Original Article

Evaluation of the treatment of Open Fracture of Tibia by Primary Nailing

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ABSTRACT

Aim
Open fracture of the tibia is most common in road traffic accident specially motor cycle accident. Topics of debate in the orthopaedic traumatology continue regarding the specific methods of bone stabilization and soft tissue management of open fracture of Tibia.

Objectives
To evaluate the results of intramedullary nailing in the open fractures of the tibia in Combined Military Hospital, Dhaka.

Material and Methods
A prospective study was done from January 2018 to June 2019in Combined Military Hospital, Dhaka. Total twenty cases were selected who sustained open fractures of tibia Gustilo and Anderson grades I, II and IIIA. Primary undreamed intramedullary interlocking nail fixation done after thorough debridement and wounds were closed with suture. All the patients were followed up for a minimum of one year.

Results
Of the total twenty cases, ten were of grade I, seven were of grade II and three were of grade IIIA injury. Dynamization was done in nine cases. The average time to union was 16.0 weeks in the grade I cases, 18.3 weeks in the grade II cases and 23.6 weeks in the grade III A cases. The mean time to union was 19.3 weeks. Infection occurred in 3 cases. Mal union was observed in one case of type IIIA. No case had any implant failure (nail / screw breakage), or deep vein thrombosis.

Conclusion
From our study we have concluded that the unreamed intramedullary nailing in cases of open fractures of the tibia with soft tissue closure results faster soft tissue and bony healing. Biomechanical stability, early rehabilitation and infection rates are also comparable to those which are seen with other methods.

Keywords
Open fracture tibia; Primary Intramedullary nailing; Functional outcomes.

INTRODUCTION

Open fracture of the Tibia is most common in road traffic accident specially motor cycle accident[1]. Topics of debate continue in the specific methods of bone stability and soft tissue management of open fracture of Tibia.[2] Among all open fractures, the tibia fracture alone are 63% .[3] The peculiar blood supply and the less soft tissue cover specially the shaft of the distal tibia make these open fractures vulnerable to infections and nonunions. The infection rate may be as maximum as 50% in the Gutillo type III-A open fractures.[3,4] Measures which were made to decrease these complications have lead to various protocols which include immediate prophylactic intravenous antibiotics, staged soft tissue debridement, fixation of the fractures, soft tissue covers as soon as possible and primary bone grafting.[5,6] External fixators have been popular earlier because it was relatively easy to

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apply and the less effect on the blood supply of the bone, but these advantages have been limited by increase rate of pin tract infections, the difficulties in soft tissue management and the risk of malunions or nonunions. The use of primary reamed intramedullary nails in the treatment of open fractures of tibia is controversial. On the other hand reamed nails give better stability to the fractures, their use causes increasing infections and nonunions as a result of the damaged endosteal blood supply.[7] Unreamed intramedullary nails may give less stability at the site of the fractures.[8,9] The various methods which are used for managing open fractures of the shaft of tibia are a practise of the ongoing efforts which are being made to improve the outcomes of the treatment of these fractures and of the continuing pursuit of more efficient and advanced methods for treating these fractures.[10] Early fixation in open fractures of the tibia by intramedullary nail is becoming a well-accepted treatment regimen in the western world. The aim of the present study was to evaluate the results of primary unreamed intramedullary nail fixation in open fractures of the tibia in the Combined Military Hospital, Dhaka.

MATERIALS AND METHODS

Total 20 patients were included in this study. Inclusion criteria were (a) patients sustained open fractures of the tibia within the first 48 hours of being injured (b) patients with fractures of the tibia within the proximal fourth of the tibia or within four centimeters of the ankle joint. Exclusion criteria were (a) history of any previous bony surgery of the same tibia (b) stiff knee (c) age less than 14 years (d) coagulation disorders and (e) head injuries. The fractures were classified according to the method of Gustilo and Anderson.[3,11] In emergency, the wound was thoroughly washed with normal saline, covered with sterile dressing and the limb was splinted. This was followed by adequate analgesia, tetanus prophylaxis and injection Amoxycillin+ Clavulaunic Acid-1.2 gm which was given intravenously 8 hourly. After a routine workup, an undreamed tibialinramedullary nailing was done by using image intensifier guidance. Both proximal and distal interlocking were done by using two screws for each (Figure-1).

