

A Prospective Study on Surgical Management of Supracondylar Fractures of Femur by Various Modalities

Dodda Prasad Reddy¹, Ravikanth Kolluri², Nagaraju P³

¹Assistant Professor, Department of Orthopedics, Kakatiya Medical College and MGM Hospital, Warangal, Telangana State.

²Assistant Professor, Department of Orthopedics, Kakatiya Medical College and MGM Hospital, Warangal, Telangana State.

³PG, Department of Orthopedics, Kakatiya Medical College and MGM Hospital, Warangal, Telangana State.

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Corresponding author: Dr. Dodda Prasad Reddy

Conflict of interest: Nil

Abstract

Background: There is an increase in the frequency of distal femoral fractures in recent times. It is because of increased urbanization and high use of transport resulting in RTA. Distal femoral fractures are difficult to treat because of the thin cortex of the distal femur and the involvement of the knee joint in fractures or osteopenic bone in the elderly. We in the current study tried to evaluate three different methods of treatment of distal femoral fractures.

Methods: This cross-sectional interventional study was conducted in the Department of Orthopedics, Kakatiya Medical College, and MGM Hospital, Warangal, Telangana State. The selected cases underwent a thorough clinical examination to find out the nature of fracture-associated injuries and the general condition of the patients. The injured limb was examined for swelling, tenderness, crepitus, abnormal mobility, and deformity. Splinting of the affected limb was done. A systemic examination was also performed. They were managed by Knee spanning External Fixator (Ex. Fix), Supra-Condylar Nail (SCN), and Locking Compression Plate (LCP)

Results: A total of n=30 fractures n=14(46.67%) cases were closed fractures. Out of these n=14 cases, n=2(14.28%) cases were treated with Ex. Fix N=7(50%) treated with SCN and n=5(35.71%) cases were treated with LCP. Similarly, for type 1 compound fractures the total number of cases was n=6, and n=2 each was treated by the three methods. In type II n=5 cases were present out of which n=2 each by Ex. Fix and LCP respectively and n=1 case by SCN. Type 3 compound fractures were n=5 cases out of which n=4 cases were treated by Ex Fix and n=1 cases by LCP.

Conclusion: Supracondylar femur fractures. remain a significant challenge to the orthopedic surgeon The significant forces applied to this area, even during restricted patient activities, require a strong implant. The best device for distal femur fixation is still a subject of debate. For all fractures, one implant is suitable. Patient factors, type of fracture, personality, soft tissue quality, and anatomical reduction of the distal femoral articular surface all influence the kind of fixation device used.

Keywords: Distal femur fractures, Knee spanning External Fixator (Ex. Fix), Supra-Condylar Nail (SCN), Locking Compression Plate (LCP)

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Introduction

Supracondylar femur fractures encompass the distal 15 cm of the femur, including the distal femoral metaphysis (supracondylar) and the articular surface of the distal femur (intercondylar), and have historically proven difficult to repair. [1] These fractures are frequently unstable, and comminuted, and occur more frequently in elderly or numerous wounded people. Regaining complete knee mobility and function may be challenging due to the close closeness of these fractures to the knee joint. Malunion, nonunion, and infection are all common complications. These catastrophic injuries might result in long-term disability. [2] Distal femoral fractures are rarer than hip fractures, accounting for just 7% of all femoral fractures. If hip fractures are omitted, the distal region of the femur is involved in 31% of femoral fractures. The annual incidence of distal femur fractures is estimated to be 37/1,000,000 people. Distal femoral fractures are more common in elderly people with osteoporosis and a susceptible soft tissue envelope, and they usually happen after low-energy trauma like falls or sprains that are worsened by a high prevalence of comorbidity (60 percent female or older than 60 years). [3] High-intensity trauma induces complicated damage with comminuted and open fractures in young patients (60 percent males, younger than 40 years old). To avoid soft tissue injury, severe comminution frequently necessitates the fixation of numerous separate pieces with a single device. The considerable stresses applied to this location, even during restricted patient activities, necessitate a robust implant; nevertheless, because of the large canal, thin cortical, and poor bone quality of the distal femur, fixation is challenging. The orthopedic surgeon has a big difficulty. Fracture type, accompanying traumas, age, pre-morbid

