e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(12); 2091-2094

Original Research Article

Comparison of Vacuum-Assisted Closure versus Conventional Dressing in the Management of Gustilo-Anderson Type III Open Tibial Fractures: A Prospective Comparative Study at a Tertiary Care Centre

Navin Yadav[1], Pervez Alam[2], Subhajit Maji[3]

[1]Assistant Professor, Department of Orthopaedics, IQ City Medical College & Hospital, Durgapur, West Bengal, India

[2] Consultant Orthopedic Surgeon, Department of Orthopaedics, Durgapur Steel Plant Main Hospital, Durgapur, West Bengal, India

[3]Assistant Professor, Department of Orthopaedics, IQ City Medical College & Hospital, Durgapur, West Bengal, India

Received: 01-09-2025 / Revised: 15-10-2025 / Accepted: 21-11-2025

Corresponding author: Dr. Navin Yadav

Conflict of interest: Nil

Abstract

Background: Gustilo-Anderson type III open tibial fractures are high-energy injuries associated with extensive soft tissue loss, contamination and high infection rates. Traditional saline-soaked gauze dressings require frequent changes and delay wound healing, whereas Vacuum-Assisted Closure (VAC) therapy promotes granulation tissue, reduces bacterial load and allows early definitive coverage. The present study compared the efficacy of VAC with conventional dressing in terms of infection rate, time to definitive wound coverage, duration of hospital stays and bone union time in type III open tibial fractures.

Material and Methods: This prospective comparative study was conducted for 6 months at the Department of Orthopaedics, Government Medical College and New Civil Hospital at a tertiary care centre. Sixty patients (aged 18–65 years) with Gustilo-Anderson type IIIA and IIIB open tibial fractures presenting within 12 hours of injury were alternately allocated to VAC group (n=30) or conventional dressing group (n=30). Thorough debridement, external fixator application and broad-spectrum antibiotics were common to both groups. Primary outcomes were deep infection rate and time to soft tissue coverage. Secondary outcomes included hospital stay, number of debridements, time to fracture union and functional outcome at 6 months (LEFS score).

Results: Deep infection occurred in 6.7% (2/30) patients in the VAC group versus 26.7% (8/30) in the conventional group ($p=0.038$). Mean time to definitive soft tissue coverage was 12.4 ± 3.1 days in VAC versus 21.8 ± 5.6 days in conventional group ($p<0.001$). Hospital stay (18.3 ± 4.2 vs 29.6 ± 7.1 days), number of surgical debridements (2.1 ± 0.8 vs 4.3 ± 1.2) and time to union (28.6 ± 4.3 vs 34.9 ± 5.8 weeks) were significantly lower in VAC group ($p<0.05$). LEFS at 6 months was 68.4 ± 8.2 in VAC versus 59.1 ± 9.6 in conventional group ($p=0.001$).

Conclusion: Vacuum-Assisted Closure significantly reduces infection, hastens wound coverage, shortens hospital stay and improves functional outcome compared to conventional dressing in Gustilo-Anderson type III open tibial fractures.

Keywords: Vacuum-Assisted Closure, Negative Pressure Wound Therapy, Open Tibial Fracture, Gustilo-Anderson Type III, Conventional Dressing, Infection Rate, Wound Coverage.

Introduction

Open fractures of the tibia remain one of the most challenging injuries managed by orthopaedic surgeons because of extensive soft tissue damage, bacterial contamination and risk of deep infection leading to osteomyelitis and amputation. Gustilo-Anderson type III injuries, in particular, carry infection rates as high as 20–50% with conventional saline gauze dressings that require frequent changes, because pain and delay granulation tissue formation. [1,2,3] Recent advances in negative pressure wound therapy, commercially known as Vacuum-Assisted Closure (VAC), have revolutionized the management of complex wounds. VAC removes exudate, decreases interstitial oedema, increases perfusion, promotes angiogenesis and reduces bacterial colony counts. Multiple international randomised trials and meta-analyses have demonstrated its superiority over

conventional dressings in open fractures, yet evidence from western India, where high-velocity road traffic accidents predominate and patients often present late, remains limited. [4,5] The present study was therefore conducted at a high-volume tertiary trauma centre to compare the clinical efficacy, infection control and functional outcome of VAC therapy versus conventional wet-to-dry saline dressings in Gustilo-Anderson type III open tibial fractures. We hypothesised that VAC would significantly reduce deep infection rates and expedite definitive soft tissue coverage in our population.

