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Operative management of distal third femur fractures using supercondylar nail

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Abstract

Background and objectives: Distal third femur fractures are often difficult to treat and they are notorious. For many complications like knee stiffness, quadriceps wasting, knee instability, malunion, non-union, joint incongruity, shortening, prolonged bed-rest and post-traumatic osteoarthritis after treated conservatively. Intramedullary retrograde nailing reduces the tendency of varus movement at fracture site and bending movement substantially reduced. Failure of fixation in osteoporotic bone should be less. 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 is 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: 25 patients with supracondylar femur fracture were studied. RIS nail was inserted through intercondylar notch. These nails have advantage of being load shearing devices, requiring little soft tissue dissection, infrequently needing bone grafting and technically easier. Preserving fracture hematoma, decreased blood loss, less operative time and decreased infection.

Results: In 25 patients, male predominate (88%) in this study. RTA was the chief cause of fracture. Surgery were performed within 6.92 days average, There were 7 open of which 5 Gustilo type 2, 2 Gustilo type 3 and 18 closed type of fracture radiological union was possible in 16.16 weeks. Average patient was followed up for 11.48 months. Average knee flexion of 100°. There were 8 knee pain, 4 shortening, 3 with protruding nail into knee joint, 1 delayed union, 2 superficial infection. Using Neer's scoring system there were 56% excellent, 16% good, 24% fair, 1% poor results.

Conclusion: Retrograde intramedullary nailing is a good fixation system for supracondylar femur fractures with less operative time and blood loss. By closed reduction, not disturbing fracture hematoma and even in open reduction less soft tissue dissection and thus reducing complications like infection, stiffness, distal screw related local symptom is a common problem and is related to implant and technique and has a definite learning curve. Utmost aseptic precaution great care required to prevent infection.

Keywords: Distal third femur fracture, Retrograde supracondylar nail, Closed reduction, Early post-operative mobilization, Weight bearing.

Introduction

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 Jones¹ & John Charnley². 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.

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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.

Methodology

In this study 20 patients with distal third fracture of femur were studied. All the cases were treated in Ashwini Hospital, Gulbarga between the period of June 2010 to June 2012. 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. Supracondylar fractures treated conservatively and fixed with other fixation systems like dynamic condylar screw, AO blade plate and condylar buttress plate are not included. The following protocol was observed for patients with supracondylar fractures of femur on arrival.

1. General and systemic examination as well as local examination of the patient.
2. Thorough assessment of patient to rule out head/ chest/ abdominal/ spinal or pelvic injury.

Results

Age of the patients ranged from 25 to 60 years with an average age of 37.4 years. Majority of the patients were in the age group of 21 to 40 years. Male patients were aged between 25 to 54 years with an average of 35.5 years. Female patients were aged between 40 to 60 years with average of 51.6 years.

Table 1: Age Distribution

Age (Years)	Total	Percent
21-30	6	30
31-40	7	35
41-50	4	20
51-60	3	15
Total	20	100

Sex Distribution

Of the total 25 patients treated with retrograde nailing, there were 22 male patients accounting for 88% of the patients and 3 female patients making up the remaining 12%.

Table 2: Sex distribution

Sex	No of Patients	Percentage
Male	17	85
Female	3	15

Side Affected

Right side was affected more commonly than left in this study group. Right side was involved in 17 patients making up for 85% of the fractures and left was involved in 8 patients accounting for 15% of the fractures. None had bilateral fractures.

Table 3: side affected

Side affected	No of Patients	Percentage
Right	17	85
Left	3	15

Mechanism of Injury

Table 4: Mechanism of injury

Mechanism of Injury	No. of cases	Percentage
Road traffic accident	14	70
Fall from height	6	30
Total	20	100

Seventy six (70%) percent fractures were sustained due to road traffic accidents and fall from height accounted for 30% of fractures. Relationship between Sex and Cause of Fracture.

Table 5: Relationship between sex and cause of fracture

Sex	Vehicular accidents		All	
	No	Percent	No	Percentage
Male	17	85	1	5
Female			2	10
Total	17	85	3	15

In males, maximum number of cases (70%) were due to vehicular accidents, where as in females fall from height was the important cause of fracture in this study.

Type of Fracture: Out of 20 fractures, only 7 fractures accounting for 35% were open fractures. Rest were closed

Table 6: type of fracture

Type of Fracture	No of Fracture	Percentage
Open	7	35
Closed	13	65

Type of Open Fracture: Among the 7 Open Fractures, 5(71%) Were Type Ii and 2(29%) Were Type Iii. Among Type Iii One Was Type Iiia And One Type Iiib. Of The 7 Cases, 4were Due To Accidents and Were All Male Patients. 3 Were Due To Fall, of which one Was Male and 2 were Female.

Table 7: Type of open fracture

Types of Open Fracture	No of Patient	Percentage
Gustilo type II	35	71
Gustilo type III	02	29

Type of Fracture Based on Ao Classification: Out of 20 fractures, type A1 fractures were 07 patients (35%), 11 patients (55%) were type A2 fracture and A3 in 2 patients (10%).

