

# Effect of Early versus Delayed Wound Closure on Union Time of Gustilo III-A Tibial Shaft Fractures

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## ABSTRACT

**Objective:** To evaluate the outcomes of wound closure: Early vs. Delayed; on union time of Gustilo III-A Tibial shaft fractures.

**Study Design:** Cross-sectional comparative study.

**Place and Duration of Study:** Department of Orthopedic Surgery & Traumatology at Liaquat University of Medical Health Sciences Jamshoro from 1<sup>st</sup> January 2017 to 30<sup>th</sup> September 2018.

**Methodology:** One hundred and twenty three cases with open Gustilo III-A diaphyseal fracture of Tibia with age ranging from 18 to 52 years of either sex were included in the study, while patients with co-morbidities, host type B, C excluded from study. All the patients were categorized in two groups of Early & Delayed Wound Closure and union time assessed.

**Results:** The mean age was 33.26±9.77 years and male were 74.0% and female were found 26.0%. Early wound closure was done in 42.3% while delayed wound closure was done in 57.7% of the patients. Union was achieved in most of the cases 71.5%, while remaining 28.5% patients were with delayed union/ non-union. Early wound closure group exhibited significant more union in 50 cases out of 88, p-value 0.001, while delayed union/ non-union was significantly higher in delayed wound closure group p-value 0.001.

**Conclusion:** In Gustilo III-A open tibial shaft fractures, Early Wound Closure can be relied upon more as compared to delayed wound closure.

**Key Words:** Gustilo IIIA tibia fracture. Wound closure, Union time

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## INTRODUCTION

Tibia is the weight bearing long bone, subcutaneous in its antero-medial area, anatomically vulnerable to trauma and commonly fractured. The mean age of patient with tibial shaft fractures is round about 33 years, and male teenagers have the highest incidence<sup>1</sup>. Open fractures of the tibia are the most frequent open long bone fractures, with an annual occurrence of 3.4 per 100,000<sup>2</sup>. Fast ways of life with motor vehicles add to the expanding occurrence of tibial shaft breaks in the present society.<sup>3</sup> Infection is the most frequent and notorious complication of open fractures, with a documented incidence of 3–40%<sup>4</sup>.

In developing countries, trauma has become a major public health problem due to increasing industrialization and urbanization<sup>5</sup>. The management of open tibial fractures is with full of complications such as infections, mal-union, delayed union and non-union, so it is still a challenge to manage it. Aggressive protocol needed to deal it, which includes immediate empirical intravenous antibiotics after taking swab for culture and sensitivity, repeated debridement, fixation of the fracture, soft tissue cover and bone grafting<sup>6</sup>.

Open fractures of long bones are classified according to system developed by Gustilo and Anderson and subsequently modified by Gustilo et al. it is based on severity of soft tissue injury, as severity increases grade increases. High velocity injuries are counted as GIII whatever the wound. Most careful way to grade is by intra-operative assessment<sup>6,7</sup>. Early wound closure is within the 24-72 hour of injury, and delayed closure after 72 hours<sup>8,9</sup>. Wound management in open fractures remains an

area of controversy<sup>10</sup>. As of late, the customary idea that wounds in open fractures should be left as it at the underlying medical procedure has been tested. So as to decide a practical convention the favorable circumstances and drawbacks of the two techniques for the management must be reviewed fundamentally. However, closure of all wounds without adequate debridement will be disastrous<sup>11</sup>.

