

Outcome of Early Closed Interlocking Intramedullary Nailing in Diaphyseal Fractures of Femur

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ABSTRACT

Background: The femur is the strongest bone in the body. Fracture femur results from the drawbacks of fast life and violence more frequently as a result of road traffic accidents. Younger working people are more and more falling prey to such high velocity accidents and subsequent disabilities. Femoral shaft fractures are responsible for a huge burden of morbidity and mortality in patients. Though there are many treatment options but interlocking intramedullary nailing is a good treatment option for femoral diaphyseal fracture. So our aim to find out the outcome of diaphyseal fracture of femur treated by closed reduction with internal fixation by interlocking intramedullary nail. **Methodology:** This prospective observational study done at Department of Orthopaedic surgery, Dhaka Medical College Hospital, total 19 patient was selected fulfilling the inclusion and exclusion criteria. Closed Intramedullary Interlocking nailing done in all patient within 7 to 10 days of admission and all patient followed up at 2nd, 6th, 12th and 24th week both clinically and radiologically and result calculated by Friedman and Wyman scoring system. **Results:** Out of 19 patients male are 15 (78.9%) and female are 4 (21.1%) mean age are 32.84 ranging from 18 to 60 years. RTA is the dominant cause of injury about 73.7% (14) then fall from height are 15.8% (3) and assault 10.5% (2). Interval between injury and operation average 7.36±1.23 days Day ranging from 5 to 10. Operation time required from 80 to 120 minutes. Mean union time is 14.05+/- 1.21 weeks. Out of 19 patient, 17 united uneventfully which is 89.5% one patient need dynamization and one lost follow-up. After calculation by Friedman and Wyman scoring system result found good in 89.5%. **Conclusion:** In the light of the findings of the study, it can be concluded that early closed Intramedullary interlocking nailing is a very effective, successful and time-tested method of treatment for diaphyseal fractures of femoral shaft. However, limitations of the study suggests that a more extensive, long term and multi centric study with better facility is needed to the confirm or discard above statement.

Keywords: Femoral shaft fracture; Interlocking intramedullary nail; Closed intramedullary nailing; Diaphyseal fracture; Early fixation; Fracture union; Functional outcome; Friedman and Wyman scoring system; Orthopaedic trauma; Bangladesh.

INTRODUCTION

Fractures of femoral shaft are among the most common fractures that orthopaedic surgeons encounter, because these fractures most often result

from high energy trauma, they are often associated with concomitant injury of internal organs. Fracture femur results from the drawbacks of fast life and violence and are major source of mortality and

morbidity in patients with such injury.¹ As industrialization and urbanization are progressing year to year with rapid increase in traffic, incidence of high energy trauma increasing with same speed. Femoral shaft fractures result from high energy trauma, commonly road traffic accidents, gunshot injuries, fall from height.² Fractures due to severe trauma are preponderant in young patients and show a predilection for males. This may become important in the economic implications of these injuries to a society such as ours.³ Femoral shaft fractures are common and potentially disabling injuries associated with substantial morbidity because the femur is the principal weight-bearing bone of the lower limb. Their management has evolved considerably from prolonged traction and conservative treatment to modern internal fixation techniques. Treatment options include skeletal traction, traction followed by cast bracing, external fixation, plate-and-screw fixation, and intramedullary nailing. The choice depends on the fracture pattern and location, degree of comminution, patient age, socioeconomic circumstances, and surgeon preference.^{3,4} In many least-developed countries, skeletal traction remains an important treatment method, although prolonged immobilization may be associated with complications such as pin-track infection, malunion, nonunion, thromboembolic disease, and pressure ulcers.⁵ Before the development of intramedullary nailing, prolonged traction, plating, and external fixation were commonly used. The introduction of Sir Gerhard Küntscher's cloverleaf nail represented a major advancement in femoral fracture management. Subsequent development of locking screws led to the concept of interlocking nailing, which is now regarded as the gold standard for femoral shaft fracture fixation.⁶ Closed intramedullary nailing preserves the extra-periosteal soft tissues and biological environment around the fracture and facilitates early mobilization. Early ambulation reduces the complications associated with prolonged recumbency and improves functional recovery.⁷ However, treatment of comminuted fractures initially presented difficulties. Küntscher's "detensor" nail, introduced in 1968, was an important predecessor of the modern interlocking nail. The subsequent development of interlocking systems helped prevent shortening, angulation, and malrotation in comminuted fractures.⁸ The evolution of interlocking nails has greatly expanded the indications for closed intramedullary fixation. Early mobilization after femoral shaft fracture provides advantages in joint mobility and overall functional and economic outcomes.⁹ Intramedullary nailing has been practiced since Hey-Groves inserted an intramedullary nail into the femur in 1921.¹⁶ Improvements in nail design, metallic alloys, surgical techniques, and fluoroscopic guidance have subsequently established intramedullary

