Research Article

Primary Fixation of Open Fractures of Tibia - A Comparison Between Intramedullary Interlocking Nail and Uniplaner AO External Fixator as Definitive Fixation

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Abstract

Background: Because of its subcutaneous course, open tibial shaft fractures are challenging to treat and there are more chances of post operative complications like infection and non union. It is a matter of debate that which implant between external fixator and intramedullary interlocking nail is better to fix these fractures.

Objective: To compare the treatment outcome in open tibial diaphyseal fractures treated with uniplaner AO external fixators versus IMIL Nail.

Methods: This prospective interventional study was conducted at the Department of Orthopaedic Surgery King Edward Medical University / Mayo Hospital Lahore between April 2022 and December 2023. A total of 64 patients (32 in each group) were included in the study. After discharge patients were followed up at 2nd, 6th, 12th, 16th , 24th and 36th weeks post-operatively and evaluated for union and infection both clinically and radiologically.

Results: Out of 64 patients, 32 underwent uniplaner AO EF and 32 received IMIL nailing. At 12 weeks post-surgery, 27 (84.3%) patients in the nail group and 11 (34.3%) in the external fixator group exhibited callus formation, with mean bridging callus time of 12.4 ± 2.2 weeks and 16.3 ± 3.6 weeks, respectively. Infections occurred in 5 (15.6%) patients in the nail group and 15 (46.8%) in the fixator group, with 4 and 7 cases eradicated by antibiotics, respectively. At 36 weeks, union was observed in 31 (96.8%) patients in the nail group and 25 (78.1%) in the EF group, while non-union was found in 1 (3.2%) patient in the nail group and 7 (21.8%) patients in the EF group.

Conclusion: IMIL Nail is a better treatment option in patients with open tibial shaft fractures where skin coverage is possible and patient presented within 6 hours of injury.

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Introduction

Tibial shaft is the most commonly fractured long bone which has an incidence of 1 in 2000, 2% of all fractures and 45% of all open bone fractures in adults.[1] Tibia is also the commonest long bone to sustain open fracture[2] with an incidence of 42.6% in Lahore[3] and that is because of its subcutaneous course. Majority of the open fractures of tibial shaft are due to road traffic accidents[4-6] and mostly occur in younger working people with fall from motorbikes.[7-9] But this epidemiology varies from country to country

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and even from region to region. Fibula is also fractured with fractures of tibia in 75 to 85% of cases.[10]

An open fracture communicates with the external environment because of skin breach.[4] Due to its superficial blood supply, open fractures of tibia are significant in terms of infection and non union if managed improperly.[11] These fractures can result into long hospital stay, repeated hospital admissions, social, mental and economic stress. A very careful treatment is needed to alleviate infection and to achieve bone union and limb function.

There are multiple options to fix open tibial shaft fractures including different types of external fixations, intramedullary nailing and many other different implants.[12-14] What treatment option is better for which patient is a matter of debate despite a large number of studies published on this topic.[15] While treating open fractures of tibia, the aims are to attain union, control infection of soft tissues and bone and have a functional and painless limb.[16-18]

Currently the trend is shifting to use IMIL nail for managing such fractures but the required intraoperative resources like image intensifier and trained person in flouroscopy are making this option challenging especially in developing countries like Pakistan. However, the decision of the technique is made keeping in view condition of the wound, fracture type and degree of muscles and soft tissue injury.[19]

Rationale of this study was to find out a safer and effective treatment option for open tibial diaphyseal fractures between AO external fixator and IMIL nail. In Pakistan, limited data is available comparing these two treatment options based on AO classification. So the purpose of this study is to compare treatment outcome of these two treatment modalities in our setup in terms of bone union and infection.

Methods

This prospective interventional study was conducted in the Department of Orthopaedics Surgery, Mayo Hospital, King Edward Medical University Lahore, from April 2022 to December 2023. A total of 64 patients (32 patients in each group) were included in the study.

Patients with AO type 42A, 42B and 42C and soft tissue injury AO-ASIF type $IO_{1,2,3}$ $MT_{1,2,3}$ and NV_1 (diagnosed on history clinical examination and radiographs), age between 18 and 70 years presenting within 12 hours of injury (on history and clinical examination) were included in the study.

Exclusion criteria was multiple fractures, neurovascular injury, fracture of contra lateral femur or tibia, fracture of ipsilateral femur, prior ipsilateral lower limb injury, previous lower limb deformity, farmyard open fractures and patients with comorbidities (diabetes mellitus, chronic liver disease, chronic kidney disease). After approval from Institutional Review Board (IRB), patients meeting inclusion criteria were selected through the Orthopeadic Emergency department of the Mayo hospital Lahore. Informed written consent was taken from every patient or his/her attendants. Test for culture and sensitivity from wound was taken and sent to the hospital laboratory. Tetanus immune status was determined and vaccination was provided if necessary. Intravenous (IV) course of Cephalosporins and Aminoglycosides were started empirically to all patients and once culture and sensitivity report was available, they were either continued if the cultured bacteria were sensitive to them, or switched to other antibiotics according to culture and sensitivity report. Duration of intravenous antibiotics was five days followed by oral antibiotics. Wound was washed and debrided. All patients in group A were managed with reamed IMIL nail while all patients in group B were managed with AO External Fixator. Movements at knee and ankle joints were allowed post-operatively and patients were mobilized with crutches one day post operatively in both study groups. We observed soft tissue infection and radiological union in follow up visit in Out patients department (OPD) at 2^{nd}, 6^{th}, 12^{th}, 16^{th}, 24^{th} and 36^{th} week postoperatively. Stitches were removed after two weeks of surgery. Soft tissue infection was assesed by Southampton wound scoring. Bone union was observed using Modified RUST criteria[20] according to which union was defined as the presence of bridging callus in at least three out of the four cortices in anteroposterior (AP) and lateral radiographs with modified RUST score of 12 out of

the total 16.

