Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2023i1.213
*Biol. Clin. Sci. Res. J., Volume, **2023**: 213*
Original Research Article

FREQUENCY OF NON-UNION IN OPEN TIBIAL SHAFT FRACTURES PRESENTING IN TERTIARY CARE CENTER OF PUNJAB TREATED WITH AO FIXATOR

SIDDIQ MZ[1], RAZZAQUE MA[2], ATIF M[*3], AHMED J[1], REHMAN MU[4], AHMED B[4]

[1]*Department of Orthopedic Surgery, Aziz Bhatti Shaheed (DHQ) Teaching Hospital, Gujrat, Pakistan*
[2]*Department of Orthopedic Surgery, BAT Hospital Multan, Pakistan*
[3]*Department of Orthopedic Surgery, King Khaled Hospital, Najran, Kingdom of Saudi Arabia*
[4]*Department of Orthopedic Surgery, BAM & DC Multan, Pakistan*
**Correspondence author email address: atif_pak83@yahoo.com*

(Received, 9th September 2022, Revised 21st February 2023, Published 23rd February 2023)

Abstract: *This study aimed to evaluate the frequency of non-union in open tibial shaft fractures presenting in the Tertiary Care Centre of Punjab, treated with an AO fixator. A descriptive study was conducted in the Department of Orthopedics, Aziz Bhatti Shaheed Teaching Hospital, Gujrat & Bakhtawar Amin Hospital Multan from 01-12-2020 to 30-09-2021. A total of 93 cases were selected for the study. Demographic data of patients were noted. All the patients were managed by the same orthopedic department team, including the candidate led by the consultant, to keep results unbiased. Patients ranged between 18-70 years of age, with a mean age of 38.12±11.12 years. There were 65 males (69.9%) and 28 females (30.1%). 33 patients (35.5%) were admitted 24-48 hours after injury. 32 patients (34.4%) had a third upper fracture. Non-union was found in 39 patients (41.9%) and malunion in 2 patients (2.1%). Based on the results, the AO external fixator is a good and viable option for open tibial shaft fractures. This is a versatile, cost-effective, satisfactory, and reliable method of stabilization of open fractures.*

Keywords: Open tibial shaft fracture, Tibia fibula, Non-union, AO fixator

Introduction

Tibia fractures are the most commonly caused fractures worldwide. Open tibial fractures occur due to severe injuries, and treatment of these fractures is a crucial process that requires aggressive debridement, adequate fixation, and early soft tissue coverage. A high incidence of these fractures will occur in patients having multiple injuries. High infection and non-union rates are associated with these fractures, a common cause of limb loss. İt is important to know the etiology and epidemiology of these fractures helps the surgeons to use resources appropriately, and adequate fixation and good soft tissue coverage ensure the best outcome for these patients (Duyos et al., 2017; Santos et al., 2018; Singh et al., 2018). Because the majority of open tibial fractures are due to high-velocity trauma such as falls from height and roadside accidents, and machine injuries. Management of these fractures is complex due to comminution at the fracture site, loss of soft tissue, and precarious blood supply. The prognosis depends on the comminution, soft tissue injury, and initial management. Bone reconstruction and advanced soft tissue coverage are usually required to get healing (Lua et al., 2017).

AO foundation popularized most external fixators and experts in the last ten years. It replaced the application of casts and splints, which caused unfavorable outcomes and a high risk of complications in open fractures (Iobst and Liu, 2016; Lawal et al., 2016). Piwani et al. conducted a study in Hyderabad on the patients with open tibia fractures treated with AO fixator; the rate of non-union was about 3.33% (Mangukiya et al., 2018). Ullah et al. conducted a similar study in Hayatabad and found that to be 7% (Sanaullah et al., 2016). Khan et al. also conducted a similar study in Lahore and found 40% (Khan et al., 2012). There is a difference in the frequency of non-union rate in the open fractures of the tibia treated with AO external fixators in the locally and internationally published data (3.33%, 7%, 40%). This may be due to the difference in the technique or difference in the experience of the operating surgeon. To resolve this conflict, there is a need to conduct this study again in the local population so that the conflict in these studies could be resolved. If proven to have low non-union frequency could help in continuing to use this procedure, or if proven to have high non-union

