

A Study of Management of Supracondylar Femur Fractures by Supracondylar Nail

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Abstract

Aims and Objective: To study the incidence and pattern of supracondylar femur fractures according to AO/ASIF classification, to assess the treatment and long-term functional outcome for supracondylar femoral fracture using retrograde nail.

Methods: In the present study twenty supracondylar femur shaft fractures were treated by retrograde nail. Of these, four were females and sixteen were males, in the age group of 20 to 70 years. Fractures were classified according to Muller's. 40% were Type A2 fractures, 20% were Type A3, 20% were Type C1, 15% were Type C2 and 5% were Type C3. All the cases were operated with retrograde intramedullary nailing using patellar splitting approach.

Results: Most common mechanism of injury was motor vehicles accidents associated with high energy trauma 12 cases (60%). Five were open fractures whereas fifteen were closed. The fractures were comminuted in 30% cases whereas 30% presented with a transverse pattern. 25% were oblique fractures and only one spiral fracture occurred in our series. The average range of knee motion in our series was 92.5 degrees. Knee stiffness occurred in one patient of type C3 fracture. There were two cases of significant shortening, one was 1.8 cms and the other was 3.1 cms, both occurred in type C2 comminuted fractures, it did not cause any morbidity and was corrected by shoe raise. The risk of infection and non-union were low. The incidence and severity of significant malunion was nil. It offers a short hospital stay, early mobilization and predictable healing.

Conclusion: Supracondylar nail is an excellent option for management of supracondylar femur fractures even in those with intercondylar extension.

Keywords: Supracondylar femur fractures, Retrograde intramedullary nailing, Supracondylar nailing, Muller's classification

1. Introduction

Supracondylar femur fractures are the most complex because of the soft tissue injury and the degree of comminution they involve. The supracondylar region because of its complex anatomy, proximity to the knee joint, a major weight bearing joint, difficulty in control over distal fragment always possess a challenge to treat. To add to this, are the associated ligamentous injuries, intra articular involvement and difficulty in anatomical alignment, which further complicated the treatment [1]. Many treatment modalities have been advocated for the treatment of the supracondylar fractures of the femur. Also the various methods of cast braces and reduction were advocated to decrease the period of immobilization. Non operative treatment of any form was always confounded with anatomical mal-alignment and knee stiffness.

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 IJBAR (2016) 07 (08)

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 and John Charnley[2,3]. Various modalities of internal fixation have been recommended including blade plates, Rush rods, Zickel devices, supracondylar plates, compression screw devices. The conventional treatment for supracondylar fracture of the femur is open reduction with plates and screws. Considerable dissection of the thigh is required with resultant devascularization of the distal fragment leading to a high rate of complications including delayed union, nonunion, failure of the implant and infection [4]. To counteract the problems assaulted with blade and plate fixation, the concept of closed intramedullary nailing evolved. Closed femoral nailing minimizes soft tissue damage to periosteal muscular blood supply and minimizes the blood loss. Though rapid healing of fracture by abundant formation of callus is predictable and infection is rare. However the rigidity of internal fixation allows for early

mobilization of the patient, recovery of function after fracture supracondylar femur is dependent upon early, exact and stable reconstruction as well as upon immediate mobilization to prevent permanent impairment. In 1970s improved result were reported with open reduction and internal fixation of the fractures of the distal femur which ensures a very high rate of success'' [3].

The aim of this study is to study the retrograde nailing in treatment of supracondylar femur, to test whether it fulfills the A. O. principles [6].

2. Material and Method

The present study consists of a series of twenty supracondylar femur shaft fractures were treated by retrograde nailing in the Department of Orthopaedics, Indira Gandhi Government Medical College and Hospital, Nagpur, Maharashtra. Of these, four were females and sixteen were males, in the age group of 20 to 70 years. Inclusion criteria included all supracondylar femur fractures of types A1, A2, A3, C1, C2 and C3, closed as well as compound Grade I and Grade II in patients of any age. The patients with compound Grade III injuries, Mullers type B, patients having infection and previous skeletal disease were excluded from the study.

After admission of patient, a careful history was elicited from the patient and or attendants to reveal mechanism of injury and the severity of trauma. A thorough clinical examination was done and preoperative treatment was given to all the patients. All patients before keeping on traction were assessed radiographically to note anatomical location of fracture, geometry of fracture, degree of comminution, intraarticular involvement and to classify the fracture pattern. Antero posterior and lateral views of the knee with thigh were taken and the fracture classified accordingly. The limb was then immobilized in Thomas splint. The patient was then taken up for surgery after investigations and making patient medically fitness for surgery.

