Annals of International Medical and Dental Research
E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-7, Issue-4 | July-August, 2021
Page no- 247-257 | Section- Research Article (Orthopedic)

Management of Supracondylar Fracture of Femur with Retrograde Short SIGN Nail

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Received: May 2021
Accepted: June 2021

Abstract

Background: Basically knees are the largest weight-bearing joints in the human body. The distal femur articulates with upper tibia at knee joint. Supracondylar fracture of the femur which is also known as fracture of distal femur. On the other hand, retrograde femoral nailing can be defined as a nailing starting from the intercondylartossa of distal femur. Aim of the study: The aim of this study was to assess the effectiveness of retrograde short SIGN nail in the management of supracondylar femoral fractures (Muller Type Al, A2 and A3). **Methods:** This was a prospective observational study that was carried out at the National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, during the period from January 2003 to December 2004. In total 14 patients with supracondylar femoral fractures of Muller type Al, A2 and A3 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. All relevant statistical analysis of different variables was analyzed according to standard statistical methods. **Results:** In this study, we found 11 patients (78.57%) had a union in due time, 2 patients (14.29%) had delayed union, and 1 patient (7.14%) developed non-union. We found 6 patients (42.86%) had a full range of knee movement, 4 patients (28.57%) had knee motion between 110-130 degrees, and another 3 patients (28.57%) had knee movement between 90-110 degrees. In this series, we observed some complications. Nonunion and implant failure 1(7.14%), delayed union 2(14.29%), superficial infection 2(14.29%), and mild deformity 5(35.71%) were encountered in some of our cases. In analyzing final outcome of this study we found 85.71% satisfactory (excellent and good) and 14.29% unsatisfactory (fair and poor) results. **Conclusion:** 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 a 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.

Keywords: Supracondylar Fracture, Femur, Retrograde Short SIGN Nail, Orthopedics.

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INTRODUCTION

Basically, the knees are the largest weight-bearing joints in the human body. The distal femur articulates with the upper tibia at the knee joint. Supracondylar fracture of the femur which is also known as fracture of distal femur occurs when the femur is broken at just above the knee. On the other hand, retrograde femoral nailing can be defined as an intramedullary nailing with intra-articular starting point, or any femoral nailing technique with a distal entry from the condyles. Dynamism is the basis of evolution. Constant changes are occurring everywhere until and unless the outcome meets the expectation. It is also true for the management of distal femoral fracture. As these fractures are high-energy trauma and their proximity to the knee joint makes its management difficult and challenging job for orthopedic surgeons. The topic has been controversial since the publication by Templeman.[1] The incidence of malunion, nonunion, and infection is relatively high in many reported series.[2] Ambulation with full weight-bearing takes 3-6 months and many patients are not satisfied with being incapacitated for this prolonged period of time. Even minor degrees of shortening and malalignment can eventuate in limp and post-traumatic arthritis.[3] 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 outlined 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 the 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 recent past years, we have C-arm at the NITOR. This nail is being in use in other parts of the world (India, Vietnam, Myanmar, etc.) and similar types of nails are used by various investigators6 to treat a 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 fracture are increasing. So this study may bring about the newer management technique in our

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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 effectiveness of retrograde short SIGN nail in the management of supracondylar femoral fractures (Muller Type Al, A2 and A3).

Specific Objective:

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

MATERIALS & METHODS

This was a prospective observational study that was carried out at the National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, during the period from January 2003 to December 2004. In total 14 patients with supracondylar femoral fractures of Muller type Al & A2 and type-A3 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 the femur is made from the findings of (a) pain, (b) thigh swelling, (c) deformity, and (d) roentgenograms. The circulation and motor function of the extremity were documented and a careful search was 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 the 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.[7] Skeletal tractions is applied to restore length at the fracture site and the limb is rested on a 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 the alignment of the extremity. According to the inclusion criteria of the study patients with supracondylar fractures of the femur, fresh injuries and less than three weeks old, closed fractures, fractures with distal epiphyseal fusion, and Muller type Al, A2, and A3 Supracondylar fracture were included. On the other hand, according to the exclusion criteria of the study patients with open fractures, fractures 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 the injury, side involved, the 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. The supine position is easier to

