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A PROSPECTIVE CASE SERIES ON THE DEFINITIVE USE OF EXTERNAL FIXATION AND VACUUM-ASSISTED CLOSURE IN OPEN TIBIA FRACTURES

Dr. Sandeep Patil V.[1*], Dr. Narendra B. S.[2], Dr. Varun V.[3]

[1*]Associate Professor, Department of Orthopaedics, Sri Madhusudan Sai Institute of Medical Sciences and Research, Chikkaballapur, Karnataka, India.
[2]Senior Resident, Department of Orthopaedics, Sri Madhusudan Sai Institute of Medical Sciences and Research, Chikkaballapur, Karnataka, India.
[3]Senior Resident, Department of Orthopaedics, Sri Madhusudan Sai Institute of Medical Sciences and Research, Chikkaballapur, Karnataka, India.

***Corresponding Author:** Dr. Sandeep Patil V
*Associate Professor, Department of Orthopaedics, Sri Madhusudan Sai Institute of Medical Sciences and Research, Chikkaballapur, Karnataka, India.

ABSTRACT

Introduction

Open fractures of the leg are quite common in road traffic accidents; the treatment of open tibial shaft fractures is very challenging, especially in developing countries where medical equipment's and orthopaedic experts are scarce, and there is a poor economy and health-seeking behaviour. The ideal protocol for open fractures of the leg is initial thorough debridement, soft tissue coverage, and intramedullary nailing or external fixator application. However, external fixators are comparatively safe in treating tibial open injuries; meanwhile, they have the advantages of minimal disruption, convenient subsequent soft tissue repair, and easy application. However, the procedure is accompanied by a serious number of problems in bone healing, alignment, and pin tract infections. Therefore, this study aimed to assess the outcome of open tibial shaft fractures treated by using external fixation as a primary and definitive treatment. The aim of this study was to evaluate the effectiveness of a uniplanar external fixator with vacuum-assisted closure application as a primary and definitive treatment for Gustilo and Anderson compound grade III B open tibial fractures.

Methods

This is a prospective study. We included all patients who underwent management for open tibial shaft fractures between April 2023 and April 2024. All the cases that were treated with uniplanar external fixators. Initial debridement with vacuum-assisted closure application was done.

Results

Ten patients with open fractures of the tibia-fibula were considered. Primary fixation of bones was done with a uniplanar external fixator and vacuum-assisted dressing, followed by split skin grafting. The use of a uniplanar external fixator with a vacuum-assisted closure dressing allows for stable fixation while minimising the risk of infection and further damage to surrounding tissue.

Conclusion
External fixators are a safe option as a primary and definitive mode of treatment in Gustilo type IIIB open fractures of the tibia.

Keywords: Open Tibia Fracture, External Fixator, Vacuum-Assisted Closure Dressing, Skin Grafting, Negative Pressure Wound Therapy.

INTRODUCTION

Tibial shaft fractures are the commonest open fractures of long bones owing to the anatomic location and precarious soft tissue coverage.[1] Open fractures of the leg are quite common in road traffic accidents. The ideal protocol for open fractures of the leg is initial thorough debridement, soft tissue coverage, and intramedullary nailing or external fixator application. External fixator may be later converted to internal fixation with reamed or unreamed intramedullary nail or left as a definitive treatment.

The goals of open fracture management are prevention of infection, soft tissue coverage, achievement of bony union, and restoration of function.[2] Important principles involve antibiotic utilisation, timing of initial surgical intervention, thorough debridement, type of wound closure, and fixation of fracture after proper alignment.[2,3]

The initial evaluation of patients with open fractures of tibial bone should follow the principles and guidelines of the Advanced Trauma Life Support System (ATLSS).[4]

Intramedullary interlocked nailing is considered the gold standard for the treatment of close diaphyseal and Gustilo Anderson type I, II, and most IIIA fractures of the tibia; however, in compound IIIB fractures, there are conflicting results in the literature, making it a grey area with no clearly defined guidelines. The treatment modalities in such fractures are primary intramedullary nailing (unreamed), external fixation followed by intramedullary nailing, and primary external fixation as a definitive treatment.[1]

A high incidence of infection has been reported in delayed intramedullary nailing. There is controversy in the literature regarding the best way of managing type II and type III open tibia fractures. External fixator as a definitive procedure, reducing the cost of one more surgery.[3]

A high rate of infection coupled with repeated surgeries adds to the overall cost of treatment, especially in rural areas of developing countries, and with almost the same effectiveness, external fixators are way more cost-effective.[1] We generally treat compound IIIB fractures with intramedullary nailing either primary or delayed; however, there is a subset of patients who cannot cope with financial implications because of repeat surgical interventions, so we continued the external fixator as a primary and definitive management.

