International Journal Dental and Medical Sciences Research
Volume 8, Issue 2, Mar.-Apr. 2026 pp: 75-81 www.ijdmsrjournal.com ISSN: 2582-6018

Outcome of Vacuum-Assisted Wound Care for Managing Grade 3 and 4 Pressure Ulcers in Patients with Spinal Cord Injury at the National Orthopaedic Hospital, Dala, Kano, Nigeria

*Kawu Ahidjo Abdulkadiri. *Abubakar Kabir, *Nurudeen Aminu Muhammad *Sani Abdullahi Tsoho, *Manman Muhammad Lawal, *Chiroma Musa Muhammad

*Department of Orthopaedic
National Orthopaedic Hospital Dala
Kano, Nigeria
Corresponding Author: Kawu Ahidjo Abdulkadiri

Date of Submission: 08-03-2026 Date of Acceptance: 20-03-2026

Abstract

Background: Patients with spinal cord injury (SCI) are at exceptionally high risk of developing pressure ulcers due to immobility, sensory loss, and impaired tissue perfusion. Grade 3 and 4 pressure ulcers represent a significant source of morbidity, prolonged hospitalisation, and mortality in this population. This study evaluates the outcomes of vacuum-assisted closure (VAC) therapy for managing Grade 3 and 4 pressure ulcers specifically in patients with spinal cord injury at the National Orthopaedic Hospital (NOH), Dala, Kano, Nigeria.

Methods: A retrospective cohort study was conducted on 38 patients with spinal cord injury and Grade 3 or 4 pressure ulcers treated with VAC therapy between January 2022 and December 2024 at NOH, Dala. Data extracted included patient demographics, injury characteristics, ulcer characteristics, duration of VAC therapy, healing outcomes, time to complete closure, complications, and length of hospital stay. Outcomes assessed included complete healing, partial healing (>50% volume reduction), treatment failure, and complication rates.

Results: A total of 38 patients (28 males, 10 females) with mean age 48.6 ± 13.8 years (range: 24–72 years) were included. Traumatic SCI accounted for 86.8% (33/38) of cases, with road traffic accidents as the predominant mechanism (78.9%). Thoracic level injury was most common (60.5%), followed by cervical (26.3%) and lumbar (13.2%). Complete neurological injury (ASIA A) was present in 68.4%. Sacral region was the most common ulcer location (71.1%), followed by trochanteric (15.8%) and ischial (13.2%). Grade 3 ulcers accounted for 47.4% (18/38) and Grade 4 for 52.6% (20/38). Mean duration of VAC therapy was 5.2 ± 1.8 weeks (range: 2–9 weeks). Complete healing was achieved in 19 patients (50.0%), partial healing in 13 patients (34.2%), and treatment failure in 6 patients (15.8%). Mean time to complete healing was 6.8 ± 1.6 weeks. Complications included wound infection (5 patients, 13.2%), VAC device malfunction (3 patients, 7.9%), and bleeding (2 patients, 5.3%). No treatment-related mortality occurred.

Conclusion: Vacuum-assisted closure therapy for Grade 3 and 4 pressure ulcers in spinal cord injury patients at NOH, Dala achieves complete or partial healing in 84.2% of patients, though outcomes are slightly inferior to general population studies, reflecting the challenges of wound healing in SCI. These findings support VAC therapy as an effective treatment modality in this vulnerable population while highlighting the need for enhanced preventive strategies.

Keywords: Vacuum-assisted closure, VAC therapy, pressure ulcers, spinal cord injury, bedsore, Nigeria

I. INTRODUCTION

Pressure ulcers represent one of the most common and devastating complications following spinal cord injury (SCI), affecting up to 85% of patients at some point during their lifetime [1]. The combination of immobility, sensory loss, motor paralysis, autonomic dysfunction, and impaired tissue perfusion creates a perfect storm for tissue breakdown over bony prominences [2]. Once established, pressure ulcers significantly increase morbidity, prolong hospitalisation, delay rehabilitation, and contribute to mortality from sepsis and other complications [3].

The economic burden of pressure ulcers in SCI patients is substantial. In the United States, annual treatment costs exceed $1.3 billion, with individual ulcers costing between $20,000 and $150,000 depending on severity [4]. In Nigeria, where healthcare resources are limited and patients

often pay out-of-pocket, the financial impact on families can be catastrophic [5].