Partial weight bearing was allowed at 6th week while full weight bearing after 10 weeks in both groups. After 12 to 16 weeks, EF was removed and Patellar Tendon-Bearing (PTB) cast applied if sufficient union was present and weight bearing increased progressively.[21]

Results

Out of 64 patients, 32 were applied uniplaner AO external fixators while 32 patients had IMIL nailing.

Out of the total 64 patients, 53 (82.8%) were males and 11 (17.1%) were females, making male to female ratio of 4:1. The mean age of the patients was 41.2 ± 9.3 years ranging from 19 to 61 years. Road traffic accidents were the most prevalent cause, that is, in 51 patients (79.6%), fall from height or stairs were 06 (9.37%), firearm injuries 05 (7.8%) and direct blow were 02 (3.1%) ss depicted in Table 1.

In the nail group 27 (84.3%) patients had callus formation (in atleast three out of four cortices with modified RUST score of 12 or above) at 12th weeks after surgery with mean time of bridging callus in nail group as 12.4 ± 2.2 weeks. On the other hand, in fixator group only 11 (34.3%) had union at 12th weeks and 14 (43.9%) between 16th and 36th weeks. Average time to callus formation was 16.3 ± 3.6 weeks in EF group.

Five (15.6%) in the nail group while fifteen (46.87%) in fixator group developed infection. Infections were successfully treated with culture specific antibiotics in four patients in nail group while one patient had severe infection in which nail was removed and secondary procdures performed. In the fixator group, six out of the fifteen infected cases were successfully treated till union was achieved while in nine patients, infection eradication was not successful and these cases needed surgical debridement and removal of fixator. In these nine cases only two achieved union carrying the total number of union in fixator group to 25 (78.1%) at 36th weeks while seven (21.8%) had non union due to infection. 31 (96.8%) patients in nail group had union at 36th weeks after surgery while only one (3.2%) had infected nonunion in which nail was removed and secondary procedures done.

Table 1: *Demographic data of the gender, age, causes, infection and union rate.*

Variable	Frequncy (N=64) IMIL Nail group = 32 / EF group = 32	Percentages (100%)
Causes		
• RTA	51	79.60%
• Falls	6	9.37%
• FAI	5	7.80%
• Direct Blow	2	3.10%
Gender		
• Males	53	82.80%
• Females	11	17.20%
Union at 12 weeks		
• IMIL Nail group	27	84.00%
• EF Group	11	34.30%
Union at 36 weeks		
• IMIL Nail group	31	96.8. %
• EF Group	25	78.10%
Infection Rate		
• IMIL Nail group	5	15.60%
• EF Group	15	46.80%
Mean Time to Callus formation (Union) in weeks ± SD		
• IMIL Nail group	12.4 ± 2.2	
• EF Group	16.3 ± 3.6	

Discussion

Open tibia shaft fractures (AO Type 42A and 42B and soft tissue AO ASIF type $IO_{1,2,3}$, $MT_{1,2,3}$ and NV_1) can be best managed with intra medullary interlocking nail as compared to AO external fixator. Treated with IMIL nail, these fractures healed quicker than those treated with AO external fixator and that too with markedly less number of infection as compared to external fixator.

We found that in more than three quarters of patients managed with IMIL nail, union was achieved at three months after surgery and nearly all patients had union at nine months. Only a few cases got infected but fortunately the infectin was less severe and teated with antibiotics. In contrary to this, only one-third of patients treated with AO EF had union at three months after surgery. By nine months, hardly about three-quarters of the patients achived union, about half of

them got infected and nearly one-quarter got nonunion, mostly due to infection.

Regarding union time, our study found at least one month quicker union in nail group than EF group which corresponds to Haonga et al[22] who reported six weeks faster union in nail group. Ayoub et al [23] found the simimmilar findings. Our findings are contrary to Cortez et al[24] who found no statistically significant difference in these two modlities. Unfortunately, there is no similar study conducted in our country based on AO classification for comparing our results.

Contrary to our findings of about three times higher rate of infection, Haonga et al[4] found no difference in both the groups. However Kisitu et al[25] reported 20.8% lower rate of superficial infection in the nail group, which favours our findings.

There were few limitations of this study including (1) malalignment and malrotation was not considered in the study, (2) Did not convert EF to IM nail which is most of the times recommended, (3) Only took superficial and soft tissues infection into account. (4) A single centre study. We recommend multi-centred larger randomized trails in future taking into account all the above mentioned limitations and functional outcomes.

Conclusion

Intramedullary interlocking nail can be successfully used to treat open fractures of the tibia (with sufficient skin coverage and intact neurovascular status) in adults 18-70 years of age having no comorbids to achieve higher rate of union and less chances of infection and non union as compared to uniplanar AO external fixator.

Ethical Approval: The Institutional Review Board, KEMU approved this study vide letter No. 415/ RC/ KEMU.

Conflict of Interest: The authors declare no conflict of interest.

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Author Contribution

SS: Conception & design, acquisition of data, drafting of article

KI: Acquisition of data

SNKN: Acquisition of data, drafting of article

MSN: Analysis & interpretation of data

RA: Drafting of article, critically revised it for important intellectual content

KNC: Analysis & interpretation of data

FM: Analysis & interpretation of data, final approval of the version to be published

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