functional and medical state, and soft tissue damage are all aspects to consider while treating these fractures. [4, 5] Recent advancements in fixation designs and improvements in surgical techniques used Retrograde IM nailing, offered potential biomechanical advantages over plates and screws because of the potential for load sharing, less soft tissue stripping, and the ability to manipulate and reduce the distal fracture fragments directly. [6] The ability to accomplish an anatomical reduction of the joint surface, restore axial alignment, and commence early movement with surgical fixation provided a distinct benefit over closed modalities of therapy. The current study aimed to study the advantages of fixation with distal femoral locking compression plates (LCP), knee spanning external fixation (Ex. Fix), and retrograde intramedullary supracondylar nailing (SCN).

Material and Methods

This cross-sectional interventional study was conducted from Sept 2020 to Feb 2022 in the Department of Orthopedics, Kakatiya Medical College, and MGM Hospital, Warangal, Telangana State. Institutional Ethical Approval was obtained for the study. Written consent was obtained from all the cases of the study.

Inclusion criteria

1. Patients above 18 years of age
2. Males and females
3. Fracture of distal 15 cms of the femur
4. Closed fractures of the distal end of the femur within 2 weeks of injury.
5. Fractures of Type A, B, and C including subtypes as per AO Muller's Classification

Exclusion criteria

1. Pathological fractures in the distal end of the femur
2. Fractures more than 2 weeks of injury
3. Distal femur fractures treated conservatively
4. Distal femur fractures treated with other methods than used in the current study

The selected cases underwent a thorough clinical examination to find out the nature of fracture-associated injuries and the general condition of the patients. The injured limb was examined for swelling, tenderness, crepitus, abnormal mobility, and deformity. Splinting of the affected limb was done. A systemic examination was also performed. A detailed history was collected including the presenting signs and symptoms as per the predesigned proforma.

Laboratory Assessment: Routine investigations included the complete hemogram with blood grouping and RH typing, renal function tests, electrolytes, bleeding and clotting time, HIV, HBsAg and VDRL, Fasting blood glucose, and erythrocyte sedimentation rate.

Imaging Studies: included the following: X-ray femur with knee joint –anterior-posterior view. X-ray femur with knee joint – lateral view. CT scan and 3D reconstruction if required

USG Abdomen to rule out associated abdominal trauma. The preoperative preparation essentially consisted of resuscitation of the patient, correction of dehydration and shock if it was present, nasogastric aspiration, urinary catheterization, parenteral broad-spectrum antibiotic coverage, and tetanus prophylaxis.

Knee spanning External Fixator (Ex Fix):

The most common indication is in severe open fractures type 3b and with vascular injuries and type C all subcategories. Intra-articular extensions are fixed with supplemental lag screws. It is a temporary fixation for initial management of fracture and soft tissues and definitive fixation within 14 days. In all the patients spinal anesthesia was used. Standard procedure was adopted for the surgery.



Figure 1: Knee spanning external fixator application in the patient

Supra-Condylar Nail (SCN): This method was commonly used to treat Type A distal femoral fractures. All the patients were operated on in spinal or epidural anesthesia. The choice of approach (open/Close) we adopted in this procedure depended on the

classification of fracture, articular and metaphyseal comminution, and quality of reduction which can be achieved with traction and external manipulation at the time of surgery. A standard procedure was adopted for this method.