Figure 1: Instruments and implants used in retrograde intramedullary nailing of supracondylar femoral fractures



According to the fracture pattern and study of anteroposterior and lateral radiographs of the knee and thigh, supracondylar nailing was planned in our study. Supracondylar nail of 316 L steel having three interlocking

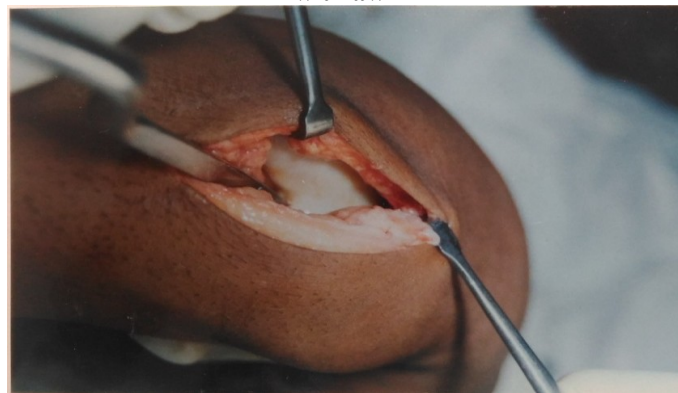
holes proximally as well as distally each was used. Multiple holes nail may be used and nail length of 15, 20, 25cm were chosen. The patients were positioned on a simple operating table in the supine position for spinal or general anaesthesia. The knee of the involved side was fixed to approximately 45 degrees by keeping roller sheets or bolster below the knee, as shown in figure 2.

Figure 2: Position of the patient on the operation table, knee flexed over bolster



Alternatively knee can be 45° flexed with the leg dangling on an adjustable fracture table angled 45° at the knee. Tourniquet applied at the proximal thigh was inflated for less blood loss and better visibility in the operative field and adequate painting and draping of the parts was done. We have used modified percutaneous incision from the lower pole of the patella to the superior border of the tibial tubercle. After that patellar tendon was split longitudinally and the posterior cruciate ligament was visualized. The entry portal was made with the help of sharp awl, 1 cm anterior to the posterior cruciate ligament in the intercondylar notch (Figure 3).

Figure 3: Entry portal made in the intercondylar notch with awl



Reduction was achieved by manual traction and application of correctional forces that vary depending on the fracture pattern. If difficulty was encountered with the reduction, the drill sleeve passed over the guide wire may be used as a joystick to achieve a reduction. After the guide wire was inserted from the distal fragment and into the proximal fragment, the position of the guide wire was confirmed under radiographic control in both the anteroposterior as well as the lateral views. Reamer was passed over the guide wire and the distal fragment was reamed with adequate size reamers.

Reaming was done incrementally to 1-2 mm wider than the anticipated nail size (Figure 4).

Figure 4: Reaming done with serial reamers



The nail that was selected was fit into the introducer/target device and was pushed in by hand and the position was verified by the use of image intensifier to confirm that the tip of the nail lies centrally the distal third of the femur and the distal articular end of the nail showed be buried 2-3 mm subchondrally so as to prevent articular impingement. Proximal and distal interlocking was done with jig and atleast two interlocking bolts of 4.5 mm were inserted. Both the cortices were drilled and the interlockings bolt of adequate size was inserted in. This was done using one screws and the position was confirmed by the sounding technique or under C-Arm image intensifier. Incisions were closed in layers after a thorough wash and achieving complete haemostasis.

Figure 5:



Figure 5a: Insertions of supracondylar nail



Figure 5b: Proximal interlocking in progress



Figure 5c: Insertion of distal interlocking screw



Figure 5d: Supracondylar nail buried subchondrally

All patients were started on intravenous antibiotics immediately and these were continued for three days followed by oral antibiotics for seven days and continued for more days in cases of compound fractures or in cases of infection. Analgesics were added according to need. All patients were mobilized on the next post operative day within limits of pain tolerance, active hip and knee mobilization

exercises were begun. Quadriceps strengthening exercises were started. By the third post operative day almost all patient began to crutch walk. Patients were kept touch-down weight bearing at two weeks and full weight bearing was started with the appearance of radiological consolidation. All the patients were followed up till the evidence of healing or declaration of the non-union for an average of ten months.