interlocking nailing as a preferred treatment for femoral shaft fractures compared with prolonged traction or plate fixation.^{5,6,10} The objective of fracture management is to achieve satisfactory restoration of length and alignment while permitting early mobilization and functional use of the affected limb. Depending on fracture level, pattern, and associated soft-tissue injury, external fixation, plates and screws, conventional intramedullary nails, and interlocking nails may be used.¹¹ Femoral shaft fractures remain a challenging problem in orthopaedic surgery, and the choice and timing of treatment continue to be debated. Appropriate selection of fixation techniques can reduce morbidity, disability, hospital stay, and complications.^{12,2} Intramedullary fixation has become widely accepted for femoral shaft fractures because it provides stable fixation with relatively limited soft-tissue disruption. However, complications such as delayed union and nonunion may still occur after intramedullary nailing.^{3,4,6,9,13-16} The Orthopaedic Trauma Association (OTA) classifies femoral shaft fractures into three principal patterns: simple, wedge, and complex.¹⁷ In multiply injured patients, temporary external fixation may be used before definitive intramedullary nailing.^{18,19} Reamed intramedullary nailing is considered the treatment of choice for most closed and selected open diaphyseal femoral fractures.¹⁻⁶ Since Küntscher's pioneering work on intramedullary fixation, considerable improvements have been made in nail design and operative techniques, while the fundamental principles of intramedullary fixation have remained largely unchanged.²⁰ Locked intramedullary nails have further expanded the indications for femoral shaft fractures, including transverse, oblique, spiral, comminuted, and segmental fracture patterns.²¹ Closed intramedullary nailing offers advantages including reduced surgical dissection, lower infection risk, shorter hospital stay, stable fixation, and improved rehabilitation.¹⁰ Intramedullary interlocking nailing is therefore regarded as the gold standard against which other treatment methods are compared.^{2,6} The timing of surgery may be categorized as immediate (within 72 hours), early (within 7–10 days), or late (after 10 days).³ The present study was undertaken to evaluate the clinical and functional outcome of early closed interlocking intramedullary nailing for femoral shaft fractures and to assess its applicability in the context of Bangladesh.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Orthopaedic Surgery, Dhaka Medical College & Hospital (DMCH), Dhaka, Bangladesh. The study was carried out over a one-year period from July 2018 to July 2019. The study

population comprised adult patients admitted to the Department of Orthopaedic Surgery with closed fractures of the shaft of the femur. Only patients fulfilling the predefined inclusion and exclusion criteria and providing informed written consent were enrolled.

Sample Size and Sampling Technique

The required sample size was initially estimated using the standard formula $n = z^2pq/d^2$. A 95% confidence level was considered, with $z = 1.96$, an estimated prevalence of diaphyseal fracture of the femur of 7%, and an admissible error of 8%. The calculated sample size was 39. However, during the study period, 19 patients with closed fractures of the femoral shaft fulfilled the selection criteria and were enrolled in the study.

Selection Criteria

Patients aged 18–65 years, admitted within 24 hours of sustaining the injury, and diagnosed with a closed fracture of the shaft of the femur were included. Patients were excluded if they had an open fracture, an associated fracture involving another part of the femur, pathological fracture, pregnancy, age below 18 or above 65 years, inability to communicate adequately with the interviewer or unwillingness to participate in the study.

Outcome Measures

The clinical outcome was assessed using the Friedman and Wyman scoring system. The assessment included activities of daily living, pain, and range of motion of the hip and knee. Outcomes were categorized as good, fair, or poor. A good result was defined as no limitation of daily activities, no pain and less than 20% loss of hip or knee movement. A fair result was defined by mild limitation of daily activities, mild-to-moderate pain, and 20–50% loss of hip or knee motion. A poor result was defined as mild limitation of daily activities, mild-to-moderate pain and more than 50% loss of hip or knee motion.

Operative Procedure

On admission, each patient underwent primary survey and resuscitation according to clinical requirements. After haemodynamic stabilization, a secondary survey, thorough clinical examination and radiological evaluation were performed. Upper tibial skeletal traction was applied before definitive surgical intervention. Patients were counselled regarding the operative procedure, expected outcome and study participation and informed written consent was obtained.

Early closed interlocking intramedullary nailing was performed when the patient was considered medically fit for surgery. Under spinal anaesthesia the patient

was positioned supine on a fracture table. Closed reduction was achieved using traction and external manipulation, with fluoroscopic confirmation. A proximal femoral entry point was established near the greater trochanter, followed by insertion of an awl and ball-tipped guide wire. The guide wire was passed across the fracture site into the distal femoral fragment under fluoroscopic guidance. Sequential flexible reaming was performed, followed by insertion of an appropriately sized intramedullary nail. Correct alignment, length, and rotational position were confirmed fluoroscopically. Proximal and distal interlocking screws were subsequently inserted under fluoroscopic guidance. The wound was closed using standard aseptic technique.

Postoperative Management and Follow-up

Following surgery, the operated limb was elevated and patients received intravenous fluids, analgesics, antibiotics and blood transfusion when clinically indicated. Postoperative anteroposterior and lateral radiographs were obtained. Isometric quadriceps exercises were initiated from the first postoperative day, while knee mobilization was encouraged as tolerated. Patients were initially mobilized with crutches without weight-bearing. They were generally discharged on the second or third postoperative day with appropriate advice regarding wound care and follow-up.