The wound was closed in layers to cover the bone. The drain was removed on the third postoperative day. The intravenous antibiotics were continued for seven

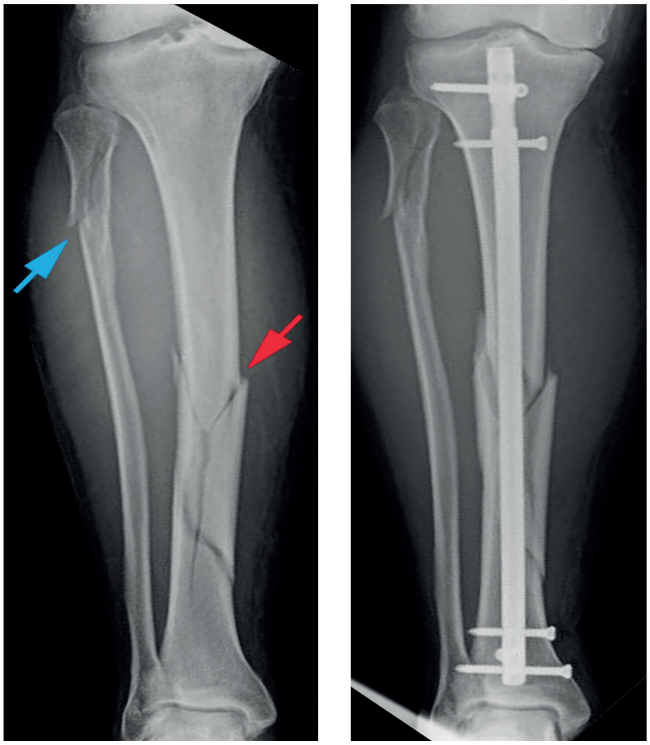

Figure-1: Primary Nailing of Open fracture shaft of Tibia.

days. If the cultures were positive for bacterial growth, then the antibiotics were continued accordingly till the cultures became negative. Physiotherapy was instituted from the third postoperative day, mobilized with appropriate walking aids, as soon as the pain permitted. Initially mobilization was started with a non-weight bearing crutch support walking, followed by a toe touch crutch support walking and progressive weight bearing, depending upon the callus formation. The patients were followed up at monthly intervals of 6 months and 3 monthly upto one year. In every follow up, the patients were assessed both clinically and radiologically for infections, the union and the range of motion at the knee and the ankle. Dynamization was done only in those cases where the fractures did not show good signs of union between 6-10 weeks. Functional evaluations were done, based on the rating scale by Ketenjian and Shelton and modified by Yokoyama *et al.*[12,13]

ETHICAL CLEARENCE

This Research Got Ethical approval from the Ethics Committee of Dhaka CMH.

RESULTS

Table I: Distribution of the respondent as per the Gustilo and Anderson classification (n=20)

Gustilo and Anderson classification	Frequency (n)	Percentage (%)
Grade I	10	50
Grade II	07	35
Grade III	03	15
Total	20	100

Table II: Distribution of the respondent according to Correlation between injury surgery interval and incidence of infection (n=20)

Time interval between the injury and the surgery	Frequency	Infection occurred n (&)
Operated within 8 hours of injury	10	0(0)
Operated after 8 hours of injury	10	3(15%)
Total	20	3(15%)

Table III: Distribution of the respondent according to the closure of the wound (n=20)

Closure of the wound	Frequency (n)	Percentage (%)
Primary closure	12	60
Secondary closure	08	40
Total	20	100

Table IV: Distribution of the respondent according to Dynamization (n=20)

