

Long Bone Fracture Fixation with Surgical Implant Generation Network Nail at Chattogram

Mohammad Qausarul Matin^{1*} Abdur Rahman² Md. Mizanur Rahman Chowdhury¹
Sayera Banu Sheuly³ Salma Akhter⁴ Chandan Kumar Das⁵

ABSTRACT

Background: The Surgical Implant Generation Network (SIGN) intramedullary nailing system was designed to treat long bone fractures in developing countries. SIGN project is the brain child of American Orthopaedic surgeon Dr. Lewis G Zirkle with objective of supplying free implants for long bone fracture patients who lives below poverty level. To evaluate the result of SIGN nail treatment for long bone fracture.

Materials and methods: This prospective observational study was carried out from February 2011 to February 2014 at the Department of Orthopaedics, Chittagong Medical College Hospital, Chattogram. Patients presented with trauma and long bone fractures were initially stabilized according to ATLS protocol and later on definitive fixation done with SIGN nail according to OT availability. Patient demography, fracture characteristics and outcome measures in terms of duration of surgery, hospital stay, complications (Superficial & deep infection) weight bearing time & union time were studied.

Results : Out of 68 patients, 61 were male and 7 were female. Age range was 18-65 years. 50 cases were femur fracture and 20 cases were tibia fracture. Among them 2 patients had bilateral femur fracture. In case of tibia, closed reduction was done in 8 cases. All the other cases were fixed after open reduction. 5 cases were revision surgeries which were previously fixed with other methods. In 6 cases, dynamization done due to delayed union. In 4 cases, there was distal screw hole infection. Hospital stay was 1-3 wks and time of union was 20 wks. 1 case of non union reported.

Conclusion: SIGN nail fixation for long bone fractures was the most effective method of treatment and had an excellent results. It is effective in fixation of acute fracture as well as late cases and non unions.

Key words : Femur and tibia; Fracture; Long bone; SIGN nail.

Introduction

Trauma is a growing global public health concern and a major cause of death and disability worldwide. Each year nearly 5 million people worldwide die from injuries, approximately the number of deaths caused by HIV/AIDS, malaria, and tuberculosis combined. Ninety percent of these injuries occur in developing countries and that number is growing. Road traffic accidents account for 1.2 million of these 5 million deaths. For each death from trauma, three to eight more are permanently disabled¹⁻³. Accidents involving motor vehicles are the main cause of nonfatal injuries, with majority being musculoskeletal trauma.

1. Associate Professor of Ortho-Surgery
Chittagong Medical College, Chattogram.
2. Assistant Professor of Ortho-Surgery
Chittagong Medical College, Chattogram.
3. Assistant Professor of Surgery
Chittagong Medical College, Chattogram.
4. Assistant Professor of Obstetrics and Gynaecology
Chattogram Maa-O-Shishu Hospital Medical College, Chattogram.
5. Professor of Ortho-Surgery
Chittagong Medical College, Chattogram.

*Correspondence: **Dr. Mohammad Qausarul Matin**
Cell: +88 01819 38 10 50
Email: drsaint007@hotmail.com

Submitted on : 6th October 2020
Accepted on : 7th December 2020

What is SIGN?

SIGN means Surgical Implant Generation Network. With the mission of improving fracture care worldwide, it was created in 1999 as a humanitarian, non-profit corporation. Goal was to provide improved health care and appropriate orthopaedic treatment of fractures at little or no cost to people in need throughout the developing world. SIGN project is the brain child of American Orthopaedic Surgeon Dr. Lewis G Zirkle. Under this project they provide SIGN nail with its accessories free of cost worldwide to under privileged people who simply can not afford health care after trauma. There are more than 150 projects worldwide in poverty stricken countries of Africa, North & South America and Asia⁴. We began our journey as SIGN family in February, 2011.

What's the speciality of SIGN nail?

The SIGN system is a solid Intramedullary Nail (IMN) with interlocking capability through a mechanical aiming device that enables the placement of proximal and distal interlocking screws without the need for image guidance. The nails are made of stainless steel, solid-stronger with less bending than hollow nails. Less infection as less area for biofilm to adhere. Slots-allow for compression and distraction of fracture site to accelerate healing. For operative fixation,

- No need of C-Arm
- No need of power reaming
- No need of fracture table.

So, can be used in countries where health care infrastructure does not provide these supports⁵⁻⁷. Chattogram is the port city of Bangladesh with lots of heavy industrial outlets with good population of trauma victims. Most of the victims are the working force and the only income generating source of their family. Due to economic constraints, most can not afford proper treatment leading to increasing number of permanent disability each year. SIGN opened the door for these poverty streaked sufferers and brought smile back to their family members.

This is a prospective observational study to evaluate the result of long bone fractures (Femur & tibia) treated with SIGN nail.

