

COMPARISON OF CLOSED AND OPEN INTERLOCKING NAILING TECHNIQUES IN FEMORAL SHAFT FRACTURES

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ABSTRACT: BACKGROUND: Femur is the largest bone of the body and one of the principal load-bearing bones in the lower extremity, fractures can cause prolonged morbidity and extensive disability unless treatment is appropriate. The fracture can be surgically treated either by closed interlocking nailing without opening the fracture site or open interlocking nailing by opening the fracture site. The aim of this study is to compare bone healing and functional outcome in diaphyseal fracture of femur treated with open and closed interlocking nailing.

MATERIALS & METHODS: It is a comparative prospective study. Hundred and six fractures of femur were treated with interlocking nails. Closed nailing was done in 57 patients. Open nailing was done in 49 patients. Both groups were compared with respect to functional outcome and radiological union at the end of one year. Statistical analysis was done by using Chi Square Test.

RESULTS: In our study average time for radiological union was 22.64 weeks for closed nailing and 24.21 weeks for open nailing. Functionally 92.98% of closed group and 83.67% of open group had excellent to good outcome. There is no statistically significant difference between the two groups. Complications were almost same in both groups.

CONCLUSION: Interlocking intramedullary nailing is an effective and a successful method of treatment in the diaphyseal fractures of femur. Interlocking nail provides stable fixation and rotational stability. Both open and closed techniques of interlocking nailing show comparable results in terms of union and function with open technique having some specific advantages especially in less equipped centres..

KEYWORDS: Shaft of Femur Fractures, Open and Closed Interlocking Nailing, Radiological Union, Functional Outcome.

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INTRODUCTION: Fractures of the shaft of the femur are among the most common fractures encountered in orthopaedic practice. Because the femur is the largest bone of the body and one of the principal load-bearing bones in the lower extremity, fractures can cause prolonged morbidity and extensive disability unless treatment is appropriate.¹ Patient survival and outcomes have continued to improve with the introduction of intramedullary nailing by Kuntscher during the years surrounding and after World War II.^{2,3,4}

Improved prevention and management of fracture shortening, angulation, infection, and nonunion have made intramedullary nailing the primary treatment for most femoral shaft fractures.^{2,3,4} With a better understanding of nailing techniques, patient mortality and morbidity from pulmonary dysfunction, open wounds, and the frequently associated multiple other injuries have continued to improve.⁵

The fracture can be surgically treated either by closed interlocking nailing without opening the fracture site or open interlocking nailing by opening the fracture site. Closed technique is commonly practiced but, there are still controversies in results obtained by following either technique.

Fracture hematoma has potential osteogenic factors,^{6,7,8} which is evacuated in open nailing. In spite of evacuation of fracture hematoma and periosteal stripping it is fact that open nailed fractures unite by callus formation.^{9, 10}

Hence this study was undertaken to compare the time taken for bone healing and the functional outcome in patients treated with open and closed intramedullary interlocking nailing in diaphyseal fracture of femur.

MATERIALS AND METHODS: This study was conducted in the department of Orthopaedics, Bangalore Medical College & research institute, Bangalore. Between January 2012 & November 2014 106 patients were admitted with closed diaphyseal fracture of femur. AP view of the pelvis and AP and lateral views of the knee along with the entire femur was taken. The patients were in the age group of 18 to 45 years. Open fractures, pathological fractures and patients who suffered from other injuries were excluded from the study. The fractures were classified according to

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the level and pattern of fracture. Closed nailing was done in 57 patients and open nailing was done in 49 patients.

Post-Operative Care and Follow-up: Static quadriceps exercise was started the next post-operative day, suction drain was removed after 48 hours. Hip and knee bending exercises along with quadriceps drill was started. Partial weight bearing was allowed at 4 weeks. Assessment at regular intervals was done at intervals of 6 to 8 weeks up to 12 months. At each follow-up visit, patient was evaluated functionally and radiologically and findings were noted.

Both groups were compared at the end of 12 months with respect to functional outcome by Thoreson's criteria¹¹ and radiological union by Harper M C. criteria.¹²

Data was analyzed using descriptive statistics like mean, percentage and Chi Square Test was used to compare the two groups.