Patients were reviewed at 2 weeks for wound assessment and suture or staple removal and subsequently at 6, 12, 16, and 24 weeks. Clinical and radiological examinations were performed during follow-up. When radiological evidence of callus formation and healing was present, gradual weight-bearing was permitted. Full weight-bearing was allowed after satisfactory fracture consolidation, generally around 14–16 weeks. Functional outcome was assessed according to the Friedman and Wyman scoring system during follow-up.

Data Collection and Statistical Analysis

Data were collected using a preformed questionnaire through direct patient or attendant interviews, clinical examinations, and radiological assessments at admission and discharge. Follow-up information was recorded according to the predefined schedule. Data were entered and analyzed using SPSS version 21.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as mean $\pm$ standard deviation. A p -value of <0.05 was considered statistically significant at a 95% confidence interval.

Ethical Considerations

Institutional review board approval was obtained from Dhaka Medical College & Hospital before

commencement of the study. The nature and objectives of the study were explained to participants or their attendants in an understandable manner. Written informed consent was obtained from the patient or

legal guardian, and a left thumb impression was obtained when necessary. Privacy, confidentiality, and voluntary participation were maintained throughout the study.

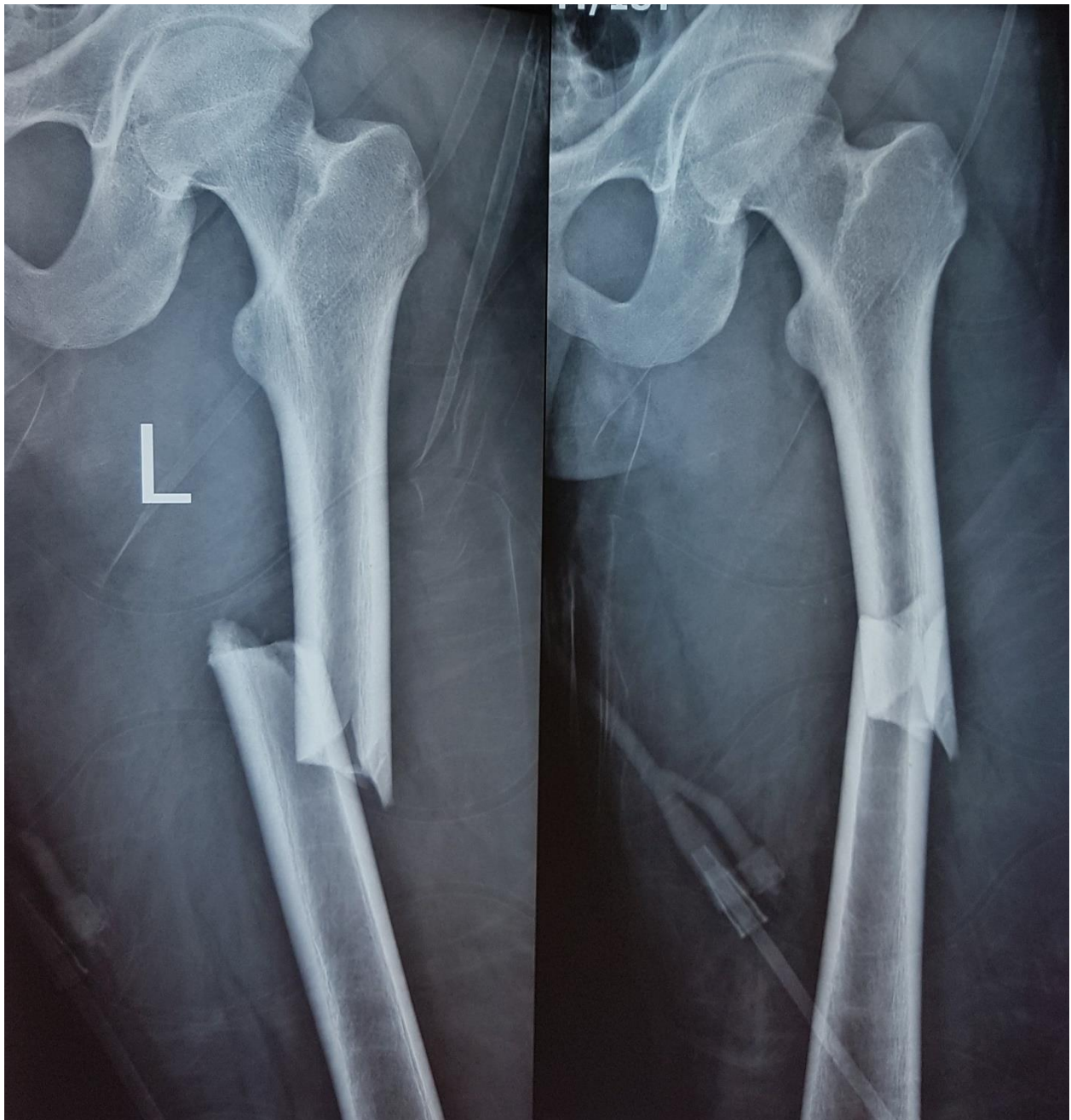


Fig 1: Pre Operative X Ray

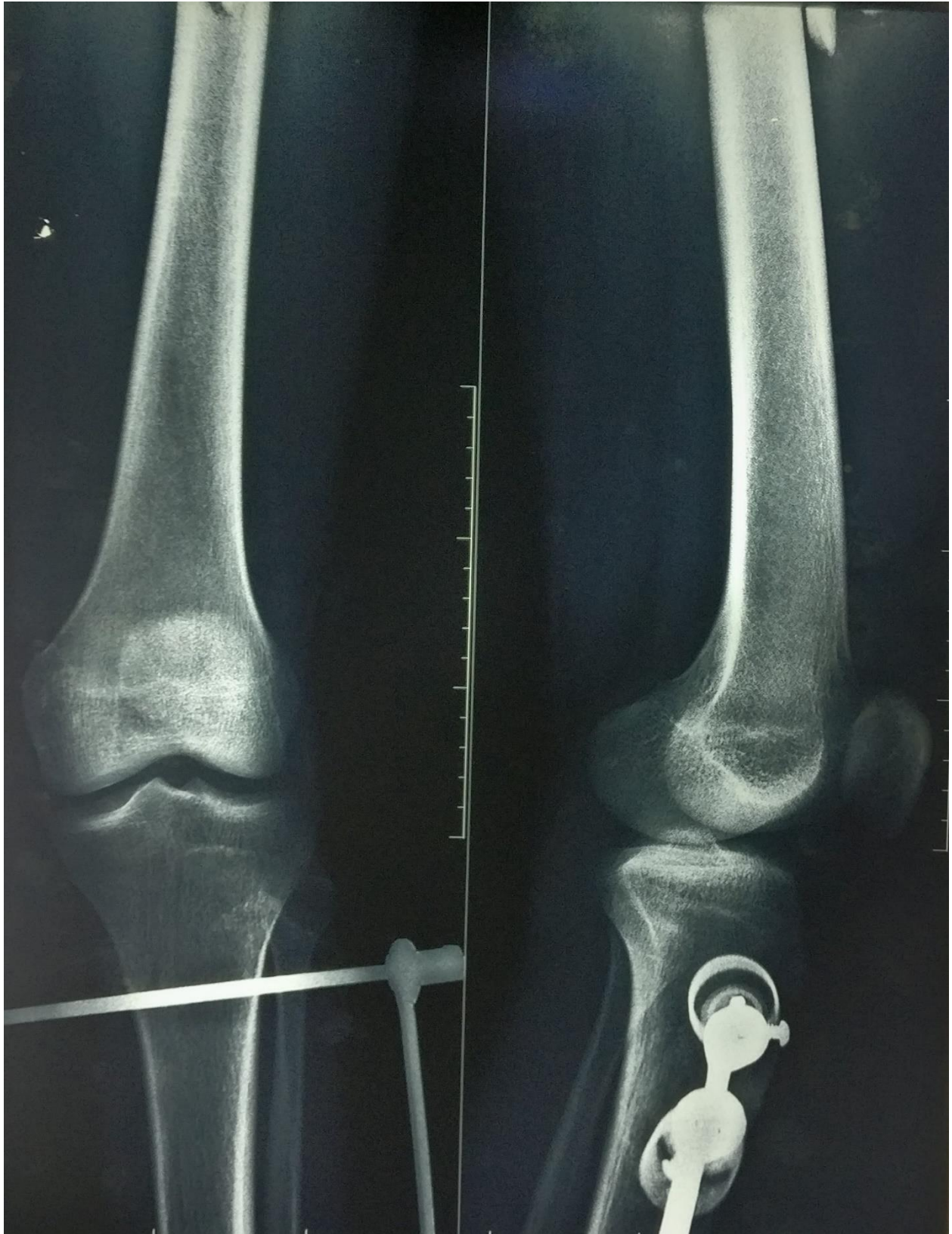


Fig 2: Pre operative Skeletal traction in situ

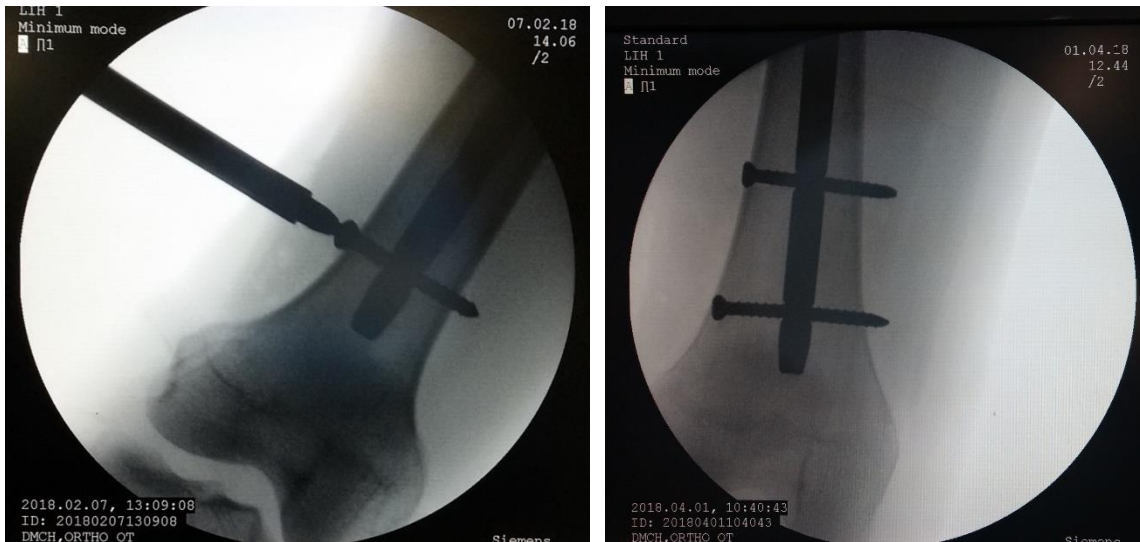


Fig 3: Insertion of distal screws

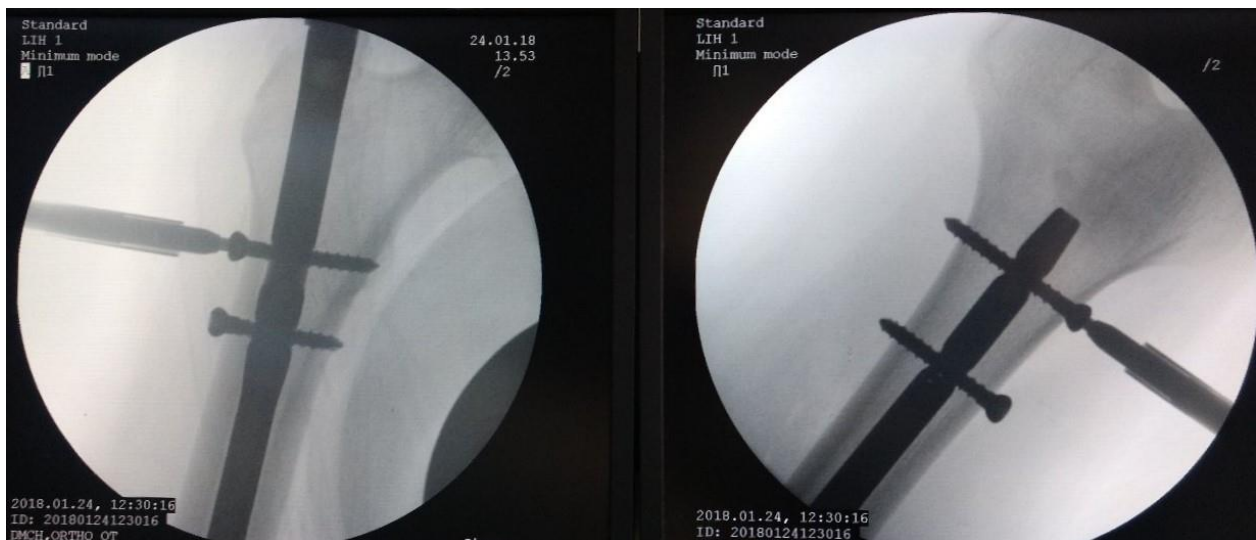


Fig 4: Both proximal and distal screws in situ



Fig 5: Wound after insertion of nail and screws

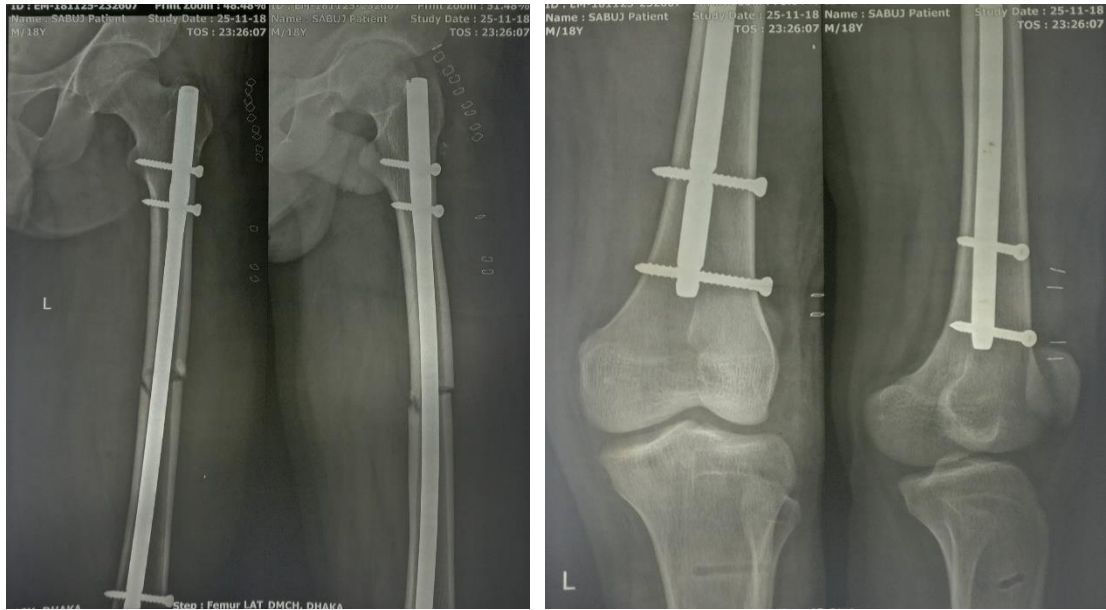


