

# Outcome of Open Fractures of Tibia Treated with Interlocking & Intermedullary Nail in Terms of Infection and Union

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## ABSTRACT

**Objective:** To find out the outcome of Gustilo Anderson Type I,II,III, A open fractures of tibia treated with intramedullary nail.

**Study Design:** A case series study

**Place and Duration of the Study:** This study was conducted at the Department of Orthopaedic Surgery, Ghurki Trust Teaching Hospital, Lahore from January 2019 to December 2019.

**Materials and Methods:** This case series study was done evaluating 60 patients presenting to us with Gustilo-Anderson I, II and III A open tibial fractures (OTFs). All patients were aged 18-70 years and had open diaphyseal tibial fractures. All included patients had a minimum follow up period of 6 months. All patients were managed adopting pre-op antibiotics, prompt debridement, fixation and primary closure. Demographic data of all cases along with mechanism of injury, time of fixation, flap coverage, union and infection rates were noted.

**Results:** Overall, mean age was noted to be  $37.17 \pm 13.5$  years. Majority of the patients, 55 (91.7%) were male. Left side was turned to be involved in majority of the cases, 32 (53.3%). Road-traffic accidents (RTA) were found to be commonest mechanism of injury. Overall, mean time to union was noted to be  $35.8 \pm 8.17$  weeks. Union was observed in 46 (76.7%). Comparatively, older age and smoking were also found to be significantly associated with delayed union ( $p < 0.05$ ). Infections were recorded among 14 (23.3%) cases. Infection was found to be significantly more common among older age and smokers ( $p < 0.05$ ).

**Conclusion:** Rates of delayed union and infections are high among GustiloAnderson Type IIIA open tibial fracture cases treated with intramedullary nailing. Comparatively younger age and no history of smoking were found to have significant relation with union and no infection post-surgery.

**Key Words:** Open tibial fractures, intramedullary nailing, union, infection.

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## INTRODUCTION

Tibia is known to be the commonest long bone involved in fractures among humans. Treating open tibial fractures (OTFs) is not easy and controversies surround views about best approach to treatment. "Gustilo-Anderson" OTF injuries require debridement, appropriate fixation. Tibial fractures commonly occur due to high-velocity injuries, like falling from height or crush trauma injuries.

Some of these fractures also result among patients having multiple injuries.<sup>2</sup> Main goals treating these individuals are to reinstate bony union without infection and completely functional pain-free limb.<sup>3</sup> Patients treated with these fractures are prone to significant rates of non-union as well as infections. GustiloAnderson OTFs can also result in loss of limb among otherwise healthy adults.<sup>4,5</sup>

Treating open fractures is considered an orthopedic emergency.<sup>6</sup> Traditional approach consists of external fixator and if possible within 6 hours of injury.<sup>7</sup> Effectiveness of intramedullary nails for acute management of OTFs is controversial mainly because of the risk of osteomyelitis among immune-compromised host and delays of more than 6 hours in operative management.<sup>8,9</sup> Outcome of open fractures also varies among different institutions. Some of the most important aspects of judging outcomes of open fractures have been infection, non-union and amputation.<sup>10</sup> Data enlisting outcomes of open fracture can also give us evidence about the quality of care and practices in different institutions. We aimed this study to find out outcome of Gustilo Anderson open fractures of tibia treated with intramedullary nail.

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**MATERIALS AND METHODS**

This case series study was done evaluating 60 patients presenting to us with Gustilo-Anderson I, II, IIIAOTFs during January 2019 to December 2019 at The Department of Orthopaedic Surgery, Ghurki Trust Teaching Hospital, Lahore. All patients were aged 18-70 years and had open diaphyseal tibial fractures. All included patients had a minimum follow up period of 6 months. Patients who were skeletally immature or had tibial fractures other than Gustilo-Anderson I,II, IIIA were not enrolled. All patients with preexisting external fixator that got changed to an intramedullary nail were also excluded. All cases who were referred from other settings were also not enrolled in this study as they were suspected to have delayed presentations. The study was approved by Institutional Ethical Committee. Written consent was sought from all study participants. All patients were managed adopting prompt debridement, fixation and primary closure as feasible. Demographic data of all cases along with mechanism of injury, time of fixation, union and infection rates were noted. Union was confirmed with radiographic evidence of callus bridging at least 3 cortices. Evaluation of radiological union was done by an FCPS orthopedic surgeon having at least 3 year post-fellowship experience. Details about infections, existence of microbes along with bacterial cultures were recorded. Deep infection as labeled as infection needing surgical debridement with positive tissue or bone cultures. For data entry and analysis, SPSS version 26.0 was employed. Age was presented as mean and standard deviation while qualitative data like gender, sides involved, mechanism of injury, presence of infection, union/non-union, and factors related to delayed union were shown as frequency and percentages. Chi square test was used to compare qualitative variables while quantitative data (age) was compared using independent sample t-test. P value below 0.05 was taken as significant.

**RESULTS**

At total of 60 patients were included. All cases were given intravenous antibiotics and managed surgically adopting thorough wound debridement and temporary fracture stabilization at the initial surgery. Overall, mean age was noted to be 37.17±13.5 years. Majority of the patients, 55 (91.7%) were male. Left side was turned to be involved in majority of the cases, 32 (53.3%). Road-traffic accidents (RTA) were found to be commonest mechanism of injury. Table number 1 shows characteristics of study participants.

Table number 2 is showing significant relationship of Gustilo-Anderson types open fractures with respect to union and revision or delayed union (p<0.001). Type-III A open fractures were noticed to have significant relationship with revision or delayed-union.