Figure 6:

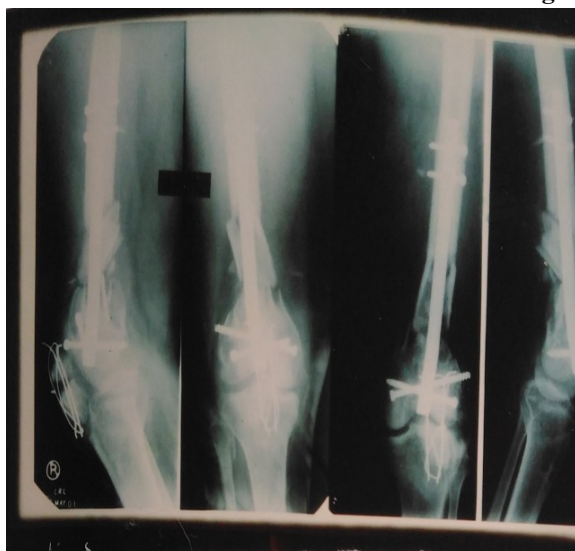


Figure 6a: Follow-up X-ray 10 months post operative (Non-union: A case of compound grade II Type C3 fracture)

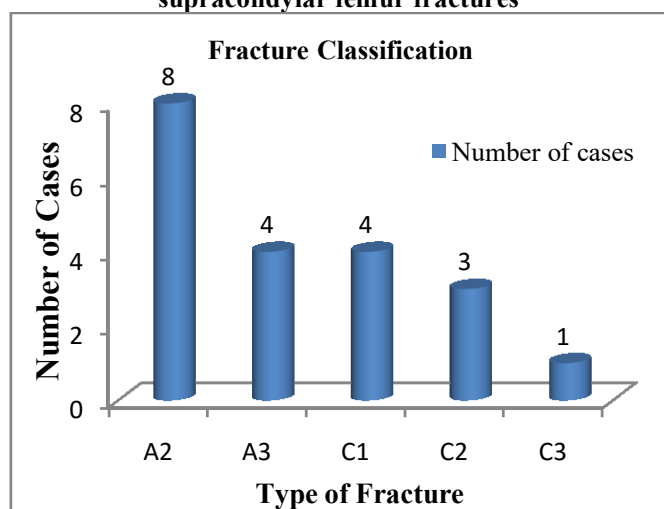


Figure 6b: A case of comminuted segmental type C2 fracture showing heterotrophic ossification leading to stiff knee

3. Observations and Results

Total twenty patients were enrolled in the study having age ranges from 20 to 70 years with the fracture being most common in the 41-50 years age group with an average of 49.77 years. Out of 20 patients 16 (80%) were male and 4 (20%) were female showing male preponderance, that is probably due to male are predominately working in factories field and travelling. Among males, the most common age group of occurrence was 41-50 years with an average age 39.8 years. Among females, most common age group was above sixty years with an average of 59.75 years. There were 12 (60%) with right sided and 8 (40%) with left sided supracondylar femoral fracture. Majority of the injuries were due to road traffic accidents, a total of 12 cases (60%), 4 (20%) were due to direct trauma to the flexed knee and 4 were due to fall (20%).

Figure 7: shows the fracture classification according to the AO-ASIF classification for supracondylar femur fractures



Most of the fractures in our series were closed (75%) whereas only five cases (25%) were open fractures. The fractures were comminuted in 30% cases whereas 30% presented with a transverse pattern. 25% were oblique fractures and only one spiral fracture occurred in our series. Associated skeletal injuries occurred in ten patients (Table 1).

Table 1: Associated skeletal injuries

Associated injuries	No. of cases
Ipsilateral tibial shaft fractures	2
Fracture medial malleolous	1
Head injury	2
Chest injury	1
Patellar fracture	1
Anterior cruciate ligament injury	2
Contralateral shaft femur fracture	1
Colles fracture	1
Metacarpal fractures	1

The patients with bilateral supracondylar fracture femur had popliteal injury on the right side, which lead to amputation of that limb. No nerve injury occurred at the time of trauma in any of the patients. Average operative time was 90 minutes and average blood loss was found to be 170 cc. Intraoperatively, closed reduction was not possible in two patients. Extension of fracture, failure to do close locking, loss of intraarticular reduction, occurred in one patient each. Articular damage occurred in two. Two incidences of nerve palsy occurred, both were neuropraxia. The average time to full weight bearing was 7.5 weeks. One patient, a case of non-union could not weight bear and average time to union was 13.7 weeks.