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achieve fracture reduction and estimation of rotational alignment. This is also a safe position for multiple injured patients. The leg was draped free and the knee was flexed at 60-90 degrees by the side of the table and 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. Factures was reduced and intramedullary y earning was done.The jig was attached to the T-handle using a shoulder bolt and hex wrench. The cannula was placed through the distal jig hole to mark where the incision was to be made through the skin. After retraction of the cannula, an incision was made on the skin. The drill was placed through the cannula. The canula and drill guide were placed next to the bone. A 25 inch (6.5 mm) drill bit was inserted through the cannula. A hole in the near cortex of the bone was made. Once through the hole, drilling of the far cortex was done with a small drill bit (3.5 mm). A soft finder was used to confirm that drill was through. With the depth gauge, the length of the screw was measured. Then insertion of appropriate sized cortical screws was done with the help of a hex driver. Using of the same principles rest of the screws were 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, a drain was removed. The patient was 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 a crutch bearing no weight on the affected side for 6 weeks and then to report to the out-patient department of NITOR. At 6 weeks a check x-ray was done. If there was radiological evidence of healing (callus), the 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 all of the cases, full weight-bearing was allowed on the operated limb. Usually, rods and screws are to be removed between the eighteenth and twenty-fourth postoperative months. All the 14 patients were followed-up for at least six months, up to a maximum of eighteen months. The 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, have some restriction of knee movement but simultaneous malalignment and some restriction of knee motion caused it to be downgraded to fair. The fair result was downgraded to poor if there were significant pain, instability, and deformity of the knee.[8]

RESULT

In this study total of 15 patients were selected for this study, but out of these, only one case was lost during follow-up. So, the remaining 14 cases were finally available for evaluation. All the patients were resuscitated, properly investigated, treated with retrograde short SIGN interlocking femoral nail, and followed

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Page no- 247-257 | Section- Research Article (Orthopedic)

up for at least 6 months and maximum up to 18 months. The range of age of the patients was 20-70 years (mean 37.5 yrs.). The majority of the patients belonged to the age group 20- 29 years (35.71%). Out of a total of 14 cases, 12(85.71%) were male and 2(14.29%) were female. The male-female ratio was 6.0:1. In this study, we found the highest number of patients had right side involvement which was 71.43%. In analyzing the mechanism of injury, we observed that the highest percentage (85.71%) of participants had sustained high-energy trauma while only 14.29% suffered from low-energy trauma. In this study six patients (42.86%) had Muller type Al fracture, five patients (35.71%) had A2 and three patients (21.43%) had A3 type of fracture. In this study 57.14%, 28.57%, 14.29% of participants taken<1, 1-2, and 2-3 weeks respectively between injury and fixation of the fracture. In analyzing the duration of hospital staying of the participants we observed 10 (71.43%) patients stayed for 2-3 weeks whereas 4 (28.57%) stayed for more than 2-3 weeks in the hospital. In this study we found 11 patients (78.57%) had a union in due time, 2 patients (14.29%) had delayed union, and 1 patient (7.14%) developed non-union. We found 6 patients (42.86%) had a full range of knee movement, 4 patients (28.57%) had knee motion between 110-130 degrees, and another 4 patients (28.57%) had knee movement between 90-110 degrees. In this study we observed 8 (57.14%) patients returned to full primary activity, 2(14.29%) patients returned to pre-injury activity with mild limitation, 3(21.43%) patients could perform routine activities with moderate symptoms, and 1(7.14%) patient was unable to perform routine activities. In analyzing final outcome of this study we found 85.71% satisfactory (excellent and good) and 14.29% unsatisfactory (Fair and poor) results.

In this series, we observed some complications. Nonunion and implant failure 1(7.14%), delayed union 2(14.29%), superficial infection 2(14.29%), and mild deformity 5(35.71%) were encountered in some of our cases.

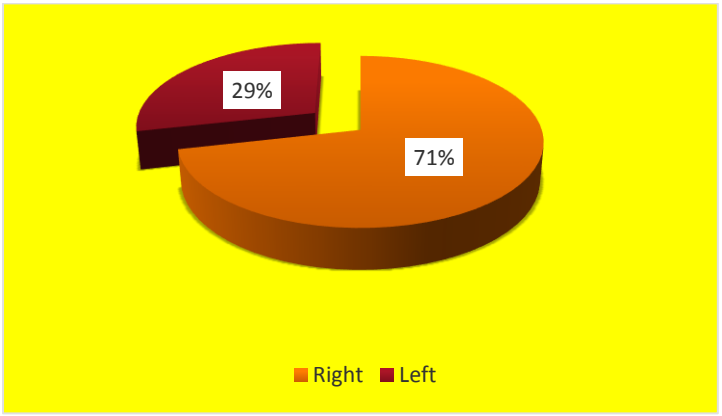

Figure I: Distribution of side involvement (N=14)

Table I: Mechanism of injury among participants (N=14)

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Vol-7, Issue-4 | July-August, 2021
Page no- 247-257 | Section- Research Article (Orthopedic)