[Citation: Siddiq, M.Z., Razzaque, M.A., Atif, M., Ahmed, J., Rehman, M.U., Ahmed, B. (2023). Frequency of non-union in open tibial shaft fractures presenting in tertiary care center of Punjab treated with AO fixator. *Biol. Clin. Sci. Res. J.*, **2023***: 213*. doi: https://doi.org/10.54112/bcsrj.v2023i1.213]

frequency can help in abandoning his procedure and opting for other techniques, which could help reduce the morbidity in these patients. This study evaluated the frequency of non-union in open tibial shaft fractures in the Tertiary Care Centre of Punjab, treated with an AO fixator.

Methodology

A descriptive study was conducted in the Ortho department of the ABSTH Hospital, Gujrat, and Bakhtawar Amin Hospital Multan. A total of 93 patients with open fractures of the tibial shaft from the Outpatient department of the hospitals were selected for the study. Detailed history and written informed consent were taken from each patient. The ethical committee approved the research design. Under aseptic conditions, spinal anesthesia was given. The thorough lavage of the limb with at least 10 liters of normal saline to clean the wound. After proper preparation and draping, a thorough debridement was done to remove all dead, dying tissue and any foreign material, assessment of damage to soft tissue and bone was done. The necrotic tissue, including skin facia tendons and necrotic muscles, was excised, but more significant bone pieces with adequate soft tissue attachment were preserved. Next, fracture stabilization was done by applying the AO external fixator. Unilateral uniplanar and unilateral biplanar, the two unilateral modalities were applied; however, the former was preferred. The wounds were not covered, and second-look debridement was done within 48 hours. Once the wound was thoroughly cleaned, and granulation started appearing within 5-7 days, delayed primary closure was done. The patients were called for follow-up after every week for 4 weeks. All the data were noted and recorded. To eliminate bias, all the patients were managed by the same team of the ortho department led by the same consultant. SPSS version 21 was used to analyze the collected data. Mean, and standard deviation was used to present numerical variables, i.e., age. Categorical variables, i.e., gender and non-union of open fracture shaft of the tibia, were presented as frequency and percentage.

Results

Patients ranged between 18-70 years of age, with a mean age of 38.12±11.12 years. There were 65 males (69.9%) and 28 females (30.1%). 33 patients (35.5%) were admitted 24-48 hours after injury (Table I). 32 patients (34.4%) had a third upper fracture (Table II). Non-union was found in 39 patients (41.9%) and malunion in 2 patients (2.1%) (Table III).

Table I: Demographic characteristics of patients (n=93)

Feature	N (%)
Male: Female	65 (69.95%): 28 (30.1%)
Age	38.12±11.12 years
Time since injury	
<24 hours	32 (34.4%)
24-48 hours	33 (35.5%)
48-72 hours	28 (30.1%)
Diabetes	14 (15.0%)
Hypertension	13 (14%)
Smoking	24 (25.8%)

Table II: Location of fracture

Location	N (%)
Upper third	32 (34.4%)
Middle third	31 (33.3%)
Lower third	30 (32.2%)

Table III: Morbidity and mortality data

Morbidity and mortality	N (%)
Wound infection	1 (1%)
Malunion	2 (2.1%)
Non-union	39 (41.9%)
Morality	0 (0%)

Discussion

Fractures of the shaft of the tibia are the most common fractures among long bones fractures in developing and developed countries, with 20 people suffering this fracture among every 100,000 every year (Milenkovic et al., 2020). İn significant number of cases, i.e., 15%-19%, the fracture does not heal and results in non-union despite modern advanced surgical techniques of early undreamed intramedullary nailing and result in significant physical handicap and psychological suffering (Ekegren et al., 2018). These fractures of the major cause of morbidity induce high hospital and financial costs on the patient. Compared to patients without non-union management, these patients result in a greater than two-fold increase in health care costs.[12] İt is substantial to identify the risk of non-union in patients and early management of this risk. Baseline characteristics such as smoking, skin integrity,

[Citation: Siddiq, M.Z., Razzaque, M.A., Atif, M., Ahmed, J., Rehman, M.U., Ahmed, B. (2023). Frequency of non-union in open tibial shaft fractures presenting in tertiary care center of Punjab treated with AO fixator. *Biol. Clin. Sci. Res. J.*, **2023***: 213*. doi: https://doi.org/10.54112/bcsrj.v2023i1.213]

degree of cortical continuity, soft tissue injury, proper initial treatment, and immediate intramedullary nailing technique are important prognostic factors that affect healing (Stewart, 2019; Tall, 2018; Wildemann et al., 2021). However, a patient's early healing response may be a more potent predictor factor for fracture healing. Lack et al. reported that any cortical bridging within four months postoperatively on radiographic assessment predicts the eventual fracture healing with an accuracy of 99%.(Raducha et al., 2019).

