Journal of Advances in Medical and Pharmaceutical Sciences

14(4): 1-7, 2017; Article no.JAMPS.35079
ISSN: 2394-1111

Intramedullary Interlocking Nailing for Long Bone Fractures of the Lower Limbs: Our Experience with Free-hand Locking

Shamsuddeen Muhammad[1*] and Abdurrahman Alhaji Mamuda[1]

[1]Orthopaedics Unit, Department of Surgery, Bayero University, Aminu Kano Teaching Hospital, Kano, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author SM designed the study, performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Author AAM managed the analyses of the study, managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMPS/2017/35079
Editor(s):
(1) Robert Dymarek, Department of Nervous System Diseases, Wroclaw Medical University, Poland.
Reviewers:
(1) Mohit Kumar Patralekh, Safdarjung Hospital and Vardhman Mahavir Medical College, India.
(2) Ashley Simela, University Hospitals, Richmond Medical Center, USA.
(3) Rajeev Dwivedi, Lumbini Medical College and Teaching Hospital, Nepal.
(4) Nusrat Hamdani, Hamdard Institute of Medical Sciences and Research, India.
Complete Peer review History: http://www.sciencedomain.org/review-history/20653

Original Research Article

Received 27th June 2017
Accepted 14th August 2017
Published 24th August 2017

ABSTRACT

Aims: To see the pattern of interlocking nailing used for fractures of lower limb's long bones in terms of the bone affected, laterality, age distribution, sex distribution, pattern of locking and early outcome.
Study Design: The study is a retrospective cross sectional study conducted over three years from April 2013 to march 2016 in a private hospital in Kano, North western Nigeria.
Methodology: All patients that had intramedullary nailing for femoral and/or tibial fractures within the period of study, were recruited. Theatre register was used to extract the file numbers of the patients. The folders were retrieved and the information extracted. The Data was analysed using XLStat software.
Results: The age ranges from 19 -70 years with a majority between 20-39 years. There is only one person below the age of twenty and is in the male category. There were a total of 87 procedures

**Corresponding author: E-mail: dshamsky@gmail.com;*

conducted on 81 patients of which 70(86.4%) were males and 11(13.6%) were females. Only 77% of the interlocking nail were locked at both ends, the remaining were locked at one end with the other end abandoned due to difficulty in getting the hole or actually not attempted. Of the 87 nailings, 5 were inappropriately locked outside by the side of the distal nail and 2 were locked distal to the tip of the nail. One femoral and 3 tibial, developed non-union requiring exchange nailing with a larger diameter nail and cancellous bone graft. 6 patients developed surgical site infection which were manage successfully with antibiotics and wound care with only 2 tibial nails requiring conversion to external fixation using Linear Rail system for compression. 70(86%) of the patient were satisfied with their treatment with very good – excellent range of motion, while 11(14%) patient have either of reduce range of motion, anterior knee pain or abnormal gait.

Conclusion: Most challenging aspect of the procedure were intraoperative radiography was not available, is correct placement of the distal locking screws. Use of a distal targeting device is the main stay, while using the guide wire to sound the drill bit/screw increases the chances of accurate placement.

Keywords: Intramedullary; interlocking; nailing; long bone; fractures.

1. INTRODUCTION

Shaft Fractures of lower limb long bone are commonly from high energy injuries often associated with a significant traumatic event, such as motovehicle or motocycle accidents, fall from height, and motovehicle striking pedestrian. Less common mechanism of femoral shaft fracture include pathological fracture, low energy torsional fracture in elderly patients and biphosphonate related stress fractures [1] The gold standard for treatment is placement of rigid statically locked intramedullary nail, which result in union in greater than 93% of times [2]. It has now become a standard treatment of long bone diaphyseal and selected metaphyseal fractures [2].