Soft tissue covering should be addressed as soon as possible, ideally during the first 72 h following trauma. Conventional wound dressing needs a longer duration, recurrent debridement, and is followed by more damage to healthy tissue and non-compliance with patients.

VAC treatment provides a good environment that allows for both open and closed treatment and better wound healing procedures under moist, hygienic, sterile conditions.[5] Primary closure is important for temporary prevention of the exposed vital structure from bacterial contamination, as well as to induce a locally normal circulatory stimulation and proliferation of wound granulation tissues.[3,5]

VAC therapies offer a more sterile, comfortable environment that benefits from both open and closed treatment and ultimately speeds up the process of wound healing under moist, sterile, and clean circumstances.[5,6] Important characteristics of a wound include sufficient blood flow, the absence of a deep infection, and adequate debridement of the wound.

This study was done with an aim to evaluate the functional outcome and complications of external fixation with VAC therapy as a primary and definitive line of management for Gustilo IIIB open fractures of the tibia.

CASE PRESENTATIONS / METHODS

After obtaining ethical clearance from the institutional ethical committee, this prospective study was conducted in the Department of Orthopaedics in Sri Madhusudhan Sai Institute of Medical Sciences and Research from April 2023 to April 2024. A series of 10 cases were included in the study with age > 18 years of either gender with open tibial shaft fractures. (GUSTILLO ANDERSON GRADE 3B wounds). After obtaining prior informed and written consent from the patients. Fracture diagnosis confirmed by clinical examination and radiography.

The open wounds were in the range of 2 to 10 cm, and all the wounds were given a thorough wash with saline and povidine solution at the time of admission, and all patients were started on a triple antibiotic regime.

All patients were treated surgically with external fixator application after reduction of fracture, and the wound defect was closed with VAC application.

The device intermittently produced suction at 125 mm Hg. Every fifth day, after assessing the size of the wound, vacuum assisted closure dressings were changed. Assessment of VAC therapy was based on mean decrease in wound size and “Modified Johner and Wruh’s criteria."[5]

RESULT

Gender	**Number of Cases**	**Percentage**
Male	7	70%
Female	3	30%
Side		
Right	6	60%
Left	4	40 %
Mechanism		
RTA	9	90 %
Fall from height	1	10 %
Fixation method	External Fixator	

Table 1: Characteristics of wound

Number of VAC changes	**Number of Patients**	**Percentage**
3 - 4	1	10%
2 - 3	8	80%
< 2	1	10%

Table 2: Number of dressings

Methods	**Number of Patients**	**Percentage**
Secondary suturing	0	0%
Split skin graft	10	100%
Skin flap	0	0%

Table 3: Closure methods at the end of VAC therapy

Complications	**Number of Patients**	**Percentage**
Pin tract Infection	1	10%
Pain	0	0%
Skin irritation	1	10%
Delayed union	1	10%

Table 4: Complications

Figure 1: Presentation at the time of causality

FIG 2 : Wound after ex-fix application and debridement

Figure 3: After VAC dressing application

Figure 4: After 3 setting of VAC dressing

Figure 5: After Split Skin Grafting

Figure 6: At follow up

Figure 7: post op x ray

Figure 8: 1 month post op x ray

Figure 9: 3 months post op x ray

Figure 10: 4th month post op x ray

DISCUSSION

The management of compound Gustilo type IIIB fractures is not well defined, with much controversy among the available choices.[1] Although it is widely accepted that emergency irrigation and soft-tissue debridement are the cornerstones of initial care for open fractures, there is no consensus on the best method of obtaining and maintaining alignment and stability of the tibia.[2] Intramedullary nails (IM), external fixation, external fixation followed by IM nailing, and plates have been proposed with, at times, less than optimal results.[2,3] Intramedullary nailing is not possible due to a contaminated wound; thus, an external fixator is the method of choice. External fixator has advantages of low blood loss and proper wound care.[3]

