

## Management of Supracondylar Fracture of Femur by Short SIGN Nail Procedure

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### Abstract

### Original Research Article

**Background:** Supracondylar fracture of femur which is also known as distal fracture occurs when the femur is broken at the knee. Retrograde femoral nailing can be defined as any femoral nailing technique with a distal entry from the condyles or through an intercondylar, intra-articular starting point. We have very few data regarding the effectiveness of retrograde short SIGN nail procedure in treating supracondylar fracture of femur. **Aim of the study:** The aim of this study was to evaluate the management and effectiveness of retrograde short SIGN nail in treating supracondylar femoral fractures (Type III, Neer and associate's classification). **Methods:** This prospective observational study was carried out at the Dept. of Orthopaedic & Traumatology, Rajshahi Medical College & Hospital, Rajshahi, Bangladesh during the period from January 2019 to December 2019. In total 38 patients with supracondylar femoral fractures of type-III (As per Neer and associates classification) were finalized by purposive sampling method as the study people of this study. This study was approved by the ethical committee of the mentioned hospital. A predesigned questionnaire containing history and examination findings of the patient, operative procedure and follow-up was used to collect the data. All data were processed, analyzed and disseminated by MS Office and SPSS version 20 as per need. **Result:** In analyzing the duration of hospital staying of the participants we observed 66% patients stayed for 2-3 weeks whereas 34% stayed for >3 weeks in the hospital. In this study we observed 73.68% had union in due time, 21.05% had delayed union and 5.26% developed non-union. In analyzing the complications among the participants, we observed, the highest numbers of participants suffered from superficial infection which was associated in 15.79%. Besides this, as complication 13.16%, 7.89%, 5.26% and 2.63% participants suffered from knee stiffness, anterior knee pain, shortening and screw loosening respectively. As final outcome of this study we found 'Excellent', 'Good', 'Fair' and 'Poor' results among 52.63%, 31.58%, 10.53%, 5.26% patients respectively. So, the satisfactory (Excellent and good) results were found among 84% and unsatisfactory (Fair and poor) results were found among 16% patients. **Conclusion:** In retrograde short SIGN nail procedure the rate of union is high with low incidence of complications. The simplicity of this method also facilitates fracture fixation in patients with multiple trauma. There are minimal chances of soft tissue disruptions and it ensures good purchase of the distal bone fragment and stable fracture fixation. Besides these this procedure ensures early joint mobilization for patients.

**Keywords:** Type III, Retrograde short SIGN nail, Supracondylar fracture, Neer and associates.

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## INTRODUCTION

Supracondylar fracture of femur which is also known as distal fracture occurs when the femur is broken at the knee. Retrograde femoral nailing can be defined as any femoral nailing technique with a distal entry from the condyles or through an intercondylar, intra-articular starting point. We have very few research-oriented data regarding the management of supracondylar fracture of femur with retrograde short SIGN nail. Dynamism is the basis of evolution. Constant changes are occurring everywhere until and

unless outcome meets the expectation. Same is true for the management of distal femoral fracture. As these fractures are high energy trauma and its proximity to the knee joint makes its management difficult and challenging job for the orthopedic surgeons. The topic has been controversial since the publication by Templeman [1]. The incidence of malunion, nonunion, and infection are relatively high in many reported series [2]. Ambulation with full weight bearing takes 3-6 months and many patients are not satisfied for being incapacitated for this prolonged period of time. Even minor degree of shortening and malalignment can

