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A clinical study of the surgical management of supracondylar femur fracture treated by retrograde intramedullary (GSH) interlocking nail

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Abstract
Background: A prospective randomized study of 20 patients who underwent fixation of the supracondylar femur fractures with GSH nail was done to study the clinical and radiological outcome of GSH interlocking nail in supracondylar femur fractures. The study also evaluated the results of the retrograde nailing in supracondylar femoral fractures in relation to knee flexion, mobilization of patients and early weight-bearing.
Materials and Methods: A study was conducted on 20 patients with Supracondylar fracture femur admitted from OPD and Casualty of Narayana Medical College and hospital, Nellore. The study was done over a period of 24 months, from October 2019 to October 2021.
Results: The follow-up duration ranged from 3 months to 23 months. Out of 20 patients, 1 patient developed knee sepsis, nail was removed immediately and the patient was lost for follow-up. 65% good to the excellent result were obtained using Neer's and Sander's evaluation scoring system.

Keywords: Supracondylar fracture, GSH, retrograde nailing

Introduction
Supracondylar and intercondylar femoral fractures are often difficult to treat and they are notorious for many complications. The traditional management of displaced fracture supracondylar of the femur was along with the principle of Watson Jones [1] & John Charnley [2].

Supracondylar fractures tend to collapse into varus. During application of an AO blade plate or dynamic condylar screw, the femur shaft is often pulled laterally, displacing the line of weight-bearing, lateral to the anatomic axis of the 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 the 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.

Objectives of the study
This work has been undertaken to study the clinical and radiological outcome of GSH interlocking nail in supracondylar femur fractures and also to study and evaluate the results of the retrograde nailing in supracondylar femoral fractures.

Materials and methods
The study was conducted on 20 patients with Supracondylar fracture femur admitted from OPD and casuality of Narayana Medical College and hospital, Nellore. The study was done over a period of 24 months from October 2019 to October 2021.

Inclusion Criteria
1. Age between 15-70 years
2. H/O Trauma (RTA, fall from height).

Exclusion Criteria
1. Mid shaft femur fractures
2. Non union.
3. Malunion.
4. Pathological fractures

Implant Used
- The implant used was an Orthocare supracondylar nail system with an instrumentation set.
- The nails are available with outer diameter of [10, 11] and 12 mm

There is 5-degree anterior bend and an anterior bow for anatomic fit. All sized nails have five interlocking holes in all lengths, two proximal holes and three distal holes, which accept interlocking screws of 4.9mm thread diameter

Results

The method used for fracture fixation was closed or open reduction and internal fixation with retrograde intramedullary supracondylar GSH nail. The duration of follow-up ranged from 3 months to 23 months. Out of 20 patients, 1 patient developed knee sepsis, nail was removed immediately and the patient was lost for follow-up. 65% good to the excellent result were obtained using Neer's and Sander's evaluation scoring system.

In this study, the youngest case was 25 years old male and the oldest was 54 years. The overall mean age was 36.15 years.

Seventy-five (75%) percent of fractures were sustained due to road traffic accidents and falls from height accounted for 25% of fractures. In this study right side affection was seen as more than twice as common as the left side.

Table 1: Distribution of Fracture

Nature of Fracture	Number of cases	Percentage
A1	8	40
A2	10	50
A3	2	10
Total	20	100

The average operative time was 96.50 minutes. 80% of cases underwent closed reduction and 20% open reduction. In the majority of patients, at least 2 screws were used distally.

The average radiological union time was 16.21 weeks of 20 patients, one patient went into deep infection after 2 months

Average full weight bearing was achieved by 11.68 weeks.

The average flexion in this study was 105 degree, with more than 50% of patients having a knee range of motion of more than 110 degrees. The average extensor lag in this study was 5.68 degrees.