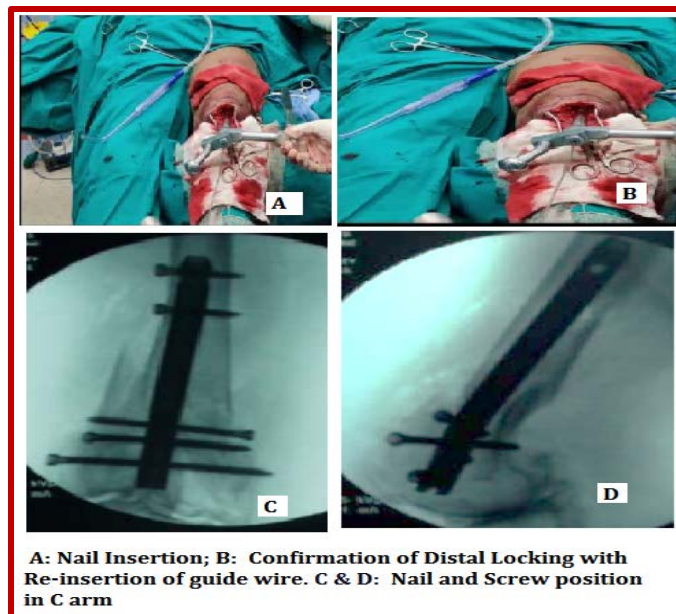


Figure 2: Supra Condylar Nail (SCN) fixation in the patient

Locking Compression Plate (LCP): The plate and screws are made of 316 L stainless steel using a gun drilling process. From 8 to 14 holes, lockable compression plates are available. For the lower end of the femur, a 4.5 mm thick plate is used. These plate heads have soft edges and are anatomically pre-contoured. Combination perforations in the plate shaft of LCP allow for the intraoperative selection of

angular stability and/or compression. LCP screws are angled 50 degrees longitudinally and 14 degrees transversely, with consistent hole spacing. Self-tapping locking screws with 3.2 mm and 4.3 mm drill bits, as well as threaded drill sleeves, are available in sizes 4.0 mm and 5.00 mm. A standard technique was used for LCP fixation.

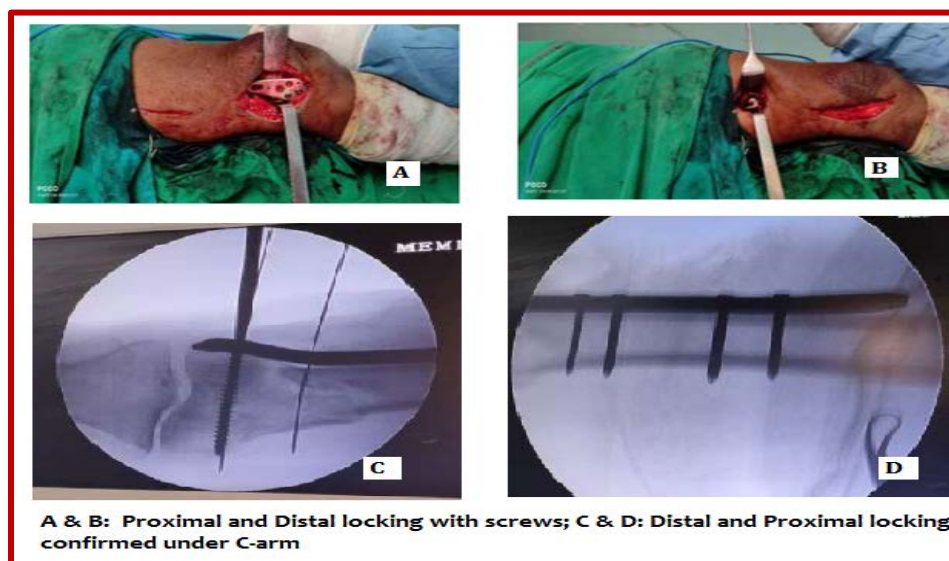


Figure 3: Locking Compression Plate (LCP) fixation in the patients

In most of the cases, antibiotics started preoperatively were continued postoperatively for 5-7 days. Physiotherapy for movements was done as per the standard protocol in each type of surgery. Sutures were removed after 8-10 days. *Follow-up:* Immediate post-operative X-ray and X-rays at 6 weeks, 12 weeks, and 24 weeks after the surgery. The patient was followed on an OPD basis after discharge. Fracture healing and range of movements were assessed every 3 months and 6 months.

Results

Out of n=30 cases, n=10 cases (33.33 %) were fixed with DCS, n=10 cases (33.33 %) were fixed with SCN and n=10 cases (33.33%) were fixed with LCP. the number of males in the study as n=22(73.3%) and females n=8(26.67%) and females were n=8(26.67%). The male to female ratio was approximately 3:1. The age-wise distribution of cases in the study is given in table 1. The mean age of the cases in the study was 35.65 ± 10.5 years and the range of age was from 21 years to 65 years.

