

## Management of long bone fractures using SIGN nail: experience from a Nigerian Hospital

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### Abstract

**Background:** Intramedullary nailing with interlocking nails has become the treatment of choice for closed diaphyseal fractures of femur and tibia. When possible locked nailing should be performed as a closed procedure. Fractures fixed by interlocking nailing have comparatively less complications in fracture healing.

**Methods:** A retrospective study of all fractures treated using SIGN nailing system at the Lagos University Teaching Hospital between December 2011 and November 2015 was carried out using information obtained from patient records and SIGN data base. These included biodata, aetiology of fractures, fracture type, injury presentation interval, associated lesions, outcome as well as complications and challenges in treatment.

**Results:** A total of 184 fixations in 169 patients were carried out over a 4years period. The studied patients were aged 17 to 88years with mean of  $37.66 \pm 13.98$  years. One hundred and sixteen (65.2%) were aged below 40 years. There were 121 males and 48 females showing a male to female ratio 2.5:1. Road traffic accident was the most common aetiology (70.8%) The acute (recent) fractures made up about 86% of the cases

seen while chronic fractures were 14%, this included malunited fracture 3.8% and non-union 10.2% The surgical approaches were ante grade in 115 cases (62.5%) and retrograde in 69 (37.5%) cases. All the retrograde procedures were performed on the femur. Fifteen patients had multiple fixations The most frequently fixed fracture using SIGN nail were femur 62.5%, tibia 31.5% and humerus 6%. The major challenges included multiple fixations in multiply injured patient as well as Fixation in non- union and malunion of three to four years post injury without image intensifier.

**Conclusion:** Sign interlocking nail system is very effective in treatment of long bone fractures. The major challenges were seen in multiply injured patients with multiple fractures. Also patients that present after several years of injury with malunion and/or non-union may pose some challenges in treatment using SIGN nail.

**Keywords:** Sign, Intramedullary Nail, Image Intensifier, External Jig, Fractures.

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### Introduction

Fracture of the femur and tibia are the commonest musculo-skeletal injuries and fractures remain a challenge for orthopaedic surgeons as far as stabilization, alignment and in cases of open fractures skin coverage are concerned.<sup>1</sup>

The current practice is locked intramedullary nailing of these fractures a method of fracture fixation that has become the treatment of choice for closed diaphyseal fracture of femur, tibia and humerus<sup>2,3</sup>.

Their use has been extended to certain intra-articular fractures in combination with shaft fractures, open fractures, malunion, non-union and pathological fractures<sup>4,5,6</sup>.

Where possible locked nailing should be performed as a closed procedure, however interlocking nails are commonly performed using an image intensifier. These are expensive and not readily available in most resource

poor countries of the world<sup>7,8</sup>

Interlocking nailing has been increasingly used to treat both acute and chronic injuries to long bones successfully; it not only improves the quality of fracture care but also reduces cost. Use of SIGN (SURGICAL IMPLANT GENERATION NETWORK) nail is significant as it is the avant- grade in nail development for use in environment without image intensifiers<sup>7</sup>

This work which describes the authors experiences and challenges using this method in treatment of complex fractures such as segmental fractures, malunion, non-union and pathological fractures is expected to contribute to knowledge in our sub region , since there are few local studies in the literatures.

This study will also help to evaluate the outcome of this mode of fracture treatment in acute as compared to chronic fractures in resource poor region of the world where limb fractures commonly present very late.

### Materials and Methods

A hospital based study of all fractures treated using SIGN nailing system at Lagos University Teaching Hospital between December 2011 and November 2015 was carried out using information obtained from patient records and SIGN data base. These included biodata,

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aetiology of fractures, fracture type, injury presentation interval, outcome as well as complications as it affects acute and chronic fractures. Analysis of outcome of treatment with respect to the time of presentation time of union and complication was performed.

The SIGN interlocking nails were inserted following SIGN operation protocols either retrograde or ante grade depending on fracture configuration as determined radiologically preoperatively.

Postoperatively all patients had similar treatment and follow-up. All the patients were given peri and postoperative intravenous antibiotics which included 1gm Cephalosporin preoperatively followed by 1gm Cephalosporin daily for 5days.

Patients were mobilized very early within 72 hours and discharged home as soon as deemed fit enough. Fracture union was assessed clinically and radiologically immediate post-operatively, at 6weeks, 12 weeks and subsequently every 6 months. The fracture was considered to have united when there was no pain or tenderness at fracture site or by squat and smile demonstration or when there is bridging callous visible on plain radiograph. All fractures that did not unite before four and six months were seen as delay union while non-union was noted when union had not occurred after 8 months of surgery. All patients were followed up for over 12 months. Complications and difficulty encountered were noted.