They are introduced into the bone remote to the fracture site and share compressive, bending and torsional loading with the surrounding osseous structure, acting as internal splint and resulting to secondary bone healing [2]. The prepared technique is the closed nailing using indirect reduction techniques and fluoroscopy to guide proper placement of entry point and locking screws. However, there is room for open technique with direct reduction of fragments. Intramedullary nailing is shown to have a lesser infection rate, high rate of union, faster return to weight bearing and activity compared to plate osteosynthesis [3]. Thus, the general agreement that intramedullary locking nail is justified in the treatment of communited and markedly displaced fractures.

The number of patients in the developing countries who will need stabilization of high energy fractures due to road traffic accidents are predicted to increase by 67% by the year 2020. This, is as a result of the number of fractures from global conflict [4]. Open fractures which are traditionally treated by initial external fixation may be fixed with a nail after taking care of the soft tissue injury. There is still no consensus about the best treatment for open fractures, but biomechanical studies show external fixation in two planes to approach the rigidity of the bone. However, it produce statistically similar result compared to intramedullary locking nail [5].

In the Humerus, the choice between plating or nailing remain controversial, since both can achieve similar result. But plating may reduce occurrence of shoulder problems [6].

Open fractures, fixed with antibiotic releasing core nail have a significantly lower infection rate, faster consolidation and fewer complications as compared to standard interlocking nail [7]. Long term Range of motion at hip and knee for early treated uncomplicated fractures is comparable to the uninjured limb regardless of nailing technique [8].

There is no significant difference between reamed and unreamed nail for treatment of tibial fracture, but reamed have lower fixation failure [9]. After given due respect to soft tissue injury, grade III shaft fractures can be fixed early with reamed interlocking nail with resultant satisfactory alignment, good range of motion, short rehabilitation period and low infection rate [10].

The most challenging step in this procedure is the precise placement of locking screws that stabilize the fragment [11,12]. This, is as a result

of deformation of the nail during insertion. Various techniques are in use, ranging from fluoroscopy guarded free hand, to the use of Jig with both proximal and distal targeting device. Chances of successful locking especially of the distal screw hole, is increased by various ingenious techniques of confirming correct screw placement intraoperatively, where there is no luxury of intra operative fluoroscopy. We tried various ingenious techniques previously without much satisfactory distal locking.

This article aims at seeing the pattern of interlocking nailing used for fractures of lower limbs' long bones in terms of: Bone affected, laterality, age distribution, sex distribution, pattern of locking and early outcome.

2. MATERIALS AND METHODS

The study is a retrospective cross sectional study conducted over three years, from April 2013 to march 2016 in a private hospital in Kano, North western Nigeria. All patient that had intramedullary nailing for femoral and/or tibial fractures within the period were recruited. Ethical clearance was obtained from research and ethics committe. There were a total of 86 patients of both sexes with age range of 19-70 years. 5 patients were excluded due to incomplete documentation. Other exclusion criteria were multiple injuries, except lower limb fracture and patients lost to follow up.

All the procedures were done by direct open reduction and nailing with free hand locking by utilizing a proximal and distal targeting device while confirming the presence of locking screw within the nail by use of a guide wire to gauge the tip- end, length of the nail, and to sound the screw.

The surgery was done by the same surgeon all through using different interlocking set but all with a proximal and distal targeting device. Average operation time over time have drop to 90 minutes.

2.1 Procedure

Patients laying supine under anaesthesia, routine prep done depending on femoral or tibial. Via lateral and anterior approaches for femur and tibia respectively, the fracture fragments were exposed and ends prepared and trial reduction done to assess congruency. Entry point created for antegrade nailing via proximal fragment. Canal reamed, fracture reduced over the nail.

A nailing guide wire is passed down to the end of the bone and the wire marked with a Kocher's forceps as it exit the jig. The wire is pulled up a little to allow drilling via the sleeve in the distal targeting device. Metallic sound and incomplete descend of the marked guide wire confirm presence of drill bit within the nail. Withdrawal of drill bit will allow descent of guide wire. When the hole is missed, gentle rocking of the jig usually brings the hole to the drill bit. The process is repeated with the locking screw this time. Same is repeated when there is need for extra locking distally. Similar process is done for the proximal after a satisfactory alignment and compression of the fragments is achieved.

