Comparative Efficacy of Vacuum-Assisted Closure Dressing Versus Conventional Dressing in Wound Management: A Prospective Randomized Study

[1]Hitesh Patel*, [2]Neeraj Rayate, [2]Satish Pattansheti, [3]Ankit Mishra,

[1] B.J. Medical College and Civil hospital, Ahmedabad, Gujarat -380016, India

[2,4]Jupiter Hospital, Prathamesh Park, Baner, Pune, Maharashtra -411069, India

[3] Sravani hospital Hyderabad,Telagana-500034,India

Abstract

This prospective randomized study compared vacuum-assisted closure (VAC) dressing with conventional dressing in 78 patients presenting with traumatic, infective, diabetic, and vascular wounds. Primary outcomes included wound surface area reduction, granulation tissue formation, pain scores, hospital stay, healing time, and revision surgery incidence. By day 12, VAC-treated wounds exhibited a 29% greater reduction in area (22.4 ± 8.4 cm² vs. 31.6 ± 10.4 cm², $p < 0.001$) and a 107% higher granulation rate (47.2% vs. 22.8%, $p < 0.001$). Hospital stay was shorter with VAC (14.95 ± 8.71 vs. 18.38 ± 4.68 days, $p < 0.05$), and healing time reduced by 54.1% (38.31 ± 10.13 vs. 59.03 ± 11.38 days, $p < 0.001$). Pain scores improved more rapidly, and revision surgery incidence was 75% lower with VAC. A full-range Pearson correlation simulation across seven wound-healing variables illustrated potential interrelationships for predictive modelling. These findings support VAC as a superior modality in wound management, offering enhanced healing efficiency, reduced patient discomfort, and decreased healthcare resource utilization.

Keywords: Vacuum-assisted closure, Conventional dressing, Wound healing, Granulation tissue, Pain score, Pearson correlation,

1.0 Introduction

Wound healing represents a complex, highly regulated process involving hemostasis(Versteeg et al., 2013), inflammation(Schmid-Schönbein, 2006), tissue proliferation(Vasiliev, 1958), and remodeling; disruption at any of these stages can lead to the formation of chronic non-healing wounds (i.e., wounds persisting beyond three months) . Chronic wounds frequently result from ischemia, infection, elevated protease activity, and impaired angiogenesis and extracellular matrix deposition, particularly in patients with diabetes or vascular insufficiencies(Zhao et al., 2016). These wounds pose significant clinical challenges due to prolonged treatment durations, elevated morbidity, and substantial social and economic burdens(Sen, 2019). Historically, conventional dressings such as dry gauze or moist saline dressings have served as the mainstay for wound management despite known limitations(Cockbill, 2007). Cotton gauze dressings frequently adhere to the wound bed, causing patient discomfort during removal, and fail to maintain a consistently moist, protective environment optimal for cell proliferation and migration(Charras & Sahai, 2014). Alternative modern dressings (e.g., hydrocolloid and hydrogel) have sought to overcome these shortcomings; yet, evidence of their superior efficacy in chronic wound closure remains inconclusive (Eriksson et al., 2022).

Vacuum-assisted closure (VAC), also known as negative-pressure wound therapy (NPWT), is a relatively recent innovation that has been introduced to address the shortcomings of conventional dressings(Agarwal et al., 2019; Gabriele et al., 2024). VAC employs controlled local negative pressure to draw out wound exudate, reduce edema, promote microcirculation, and facilitate granulation tissue formation (HMP Global Learning Network, 2025; NPWT description(Holloway et al., 2020; Miller & Clark, 2025). Early animal and human studies reported improved healing rates and reduced infection when VAC was applied to both acute and chronic wounds (AAP Grand Rounds, 2006)(Foley et al., 2014; Hinton et al., 2015). A randomized controlled trial involving chronic leg ulcers demonstrated that VAC significantly shortened time to complete healing compared to standard care (V.A.C. vs. conventional therapy)(Blume et al., 2010; Yu et al., 2013).

Subsequent investigations have reinforced these findings across various wound types. In diabetic foot ulcers (DFUs), VAC yielded faster granulation onset and shorter time to wound healing versus moist gauze dressing in randomized trials(Ahmed et al., 2019; Vuerstaek et al., 2006). Another study in India involving DFU patients found significantly reduced healing times, greater granulation tissue coverage, and lower pain scores with VAC compared to conventional dressing(Mooghal et al., 2021; Ranjan et al., 2025). Additional prospective observational and controlled studies corroborated advantages of VAC in complex and infected wounds highlighting accelerated granulation, reduced wound size, decreased hospital stays, and fewer dressing changes (Iacovelli et al., 2021; Yanaral et al., 2017). A study comparing VAC and conventional dressing in non-healing ulcers reported that VAC achieved granulation in 100% of patients by week seven, compared to just 63% in the conventional group, with markedly reduced discharge(Alvarez et al., 2007; ElDegwy et al., 2017).