Injury types			Mechanism of injury		
	n	%		n	%
High-energy trauma	12	85.71	Motor vehicle accident	5	35.72
			Motor cycle accident	2	14.29
			Auto-pedestrian accident	3	21.42
			Fall from height	2	14.29
Low-energy trauma	2	14.29	Fall from bed	1	7.14
			Fall on slippery ground	1	7.14
Base	14	100.0		14	100.0

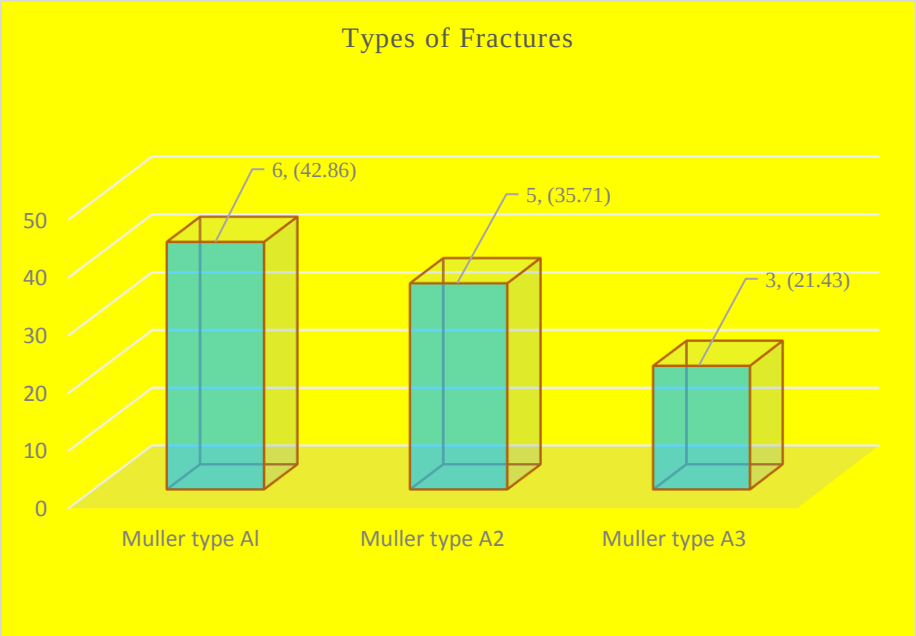

Figure II: Types of fractures (N=14)

Table II: Distribution of time interval between injury and fixation of fracture (N=14)

Time interval (wks.)	n	%
<1	8	57.14
1-2	4	28.57
2-3	2	14.29
Base	14	100.0

Table III: Duration of hospital stay (N=14)

Hospital stay (weeks)	n	%
2-3	10	71.43
3-4	4	28.57
Base	14	100.0

Table IV: Types of union (N=14)

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Vol-7, Issue-4 | July-August, 2021
Page no- 247-257 | Section- Research Article (Orthopedic)

Type of union	n	%
Union	11	78.57
Delayed union	2	14.29
Non union	1	7.14
Base	14	100.0

Table V: Range of knee motion among participants (N=14)

Range of knee motion	n	%
90°- 110°	4	28.57
110°-130°	4	28.57
130°-145°	6	42.86
Base	14	100.0

Table VI: Assessment of activity level of participants (N=14)

Activity level	n	%
Returned to pre-injury Activities	8	57.14
Pre-injury activities with mild limitations	2	14.29
Routine activities with moderate symptoms	3	21.43
Unable to perform routine activities	1	7.14
Base	14	100.0

Table VII: Complication among participants (N=14)

Complications	n	%
Non-union with implant failure	1	7.14
Delayed union	2	14.29
Superficial Infection	2	14.29
Deformity	5	35.71

Table VIII: Distribution of final outcomes (N=14)

Results	Total (n)	Grade (n)			%
		Al	A2	A3	
Excellent	7	5	2	0	50.0
Good	5	1	3	1	35.72
Fair	1	0	0	1	7.14
Poor	1	0	0	1	7.14
Base	14	6	5	3	100.0

DISCUSSION

The aim of this study was to assess the effectiveness of retrograde short SIGN nail in the management of supracondylar femoral fractures (Muller Type Al, A2 and A3). 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