With perfection of this technique over the last one year success of locking both proximal and distally is almost 100%.

3. RESULTS AND DISCUSSION

The age, ranges from 19 -70 years, with a majority between 20-39 years. There is only one person below the age of twenty and is in the male category.

Table 1. Age and sex distribution

Age range	Sex	
	Male	Female
20-39	1	0
20-39	37	1
40-59	27	9
80-79	5	1
≥80	0	0

There is a total of 87 procedures conducted on 81 patients of which 70(86.4%) male and 11(13.6%) females.

There are thirty femoral and fifty-seven tibial nailing done of which 3 had a floating knee, 2 bilateral tibial and 1 bi femora. Only 5 females have femoral fracture and 8 with tibial fracture. There are 34 fractures on the left side (39%) and 56(61%) on the right side.

Only 77% of the interlocking nail were locked at both ends, the remaining were locked at one end with the other end abandoned due to difficulty in getting the hole or actually not attempted. Of the 87 nailings, 5 were inappropriately locked outside by the side of the distal nail and 2 locked distal to the tip of the nail.

1 femoral and 3 tibial developed non-union requiring exchange nailing with a larger diameter

nail and cancellous bone graft. 6 patients developed surgical site infection which were manage successfully with antibiotics and wound care with only 2 tibial nails requiring conversion to external fixation using Linear Rail system for compression.

70(86%) of the patients were satisfied with their treatment with very good-excellent range of motion, while 11(14%) patient have either of reduce range of motion, anterior knee pain or abnormal gait.

