

## Surgical Management of Tibial Shaft Fracture of Adult Patients with Closed Antegraded Interlocking Intramedullary Nail

Md. Tariqul Islam<sup>1\*</sup>, Md. Nazibullah<sup>2</sup>, Anam Ahmed Ripon<sup>3</sup><sup>1</sup>Assistant Professor of Orthopedics, TMSS Medical College, Bogura, Bangladesh<sup>2</sup>Associate Professor of Orthopedics, TMSS Medical College, Bogura, Bangladesh<sup>3</sup>Registrar of Orthopedics, TMSS Medical College, Bogura, BangladeshDOI: [10.36347/sjams.2020.v08i09.039](https://doi.org/10.36347/sjams.2020.v08i09.039)

| Received: 31.08.2020 | Accepted: 08.09.2020 | Published: 28.09.2020

\*Corresponding author: Md. Tariqul Islam

## Abstract

## Original Research Article

**Background:** Tibial shaft fracture is relatively common fracture in all age groups followed by direct or indirect violence. Intramedullary interlocking nail is commonly used for treating fractures shaft of the tibia. We have very few data regarding this issue. **Aim of the Study:** The aim of this study was to assess the efficacy of interlocking intramedullary nail for the management of tibial shaft fractures of adult patients. **Material and methods:** This was a retrospective study and it was carried out during the period from January 2017 to January 2020 in TMSS Medical College & RCH, Bogura and Natore Trauma Centre & Hospital, Natore, Bangladesh. The study was approved by the ethical committees of both the mentioned institute. Before starting the main intervention the proper written consents were taken from all the participants. In total of 38 adult patients of above 18 years age from both sexes with closed fracture shaft of tibia were included as the study population. All data were collected, analyzed and disseminated by MS Office program. **Results:** The average duration of operation for each patient was  $48.553 \pm 6.46$  mins. The length of the incision among 48 patients recorded from 3~5cm and the average length of the incision was  $3.658 \pm 0.56$  cm. The average blood loss in the operation was  $34.211 \pm 4.73$  ml. The postoperative hospital stay was recorded from 7~14 day and the average hospital stay of those patient was  $9.911 \pm 1.98$  days. The number of X-ray exposure during the whole follow-up recorded from 11~17.5 seconds and average X-ray exposure time was 13.5 second. All the patients were able to walk properly at our last follow-up. Average weight bearing time was  $5.763 \pm 1.49$  weeks. In final outcome analysis of this study we found satisfactory result in 32 patients which was 84% and unsatisfactory in 6 patients which was 16% of the total study people. **Conclusion:** Intramedullary interlocking nail is an excellent method for closed, type1, 2 and 3A open fractures of tibia. The outcome of interlocking intramedullary nail is for the management of tibial shaft fracture has an excellent functional outcome.

**Keywords:** Tibial shaft fracture, Intramedullary nailing, Shaft fracture, Antegraded.

**Copyright @ 2020:** This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

## INTRODUCTION

Tibia is the commonest fracture amongst of all long bones of the body. The shaft of tibia is more subcutaneous so incidence of open fracture is very high. Management of the tibial shaft fracture is still a greater challenge. Distal third segment has a deficient blood supply so this area is prone to delayed union or non-union. Fracture of the tibia have a variety of treatment methods have been suggested for these injuries, including non-operative treatment, external fixation, intramedullary nailing and plate fixation [1]. However, each of these treatment options is associated with certain challenges. Non operative treatment may be complicated by loss of reduction and subsequent malunion. Similarly, external fixation of distal tibia fractures may result in insufficient reduction, malunion,

and pin tract infection. Intramedullary nailing is indicated for the majority of closed lower third tibia and middle and lower third junction fractures of the tibia [2]. Tibial shaft fractures are the third most common long-bone fractures in the pediatric age group with an incidence of 15%. These fractures are also the second most common fractures requiring hospitalization after femoral fractures. A closed reduction followed by casting is the mainstay treatment in these fractures. Though surgery is not required in most patients, it may be required in patients with open fractures, polytrauma, neurovascular injury, and unstable fractures causing unacceptable angulation. Surgical treatment can be performed with different fixation methods such as intramedullary fixation, crossed Kirschner wires (K-wires), or external fixators. External fixators are the first-line treatment in fractures with severe soft-tissue

