

EARLY OUTCOME OF OPEN LOCKED INTRAMEDULLARY NAILING OF FEMORAL DIAPHYSEAL FRACTURES IN A RESOURCE – POOR SETTING.

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ABSTRACT

BACKGROUND: Closed locked intramedullary nailing is largely considered the preferred treatment option for fractures of the femoral diaphysis, owing to its associated high union and low complication rates. In resource poor regions where intraoperative imaging is not readily available, most of these injuries are treated by open locked intramedullary nailing and plate osteosynthesis. This study was designed to assess the outcome of open locked intramedullary nailing of femoral diaphyseal fractures.

METHODS: Medical records and radiographs of all adult patients who had open locked intramedullary nailing of fractures of the femoral diaphysis between January 1, 2013 and July 31, 2017 were retrieved. A total of 45 patients with 46 fractures of the femoral diaphysis were retrospectively studied. Each patient was followed up for at least 12 months. Early outcome of treatment was assessed using the Thorresen's criteria.

RE#SULTS: A total of 45 patients (24 male; 21 female) with 46 femoral diaphyseal fractures were studied. The age range of the patients was 18 years to 80 years, with a mean age of 33.56 (SD=12.87) years. Forty two (91.3%) cases were closed fractures. Twenty four (53.3%) patients had right femoral diaphyseal fracture. The overall union rate was 95.7%. The range of time to fracture union was 12 weeks to 34 weeks, with an overall mean time to fracture union of 13.65 ± 3.57 weeks. Ipsilateral knee joint stiffness (n=4, 8.7%) and osteomyelitis (n=3, 6.5%) were the commonest complications recorded. Overall infection rate was 10.8%. Using the Thoresen's criteria, the overall outcome of treatment in this study was excellent in 37 (80.4%) patients.

CONCLUSION: There is no significant difference between the outcome of open nailing compared to closed nailing of femoral diaphyseal fractures

Keywords: Locked intramedullary nailing, femoral diaphyseal fractures

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INTRODUCTION

Fractures of the femoral diaphysis are one of the most common fractures encountered in orthopaedic practice.¹ These injuries usually result from high energy trauma such as following road traffic accidents, falls from height, gunshot injuries, physical assault and contact sports, and may be associated with multiple system injuries.^{2,3} Treatment of fractures of the femoral diaphysis have evolved over the years due to the improved understanding of local anatomy, impact of treatment, and the biomechanics of fixation techniques.⁴

Interlocking intramedullary nailing is the treatment of choice for most femoral diaphyseal fractures¹⁻⁶. In developed regions of the world, closed nailing has largely replaced open nailing in the treatment of these fractures, leading to superior outcomes in terms of post operative infection and fracture union rates.¹⁻⁴ Closed intramedullary nailing is largely believed to be associated with higher healing and lower infection rates when compared to open nailing, due to retention of the fracture haematoma and less disruption of soft tissues, including the periosteum at the fracture site. However, the need for fracture table and image intensifier for reduction of bone fragments is a major limitation in resource-poor regions.^{1,5,7}

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Complications following interlocking intramedullary nail fixation of femoral diaphyseal fractures include infection, stiffness of adjacent joints, malunion, non-union, limb length discrepancy and mechanical implant failure.⁸⁻¹⁴ While infection rates ranging from 1.5% to 10% complicating open intramedullary nail fixation of femoral diaphyseal fractures have been reported, values less than 1% have been attributed to closed nailing.¹ Varying degrees of ipsilateral knee pain and stiffness often complicate femoral diaphyseal fracture, and may arise as a result of undiagnosed concomitant injuries to the affected joints, fracture location, inadequate mobilization and type of treatment offered.^{1,2,3} Different authors have proposed various criteria for the assessment of early outcome of treatment of femoral shaft fractures with locked intramedullary nails.^{15,16} Thoressen graded the outcome of treatment into 'excellent, good, fair or poor' using the degree of malalignment, limb shortening and the range of motion of the ipsilateral knee joint.¹⁵ In resource-poor societies, nailing of fractures of the femoral diaphysis is usually done open using external jig, due to the high cost of implants and instruments, as well as non-availability of image intensifiers. This study was designed to evaluate the early outcome of open locked nailing of fractures of the femoral diaphysis.