Table 1: Age group of the cases included in the study

<i>Age Group (Yrs)</i>	<i>Frequency</i>	<i>Percentage</i>
21-30	9	30.00
31-40	5	16.67
41-50	5	16.67
51-60	4	13.33
>60	7	23.33
Total	30	100.0

Out of n=30 cases, n=17 (57 %) fractures were due to road traffic accidents and n=13(43%) cases were due to accidental fall on the ground and fall from height depicted in table 4. All the cases included in the study had unilateral fractures. N=18(60%) fractures were on the right side and n=12(40%) cases were on the left side.

Table 2: Mechanism of Injury in the cases of study

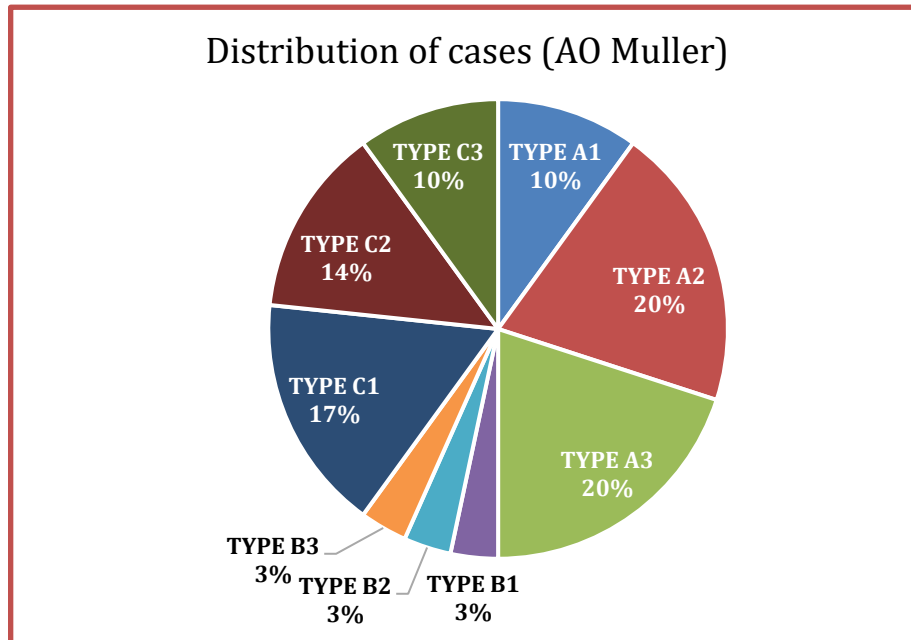
<i>Mechanism Of Injury</i>	<i>Frequency</i>	<i>Percentage</i>
RTA	17	56.6
Accidental Fall On the Ground	7	23.3
Accidental Fall From Height	6	20.0

The type of wound and method of fixation as depicted in table 3 reveals that out of n=30 fractures n=14(46.67%) cases were closed fractures. Out of these n=14 cases, n=2(14.28%) cases were treated with Ex. Fix N=7(50%) treated with SCN and n=5(35.71%) cases were treated with LCP. Similarly, for type 1 compound fractures the total number of

cases was n=6, and n=2 each being treated by the three methods. In type II n=5 cases were present out of which n=2 each by Ex. Fix and LCP respectively and n=1 case by SCN. Type 3 compound fractures were n=5 cases out of which n=4 cases were treated by Ex Fix and n=1 cases by LCP.

Table 3: Type of wounds with the method of fixation

Compound/closed	EX. FIX	%	SCN	%	LCP	%
Closed	2	14.28	7	50.00	5	35.71
Type 1 compound	2	33.33	2	33.33	2	33.33
Type 2 compound	2	40.00	1	20.00	2	20.00
Type 3 compound	4	80.00	0	0.00	1	20.00

**Figure 4: Distribution of cases based on AO Muller's classification****Table 4: Type of Fracture and Mode of Fixation used in the study**

Type of fracture	Number of cases	Ex. Fix.	%	SCN	%	LCP	%
Type A1	3	0	00.00	2	66.67	1	33.33
Type A2	6	0	00.00	3	50.00	3	50.00
Type A3	6	1	16.67	3	50.00	2	33.33
Type B1	1	0	00.00	0	00.00	1	100.0
Type B2	1	0	00.00	0	00.00	1	100.0
Type B3	1	0	00.00	0	00.00	1	100.0
Type C1	5	2	40.00	1	20.00	2	40.00
Type C2	4	3	75.00	0	00.00	1	25.00
Type C3	3	3	100.0	0	00.00	0	00.00