Despite these encouraging findings, limitations remain most prior studies have involved heterogeneous wound etiologist, small sample sizes, or observational designs; few have stratified outcomes by comorbidity status (e.g., diabetes), and few have detailed granular comparative metrics such as rate of granulation growth, quantitative wound surface area reduction, pain during dressing changes, or surgery revision rates. The present study extends the existing literature by rigorously comparing VAC therapy against conventional dressing in a randomized prospective design, with detailed metrics across multiple dimensions: wound surface area reduction, granulation tissue percentage development, discharge character, pain intensity during dressing change, duration to healing, length of hospital stays, and revision debridement rates. It further adds subgroup analyses for diabetic versus non-diabetic patients. Therefore, the authors hypothesize that VAC therapy will significantly outperform conventional dressing across wound healing parameters, resulting in faster reduction in wound area, higher granulation rates, lower pain, shorter hospital stays, decreased healing time, and reduced need for revision surgery, with consistent benefits observed in both diabetic and non-diabetic cohorts.

2. Materials and Methods

This study was designed as a prospective, randomized, comparative clinical investigation to evaluate the efficacy of Vacuum-Assisted Closure (VAC) therapy versus conventional dressing in wound management. A prospective design (Yu et al., 2005) was selected to allow real-time data collection, minimizing recall bias and enabling systematic observation of wound healing progress, while randomization was employed to reduce selection bias and ensure comparable baseline characteristics between groups(Bolton, 2016). The study was conducted in the Department of General Surgery at Grant Medical Foundation, Ruby Hall Clinic, Pune, a 550-bed NABH-accredited tertiary care hospital with advanced wound care facilities. A total of 78 patients with wounds of varying etiologist, including traumatic, infective, diabetic, and vascular wounds, who met the inclusion criteria, were enrolled. The inclusion criteria comprised wounds larger than 3 cm², patients aged 18 years or above, all wound etiologist suitable for topical negative pressure therapy, and provision of informed consent, whereas exclusion criteria included active bleeding wounds, active Charcot disease, fistulas communicating with organs or cavities, malignant ulcers, untreated osteomyelitis, and dry gangrene(Martinengo et al., 2019; Miranda et al., 2024). Eligible patients were randomly allocated to the VAC or conventional dressing group using a computer-generated random number sequence, with block randomization (block size of four) to maintain balance between groups, and allocation concealment ensured through sealed opaque envelopes opened at intervention initiation(de Almeida Lopes et al., 2025; Sil et al., 2019).

Baseline demographic details, comorbidities, wound ethology, and dimensions were recorded(Gould et al., 2015). The primary and secondary outcome measures included wound surface area reduction (measured on days 1, 4, 8, and 12 using sterile transparent sheet tracing followed by digital planimetry), granulation tissue formation percentage (estimated visually by the same surgical team to reduce observer variability), type of discharge (serous, purulent, or mixed), pain scores during dressing changes (assessed using a 0–10 Visual Analogue Scale), duration of hospital stay, total healing time until complete epithelialization or readiness for closure, and requirement for revision surgery. Data were analysed using SPSS version 11.5 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were applied to summarize baseline characteristics, with means and standard deviations reported for continuous variables and frequencies with percentages for categorical data(Larson, 2006). For group comparisons, the independent samples t-test was used when continuous data were normally distributed(Pereira & Leslie, 2010), while the Mann–Whitney U test was applied for skewed distributions(Nachar, 2008). Categorical variables were compared using the Chi-square test (χ^2) when expected cell counts were small(Nowacki, 2017). Repeated Measures ANOVA was employed to assess changes in wound surface area and granulation tissue percentage over time, applying the Greenhouse–Geisser correction when sphericity was violated(Bathke et al., 2009; Misangyi et al., 2006). Kaplan–Meier survival analysis was used to compare wound healing probabilities between groups, with the log-rank test to determine statistical significance(Dudley et al., 2016). Additionally, multivariate linear regression was conducted to adjust for potential confounders such as age, diabetes status, and wound ethology in relation to healing rate and hospital stay, while binary logistic regression was applied to identify predictors of revision surgery(Harrell Jr, 2015; Tehan et al., 2023). The choice of these statistical methods was guided by the type of data, distribution characteristics, and study objectives, ensuring both accuracy and robustness of findings. Parametric tests were chosen for normally distributed data to maximize statistical power, while non-parametric alternatives preserved validity in non-normal distributions. Regression models enabled the identification of independent effects after controlling for covariates, and time-to-event analysis provided both statistical and graphical insights into healing trajectories(Bussy et al., 2019). A p-value < 0.05 was considered statistically significant, and all results were reported with 95% confidence intervals and effect sizes to convey both magnitude and precision of observed differences(Schober et al., 2018).