Grade 3 pressure ulcers involve full-thickness skin loss with damage extending to subcutaneous tissue, while Grade 4 lesions extend to underlying muscle, bone, or supporting structures, often with osteomyelitis [6]. These advanced ulcers rarely heal with conservative measures alone, typically requiring surgical intervention [7]. Traditional treatment includes debridement, moist wound dressings, infection control, pressure relief, and nutritional support, but healing times are prolonged and recurrence rates high [8].

Vacuum-assisted closure (VAC) therapy, also known as negative pressure wound therapy (NPWT), has emerged as a valuable adjunct in pressure ulcer management [9]. By applying controlled subatmospheric pressure to the wound bed, VAC promotes granulation tissue formation, reduces oedema, decreases bacterial colonisation, enhances blood flow, and prepares the wound for definitive closure [10]. Multiple studies have demonstrated its efficacy in complex wounds, including pressure ulcers in SCI patients [11,12].

The pathophysiology of pressure ulcer development in SCI differs from other patient populations. Beyond immobility, SCI patients exhibit altered tissue perfusion due to loss of sympathetic tone, muscle atrophy reducing padding over bony prominences, and impaired wound healing related to nutritional deficiencies and recurrent infections [13]. These factors make pressure ulcers in SCI particularly challenging to treat and prone to recurrence.

Recent international studies have explored enhanced protocols for pressure ulcer management. Tian et al. demonstrated that autologous platelet-rich plasma (PRP) combined with VAC therapy achieved 93.33% effectiveness in pressure ulcer repair, significantly higher than VAC alone (80.00%), with complication rates reduced from 33.33% to 6.67% [14]. Liu et al. reported 94.55% total effective rate with continuous irrigation and PRP-enhanced VAC, compared to 76.36% with VAC alone [15]. These findings suggest potential for improved outcomes with combination therapy.

The National Orthopaedic Hospital (NOH), Dala, Kano, established in 1959, is one of Nigeria's three specialisedorthopaedic tertiary institutions and serves as a major referral centre for spinal cord injury patients from across northern Nigeria [16,17]. The hospital manages a high volume of traumatic SCI cases, predominantly from road traffic accidents, with many patients developing pressure ulcers during acute care or rehabilitation [18]. Despite the clinical importance of this problem, data on VAC therapy outcomes specifically in SCI patients from Nigerian centres remain limited.

This study aims to evaluate the outcomes of vacuum-assisted closure therapy for managing Grade 3 and 4 pressure ulcers specifically in patients with spinal cord injury at NOH, Dala, Kano, over a three-year period.

II. METHODOLOGY

This was a retrospective cohort study conducted at the National Orthopaedic Hospital, Dala, Kano, Nigeria, between January and December 2024, reviewing patients treated from January 2022 to December 2024. The hospital is a 260-bed federal tertiary institution with dedicated spinal cord injury, orthopaedic, and plastic surgery units [16].Ethical approval was obtained and due to the retrospective nature, requirement for individual patient consent was waived. Patient confidentiality was maintained through anonymized data collection.

All patients aged 18 years and above with traumatic or non-traumatic spinal cord injury and Grade 3 or 4 pressure ulcers (National Pressure Injury Advisory Panel staging system) [6] treated with VAC therapy at NOH, Dala during the study period were eligible. A total of 38 patients met inclusion criteria.

Inclusion criteria were: (1) age ≥18 years; (2) confirmed spinal cord injury (any level, any severity); (3) Grade 3 or 4 pressure ulcer; (4) treatment with VAC therapy for minimum 2 weeks; (5) complete medical records available. Exclusion criteria were: (1) patients with untreated osteomyelitis requiring surgical resection; (2) patients with malignant ulcers; (3) patients with bleeding disorders; (4) incomplete records.

All patients underwent initial surgical debridement to remove necrotic tissue and achieve a clean wound bed. VAC therapy using low pressure suction machine readily available was applied with settings of -125 mmHg continuous or intermittent pressure based on clinician preference and wound characteristics. Dressings were changed every 48–72 hours. Therapy continued until wound closure, readiness for surgical reconstruction, or treatment failure. Adjunctive measures included pressure-relieving mattresses, regular turning protocols (2-hourly), nutritional support (high protein diet, supplementation), and infection control based on culture results.

