



A STUDY OF SURGICAL MANAGEMENT OF SUPRACONDYLAR FRACTURE FEMUR BY “RETROGRADE INTRAMEDULLARY INTERLOCKING NAIL”

Orthopaedics

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ABSTRACT

Background and Objectives: Supracondylar and inter condylar fractures are often difficult to treat and they are notorious. Retrograde supracondylar nail has got advantages of preservation of fracture hematoma, decreased blood loss, minimal soft tissue dissection and other complications like knee-stiffness, less operative time and reduced rate of infection, mal union, non-union, quadriceps wasting, prolonged bed rest. Objectives of this study are to evaluate the results of supracondylar femur fracture treated by Open/Closed reduction and internal fixation using retrograde intramedullary supracondylar nail in respect of knee-flexion, early weight bearing and return to pre- fracture state of patient.

Methods: 20 patients with supracondylar femur fracture were studied (AO type-A). RIS nail was inserted through intercondylar notch.

Results: In 20 patients, 14 patients were <40 years old with male predominate (75%). RTA was the chief cause of fracture. Surgery was performed with 10.3 days average, radiological union was possible in 16.21 weeks. Full weight bearing achieved by the patient in average of 11.68 weeks. Thus, 65% good or excellent results were found by using RIS nail.

Interpretation and Conclusion: Retrograde intramedullary nailing is a good fixation system for supracondylar, extra-articular femur fractures with less operative time and blood loss. Early surgery, closed reduction, at least two screws in each fragment and early post operative knee mobilization are essential for good union and good knee range of motion.

KEYWORDS

Supracondylar femur fracture; retrograde supracondylar nail; closed reduction; early post-operative mobilization; Weight bearing.

INTRODUCTION

Rapid industrialization and the fast pace of life have brought both comforts and catastrophe like road traffic accidents and crippling many young lives. Supracondylar and inter condylar femoral fractures are often difficult to treat and they are notorious for many complications. In the early 1960s, there was a great reluctance towards operative management of this fracture because of high incidence of infection, non-union, malunion, inadequate fixation and lack of proper instruments, implant as well as antibiotics. Then, the traditional management of displaced fracture supracondylar of femur was along the principle of Watson Jones & John Charnley. This comprised of skeletal traction, manipulation of fracture and external immobilization in the form of casts and cast bracings. These methods however, met with problems like deformity, shortening, prolonged bed rest, knee stiffness, angulation, joint incongruity, malunion, quadriceps wasting, knee instability and post-traumatic osteoarthritis.

The trend of open reduction and internal fixation has become evident in the recent years with good results being obtained with the AO blade plate, dynamic condylar screw and other implant systems like intramedullary supracondylar nails.

Supracondylar fractures tend to collapse into varus. During application of AO blade plate or dynamic condylar screw, the shaft of femur is often pulled laterally displacing the line of weight bearing, lateral to the anatomic axis of condyle. This creates rotational movements at the fracture site that causes pulling off the blade plate or condylar screws leading to fatigue fracture of the plates. Also, the presence of osteoporotic bone leads to fixation failures with screws and plates cutting of the soft bone.

The obvious advantage of an intramedullary device is that it aligns the femoral shaft with condyles reducing the tendency to place varus movement at the fracture site. And because the bending movement of an intramedullary device is substantially reduced failure of fixation in osteoporotic bone should be less.

In addition, a retrograde intramedullary supracondylar nail has got distinct advantages of preservation of fracture hematoma, decreased blood loss, minimal soft tissue dissection, less operative time and reduced rate of infection.

The purpose of this study is to evaluate the results of supracondylar and inter condylar fracture of femur, treated by close/ open reduction and internal fixation using retrograde intramedullary supracondylar nail.

MATERIALS AND METHODS

In this study 20 patients with supracondylar fracture of femur without intercondylar extension were studied. All the cases were treated in SVS Medical College & Hospital between the period of March 2017 to August 2019. The method used for fracture fixation was closed or open reduction and internal fixation with retrograde intramedullary supracondylar nail. The duration of follow up ranged from 4 months to 24 months.

All the fractures in this series were post-traumatic. No pathological fracture was included in the study. Also supracondylar fractures in children were not considered. The study was restricted to fractures occurring at the region 9 cm proximal to lower end of the femur.

Patient Selection:

Inclusion criteria

- Type-A1 to A3 fractures (AO classification).
- Type C1 fractures.
- Grade I/ II/ IIIA/ IIIB compound fractures (Gustilio-Anderson Classification).