Out of 19 patients, 4 had shortening 2 shortening of 22 mm and 2 shortening of 25 mm

Table 2: Varus/Valgus Malalignment

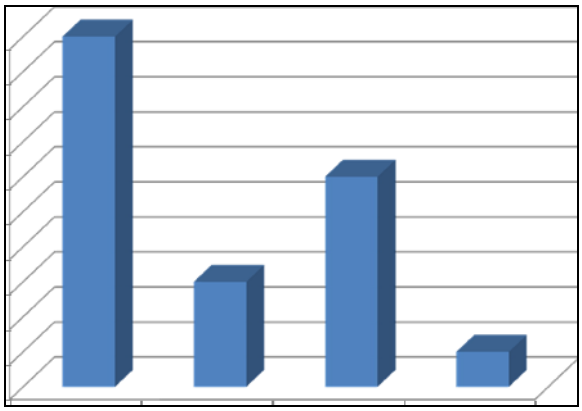
Malalignment of >5 degree	Number of cases	Percentage
Varus	5	25

In this study, very few patients had significant varus/valgus malalignment.

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

Neer's Rating

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



Graph 1: Neer's and Sander's Rating

Average knee flexion for closed reduction- 1050 Average knee flexion for open reduction – 101. The final knee flexion seems to become slightly better if nails with a larger diameter were used. 8 patients (62%) out of 13 with 250mm long nail had ≥110 degree knee flexion. 5 out of 6 patients (83%) with 12 mm diameter had ≥ 110 degree 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 the 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 11.5 weeks Average weight-bearing for open reduction 12 weeks

Discussion

Age Incidence

Mean age group reported in the previous series were: Lucas SE *et al*. (1993) [7] reported 39 years as mean age group. Watanabe Y (2002) [3] reported 64 years as mean age group. In the present series, the mean age was 36.15 years

Sex Incidence

Watanabe Y (2002) [3] study, whose mean age was 64 years, there were 4 male and 20 female patients.

In the present series, there were 18 male patients with an age group 34.89 years, and 2 female with an average age of 47.5 years.

Mechanism of Injury

Studies conducted by Schatzker *et al*. (1974) [4], Yang RS *et al*. (1990) [5] and Leung KS *et al* (1991) [6], demonstrated road traffic accidents as the major causal factor. Lucas SE (1993) [7] reported 79% road traffic accident, 17% fall and 4% gunshot woundIn the present series, road traffic accidents accounted for 75% of cases and 25% resulting from fall.

Associated Injuries/ Illness

In the present series, 6 patients had associated injuries. Of the 6 injured patients, 2 with ipsilateral proximal tibial fracture had knee flexion of average 82.5° and extensor lag of > 10°. The patient with patellar fracture had knee flexion of 100° and an extensor lag of 8°. Two patients with tibial spine fracture had average knee flexion of 102.5° and extensor lag of 9°.

Thus, it appears that though a significantly less number of patients in the present series had associated trauma, it seems to affect the final outcome. This can be attributed to delayed

mobilization and delayed weight bearing in these patients.

Injury-Surgery Interval

Lucas SE (1993) [7] observed that average injury-surgery interval of 6 days. Watanabe Y (2002) [3] observed the average injury surgery interval of 3 days In the present series, the injury-surgery interval was 10.3 days

Operative Time

Gyning JB (1999) [8] reported an average operative time as 112 minutes. Kumar A (2000) [9] reported an average operative time as 58 minutes. Watanabe Y (2002) [3] reported an average operative time as 108 minutes. Gellman GE (1996) [10] reported operative time for Type-A 113 minutes. Christodoulou A (2005) [11] reported an average operative time of 92 minutes.

Average operative time in this series was 96.5 minutes (75-140 minutes).

Radiological Union

Danziger MB (1995) [12] reported an average radiological union time 12.4 weeks. Gellmann GE (1996) [10] reported an average radiological union time of 12 weeks. Kumar A (2000) [9] 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.

Knee Flexion

Kumar A (2000) [9] obtained an average knee flexion of 100 degrees. Watanabe Y (2002) [3] obtained a moderate knee flexion of 102 degrees. Ingman AM (2002) [13] obtained an average knee flexion of 101 degrees. In the present study, the knee flexion was 105 degrees

Knee Extension Lag

Watanabe Y (2002) [3] documented an extensor lag of 5 degrees. The average extensor lag in the present series was 5.68 degrees.

Shortening

In Lucas SE (1993) [7] study 1 patient had shortening of >3 cm while Gellmann GE (1996) reported 6 out of 24 patients having 2 cm shortening. In the present study, 4 patients had shortening with an average 2.35 cm and could be compensated by giving a shoe raise.