**Table No.1: Characteristics of Study Participants**

Characteristics		Number (%)
Gender	Male	55 (91.7%)
	Female	5 (8.3%)
Side Involved	Left	32 (53.3%)
	Right	28 (46.7%)
Mechanism of Injury	Road-Traffic Accident	40 (66.7%)
	Industrial Reasons	14 (23.3%)
	Assault	2 (3.3%)
	Sports	2 (3.3%)
	Falling from Height	2 (3.3%)
Gustilo-Anderson Types	I	30 (50.0%)
	II	20 (33.3%)
	III	10 (16.7%)

**Table No.2: Distribution of Gustilo-Anderson Types Open Fractures with respect to Union or Revision / Delayed Union**

Gustilo-Anderson Types	Union (n=46)	Revision or Delayed Union (n=14)	P-Value
I (n=30)	28(60.9%)	2 (14.3%)	<0.0001
II (n=20)	16(34.8%)	4 (28.6%)	
III-A (n=10)	2(4.3%)	8 (57.1%)	

**Table No.3: Factors Linked with Revision or Delayed Union**

Factors		Revision or Delayed Union (n=14)	Union (n=46)	P-Value
Age in Years (Mean±SD)		39.51±12.8	30.81±14.3	0.046
Gender	Male	12 (85.7%)	43 (93.5%)	0.3574
	Female	2 (14.3%)	3 (6.5%)	
Smoker	Yes	6(42.9%)	8 (17.4%)	0.0485
	No	8 (57.1%)	38 (82.6%)	
Time from injury to 1 <sup>st</sup> Debridement (hours)	<6	9 (64.3%)	31 (73.9%)	0.8291
	>6	5 (35.7%)	15 (26.1%)	

Overall, mean time to union was noted to be 35.8±8.17 weeks. Union was observed in 46 (76.7%) cases. Table number 3 is showing factors linked to delayed union or revision. Comparatively, older age was significantly linked to delayed union (p=0.0460). Smoking was also

found to be significantly associated with delayed union (42.9% vs. 17.4%,  $p=0.0485$ ). Early surgical debridement was not noted to have significant effect on union. Infections were recorded among 14 (23.3%) cases. Out of these 14 cases, 9 were treated with antibiotics and wound wash while remaining 5 had removal of implant and ilizarov applied.

## DISCUSSION

Treatment of OTFs is considered tricky and satisfactory outcomes depend upon multiple factors.<sup>10</sup> Lots of work has been done describing various forms of treatment for OTFs but best treatment option is yet to be labeled. Intramedullary nailing is shown to have good success for the treatment of OTFs. This study is one of the biggest open tibial GustiloAnderson fractures series documented in the recent years in Pakistan. In the present study, 91.7% of the cases were male. Data from other parts of the world have reported male predominance ranging from 66-93.2% cases of OTFs.<sup>11,12</sup> Data from Malaysia revealed 84.6% of OTF cases to be male.<sup>13</sup> In a country like Pakistan where males are more exposed to outdoor and daily living activities, a clear predominance of male cases forming majority of OTF cases is not surprising.

RTAs were the commonest cause of OTFs in the present study, comparing 66.7% of total cases. Local study conducted by Haq SN et al also revealed that 78.5% cases of open diaphyseal fractures of tibia were caused due to RTAs.<sup>14</sup> Data from Nigeria revealed 71% cases due to RTAs while researchers from developed countries also noted RTAs to cause 58% of OTFs.<sup>11,15</sup>

In this study, 23.3% had non-union or delayed union and needed further treatment. A study done by Singh A et al reported that 41.1% of the treated GustiloAnderson OTF cases required further procedures following delayed union.<sup>12</sup> Singh A et al revealed that intramedullary nailing in the treatment of OTFs is associated with high rates of non-union or delayed union and require revision and further treatment. In the present study, Infections were recorded among 23.3% cases. The infection rates seen among OTFs range between 9-52%.<sup>12,16-18</sup> Appropriate debridement along with young age and no prior history of smoking can certainly aid minimizing chances of infection. Infection rate is considered to be directly linked to severity of injuries as described by "Gustilo-Anderson Classification" and host comorbidities. Superficial infections commonly resolve and need minimal interventions while deep infections require multiple additional surgeries and form major chunk of morbidities. In the present work, out of a total of 14 patients who experienced infections, 9 were treated with antibiotics and wound wash while remaining 5 had removal of implant and ilizarov applied.

In the present study, smoking was linked to delayed union and infection. Similar findings have been

reported by Singh A et al where history of smoking was significantly associated with non-union and presence of infections following treatment of OTFs.<sup>12</sup> Schmitz MA et al also reported prolonged time of healing among smokers with OTFs while Patel RA et al in their systemic review evaluating "effect of smoking on bone healing" revealed very similar findings.<sup>19,20</sup>

Our study had some limitations as well. Being a single center study, the findings cannot be generalized. We also did not have any comparator group so cannot conclude intramedullary nailing as the best possible choice handling Gustilo Anderson OTFs. We were also unable to record functional outcome, patient's preference and cost issues in the present research.

## CONCLUSION

Rates of delayed union and infections are high among GustiloAnderson TYPE IIIA open tibial fracture cases treated with intramedullary nailing. Comparatively younger age and no history of smoking were found to have significant relation with union and no infection post-surgery.

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### Author's Contribution:

Concept & Design of Study:	Umair Ahmed
Drafting:	Mudassar Hassan
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**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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