## Results

A total of 184 fixations in 169 patients were carried out over 4years period using SIGN interlocking nailing system. The studied patients were aged 17 to 88years with mean of  $37.66 \pm 13.98$  years. One hundred and sixteen (65.2%) were below 40years. There were 121 males and 48 females showing a male to female ration 2.5: 1

Road traffic accident was the most common aetiology seen in one hundred and forty three (77.7%) patients followed by fall from height with sixteen (8.7%) patients; Gunshot was the cause in twelve (6.5%) patients. Others include Industrial accident, assault and Domestic accident with 1.1%, 2.2% and 3.8% respectively. The distributions of the involved bones include femur 62.5% Tibia and humerus 31.5% and 6% respectively. Fifteen patients had multiple fixations. The radiological configuration of the fracture lines were transverse 39%, oblique 46%, segmental 7% and comminuted 8%. Close fracture constituted 90.2% of the cases where as open fractures to was 9.8%. The acute (recent; presenting within four weeks) fractures made up about 86% of the cases seen while chronic fractures were 14%, this included malunited fracture 3.8% and non-union 10.2% The surgical approaches were ante grade in 115 patients (62.5%) and retrograde in 69 (37.5%) cases.

All the retrograde procedure were performed on the femur. Postoperatively plain radiograph confirmed that 98.4% (181cases) had satisfactory positioning of the nail and interlocking screws with distal missed in 3cases.

32% of the nails were surgically performed with image intensifier while the remaining 68% were done using slot finder and external Jig without image intensifier. Reasons were either surgeon's preference or non availability of image intensifier at the time of surgery.

Estimated mean blood loss was 850mls  $\pm$  120mls in acute fractures and 1095  $\pm$  107mls in chronic fractures.

Mean Union time was  $3.39 \pm 1.67$  months. Majority of the patients were followed up for 12months to determine the functional outcome. Fifteen patients had multiple fixations

Complications seen were screw loosening in two elderly patients, two nail breakages. Non-union was seen in 3 patients and delayed union observed in 2 cases. Superficial wound infections was seen in six patients all had initial non-union prior to the fixation Other complications were ankle stiffness, oedema and quadriceps wasting and these were treated with physiotherapy and limb elevation.

## Discussion

A fracture is well recognized as a break in the continuity of bone. They are mostly caused by road traffic accidents which is the most common cause of morbidity and mortality in the productive period of life.<sup>4,6,8</sup>

Patients between 20 years and 40 years of age constituted 65.2 % of the cases. This is not surprising because they are the active productive age group within the society.<sup>4,9</sup> The sex ratio 2.5:1 is also in keeping with other reports this goes further to emphasizes the greater vulnerability to males to trauma.<sup>5, 6, 7</sup> The choice of surgical method of treatment and/ or fixation is of great concern to the orthopaedic surgeons all over the world more so to surgeons in resource scarce countries of the world especially in West African subregions<sup>4,9</sup>.

In our study, fracture of femur were fixed using SIGN nail in 62.5% while tibia and humerus constituted 31.5% and 6.0% respectively. Previously most long bone fracture occurring in the diaphysis were fixed using plate and screws, in some cases with Kuntschner nails, however with recent advances in operative image intensifier, interlocking nail has become method of choice. And, indeed, has become the gold standard for the care of unstable long-bone fractures. However, for successful placement of nail and screws there may be the need for a reliable intra- operative image intensifier support,<sup>5,6,10</sup>

This is especially so in malunion, Non-union and severely commuted fractures where the anatomical configuration of the bone is altered. Interlocking nailing

has been increasingly used to treat both acute and chronic fractures to long bones.<sup>10,11</sup> These are commonly performed in developed countries using image intensifier.

However, it is now feasible to achieve interlocking nail insertion with SIGN (Surgical Implant Generational Network) by the use of an external jig and slot finder<sup>12,13</sup>. In our study 32% of the nails were surgically performed with image intensifier while the remaining 68% were done using slot finder and external Jig. Reasons were either surgeon's preference or non availability of image intensifier at the time of surgery. Only 3 three cases of missed distal screws were encountered, all in cases carried out without image intensifier which was not clinically significant.

Therefore successful interlocking nailing using the SIGN method without Image Intensifier is feasible and should not only improve the quality of fractured care, but should also lead to reduction of exposure to intra-operative ionizing radiations.<sup>4,11</sup>

Most of the patients received treatment in nearby hospital before presentation to our centre. Twenty five (14%) of the patients presented over 6 months post injury with either Non-union or malunion. Some of these patients were treated initially by traditional bone setters before presentation. In developed countries where facilities for operation and proper management are easily available most of their patients reach hospital in time ensuring better outcome.