Table 8: Type of fracture based on AO classification

AO Type	No. of Patients	Percentage
A1	7	35
A2	11	55
A3	2	10
Total	20	100.00

Duration of Surgery

In 15 cases (75%) the duration was less than 90 minutes, in 3 cases (15%) the duration was 91 – 120 minutes and in 2 cases (10%) it was more than 120 minutes. Average operative time for all fractures was 83.92 minutes. It was observed that the operative time was more during intial learning curve and it came down with experience.

Table 9: duration of surgery

Operative Time	No. of Cases	Percentage
<90min	15	75
90-120min	3	15
>120min	2	10
Total	20	100.00

Follow Up

All the patients were followed up for an average of 11.48 months (ranging from 4 to 24 months). All fractures united eventually.

Table 10: follow up

Follow up in months	No of patients	Percentage
<6	3	15
6-12	7	35
12-18	9	45
18-24	1	5

Time to Union: Average time for fracture union was 16.16 weeks (ranging from 16 weeks to 6 Months). There was 1 delayed union. There were no non unions. There were no malunions. None of the patients required bone grafting.

Table 11: Time to union

Union (Weeks)	No. of cases	Percentage
<16	10	50
16-18	8	40
18-20	2	10

Table 14: Functional rating ass per Neer’s rating score

Rating	No of Cases	Percentage
Excellent > 85 points	12	60
Good 70-84 points	4	20
Fair 50-69 points	3	15
Poor <50 points	1	5

Discussion

Comparing our study with that of the previous reported series, the demographic profile is as follows

Table 15: Comparison of Demographic Profile

Series	Age Group (Years)	Average Age	Male (No.)	Female (No.)
Seifert J <i>et al</i> [2]	17-92	44	29 17-75yrs (avg 34.3yrs)	18 19-92 yrs (avg 53.8yrs)
Wisniewski T <i>et al</i> [3]	58-89	67	23	09
Bel JC <i>et al</i> [4]	16-96	61	12	17
Janzing HMJ <i>et al</i> [5]	65-96	82	02	22
Gellman RE <i>et al</i> [6]	24-84	50	10 29-61yrs9 AVG 39YRS)	12 26-84YRS (AVG 60YRS)
Lucas SM <i>et al</i> [7]	15-69	39	13	11
Present	25-60	37.4	22 25-54 (avg 35.5yrs)	3 40-60 (avg 51.6yrs)

The demographic profile of our series is closely comparable with Seifert J *et al*, [2] Lucas SM *et al*, [7] and Gellman RE *et al*. [6] Mechanism of injury and fracture characteristics of our series were comparable with that of Seifert J *et al*, [2] Lucas

Table 12: Time at which full weight bearing achieved

Achieved time (weeks)	No. of cases	Percentage
8-10	8	40
>10-12	4	20
>12-14	4	20
>14-16	3	15
>16-18	1	5
>18-22		
>22		

Average full weight bearing was achieved by 11.68 weeks. **Knee Flexion:** Average flexion in this study was 100 degree with more than 50% patients having knee range of motion more than 110 degree.

Table 13: Knee flexion

Knee Flexion (Degrees)	No. of cases	Percentage
<90	3	15
91-109	5	25
>110	12	60

Complications

The complications we encountered include anterior knee pain in 8 patients, shortening in 4 patients and 3 patients had the nail projecting into the knee joint causing patella-femoral impingement and arthrosis. There was two cases superficial infection which subsided after debridement and antibiotics. There was one delayed union. There were no cases of implant failures

Functional Rating as Per Neer’s Rating Score

Long term final results were rated using Neer’s rating system, which allots points for pain, function, working ability, joint movements, gross and radiological appearance. Neer’s score was assigned for each patients after 24 to 36 weeks. Using this scale there were 12(60%) excellent results, 4(20%) good results, 3(15%) fair results and 1(5%) poor result.

SM *et al*, [7] and Gellman RE *et al*, [6] Janzing HMJ *et al*. [5] extra articular and intraarticular fracture percentages were closely resembling Janzing HMJ *et al*, [5] Seifert *et al* [1] and Wisniewski *et al*. [3]

Table 16(a): Comparison of Fracture

Series	Total no of fractures	Open	Closed	Extra articular (type A)	Intraarticular (type C)
Seifert J <i>et al</i> [2]	48	10(21%)	38(79%)	37(79%)	11(23%)
Wisniewski <i>et al</i> [3]	32	0(0%)	32(100%)	25(78%)	07(22%)
Bel JC <i>et al</i> [4]	33	09(27%)	24(73%)	15(45%)	18(55%)
Janzing HMJ <i>et al</i> [5]	24	01(4%)	23(96%)	20(83%)	04(17%)
Gellman RE <i>et al</i> [6]	24	08(33%)	16(67%)	11(46%)	13(54%)
Lucas SM <i>et al</i> [7]	25	09(36%)	16(64%)	06(24%)	19(76%)
Present	25	07(28%)	18(72%)	25(100%)	0(0%)