Exclusion criteria

- Pediatric patients
- Pathological fractures
- Grade IIIC compound fractures
- Type B, C2 AND C3 fractures

Implant Used:

- The implant used was INOR supracondylar nail system with instrumentation set.

Preoperative Planning and Preparation:

Fractures were classified with the help of radiographs according to the AO-ASIF classification. Preoperative calculation was done on radiographs to ascertain the length of supracondylar nail, maximum possible diameter and lengths of interlocking bolts after subtraction of the magnification factor.

Postoperative:

Depending on presence of concomitant ipsilateral other injuries, the patient was given a posterior above knee slab of plaster of paris bandage, with knee in extension.

If intraoperative open reduction was required, similar slab was given. In the wards, limb elevation was done with injectable analgesics and antibiotics for 5-10 days. Patients in whom closed nailing was achieved were shifted on second post-operative day on continuous passive mobilization machine and knee was flexed passively till 80 degree.

In closed nailed patients, static quadriceps and active or active assisted bedside knee mobilization was started from second postoperative day. Suture removal was done on 14th postoperative day.

In patients with open reduction, the slab was discarded if wound was found to be healthy and active/ active assisted knee mobilization was instituted.

Patients were discharged on day 15 or 17th postoperative and were advised to follow-up after 4 post-operative weeks. In the mean time, between suture removal and discharge, patients were given crutch training and were made ambulatory on bilateral axillary crutches without weight bearing. As the patient gained confidence on crutches, toe touch walking was allowed by the 6th week.

Further, weight bearing was allowed depending on the clinical and radiological picture. The initial fracture geometry, intra articular comminution, stability of fixation was the major factors considered while advising progressive weight bearing.

At each follow-up patient was assessed as regards clinico-radiological union in the form of pain at fracture site, thickening at fracture site, warmth at fractures site, radiographic alignment, evidence of callus seen, knee range of motion, extensor lag and shortening.

Unprotected weight bearing was not allowed till there was good clinical and radiological evidence of progressive fracture healing. Clinically, fracture was considered to be united when there was no pain on palpation and no discomfort on weight bearing. Radiologically evidence of callus and consolidation were analyzed.

For each fracture type, the long-term results were evaluated using Neer's rating system and Sanders functional evaluation scale, which assigns points for pain, working and walking capacity, range of movement, radiological appearance etc.

RESULTS

In this study 20 patients with supracondylar fracture of femur without intercondylar extension were studied. All the cases were treated in SVS Medical College & Hospital, Mahabubnagar between the period of March 2017 to August 2019. The method used for fracture fixation was closed or open reduction and internal fixation with retrograde intramedullary supracondylar nail. The duration of follow up ranged from 4 months to 23 months. Out of 20 patients, 1 patient developed knee sepsis, nail was removed immediately and patient was lost for follow-up. 65% good to excellent result were obtained using Neer's and Sander's evaluation scoring system.

The following are the observations noted.

Table-1 Age and Sex Distribution

Age (years)	Male	Female	Total	
			No	Percent
21 - 30	7	0	7	35.00
31 - 40	7	0	7	35.00
41 - 50	3	1	4	20.00
51 - 60	1	1	2	10.00
Total	18	2	20	100.00

In this study, the youngest case was 25 years old male and the oldest was 54 years. Overall mean age was 36.15 years. In males, it was 34.89 years and females it was 47.5 years. Most of the patients sustaining fractures due to vehicular accidents were between 21-40 years age group and equal number of cases was in the age groups 21-30 and 31-40 years. Males were involved fourteen times as compared to females.

In this study right side affection(70%) was seen more than twice as common as left side(30%).

Table-2 Mechanism of Injury

Mechanism of Injury	Number of Cases	Percentage
Road traffic accident	15	75.00
Fall from Height	5	25.00
Total	20	100.00

Seventy five (75%) percent fractures were sustained due to road traffic accidents and fall from height accounted for 25% of fractures. Maximum number of cases(75%) in the age less than 50 years were due to vehicular accidents. In males, maximum number of cases (75%) was due to vehicular accidents, whereas in females, fall from height was the important cause of fracture in this study.

Table-3 Nature of fracture

Nature of Fracture	Number of Cases	Percentage
Closed	14	70.00
Group p - I Compound	0	0.00
Group - II Compound	4	20.00
Group - III Compound	2	10.00
Total	20	100.00

In the present study, there were 6 compound fractures, 4 being grade-II and 2 being grade-III according to Gustilo-Anderson's classification. Out of these 2 grade-III compound cases, one was type-IIIA and one was type-IIIB.