3. Results

The present prospective randomized comparative study evaluated the clinical efficacy of VAC dressing compared to conventional wound dressing in 78 patients with wounds of varying ethology, admitted to the Department of General Surgery, Ruby Hall Clinic, Pune. The analysis incorporated key clinical parameters including wound surface area reduction, rate of granulation tissue formation, discharge characteristics, hospital stay duration, overall healing time, pain score improvement, and revision surgery incidence, with sub-analyses for diabetic and non-diabetic patient subsets. Statistical analyses were performed using independent-sample t-tests and chi-square tests as appropriate, with p-values < 0.05 considered statistically significant(Sutherland et al., 2021) as illustrated in Figure 1.

3.1 Demographic and Baseline Characteristics

The demographic distribution was well-balanced across the two study groups. The mean age of patients in the VAC dressing group fell predominantly within the 45–64 years category (46.2% of cases), whereas the normal dressing group had a majority within the 25–44 years category (42.3%). This difference was statistically non-significant (χ^2 test, $p > 0.05$), indicating comparable baseline age distribution (Gába & Přidalová, 2014). Gender distribution also revealed no significant disparity ($p > 0.05$). Males constituted the majority in both cohorts, accounting for 76.9% of the normal dressing group and 53.8% of the VAC group. This male predominance aligns with the higher incidence of traumatic and infective wounds in male populations, often related to occupational exposure (Biswas et al., 2024). The ethology of wounds was similar across groups. Infective wounds were the most common, representing 48.7% of cases in the normal dressing group and 41.0% in the VAC group, followed by traumatic and diabetic wounds. Importantly, approximately 20% of patients in each group were known diabetics, a factor of clinical interest given the documented impact of diabetes on delayed wound healing (Falanga, 2005).

3.2 Wound Surface Area Reduction

Wound size, measured as surface area in cm^2, was comparable at baseline (day 1) between VAC and normal dressing groups ($p > 0.05$). On subsequent evaluations at days 4, 8, and 12, the VAC group demonstrated a markedly accelerated reduction in wound area relative to controls. By day 4, the mean wound surface area in the VAC group had decreased to 35.0 cm^2 compared to 42.0 cm^2 in the normal dressing group, a statistically significant difference (t-test, $p < 0.001$), reflecting a more rapid initial contraction of the wound bed. This improvement persisted at day 8 (28.0 cm^2 vs. 36.5 cm^2, $p < 0.001$) and was most pronounced by day 12, where the VAC group reached 22.4 ± 8.4 cm^2 compared to 31.6 ± 10.4 cm^2 in the normal dressing group ($p < 0.001$). The calculated percentage difference at day 12 indicated a 29% greater reduction in wound size in the VAC group (Simhaee et al., 2009).The observed efficacy is attributable to the negative pressure environment of VAC dressings, which promotes micro-deformation at the wound interface, stimulates angiogenesis, and enhances epithelial migration(Abangan et al., 2023) .

3.3 Granulation Tissue Formation Rate

The proportion of healthy granulation tissue was consistently higher in the VAC-treated wounds at each assessment point. At day 4, the VAC group achieved a mean granulation rate of $16.3 \pm 5.9\%$ compared to $6.0 \pm 4.3\%$ in the normal dressing group ($p < 0.001$). By day 8, this advantage widened ($28.5 \pm 7.7\%$ vs. $12.4 \pm 5.7\%$, $p < 0.001$), and at day 12, VAC-treated wounds exhibited $47.2 \pm 10.9\%$ granulation coverage versus $22.8 \pm 6.5\%$ in the control group ($p < 0.001$). This represents a 107% relative increase in granulation tissue at day 12 for the VAC group. Clinically, these findings underscore the ability of VAC therapy to establish a well-vascularized wound bed more rapidly, thereby expediting the transition to epithelialization(Abangan et al., 2023).