Materials and methods

This is a prospective observational study. Study period was between February 2011 to February 2014. The place of study was Department of Orthopaedics, Chittagong Medical College Hospital, Chattogram. Patients presented with trauma and long bone fractures were initially stabilized according to ATLS protocol. Patients who met the criteria & gave consent to get enrolled in the programme were selected and definitive fixation done with SIGN nail. Patient demography and outcome measures were studied in terms of duration of surgery, hospital stay, complications (Superficial & deep infection) & union time.

Inclusion criteria

- Age – 18 years & above
- Close fracture and Gustillo type-1, II & III-A fracture of shaft of tibia & femur
- Patient unable to bear expenses of treatment
- Who consented to come for follow up.

Exclusion criteria

- Age < 18 years
- Fracture within 5 cm of proximal & distal articular surface
- Gustillo type III-B & III-C fractures
- Fracture shaft with intra articular extension
- Serious head injury, spinal injury & polytrauma patient.

Before commence the study necessary permission was obtained from the proper authority.

Results

Total number of patients were 68. 61 were male and 7 were female. 11 cases lost in follow up.

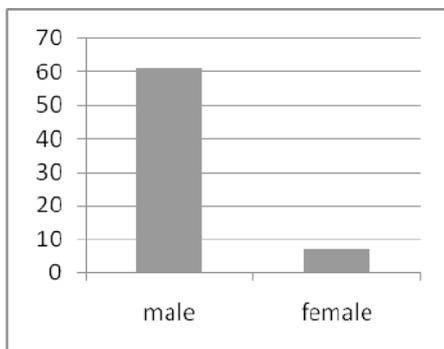


Figure 1 : Chart showing male-female ratio

Age range was 18-65 years (Av. 38 years).

59 cases were following motor vehicle accident.

50 cases were Femur & 20 cases were Tibia. One patient had ipsilateral fracture of femur and tibia. Another patient had bilateral fracture femur.

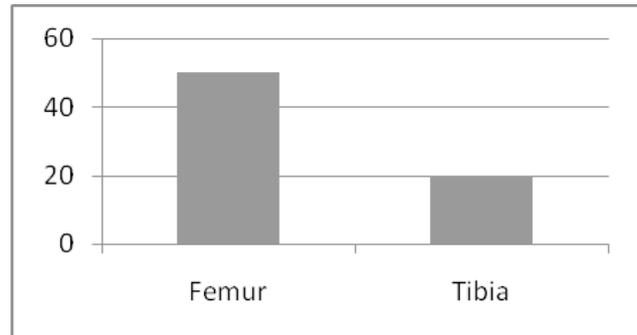


Figure 2 : Chart showing number of tibia and femur

8 cases of Tibia were done by closed method & rest were done by open procedure. Operative time was 105 minutes (Range 60-180 minutes). All done by antegrade nailing. 5 cases were revision surgeries. Dynamization in 6 cases due to delayed union. In 4 cases, distal screw hole infection found. Among them two were deep seated infection. Hospital stay was 1-3 wks (Av. 14 days). Weight bearing was allowed after 12 wks. Mean time of union was 20 wks. 1 case of non union reported.