PATIENTS AND METHODS

Medical records and radiographs of all adult patients who had open locked intramedullary nailing of fractures of the femoral diaphysis between January 1, 2013 and July 31, 2017 were retrieved. Patients with missing or incomplete records, previously fixed fractures, pathological fractures, Gustillo Types 3B and 3C fractures, incomplete records as well as follow up duration less than 12 months were excluded from the study.

A total of 45 patients with 46 fractures of the femoral diaphysis were studied. Each patient had open locked intramedullary nailing within 2 weeks of presentation. Isometric quadriceps exercise as well as passive range of motion exercise of the knee and hip joints of the operated limb were commenced within 48 hours post operation. Crutch-aided non weight bearing movement was commenced within 72 hours post operation, and patients were discharged to the outpatient clinic within 7 to 14 days post operation. During the

follow up period, each patient was assessed for ipsilateral knee pain and stiffness, limb shortening and malalignment, as well as surgical site infection. Fracture healing was assessed at the out-patient clinic at 4-weekly intervals with plain radiographs of the treated limb. Fracture was adjudged to have healed when adequate callus bridge was seen on at least 3 cortices, and only then was crutch-aided weight bearing commenced. Each patient was followed up for at least 12 months.

Records of patients' demographic data as well as clinical type of injury, approach to the medullary canal and time to fracture union were identified. Preoperative and postoperative plain radiographs were reviewed to classify the fractures using the Winkquist and Hansen system, as well as confirm the documented treatment and time to fracture union. Patients' records and postoperative radiographs were also reviewed for the following complications: surgical site infection, ipsilateral knee joint pain and stiffness, shortening, malunion, nonunion and mechanical implant failure. Using Thorresen's criteria, early outcome of treatment was assessed to be excellent, good, fair or poor.

RESULTS

A total of 45 patients (24 male; 21 female) with 46 femoral diaphyseal fractures were studied. The age range of the patients was 18 years to 80 years, with a mean age of 33.56 (SD=12.87) years. Forty two (91.3%) cases were closed fractures. Twenty four (53.3%) patients had right femoral diaphyseal fracture. Winkquist and Hansen type I injuries constituted 45.5% (n=31) of the study population. See table 1. Most of the cases (n=27, 58.7%) were mid diaphyseal injuries.

Table 1: Pattern and distribution of injury.

Variables	Frequency (%)	
	Male	Female
Laterality of Injury		
Right	12	12
Left	11	9
Bilateral	1	0
Clinical Type of Injury		
Closed	24	18
Open	1	3
Winkquist and Hansen Type of Injury		
Type I	4	4
Type II	11	7
Type III	3	6
Type IV	5	3
Type V	2	1

Approach to the medullary canal was antegrade in 28 (60.9%) cases. See table 2. The overall union rate was 95.7%. The range of time to fracture union was 12 weeks to 34 weeks, with an overall mean time to fracture union of 13.65 ± 3.57 weeks. One case required dynamization to achieve union. No association was established between Winquist and Hanssen classification of injury and time to fracture union ($p=0.582$). Ipsilateral knee joint stiffness ($n=4$, 8.7%) and osteomyelitis ($n=3$, 6.5%) were the commonest complications recorded. See table 3. Overall infection rate was 10.8%.

Table 2: Distribution of anatomical site of injury and approach to the medullary cavity.

Anatomical site of injury	Approach to medullary cavity	
	Antegrade	Retrograde
Proximal diaphysis	9	1
Mid diaphysis	16	11
Distal diaphysis	3	6

Table 3: Distribution of complications.