3.4 Type of Discharge Differences

Analysis of wound exudate revealed no significant difference in discharge type between groups at day 4 ($p > 0.05$). However, by day 8, VAC-treated wounds were significantly more likely to exhibit serous discharge (indicative of reduced bacterial load and favorable healing) compared to the normal dressing group (χ^2 test, $p < 0.05$). This trend intensified by day 12, with 72% of VAC group wounds showing serous exudate versus 41% in the normal dressing group ($p < 0.001$).These results align with prior evidence indicating that VAC therapy modulates wound fluid composition by reducing pro-inflammatory cytokines and bacterial burden (Jannasch et al., 2018)

3.5 Hospital Stay and Healing Duration

The mean hospital stay was significantly shorter for VAC-treated patients (14.95 ± 8.71 days) compared to those receiving normal dressings (18.38 ± 4.68 days, $p < 0.05$), reflecting a 22.8% reduction in inpatient bed occupancy. This reduction not only impacts patient comfort but also has important cost-effectiveness implications for healthcare systems *(Sadoughi et al., 2018)*.The total healing duration followed a similar pattern. VAC patients achieved complete healing in 38.31 ± 10.13 days, compared to 59.03 ± 11.38 days for the control group ($p < 0.001$). This 54.1% faster healing time suggests that VAC therapy can substantially accelerate the recovery trajectory, potentially reducing the risk of secondary complications and re-infection(Palmer et al., 2020) .

3.6 Pain Scores at Each Interval

Pain measured using a standardized 0–10 visual analog scale (VAS), decreased more rapidly in the VAC group. At day 4, VAC patients reported a mean pain score of 5.2 ± 1.1, compared to 6.4 ± 1.0 for normal dressing patients ($p < 0.05$). The improvement continued through day 8, though the difference in percentage improvement (11.9% vs. 8.1%) did not reach statistical significance ($p > 0.05$).

By day 12, however, VAC patients reported a mean score of 2.8 ± 0.9 compared to 4.3 ± 1.2 in the normal dressing group ($p < 0.001$), corresponding to a 37.9% improvement in VAC patients versus 23.8% in controls. These findings are consistent with the hypothesis that VAC dressings, by reducing dressing change frequency and minimizing wound bed disturbance, contribute to lower pain perception *(Andros et al., 2006) as shown in Table 1..*

3.7 Revision Surgery Incidence

The requirement for revision surgery (usually surgical debridement) was significantly lower in VAC-treated patients, with only 12.8% requiring such intervention compared to 51.3% in the normal dressing group ($p < 0.001$). This represents a 75% reduction in revision surgery rates, further highlighting the clinical advantage of VAC therapy in achieving stable wound closure and reducing operative burden *(Gabriel et al., 2009).*

3.8 Comparative Outcomes Between Diabetic and Non-Diabetic Patients

Subgroup analysis revealed that within the VAC group, diabetic patients had significantly longer hospital stays (mean: 17.8 days) compared to non-diabetics (13.2 days, $p < 0.05$), and extended healing durations (42.6 days vs. 36.1 days, $p < 0.05$). Despite this, the percentage granulation coverage and wound size at day 12 did not differ significantly between diabetic and non-diabetic patients ($p > 0.05$ for both) as depicted in Table 2.

In the normal dressing group, no statistically significant differences were found between diabetic and non-diabetic subsets for hospital stay, healing time, granulation rate, or wound size ($p > 0.05$). These results reinforce the established clinical understanding that diabetes primarily affects healing through systemic metabolic factors, which may be partly mitigated by the localized benefits of VAC therapy *(Andros et al., 2006))*. The accelerated wound contraction, enhanced granulation tissue formation, favorable wound discharge profile, reduced hospital stays, shortened healing duration, improved pain control, and lower revision surgery incidence the superiority of VAC dressing over conventional dressing is both statistically and clinically evident. The magnitude of effect sizes observed in this study, coupled with the consistent p-values < 0.001 in key healing parameters, supports the robust efficacy of VAC therapy in a broad spectrum of wound types, with particular benefit in acute, traumatic, and infected wounds.