Dynamization	Frequency(n)	Percentage (%)
Yes	9	45
No	11	55
Total	20	100

Table V: Distribution of the Dynamized Cases according to Grading (n=20)

G & A Grading(*)	No. of cases	Status at 6 months	Management	Final Outcome at 24 months
Grade I	1	Union	-	United
Grade II	3	Union	-	United
Grade III A	5	Union	-	United

Table VI: Distribution of the respondent according to average time to union (n=20)

Average time to union	Frequency	Percentage (%)
grade I	16.0 weeks	60
grade II	18.3 weeks	02
grade III	23.6 weeks	
The mean time to union was 19.3 weeks		

Table VII: Distribution of the respondent according to complications after intramedullary nailing (n=20)

Complication		I	II	IIIA	Total	Percentage (%)
Infection		0	0	3	3	15
Delayed Union		0	0	0	0	0
Mal Union		0	0	1	1	5
Nail / Screw Breakage		0	0	0	---	---
Compartment Syndrome		0	0	0	0	---
Deep Vein Thrombosis		0	0	0	---	---
Anterior Knee Pain		1	2	3	6	30
Limb Length Discrepancy		0	0	1	1	5
Restriction of Knee Motion	75 to 50%	1	0	1	3	15
	Less than 50%	1	0	0		
Restriction of Ankle Motion	75 to 50%	1	0	2	3	15
	Less than 50%	0	0	0		

DISCUSSION

In this study, we included twenty open tibial fractures, with a follow up of one year. Out of twenty open tibial fractures as per the Gustillo and Anderson classification 10 were of grade I, 07 were of grade II, 03 were of grade IIIA .[3,11] The time interval between the trauma and the operation was less than 8 hours in 10 cases, it was 8-16 hours in 7 cases, it was 16-24 hours in 3 cases. The wound closer was done primarily in 12 cases; secondery closure was done in 8 cases. We were able to do primary closure of the wound in 60% cases (12) and a secondary closure was done in 40% of the cases (8). These treatment outcome were comparable to those of Yokoyama *et al.*,[13] who reported successful primary closures in 70.2% cases and secondary closures in 29.8% cases. As there were no external fixator frames around the injured legs it was easier for us to do soft tissue management. Dynamization was done in 9 cases(45%) (Table-IV), where no signs of union were present at

Table VIII: Distribution of the respondent according to functional results (n=20)

Functional results	I	II	III A	Total	Percentage (%)
Excellent • Normal	5	5	2	12	60
Good • Occasional pain with prolonged use • Joint motion, 75% normal • Trivial swelling • Normal gait	2	1	1	4	20
Fair • Pain on ordinary activity • Joint motion, 50% normal • Small amount of swelling • Slight limp	0	0	3	3	15
Poor • Constant pain • Joint motion, < 50% normal • Any visible deformity • Limp, gait on cane or crutch	1	0	0	1	5