Medical records, operative notes, and wound care charts were reviewed using a standardised data extraction form. Data collected included:

1. Demographic characteristics: Age, sex, comorbidities.

2. Injury characteristics: Level of injury (cervical, thoracic, lumbar), ASIA impairment scale grade, mechanism (traumatic vs. non-traumatic), time since injury.
3. Ulcer characteristics: Grade (3 or 4), anatomical location (sacral, trochanteric, ischial, others), size (cm^2), duration before VAC initiation, presence of infection, osteomyelitis status.
4. Treatment details: Duration of VAC therapy, number of dressing changes, adjunctive therapies (debridement, antibiotics, nutritional support, flap reconstruction after VAC).
5. Outcome measures: Complete healing (full wound closure), partial healing (>50% volume reduction), treatment failure (no improvement or deterioration), time to complete healing, complications (infection, bleeding, device malfunction), length of hospital stay.

Data were entered into Microsoft Excel and analysed using SPSS Version 25.0. Descriptive statistics (frequencies, percentages, means, standard deviations, ranges) were calculated for all variables. Subgroup analysis compared outcomes by ulcer grade and injury level. Statistical significance for comparisons was set at $p < 0.05$.

III. RESULTS

A total of 38 patients met inclusion criteria. Table 1 presents demographic and injury characteristics.Mean age was 48.6 ± 13.8 years (range: 24–72 years). Male predominance (73.7%) reflects SCI demographics in Nigeria [18]. Traumatic SCI accounted for 86.8%, with road traffic accidents the predominant mechanism (78.9%). Thoracic level injury was most common (60.5%), and complete neurological injury (ASIA A) in 68.4%.

Table 2 presents characteristics of pressure ulcers.Sacral region was the most common location (71.1%), consistent with prolonged supine positioning [7]. Grade 4 ulcers predominated (52.6%). Seven patients (18.4%) had multiple ulcers. Wound infection at presentation was present in 42.1%, and confirmed osteomyelitis in 15.8%.

Mean duration of VAC therapy was 5.2 ± 1.8 weeks (range: 2–9 weeks). Mean number of dressing changes was 14.2 ± 4.8. Continuous pressure mode was used in 30 patients (78.9%), intermittent in 8 patients (21.1%).

Table 3 presents treatment outcomes.Complete healing was achieved in 19 patients (50.0%), with mean time to healing of 6.8 ± 1.6 weeks. Partial healing occurred in 13 patients (34.2%), of whom 7 subsequently underwent flap reconstruction. Treatment failure occurred in 6 patients (15.8%), attributed to uncontrolled infection (4 patients), non-compliance with pressure relief (1 patient), and severe malnutrition (1 patient).

Table 4 presents outcomes stratified by ulcer grade.Grade 3 ulcers had significantly higher complete healing rates (66.7% vs. 35.0%, p=0.03) and shorter healing times (5.8 vs. 7.6 weeks, p=0.02) compared to Grade 4 ulcers.By injury level, thoracic SCI patients had the lowest complete healing rate (43.5%), compared to cervical (60.0%) and lumbar (60.0%), though differences were not statistically significant (p=0.48).

Table 5 presents complications encountered.Overall complication rate was 44.7%, higher than in general population studies [14]. Wound infection was the commonest complication (13.2%), reflecting the vulnerability of SCI patients to infection [13].

Mean length of hospital stay was 9.6 ± 4.2 weeks (range: 5–20 weeks). Patients achieving complete healing had shorter stays (7.8 ± 2.8 weeks) compared to partial healing (10.4 ± 3.6 weeks) and treatment failure (14.2 ± 4.8 weeks) (p=0.01).

IV. DISCUSSION

This study provides the first systematic assessment of vacuum-assisted closure therapy outcomes for Grade 3 and 4 pressure ulcers specifically in spinal cord injury patients at NOH, Dala, Kano, demonstrating complete or partial healing in 84.2% of patients. These outcomes, while favourable, are slightly inferior to our previous series in general population (86.8%) [19], reflecting the unique challenges of wound healing in SCI.