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E-ISSN: 2395-2822 | P-ISSN: 2395-2814
Vol-7, Issue-4 | July-August, 2021
Page no- 247-257 | Section- Research Article (Orthopedic)

distal third femoral fractures.[9] Comparison among these studies is often difficult as 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 age of the patients varied from a minimum of 20 years to a maximum of 69 years, the mean age being 37.5 years. Similar findings were also being noted by Tornetta and Tiburzi[10] where the average age of the patients was 38 years and 39 years respectively. When compared to sex as the male-female ratio, the incidence of series of Ricci et al.[11] was 8:3 and it was 6:1 in this series. Regarding the nature of trauma resulting in distal femoral shaft fractures; it was found that the majority (85.71%) occurred due to high energy trauma. Out of 85.71 percent, 35.72% and 21.43% of fractures of distal femur occurred due to motor vehicle and auto-pedestrian accidents respectively. Only 14.29 % of distal femoral fractures occurred due to low energy trauma as a result of domestic falls 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 the 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 have a tendency towards rotational instability and shortening in the capacious area of the 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 malalignment 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 malunion in their series. In this series 3 patients (Case no. 2, 10, 11) developed posterior angulations of 5 degrees. And case no. 14 developed 10 degrees' valgus deformity. 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 an average of 9 degrees of varus deformity. Ostrum et al.[13] did not find shortening in their series. In this study, shortening of femur developed in four patients 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. Two patients (14.29%) developed superficial surgical wound infection: both at the thigh. 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 cephalexin. Culture of wound swab from case no 14 yielded growth of mixed bacteria (Staphylococcus aureus and Pseudomonas), mostly resistant to crystalline penicillin, ampicillin, amoxicillin, cloxacillin, co-trimoxazole. They were sensitive to ceftazidime, gentamycin, and netilmycin. In

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Vol-7, Issue-4 | July-August, 2021
Page no- 247-257 | Section- Research Article (Orthopedic)

this series, we did not find any knee sepsis. Both the patients responded well to antibiotics used according to the culture and sensitivity report and healed quickly. Handolin[12] noted superficial infections in 3 of his 46 cases (6.52%). did not find any infection in their series. In this series, all cases had closed fractures and antibiotics (3rd generation cephalosporin) had been started preoperatively and continued postoperatively for 2 weeks. Postoperatively all patients were under 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 a physiotherapist. One patient (case no. 4) gained 120 degrees range of knee motion after manipulation. Ricci et al.[11] manipulated the knee in two patients due to knee stiffness in their series. Regarding the range of knee motion, six (42.86%) patients had almost full range of motion, four (28.57%) patients had an average range of knee motion between-130 degrees and another four (28.57 %) patients had an average range of knee motion between 90-110 degrees. The mean range of knee motion was 123.8 degrees in the series of Saw and Lau.[14] In the series[15] range of knee motion was average 117 degrees. In the case of Ostrum et al.[13] average range of knee, the motion was 120 degrees. The mean range of knee motion in this series was 122.7 degrees. We got a 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 degrees of motion before discharge. Ninety 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. The period of fracture healing was 14 to 28 weeks (average 18.27 weeks) in this series. The period of fracture healing was average 22.4 weeks in the series,[13] an average of 13.1 weeks was in the series,[10] 17.5 weeks in the series[12] and 17.6 weeks in the series.[14] Nonunion occurred in one patient. 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%, and 4.7% cases respectively in their series. Delayed union occurred in 2(14.28%) patients (case no 3&7) in this series and ultimately needed dynamization for 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 the delayed union in their series. In this series, some of the patients complained of mild to moderate type of pain over the thigh and ipsilateral knee after the operation and improved after the union of bone. One patient (case no. 14) complained of constant pain at the fracture site and knee. Ricci et al.[11] found minor knee pain in some patients of their series. Handling et al.[12] noted anterior knee pain in 22.72% of patients in their series. In the final follow-up, the satisfactory result (excellent and good) of this series was 85.71%. The satisfactory result of Legion and Feldmann[15] was 90%. This study was done on fourteen patients and the follow-up period was short (average 11.5 months). So, further prospective study, a larger sample, and a longer period of follow-up is required to

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E-ISSN: 2395-2822 | P-ISSN: 2395-2814
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Page no- 247-257 | Section- Research Article (Orthopedic)

delineate the long-term outcome of the knee joint function.

CONCLUSION

In conclusion, retrograde short SIGN nail is a reliable alternative, when options in the treatment of supracondylar femoral fractures are considered. Despite the fact that at the start of our learning curves we performed the operations, the average clinical and radiological results were encouraging. 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. The rate of union is high, with a low incidence of complications. The simplicity of this method also facilitates fracture fixation in patients with multiple trauma. However, little is known about the long-term effect of trans-articularly inserted retrograde femur implants. So, long-term follow-up and large-scale studies are needed to evaluate the final effect of this procedure.

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Source of Support: Nil, Conflict of Interest: None declared

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