The duration of surgery was between 60 – 90 minutes in n=22 cases out of which Ex Fix, n=7 cases, n=9 cases of SCN, n=5 cases of LCP. the duration was between 90 – 120 minutes in n=5 cases total out of which n=2 cases each of Ex Fix, SCN and LCP had n=3

cases. Duration of surgery > 120 minutes seen in n=3 cases of which n=1 cases of Ex Fix and n=2 cases of LCP. The average range of motion recorded post-operatively is given in figure 2.

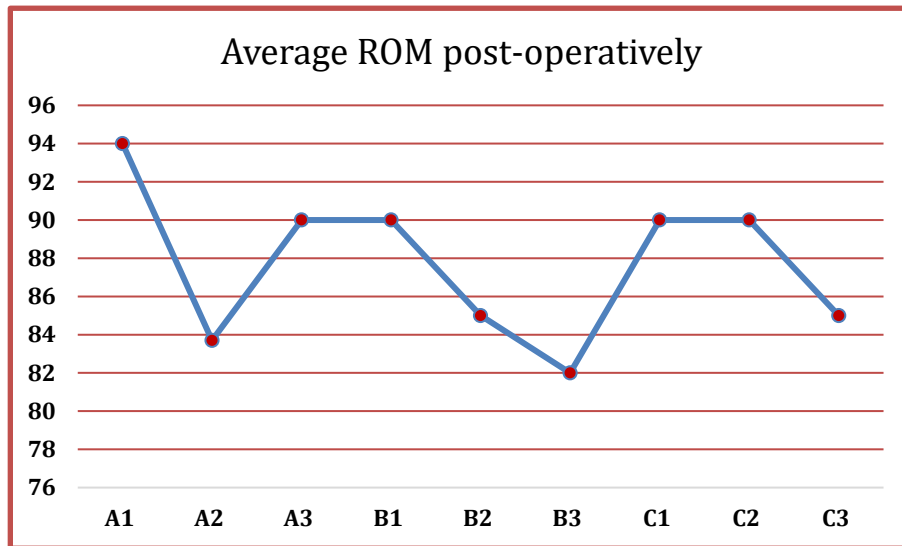


Figure 5: Average Range of Motion (ROM) in degrees recorded in cases of the study

The study of the range of motion versus mode of fixation revealed that LCP and SCN fixation achieved the best range of motions. The mean range of motion of LCP was $90.25 \pm 3.5^\circ$ and SCN was $87.5 \pm 5.5^\circ$. The external fixation achieved less range of motion postoperatively the mean value was $55.60 \pm 7.5^\circ$. For patients aged between 20 to 30 years the average time for healing was 15.2 weeks, for 30-40 years it was 15.5 weeks, for 40-50 years it was 15 weeks, and for 50-60 years was 16.3 weeks. The mean time for healing in type A1 type A2

and type A3 fractures was 14 weeks in type C1 it was 17 weeks, type C2 it was 18 weeks and in type C3 it was 18 weeks. The time for radiological union in cases of Ex. Fix showed 80% of cases were healed within the period of 14 – 18 weeks and n=2 cases of nonunion were found in this group. In SCN and LCP groups the average radiological union time was 12 – 14 weeks in 80% of cases no case of nonunion or delayed union was reported in these groups. The Neer’s scores of the cases in the study have been depicted in table 5.

Table 5: Neer’s score and mode of fixation in the cases of study

Type of surgery	Neer’s Scores			
	Excellent	Good	Fair	Poor
Ex. Fix	2	5	3	0
SCN	2	7	1	0
LCP	2	8	0	0

N=1 case of LCP fixation had bleeding and n=1 case had the infection. N=1 case of Ex. Fix had an infection and n=1 case had pain; n=1 case of SCN had pain post-operatively given in table 6.

All the complications were minor and managed adequately and did not affect the outcomes of the study.