The complete healing rate of 50.0% in this SCI cohort is lower than the 55.3% we reported in mixed population [19] and the 55-65% rates reported in some international series [11,12]. This difference is expected given the pathophysiology of SCI: impaired tissue perfusion from sympathetic dysfunction, muscle atrophy reducing vascularity, and systemic factors including recurrent infections and nutritional deficiencies [13,20].

The partial healing rate of 34.2% is clinically valuable, as it often enables subsequent flap reconstruction with lower failure risk [7]. Seven patients in this series underwent successful flap surgery after VAC preparation, consistent with the concept of VAC as a bridge to definitive closure [8].

Our outcomes compare reasonably with international studies. Tian et al. reported 80.00% effectiveness with VAC alone in pressure ulcers (all causes), improving to 93.33% with PRP combination [14]. Liu et al. reported 76.36% effectiveness with VAC alone [15]. Our 84.2% overall success rate exceeds these VAC-alone

figures, possibly reflecting our protocol including aggressive debridement and nutritional support.

The Cochrane review of NPWT for pressure ulcers noted limited high-quality evidence but suggested potential benefits over conventional dressings [21]. Our findings support this conclusion in the SCI subpopulation.

The significantly poorer outcomes in Grade 4 ulcers (35.0% complete healing vs. 66.7% for Grade 3) underscore the importance of early intervention before ulcers progress to involve bone [22]. The 15.8% osteomyelitis rate in this series is consistent with literature reporting 15-30% bone involvement in advanced pressure ulcers [23].

The higher complication rate in this series (44.7%) compared to our general population study (31.6%) [19] and the Tian et al. VAC-alone group (33.33%) [14] reflects SCI-specific vulnerabilities. Wound infection (13.2%) was the commonest complication, consistent with reports that SCI patients have impaired immune function and higher infection risk [13,24].

Device malfunction (7.9%) was higher than in our general series (5.3%), possibly related to longer treatment duration in SCI patients (5.2 vs. 4.8 weeks) and challenges of maintaining equipment in spinal units [19].

The predominance of traumatic SCI (86.8%), road traffic accidents (78.9%), and thoracic level injuries (60.5%) in this series reflects Nigerian epidemiology [18,25]. The high proportion of complete injuries (68.4%) and the prevalence of pressure ulcers (often developing before referral) highlight gaps in acute care and prevention [5].

NOH, Dala serves as a regional referral centre for SCI, managing patients from across northern Nigeria [16,17]. The availability of VAC therapy represents an important advance, but the 18.4% rate of multiple ulcers and 42.1% infection at presentation indicate that many patients arrive with established complications [18].

These findings have several implications for SCI care at NOH, Dala:

1. Prevention emphasis: The challenges of treating established pressure ulcers reinforce the critical importance of prevention through pressure relief protocols, skin inspection, and early intervention [1,3].
2. Early VAC initiation: Better outcomes in Grade 3 ulcers support early VAC therapy before progression to Grade 4 [22].
3. Enhanced protocols: The superior outcomes with PRP combination in literature [14,15] suggest exploring adjunctive therapies at NOH, Dala.
4. Multidisciplinary care: Optimal outcomes require integrated teams including spinal surgeons, plastic surgeons, nutritionists, and specialised nurses [4].
5. Patient/family education: Given the high rate of non-compliance as a factor in treatment failure (1 patient), structured education on pressure relief is essential [5].

The slight inferiority of outcomes in this SCI cohort compared to our general population study [19] validates the concept that SCI patients represent a higher-risk subgroup requiring enhanced interventions and realistic expectations.

This study has several limitations. First, retrospective design limits data completeness. Second, single-centre design limits generalisability. Third, relatively small sample size (n=38) limits subgroup analyses. Fourth, absence of a control group prevents direct comparison with conventional dressings. Fifth, variable follow-up may underestimate late recurrence. Sixth, lack of standardised wound measurement protocols may affect healing assessment accuracy.

Prospective studies with standardised protocols and control groups would strengthen evidence. Research on cost-effectiveness of VAC therapy in Nigerian SCI patients would inform resource allocation. Studies exploring combination therapies (PRP, antimicrobials) could identify enhance protocols. Establishment of a SCI pressure ulcer registry would facilitate continuous quality improvement.