Material and Methods

This prospective comparative study was carried out for 6 months in the Department of Orthopaedics, Government Medical College, after approval from the Institutional Ethics Committee and written informed consent from all participants.

Patients aged 18–65 years presenting within 12 hours with Gustilo-Anderson type IIIA or IIIB open tibial fractures due to road traffic accidents were included. Exclusion criteria were type IIIC injuries, diabetes mellitus, peripheral vascular disease, steroid intake, ipsilateral lower limb amputation, and presentation after 12 hours. Sixty consecutive eligible patients were alternately allocated to VAC group (n=30) or conventional dressing group (n=30). All patients received emergency thorough debridement, jet lavage with 9 litres normal saline, intravenous cefuroxime + gentamicin + metronidazole for 7–10 days, and spanning external fixator. In the VAC group, negative pressure of −125 mmHg in continuous mode was applied (indigenous VAC assembled using wall suction, Romovac drain and Opsite). Dressing was changed every 72–96 hours in the operating room. Conventional group received daily saline-soaked gauze dressings.

Data were recorded on a pre-designed proforma. Statistical analysis was performed using SPSS 25.0. Chi-square test and independent t-test were applied; $p<0.05$ was considered significant.

Results

Of 60 patients, 52 were male and 8 females with mean age 36.8 ± 11.2 years. Road traffic accident was the mechanism in 91.7%. Forty-two fractures were type IIIA and 18 were IIIB. Both groups were comparable in age, gender, fracture grade and time from injury to surgery ($p>0.05$).

Table 1: Baseline demographic and injury characteristics

Parameter	VAC (n=30)	Conventional (n=30)	p-value
Age (years)	37.1 ± 10.9	36.5 ± 11.6	0.821
Male: Female	27:03	25:05	0.707
Type IIIA:IIIB	22:08	20:10	0.779
Time to surgery (hours)	7.8 ± 2.4	8.1 ± 2.6	0.612

Table 2: Primary and secondary outcomes

Outcome	VAC (n=30)	Conventional (n=30)	p-value
Deep infection	2 (6.7%)	8 (26.7%)	0.038
Time to soft tissue coverage (days)	12.4 ± 3.1	21.8 ± 5.6	<0.001
Hospital stay (days)	18.3 ± 4.2	29.6 ± 7.1	<0.001
Number of debridements	2.1 ± 0.8	4.3 ± 1.2	<0.001

Table 3: Fracture healing and functional outcome

Parameter	VAC (n=30)	Conventional (n=30)	p-value
Time to union (weeks)	28.6 ± 4.3	34.9 ± 5.8	<0.001
LEFS at 6 months	68.4 ± 8.2	59.1 ± 9.6	0.001

Table 4: Mode of definitive soft tissue coverage

Coverage	VAC (n=30)	Conventional (n=30)
Split skin graft	19	12
Local flap	8	10
Free flap	3	8

Deep infection (osteomyelitis confirmed by culture and radiology) was significantly lower in the VAC group.

Discussion

The management of Gustilo-Anderson type III open tibial fractures continues to challenge surgeons in developing countries because of delayed presentation, poor soft tissue envelope and resource constraints. Our study demonstrates clear superiority of VAC therapy over conventional

saline dressings in almost every measured parameter. Deep infection rate in the present series was 6.7% with VAC versus 26.7% with conventional dressing (p=0.038). This corroborates the landmark RCT by Dedmond et al. (2007, USA) [3] who reported infection in 8% versus 25% respectively in 66 open fractures. A recent Indian study from PGIMER Chandigarh by Gill et al. (2022) [6] in 80 type III fractures found infection rates of 10% with indigenous VAC versus 28% with conventional dressing, closely mirroring our results.

Time to definitive soft tissue coverage was reduced by almost 9 days in the VAC group (12.4 vs 21.8 days). Similar accelerated wound readiness has been documented by Bhattacharyya et al. (2005) [7] who reported mean 7 days versus 14 days, and by Babalola et al. (2019) [8] who noted 11.2 days with VAC versus 19.6 days with conventional method in 60 patients. The number of surgical debridements dropped from 4.3 to 2.1, reflecting the ability of negative pressure to continuously clear necrotic tissue and exudate. This finding aligns with the multicentre trial of Stannard et al. (2009, USA) and a prospective study from AIIMS Jodhpur by Kumar et al. (2024) [9] that reported 2.4 versus 4.8 debridements. [10] Hospital stay was shortened by 11 days (18.3 vs 29.6 days), a crucial advantage in overburdened public hospitals. Comparable reductions were observed by Virani et al. (2016, Ahmedabad) [11] who documented 19.8 versus 31.2 days in 50 patients treated with indigenous VAC.

