

# Functional Outcome of Solid Intramedullary Interlocking Nail in Tibial Diaphyseal Fractures

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## ABSTRACT

### Background

Tibial diaphyseal fractures are of high concern nowadays, both due to their increasing incidence as a result of motor vehicle accidents and also due to the high rate of associated complications. Closed intramedullary nailing is the treatment of choice in stabilizing displaced diaphyseal fracture of tibia. This study aims to evaluate functional outcome of solid intramedullary interlocking nail in tibial diaphyseal fractures.

### Method

This is a prospective observational study from June 2015 to December 2016 done in National Trauma Center, Kathmandu among 30 patients having closed or Gustilo type I and II open fractures. All fractures were fixed with solid intramedullary interlocking (SIGN) nail and followed clinically and radiologically for union and for any complications. Modified Johner and Wruh's criterion was used to assess functional outcome.

### Result

80% cases were males. Mean age was 32.16 years (range = 18-72 years). Road traffic accident was the most common cause (60%). 46.7% were closed fractures and 33.3% were comminuted or segmental. 40% had distal third fracture and fibula was also involved in 70% cases. Mean time for radiological union was 14 weeks and clinical union was 10 weeks. 30% had mild anterior knee pain which was managed with analgesics. 10% had mild superficial infection, which was managed with antibiotics. Excellent, good, fair and poor results were obtained in 66.67%, 10%, 13.33% and 0% cases respectively.

### Conclusion

Solid intramedullary interlocking nailing for closed tibial diaphyseal fracture has excellent outcomes. It can be performed without fluoroscopy. It provides high rate of union, less complications and early return to function.

## KEY WORDS

Fracture Fixation, Intramedullary, Tibial Fracture

## INTRODUCTION

Tibia is the most commonly fractured long bone because of its location.<sup>1</sup> Treatment of tibial fracture in adult is a challenge to orthopedic surgeons due to poor soft tissue coverage and poor blood supply. The acceptable treatment goal for fractured tibia is union: maintaining normal length, normal alignment without rotation and deformity, normal joint movement and reduced hospital stay. Closed IMIL nailing currently is considered the gold standard treatment for most closed and Gustilo Anderson type I, type II and type IIIA tibial shaft fractures.<sup>2,3,4</sup> Currently, there are two types of IMIL nail: solid and hollow. In this study, we used the SIGN (Surgical Implant Generation Network) solid nails which were donated free of cost to our institution by SIGN Network USA. Solid IMIL (SIGN) nail fixation has been popular amongst surgeons in our institute for quite some time. This study aims to assess the functional outcome of solid IMIL nail in our setup.

## METHODS

This study was a prospective observational study conducted in National Trauma Center and Bir Hospital, Kathmandu from July 2015 to December 2016 among 30 patients of  $\geq 16$  years of age with closed physis who had closed or Gustilo type I and II open tibial fractures located 7 cm below knee joint to 5 cm above ankle joint that were less than 2 weeks old. Fractures previously treated with external fixator, infected fractures, Gustilo Anderson Type III open fractures, polytrauma and multiple trauma and fractures in patients less than 16 years old or with open physis were excluded from the study. Surgeries were performed in the operation theatres of above mentioned hospitals using solid intramedullary SIGN nails by certified SIGN surgeons without the use of fluoroscopy, after taking informed consent from the patients. Patients were not charged for nails as these were donated to our institution.

Post-operatively, intravenous antibiotics (Cefazolin) was given for 3 days and then continued orally for next 5 days. Check x-rays were taken on 1<sup>st</sup> post-operative day. Isometric quadriceps exercises and knee and ankle joints range of motion exercises were started on 2<sup>nd</sup> post-operative day. Suture was removed on 14<sup>th</sup> post-operative day. Weight bearing as tolerated was started immediately next day if fixation was stable and progressed to full weight bearing as soon as patient felt comfortable. Mean duration for partial weight bearing was by 3.3 days and full weight bearing by 7 weeks. Patients were followed up clinically and radiologically on 2 weeks, 6 weeks, 12 weeks, 6 months and 9 months. Postoperative complication were noted in each visits like infection, compartment syndrome, delayed union, malunion, non-union, implant failure (breakage of nail or interlocking screws) etc. Radiological evidence of bony union such as trabecular bridging calluses across the fracture site in anteroposterior (AP) radiograph of leg

along with the signs of clinical union such as non-tender, immobile fracture site and weight bearing without pain and squat & smile was noted during each follow ups. Functional outcome was measured by Modified Johner and Wruh's criteria.<sup>5</sup>

Data was entered in Statistical Package for the Social Sciences (SPSS) version 22 for Windows and analyzed using appropriate tools. The collected data was analyzed by student 't' test for continuous variables and with chi-square test for the categorical variables.