loss, although they have been associated with several complications such as delayed union, malunion, high incidence of pin tract infections, and leg-length inequality [3, 4]. On the other hand, although rigid intramedullary nails are a popular treatment option in adults, they are not recommended in children due to an increased risk of proximal tibial epiphyseal injury. Therefore, in children, titanium elastic nails (TENs) are used instead, which are inserted into the metaphysis without causing epiphyseal injury. TENs are known to provide several advantages such as reduced soft-tissue injury, minimal proximal tibial epiphyseal injury, stable and flexible mobility, application without opening the fracture line, reduced treatment costs, and shorter operative times. Due to these advantages, TENs have become highly popular in the treatment of tibial shaft fractures [5, 6]. Nevertheless, TENs have also been shown to have several disadvantages such as an inability to achieve stability in patients with complex fractures or severe soft-tissue injury, delayed union in advanced-age pediatric patients, and increased risk of complications such as delayed union and compartment syndrome in the treatment of complex fractures in patients older than 14 years with a body weight of over 50 kg. For these reasons, elastic nails should be utilized only in selected patients [7, 8]. The use of locked intramedullary nails has advantages in that it is associated with higher fracture union rates in over 97% of the cases [9]. It results in lower tensile and shear stresses on the implant than plate fixation, lower infection rates, and less extensive exposure and dissection during insertion [10]. Locked intramedullary nailing has the advantage of preserving periosteal blood supply and controls alignment, translation, and rotation after fracture stabilization [11]. Locking of the nail allows for restoration of length and early functional use of the extremity, thereby reducing the length of hospital stay and facilitating early return to work [12]. Plate fixation for the operative management of tibial and femoral shaft fractures is less desirable. It is associated with additional soft tissue injury during exposure, reduced vascularity beneath the plate, increased blood loss, stress shielding of the bone, and increased risk of infection [13]. Locked intramedullary nailing for the operative fixation of tibial and femoral shaft fractures has become generally acceptable in the management of these fractures in Nigeria. The last decade has witnessed considerable development with regard to this procedure and the availability of both instrumentation and implants in various centers. The results of these procedures from various centers have been quite impressive and compares to that obtained globally [14].

## MATERIALS AND METHODS

This was a retrospective study and it was carried out during the period from January 2017 to January 2020 in TMSS Medical College & RCH, Bogura and Natore Trauma Centre & Hospital, Natore, Bangladesh. The study was approved by the ethical committees of both the mentioned institute. Before

starting the main intervention the proper written consents were taken from all the participants. In total of 38 adult patients of above 18 years age from both sexes with closed fracture shaft of tibia were included as the study population. Due to lack of easy availability of nail and high cost and study period, total number of cases was less. On clinical and radiological basis at the emergency or outpatient department of TMSS & RCH, cases were diagnosed as open and closed fracture shaft of tibia. According to the inclusion criteria of this study, adult patient of above 18 years old from both sexes with closed fracture shaft of tibia, open fracture G-I, II, and IIIA of shaft of tibia, segmental fractures and fresh fractures and patients with all extra articular closed fracture of distal 1/3<sup>rd</sup> were included. On the other hand, according to the exclusion criteria of this study, children (Age<18years), patients with open fracture, pathological fracture and physically unfit patients for anesthesia, patient with nerve injury, patients treated conservatively and those not giving consent for surgery, patient who were lost to follow up or died before fracture union were excluded. Interlocking nailing of tibia is indicated in comminuted fractures, segmental fractures, proximal and distal third of tibial fractures etc. Under spinal anesthesia the part is painted and draped properly. Then close reduction of fracture is done by traction and manipulation and the accuracy of the reduction is checked by c-arm. A short 4-5cm longitudinal incision is made over the upper aspect of the tibia through the mid-substance of the ligamentum patellae. A bone awl is introduced just medial to the tip of greater tuberosity and a guide wire is then passed cross the fracture and its position checked in the C-arm. If the guide wire is in proper position, it is advanced gently into the distal fragment. Manipulation of the fracture is done if there is difficulty in negotiating the guide wire through the fracture. Appropriate sized flexible reamers are passed through the guide wire the canal of both proximal and distal fragment is reamed to accept the nail. The appropriate sizes of nail is then fixed and introduced the nail through the proximal fragment in a ante grade manner and extend up to the distal end of proximal fragment and fracture is reduced and proceed the nail into the distal fragment up to 1-2cm above the upper margin of olecranon fossa by hammering. The distal locking screw inserted under the guidance of zig which is confirmed with C-arm. The proximal locking screw is then inserted under the guidance of zig and confirmed with C-arm. Then wounds are closed in layers and dressing is given. Proper length of the nail is critical because too short nail may not allow impaction into the distal part or lead to deep insertion of the nail into the humeral head, rendering potential removal of the nail extremely difficult. On the other hand, too long nail may keep the fracture ends apart and cause impingement of the shoulder. The selection of nail diameter should be equal or 1 size more than or equal to the reamer to provide a snug fit. Patient can be permitted to move the operated limb on the next day. Active and active assisted

