

Interlocking Nail Screw Targeting With the *Sign* Interlocking System

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Abstract: Background: Long bone fracture fixation has undergone a series of developments over the years, with the use of locked intramedullary nails now being widely accepted as the treatment of choice for most long bone fractures. The challenge in the use of these locked nails has been in the accurate targeting of the screw holes to enable passage of the locked screws. The use of intraoperative imaging such as the C arm is a tool used to assist accurate screw hole targeting. Incentres that do not have such imaging assistance, the use of external jig systems are employed for screw hole targeting. The surgical implant generation network (SIGN) is one of such systems. We present the result of screw targeting with the SIGN system. **Methods:** This was a retrospective study carried out at the Jos University teaching hospital on patients who had fracture fixation using the SIGN interlocking nail system from January 2013 to October 2014. **Results:** 36 fractures were fixed using the SIGN system in patients whose ages ranged from 19 to 64 years with a mean age of 37 years +/-13.1 years. The male female ratio was 2.3:1. A total of 94 screws were inserted. 53 distal screws were inserted while 41 proximal screws were inserted. 3 screws were not within the nail. All the missed screws were distal screws. Total accurate screw hole targeting was 96.8% and total missed screw percentage 3.2%. Accurate distal screw percentage 94.3% while distal missed screw percentage was 5.7%. **Conclusion:** The SIGN interlocking system has a good mechanism for accurate targeting of the screw holes in interlocking nail fixation in the absence of intraoperative imaging modalities.

Keywords: Interlocking nail, screw, targeting, SIGN.

I. Introduction

Long bone fracture fixation has undergone several developments over time; from the use of various bone immobilizing devices, to the use of plate and screw fixation, to the use of non-locked intramedullary nails and now with locked intramedullary nails, which is currently accepted as the standard treatment choice for most long bone fractures(1-5). It has been shown to be an effective modality for long bone fracture fixation with good results(6-8). The interlocking screws were introduced to confer rotational stability on the construct which had hitherto been a constraint of the non-locked intramedullary nail(9-11). The interlocked nail is commonly locked with screws at the proximal and distal ends of the nail into each bone fragment of the fracture. The challenge with the interlocked nail has been in the accurate targeting of the screw holes to enable introduction of the locking screws. This problem is more prevalent with the distal screw hole(9, 12-15). Various modalities for targeting the screw holes have been used with results improving with better techniques. Commonly used is the free hand technique with intra operative fluoroscopy, the use of external jigs and more recently laser guided techniques and electromagnetic computerized tracking techniques have been employed to improve the accuracy of screw hole targeting and particularly for the distal screw hole(1, 3, 12, 13, 16, 17). The use of intraoperative image guided screw placement has shown good results and is widely employed(13, 15,18). The use of intraoperative image guidance such as the fluoroscopy or the use of the C arm however is not readily available in less developed countries around the world such as in sub Saharan Africa, parts of South America, and in some countries in the Middle East and Asia(19-21). There has thus been the challenge of using the interlocking nail with high rates of accurate screw positioning. Also the use of intra operative fluoroscopy alone in screw targeting also exposes the patient and surgical team to some levels radiation(18, 22,23). External jig systems can be employed also with fluoroscopy to reduce the radiation exposure(3, 4,12). Several systems are available which use external jigs to target the screw holes without the need of intraoperative image assistance or can be used with intra operative fluoroscopy to reduce radiation exposure(4, 14). The Surgical Implant Generation Network (SIGN) interlocking nail system was developed to meet the requirement of accurate locking screw positioning during fracture fixation using interlocking nails in resource poor countries and war torn environments, where intra operative imaging was not available(24). Incidentally it is in these countries that the burden of trauma is quite high. This study was carried out with a view to determining the result of screw placement using the SIGN interlocking nail system.