This retrospective study demonstrates that vacuum-assisted closure therapy for Grade 3 and 4 pressure ulcers in spinal cord injured patients in NOH Dala Kano achieves complete healing in 50.0% and overall success (complete or partial healing) in 84.2% of patients. Mean healing time was 6.8 weeks, and complication rates (44.7%) were higher than in general population, reflecting SCI- specific challenges. Grade 3 ulcers had significantly better outcome than Grade 4, supporting early intervention. These findings support VAC therapy as an effective treatment modality in this vulnerable population while highlighting the need for enhanced preventive strategies and exploration of combination therapy to improve outcomes.

REFERENCES

[1]. Kruger EA, Pires M, Ngann Y, Sterling M, Rubayi S. Comprehensive management of pressure ulcers in spinal cord injury: current concepts and future trends. J Spinal Cord Med. 2013;36(6):572-85. [CrossRef]

[2]. Byrne DW, Salzberg CA. Major risk factors for pressure ulcers in the spinal cord disabled:

a literature review. Spinal Cord. 1996;34(5):255-63.
[3]. Regan MA, Teasell RW, Wolfe DL, et al. A systematic review of therapeutic interventions for pressure ulcers after spinal cord injury. Arch Phys Med Rehabil. 2009;90(2):213-31. [CrossRef]
[4]. Brem H, Maggi J, Nierman D, et al. High cost of stage IV pressure ulcers. Am J Surg. 2010;200(4):473-7. [CrossRef]
[5]. Nwankwo OE, Uche EO, Okorie E, Nnezianya I. Epidemiological and treatment profiles of spinal cord injury in southeast Nigeria. Spinal Cord. 2013;51(12):898-901.
[6]. Edsberg LE, Black JM, Goldberg M, McNichol L, Moore L, Sieggreen M. Revised National Pressure Ulcer Advisory Panel pressure injury staging system. J Wound Ostomy Continence Nurs. 2016;43(6):585-97. [CrossRef]
[7]. Batra RK, Aulakh HS, Gupta AK. VAC therapy in large infected sacral pressure ulcer grade IV—can be an alternative to flap reconstruction? Indian J Surg. 2014;76(2):162-4. [CrossRef]
[8]. Smith N. The benefits of VAC therapy in the management of pressure ulcers. Br J Nurs. 2004;13(22):1359-65. [CrossRef]
[9]. Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment. Ann Plast Surg. 1997;38(6):563-77.
[10]. Moues CM, Heule F, Hovius SE. A review of topical negative pressure therapy in wound healing: sufficient evidence? Am J Surg. 2011;201(4):544-56. [CrossRef]
[11]. Ford CN, Reinhard ER, Yeh D, et al. Interim analysis of a prospective, randomized trial of vacuum-assisted closure versus the Healthpoint System in the management of pressure ulcers. Ann Plast Surg. 2002;49(1):55-61. [CrossRef]
[12]. Gupta S. Guidelines for managing pressure ulcers with negative pressure wound therapy. Adv Skin Wound Care. 2004;17(Suppl 2):1-16.
[13]. Consortium for Spinal Cord Medicine Clinical Practice Guidelines. Pressure ulcer prevention and treatment following spinal cord injury: a clinical practice guideline for health-care professionals. J Spinal Cord Med. 2001;24(Suppl 1):S40-101.
[14]. Tian B, et al. The application effect of autologous platelet-rich plasma combined with negative pressure sealing drainage technology in pressure ulcer wound repair. Medicine (Baltimore). 2024;103(44):e39672. [CrossRef]
[15]. Liu Y, et al. Clinical evaluation of continuous irrigation with Bikerui combined with negative pressure closed drainage and platelet-rich plasma technique for treatment of stage III–IV pressure ulcer. Postepy Dermatol Alergol. 2024;41(2):181-8. [CrossRef]
[16]. National Orthopaedic Hospital Dala Kano. About Us [Internet]. Kano: NOH Dala; 2025. Available from: https://nohkano.gov.ng/
[17]. National Orthopaedic Hospital Dala Kano. Clinical Education & Training [Internet]. Kano: NOH Dala; 2025. Available from: https://nohkano.gov.ng/clinical-education-training/
[18]. Abubakar K, Suleiman A, Umar M, et al. Pedicle screw fixation in 713 patients with spinal disorders at the National Orthopaedic Hospital, Dala, Kano, Nigeria. Unpublished data. 2026.
[19]. Author. Outcome of vacuum assisted wound care for managing grade 3 and 4 pressure ulcers at the National Orthopaedic Hospital Dala, Kano, Nigeria. Unpublished data. 2026.
[20]. Marangi GF, et al. Switching from galenic to advanced dressings or vacuum assisted closure therapy can improve quality of life of patients with chronic non-responsive pressure skin ulcers. Adv Wound Care. 2024;13(3):131-9. [CrossRef]
[21]. Shi J, Gao Y, Tian J, et al. Negative pressure wound therapy for treating pressure ulcers. Cochrane Database Syst Rev. 2023;5(5):CD011334. [CrossRef]
[22]. Su S, et al. Wound management of multi-site pressure ulcer at different stages in elderly patients. Clin CosmetInvestig Dermatol. 2021;14:749-55. [CrossRef]
[23]. Bodavula P, Liang SY, Wu J, VanTassell P, Marschall J. Pressure ulcer-related pelvic osteomyelitis: a neglected disease? Open Forum Infect Dis. 2015;2(3):ofv112. [CrossRef]
[24]. Allegranzi B, Bagheri Nejad S, Combescure C, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011;377(9761):228-41.
[25]. Uche EO, Nwankwo OE, Okorie E, Nnezianya I. Cervical spine injury: A ten-year multicenter analysis of evolution of care and risk factors for poor outcome in southeast Nigeria. Niger J Clin Pract. 2015;18(2):203-8.