exercises for the knee are done on 2nd POD. Bedside standing with an axillary crutches can be permitted after 2-3 days. Axillary crutches should be used during walking, non-weight bearing on the operated leg. Suture

removal was done in all patient on 12th POD. Partial Weight bearing on the affected limb should be permitted at the end of 6weeks.

**Table-1: Johner and Wruh's Criteria**

Criteria	Excellent	Good	Fair	Poor
Non-union, Osteomyelitis, Amputation	None	None	None	Yes
Neurovascular disturbances	None	Minimal	Moderate	Severe
<b>Deformity</b>				
Varus/valgus	None	6-Feb	10-Jun	>10
Anteversion / Recurvatum	0-5	10-Jun	20-Nov	>20
Rotation	0-5	10-Jun	20-Nov	>20
Shortening	0-5mm	6-10mm	11-20mm	>20 mm
<b>Mobility</b>				
Knee%	Normal	>80%	>75%	<55%
Ankle%	Normal	>75%	>50%	<50%
Subtalar%	>75%	>50%	<50%	-
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Insignificant	Significant
Strenuous activity	Possible	Limited	Severely limited	Impossible

Antegrade closed intramedullary nailing, and in some cases with minimal opening at the fracture site to achieve reduction, were used. The medullary canals were reamed in all the cases and two screws were inserted to achieve proximal and distal locking in those stabilized with locked intramedullary nail. Parameters with regard to intraoperative blood loss, postoperative wound infection, length of hospital stay, and fracture union were followed up. The outcomes were assessed by Johner and Wruh's criteria.

## RESULTS

In total 38 patients according to the inclusion and exclusion criteria of the study were included as the study population. There were total 22 male and 16 female patients in this study. The age group included in this study was over 18 years (from 18-70). In this study among all the participants the highest number of patients were from 20-30 years' age group which was 31.58%. Then 26.32%, 15.79%, 13.16%, 7.89% and 5.26% participants were from 30-40 years', 40-50 years', <20 years', 50-60 years' and >60 years' age groups respectively. In analyzing the mechanism of injury we found the highest number of patients were injured by road traffic accident which was 22 in number. Besides this, 6 patients and another 6 patients were injured by fall from height and physical assault. The rest 4 patients were found who were injured by 'fall over slippery ground'. In this study, in 63% patients were associated right side injury whereas 37% patients were associated with left side injury. In this study, open fracture (G-I, II & III A) were 16% whereas closed fracture were 84%. In analyzing area of bone

involvement among participants we found 18 patients with middle 1/3rd, 12 patients with distal 1/3rd and 8 patients with proximal 1/3rd bone involvement. The operative time of internal fixation was 4-9 days after injury, with an average of 6 days. All patients were followed up timely. Duration of operation time was recorded from 40~60 min and the average duration of operation for each patient was  $48.553 \pm 6.46$  mins. The length of the incision among 48 patients recorded from 3~5cm and the average length of the incision was  $3.658 \pm 0.56$  cm. Intraoperative blood loss during operation was recorded from 25 ~ 40 ml. The average blood loss in the operation was  $34.211 \pm 4.73$  ml. The postoperative hospital stay was recorded from 7~14 day and the average hospital stay of those patient was  $9.911 \pm 1.98$  days. The number of X-ray exposure during the whole follow-up recorded from 11~17.5 seconds and average X-ray exposure time was 13.5 second. All the patients were able to walk properly at our last follow-up. Average weight bearing time was  $5.763 \pm 1.49$  weeks. In final outcome analysis of this study we found satisfactory result in 32 patients which was 84% and unsatisfactory in 6 patients which was 16% of the total study people.