Table 16(b): The numbers and percentage of AO types of fractures are

Series	A1	A2	A3	C1	C2	C3
Gellman RE <i>et al</i> [6]	3(12%)	3(12%)	5(21%)	4(17%)	3(12%)	6(26%)
Lucas SM <i>et al</i> [7]	0(0%)	4(16%)	5(21%)	4(17%)	3(12%)	6(26%)
Present	10(40%)	13(52%)	2(8%)	0(0%)	0(0%)	0(0%)

Comparing our data with the previous series, we found similar results regarding union rates, outcome and complications

Table 17(a): Comparison of union rate

Series	Operative time	Follow up	Union rate	Remarks
Seifert <i>et al</i> [2]		12-37months Avg: 33weeks	9-17weeks Avg: 12.6weeks	All fractures healed; 1 open reduction done
Gellman RE <i>et al</i> [6]	60-315min Avg: 154min	4-36months Avg: 18months	2-4months Avg: 3months	All healed 1bone graft
Lucas SM <i>et al</i> [7]	156min	Minimum of 5months		All healed 16(67%)multiple injuries; 1 open reduction
Bel JC <i>et al</i> [4]	Avg: 150min	Minimum of 12months	Avg: 12weeks	All healed
Janzing HMJ <i>et al</i> [5]		Minimum of 12months Avg:19months		All healed 1 open reduction
Present	Avg: 83.92min	4-12months Avg: 11.48 months	16-24weeks Avg: 16.16weeks	All healed 5 open reduction

Table: 17(b): Comparison of complications

Series	Functional results	Complications
Seifert <i>et al</i> [2]	Leung score: A:16% fair, 16% good,16% excellent C: 18% fair,73% good, 19% excellent No difference between type A and C	1DVT, 2shortening, 1insufficient fracture reposition, 1spiral fracture, 2retropatellar chondral lesion
Gellman RE <i>et al</i> [6]	Sanders Score: 4excellent, 15good, 2fair, 2poor A:3 excellent, 16 good, 1poor C:1excellent, 9good, 2fair, 1poor Average flexion 106 degree (55-150)	1malunion, 6shortening, 3nail impingement, 1missed locking bolt, 2required arthrolysis
Lucas SM <i>et al</i> [7]	Average ROM 100 degree Average flexion 104 degree Average extensor lag 4 degree A:ROM 920 lag 60 flexion 980 C:ROM 1030 lag 30flexion 1060	4knee pain, 1malunion, 1shortening, 1bent nail, 1brokennail, 1infection, 6required arthrolysis, 7irritation at screw site, 2post traumatic arthritis
Bel JC <i>et al</i> [4]	Average ROM 110 degree(range 60-120)	3malunion,1shortening
Janzing HMJ <i>et al</i> [5]	56% excellent, 33% good, 11% fair No failures	5distal lock bolt loosening, 4shortening,5malunion
Present	Neer's score 56% excellent, 16% good, 24% fair, 1% poor	8 knee pain, 4 shortening 3 nail protrusion, 1delayed union, 2infection

All the fractures in the present study healed in an average of 16.16 weeks. Previous studies with lateral fixation device report similar rates of union and time to union. Numerous rating scales are used to determine the functional outcome after surgical treatment of supracondylar fracture of femur. Neer, HSS, Karlstrom and Olerud. Leung, Schatzker, Sanders are some scales in vogue. We used Neer's score since it emphasizes on important patient outcome variables such as pain, functions as related to daily living activities, range of motion, return to work, gross anatomic alignment and roentgen graphic evaluation of union and mechanical alignment. However no rating scale is validated to be superior to other. True common confounding variables in the present study that were not evaluated properly are associated injuries and pre-existing arthritic condition, both which can lower the score. We acknowledge these limitations in this study. Range of motion was on par with previously reported studies; Kolmert *et al* 92 degree, 8 Gile *et al*. 120 degree, 9 Shelton *et al* 115

degree,10 Iannacone 90 degree,11 Gynning 130 degree,12 Henry 105 degree,13 Gellman 104 degree6 and Lucas *et al* 100 degree.7 In this study average ROM is 100 degree for all fractures. Younger patients attained better results than the elderly patients. Presumably this is because the younger group adhere to strict and vigorous physiotherapy postoperatively than elderly group. Most of the patients had their heal in excellent alignment without shortening. The 1-3cm shortening that occurred in 4 patients did not affect their function. All of them could well with shoe raise. Of great concern than the loss of alignment is the problem of nail impingement. 3patients had nail protruding in the knee joint. This was due to technical error when distal locking screw missed the nail, allowing migrating distally or may because of poor instrumentation. None of the patients agreed for second surgery. Meticulous attention to the technical details will avoid such mishaps. Eight patients had knee discomfort with occasional pain. Pain could be due to nail protrusion into the joint or malunion and

secondary osteoarthritis. All the patients were comfortable with simple analgesics. The origin of pain needs further research. There were two case of superficial infection which subsided after debridement and intravenous antibiotics.

Conclusions

Retrograde intramedullary supracondylar nail is a good fixation system for distal third femoral fractures, particularly extra-articular type.

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