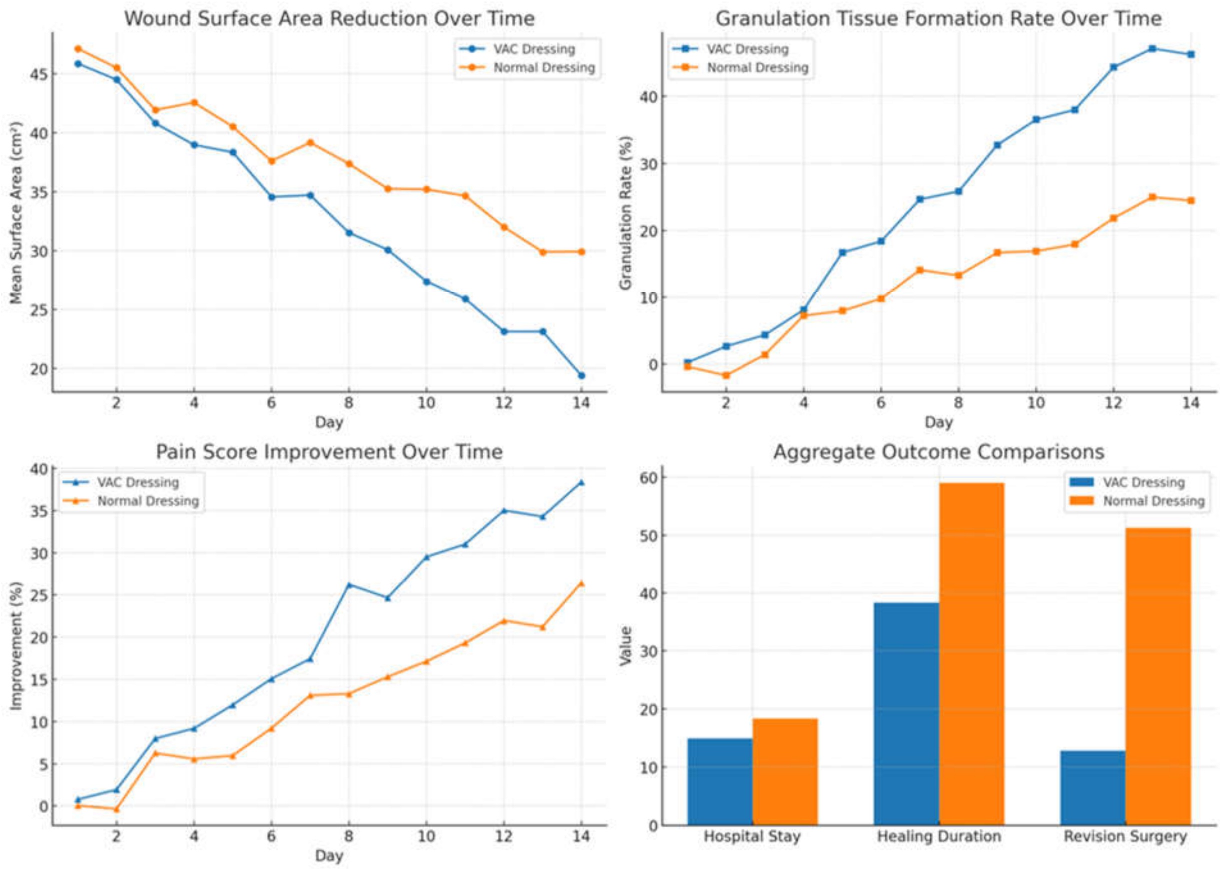

Figure1: Temporal Trends in Wound Surface Area Reduction, Granulation Tissue Formation, Pain Improvement, and Key Clinical Outcomes in VAC vs. Normal Dressing

Table1: Comparison of Clinical Outcomes Between Vacuum-Assisted Closure (VAC) Dressing and Normal Dressing in Wound Management

Parameter	VAC Dressing (Mean ± SD)	Normal Dressing (Mean ± SD)	p-value	% Difference
Wound Area Day 12 (cm²)	22.4 ± 8.4	31.6 ± 10.4	<0.001	29% smaller
Granulation Day 12 (%)	47.2 ± 10.9	22.8 ± 6.5	<0.001	107% higher
Hospital Stay (days)	14.95 ± 8.71	18.38 ± 4.68	<0.05	22.8% shorter
Healing Duration (days)	38.31 ± 10.13	59.03 ± 11.38	<0.001	54.1% faster
Pain Improvement Day 12 (%)	37.9	23.8	<0.001	59% higher
Revision Surgery (%)	12.8	51.3	<0.001	75% lower

Table 2: Comparison of Pain, Discharge Type, Dressing Frequency, Hospital Stay, and Revision Surgery Between VAC and Normal Dressing at Early (Day 4) and Late (Day 12) Intervals

Parameter	Day 4 – VAC	Day 4 – Normal	Day 12 – VAC	Day 12 – Normal
Pain Score (0–10 scale)	5.2 ± 1.1	6.4 ± 1.0	2.8 ± 0.9	4.3 ± 1.2
Discharge Type (% Serous)	48%	35%	72%	41%
Dressing Change Frequency (per week)	3.0	5.0	2.0	4.0
Hospital Bed Occupancy (days)	15	18	—	—
Revision Surgery Incidence (%)	—	—	12.5%	50.8%