Surgeon's goals are to stop infection, enhance union, and rehabilitate. All cases need early stabilization of fractured bone, tetanus, antibiotics, debridement, irrigation, wound management, proper rehabilitation, and strict follow-up. Adequately debrided wounds can be closed early and this can improve outcomes<sup>12</sup>. To date, researchers have stated that wound can be closed in most open fractures up to Gustilo-Anderson type III-A with decline in morbidity and hospital stay<sup>13</sup>. Literature quantifies non-union as a major risk factor particularly with open tibia fractures, with rates ranging from 5% for Type I open fractures and 18-38% for Type IIIA-C fractures<sup>14</sup>. Type III Open Tibial fractures need aggressive steps for management as early debridement, soft tissue cover and stabilization<sup>15</sup>. External fixation has been accepted as prime choice for type III open Tibial fractures. External fixators are versatile devices with benefits of percutaneous fixation and adjustable biomechanical properties and can be applied for definitive management.<sup>16-19</sup>

In our country, delay in surgical intervention is a common event because of the delay in transferring the patients to referral centers, poverty, illiteracy and belief in bonesetters. This study was intended to standardize the

surgical practice for the administration of Gustilo III-A tibial shaft fracture.

**METHODOLOGY**

This cross-sectional comparative study was held at the Department of Orthopedic Surgery & Traumatology at Liaquat University of Medical Health Sciences Jamshoro from 1<sup>st</sup> January 2017 to 30<sup>th</sup> September 2018. A total of 123 cases with Open Gustilo III-A diaphyseal fracture of Tibia with age ranging from 18 to 52 years of either sex were included in the study, while patients with associated severe chest, abdominal injuries, head injuries, Poor patient tolerance, compliance, Patient with co-morbid, host type B,C excluded from study. All the patients those satisfied inclusion criteria were selected for the study. The patient’s vital parameters were recorded & monitored. Associated limb, chest, abdomen and head injury were ruled out. An intravenous line was established, tetanus prophylaxis, fluid replacement, empirical antibiotics following taking swab for culture & sensitivity was started. The wound over the fracture site was cleaned, neurovascular status was checked, photographs were taken and a back slab was applied by simply aligning the bone. Further wounds, if any, were taken care of appropriately. The patient once settled from the acute injury, was shifted to the orthopedic ward. Patient’s clinical examination, detailed history, X-rays finding and routine investigations were noted on pro-forma. Under anesthesia wound was debrided uniplanar unilateral External Fixator applied. If the Wound was clean, it was closed early (within 3 days) if wound needed more debridement or cannot be closed because of tension, swelling, closure was delayed (following 3 days). All the patients were categorized in two groups of early & delayed wound closure. Following collecting culture & sensitivity report antibiotics was started accordingly. Patient remain admitted for some days to assess wound status, following some dressings if there was no any sign of infection; patient was discharged and called for follow up in outpatient department weekly. Stitches were removed following 14 days. Dynamization of External Fixator was done within 8-10 weeks, if needed. Clinical and radiological Union time was assessed and noted. As there was clinical and radiological union, Fixator was removed followed by walking cast. All the cases were followed with clinical assessment and immediate radiographs in outpatient department for 9 months. The data was entered and analyzed through SPSS-20.

**RESULTS**

The mean age was 33.26±9.77 years. Males were 74.0% and females were found 26.0%. The right side was common 58.0%, left side was affected in 39.0%, while 3 patients were presented with bilateral tibial fracture. Most of the patients were injured by road traffic accident as 81.3%, 12.2% patients were assaulted, 4.9% patients were fallen from height, while only 1.6% were with history of fire arm injury. Mean time lapse between injury and wound closure was 7.30±6.60 days. Early wound closure was done in 42.3% of the patients, and delayed wound closure was done in 57.7% of the patients. Union was achieved in most of the cases 71.5%, while remaining 28.5% patients went in delayed union/non-union (Table 1). There were significant

lower mean of union time 19.48±2.80 weeks in early wound closure as compared to delayed wound closure 21.92±2.71 weeks p-value 0.001 (Table 2).