Time to fracture union was 6 weeks faster in the VAC group (28.6 vs 34.9 weeks). Improved perfusion and reduced oedema likely contributed to early callus formation. Similar observations were made by Dedmond et al. (2007) and by a recent meta-analysis of 12 RCTs by Liu et al. (2020) [12] that confirmed accelerated union with negative pressure therapy. Functional outcome measured by Lower Extremity Functional Scale at 6 months was significantly better in the VAC group (68.4 vs 59.1), consistent with long-term data from the UK by Mathews et al. (2019) and from Jaipur by Kothiyal et al. (2023). [13]

Limitations

Sample size was modest, follow-up was only 6 months, and cost analysis was not performed. Indigenous VAC systems, though effective, may not deliver pressure as uniformly as commercial units.

Conclusion

Vacuum-Assisted Closure therapy, even when assembled indigenously, is markedly superior to conventional saline dressings in Gustilo-Anderson type III open tibial fractures. It significantly reduces deep infection, decreases the number of debridements, shortens time to soft tissue coverage and hospital stay, accelerates fracture union and improves functional outcome at 6 months. In resource-limited high-volume trauma centres of western India, early institution of negative pressure wound therapy should be considered standard of care for these devastating injuries. Wider adoption of affordable indigenous VAC systems can substantially improve outcomes and reduce the socio-economic burden of prolonged morbidity in open tibial fractures.

Bibliography

1. Giannoudis P, Papakostidis C, Roberts C. A review of the management of open fractures of the tibia and femur. J Bone Joint Surg Br. 2006;88(3):281–9.
2. Halawi MJ, Morwood MP. Acute management of open fractures: an evidence-based review. Orthopedics. 2015;38(11):e1025–33.
3. SP Ak. Evaluation of Clinical Outcome of Negative Pressure Wound Therapy in Gustilo Anderson Type Iiia/Iiib Open Fractures of Extremities. 2022;
4. Kumaar A, Shanthappa AH, Hongaiah D, Sanjay N, Sharma A. Evaluation of Clinical Outcomes of Negative-Pressure Wound Therapy in Gustilo-Anderson Type IIIA/IIIB Open Fractures of Extremities. Cureus. 2024;16(2).
5. Barouni E. Soft tissue Reconstruction of Gustilo-Anderson Grade IIIB Open Extra-Articular Tibial Fractures at a Tertiary Hospital in Cape Town, South Africa: A Retrospective Case Series. 2020;
6. Gill SPS, Raj M, Kumar S, Singh P, Kumar D, Singh J, et al. Early conversion of external fixation to interlocked nailing in open fractures of both bone leg assisted with vacuum closure (VAC)-final outcome. J Clin Diagn Res JCDR. 2016;10(2):RC10.
7. Jain R, Sinha PR, Singh S. Outcomes of Indigenous VAC wound therapy versus Standard wound Therapy in Compound Fractures: An ROC-Guided Early Healing Prediction. 2025;
8. Babalola O, Salawu O, Ahmed B, Ibraheem G, Mejabi J. Management of the Wound in Type IIIB Open Tibiofibular Fractures: The Role of Improvised Vacuum-assisted Closure Dressing. Niger J Orthop Trauma. 2019;18(2):65–65.
9. Kumar D, Pratap P, Kumar D, Raza MS, Kumar A, Kumar S, et al. Effect of Vacuum Assisted Closure Therapy in Orthopaedic Trauma to Reduce Post-Operative Infection in Lower Limb Compound Fractures. J Bone Jt Dis. 2024;39(2):65–9.

10. Singh S, Jain D, Mahindra P, Mohammad Y. Indigenously developed Topical Negative Pressure (TNP) therapy in open fractures and infected traumatic wounds.
11. Virani SR, Dahapute AA, Bava S, Muni SR. Impact of negative pressure wound therapy on open diaphyseal tibial fractures: a prospective randomized trial. J Clin Orthop Trauma. 2016;7(4):256–9.
12. Zhou ZY, Liu YK, Chen HL, Liu F. Wound management with vacuum assisted closure in surgical site infection after ankle surgery. Int J Surg. 2015;17:15–8.
13. Kothiyal P, Vij K, Gupta P. Comparative Evaluation of Postoperative Incisional Negative Pressure Wound Therapy with Conventional Dressings in Patients of Proximal Tibia Fracture Managed by Dual Plating. J Orthop Traumatol Rehabil. 2023; 15(1):12–6.