The average hospital stay was 5.65 days from admission to operation and 11.95 days from operation to discharge. The average hospital stay was 17.6 days. Mode of reduction was closed in 80% of the patients, two (10%) required open reduction. There was one case of significant

varus deformity of seventeen degrees in one patient, which did not cause any morbidity to the patient. One case of deep infection was reported and two case of superficial infection occurred. All responded to conservative management and did not have any adverse effect on fracture healing.

Most of the patients were crutch walking in the early post operative patient and could be actively mobilized for hip and knee exercises. All but one patient had good range of knee motion. The average range of knee motion in our series was 92.5 degrees. Knee stiffness occurred in one patient of type C3 fracture. There were two cases of significant shortening, one was 1.8 cms and the other was 3.1 cms, both occurred in type C2 comminuted fractures. The shortening did not cause any morbidity and was corrected by shoe raise. One case of delayed union and one case of nonunion occurred. Secondary supplementary procedures were required in two patients. Debridement and resuturing was done for deep infection and bone grafting was done for non union. Anterior knee pain and quadriceps atrophy occurred in two patients. Patello femoral arthritis, fatigue fractures, missed locking screws did not occur in any of the patients. There was no incidence of compartment syndrome, vascular damage or fatigue fractures.

4. Discussion

The present study included supracondylar femur fractures, open as well as closed with or without intercondylar extension treated with the GSH supracondylar nail. The favourable results in this series are comparable with those in the other series; this was due to the adherence to the principles of stabilization with internal fixation and early functional rehabilitation. The minimum age of the patient was twenty years, whereas the maximum age was sixty eight years old. Average age of occurrence varied for males (39.8 years) and females (59.7 years). The mean age in the series was 49.7 years. The comparative age occurs in other studies [7-10]. The maximum number of patients was males; one of the causes of preponderance in the males could be the fact that this fracture is usually associated with high energy trauma to which males are more commonly exposed than the females [7,11-13]. The motor vehicles accident was the most common mode of injury causing this pattern of fracture. Trivial trauma causing this fracture occurred in 15% of our cases, all were osteoporotic females above 60 years of age. This was compared with different studies [7,10,12-14]. We used the AO-ASIF group fracture classification for supracondylar femur fracture. The most common type of fracture pattern was type A2, extraarticular simple supracondylar, displaced with some fragmentation. It was comparable to the study of Leung [4] which showed an almost similar distribution of the fracture pattern. One patient in our series was a type C3 fracture. The severely comminuted type A3, C2 and C3 were most commonly associated with ligament injuries, suggesting the severity of

the trauma. There were 5 cases of open fractures (25%), most of them were compound grade I or grade II injuries. According to Insall[15], the incidence of open wound varies from 8-38%. The mechanism of open fractures is that of a blow to the front of the knee with the distal end of the shaft coming out through the front of the extensor mechanism. The quadriceps can usually be closed to protect the bone. One compound fracture was treated on an emergency basis. The rest were debrided and electively operated after the wound was healthy. Two compound fractures developed infection, which was superficial and controlled by antibiotics alone. There was one case of deep infection. Compound fractures also had good results contrary to what was believed. The wound condition, grade of injury and infection should be taken into account before nailing. This results compared with various studies [7,10, 16-18].

One patient, four days old injury had bilateral supracondylar fracture with right sided arterial involvement leading to amputation on the right side. Retrograde nailing was done on the other side. There was no associated nerve injury in our series. Comparable results found in different studies [8-10,19]. The average time to operation was 5.65 days. 65% of cases were operated within seven days. 35% of cases were operated within 8-4 days. The time to operation was longer because of problems regarding fitness and implant affordability. One compound injury was operated immediately. Early surgical intervention is significant in terms of early patient mobilization, and thus decreases the risks associated with immobilization such as DVT, bed sores, pulmonary complications and knee stiffness. Average stay of patients following operation was 11.95 days. Patients were discharged after suture removal and when they were doing physiotherapy properly. Five patients had wound healing problems and were discharged between 10-19 days. Two of them were diabetics. Three compound injuries were kept for >20 days till control of the infection. The average total duration of stay in the hospital is 17.6 days. This was less than that in the series of Siliski¹⁸ in which average duration of stay was 33.2 days.