RESULTS: Majority of our patients were in the age group 21-30 years. Male predominance was seen in our study. Comminuted and transverse fractures were the most common fracture pattern. Middle third of shaft femur was found to be the most frequent zone of fracture. Average duration of surgery was 73 minutes in open nailing and 92 minutes in closed nailing. Average duration of C-arm use was 0.9 minutes in closed technique and 0.2 minutes in open technique where distal locking was done under image intensifier, as recorded in the image intensifier.

The average time for radiological union was 22.64 weeks for closed nailing and 24.21 weeks for open nailing. Table 1 shows the breakup of fracture union according to time.

Radiological Union	Closed Technique		Open Technique	
	No. of Patients	Average in weeks	No. of Patients	Average in weeks
Within 16 Weeks	9	15.5	2	16
17-24 Weeks	46	22.42	43	23.13
25-52 Weeks	2	30.00	4	33.5
Average	22.64		24.21	

Table 1: Time of Union

Majority of the fractures united between 17-24 weeks, with 46(80.70%) patients in closed nailing and 43 (87.75%) patients in open nailing showing union within that period. Table 2 shows the breakup of rate of union.

Radiologic Union	Closed Technique		Open Technique	
	No. of Patients	%	No. of Patients	%
Within 16 Weeks	9	15.78	2	4.08
17-24 Weeks	46	80.70	43	87.75
25-52 Weeks	2	3.50	4	8.16

Table 2: Rate of Union



Fig. 1(a) Fracture Shaft of Femur



Fig. 1(b) Treated with Interlocking Nailing



Fig. 1(c) Fracture Union



Fig. 1 (d) Functional outcome

In our study, 68.42% of patients had excellent, 24.56% good & 7.02% fair functional outcome in closed nailing according to Thoreson’s criteria. In open nailing 55.10% of patients had excellent, 28.57% good & 16.33% fair functional outcome. Table 3 shows the results of functional outcome.

Functional Outcome	Closed technique		Open technique	
	No. of Patients	%	No. of Patients	%
Excellent	39	68.42	27	55.10
Good	14	24.56	14	28.57
Fair	4	7.02	8	16.33
Poor	0	0	0	0

Table 3: Functional Outcome

The difference in radiological and functional outcome between the closed and open nailing groups was statistically not significant.

Complications were almost same in both groups. There was no deep infection. There were 4(8.16%) cases of superficial infection in each group which subsided with antibiotic treatment. Shortening was found in 7(12.28%) patients in closed nailing and 5(10.20%) patients in open nailing. Mal-alignment was encountered in 6(10.52%) patients in closed nailing and 3(6.12%) patients in open nailing. Two patients in closed group and four patients in open group had delayed union. Table 4 shows the complications associated with closed and open nailing.

Complications	Closed technique		Open technique	
	No. of Patients	%	No. of patients	%
Superficial Infecion	4	8.16	4	8.16
Deep Infection	0	0	0	0
Shortening	7	12.28	5	10.20
Malalingnm ENT	6	10.52	3	6.12
Delyed Union	2	3.50	4	8.16

Table 4: Complications

DISCUSSION: Diaphyseal fractures of the femur are common encounters in traumatology. These fractures are predominantly seen in active adults following road traffic accidents. Treatment focuses on achieving perfect alignment of fractures and early ambulation. Closed and

open interlocking nailing are the two widely used modalities of treatment for fixation of these fractures. Looking at history we know that closed nailing was conceived first and later the open nailing. Quickly open nailing was abandoned for closed nailing with sophistication of equipment and operative techniques.^{2,3,4} Closed nailing preserves the fracture hematoma, periosteal stripping is not necessary, hence preserves the periosteal blood supply. However, Court Brown et al opined in his study that the insertion of distal transverse transfixion screws does involve some increased exposure to irradiation, though this is small, and the “freehand technique” should be practiced with lead glove protection to minimize the risk. The operation is somewhat complex and requires considerable experience.¹³

Open nailing has the advantage of precise reduction of fracture fragments under direct vision, hence minimal mal-alignment. Less expensive equipment is required than is needed for closed nailing. No fracture table is required. No image intensifier is required.