Fig 6: Immediate post operative X-Ray



Fig 7:X-Ray at 6th week

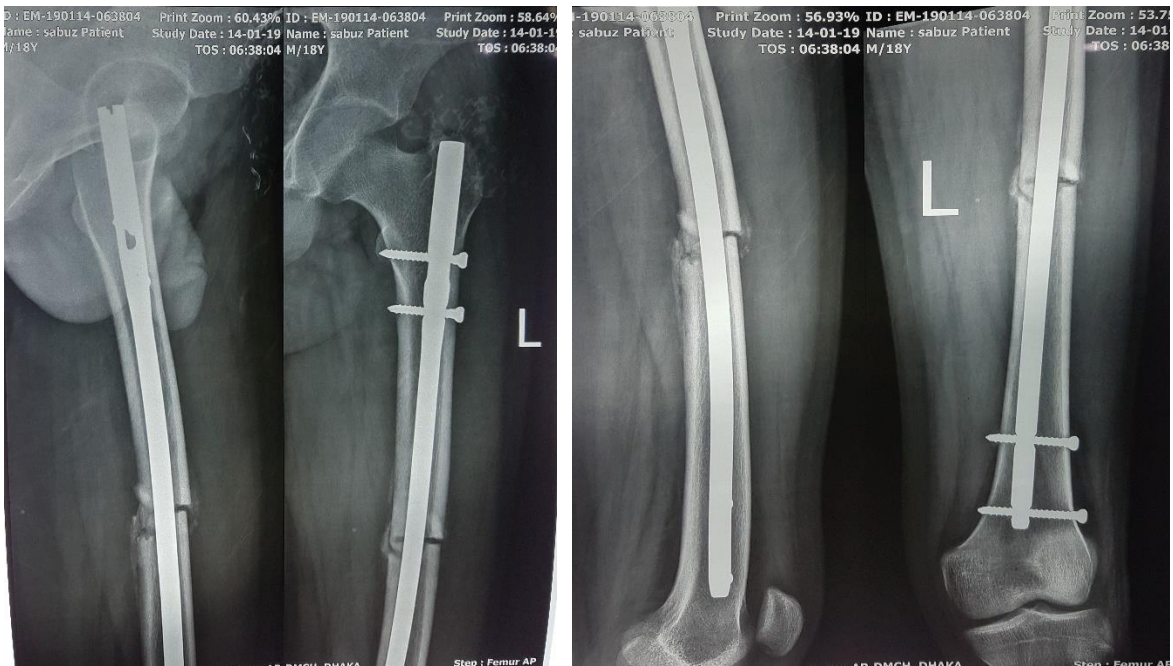


Fig 8: X-Ray at 12th week



Fig 9: Follow up at 16th week

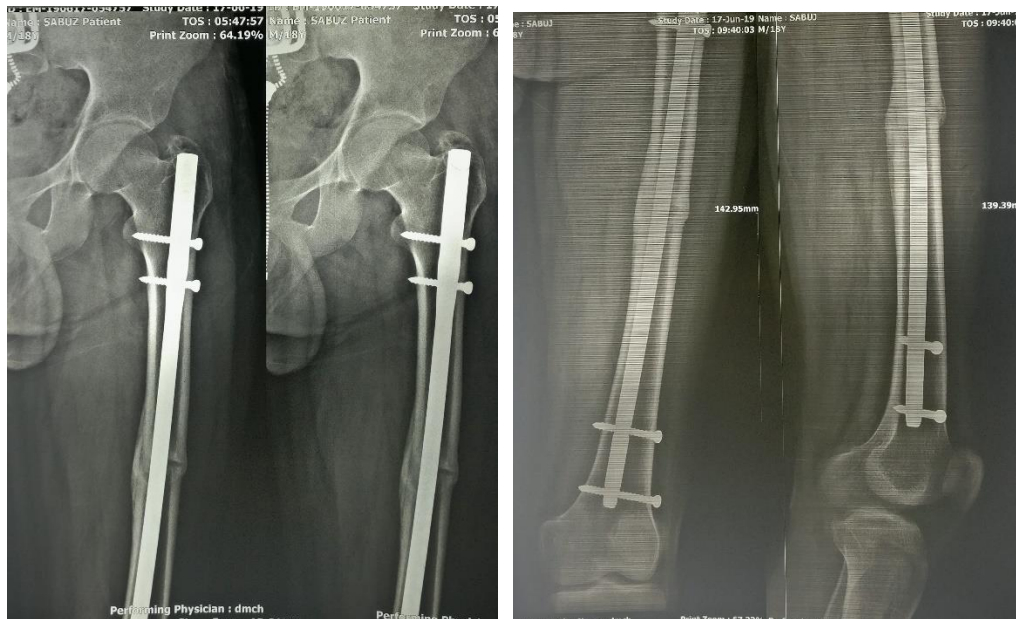


Fig 10: Follow up at 24th week



Fig 11: At 24th week

RESULTS

Table 1: Distribution of the study population by demographic characteristics (n=19)

Variables	Number	Percentage
Gender		
Male	15	78.9
Female	4	21.1
Age(Years)		
Mean±SD	32.84±14.13	
Minimum age	18	
Maximum age	60	

Table 1 shows the distribution of the study population by demographic characteristics like gender and age. There was male predominance with 78.9% with mean age 32.84±14.13.