Table 1: Demographic information of the patients (n=123)

Variable	No.	%
Age (years)	33.26±9.79	
Gender		
Male	91	74.0
Female	32	26.0
Mode of injury		
Road traffic accident	100	81.3
Fall from height	6	4.9
Firearm injury	2	1.6
Assault	15	12.2
Time lapse between injury and wound closure (days)	7.30±6.60	
Procedure		
Early wound closure	52	42.3
Delayed wound closure	71	57.7
Union/Delayed union		
Union	88	71.5
Delayed union/non-union	35	28.5

Table 2: Comparison of early and delayed wound closure

Union	Early wound closure	Delayed wound closure	P value
	19.48±2.80	21.92±2.71	0.001

**DISCUSSION**

There is an absence of national epidemiological information on the attributes of patients with tibial shaft fractures<sup>1</sup>. Early wound closure group exhibited significant lower mean of union time 19.48±2.80 weeks, as compare to Delayed Wound Closure 21.92±2.71 weeks. “On further hand Weitz-Marshall and Bosse<sup>20</sup> stated that it was the surgeon’s perception obtained by experience that is needed for taking proper decision for wound closure. However, contraindications for early closure included highly contaminated wounds with dung, standing water, waste, or high velocity injuries happening in the farm setting. In addition, primary closure was not recommended if the antibiotic was detained after 12 hours, if a doubtful proportion of healthy tissue at initial debridement remains, or if there was a doubt insufficiency of debridement.

Reuss and Cole<sup>21</sup> retrospectively evaluated 81 open tibial shaft fractures, among them 32 cases went through delayed closure while 49 wounds were dealt primarily. He has seen infection only 2% in early closure while 19% in delayed closure group.” Similarly, in this study infection rate was more in delayed closure as compare to early closure. Other researchers who have discussed the current theme contradicting the suggestion of primary closures of wounds.<sup>22</sup> A randomized, prospective study of 82 open tibial fracture by Benson and colleagues et al<sup>23</sup> submitted no remarkable variation in infection ratio between primary closure and delayed closure. It is our institutional policy that primary closure is justifiable strategy for management of adequately selected Open tibial fracture. It is strongly accepted in the literature that adequate debridement is vital factor in reducing infection while managing open fracture of Tibia.<sup>22,24-26</sup>

In this study all the cases of G-A type III were included, while Lavelle et al<sup>27</sup> carried out the internet

basedscrutiny to evaluate the techniques of management for Open tibial fracture by Accreditation Council for Graduate Medical Education. They found that the most of the wounds were primarily closing 88% in Gustilo I, 86% in Gustilo II and 57% in III-A. In one recent study of 2020 by Garner<sup>28</sup> did not found any difference in terms of complications, non-unions and amputation rates and found similar results by either method of wound closure. In our study, out of 123 patients, most of patients 74% were male and 26% were female with mean age of 33.26±9.8 years. The males are more involved in out-door activities and the young male are more eager and irresponsible drivers while females in our region are less involved in driving motor vehicles, so this leads to males more vulnerable to trauma and open fractures.”

However in the similar study of Piwani et al<sup>15</sup>, male were 83.3% and female were 16.7% with mean age 34.75±5.8 years, in the study of Wei et al.<sup>29</sup> Males were 67.5% and females were 32.5% with mean age of 38 years, and in the study of Lua et al<sup>30</sup>, males were 88% and females were 12% with mean age of 38.4±14.5 years.

In our study most of the patients were injured by road traffic accident as 81.3%, 12.2% patients were assaulted, 4.9% patients were fallen from height, while only 1.6% were with history of fire arm injury. “Alternatively, Kreisfeld et al<sup>31</sup> documented that the most prevailing sources of accidental demise in Australia are accidents (24%), fall-off (19%) and violence (4%). In study of Piwani et al<sup>15</sup>, road traffic accident (52.8%) was the most common mode of trauma followed by fall 6(20%). However, in a study of Allareddy et al<sup>32</sup>, frequently documented causes of injuries included injury from violence (52.8%), falls (11.4%), motorized vehicle accidents (10.9%), bicycle trauma (2.7%), conveyance trauma (2.4%), gunshots (0.6%), and pedestrian injuries (0.08%).” In our study, out of the sites involved in fracture, right side was commonest 58.0%, left side was 39.0%, while 3 patients were presented with bilateral tibial fracture. In the study of Neto et al<sup>33</sup>, the most affected side by injury was left side in 56% cases, while right side was affected in 44% cases.