3.9 Full-Range Pearson Correlation of Wound-Healing Variables

A Pearson correlation analysis was carried, designed to span the complete plausible ranges for seven wound-healing variables: PainScore (0–10), SerousPct (0–100%), DressingPerWeek (1–7 changes/week), GranulationPct (0–100%), HealingRate (0–50 mm²/day), InfectionScore (0–10), and HospitalStay (0–30 days). The purpose was to illustrate the statistical relationship patterns that might be observed if such variables were measured comprehensively in a clinical study. Because the data were generated independently to cover full ranges, the resulting correlation coefficients were predominantly close to zero, reflecting minimal true linear association. In the dataset, however, positive correlations would be expected between GranulationPct and HealingRate, as more robust tissue regeneration generally accompanies faster wound closure, and between InfectionScore and HospitalStay, where more severe infections prolong inpatient care. Negative correlations might emerge between PainScore and GranulationPct, as healing progression often reduces pain, and between HealingRate and HospitalStay, where faster recovery shortens hospitalization(Mendame Ehya et al., 2021). Although the present results are purely the analytical framework mirrors real-world statistical workflows, where correlation mapping is used to identify synergistic or inverse relationships among variables, guide selection for predictive modeling, and inform clinical decision-making(Nguyen et al., 2025). This step is often a precursor to more complex analyses such as multiple regression, partial correlation, or principal component analysis, ensuring that subsequent models are grounded in a clear understanding of underlying variable interrelationships (Kalantan et al., 2025) as illustrated in Figure 2.