eventuate in a limp and post traumatic arthritis<sup>3</sup>. Therefore, the art of femoral fracture care is a constant balancing of the often conflicting goals of anatomic alignment and early functional rehabilitation of the limb [3]. The history of femoral fracture management reflects this underlying dilemma. In the 1960s, non-operative treatment methods produced better results. In 1967 Neer *et al.*, published a review of 110 supracondylar fractures treated with traction, casting and several types of internal fixations. They concluded that these fractures were not suitable for internal fixation [4]. But significant advances have been made in the management of supracondylar fracture in the past two decades. Surgical principles outline by AO/ASIF (Association for the Study of Internal Fixation) in the treatment of these fractures have improved operative results significantly. It is now recognized that operative fixation with the ability to obtain an anatomic reduction of the joint surface, restoring axial alignment and beginning early range of motion presents clear advantages over closed means of treatment [5]. The advent of interlocking nails has greatly expanded the indications for distal third femoral fractures especially comminuted fractures. This technique started in early 80s and quickly popularized all over the world. Recently several retrograde intramedullary nails (SIGN, BIOMET, ACE) have been designed to specifically address supracondylar fractures. This study was undertaken to treat supracondylar femoral fractures with retrograde short SIGN (Surgical Implant Generation Network) nail. Interlocking nailing needs sophisticated instruments like C-arm and technical expertise. We are lacking these modern instruments and cannot provide all of our orthopedic centers with C-arm and expertise. In the recent past years we have C-arm in the NITOR. This nail is being in use in other parts of the world (India, Vietnam, Myanmar etc.) and similar type of nails are used by various investigators [6] to treat supracondylar femoral fracture with encouraging results. In Bangladesh no such type of study was done before. Moreover due to increased motor vehicle accidents the incidences of this type of fractures are increasing. So this study may bring about the newer management technique in our country and will reveal the pros and cons of this nail over other conventional devices used for the management of supracondylar femoral fractures. In this system of interlocking only one jig is used, so distal locking is not a problem. This nail gives stable fixation and periosteal stripping is also less. It requires much less time to perform the procedure than other conventional devices.

## OBJECTIVES

### General Objective:

- To assess the management and effectiveness of retrograde short SIGN nail in treating supracondylar femoral fractures (Type III, Neer and associate's classification).

### Specific Objective:

- To ascertain the status of union of supracondylar femoral fractures by retrograde short SIGN nail.
- To observe the functional outcome of retrograde short SIGN nail in the management of supracondylar femoral fractures.

## METHODOLOGY & MATERIALS

This was a prospective observational study which was carried out at the Dept. of Orthopaedic & Traumatology, Rajshahii Medical College & Hospital, Rajshahi, Bangladesh during the period from January 2019 to December 2019. In total 38 patients with supracondylar femoral fractures of type-III (As per Neer and associates classification) [7] were finalized by purposive sampling method as the study people of this study. A pretested and predesigned questioner containing history and examination findings of the patient, operative procedure and follow-up was used to collect the data. The diagnosis of supracondylar fracture of femur was made from the findings of pain, swelling, deformity and roentgenograms. The circulation and motor function of the extremity are documented and a careful search is made on the ipsilateral lower extremity injuries. When femoral shaft fractures are caused by high-energy accidents, the following roentgenograms are obtained: cervical spine films, chest x-ray, A/P view of pelvis and A/P and lateral views of the knee. Lateral view of proximal third of femur should be taken to exclude ipsilateral neck fracture which was not initially diagnosed in as many as 50 percent of reported cases. Skeletal traction is applied to restore length at the fracture site and the limb is rested on Braun Bohler splint. Early application of traction is a critical point of initial fracture care; it reduces hemorrhage at the fracture site, reduces pain and maintains alignment of the extremity. According to the inclusion criteria of the study patients with supracondylar fractures of femur, fresh injuries and less than three weeks old, closed fractures, fractures with distal epiphyseal fusion and Type III (Neer and associates classification) supracondylar fractures were included. On the other hand according to the exclusion criteria of the study patients with open fractures, fracture without epiphyseal fusion, old injuries of more than three weeks and pathological fractures were excluded from the study. Age, sex and occupation were considered as demographic variables whereas nature of injury, side involved, time interval between injury and operation, hospital stay, muscle wasting, range of knee motion, functional outcome, complications, fracture configuration and union were considered as the clinical variables. At operation, patients were placed in the supine position on the operation table. Supine position is easier to achieve fracture reduction and estimation of rotational alignment. This is also a safe position for multiply injured patients. Leg was draped free and knee was flexed at 60-90 degrees by the side of the table over a bolster placed at the lower part of the back of the thigh. Knee flexion allowed proper access to the entry