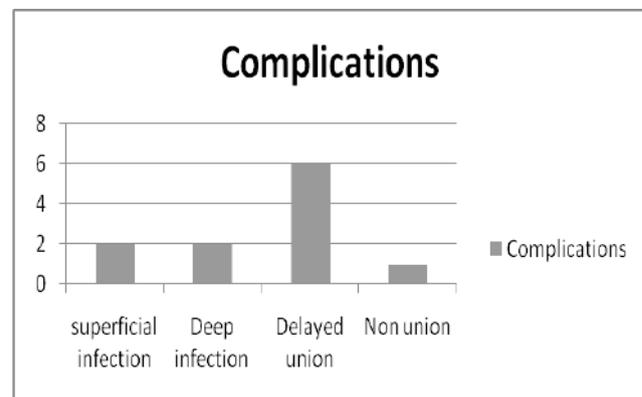


Figure 3 : Complications after surgery



Figure 4 : Segmental comminuted fracture Femur –pre op/post op /after union



Figure 5 : Fracture Tibia fibula- pre op/ after union/removal



Figure 6 : Pre op/ Post op/After union

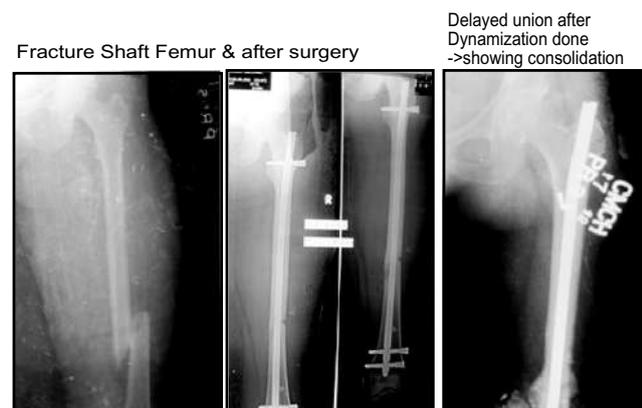


Figure 7 : Pre op/Post op/After union

Discussions

Road traffic accidents are the major cause of long bone fractures in developing world, and tibia and femur are the most commonly involved bones. Males most commonly involved. Most cases were following motor vehicle accident. SIGN nail is a solid nail with a 9 degree bend in proximal 5 cm. Has two dynamic locking slots distally and one dynamic and one static slot proximally. Designed to be placed without use of fluoroscopy, power reaming or a fracture table and may be inserted in either an antegrade or a retrograde direction⁵⁻⁷. Open reduction of the fracture usually necessary as no fluoroscopy used & since it is a solid nail no option to put guidewire after preliminary close reduction. Also there is a lengthy delay between the time of injury and surgery. Cause being late presentation and overload of patients at our centre. Closed IM interlocking nailing is the gold standard treatment⁸.

Mode of injury was motor vehicle accident in 59 out of 68 cases. All the cases in our series were done antegradely. All needed open reduction except 8 cases of tibia which could be done by closed method. Patients who were operated after three weeks and those with multiple comminution were augmented with autogenous cancellous bone graft. Follow up was done at 2 wks, 6 wks, 12 wks and subsequently at every 12 wks interval. Healing rate with SIGN nail was comparable to reported cases done by closed methods⁸⁻¹⁰. All fractures healed except one after intramedullary fixation with the SIGN nail. 6 fractures required nail dynamization for the treatment of delayed union. Two interlocking screws located distant from the insertion point missed the screw hole of nail, acted as polar screw and did not lead to any further complications. Two distal fractures healed in valgus angulation of >10 degree. Hospital stay for patients with SIGN surgery was 7-21 days. Complications encountered with this intervention included superficial (two patients) & deep infection (two patients) all involving the distal screw site which is comparable with studies on SIGN nail by Ikem et al and Ikpeme et al^{11,12}. The superficial infections were managed by antibiotics and dressings with povidone iodine. Deep infection necessitated nail removal after consolidation. Mean duration to union was 20 weeks which is comparable to other studies with different nails^{11,8}. One case of non union was reported. It was an exchange nailing for previously operated fracture shaft of femur with conventional first generation hollow nail. The patient was an expatriate worker living in Saudi Arabia and follow up could be done only through internet.

Limitations

- Sample size small.
- Single centre study.

Conclusion

We serve a population of around 15 million living in an area of around 250 sq. miles with even some part of bordering Myanmar. Modern management of trauma patient is very expensive, difficult and far beyond the reach of average populations of our country. With the SIGN surgery, it is free of cost. Patients heal more quickly, shortening their hospital stay. Therefore, the burden on families is reduced allowing them to return home and to their livelihood early. SIGN nail fixation for long bone fractures was an effective method of treatment and had excellent results. It is effective in fixation of acute fractures as well as late cases and non unions.

Disclosure

All the authors declared no competing interests.

References

1. Beveridge M, Howard A. The burden of orthopaedic disease in developing countries. *J Bone Joint Surg Am.* 2004; 86:1819-1822.
2. GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. A Systemic Analysis for the Global Burden of Disease study. *Lancet.* 2017; 390:1211-1259.

3. Zirkle LG Jr - Injuries in developing countries—how can we help? The role of orthopaedic surgeons. *ClinOrthop Relat Res.* 2008; 466 (10):2443–2450.
4. www.sign-post.org.
5. Zirkle LG -Technique Manual of SIGN IM Nail & Interlocking Screw System Insertion &Extraction Guide. Revision # TM. 2008;11(15):33.
6. Zirkle LG, Shearer D. SIGN technique for retrograde and antegrade approaches to femur. *Tech Orthop.* 2009; 24:247-252.
7. Carsen S, Feebel R. T, Part S. S. H, Simon D. A. Treatment with the SIGN Nail in closed Diaphyseal Femur Fractures Results in Acceptable Radiographic Alignment. *Clin Orthop Relat Res.* 2015; 473:2394-2401.
8. Ricci, William M. MD; Gallagher, Bethany MD; Haidukewych, George J. MD Intramedullary Nailing of Femoral Shaft Fractures: Current Concepts. *JAAOS.* 2009 ; 17(5):296-305.
9. EL-Menyar A, Muneer M, Samson D et al. Early versus late Intermedullary nailing for traumatic femur fracture management : Meta Analysis. *J Orthop Sur Res.* 2018; 160:3. Doi.org/10.1186/S-13018-0856-4.
10. Shah RK, Moehring D, Singh R et al. Surgical Implant Generation Network (SIGN) intramedullary nailing for open fractures of the tibia. *Int Orthop.* 2004; 28:163–166.
11. Ikem IC, Ogunlusi JD, Ine HR- Achieving interlocking nails without using an image intensifier. *IntOrthop.* 2007; 31(4):487–490.
12. Ikpeme I, Ngim N, Udosen A, Onuba O, Enembe O, Bello S. External jig-aided intramedullary interlocking nailing of diaphyseal fractures: Experience from a tropical developing centre. *Int Orthop.* 2011; 35:107-111.