**Table-2: Age distribution of participants (n=38)**

Age	n	%
<20 years	5	13.16%
20-30 years	12	31.58%
30-40 years	10	26.32%
40-50 years	6	15.79%
50-60 years	3	7.89%
>60 years	2	5.26%

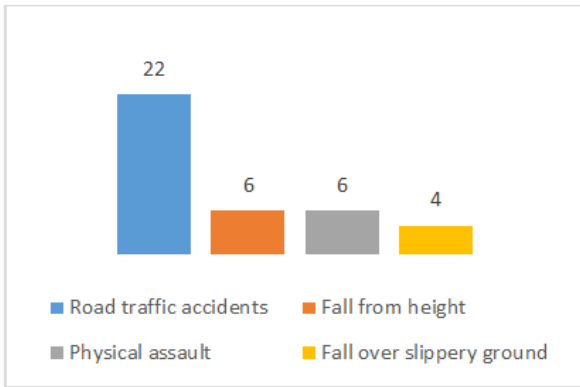


Fig-1: Mechanism of injury among participants (n=38)

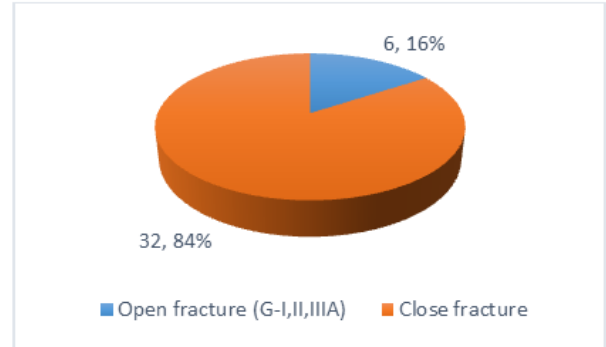


Fig-3: Types of injury among the participants (n=38)

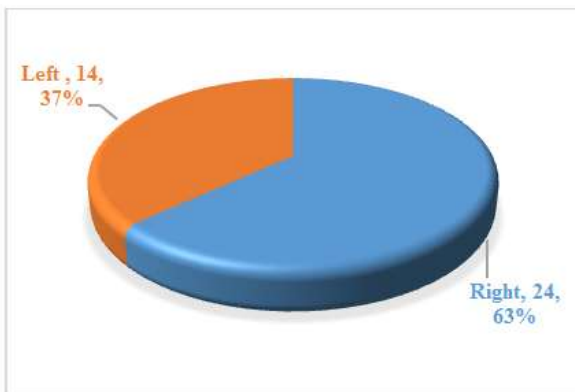


Fig-2: Mechanism of injury among participants (n=38)

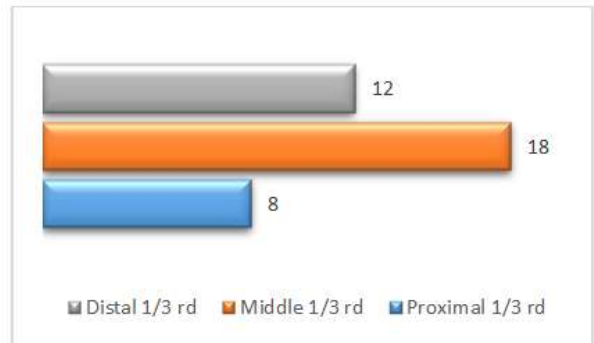


Fig-4: Area of bone involvement among participants (n=38)

Table-3: General outcomes among participants (n=38)