portal of the nail. The portal of entry of the nail was in the intercondylar fossa just anterior to the femoral attachment of the posterior cruciate ligament. The jig was re-attached to the T-handle using shoulder bolt and hex wrench. The canula was placed through the distal jig hole to mark where the incision was to be made through the skin. After retraction of the canula incision was made on the skin. The drill was placed through the canula. The canula and drill guide were placed next to the bone. A 25 inch (6.5 mm) drill bit was inserted through the canula. A hole in the near cortex of the bone was made. Once through the hole, drilling of the far cortex was done with small drill bit (3.5 mm). With the depth gauge the length of the screw was measured. Then insertion of appropriate sized cortical screws was done with the help of hex driver. Using the same principles rest of the screws was inserted. Postoperatively limb was elevated on a pillow keeping the knee in slight flexion. The patients started isometric quadriceps exercises after 24 hours of operation. After 48 hours, drain was removed. The patient were allowed to move out of bed using crutches and without bearing weight on the operated limb and passive range of motion was started. Stitches were removed on the 10th postoperative day. Postoperatively antibiotics were given routinely for 2 weeks in all cases. Patients were discharged with the advice to walk on crutch bearing no weight on the affected side for 6 weeks and then to report to the out-patient department. At 6 weeks a check x-ray was done. If there was radiological evidence of healing (callus), patient was allowed to touch the toe and gradually bear some weight, but never more than half. At 12 weeks further review was done. A check x-ray was routinely done and in most of the cases full weight bearing was allowed on the operated limb. Usually rods and screws are to be removed between eighteenth and twenty-fourth postoperative months. All the patients were followed-up for at least six months, up to a maximum of eighteen months. Duration of hospital stay in this series was 2-4 weeks. The results were designated as excellent, good, fair and poor according to the alignment of fracture, the range of motion of the ipsilateral knee, stability of the knee and the degree of pain. An excellent result meant that the patient had full, pain free function of the extremity. In patients who would have had a good result, has some restriction of knee movement but simultaneous malalignment and some restriction of knee motion caused it to be downgraded to fair. Fair result was downgraded to poor if there were significant pain, instability and deformity of knee [8].

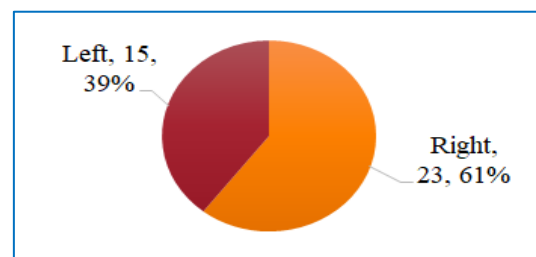
**RESULT**

In this study in total 38 cases were finally evaluated. All the patients were resuscitated, properly investigated, treated with retrograde short SIGN interlocking femoral nailing and followed up for at least 6 months and maximum up to 18 months. The participants were selected from several ages' groups. Out of total 38 cases, 27 (71%) were male and the rest

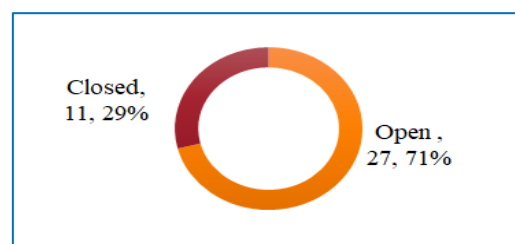
11 (29%) were female. So, the male-female ratio was 2.45:1. The highest number of the participants of this study were from 21-30 years' age group which was 34%. In this study we found the highest number of patients had right side involvement which was 61%. Most of the fractures were open type which was 71%. In analyzing the mechanism of injury, we observed that, the highest percentage (39.47%) of participants had sustained high-energy trauma while only 5.26% suffered from low-energy trauma. In this study 53%, 31%, 16% participants taken <1, 1-2 and >3 weeks respectively between injury and fixation of fracture. In analyzing the duration of hospital staying of the participants we observed 66% patients stayed for 2-3 weeks whereas 34% stayed for >3 weeks in the hospital. In this study we observed 28 patients (73.68%) had union in due time, 8 patients (21.05%) had delayed union and 2 patient 5.26% developed non-union. In analyzing the complications among the participants, we observed, the highest numbers of participants suffered from superficial infection which was associated in 6 (15.79%). Besides this, 13.16%, 7.89%, 5.26% and 2.63% participants suffered from knee stiffness, anterior knee pain, shortening and screw loosening respectively. As final outcome of this study we found 'Excellent', 'Good', 'Fair' and 'Poor' results among 52.63%, 31.58%, 10.53%, 5.26% patients respectively. So, the satisfactory (Excellent and good) results were found among 84% and unsatisfactory (Fair and poor) results were found among 16% patients.