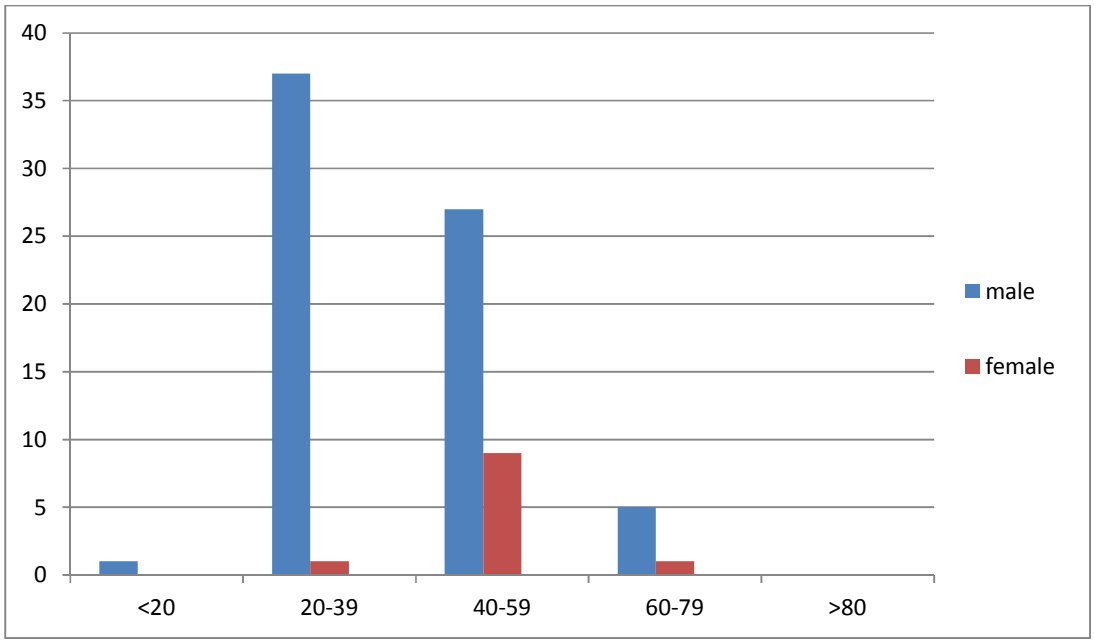

Fig. 1. Age sex distribution

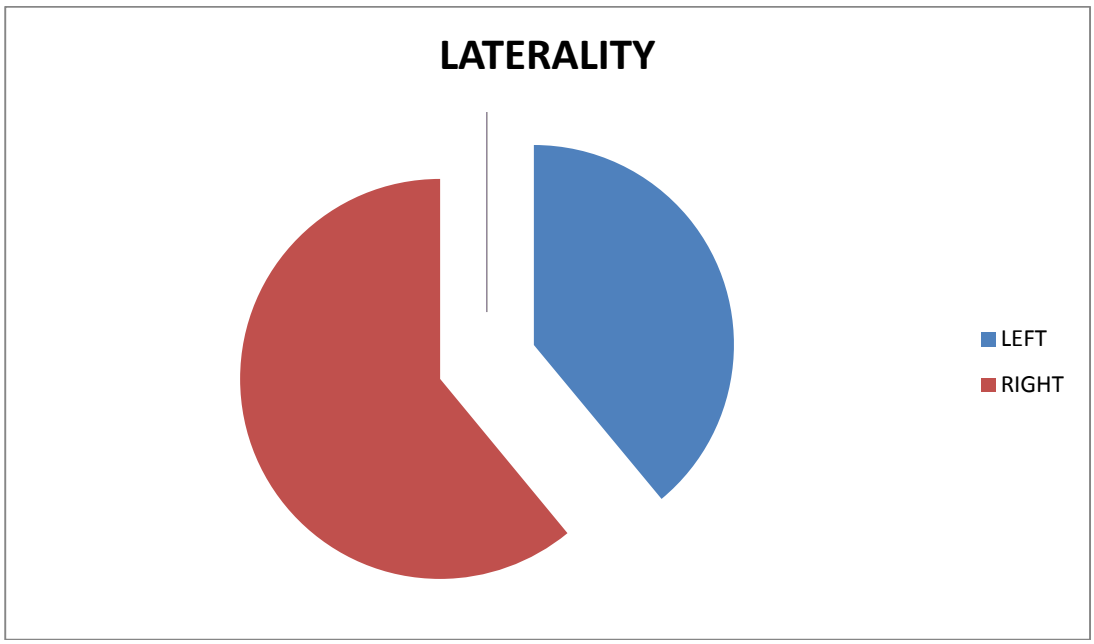

Fig. 2. Laterality of fractures

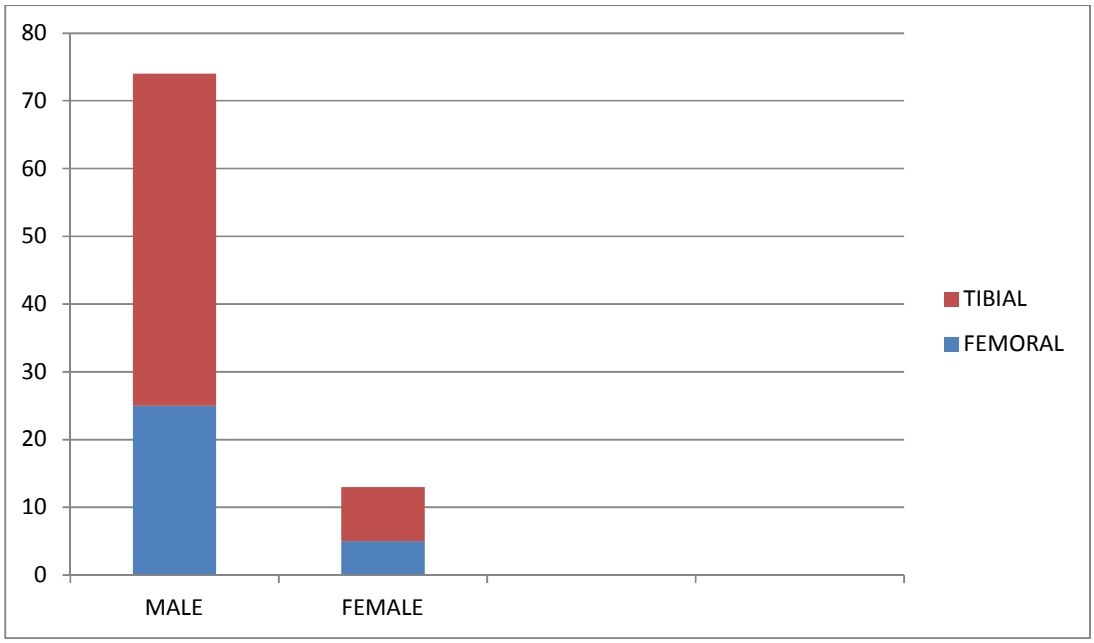

Fig. 3. Bone distribution by sex

3.1 Discussion

There are various studies conducted on various aspect of Inter-Locking Nail (ILN) for shaft fractures in long bone. Since all the patients in this study had shaft fractures, that were closed or not more than Gustillo 2, one can relates pattern of nailing with such categories of fracture.

Fig. 4. Proximal locking not done, distal missed

Most of the nailing were done in male within the class range of 20-39, and 40-49 in the female group. This is similar to what is documented by other researchers, with average male age of 36.9years and 56.2 for the female [13,14]. This is not surprising as most of the fracture cases we see are related to motovehicular accident. The male to female ratio is 6.4 :1 which is similar to 4.8 :1 reported by Zbigniew Gugala, Arvind Nana, Ronald W. Linssey [15], however, its quite different from what was reported by Courl-Brown, (1.9:1) [15]. This may be partly explained by lifestyle difference, were majority of the females in our locality are full time house wives with minimal activity on the major roads.

Fig. 5. Nail locked only proximally

Unilateral nailing was done in 93% where 3.4%, 2.3% and 1.2% are floating knee, both tibia and both femora respectively. This is similar to 96.5% and 3.5% unilateral and bilateral respectively from other studes [15]. Majority of nailing was done for tibial shaft fractures and this account for almost all the open fractures in the study - 57 against 30 femoral fracture. This is the documented picture seen considering the modal age group and the common mechanism of injury as motovehicular accidents. 39% of all the procedures were carried on the left side, with right having a majority, 61%. No similar comparism was found in the literature and we have no explanation for such occurrence.