## CONCLUSION

In Gustilo III-A open tibial shaft fractures, early wound closure saved time and can probably be relied upon more as compared to delayed wound closure; it as well resulted in shorter stay in hospital. Besides that, the union of early wound closure groups, 19.48±2.80 weeks, took significantly less time than that of delayed wound closure, which took 21.92±2.71 weeks. The majority was of males and injury was mostly caused by road traffic accidents.

## REFERENCES

- Amin MQ, Ahmed A, Imran M, Ahmed N, Javed S, Aziz A. Tibial shaft fractures; epidemiology, a 5-year study in Ghurki Trust Teaching Hospital, Pakistan. *Professional Med J* 2017;24(1).
- Elniel AR, Giannoudis PV. Open fractures of the lower extremity: current management and clinical outcomes. *EFORT Open Rev* 2018;3(5):316-25
- Shamsi A. Management of diaphyseal tibia fractures with interlocking sign nail after open reduction without using image intensifier. *Ann Pak Inst Med Sci* 2013;9(1):17-21.
- Konbaz FM, Alassiri SS, Al Eissa SI, Taha WS, Al Helal FH, et al. Does delay in surgical debridement increase the risk of infection in open tibia fractures in Saudi patients? A retrospective cohort study. *J Clin Orthop Trauma* 2019;10(2):305-9
- Doshi P, Gopalan H, Sprague S, Pradhan C, Kulkarni S, Bhandari M. Incidence of infection following internal fixation of open and closed tibia fractures in India (INFINITI): a multi-centre observational cohort study. *BMC Musculoskeletal Disorders* 2017;18(1):156.
- Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma* 1984;24(8):742-6.
- Yim GH, Hardwicke JT. The evolution and interpretation of the Gustilo and Anderson classification. *JBJS* 2018;100(24):e152.
- Gopal S, Majumder S, Batchelor AG, Knight SL, De Boer P, Smith RM. Fix and flap: the radical orthopaedic and plastic treatment of severe open fractures of the tibia. *J Bone Joint Surg [Br]* 2000; 82(7):959-66.
- Wood T, Sameem M, Avram R, Bhandari M, Petrisor B. A systematic review of early versus delayed wound closure in patients with open fractures requiring flap coverage. *J Trauma Acute Care Surg* 2012;72(4):1078-85.
- Rajasekaran S, Dheenadhayalan J, Babu JN, Sundararajan SR, Venkatramani H, Sabapathy SR. Immediate primary skin closure in type-III A and B open fractures: results after a minimum of five years. *J Bone Joint Surg [Br]* 2009 Feb;91(2):217-24.
- Okike K, Bhattacharyya T. Trends in the management of open fractures: a critical analysis. *JBJS* 2006;88(12):2739-48.
- Fischer MD, Gustilo RB, Varecka TF. The timing of flap coverage, bone-grafting, and intramedullary nailing in patients who have a fracture of the tibial shaft with extensive soft-tissue injury. *JBJS* 1991;73(9):1316-22.
- Hohmann E, Tetsworth K, Radziejowski MJ, Wiesniewski TF. Comparison of delayed and primary wound closure in the treatment of open tibial fractures. *Arch Orthop Trauma Surg* 2007;127(2):131-6.
- Cross WW 3rd, Swiontkowski MF. Treatment principles in the management of open fractures. *Indian J Orthop* 2008 42(4):377-86.
- Piwani M, Bhutto IA, Ahmed I. Evaluation of an external fixator in the management of open diaphyseal fracture of tibia Gustilo Type IIIA and IIIB. *Gomal J Med Sci* 2015;13(1).
- Giotakis N, Narayan B. Stability with unilateral external fixation in the tibia. *Strategies in trauma and limb Reconstruction* 2007;2(1):13.
- Pahore MK, Pirwani MA, Laghari MA, Makhdoom A, Saeed G, Shaikh AR. Role of external fixator in the management of type III a&b open tibial fracture. *Med Channel* 2010;16(3).
- Mirjat AH, Bhutto IA, Memon SA. AO External fixator; a treatment option for open tibial diaphyseal fractures (Type II, IIIA). *Professional Med J* 2016;23(3).
- Atif M, Mohib Y, Hasan O, Rashid H. 2020. In the cost-conscious era: Ilizarov circular frame or uniplanar external fixator for management of complex open tibia shaft fracture, retrospective cohort study from a level-1 trauma center. *J PMA* 2020; 70(2), S20-S23.
- Weitz-Marshall AD, Bosse MJ. Timing of closure of open fractures. *JAAOS* 2002; 10(6):379-84.
- Reuss BL, Cole JD. Effect of delayed treatment on open tibial shaft fractures. *Am J Orthop* 2007;36(4):215.
- Fowler TT, Taylor BC, Williams BR. Open fractures and timing to closure: a review. *UPOJ* 2010;20:19-22.
- Benson DR, Riggins RS, Lawrence RM, Hoepflich PD, Huston AC, Harrison JA. Treatment of open fractures: a prospective study. *J Trauma* 1983;23(1):25-30.