**Table 1. Modified Johner and Wruh's Criteria**

Criteria	Excellent	Good	Fair	Poor
Nonunion/ infection	None	None	None	Yes
Neurovascular injury	None	Minimum	Moderate	Severe
<b>Deformity</b>				
Varus/Valgus	None	2-5°	6-10°	>10°
Ant/Posterior	0-5°	6-10°	11-20°	>20°
Shortening	0-5mm	6-10mm	11-20mm	>20mm
<b>Mobility</b>				
Knee	Full	>90%	90-75%	<75%
Ankle	Full	>75%	75-50%	<50%
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Mild limp	Significant limp

## RESULTS

Among 30 patients, 24 (80%) were males and 6 (20%) females. Male to female ratio was 4:1. Age of the patients ranged from 16 years to 72 years with mean age of 32.16 years. 20 patients were in the age group 18-39 years, 7 patients in 40-54 years, 2 patients in the age group 55-70 years and only one patient above 70 years of age. 18 patients (60%) had fracture as the result of road traffic accidents. 10 patients (33.3%) had fall injury and 2 patients (6.7%) had fracture due to physical assault. Motor cycle accident was the most common cause of road traffic accident. 60% (18) patients had fracture on the right side. 16 (53.3%) had closed tibial fractures. 8 patients (26.67%) had open Gustilo Anderson I fracture and 6 patients (20%) had open Gustilo Anderson type II fractures. Comminuted/segmental fractures were the most commonly encountered. 10 patients (33.3%) had comminuted or segmental fractures. 8 patients (26.67%) had oblique fractures. Transverse fracture and spiral fractures each accounted for 6 patients (20%). 12 patients (40%) had fractures of the middle third/midshaft and distal third each whereas proximal third fractures occurred only in 6 cases (20%). In 70% cases (21), fibula was also fractured along with tibia. In 19 cases, surgery was completed within 1 hour. Mean duration was 55.13 minutes (range: 37 – 80 minutes). Range of hospital stay was 3-14 days. Mean duration of radiological and clinical union was 14 weeks and 10 weeks respectively. 3

patients (10%) had superficial infection which was treated with antibiotics and resolved without any sequel. 9 patients (30%) had mild anterior knee pain which was managed with analgesics. Excellent results were seen in 20 cases (66.67%), good results in 6 cases (20%) and fair result in 4 patients (13.33%).

## DISCUSSION

Treatment of tibial fractures is expensive in our country, due to high cost of implants as well as low socio-economic status of the patients. We used SIGN nail in our study which was provided free of cost to our institution by SIGN Network USA and patients did not have to pay for it. Distal locking in intramedullary nail is usually time consuming. Due to the presence of external zig for distal locking and slot finder, it was easy to perform distal locking in SIGN nails. All surgeries were performed without fluoroscopic guidance which is a boon to a poor country like ours where such facilities are not available in all centers.

In our study, majority of the patients were under 40 years of age. This was comparable to other studies.<sup>6,7</sup> This could be due to the out-door activities, and occupational exposure of the younger age group population. Road traffic accident was the most common cause of injury accounting for 60% cases. It was also the commonest cause in studies by Hooper et al<sup>3</sup> and Bone et al.<sup>8</sup>

Weight bearing as tolerated was started immediately next day if fixation was stable and progressed to full weight bearing as soon as patient felt comfortable. Mean duration for partial weight bearing was by 3.3 days and full weight bearing by 7 weeks. All patients had normal knee, ankle and subtalar joint motion.

Radiological union was seen at around 14 weeks (range 13-16 weeks) and clinical union was achieved at an average of 10 weeks with range from 9-12 weeks. Ali Akhtar<sup>9</sup> described fracture union at an average of 5 months with range from 3-8 months. Manas Shah<sup>10</sup> described average radiological union at 15-16 weeks and clinical union at 12

weeks. I Khan et al<sup>11</sup> described radiological union at 163 days and clinical union at 3 months whereas IC Ikem et al<sup>12</sup> described radiological union at 3 months. RK Shah<sup>13</sup> described radiological union at 22 weeks. Earlier union in our study might be due to the inclusion of only closed or grade I and II open fractures in our study.

In our study, 30% cases had mild anterior knee pain, which was managed with oral analgesics and physiotherapy. 10% cases had superficial infection, which was managed with antibiotics and healed without any sequelae. There were no cases of implant failure or breakage. In study by I. Khan et al<sup>11</sup>, no nail was broken while interlocking screws were broken in 2 patients.

Final result was expressed in terms of Modified Johner and Wruh's criteria. Excellent results were seen in 20 cases (66.67%), good results in 6 cases (20%) and fair result in 4 patients (13.33%). There were no poor results. Ali Akhtar et al<sup>10</sup> reported 43.3 % excellent results, 33.3% good, 16.6% fair and 6.6% poor results using SIGN nail in tibial diaphyseal fractures. No other studies used this criterion for functional outcome of SIGN nail in tibial diaphyseal fractures.

## CONCLUSION

Solid intramedullary interlocking nailing system can be considered as a suitable option for treatment of closed and Gustilo I & II open fractures of tibia. Advantages include short operative time, early mobilization, short hospital stay and early weight bearing. The unique locking mechanism allows proximal and distal locking even without fluoroscopic guidance, hence the nail can be used at centers where fluoroscope is not available. We recommend a multicentre study with larger sample size along with control group and longer follow up to evaluate long term outcomes.

## DISCLAIMER

All nails were donated free of cost to our institution by SIGN Network USA. Patients did not have to pay for nails.

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