II. Methodology

This was a retrospective study carried out on prospectively collected data, at the Jos university teaching hospital, Jos Nigeria, from January 2013 to October 2014. Data was obtained from the SIGN surgery forms, patients case notes and post-operative x rays of patients who had interlocking nail fixation using the SIGN interlocking system. The SIGN system uses an external jig with slot finders and cannulated guides which approximate to the screw holes in the nail through which the locking screws are passed into the nail once it is inserted in the medullary canal. No intraoperative imaging assistance is required. All consecutive patients who had SIGN interlocking fixation were included in the study. Patients who had interlocking nail fracture fixation with other systems were excluded from the study. The data was analyzed for simple means and percentages using the Epi info statistical software.

III. Results

A total of 35 patients were recorded with 36 fractures fixed. The patients ages ranged from 19 years to 64 years with a mean age of 37 years +/-13.1 years. The male female ratio was 2.3:1. 28 patients had fixation of the femur (77.8%) while 8 patients had fixation of the tibia(22.2%), one patient had fixation of both the tibia and femur. Of those that had the femur fixed, 15 were via the ante grade method and 13 were done using the retrograde approach. A total of 94 screws were inserted. 53 distal screws were inserted while 41 proximal screws were inserted. 3 screws were not within the nail. All the missed screws were distal screws. Total accurate screw hole targeting was 96.8% and total missed screw percentage 3.2%. Accurate distal screw percentage 94.3% while distal missed screw percentage was 5.7%. For the proximal screws there was 100% accurate screw hole targeting.

Tables

Table 1. Table of fracture fixation.

Bone fixed	Number	Percentage %
Femur Ante grade	15	41.6 %
Retrograde	13	36.2 %
Tibia	8	22.2 %
Total	36	100 %

Table 2. Table of screw targeting insertion

Screw location	Number	Number of accurate screws and %	Number of missed screws and %
Proximal	41	41 (100%)	0 (0%)
Distal	53	50 (94.3%)	3 (5.7%)
Total	94	91 (96.8%)	3 (3.2%)

IV. Discussion

From the above findings the SIGN targeting device gives a high percentage of accurate screw hole targeting. In this study we got a total accurate screw placement percentage of 96.8%. The proximal screw holes were correctly targeted in all cases and the missed screws (3.2%) were in the distal holes, which has shown the relative difficulty in targeting the distal holes as also alluded to by several other authors (12, 13, 15). The use of external jig systems for screw hole targeting is becoming more popular not only for its use in the developing world but also in more developed countries as the use of external jigs with the intra operative fluoroscopy has been shown to reduce the radiation exposure times and its consequent hazards (3, 4, 12). The percentage of missed distal screws in this study was 5.7% which is similar to a study carried out by Babis et al which had a missed distal screw percentage of 5.2% (3). Ogunlusi et al (20) also reported several distal screw mal positioning, though the occurrence was greatly reduced by improved technique. A study by Sekimpi et al in Uganda also had 2 missed screws in 50 patients treated for femoral fractures with the SIGN interlocking nail system (24). A few factors have been shown to cause the relative difficulty in the distal screw hole targeting. Chief of these is the deformation the intramedullary nail undergoes as it is passed through the intramedullary canal (13). This deformation causes the distal screw hole in the nail to be mal aligned with the external jig distally and accounts for the difficulty in accurate targeting of the distal screw hole. The intra medullary cavity of the femur is bowed anteriorly and is not a straight canal (25). This bowing may not be exact to that of the nail being used, thus there is some deformation of the nail as it passes through the canal and this is made worse when the nail is passed with greater force required to pass it through the intramedullary canal. For the proximal screw hole though, its location in the intramedullary canal goes through a very short track within the intramedullary canal and thus, hardly any deformation occurs resulting in the screw hole aligning accurately with the external jig and resulting in easier targeting of the proximal screw hole. The SIGN system has been shown from the above results, that a fairly good percentage of accurate screw placements for interlocking nail can be achieved even in the absence of intra operative image guidance.

V. Conclusion

The accurate targeting of screw holes can be challenging and time consuming particularly for the distal screws in interlocking nail fixation of long bone fractures. The SIGN interlocking nail system has a good mechanism for accurate targeting of the screw holes in interlocking nail fixation of long bone fractures in the absence of intraoperative imaging modalities.

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