In open tibial fractures, AO external fixator provides a good fixation for the bone, helps solve complex soft tissue problems, provides access to wounds, and avoids damage to vital structures. AO external fixator provides safe and effective external fixation techniques, avoids damage to vital structures, and provides wound access (Kojima and Ferreira, 2011). A total of 93 patients were included in the study. The average age of the patients in the current study was 38.12±11.12 years. These findings were consistent with the studies carried out by Khan et al. at Peshawar and another study by McQueen et al (Association, 1996; Swiontkowski et al., 2000). The majority of patients in my study were males, 69.9%. These findings were closer to the study by Khan et al. [17] and Awais et al. (Burwell, 1971), which also revealed male predominance (93.33%). This distribution can be explained as in our socio-economic setup, males being the earning hands more prone to roadside accidents and other injuries in outdoor and indoor professional activities and also more prone to sports injuries. Females are mostly less involved in outdoor activities and sports. In our study, we calculated that the outcome variable non-union was present in 39 (41.9%) and absent in 28 (30.1%) patients. Khan et al. demonstrated comparable results with the current study; they showed 40% of non-union cases. On the other hand, in their study, Iqbal et al. (McQueen and Gaston, 2000) and; reported a 14.2% rate of non-union in open tibial shaft fractures. In a study by Ghaloo, non-union was found in 11.1% of patients (McQueen and Christie, 1996). Study by Chan et al. revealed non-union in 60% (Abraham et al., 1998).[22] Stratification of results showed that in the male gender with the age of 18-30 years, non-union was found in 8 cases and absented in 10 cases. In the female gender, it is found in 1 case and absent in 6 patients. Similarly, male patients aged 31-50 had non-union in 14 cases and were absent in 23 cases. On the other hand, in females, 6 patients were non-union and absent in 11 cases.

Conclusion

In conclusion, AO external fixator is a good option for open tibia shaft fractures. External fixators application is a versatile, cost-effective, satisfactory, and reliable method of open tibial fractures.

Conflict of interest

The authors declared absence of conflict of interest.

References

Abraham, P., Leftheriotis, G., and Saumet, J. (1998). Laser Doppler flowmetry in the diagnosis of chronic compartment syndrome. *The Journal of Bone and Joint Surgery. British volume* **80**, 365-369.

Association, O. T. (1996). Fracture and dislocation compendium. *J Orthop Trauma* **10**, 36-40.

Burwell, H. N. (1971). Plate fixation of tibial shaft fractures: a survey of 181 injuries. *The Journal of Bone and Joint Surgery. British volume* **53**, 258-271.

Duyos, O. A., Beaton-Comulada, D., Davila-Parrilla, A., Perez-Lopez, J. C., Ortiz, K., Foy-Parrilla, C., and Lopez-Gonzalez, F. (2017). Management of open tibial shaft fractures: does the timing of surgery affect outcomes? *JAAOS-Journal of the American Academy of Orthopaedic Surgeons* **25**, 230-238.

Ekegren, C. L., Edwards, E. R., De Steiger, R., and Gabbe, B. J. (2018). Incidence, costs and predictors of non-union, delayed union and mal-union following long bone fracture. *International journal of environmental research and public health* **15**, 2845.

Iobst, C. A., and Liu, R. W. (2016). A systematic review of incidence of pin track infections associated with external fixation. *Journal of Limb Lengthening & Reconstruction* **2**, 6.

Khan, T. B., Shah, Z. A., Aslam, N., and Arif, U. (2012). Complications of the Use of AO External Skeletal Fixator in the Treatment of Type â€“III Open Tibial Fractures. *Annals of King Edward Medical University* **18**, 25-25.