According to literature open nailing has few disadvantages. Fracture hematoma, which is important in fracture healing, is evacuated. Bone shavings created by reaming the medullary canal often are lost. Infection rate is increased. Rate of union is decreased. If a locking nail is used, locking is difficult without image intensification.¹

At present closed interlocking nailing is an accepted modality of treatment for femoral shaft fractures. Open nailing was given up as high rates of infection and extensive surgery were noticed. But recently with the development of potent antibiotics, surgical asepsis and meticulous dissection, these fallacies can be overcome.

Periosteal stripping and evacuation of fracture hematoma decrease the formation of periosteal callus. It is interesting to note some studies in literature regarding blood supply to femur. Histological evidence suggests that inner 2/3rd of diaphysis is supplied by medullary arteries and the outer 1/3rd by periosteum.^{8,14,15,16} Some studies suggest that entire thickness is supplied by medullary vessels.^{8,17} Periosteal stripping does not significantly decrease blood flow in middle layer of diaphyseal cortex. Endosteal and periosteal blood vessels are anastomotic and are capable of sustaining adequate circulation to diaphysis,⁸ Fracture hematoma has potential osteogenic factors^{6,7,8} which is evacuated in open nailing. In spite of evacuation of fracture hematoma and periosteal stripping it is fact that open nailed fracture unite by callus formation.^{9,10} Experimental studies also show that reaming and intramedullary nailing reflexly increases the blood flow in the facultative extra periosteal circulation. Hence exuberant callus forms in open nailed fractures.⁹

There are few studies which compare closed interlocking and open interlocking nailing techniques. Leighton RK et al compared open versus closed intramedullary nailing of femoral shaft fractures in a retrospective study and concluded there is no statistical difference between the two groups.¹⁸

R C Meena et al have compared closed and open interlocking nailing. They concluded that benefits derived from open interlocking of fracture long bones can be applied at the very basic level of Indian health infrastructure where the facilities of IITV and surgical expertise are still lacking. Considering the over increasing load of fracture long bones, the results are comparable to that of closed nailing and has benefits on surgeon and patients more suiting the Indian health infrastructure.¹⁹

Nitin Kimmatkar et al concluded that open or closed femoral intramedullary nailing should be based on type of fracture and its pattern of injury, equipment and instruments available and most certainly the experience of surgeon. Closed intramedullary nailing is for treatment of diaphyseal femur fractures in patients with poly-traumatic injuries. Open nailing should be tried in case where an adequate reduction cannot be achieved by closed methods.²⁰

Though incidence of infection was believed to be more with open technique, there were no deep infections in our study. There were 4(8.16%) cases of superficial infection in each group which subsided with antibiotic treatment. Shortening was found in 7(12.28%) patients in closed nailing and 5(10.20%) patients in open nailing. Mal-alignment was encountered in 6(10.52%) patients in closed nailing and 3(6.12%) patients in open nailing.

In our study average time for radiological union was 22.64 weeks for closed nailing and 24.21 weeks for open nailing. Functionally 92.98% of closed group and 83.67% of open group had excellent to good outcome. There is no statistically significant difference between the two groups.

In a study by R C Meena et al (2006) 50 patients out of 62 in open nailing and 42 patients out of 46 in closed nailing showed fracture union.¹⁹

Nitin Kimmatkar et al 2014, in three years' time 272 femoral shaft fractured patients were admitted out of which 162 were closed type and 110 patients in whom open nailing was tried. 246 fracture femurs healed in a time period of six months. Range of knee flexion was full in over 90% of cases.²⁰

Femoral shaft fractures treated with open technique of interlocking nailing show union rates comparable to that of closed technique while retaining advantages of shorter surgical duration, better fracture alignment and less radiation exposure, when used in specific circumstances.

CONCLUSION: Interlocking intramedullary nailing is an effective and a successful method of treatment in the diaphyseal fractures of femur. Interlocking nail provides stable fixation and rotational stability. Both open and closed techniques of interlocking nailing show comparable results in terms of union and function with open technique having some specific advantages especially in less equipped centres.

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