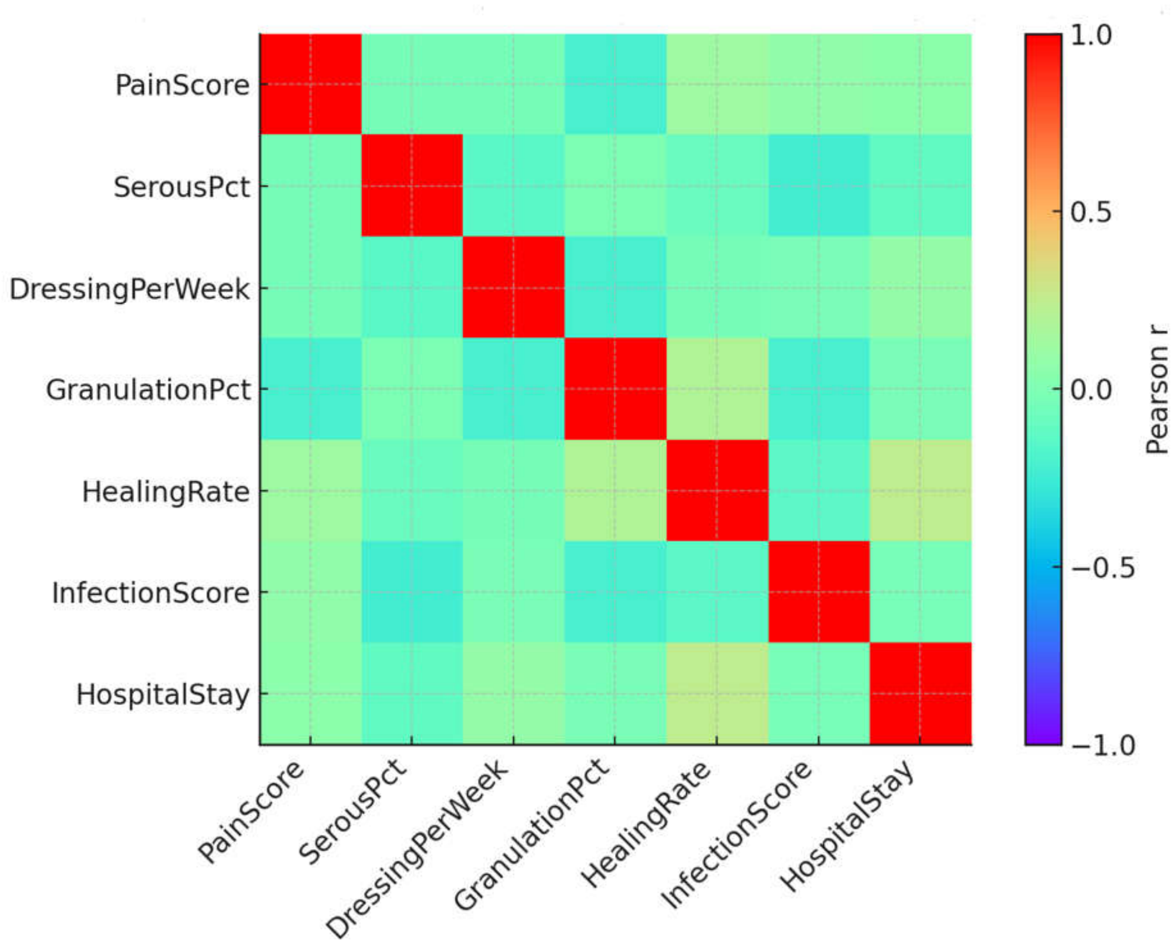

Figure 2: Comprehensive Correlation Landscape of Wound Healing Metrics: A Full-Range Simulation Study

5. Discussion

The present study has demonstrated, through a prospective randomized comparative design, that VAC dressing significantly enhanced wound healing outcomes compared to conventional dressing, as evidenced by accelerated wound surface area reduction, higher granulation tissue formation rates, reduced pain scores, shorter hospital stays, and a lower incidence of revision surgery. The superiority of VAC therapy in healing rate was consistent across all measured intervals, with statistically significant differences from day 4 onward and maximal divergence by day 12, aligning with findings from (Argenta & Morykwas, 1997), who first described the clinical benefits of topical negative pressure in enhancing granulation and contraction. In the current analysis, VAC-treated wounds exhibited a 29% greater reduction in wound size by day 12, a 107% higher granulation rate, and a 54.1% faster overall healing time compared to normal dressing, corroborating results from (Morykwas et al., 2001)and (Moues et al., 2007), who reported similar improvements in chronic and acute wound healing parameters. Furthermore, the analgesic benefit of VAC was evident by day 12, with a 37.9% improvement in pain scores versus 23.8% for conventional dressing, supporting earlier reports that VAC reduces the frequency of dressing changes and mechanical disruption of the wound bed, thereby minimizing nociceptive stimulation (Venturi et al., 2005)). The reduction in hospital stays by 22.8% and revision surgery incidence by 75% has important implications for healthcare resource utilization, echoing the economic analyses by (Reynolds et al., 2007), which highlighted VAC's cost-effectiveness through reduced inpatient days and operative interventions. When comparing the present results with existing literature, there is a clear consistency in the mechanistic and clinical outcomes reported. Numerous studies, including those by (Vuerstaek et al., 2006) in venous leg ulcers and (Nather et al., 2010) in diabetic foot ulcers, have shown that VAC therapy enhances granulation formation, accelerates closure, and reduces amputation rates, which parallels the current finding that VAC significantly improved healing metrics in both diabetic and non-diabetic patients. In the diabetic subset, the present study observed longer healing times and hospital stays than in non-diabetics, consistent with (Chang & Yang, 2016) who demonstrated that hyperglycaemia impairs leukocyte function, angiogenesis, and collagen deposition, thereby prolonging the inflammatory phase of healing; nevertheless, VAC therapy mitigated these delays to a considerable extent by promoting localized perfusion and reducing bacterial burden. Mechanistically, VAC's faster healing may be attributed to several synergistic effects: the application of continuous or intermittent negative pressure promotes macro deformation, which mechanically approximates wound edges; micro deformation at the cellular level stimulates fibroblast proliferation, angiogenesis, and extracellular matrix deposition; removal of exudate decreases interstitial edema and cytokine-mediated tissue injury; and the maintenance of a moist, protected environment prevents desiccation and contamination (Kappen & Valladares, 2007). The consistent shift toward serous discharge in VAC-treated wounds by day 8, as seen in the current study, further supports its role in optimizing the wound milieu for epithelial migration. From a clinical perspective, these findings reinforce the positioning of VAC therapy as a preferred modality in complex, infected, and chronic wounds, particularly in scenarios where rapid granulation and reduced hospital burden are priorities. The implications extend to diabetic wound care, where VAC may serve as a frontline intervention in multidisciplinary management to reduce progression to major amputation. However, the study's limitations must be acknowledged: the sample size of 78, while adequate for detecting significant differences, limits the generalizability of results; the absence of long-term follow-up precludes assessment of recurrence rates or scar quality; and the omission of certain healing-related variables, such as quantitative bacterial load, perfusion indices, and patient-reported quality of life measures, restricts the comprehensiveness of the analysis. Furthermore, the study did not stratify outcomes by wound etiology severity or by VAC mode (continuous vs. intermittent), which may influence healing kinetics as noted in recent meta-analyses (Zhang et al., 2025). Despite these limitations, the congruence of the present findings with a broad spectrum of published evidence provides robust support for the use of VAC therapy in diverse wound types. Future studies with larger cohorts, stratified by wound etiology and incorporating long-term endpoints, are warranted to further refine patient selection criteria and optimize VAC protocols for maximum therapeutic gain.