Complications

a) Infection

There has been no report of infection by any authors except for Lucas SE (1993) [7] who reported one case of the septic knee.

In the present series, there was one case of septic knee, 1 month after nail insertion and nail was removed immediately and then patient was lost from follow-up.

b) Non-Union

Four cases of non-union were reported by Iannacone WM (1994) [14], which were treated with bone grafting and revision fixation.

Kumar A (2000) [9] reported one case of non-union but attributed it to a technical error, rather than implant. All other studies reported good and solid union.

In the present series, also there was no case of non-union and all patients united radiologically at >3 months interval from surgery.

c) Delayed Union

Danziger MB (1995) [12] also reported a case of delayed union.

In the present series, there was a case of Al-2 type of supracondylar fracture, associated with ipsilateral comminution fracture proximal tibia, immobilized thepatient for 10 weeks and showed bridging callus and clinical signs of the union at 24 weeks. No secondary procedure was done in that patient except for delayed full weight bearing.

d) Distal Migration of Nail

Gynning JB (1999) [16] reported a case in which the distal locking screws broke at 3 months and the nail protruded in knee joint by 2 cm.

In the present series, there was a case of type-A3-2 fracture in which with weight bearing, the single distal screw cut through the femoral condyles and migrated into surrounding soft tissue. The patient had restricted knee flexion because of mechanical block and painful knee flexion. The implant was removed after the fracture had completely healed

e) Distal Screw Breakage/ Local Symptoms at Distal Screw

Gynning JB (1999) [16] reported no screw breakage but in 5 of his patients, distal screws backed out and were removed under local anesthesia after fracture union. Kumar A (2000) [9] reported a case of loosening of distal screw in 1 patient 4weeks after surgery which was removed without affecting final outcome.In the present series, there were 3 patients who complained of pain at the site of distal screws, which required screw removal after fracture healing.

f) Stress fracture

Kumar A (2000) [9] reported 2 cases of stress fracture at the proximal tip of nail who also had ipsilateral total hip stem. He attributed the fracture to high stress concentration between two intramedullary implants in an osteoporotic bone. In the present series, there was no case of stress fracture.

g) Implant Failure

High implant failure rate was reported by Danziger MB (1995) [15] and Iannacone (1994) [14] in their studies where nails with multiple holes were used along with 6.4 mm locking screws. With the modification of the nail to total 4 to 5 holes placed at both ends with screw size of 5.0mm, no implants failure has been reported in newer studies. In the present study also, there were no cases of implant failure.

h) Impingement: In the present series 1 nail was kept slightly protruding in the intercondylar notch, due to error in technique. They were removed after solid bone union.

i) Neer's and Sander's Rating

Neer *et al*. (1967) [17] reported 52% satisfactorily results with operative method. Janzing *et al*. (1998) [18] used retrograde nailing to treat 26 distal femoral fractures and 72% had neer score of 85 points or more (excellent).In the present series, 65% had Neer score of good to excellent. Also 65% had Sander's score 37 of good to excellent

Conclusion

1. Retrograde intramedullary supracondylar nail is a good fixation system for distal third femoral fractures, particularly extra-articular type
2. The operative-time is lessened with decrease in blood

loss.
3. Closed reduction can be achieved by not disturbing fracture hematoma and soft tissue.
4. Even with open reduction, there is less soft tissue trauma and less postoperative stiffness.
5. Distal screw related local symptoms is a common problem and is related to implant and technique.
6. Utmost great care is required to avoid infection.
7. There is no non-union, less delayed unions and rates of angular or rotational malunions.
8. Non-requirement of bone graft decreases the morbidity associated with donor site.
9. 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.
10. There is no much difference in individual fracture type healing and weight bearing.

Thus, supracondylar nail is the optimal tool for many supracondylar fractures of femur. It provides rigid fixation in a region of femur, where a widening canal, thin cortices and frequently poor bone stock make fixation difficult. Surgical exposure for nail placement requires significantly less periosteal stripping and soft tissue exposure than that of lateral fixation devices. Orthopaedic surgeons experienced with intramedullary nailing will find the supracondylar GSH nail a useful technique, but requires attention to prevent complications.

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