Fig. 6. Successful locking at both ends

Regarding the locking of the nail, the distal locking is much more challenging and time consuming compared to the proximal. This is so despite the jig due to deformation of the nail during insertion. The standard practice is locking both fragments with one or two screws. Even though, similar results in terms of rate of union have been obtain with locking of shorter of the fragments or the less stable fragment. This may not have place in unreamed and communited fractures. 77% of the nails were locked at both ends, while the 23, locked only at one end, was either due to difficulty attributed to deformation of the nail or perceived to be unnecessary in press fit and rotationally stable fractures intraoperatively. Correct placement of distal screw confirmed with post operative x-ray is found in 92%, with the remaining percentage missed usually to the side of the nail. This is similar to findings by other studies with locking rates of 96% and 100% respectively [16,17].

Union was achieved in 97.7% of the cases, with only 1 femoral (segmental) and 3 tibial, developing non-union, requiring exchange nailing and bone grafting to achieve union. This is similar to what was reported by Eric Kubiac [3]. Infection rate stood very low in our study, with only 6 cases of which four were superficial infections resolving with antibiotics and local wound care, while 2(open fractures) required conversion to external fixation, with interfragmentary compression using Linear Rail system to control infection. Low Infection rates is a documented fact especially in close fractures fixed by closed techniques [3,17].

70 patients (86%) have very Good to Excellent outcome based on recovery of range of motion of hip and/or knee, anterior knee pain and gait. Similar result was reported for long term outcome of femoral fracture [8].