6-10 weeks. At 6 months of follow up all cases showed union. Routine dynamization was not done in our study. Whittle *et al.*,[14] have stressed that in unreamed nailing for open tibial fractures, the locking bolts should be removed only if there is minimal callus at the fracture site at 12-16 weeks of follow up. Yokoyama *et al.*,[13] reported a mean union time of 15 months in more than 50% of the type-III fractures, whereas the overall mean union time in their series was 6.6 months, which was comparable with our series (5 months). Agrawaawal A, *et al.* conducted a study in 2013 where Dynamization was done in 9 cases. The average time to union was 16.0 weeks in the grade I cases, it was 18.3 weeks in the grade II cases, it was 23.6 weeks in the grade III A cases, it was 28.4 weeks in the grade III B cases and it was 32 weeks in the grade III C cases. The mean time to union was 20.7 weeks.[15] The average time to union was 16.0 weeks in the grade I cases, it was 18.3 weeks in the grade II cases, it was 23.6 weeks in the grade III A cases. The mean time to union was 19.3 weeks. Inspite of thorough wound debridement and adequate soft tissue coverage, there was overall 15% infections, all of which were in the Grade IIIA open fractures and all these patients had been operated after the golden time period interval. The delay in the surgery could be the reason, because our institute is a tertiary referral centre where patients come after a primary management outside. The delayed management of these high velocity type III injuries with extensive tissue damage and contamination exacerbates bacterial colonization and chronic deep infections. Gustilo and Anderson reported a 2-16% incidence of infections, a majority of which were type III compound injuries.[11] Sargeant *et al.*, suggested that cortical necrosis is less likely to occur with a loosely fitted intramedullary nail than a snugly fitted reamed nail.[16] The main complication was infection, which occurred in 03 cases (Table-IV). Three cases of Grade III A got infected (1 case with Coagulase Negative *Staphylococcus* and 2 cases with *Pseudomonas aeuroginosa*). Both were successfully managed with repeated wound debridements and antibiotics accordingly. Malunion was observed in 1 case of type IIIA. No case had any implant failure (nail/screw breakage) or deep vein thrombosis. Reduced ranges of motion were observed at the knees in 3 cases and at the ankles in 3 cases. Anterior knee pain was seen in 6 cases. A limb length discrepancy was observed in 1 case of type IIIA, which was less than 1cm.

Based on the functional grading scale which was produced by Ketenjian and Shelton[12] and modified by Yokoyama *et al.*,[13] we recorded excellent results in 12 cases (60%); good results in 4 cases (20%); fair results in 3 cases (15%); and poor results in 1 case (5%). In our study, anterior knee pain was observed in 30% cases. Court-Brown *et al.*,[17] reported a 36% incidence of anterior knee pain and they advocated the techniques of using a more upper and a lateral entry point, hyper flexing the knee during the nail insertion and extending the knee during the screw insertion to lessen the irritation of the overlying tendons. We recorded restricted motions at the knees in 3 cases (15%) and restricted motions at ankles in 3 cases (15%). This incidence can further be reduced by early knee and ankle mobilization with the use of quadricep exercises. Based on the functional scale of Ketenjian and Shelton [12], which was modified by Yokoyama *et al.*, [13], we encountered 1 poor result in a case of type I injury. This patient had an associated ipsilateral fracture at the lower end of the femur (closed). In this case, the tibial fracture was found to be united at 18 weeks of follow up, but the femoral fracture went into a delayed union. This patient could not do knee mobilization early, resulting in a decreased range of motion at the knee (less than 50% of the

normal). Regarding functional results as per Ketenjian and Shelton[12] Criteria modified by Yokoyama et al,.[13] in our study, 12 patients (GradeI-5 cases, GradeII-5 cases, Grade IIIA-2 cases) showed Excellent results, 4 patients (GradeI-2 cases, GradeII-1 cases, Grade IIIA-1 cases) showed Good results and 3 patients of grade IIIA showed fair results. Yokoyama *et al.*, [13] reported 89% good to excellent results. These results are comparable to our results (good to excellent results in 83.4% of the cases). Ali A, *et al.* found in their study that excellent result were obtained from 9 cases (75%), good results were found in 2 cases (16.67%), fair results from 1 case (8.33%).[18] In our results showed that the aggressive treatment of the open fractures of tibia is effective. We accept that this approach is radical and that it has been claimed that immediate soft tissue coverage is not safe. However, the analysis of our results showed good union rates and low rates of infections, thus supporting the concept that a delay is not necessary if the healthy soft tissues can be imported reliably into the zone of the injury. Overall, these results show that in the grade I, II and IIIA open tibial fractures, a primary unreamed intramedullary nailing can be safely done, with minimal complications and excellent functional results.

CONCLUSIONS

From our study it can be concluded that the primary unreamed intramedullary nailing in cases of open fractures of the tibia with soft tissue closure results faster soft tissue and bony healing. Biomechanical stability, early rehabilitation and infection rates are also comparable to those which are seen with other methods.

Conflict of Interest: Nil

Authors's contribution: All authors contributed equally in the work.

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