Parameters	Average value
Blood loss	34.211 ± 4.726 ml
Union time	15.579 ± 3.390 weeks
Hospital stay	9.911 ± 1.989 days
Incision length	3.658 ± 0.558 cm
Duration of operation	48.553 ± 6.46mins
Time (Day of fracture-operation)	5.474 ± 2.33 days
Weight bearing time	5.763 ± 1.49 weeks

Table-4: Outcome regarding Johner and Wruh's Criteria among participants (n=38)

Criteria	Excellent	Good	Fair
Non-union, Osteomyelitis, Amputation	38	0	0
Neurovascular disturbances	38	0	0
Deformity			
Varus/valgus	30	3 varus 4	10-Jun
		5 varus 2	
Anteversio/Recurvatum	0-5	10-Jun	20-Nov
Rotation	0-5	10-Jun	20-Nov
Shortening	0-5mm	6-10mm	11-20mm
Mobility			
Knee%	30	95% 6	78% 1
Ankle%	30	95% 4	65% 1
Subtalar%	>75%	>50%	<50%
Pain	None	Occasional	Moderate
Gait	Normal	Normal	Insignificant
Strenuous activity	Possible	Limited	Severely limited



**Table-5: Final outcome among the participants (n=38)**

Final outcome	n	Percentage
Satisfactory result	32	84%
Unsatisfactory result	6	16%

## DISCUSSION

Fracture shaft of tibia is the most common fractures seen in the arena of orthopedics. Over the years, various modalities of treatment have been invented. The principle of biological osteosynthesis is rightly applied in long bone fracture healing and hence the selection of intra-medullary interlocking nailing in this study for the management of closed, type1, 2 and 3A open fractures. In this study 32 patients were treated by closed reduction and internal fixation by interlocking intramedullary nail and 6 patients were treated by open reduction and internal fixation by interlocking intramedullary nail. Minimum follow up time was 6 months and maximum 18 months. Most of the patients were found from under 20-30 years of age group (32%) while next common age group 31-40 years (26.31%). The mean age incidence was 35.07( $\pm$ 13.09). Male population was constituted 57.89% of causes while the females made up remaining 42.10%. Student were affected more than others (26.31%) and second next group were housewife (23.68%) in this series. Road traffic accident was the most common cause of the injuries in this study 57.89%. Second common cause was fall from height and physical assault counting each approx. 15.79%. In this study, right side affected more (63.16%) than left side (36.84%). Most fracture occurred in the middle third of the shaft of tibia (47.37%), followed by lower third (31.58%) and junction between proximal and middle third 21.05%. In this series the period between time of injury and operation ranged from 3 days to 12 days with an average 5.474  $\pm$  2.33 days. Postoperative hospital stay in this series was minimum 7 days and maximum 14 days Mean postoperative stay 9.911  $\pm$  1.989 days. The number of femoral shaft fractures managed operatively by intramedullary nailing far outnumber those carried out for tibial shaft fractures, as noted in our series. Similar studies have reported the same pattern with up to 50% of tibial fractures being managed conservatively with good results [15]. Very young adults were found to be commonly affected by these fractures as they occur following high energy injuries such as motor vehicular accidents. The predisposition of this particular age range correlates with their activity level and lifestyle. Although union rates of over 95% have been reported following intramedullary nailing, our series reported a slightly lower union rate of 84.2% [9]. This may be associated with assessment time. In most of the reported series, the time to union were assessed at between 20 weeks to 25 weeks [16]. In our series the union rates were assessed at 16 weeks. Our series also substantiated the benefit of locked intramedullary nailing with regards to reduced blood loss, good union rates, reduced

length of hospital stay, reduced infection rate, and early ambulation [11]. The use of alternate implant was found to be quite high, with 64.5% of the reasons being financial constraints. Poverty and financial constraints have been found to be a major impediment in accessing qualitative health care [17]. Union time of fractures in this series was minimum 12 weeks and maximum 24 weeks with the Mean 15.579  $\pm$  3.390 weeks. Postoperative infection (Superficial wound infection) in 4 patient, which was controlled by regular dressing and sensitive antibiotic and knee and ankle pain in 2 cases. In this study infection rate was 10.53% due to our operation theatre facilities are not adequate and knee & ankle pain 5.26% may be due to involvement of the patellar tendon and infra-patellar pad of fat, also due to technical operative fault like protrusion of nail. In this study, overall satisfactory result was found in 32 (84%) cases and unsatisfactory in 6 (16%) cases.

