ORIGINAL ARTICLE

EFFICACY AND SAFETY OF INTERLOCKED INTRAMEDULLARY NAILING FOR OPEN FRACTURE SHAFT OF TIBIA

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Background: Due to increasing population and changing human habits the number of accidents and high energy trauma is rising. Management of open fracture tibia is a complex problem and is a challenge for both orthopaedic and plastic surgeons. The study was carried out to ascertain the efficacy and safety of interlocked intra-medullary nailing for open shaft tibial fractures in patients presenting at or after 24hr of injury. **Methods:** In this descriptive case series, over a period of 6 moths, 163 consecutive cases of open fracture of tibial shaft were reviewed in terms of clinical profile, time of presentation, and gender distribution. **Results:** In this study mean age was 30±0.02 years. Males comprised 85% of study population while 15% were females. Gustilo-I type fracture and Gustilo-II type fracture was diagnosed in 90% and 10% patients respectively. Thirty three percent patients had wound infection while fracture union was found in 15% cases. Moreover interlocked intramedullary nailing for open fracture shaft of tibia was safe in 80% patients while this procedure was effective in 85%. **Conclusion:** Un-reamed, interlocked intra-medullary nailing may be considered as a suitable option for treatment of open fractures of tibia.

Keywords: Tibia, intramedullary nailing, open fractures shaft

J Ayub Med Coll Abbottabad 2016;28(2):341–4

INTRODUCTION

Tibia is one of the long bones of human body. Due to its superficial location tibial fractures are common.[1] Open fractures of the tibial shaft are ordinarily a result of high energy trauma e.g., road traffic accidents.[2] Due to increasing population and changing human habits the number of accidents and high energy trauma is rising.[3] Management of open fracture tibia is a complex problem and is a challenge for orthopaedic surgeons as well as plastic surgeons.[4–6] Different options for management of open tibial fracture are irrigation, external fixation, debridement, intra-medullary nailing external fixation and plating.[1–7]

Currently the treatment of choice for fractures of tibial shaft below Gustilo type-IIIA presenting within 6–8 hours is locked intra-medullary nailing. The benefits of intra-medullary nailing include early movement of adjacent joints and preservation of the sleeve of soft tissue around the fracture site. With the proximal as well as distal locking of the intra-medullary nails one can control the alignment, rotation and length in fractures which are unstable. The locking of nails also allows for the steadiness of tibial fractures distal to the tibial tubercle or those located as far as 3–4 cm proximal to the ankle joint[1,8] as shown in figure-1.

After intramedullary reaming, a large size nail can be used with reaming and small type nail used in non-reamed type nailing.[8,9] Multipotent stem cells and osteoblasts are used in reaming for bone grafting because these cells have a relatively high potential for osteogenesis. Current available evidence suggests no harmful effects of the tibial canal widening on union of fracture and that widening of tibial canal may have a favourable role in promoting healing of fractures.[8] In poly trauma cases it is recommended that the fractures of long bones e.g., femur and tibia be fixed by intra-medullary inter-locking nailing, as intra-medullary nailing allows for early recovery.[10] Early fixation of multiple fractures has been shown to decrease the occurrence of acute respiratory distress syndrome (ARDS) as well as fat embolism.[11]

Plating of open tibial shaft fracture is not a good method because of wide exposure during surgery and periosteal disruption. In k-nail fixation there is a risk rotational deformity of the leg especially in comminuted fractures. In external fixation there is risk of infection and also patient feels pain and stiffness of the knee.[1]

Intramedullary interlocking nailing has complications too like non-union, implant failure, and wound infections and joints stiffness. In such one previous study, fracture union (efficacy) after close inter locking nailing of open fracture shaft of tibia was 96% and frequency of infection was 12% making safety to be 88%.[12] This study was carried out to ascertain the efficacy and safety of interlocked intra-medullary nailing for open shaft tibial fractures in patients presenting at or after 24 hr of injury.

MATERIAL AND METHODS

The study was conducted at Orthopaedics Unit, Ayub Medical College, Abbottabad. The study design was

cross sectional and duration was six months (December 2010 till August 2011). A total of 163 patients were included and Consecutive (Non probability sampling) sampling technique was used. Inclusion criteria included all male and female patients of age 16 years and above with Open Fracture shaft of tibia Gustilo I, II, and III A presenting at or after 24 hours of injury. And exclusion criteria included patients with fracture of tibial shaft previously treated by any surgical interventions or bone setter, Pathological fractures as they also need primary pathology to be dealt with first, and patients who were medically unstable patient because they carried anaesthetics and surgical risks. In such situation less invasive and short procedures are recommended initially till stabilization of patient's condition. Efficacy was measured in terms of fracture union, i.e., fracture was considered united if there was bridging of the fracture space by callus formation as seen radiologically at 16 weeks follow up.