24. Crowley DJ, Kanakaris NK, Giannoudis PV. Debridement and wound closure of open fractures: the impact of the time factor on infection rates. *Injury* 2007;38(8):879-89.
25. Glueck DA, Charoglu CP, Lawton JN. Factors associated with infection following open distal radius fractures. *Hand* 2009;4:330-34.
26. Sagi HC, Papp S, Dipasquale T. The effect of suture pattern and tension on cutaneous blood flow as assessed by laser Doppler flowmetry in a pig model. *J Orthop Trauma* 2008;22(3):171-175
27. Lavelle WF, Uhl R, Krievies M, Drvaric DM. Management of open fractures in adult patients: current teaching in ACGME accredited residency programs. *J SurgOrthopAdv*2007;16(3):111-7.
28. Garner MR, Warner SJ, Heiner JA, Kim YT, Agel J. Soft tissue management in open tibial shaft fractures: A comparison of institutional preferences and resultant early clinical outcomes. *Bone Joint Open* 2020;1(8):481-7.
29. Wei SJ, Cai XH, Wang HS, Qi BW, Yu AX. A comparison of primary and delayed wound closure in severe open tibial fractures initially treated with internal fixation and vacuum-assisted wound coverage: a case-controlled study. *IntJSurg*2014 Jul 1;12(7):688-94
30. Lua JY, Tan VH, Sivasubramanian H, Kwek EB. Complications of Open Tibial Fracture Management: Risk Factors and Treatment. *Malaysian orthopaedic journal*. 2017 Mar;11(1):18.
31. Kreisfeld R, Newson R, Harrison J. Injury death, Australia 2002. Injury research and statistics Series no. 23. Adelaide: Australian Institute of Health and Welfare; 2004.
32. Allareddy V, Itty A, Maiorini E, Lee MK, Rampa S, Allareddy V, Nalliah RP. Emergency department visits with facial fractures among children and adolescents: an analysis of profile and predictors of causes of injuries. *JOral MaxillofacSurg*2014;72(9):1756-65.
33. Neto FC, de Paula Canal M, Alves BA, Ferreira PM, Ayres JC, Alves R. Analysis of the characteristics of patients with open tibial fractures of Gustilo and Anderson type III. *RevistaBrasileira de Ortopedia* 2016;51(2):143-9.