**Table-1: Mechanism of injury among participants (n=38)**

Age (Year)	n	%
≤20	3	7.89
21-30	13	34.21
31-40	10	26.32
41-50	6	15.79
51-60	4	10.53
>60	2	5.26
Total	38	100



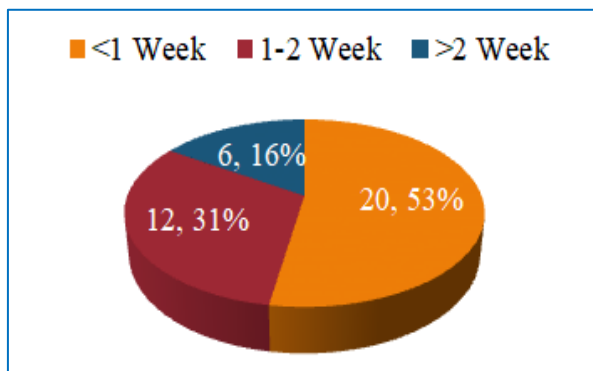
**Fig-1: Distribution of side involvement (n=38)**



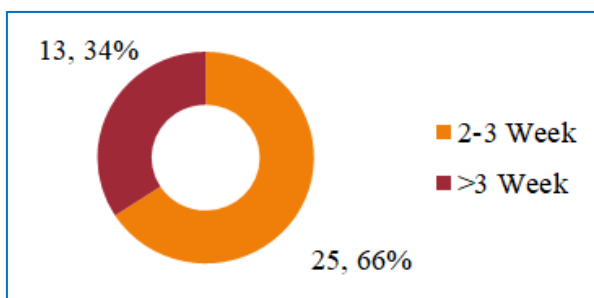
**Fig-2: Types of fracture among the participants (n=38)**

**Table-2: Mechanism of injury among participants (n=38)**

Mechanism	n	%
High-energy trauma	15	39.47
RTA	10	26.32
Fall from height	6	15.79
Sports injury	5	13.16
Low-energy trauma	2	5.26
Total	38	100



**Fig-3: Distribution of time interval between injury and fixation of fracture (n=38)**



**Fig-4: Duration of hospital staying (n=38)**

**Table-3: Types of union (n=38)**

Type of Union	n	%
Union	28	73.68
Delayed Union	8	21.05
Non-union	2	5.26
Total	38	100

**Table-4: Complication among participants (n=38)**

Complications	n	%
Superficial infection	6	15.79
Knee stiffness	5	13.16
Anterior knee pain	3	7.89
Shortening	2	5.26
Screw loosening	1	2.63

**Table-5: Distribution of final outcomes (n=38)**

Results	n	%
Excellent	20	52.63
Good	12	31.58
Fair	4	10.53
Poor	2	5.26

## DISCUSSION

The aim of this study was to evaluate the management and effectiveness of retrograde short SIGN nail in treating supracondylar femoral fractures (Type III, Neer and associate’s classification). Management of distal femoral fracture has historically been difficult. This challenging circumstance was dealt with by various authors with various methods at different times. Numerous investigators have reported the results of reamed interlocking nailing in distal third femoral fractures<sup>9</sup>. Comparison among these studies is often difficult and wide variations frequently exist. Discrepancies may be attributed to factors including patient selection, various methods of rehabilitation after injury, and differences in length of follow-up. Patients in various clinical series also differ not only with respect to the severity of these injuries or the presence of concomitant injuries, but with regard to age, sex, lifestyle and level of activity. In the present series, the mean age of the participants was 36.50 years. Similar findings were also been noted by Tornetta and Tiburzi<sup>10</sup> where the average age of the patients were 38 years and 39 years respectively. When compared to sex as male-female ratio, the incidence of series of Ricci *et al.*, [11] was 8:3 and it was 6:1 in this series. In analyzing the mechanism of injury of this current study, we observed that, the highest percentage (39.47%) of participants had sustained high-energy trauma while only 5.26% suffered from low-energy trauma. Only 14.29 % of distal femoral fractures occurred due to low energy trauma as a result of domestic fall or other accidents. In the series [11], high velocity traumas accounted for 76 % in distal third femoral fractures. Supracondylar nailing was initially introduced for the treatment of low femoral shaft fractures. Due to distal position of the interlocking screw; they were later used for distal femoral fractures. Moreover in cases of severe metaphyseal comminution, supracondylar nailing offers more biological fixation. Interlocking intramedullary nailing is especially advantageous in comminuted fractures that has tendency towards rotational instability and shortening in the capacious area of distal third femoral shaft. The results of the present series were comparable with the reports of retrograde interlocking in distal third femoral fractures [11]. This series had a few problems of mal-alignment as those reported by Ricci *et al.*, [11]. Varus and valgus angulations (4.4%) were 5 degrees and 7 degrees respectively in the series [11] did not find any mal-union in their series. The experience regarding this series was minimum and the follow-up period was also short compared to the above-mentioned series, though the problems of malalignment were not as much as the series of Handolin [12] who showed average 9 degrees of varus deformity. Ostrum *et al.*, [13] did not find shortening in their series. In our study, shortening of femur developed in 2 patients (13%) of 0.5 cm (case no. 2, 3, 7, 10) and 2 cm (case no. 14). There were some degrees of comminution in all these cases. In our study, 6 patients (15.79%) developed superficial surgical wound infection. The infection was