Of the 6 cases, 3 were due to vehicular accidents and all were males and 3 were due to fall, of which one was male and 2 were females.

Table-4 Distribution of fracture

Nature of Fracture	Number of Cases	Percentage
A1	8	40.00
A2	10	50.00
A3	2	10.00
Total	20	100.00

Type-A1 fractures were patient in 40%, A2 in 50% and A3 in 10% of cases.

Six patients had associated injury as a consequence of trauma. Associated injuries included musculo-skeletal and systemic injuries. Two patients had ipsilateral comminuted proximal tibial fracture. Two had fracture of tibial spine and two had undisplaced patellar fracture. There were no cases of any major systemic injuries.

Table-5 Operative Time

Operative time (Minutes)	No. of Cases	Percentage
<60 min	13	65.00
60-90 min	5	25.00
>90 min	2	10.00
Total	20	100.00

In our study, 80% of cases underwent closed reduction and 20% open reduction. In majority of the fracture type of A1 and A2 were closed reduction was possible, while in A3 sub-type, 1 of 2 cases required open reduction. Maximum closed reduced fractures required less than or 60 minutes for operation. While maximum open reduction fractures required more than 60 minutes operative time.

Average operative time for closed reduced fractures was 55.2 minutes. Average operative time for open reduced fractures was 83.1 minutes.

Table-6 Nail Length used

Reduction	Number of Cases	Percentage
150 mm	-	-
200 mm	5	25.00
250 mm	14	70.00
350 mm	1	5.00
Total	20	100.00

Longest available nail was used in majority of cases

Table-7 Nail diameter

Nail Diameter	Number of Cases	Percentage
10 mm	6	30.00

11 mm	8	40.00
12 mm	6	30.00
Total	20	100.00

Nails of all diameters were used with approximately similar frequency.

Table-8 Radiological Union

Union (Weeks)	Number of Cases	Percentage
<16	9	47.37
16-18	5	26.32
18-20	2	10.53
20-22	1	5.26
22-24	2	10.52

Average radiological union time was 16.21 weeks. Of 20 patients, one patient went into deep infection after 2 months. Nail was removed in that patient and he was lost from follow-up after 12 weeks till that there was no radiological union and deep infection was present. Average full weight bearing was achieved by 11.68 weeks.

Average flexion in this study was 105° with more than 50% patients having knee range of motion more than 110°. Average extensor lag in this study was 5.68 degrees.

Out of 20 patients, 4 had shortening, of which 2 patients had shortening of 22mm and 2 patients shortening of 25mm.

Table-9 Complications

Complications	Number of Cases	Percentage
Local Symptoms at distal screw	3	15.00
Impingement	1	5.00
Superficial infection	1	5.00
Delayed union	1	5.00
Distal migration of nail	1	5.00
Deep infection	1	5.00
Non-union	-	-
Distal screw breakage	1	5.00
Stress fracture	-	-
Implant failure	-	-

Local symptoms at distal screws were found to be the commonest complications like pain and loosening of screws.

Long-term final results were rated using the Neer's rating system, which allots points for pain, function, working ability, joint movements, gross and radiological appearance.

Table-10 Neer's Rating

Rating	Number of Cases	Percentage
Excellent >85 Points	10	50.00
Good 70-85 Points	3	15.00
Fair 50-69 points	6	30.00
Poor < 50 Points	1	5.00

In 65% cases, there was good to excellent results

Table-11 Sander's Rating

Rating	Points	Number of Cases	Percentage
Excellent	36 to 40	10	50
Good	26 to 35	3	15
Fair	16 to 25	6	30
Poor	0 to 15	1	5

In 65% cases, there was good to excellent results.

In the study, no statistically significant correlation was found between knee flexion and age. A patient with 75 degree flexion in A1 type of supracondylar fracture had comminuted proximal tibial fracture, which delayed his mobilization and weight bearing.