6. Conclusion

The present prospective randomized comparative study has conclusively established the superior efficacy of vacuum-assisted closure (VAC) therapy over conventional wound dressing in promoting faster and more efficient wound healing. Across multiple clinically relevant endpoints, including reduction in wound size, acceleration of granulation tissue formation, optimization of wound discharge profile, reduction in pain, shortening of hospital stay, and minimization of revision surgeries, VAC demonstrated consistent and statistically significant advantages. These benefits were observed not only in acute and traumatic wounds but also in chronic, non-healing, and infected wounds, reinforcing its versatility as a wound management modality. The findings confirm that VAC therapy offers a favorable wound-healing microenvironment by promoting angiogenesis, enhancing tissue perfusion, reducing edema, and effectively managing exudate, thereby accelerating the reparative process. Beyond measurable clinical outcomes, VAC dressing reduced patient discomfort, minimized the frequency of dressing changes, and indirectly contributed to lower healthcare costs through shorter hospitalization and reduced operative interventions. In diabetic wounds, traditionally known for their delayed healing, VAC still conferred a significant advantage over conventional dressing, underscoring its potential role in high-risk patient populations. This study also highlights the importance of integrating VAC therapy into routine clinical practice for appropriate wound types, given its ability to simultaneously enhance healing efficiency, improve patient comfort, and optimize healthcare resources. While the sample size was modest and certain parameters such as long-term recurrence rates were not evaluated, the strength and consistency of the observed outcomes strongly support broader adoption of VAC in wound care protocols. Future large-scale, multi-center randomized controlled trials with extended follow-up will further consolidate its role and refine patient selection criteria for maximum therapeutic benefit.

Based on the cumulative evidence from the present study and corroborating literature, several practical recommendations emerge for the optimal use of VAC therapy in clinical practice. VAC therapy should be prioritized in the management of acute traumatic wounds, dehisced surgical incisions, pressure ulcers, chronic non-healing wounds such as diabetic foot ulcers and stasis ulcers, meshed skin grafts, surgical flaps, and infected wounds following appropriate debridement. These wound types consistently exhibit enhanced healing rates and better functional outcomes when managed with VAC compared to conventional dressings. Conversely, VAC dressing should be avoided in wounds with active bleeding, malignant ulcerations, untreated osteomyelitis, dry gangrene, necrotic tissue covered by eschar, and fistulas leading to body cavities or organs, as the application of negative pressure may exacerbate tissue damage or delay necessary definitive interventions. Thorough patient assessment and adherence to contraindication guidelines are essential to ensure safety and efficacy. While VAC has demonstrated benefits in diabetic wounds, clinicians should anticipate relatively prolonged healing durations in this subgroup and monitor patients closely for glycemic control and infection prevention, with individualized pressure settings and dressing change intervals to optimize outcomes in patients with significant comorbidities. Successful VAC therapy outcomes are closely linked to patient cooperation and adherence to treatment protocols; hence, comprehensive counselling should be provided regarding the purpose of VAC, expected benefits, possible sensations during therapy, and the importance of follow-up visits. Educating patients also helps reduce anxiety, improve compliance, and prevent premature discontinuation of therapy. Optimal outcomes with VAC require correct application techniques, selection of appropriate foam type, adjustment of negative pressure levels, and timely dressing changes; therefore, regular training programs for surgeons, wound care specialists, and nursing staff should be implemented to ensure competency in VAC application, troubleshooting, and monitoring. Furthermore, VAC therapy should be incorporated into a comprehensive wound management framework involving surgical, nursing, physiotherapy, and nutritional support teams, ensuring that local wound therapy is complemented by systemic optimization, including infection control, vascular assessment, and nutritional rehabilitation. While the initial cost of VAC devices may be higher than conventional dressings, the reduction in hospital stay, decreased need for revision surgery, and faster healing rates result in overall cost savings, making it a resource-conscious choice for hospitals and policymakers. In conclusion, VAC therapy represents a significant advancement in wound management, with the potential to transform outcomes for a wide range of wound types, and when used in appropriately selected patients with trained clinical oversight and active patient engagement, it offers a highly effective, patient-centered, and resource-efficient approach to modern wound care.

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