treated by local wound dressing; pus was sent for culture and sensitivity, which yielded growth of *Staphylococcus aureus* in case no. 2, mostly resistant to crystalline penicillin, ampicillin, amoxicillin, cloxacillin, co-trimoxazole. *Staphylococcus aureus* was sensitive to ciprofloxacin, gentamycin and cephalixin. In our study, postoperatively all patients were in close supervision. In this series, manipulation of two knees under G/A was done after 12 weeks due to stiffness. None of the cases had received physiotherapy under the supervision of physiotherapist. One patient gained 120 degrees range of knee motion after manipulation. Ricci *et al.*, [11] manipulated knee in two patients due to knee stiffness in their series. The mean range of knee motion was 123.8 degree in the series of Saw and Lau [14]. In the series [15] range of knee motion was average 117 degrees. In case of Ostrum *et al.*, [13], average range of knee motion was 120 degrees. The mean range of knee motion in this series was 122.7 degrees. We got better range of motion due to our fracture type and setting the early range of motion just after removing the drain and gaining about 90 degree of motion before discharge. More than 90 percent of the fractures were united in this series and were capable of full weight bearing. The fracture union was defined as the period between injury and full weight bearing. Roentgenographically healed fracture was characterized by cortical bridging in two views. Period of fracture healing was 14 to 28 weeks (average 18.5 weeks) in this series. Period of fracture healing was average 22.4 weeks in the series [13], average 13.1 weeks were in the series [10], 17.5 weeks in the series [12] and 17.6 weeks in the series [14]. In our study nonunion occurred in 2 patients. There was severe comminution at the fracture ends. The patient ended up with implant failure. This patient was then managed by curettage of fibrous tissue from the fracture site followed by bone grafting and fixation with retrograde long SIGN nail. Tornetta and Tiburzi [10] did not find any nonunion in their series. But Ricci *et al.*, [11] found nonunion of 6%, 6% and 4.7% cases respectively in their series. Delayed union occurred in 21% patients in this series and ultimately needed prompt healing. Ostrum *et al.*, [13] found delayed union in a few fractures in their series and Ricci *et al.*, [11] found 17% cases of delayed union and Handolin *et al.*, [12] noted 10.9% of delayed union in their series. In this series some of the patients complained mild to moderate type of pain over the thigh and ipsilateral knee after operation and improved after union of bone. One patient complained of constant pain at the fracture site and knee. Ricci *et al.*, [11] found minor knee pain in some patients of their series. Handolin *et al.*, [12] noted anterior knee pain in 22.72% of patients in their series. In final follow-up, the satisfactory result (excellent and good) of this series was 84%. Satisfactory result of Leggon and Feldmann [15] was 90%.

## CONCLUSION AND RECOMMENDATIONS

Among existing several procedure retrograde short SIGN nail is a reliable alternative, when options in the treatment of supracondylar femoral fractures are considered. The rate of union is high, with low incidence of complications. The simplicity of this method also facilitates fracture fixation in patients with multiple trauma. There were minimal soft tissue disruptions and good purchase of the distal bone fragment and stable fracture fixation with this method, allowing early joint mobilization. This was a single centered study with a small size sample. So the findings of this study may not reflect the exact scenario of the whole country. For getting more specific results we would lie to recommend for conducting similar more studies in several places with larger size sample.

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**Conflict of interest:** None declared

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