Safety was operationally determined in terms of Wound infection i.e. purulent discharge from operation site seen clinically through naked examination and confirmed by culture in the laboratory till 2 weeks follow up

RESULTS

This cross-sectional study was conducted at the department of orthopaedics Ayub Teaching Hospital, Abbottabad with a sample size of 163 to observe the efficacy and safety of interlocked intramedullary nailing for open fractures of shaft of tibia and the results were analysed as follows:

Age distribution among 163 patients was analyzed as n=57(35%) patients were in age range 20–30 years, n=82 (50%) patients 31–40 years old, n=16 (10%) patients were 41–50 years old and n=8(5%) patients were older than 50 years. The mean±SD age was 30±0.02 years (Table-2). Gender distribution among 163 patients was analyzed as n=139 (85%) patients were male and n=24 (15%) patients were female (Table-3). Gustilo type of fracture among 163 patients was analyzed as n=147 (90%) patients had Gustilo-I type fracture while n=16 (10%) patients had Gustilo II type fracture (Table-4).

Follow up 2nd and 16th weeks was analyzed as wound infection was found in n=33(20%) patients and no wound infection cases were n=130 (80%) while fracture union was found in n=139 (85%) cases and no fracture union was found in n=24 (15%) cases (Table-1).

Efficacy and safety of interlocked intramedullary nailing among 16 cases was analyzed as interlocked intramedullary nailing for open fracture shaft of tibia was safe in n=130 (80%) patients while it was no effective in n=33 (20%) patients. On the other hand this procedure was effective in n=139 (85%) and was not safe in 24 (15%). (Table-2).

Association of efficacy and safety of interlocked intramedullary nailing in age distribution was analyzed as in 130 Safe cases of interlocked intramedullary nailing for open fracture shaft of tibia, 46 patients were in age 20–30 years, 65 patients were aged 31–40 years, 11 patients had their age between 41–50 years and 8 patients were older than 50 years. While in 139 cases of effective procedure, 48 patients were in age 20–30 years, 69 patients were in age 31–40 years, 14 patients were in age ranged 41–50 years and 8 patients were in age ranged 51–60 years. (Table-2).

Association of efficacy and safety of interlocked intramedullary nailing in gender distribution was analyzed as in 130 safe cases of interlocked intramedullary nailing for open fracture shaft of tibia, 115 patients were male and 15 patients were female. While in 139 cases of effective procedure, 119 patients were male and 20 patients were female. (Table-3).

Association of efficacy and safety of interlocked intramedullary nailing in Gustilo was analyzed as in 130 safe cases of interlocked intramedullary nailing for open fracture shaft of tibia, 121 patients were Gustilo I and 9 patients were Gustilo II. While in 139 cases of effective procedure, 128 patients were Gustilo I and 11 patients were Gustilo II. (Table-4).

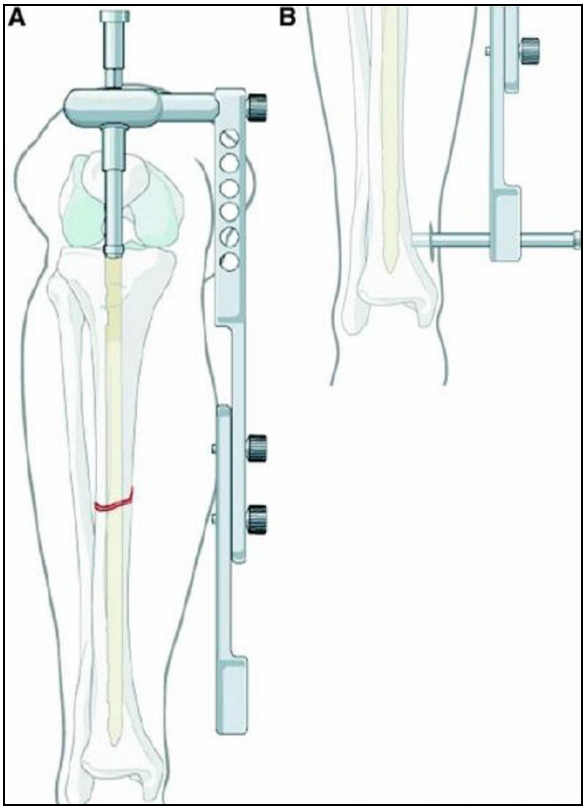

Figure-1: Locking of nails

Table-1: Frequency of complications

Follow Up		Frequency	Percentage
Wound Infection 2nd Week	Yes	33	20%
	No	130	80%
Total		163	100%
Fracture Union 16th Week	Yes	139	85%
	No	24	15%
Total		163	100%