Complication	Frequency	(%)
Superficial infection	2	4.3
Osteomyelitis	3	6.5
Knee stiffness	4	8.7
Limb shortening	2	4.3
Delayed union	1	2.1
Malunion	2	4.3
Non union	2	4.3

All ($n=2$, 4.3%) cases that had superficial surgical site infection in this study progressed to fracture union, while 2 (4.3%) out of the 3 cases which had deep infection/osteomyelitis failed to achieve union. For the 2 cases of non union, healing was achieved by exchange nailing with cancellous bone grafting in one, and compression plating with cancellous bone grafting in the other. Using the Thoresen's criteria, the overall outcome of treatment in this study was excellent in 37 (80.4%) patients. See table 4.

Table 4: Assessment of outcome of treatment using the Thoresen criteria.

Outcome of treatment	Frequency	(%)
Excellent	37	80.4
Good	5	11.0
Fair	2	4.3
Poor	2	4.3
Total	46	100

DISCUSSION

The debate on whether closed nailing of femoral diaphyseal fractures has a superior outcome compared to closed nailing has persisted over the years. It is widely believed that due to the loss of fracture haematoma and disruption of soft tissues including the periosteum at the fracture site, outcome of treatment following closed nailing is superior when compared to open nailing. However, shorter operating time and better reduction of fragments under direct vision are some of the advantages of open nailing. In a comparative study of femoral shaft fractures treated with intramedullary nails, Harper¹⁷ reported no significant difference in the average time of hospitalization of patients treated by either open or closed nailing.

He also noted that the 2 groups had a similar incidence of postoperative complication except for rotational malunion, which was more in the closed nailing group. Time to weight-bearing, type and rate of callus formation, time to osseous healing, as well as extent of residual disability also appeared similar in both groups. However, he noted that postoperative morbidity appeared greater for the fractures treated open, while intraoperative complications dominated in the fractures that were treated closed.

In another comparative study, Leighton et al¹⁸ reported no significant difference in the outcome of femoral shaft fractures treated by either open or closed nailing. They recommended that the decision to choose between open and closed nailing should be based on the fracture pattern, surgeon's experience and the availability of resources. Rokkanen et al¹⁹ on the other hand reported a slightly superior outcome for closed nailing over open nailing.

High fracture union rates have been attributed to both open and closed nailing of femoral diaphyseal fractures. Ertörer et al²⁰ reported a union rate of 93.6% and an average time to fracture union of 14 weeks, following closed unreamed nailing of 73 fractures of the femoral diaphysis. Using the Thoresen criteria, results were excellent or good in 87.7% of their study population. These observations are similar to those reported by Salawu et al²¹, who achieved a

fracture union rate of 95.3% following the treatment of 43 fractures of the femoral shaft by open nailing. The average time to union was 14.0 ± 1.2 weeks, while excellent results (using the Thoresen's criteria) were obtained in 93% of their study population. However, Burc et al²² in a study reported a lower fracture union rate of 90.9%, and a much longer average time to fracture healing of 18.3 weeks. Outcome was excellent/good in 63.6% of the study population.

In this study, the decision to treat all the fractures by open nailing was solely due to the non availability of intraoperative imaging. This is the case in most Sub-Saharan countries where health is under-funded, and health insurance schemes are largely nonexistent. We did not find any association between Winquist and Hanssen classification of injury and time to fracture union ($p=0.582$).

We observed a fracture union rate of 95.7% and mean fracture healing time of 13.65 weeks \pm 3.57 weeks, figures that are quite close to those reported by Ertürer et al²⁰ and Salawu et al²¹. Similarly, we recorded excellent/good outcome in 91.4% of our study population. This is quite close to the figures reported by Ertürer et al²⁰ and Salawu et al²¹, and in line with the outcomes of the studies done by Harper¹⁷ and Leighton et al¹⁸ which did not show any significant difference between fractures treated by closed nailing and those treated by open nailing.

CONCLUSION

We conclude that there is no significant difference between the outcome of open nailing compared to closed nailing of femoral diaphyseal fractures. The decision on which method of treatment to use should depend on the availability of resources, pattern of injury and the surgeon's experience.

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