## CONCLUSION

Intramedullary interlocking nail is an excellent method for closed, type1, 2 and 3A open fractures of tibia. The outcome of interlocking intramedullary nail is for the management of tibial shaft fracture has an excellent functional outcome. These results may be helpful in the treatment arena of orthopedics and in further similar studies. But this study was conducted on a small sized sample. So the findings of this study may not reflect the exact scenario of the whole nation.

## REFERENCES

- Walker M, Palumbo B, Badman B, Brooks J, Van Gelderen J, Mighell M. Humeral shaft fractures: a review. *J Shoulder Elbow Surgery Am Shoulder Elbow Surg.* 2011; 20(5):833–844.
- Rommens PM, Kuechle R, Bord T, Lewens T, Engelmann R, Blum J. Humeral nailing revisited. *Injury.* 2008; 39(12):1319–1328.
- Joeris A, Lutz N, Wicki B, Slongo T, Audigé L. An epidemiological evaluation of pediatric long bone fractures - a retrospective cohort study of 2716 patients from two Swiss tertiary pediatric hospitals. *BMC Pediatr.* 2014; 14:314.
- Galano GJ, Vitale MA, Kessler MW, Hyman JE, Vitale MG. The Most Frequent Traumatic Orthopaedic Injuries from a National Pediatric Inpatient Population. *J Pediatr Orthop.* 2005; 25:39–44.
- Ligier J, Metaizeau J, Prévot J, Lascombes P. Elastic Stable Intramedullary Pinning of Long Bone Shaft Fractures in Children. *Eur J Pediatr Surg.* 1985; 40:209–212.
- Patel NK, Horstman J, Kuester V, Sambandam S, Mounasamy V. Pediatric tibial shaft fractures. *Indian J Orthop.* 2018, 52, 522–528.
- Gordon JE, Gregush RV, Schoenecker PL, Dobbs MB, Luhmann SJ. Complications After Titanium Elastic Nailing of Pediatric Tibial Fractures. *J Pediatr Orthop.* 2007; 27:442–446.

8. Pandya NK, Edmonds EW, Mubarak SJ. The incidence of compartment syndrome after flexible nailing of pediatric tibial shaft fractures. *J Child Orthop*. 2011; 5:439–447.
9. Winkquist RA, Hansen ST Jr, Clawson DK. Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases. *J Bone Joint Surg Am* 1984; 66:529- 39.
10. Strecker W, Suger G, Kinzl L. Local complications of intramedullary nailing. *Orthopade*. 1996; 25:274- 91.
11. Timmerman LA, Rab GT. Intramedullary nailing of femoral shaft fractures in adolescents. *J Orthop Trauma*. 1993; 7:331-7.
12. Court- Brown CM, Keating JF, McQueen MM. Infection after intramedullary nailing of the tibia. Incidence and protocol for management. *J Bone Joint Surg Br*. 1992; 74:770- 4.
13. Huang P, Tang PF, Yao Q, Liang YT, Tao S, Zhang Q. A comparative study between intramedullary nailing and plate- screw fixation in the treatment of tibial shaft fractures. *Zhongguo Gu Shang*. 2008; 21:261- 3.
14. Duan X, Al- Qwbani M, Zeng Y, Zhang W, Xiang Z. Intramedullary nailing for tibial shaft fractures in adults. *Cochrane Database Syst Rev*. 2012; 1:CD008241.
15. Toivanen JA. The management of closed tibial shaft fractures. *Current Orthopaedics*. 2003; 17:167- 75.
16. Brumback RJ, Uwagie- Ero S, Lakatos RP, Poka A, Bathon GH, Burgess AR. Intramedullary nailing of femoral shaft fractures. Part II: Fracture- healing with static interlocking fixation. *J Bone Joint Surg Am*. 1988; 70:1453- 62.
17. Rodin J, de Ferranti D. Universal health coverage: The third global health transition? *Lancet*. 2012; 380:861- 2.