Estimated mean blood loss was 850mls  $\pm$  120mls in acute fractures higher in patients with multiple fixations and 1095  $\pm$  107mls in chronic fractures, (more losses seen in chronic fractures and those patients with multiple fracture fixations.) Also the average operation time was 97.5  $\pm$  25.0min. The chronic fractures took more time than the acute fracture due to additional procedure required for bone graft and excision of the atrophic ends of the fracture site. Fifteen patients had multiple fixations which resulted in increased operation time and blood loss requiring blood transfusion.

In most studies the average union period has been identified as three to four months<sup>1,5</sup>. In our study our follow up extend beyond four months so it is not possible to comment exactly on incidence of delayed union as most of the delay occurred in patient with chronic fractures which ordinary is expected to have a long union time compared to acute fracture.

All the patients were allowed exercise in the bed within 24hours. Patients with isolated fracture were mobilized with on crutches or Zimmer frame on the very next day. Others were mobilized out of the bed in the first week of their operation. The patients were therefore discharge home early and encouraged to resume work with little or no complications noted. This is added advantage of interlocking nailing over other methods of

fracture fixation giving a better outcome.

Three of our patients who developed knee stiffness, all had fracture close to the knee joint. Two patients had nail breakage, both had exchange nail with larger diameter nails. Six (3.6%) cases of superficial wound infection were noted all were treated successfully with extended antibiotic administration. This level of infection is comparable with what was seen in other studies<sup>5</sup>.

Two cases of screw loosening due to severe osteoporosis were recorded. Both were seen in elderly patients with poor bone stock, they did not require additional intervention. The functional outcome was generally very good comparable to what was obtained elsewhere in the world.

It is important to emphasize that proficiency in the use of these SIGN interlocking nail instrumentation will come with practice and help decrease rate of missed screws and also reduce blood loss. The use of SIGN nail system with external Jig and slot finder has made interlocking nail fixation of fractures feasible in developing countries without Image Intensifier. Early presentation will certainly improve observed outcome.

### Conclusion

SIGN interlocking nail system is very effective in treatment of long bone fractures, particularly in developing countries like ours where image guidance is not always available. Delayed presentation and the presences of multiple fractures constitute major challenge to the use of this system of fracture care. We recommend it to other surgeons in our region and also advocate for earlier presentation among fracture patients to improve outcome of management.

### References

1. Enweluzo G.O, Adekoya-Cole T. A, Mofikoya B. O, Giwa S.O, Badmus O.O. Morbidity of open Tibia fractures in Lagos, Nigeria. East and Central. African Journal of surgery. 2015 20(2); 37-43.
2. Brumback R.J. The rationales of interlocking nailing of the femur, tibia and humerus. An Overview Clin orthop. Relat. Res. 1996: 324; 292-320.
3. Naeem-Ur-Razaq M, Qasim M, Khan MA, Sahibzada AS, Sultan S. Managemeng outcome of close femoral shaft fracture by open SIGN Interlocking nail. J Ayub Med. Coll Abbottabad; 2009; 21(1) 21-4
4. Ikem I.C; Oginni L. M, Bamgboye E. A. Open fractures of the lower limb in Nigeria. Int. Orthop. 2001; 25(6): 386-388.
5. Onabowale B.O ,Onuminya J. E, Essien A. I, Ukegbu N. D; The management of open tibia shaft fractures the National Orthopaedic Hospital experience . Nig J surg .1995; 2: 37-42.
6. Soni R. K, Mehta S.M, Awasthi B, et al ; Radiation . Free insertion of distal interlocking screw in tibia and femur nailing .A simple technique .J Surg. Tech. Case Rep 2012;

- 4(1) 15-18.
7. Ikem I. C, ogunlusi, J.D, Ine H. R; Achieving interlocking nails without using an image intensifier *Int. Orthop.* 2007; 31 (4):487-490.
8. Moor BK, Ehlinger M, Ariettaz Y. Distal locking of femoral nails mathematical analysis of the appropriate targeting range. *Orthop Traumatol Surg Res* 2012; 98: 85-9
9. Karuppiyah SV, Johnstone AJ, Distal locking in femoral intermedullary nailing system. *J Biomed Sci. Eng* 2012; 5(10): 593-6.
10. Shah RK, Moehring HD, Singh RP, Dhakal A. Surgical Implant Generation Network(SIGN) Intermedullary nailing of open fractures of the tibia. *Int. Orthop* 2004; 28(3): 163-166.
11. Abdislam K. M, Bonnaire F; Experimental model for a new distal locking aiming device for solid intramedullary tibia nails. *Injury* 2003; 34(5): 363- 366.
12. Krettek C, Konemann B, Miclau T, Kolbli T. Machreich T, Kromm A, Ischerne A: A new mechanical aiming device for placement of distal interlocking screws in femoral nail; *Arch Orthop. Trauma Surg.* 1998; 117 (3): 147- 152.
13. Atiq G, Satar A, Inam M; Treatment of long bones fractures with surgical implant generation network (SIGN) nail *RMJ* 2012; 37(2) 176-8