International Journal Dental and Medical Sciences Research
Volume 8, Issue 2, Mar.-Apr. 2026 pp: 75-81 www.ijdmsrjournal.com ISSN: 2582-6018

Table 1: Demographic and Injury Characteristics of Patients (n=38)

Characteristic	Number (n)	Percentage (%)
Sex		
Male	28	73.7%
Female	10	26.3%
Age group (years)		
18–35	12	31.6%
36–50	14	36.8%
51–65	8	21.1%
65& above	4	10.5%
Mechanism of injury		
Road traffic accident	30	78.9%
Fall from height	5	13.2%
Non-traumatic	3	7.9%
Level of injury		
Cervical (C1–C7)	10	26.3%
Thoracic (T1–T12)	23	60.5%
Lumbar (L1–L5)	5	13.2%
ASIA grade		
A (Complete) 26	26	68.4%
B (Sensory only) 8	8	21.1%
C (Motor useless) 4	4	10.5%
Time since injury		
< 6 months	14	36.8%
6–12 months	12	31.6%
>12 months	12	31.6%

Table 2: Pressure Ulcer Characteristics (n=38 patients, 45 ulcers)

Characteristic	Number (n)	Percentage (%)
Ulcer grade		
Grade 3	18	47.4%
Grade 4	20	52.6%
Anatomical location (45 ulcers)		
Sacral	32	71.1%
Trochanteric	7	15.6%
Ischial	6	13.3%
Multiple ulcers	7 patients	18.4%
Mean ulcer size (cm^2)	48.6 ± 22.4	
Wound infection at presentation	16 patients	42.1%
Osteomyelitis (confirmed)	6 patients	15.8%

Table 3: Treatment Outcomes Following VAC Therapy (n=38)

Outcome	Number (n)	Percentage (%)
Complete healing	19	50.0%
Partial healing (>50% volume reduction)	13	34.2%
Treatment failure	6	15.8%
Overall success (complete + partial)	32	84.2%

Table 4: Outcomes by Ulcer Grade

Outcome	Grade 3 (n=18)	Grade 4 (n=20)	p-value
Complete healing	12 (66.7%)	7 (35.0%)	0.03
Partial healing	5 (27.8%)	8 (40.0%)	0.04
Treatment failure	1 (5.6%)	5 (25.0%)	0.09
Mean healing time (weeks)	5.8 ± 1.4	7.6 ± 1.8	0.02

Table 5: Complications of VAC Therapy (n=38)

Complication	Number (n)	Percentage (%)
Wound infection (new or worsening)	5	13.2%
VAC device malfunction	3	7.9%
Bleeding (minor, controlled)	2	5.3%
Pain during dressing changes	4	10.5%
Skin maceration periwound	3	7.9%
Overall complications	17	44.7%