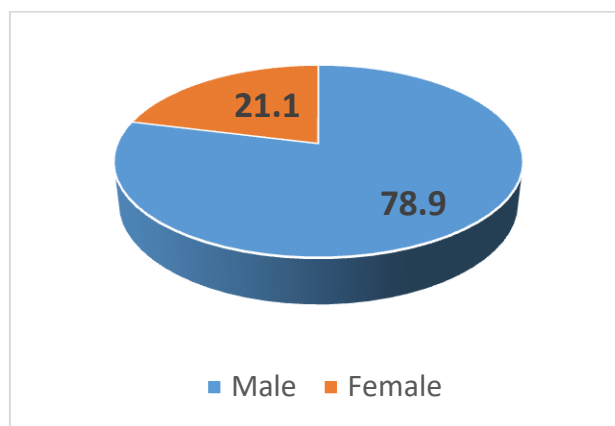


Fig 12: Figure showed the distribution of participants by gender

Table 2: Distribution of the study population by clinical and operative variables (n=19)

Variables	Number	Percentage
Mechanism of injury		
Assault	2	10.5
Fall from height	3	15.8
RTA	14	73.7
Time duration between injury and operation (days)		
Mean±SD	7.36±1.23	
Minimum	5	
Maximum	10	
Operation Time(minutes)		
Mean±SD	98.68±11.64	
Minimum	80	
Maximum	120	
Union Time(weeks)		
Mean±SD	14.05±1.21	
Minimum	13	
Maximum	18	

Table 2 shows the distribution of the participants by clinical presentation, per operative and post operative variables. The table was expressed in mean±SD.

Table 3: Distribution of the study participants according to union characteristics (n=19)

Characteristics	Number	Percentage
Union	17	89.5
Delayed Union	1	5.3
Lost in follow Up	1	5.3
Total	19	100.0

Table 3 showed the union outcome rate after surgery. The results were expressed in Number (percentage). Union rate was found in predominant cases 89.5%.

Table 4: Distribution of the final outcome of the participants according Friedman and Wyman scoring system (n=19)

Final Outcome	Number	Percentage
Fair	1	5.3
Good	17	89.5
Lost Follow up	1	5.3
Total	19	100.0

Table 4 showed the final outcome after surgery which is categorized by Friedman and wyman scoring system. Results were expressed in Number(percentage). It was noted that outcome is good in 89.5% cases.

DISCUSSION

Diaphyseal fractures shaft of femur is most common fracture encountered by the orthopaedic surgeon in emergency department. Clinically patients will be having pain, swelling, deformity, unable to walk and in some shock due to hypovolemia. Examination shows tenderness, swelling, abnormal mobility at the fracture site. X ray examination of the femur full length including hip and knee joint anteroposterior and lateral views confirms the fracture and proper planning.¹ The closed reduction and skeletal traction application and immobilization over bholer braun splint has got complications like prolonged immobility over a period of six to ten weeks, malunion, deep vein thrombosis, pulmonary infections and psychological disorders like depression. Open reduction and internal fixation using plate and screws has got various disadvantages like highly prone for infection, implant failure and needs additional support like thigh brace. Open reduction and internal fixation using intramedullary nailing has got the disadvantages like infection, delayed and non-union lengthy surgical scar. Closed reduction and internal fixation using intramedullary interlocking nail has advantages over all the methods described above in the form of short incision, less bleeding, less morbidity, early mobilization, speedy recovery, less incidence of infection and delayed and non-union.¹ Intramedullary interlocking nailing has now been regarded as gold standard against which other methods are compared.^{2,6} Timing of surgery categorized as Immediate (within 72 hrs.), Early (within 7-10 days)²² and Late (after 10 days).³ Here we have made an attempt to evaluate the Outcome of Early Closed Interlocking Intramedullary Nailing in Diaphyseal Fractures of Femur. The optimal time for nailing of closed femoral diaphysis fractures has been suggested by BRUMBACK4 et al (1988) as 7 to 10 days for elective admissions and immediately for patients with polytrauma to allow prompt mobilization. 30 In country like Bangladesh it's very difficult to operate such patient within 72 hours due to shortage of resource and over burden of the patient. So, surgery within 7 to 10 days we categorized as Early.²² This prospective observational study was carried out to see the outcome of Early Closed Interlocking Intramedullary Nailing in Diaphyseal Fractures of Femur. In this study sample size was 19. Age distribution: In this study, fracture shaft of the femur was most common in younger people with mean age of 32.84, ranging from 18 to 60 yrs. (Kimmatkar N et al., 2014)¹⁴ in his series reported fracture shaft of femur common in adult with mean age 35.8 years age group. (Umar M. et al 2004) observed mean age of 36 years, which are near similar with this study. Ex Distribution: Males were predominantly prone to fracture shaft of the femur due to high incidence found in motor vehicular accidents, in this study males were