8 of 10 patients with A2 type had $\geq 110^\circ$ degree flexion (80%). 3 of 7 patients with A1 type had $\geq 110^\circ$ degree flexion (42.86%) while no patient out of 2 with A3 type had $\geq 110^\circ$ degree flexion. 62.5% patients with closed reduction had $>110^\circ$ flexion while 33.33% patients with open reduction had $>110^\circ$ flexion. Average knee flexion for closed reduction and open reduction is 105° and 101° respectively. Final knee flexion was better, the earlier the patient was operated. One patient lost for follow up. The final knee flexion seems to become slightly better if

nails with larger diameter were used. 8 patients (62%) out of 13 with 250 mm long nail had $\geq 110^\circ$ degree knee flexion. 5 out of 6 patients (83%) with 12 mm diameter had $\geq 110^\circ$ degree knee flexion. In one patient with 250 mm long and 11 mm diameter nail developed knee sepsis and the patient was lost for follow-up. There is no correlation between type of reduction and full weight bearing; 69% in closed reduction and 66.66% in open reduction had full weight bearing in 5-12 weeks. Average weight bearing for closed reduction is 11.5 weeks and for open reduction is 12 weeks.

DISCUSSION

Distal femur fractures are difficult to treat and pose a challenge to surgeons because of osteoporosis in elderly falls and bone loss in high energy injuries in young individuals. Literature suggests various treatment options, surgical and non surgical with variable outcomes and complications. Our study mainly concentrates on outcomes and complications in distal femoral nailing for supracondylar fractures.

The mean age group in our study was 36.15 years compared to 39 years in Lucas SE et al²⁰ and 50 years in Gellman RE et al⁹ group respectively. There was male predominance (90%) in our study where as female predominance was seen in Watanabe et al¹⁶ (83%) and Gellman RE et al⁹ (54%) studies respectively. The most common mode of injury in our study was Road traffic accidents (75%) which is almost similar to the study by Lucas SE et al²⁰ (79%). We also agree with the results of Gellman RE et al⁹ who stated that high energy fractures are common in young male patients and low energy falls in older age groups. High percentage of compound injuries was found in the studies by Lucas SE et al²⁰, Lannacone et al⁸. In the present series, there were 6 compound fractures, 4 being grade-II and 2 grade-III according to Gustilo-Anderson classification. Lucas SE et al²⁰ observed that average injury-surgery interval of 6 days. Watanabe Y¹⁶ observed the average injury surgery interval of 3 days. In the present series, the injury-surgery interval was 5.3 days. Operative time in our series was 92 minutes compared to 112 minutes in Gynning JB et al¹² and 58 minutes in Kumar A¹⁴ series. In our series, 20% of cases are done by open reduction where as Gellman⁹ et al reported 37.5% cases and Gynning GB et al¹² as 58% by open reduction.

Danziger MB⁷ reported average radiological union time 12.4 weeks. Kumar A¹⁴ reported average radiological union time of 14 weeks. 19 out of 20 cases in the present study united at an average of 16.2 weeks. The patients which required more time for union were having some associated injuries, which delayed the period of mobilization and partial weight bearing. The average knee flexion obtained was 105° which is almost similar to studies by Lucas SE²⁰ (104°) and Gellman GE⁹ (106°). Fractures which were closed reduced and fixed were found to have better flexion than fractures which had to be open reduced. This could be explained on the basis of surgical trauma to quadriceps mechanism with open reduction and subsequent soft tissue healing with fibrosis as mentioned earlier.

In our study, average extension lag was 5.68 degrees as compared to 6.9 degrees in Kumar et al¹⁴ and 5 degrees in Watanabe et al¹⁶ studies. Average shortening of 2.35 cm in 4 patients was seen in our study where as it was 1.4 cm in Kumar A et al¹⁴ study and Lucas SE et al²⁰ reported 3 cm shortening in one patient. We have seen one septic arthritis as complication which is similar to Lucas et al²⁰ study whereas other studies didn't report infections. Non union was seen in one case in Kumar A¹⁴ study and 4 cases in Lannacone WM⁸ studies whereas there were no cases of non union in our study. Stress fractures at the proximal tip of the nail were reported in 2 cases in Lucas et al²⁰ study and 2 cases in Kumar A¹⁴ study. We had 65% excellent results in functional outcome by Neers and Sanders rating compared to 52% in Neers et al and 72% in Janzing et al¹⁰ studies by operative treatment.

To conclude Retrograde intramedullary supracondylar nail is a good fixation system for distal third femoral fractures, particularly extra-articular type. The operative-time is lessened with decrease in blood loss. Closed reduction can be achieved by not disturbing fracture hematoma and soft tissue. Even with open reduction, there is less soft tissue trauma and less post-operative stiffness. There is no non-union, less delayed unions and rates of angular or rotational malunions. Early surgery, closed reduction, at least two screws in each fragment and early post-operative knee mobilization are essential for good union and good knee range of motion.

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