Table 6: Postoperative Complications and mode of Fixation

<i>Complication Vs Mode of Fixation</i>	<i>Number of Cases</i>	<i>Ex. Fix</i>	<i>SCN</i>	<i>LCP</i>
Bleeding	1	0	0	1
Shock	0	0	0	0
Infection	2	1	0	1
Pain	2	1	1	0
Fat Embolism	0	0	0	0

Discussion

The current trends of supracondylar femur fracture patterns are toward complex comminuted fractures, especially in young individuals. Improved healthcare resulted in a longer life span and subsequently presents us with more osteoporotic fractures with a high rate of complications. The objective of our treatment is to restore a stable limb so that you may walk about painlessly. Stability is restored by first fixing the bone and then mending it. Maintaining anatomic alignment and length while avoiding stiffness allows you to regain function. Pain is avoided by avoiding arthritis, which involves the restoration of anatomically congruent joint surfaces and the maintenance of the limb's normal mechanical axis. The considerable stresses applied to this location, even during restricted patient activities, necessitate a robust implant; nevertheless, because of the large canal, thin cortical, and poor bone quality of the distal femur, fixation is challenging. In the present study as n=22(73.3%) and females n=8(73.33%) and females were n=8(26.67%). The male to female ratio was approximately 3:1. Olerud et al., [7] found out of a total of n=16 cases of distal femur fractures n=10 were males and n=6 were females. This might be because the majority of the mobile population is male and so more prone to accidents. The mean age of the cases in the study was 35.65 ± 10.5 years.

The mean age of patients with distal femur fractures in Harrison et al., [8] study was found to be 50 years. The mean age of the cases in this study is less could be because 56.6% of the cases in the study were having distal femoral fractures due to road traffic accidents involving young age individuals. Siliski et al., [9] in their study found n=52 cases of femoral fractures and 75% of the cases were due to high energy trauma and 39% of open injuries. In this study, 46.67% of injuries were closed injuries and 53.33% were open injuries. In this study, the distribution of fractures is given in Figure 1. Lucas et al., [10] found 10.71% of A1 fractures 14.28% of A2 fractures, 7.14% of A3 fractures, 14.28% of C1 fractures 35.71% of C2 fractures, and 17.86% of C3 fractures. A comparison of the fixation, healing, and Range of Motion (ROM) in comparison with other similar studies has been depicted in table 7. In the present study the healing by Ext. Fix was 18.6 and the mean ROM was 75 degrees. Ifthikar et al., [11] in their study found a healing time of 19 weeks and a range of motion ROM of 74 degrees with Ext Fix in agreement with the findings of the current study. Pritchett et al., [12] noted healing with an Ext Fix of 18 weeks, and the range of motion was 70 degrees. Gellman et al., [13] with SCN noted a healing period of 16 weeks and a range of motion of 106 degrees. In this study, we found healing with an SCN of 15.6 weeks and ROM of 91 degrees.

Table 7: Comparison of Type of Fixation Healing and ROM with other studies

<i>Study</i>	<i>Fixation Type</i>	<i>Healing, Weeks</i>	<i>ROM Degree</i>
Gellman et al., ^[13]	SCN	16	106
Ifthikar et al., ^[11]	Ex. Fix	19	74
Giles et al., ^[14]	DCS	16.3	90
Pritchett et al., ^[12]	Ex. Fix	18	70
Present study	Ex. Fix	18.6	75
	LCP	16.2	95
	SCN	15.6	91

The results of LCP in the present study were that 80% of patients had good results and 20% had excellent results. Results with Ex. Fix is, 70% good and 30% fair. [14] The results with SCN was 20% excellent and 80% good The results of the present series were comparable with a study done by Schatzker J et al., [15] also obtained excellent or good results in 74% of the patients. N=1 case of LCP fixation had bleeding and n=1 case had an infection. N=1 case of Ex. Fix had an infection and n=1 case had pain; n=1 case of SCN had pain postoperatively. The rate of complications is in agreement with similar studies in this field. [16-19]

Conclusion

Supracondylar femur fractures. remain a significant challenge to the orthopedic surgeon The significant forces applied to this area, even during restricted patient activities, require a strong implant. The best device for distal femur fixation is still a subject of debate. For all fractures, one implant is suitable. Patient factors, type of fracture, personality, soft tissue quality, and anatomical reduction of the distal femoral articular surface all influence the kind of fixation device used.

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