Kojima, K. E., and Ferreira, R. V. (2011). Tibial shaft fractures. *Revista brasileira de ortopedia* **46**, 130-135.

Lawal, Y. Z., Ejagwulu, F. S., Salami, S. O., and Mohammed, S. (2016). Monolateral frame external fixators in the definitive management of open limb fractures in North-western Nigeria. *Sub-Saharan African Journal of Medicine* **3**, 137.

Lua, J., Tan, V., Sivasubramanian, H., and Kwek, E. (2017). Complications of open tibial

[Citation: Siddiq, M.Z., Razzaque, M.A., Atif, M., Ahmed, J., Rehman, M.U., Ahmed, B. (2023). Frequency of non-union in open tibial shaft fractures presenting in tertiary care center of Punjab treated with AO fixator. *Biol. Clin. Sci. Res. J.*, **2023***: 213*. doi: https://doi.org/10.54112/bcsrj.v2023i1.213]

fracture management: risk factors and treatment. *Malaysian orthopaedic journal* **11**, 18.

Mangukiya, H. J., Mahajan, N. P., Pawar, E. D., Mane, A., and Manna, J. (2018). Functional and radiological outcome in management of compound tibia diaphyseal fracture with AO monolateral fixator versus Limb reconstruction system. *Journal of orthopaedics* **15**, 275-281.

McQueen, M., and Christie, J. (1996). Acute compartment syndrome in tibial diaphyseal fractures. *The Journal of Bone & Joint Surgery British Volume* **78**, 95-98.

McQueen, M., and Gaston, P. (2000). Acute compartment syndrome: who is at risk? *The Journal of Bone & Joint Surgery British Volume* **82**, 200-203.

Milenkovic, S., Mitkovic, M., and Mitkovic, M. (2020). External fixation of segmental tibial shaft fractures. *European Journal of Trauma and Emergency Surgery* **46**, 1123-1127.

Raducha, J. E., Swarup, I., Schachne, J. M., Cruz Jr, A. I., and Fabricant, P. D. (2019). Tibial shaft fractures in children and adolescents. *JBJS reviews* **7**, e4.

Sanaullah, S. K., Ali, B., Hakeem, A., Ahmed, I., and Khan, M. (2016). AO external fixator in the management of open fracture of tibia. *Rawal Med J* **41**, 459-61.

Santos, A. d. L., Nitta, C. T., Boni, G., Sanchez, G. T., Tamaoki, M. J. S., and REIS, F. B. D. (2018). Evaluation and comparison of open and closed tibia shaft fractures in a quaternary reference center. *Acta Ortopédica Brasileira* **26**, 194-197.

Singh, A., Hao, J. T. J., Wei, D. T., Liang, C. W., Murphy, D., Thambiah, J., and Han, C. Y. (2018). Gustilo IIIB open tibial fractures: an analysis of infection and nonunion rates. *Indian Journal of Orthopaedics* **52**, 406-410.

Stewart, S. (2019). Fracture non-union: a review of clinical challenges and future research needs. *Malaysian orthopaedic journal* **13**, 1.

Swiontkowski, M. F., Agel, J., McAndrew, M. P., Burgess, A. R., and MacKenzie, E. J. (2000). Outcome validation of the AO/OTA fracture classification system. *Journal of orthopaedic trauma* **14**, 534-541.

Tall, M. (2018). Treatment of aseptic tibial shaft non-union without bone defect. *Orthopaedics & Traumatology: Surgery & Research* **104**, S63-S69.

Wildemann, B., Ignatius, A., Leung, F., Taitsman, L. A., Smith, R. M., Pesántez, R., Stoddart, M. J., Richards, R. G., and Jupiter, J. B. (2021). Non-union bone fractures. *Nature Reviews Disease Primers* **7**, 57.

[Citation: Siddiq, M.Z., Razzaque, M.A., Atif, M., Ahmed, J., Rehman, M.U., Ahmed, B. (2023). Frequency of non-union in open tibial shaft fractures presenting in tertiary care center of Punjab treated with AO fixator. *Biol. Clin. Sci. Res. J.*, **2023***: 213*. doi: https://doi.org/10.54112/bcsrj.v2023i1.213]