Table-2: Age distribution

Efficacy and Safety		20–30 years	31–40 years	41–50 years	51–60 years	Total	%
Safety	Yes	46	65	11	8	130	80
	No	11	17	5	0	33	20
Total		57	82	16	8	163	100
Efficacy	Yes	48	69	14	8	139	85
	No	9	13	2	0	24	15
Total		57	82	16	8	163	100

Table-3: Gender distribution

Efficacy and Safety		Male	Female	Total
Safety	Yes	115	15	130
	No	24	9	33
Total		139	24	163
Efficacy	Yes	119	20	139
	No	20	4	24
Total		139	24	163

Table-4: Type of fracture distribution

Efficacy and Safety		Gustilo I	Gustilo II	Gustilo III	Total
Safety	Yes	121	9	0	130
	No	26	7	0	33
Total		147	16	0	163
Efficacy	Yes	128	11	0	139
	No	19	5	0	24
Total		147	16	0	163

DISCUSSION

The prognosis of open tibial shaft fractures which result after application of high energy trauma depends mostly on the intensity of the injuries to soft tissues, the degree of contamination of wound, the configuration of the tibial shaft fracture, and the magnitude of comminution. The prevalence of complications of tibial shaft fractures has decreased in recent years due to improvements in the techniques of wound covering as well as application of fixation devices, but there still is ample room for optimal management of open fractures of tibial shaft.

There is a high incidence of malunion and deep infection with the plaster-cast treatment.[13]Nicoll reported a 15% infection rate in a study in which 144 patients with open tibial fractures were treated with plaster-cast. More recently, in a series of twenty-four open tibial fractures treated with a plaster cast, Puno *et al*. have reported malunion in 12.5% patients.[14] Therefore, stable fractures with minimum injury to the soft tissues should preferably be treated with immobilization in a plaster cast.

In the past, external fixators have been extensively used for the management of open fractures of shaft of tibiae owing to the versatility and their ability to facilitate early soft-tissue healing. They provide rigid fixation with relatively low rate of deep infection. However, a high incidence of pin tract infection, mal union, bulky appearance & loss of reduction after removal has been noted in patients treated with external fixators.[15]

In our study 20% patients had wound infection while 80% patients didn't had wound infection while on the other had 15% cases had fracture union while 85% cases didn't had fracture union. Similar findings were observed in study done by Bach and Hansen[15] in which 13 percent cases had wound infection, 10 percent rate of pin tract infection, and 10 percent rate of malunion in their series.

Application of a plate provides rigid internal fixation of an unstable fracture and reduces the problem of nonunion. However, an unacceptably high rate of infection has been noted in patients with open tibial fractures because of the need to strip the soft tissue for plate application. Ruedi *et al* has reported an infection rate of 11% in in open tibial fractures treated with plating.[16]

Our study shows that interlocked intra-medullary nailing for open fracture shaft of tibiae was safe in 80% patients while this procedure was effective in 85% patients. Similar results were found in study done by Joshi D *et al*[20] in which intramedullary nailing for open fracture shaft of tibia was effective in 85% patients while this procedure was safe in 82% patients.

The interlocked intra-medullary nailing coupled with reaming results in almost no malunion owing to its ability to control length of the limb as well as the angulations and rotation at the joints. Reaming, however, destroys the endosteal blood supply, further devascularizing the compromised bone.[17]

On the other hand, interlocking intra-medullary nailing without reaming has been reported to be more advantageous as compared to nailing with reaming.

Experimental studies involving un-reamed nailing have found a considerably less reduction in the cortical circulation. In a study un-reamed intra-medullary nailing was associated with a 31% in cortical circulation while the reduction in cortical circulation after intra-medullary nailing with reaming was found to be 71%.[18] Additionally, the reaming of open fractures enables the propagation of contamination of wound along the medullary cavity as well as stripping of smaller bone fragments attached to the soft tissues.

Slow re-vascularization as well as delayed osseous union have also been reported to have

occurred following reaming. The hollow nails cause more infection because their surface area is twice that of a solid nail and therefore the amount of dead space is increased. In addition, cortical necrosis is more likely to occur with a snugly fitted reamed nail than with a loosely fitted intra-medullary nail. The adherence of bacteria to the nails is made more difficult by the smoothness of the surface of solid nails and it may indirectly lead to a decreased susceptibility to infection.[19]

In our series, Gustilo Type II injury was associated with deep infection and valgus malunion. 2–6% incidence of deep infection in Gustilo Type III injuries has been reported in literature. Therefore careful selection of patients for using unreamed SIGN nail in Gustilo Type II injuries is recommended.

CONCLUSION

Un-reamed, interlocked intra-medullary nailing may be considered as a suitable option for treatment of open fractures of tibia

AUTHOR'S CONTRIBUTION

NA: Primary Author; research work. MSK: Research work/data collection. SAA: Statistical Analysis and medical writing, ASA, SKA, SS, KS, FSL: Data collection, data analysis, and write-up.

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