The 4 criteria estimate the outcomes: severe soft tissue injuries, open fracture with reduced blood supply, wound contamination, and fracture instability and stabilisation focus on skeletal fixation and final wound closure.[5] Negative pressure dressings are an attractive option for the interim management of open fracture wounds.[6] Many studies have supported primary external fixation of open tibial fractures followed by definitive internal fixation as and when the soft tissue condition permits. In a meta-analysis of randomised controlled studies comparing primary external fixators with intramedullary interlocked nailing (unreamed), no statistically significant difference was found between the two procedures.[1]

Giannoudis et al. reported a 24% incidence of delayed union in 536 open fractures treated by an external fixator, of which 82% were Gustilo type III fractures;[7] Michail Beltrios et al. reported a union rate of 87.27%; they had eighteen cases of non-union, 21 delayed unions, and four cases of mal-union; pin-tract infection was seen in 26.36% of patients; and chronic osteomyelitis in three cases.[8]

In our study, the patients at our institute could not afford the financial burden of repeated surgeries, and as an external fixator was available in our institute and was provided free of cost to the patient, we continued it as a definitive method.

We selected 10 patients with open tibial shaft fracture; 7 were male and 3 were female. The age distribution of open tibial fracture was a mean of 34 ± 14 SD years, and the commonly affected age group was between 21 to 40 years with male predominance. The leading cause of the tibial fracture was a road traffic accident (9 cases). Padhi et al. had evaluated and analysed the factors affecting management of open tibial fractures in rural and tribal areas of developing countries; they observed an average time to union of 25.7 weeks.[9] In our study, the average union time was 24 weeks, delayed union in 10% cases, and pin track infection was seen in 10% patients.

CONCLUSION

Our study revealed that external fixators can be safely used as the primary and definitive mode of treatment in complex open fractures of the tibia, especially in settings where soft tissue injury is significant, with satisfactory results comparable to other modalities, in a cost-effective manner, especially in the resource-limited conditions of developing countries. The use of a of a uniplanar external fixator with vacuum-assisted closure dressing allows for stable fixation while minimising the risk of infection and further damage to surrounding tissue. Skin grafting, when combined with this fixation technique with vacuum dressing, offers a reliable method for addressing soft tissue coverage, facilitating wound healing, and reducing the need for further extensive reconstructive procedures. Although complications such as pin tract infection and delayed union were observed, these were managed with appropriate clinical interventions. And most patients achieved satisfactory function recovery. This technique demonstrates a favourable balance between fracture stabilisation and soft tissue management, providing a viable option for open tibia fractures. Further studies with larger cohorts and longer follow-up periods are recommended to refine indications and outcomes for this approach.

REFERENCES

[1] Anjum R, Singh N, Aggarwal J, et al. Unilateral external fixator as the primary and definitive treatment modality in type IIIB open tibial fractures: a retrospective study. Indian Journal of Orthopaedics 2019;5(1):52-6.
[2] Beltsios M, Savvidou O, Kovanis J, et al. External fixation as a primary and definitive treatment for tibial diaphyseal fractures. Strategies in Trauma and Limb Reconstruction 2009;4:81-7.
[3] Garg P, Sodha R, Hamid FB, et al. Clinical study of functional outcome of external fixator device as a primary definitve treatment of open tibia fracture. Prof. (Dr) RK Sharma 2021;21(1):768.
[4] Yeab M. Outcome of Open tibial shaft fractures treated using external fixation as a primary and definitive treatment in Tibebe Ghion Specialized Hospital, Bahirdar, Ethiopia (Doctoral dissertation).
[5] Kumar A, Hosangadi A, Ramesh M. Outcome of vacuum assisted dressing in open comminuted tibial fracture with primary fixation. Scripta Medica 2023;54(1):69-74.
[6] Stannard JP, Volgas DA, Stewart R, et al. Negative pressure wound therapy after severe open fractures: a prospective randomized study. J Orthop Trauma 2009;23(8):552-7.
[7] Giannoudis PV, Papakostidis C, Roberts C. A review of the management of open fractures of the tibia femur. J Bone Joint Surg Br 2006;88:281-90.
[8] Michail Beltrias, Olga Sarridou, John Kovam's. External fixation on a primary and treatment for tibia diaphyseal fracture. Strategies Trauma Limb Reconstr 2009;4(2):81-7.
[9] Padhi NR, Padhi P. Use of external fixators for open tibial injuries in the rural third world: panacea of the poor? Inj 2007;38(2):150-9.