4. CONCLUSION

Fracture of lower limb long bones shaft that are amenable to interlocking nail should be manage as such, despite the challenge of intraoperative radiograph in most of our centres in developing countries. Unavailability of intra operative radiograph should not discourage use of inter locking nail, which is the gold standard; since use of proximal and distal targeting device with various ingenious manoeuvres have produce similar success to standard techniques in terms of success of distal locking and union rates.

CONSENT

Consent was seeked for during admission and preserved.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sahmir Sadic, Svemir Custovic, Mahir Jasarevic, et al. Complication and functional recovery in treatment of femoral shaft fractureswith unreamed

intramedullary Nail. Med Arch. 2014; 68(1):30-33.
2. Bong Mathew R, Kumner Frederic J, Koval Kenneth, et al. Intramedullary nailing of the lower extremity: Biomechanism and biology. Journal of American Academy of Orthopedic Surgeon. 2007;15(20):97-106.
3. Eric Kubiac. Intramedullary nailing of femoral shaft fractures. Clinical Trial. Gov; 2016.
4. Lewis G, Zirlde Faseeh Shahab. Interlocked intramedullary nail without fluoroscopy. Orthopaedic Clinic North America. 2016;47:57-66.
5. Hanbin Ouyang, Jun Xiong, Peng Xiang, et al. Humeral shaft fracture: An updated meta analysis. J. Shoulder and Elbow Surgery. 2013;22(3):387-395.
6. Fabio Lucas Rodrigues, Luiz Carlos de Abreu, Victor E Valenti, et al. Bone tissue repair in patients with open diaphyseal tibial fracture treated with biplane external fixation or reamed locked intramedullary nail. Injury. 2014;45(5):32-35.
7. Mostafa el Moumini, Emma Heather Voogd, Henk Jantan Duis, et al. Long term functional outcome following intramedullary nailing of femoral shaft fractures. Injury. 2012;43(70):1154-1158.
8. Nuno Craveiro-Lopez. Treatment of open tibial fracture with locked intramedullary nail with a core release of antibiotic: Comparative study with standard intermedullary nail. Revue de Chirurgie Orthopedique et Traumatologigue. 2016; 102(7):112-115.
9. Yu Guangshu, Wang Yu, Xu Zhiging, et al. Reamed or unreamed intramedullary nailing for tibial fracture; A meta analysis. Chinese Journal of Traumatology. 2014; 17(4):229-234.
10. Singh D, Garg R, Bassi JL, et al. Open grade III fractures of the femoral shaft: Outcome after early reamed intramedullary nailing. Orthopaedic and traumatology: Surgery and Research. 2011;97(5):506-511.
11. Vilmos vecsei, Stefan Hajdu, Lukas L Negrin. Intramedullary nailing in fracture treatment: History, science and kunntscher's revolutionary influence in Vienna, Austria. Injury. 2011;43(4): 1-5.
12. Z. Kamariarakis, I Buliev, N Pallikarakis. Robust identification and localization of intramedullary nail holes for distal locking using CBCT: A simulation study. Medical engineering and physics. Distal locling with Mechani. 2011;33(4);479-489.
13. David Warwick, Selvadurai Nayagam. Fracture of tibia and fibular. Apley's Systems of Orthopaedic and Fracture. 9th Edition. 2010;897-904.
14. Court-Brown CM, Rimmer S, Prakash U. et al. The epidemiology of open long bone fractures. Injury. 1998;29(7):529-534.
15. Zbigniew Gugala, Arvind Nana, Ronald W Linssey. Tibial intramedullary nail distal interlocking screw placement; Comparism of the free hand versus distally based targeting device technique. Injury. 2011;32:21-25.
16. Yvan Arlettaz, Alexander Domminguez, Alain Farron. Distal locking of femoral nail: Evaluation of a new radiation-independent targeting system. Journal of trauma. 2012.
17. Anastropoulos G. Distal locking with mechanical jig. Injury; 1994.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/20653