predominant about 78.9% and female are 21.1%. (Maruthi CV et al., 2016)¹, found male predominance 63.34% and female 36.37% which is almost similar with the present study. Mechanism of injury: In this study had vehicular accident as the main cause of fracture of femoral shaft i.e. 73.7%, (Kumar VA et al. 2015)³ also had 75% of cases because of motor vehicular accidents. This observation by various authors implies that fracture shaft femur is usually a result of high energy trauma. Operation Time: In our study mean duration of operation was 98.68 minute (range 80 to 120 minutes) which is quite satisfactory regarding the outcome and safety of patient and surgeons as C-Arm is used throughout the procedure. (Umar M et al., 2004)²³ shows his mean duration of surgery was 180 minutes (range 120 to 540 minutes) + SD (76 minutes). Deepak KM et al. (2012)⁹ shows average duration of surgery was 120 minutes (range, 90-150 minutes). So it's quite impressive in our study. Healing Time: 18 patients in this study achieved union. The average time for healing of the fracture was 14.05 weeks. (Maruti CV et al. 2026)¹ shows in his study the average time of union was 16.84 weeks. Result of healing time earlier than previous study. (Qureshi zz et al. 2012)¹² shows mean union time 14.3 +/- 1.3 weeks which is similar to our study. Out of 19 patient union occurs in 17 patient, one patient developed delayed union and need dynamization and one patient lost follow up. Most fracture occurs on right sided femur and injury operation interval was 7.36±1.23 days. (Roy et al., 2014)²² showed his admission operation interval varied from 2-15 days. Mean interval being 5.06 days. The optimal time for nailing of closed femoral diaphysis fractures has been suggested by BRUMBACK4 et al (1988) as 7 to 10 days for elective admissions and immediately for patients with polytrauma to allow prompt mobilization. Which is similar to our study.²² Femoral shaft fractures are usually the result of high energy trauma. Affected people are younger who are in the productive age group and are prone for economic and social burden to their families and to the society if the recovery is not satisfactory. In many of these cases the bone unites with shortening, angulation or displacement if treated conservatively. An adequate reduction and rigid immobilization by some form of internal fixation is essential in femoral shaft fractures. Introduction of closed locked intramedullary nailing has revolutionized the management of fractures of femur because of its minimal surgical exposure and less demanding surgical skills and facilitates early ambulation.

CONCLUSION

In the light of the findings of the study, it can be concluded that closed Intramedullary interlocking nailing is a very effective, successful and time tested

method of treatment for diaphyseal fractures of femoral shaft because of Stable fixation, Faster rate of fracture union, Lower rate of complications like infection or non-union and allows early mobilization & return to routine activities. Interlocking nailing gives rotational as well as axial stability and should be given chance for diaphyseal femur fracture treatment whenever possible.

Strengths of the Study

The strengths of this study include its prospective observational design and the standardized clinical and radiological follow-up of patients at predefined intervals up to 24 weeks. The study evaluated clinical, radiological, fracture-union, and functional outcomes following early closed interlocking intramedullary nailing of femoral shaft fractures. Functional outcome was assessed using the Friedman and Wyman scoring system, providing a structured assessment of pain, activities of daily living, and range of motion. The study was conducted in a tertiary-care orthopedic setting, allowing systematic assessment of patients undergoing the same surgical treatment.

Limitations of the Study

- The study was done in limited time of span; cases were collected from only one center; hence may not represent the whole population of the country.
- The sample size was small.
- Follow up was short.
- C-Arm was out of order from February 2019 to July 2019.
- Patients are very reluctant to follow up.
- Limitations of resources.

Recommendations

- Further multi centered cohort study with large sample size should be recommended.
- Further prospective study with larger sample and longer follow-up period is recommended.
- Adequate instrument specially C-Arm should make available round the clock at emergency operation theatre.

Consent for Publication

Consent for publication was obtained from the participants for the use of relevant clinical and radiological images in this article. All images and clinical information were reviewed to ensure that the identity of the participants was not disclosed.

Conflict of Interest

The authors declare that they have no conflict of interest related to this study, its publication, or the interpretation of the findings.

Source of Funding

This study received no specific grant or financial support from any government agency, commercial organization, or other funding body. The study was conducted using the institutional resources of Dhaka Medical College & Hospital, Dhaka, Bangladesh.

Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available because they contain participant-related clinical information but may be available from the corresponding author on reasonable request, subject to institutional and ethical restrictions.

Authors' Contributions

All authors contributed to the conception and design of the study, clinical management and/or data collection, interpretation of the findings, and preparation and critical revision of the manuscript. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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