19] One of the common complications of distal femur fractures is knee stiffness. It was seen in two patients with open fractures and soft tissue injury of grade 1 and 2 in our study. The average post operative range of motion reported by Seinsheimer *et al*. [9] was from 100 to 125 degrees. The average range of motion in our series is 87 degrees. It was also seen that extra articular fractures had better knee function compared to intra articular fractures.

The other dreaded complication is infection, which has been the prime deterrent to acceptance of internal fixation. Extensive soft tissue injury and prolonged operating time are the factors that increase the rate of infection. Neer's *et al*. [1] reported 20% infection rate. Others like M Siliski *et al*. [20] reported 5.7% infection rate. We had 2 infection (1 deep and 1 superficial) i.e. 7%. Despite infections, healing occurred and implants were removed later to promote definite cure of the infection.

In our series, two patients were found to have implant failure. One was due to breakdown of screws of locking compression plate which itself was quite a costly procedure. This highlights the need for proper selection of patients for this procedure. The other was due to breakage of distal screws of intramedullary nail.

In 2 of our patients malunion was seen, 1 had valgus deformity and 1 had varus. There was no case of non – union. Delayed union was seen in 1 and required bone graft. The average follow up of the patients was 7.4 months.

Neer's and associates[1] scoring system analyzed the outcome of the management. It is based on clinico – radiological criteria and was specifically developed for distal femoral fractures. On analyzing the results according to the type of fractures, 71.4% of type A fractures [21] had excellent to satisfactory results as compared to 50% of the type C fractures. The younger individuals (age 18 – 40) had better functional outcome when compared to of elderly individuals.

Different implants were used in fixation of fractures in the study. In our study 3 out of 7 of D.C.S were unsatisfactory[22] as compare to D.C.P. in which 1 was successful of 1 case. Even though small number of D.C.P which provide good rotational control of the distal fragment with multiple screws, easy technique, non bulky as compare to D.C.S where only one screw is holding the distal fragment.

The weakness of this study is obvious. This is an analysis of uncontrolled population with no strict criteria of treatment modality and many surgeon's involvement. Nevertheless the obvious results by surgery make the conclusion valid.

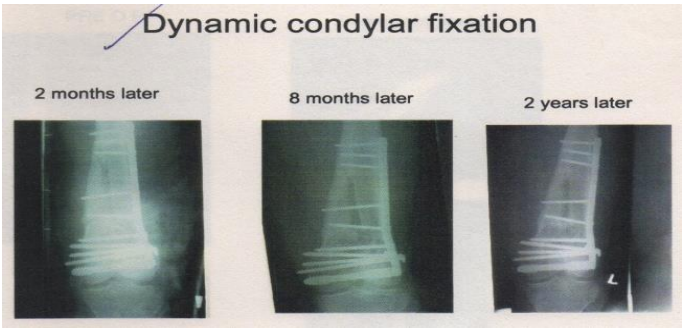
Conclusions

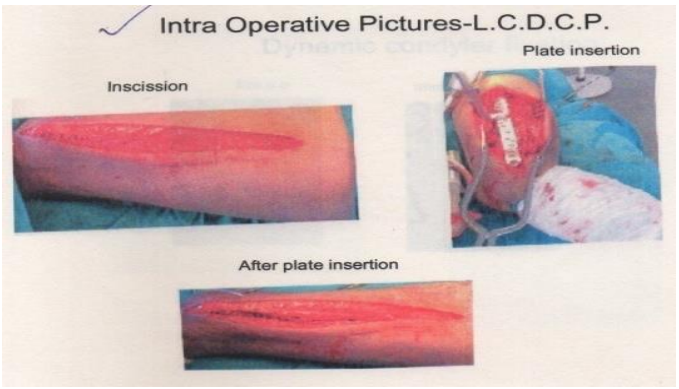
Thirty patients with femoral fractures were treated, 4 by conservative management and 26 by surgical management. The end results were analyzed after follow up.

- Distal femoral fractures are common in young males in the age group of 20 – 40 years.
- It was mainly seen with high velocity high impact injuries.
- Closed type fractures are common.
- Neuro – vascular compromise is rare.
- Type – A fractures are common, especially type A – 1.
- X – Ray are not true indicative of actual fractures.
- Bone grafting is rarely necessary, inspite of comminution.
- Surgical management allows stable and good fixation of fracture, joint congruity and early knee motion especially for intra articular fractures.
- Extra – articular fractures have good functional outcome.
- Type A fractures have good result while compared to Type C fractures.

Summary
Fractures of distal femur can be very effectively treated by surgical methods and fair results can be achieved in properly selected patients with conservative management. It should emphasized that satisfactory osteosynthesis of fractures of this type is a difficult procedure, which should not be attempted until one has mastered the technique. Although the series presented here is small, it seems to show that after stable osteosynthesis is achieved by the right approach and correct surgical technique, these fracture will heal in most cases without much loss of joint function.

Future Scope
In our small series, we have not tried minimally invasive percutaneous osteosynthesis (MIPO).Since biological healing via this technique, may reduce infection and healing and need to assessed [4].





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