Immediate post-operatively, the limb was kept elevated with knee in flexion on a Bohler splint and a crepe bandage was applied to decrease the post operative swelling. The patients were started on physiotherapy as early as possible, when pain allowed so, usually by the 2nd or 3rd day. Emphasis was placed on the isometric quadriceps contraction exercises. Active flexion and extension exercises of the knee while sitting and quadriceps strengthening exercises were started. Crutch walking without weight bearing was started on the third to fourth post operative day. All but one patient were crutch walking on the third post operative day. This post operative regimen of early mobilization had distinct and beneficial advantages in terms of functional outcome. Early mobilization improved knee and hip range of motion and prevented knee stiffness. It also prevented quadriceps atrophy

and helps in early healing thereby reducing morbidity and hospital stay. The average time to healing was 13.7 weeks in our series. Accordingly full weight bearing was individualized in each patient. 80% of patients were full weight bearing within 6-8 weeks. 10% were weight bearing within 4-6 weeks. Two patients (10%) both with comminuted segmental fracture pattern required 11 weeks for full weight bearing. Average time to full weight bearing in our series was 7.5 weeks which was comparable to other studies [4,16].

Union was defined clinically as the patient could walk unaided without crutches and there was no pain at the fracture site and radiologically, the union was defined as the formation of the continuous bridging callus. The mean union time in our series was 13.7 weeks and this was comparable to that in the standard series[7,14,17]. The minimum time to union was 10 weeks whereas the maximum time to union was twenty four weeks in one compound comminuted segmental fracture pattern. The comparative average time to union in all modalities of fixation was same as that of the supracondylar nail. In terms of knee range of motion, most of our patients had a knee range of motion 100° or greater than 100° . Thirteen patients had a knee range of motion within a range of 100° - 135° . Five patients had a knee range of motion less than 100° . Two of these had compound comminuted A3 fracture; whereas others were type C1 or type C2 fractures. The fractures with intraarticular involvement and comminution tend to have a decreased range of motion. One patient had a stiff knee; it was a case of comminuted segmental C2 fracture. The fracture with comminution in the condyles tends to have more limitation of knee range of motion. Physiotherapy, early mobilization due to rigid fixation goes a long way in improving the knee range of motion. This was comparable to the range of motion in the other studies [7,10].

Shortening in our series did not pose a problem in functional outcome. There was one varus deformity (5%) occurred as a functional outcome. There was no valgus and recurvatum deformity in our series. Non-union, as a complication is rare due to the stable rigid intramedullary fixation offered by the supracondylar nail. There was one case of non-union, it occurred in compound grade II, Type C3 fracture with severe comminution and associated patellar fracture. There was a case of deep infection which occurred in a compound grade I injury. Two cases of superficial infection occurred in compound fractures. These results were comparable to other series [17,20,21]. Compound injuries should be adequately debrided and washed and appropriate antibiotics started, to prevent the onset of infection. Anterior knee pain occurred in two patients; the pain gradually subsided with analgesics. The cause was irritation of the tissues around the long screws. Quadriceps atrophy and weakness occurred in two of our patients. One was a case of C2 comminuted segmental fracture with stiff knee, and the other was a compound C3 fracture which went into non-

union. Lack of physiotherapy and early weight bearing was a major factor. Leung[4] reported a similar case in his series. Knee stiffness occurred in one patient; a case of C2 comminuted segmental fracture. This patient developed heterotrophic ossification around the collateral ligaments. This was a major cause of the stiffness in this patient. Delayed union occurred in one patient, a case of compound grade I comminuted A3 fracture. Close reduction was not possible in one patient due to soft tissue interposition. Extension of fracture line occurred in one patient with comminuted segmental C2 injury fortunately the fracture went to union. Intra-articular comminution occurred in two patients of type C2 fractures; there was no problem with healing. Articular cartilage damage occurred in two patients while driving the nail inside. In one case, due to mismatch of jig and severe soft tissue swelling, proximal screw interlocking was done under vision. Sciatic nerve palsy occurred in two patients.

All patients ultimately went to union. One patient had a stiff knee. All other patients had excellent results as compared to other standard series in the terms of the early weight bearing, time to union and complication rate. The malunion and shortening were insignificant. There was one case of nonunion and one case of delayed union. Both went to union finally. Thus the results were excellent in 95% of the patients, comparable to those in other standard series.

5. Conclusion

The study was conducted to assess the functional outcome of treatment of supracondylar femoral fractures by retrograde intramedullary nailing. The management of these difficult and complex fractures by supracondylar nailing provides significant advantages such as less operative time, minimal soft tissue stripping, minimal blood loss, decreased need for bone grafting and reasonably rigid fixation in osteoporotic bones. Also it offers a short hospital stay, early mobilization and predictable healing. Thus we conclude that supracondylar nail is an excellent technique for management of supracondylar femoral fractures even in those with intercondylar extension.

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