Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 5s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Comparison of Vacuum-Assisted Closure (VAC) Therapy and Conventional Dressing on Wound Healing in Diabetic Foot Ulcer: A Randomized Controlled Trial

Dr. Dharaneesh. S. S[1], Dr. J. Sridhar[*2], Dr. Dhinesh Kumar[*3], Dr. Premnath[*4], Dr. Abhiram kanth[*5], Dr. Sudhan S[*6]

[1]General surgery - Post Graduate, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, Vinayaka Mission's Research Foundation

[*2]Professor & HOD, Department of General surgery, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, Vinayaka Mission's Research Foundation

[*3]Assistant Professor, Department of General surgery, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, Vinayaka Mission's Research Foundation

[*4]Senior Resident, Department of General surgery, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, Vinayaka Mission's Research Foundation

[*5]Senior Resident, Department of General surgery, Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem, Tamil Nadu, India, Vinayaka Mission's Research Foundation

[*6]Postgraduate

Cite this paper as: Dr. Dharaneesh. S. S, Dr. J. Sridhar, Dr. Dhinesh Kumar, Dr. Premnath, Dr. Abhiram kanth, Dr. Sudhan S, (2025) Comparison of Vacuum-Assisted Closure (VAC) Therapy and Conventional Dressing on Wound Healing in Diabetic Foot Ulcer: A Randomized Controlled Trial. *Journal of Neonatal Surgery*, 14 (5s), 499-508.

ABSTRACT

Background: Diabetic foot ulcers (DFUs) represent one of the most serious complications of diabetes mellitus, leading to prolonged morbidity, reduced quality of life, and an increased risk of lower limb amputation. India, being home to one of the highest populations of diabetics globally, faces a growing burden of DFUs. Conventional dressing has been the standard treatment for DFUs, but it is associated with prolonged healing time and a substantial risk of infection. Vacuum-Assisted Closure (VAC) therapy, a negative pressure wound therapy (NPWT), has emerged as a promising alternative for faster wound healing. By promoting angiogenesis, reducing bacterial load, and enhancing granulation tissue formation, VAC therapy may significantly improve outcomes in DFU patients. This study aims to compare the efficacy and safety of VAC therapy against conventional dressing in terms of wound healing time, granulation tissue formation, and associated complications.

Objectives: The primary objective of this study was to evaluate the effectiveness of VAC therapy compared to conventional dressing in achieving complete wound healing in DFU patients. Secondary objectives included assessing the rate of granulation tissue formation, reduction in ulcer size, pain perception, infection rates, and the incidence of complications such as bleeding and minor amputations.

Methods: A prospective, randomized controlled trial was conducted at a tertiary care hospital in India between November 2022 and December 2023. A total of 54 patients diagnosed with DFU and fulfilling the inclusion criteria were enrolled and randomized into two groups: the VAC therapy group (n=27) and the conventional dressing group (n=27). Baseline characteristics, including age, gender, Wagner classification, and comorbidities, were recorded. VAC therapy was applied with negative pressure maintained at 125 mmHg, and dressings were changed every 3–5 days. The conventional dressing group underwent saline-moistened gauze dressings changed daily. Wound healing was assessed using granulation tissue visual scores, reduction in ulcer size, and time to complete epithelialization. Pain was evaluated using the Visual Analog Scale (VAS), and infection rates were documented. Statistical analysis was performed using SPSS version 22, with a p-value of <0.05 considered significant.

Results: Patients in the VAC therapy group demonstrated a significantly shorter wound healing time (mean 24.3 ± 5.1 days) compared to the conventional dressing group (mean 39.8 ± 6.4 days, $p<0.001$). The mean granulation tissue formation rate was higher in the VAC group (2.3 cm^2/day) than in the conventional dressing group (1.4 cm^2/day, $p=0.002$). A significantly greater percentage reduction in ulcer area was observed in the VAC group (74.5%) than in the conventional dressing group (48.7%, $p<0.001$). Pain scores (VAS) at 24 and 48 hours were lower in the VAC therapy group ($p<0.05$), indicating better pain control. Infection rates were also reduced in the VAC group (14.8%) compared to the conventional dressing group (29.6%, $p=0.03$). The incidence of bleeding and minor amputations did not differ significantly between the groups.

Conclusion: This study demonstrates that VAC therapy significantly enhances wound healing in DFU patients compared to conventional dressing by promoting faster granulation tissue formation, reducing infection rates, and decreasing overall healing time. Additionally, VAC therapy was associated with better pain control, contributing to improved patient compliance and comfort. Given these benefits, VAC therapy should be considered a superior alternative to conventional dressing for DFU management. Future studies with larger sample sizes and longer follow-up periods are warranted to further validate these findings.

Keywords: *Diabetic Foot Ulcer, Vacuum-Assisted Closure, Negative Pressure Wound Therapy, Conventional Dressing, Wound Healing, Granulation Tissue, Infection Control, Randomized Controlled Trial*

1. INTRODUCTION

Diabetic foot ulcer (DFU) is a debilitating complication of diabetes mellitus, significantly contributing to morbidity, prolonged hospital stays, and increased healthcare costs. It is a leading cause of non-traumatic lower limb amputations, with global estimates suggesting that 15% to 25% of all diabetic patients will develop a foot ulcer during their lifetime **[1]**. The burden of DFUs is particularly high in India, where the prevalence of diabetes is rapidly rising, leading to an increasing number of cases requiring specialized wound care. The pathophysiology of DFUs is complex, involving neuropathy, ischemia due to peripheral arterial disease, and secondary infections, all of which create a challenging environment for wound healing **[2]**. The prolonged nature of DFU healing increases the risk of severe infections, osteomyelitis, and gangrene, further escalating the chances of limb amputation. Despite significant advancements in diabetes management, DFUs remain a serious clinical challenge that requires multidisciplinary and innovative therapeutic approaches **[3]**.

The conventional approach to DFU management primarily involves regular wound debridement, infection control, offloading techniques, and moist wound healing with saline-moistened gauze dressings **[4]**. However, conventional dressing methods are often associated with prolonged healing time, excessive wound exudate accumulation, increased bacterial colonization, and frequent dressing changes, leading to greater patient discomfort and higher risks of complications. Given these limitations, advanced wound care technologies such as Vacuum-Assisted Closure (VAC) therapy, also referred to as Negative Pressure Wound Therapy (NPWT), have emerged as promising alternatives **[5]**. VAC therapy involves the application of controlled sub-atmospheric pressure over the wound, which is thought to promote faster healing by stimulating granulation tissue formation, reducing edema, increasing vascular perfusion, and decreasing bacterial colonization. Several studies have demonstrated that VAC therapy accelerates wound closure, reduces the need for frequent dressing changes, and enhances overall patient outcomes, making it a valuable intervention for DFU management **[6]**.

Despite the growing evidence supporting VAC therapy, its superiority over conventional dressing remains a subject of debate, particularly in resource-limited settings. The cost and accessibility of VAC therapy devices pose significant challenges, especially in developing countries like India, where healthcare infrastructure and financial constraints influence treatment choices **[7]**. Additionally, while some studies report faster healing rates with VAC therapy, others suggest that conventional dressings may still be effective, particularly when used with adjunctive therapies such as topical antimicrobial agents and advanced wound care materials. The lack of clear, standardized clinical guidelines on the routine use of VAC therapy for DFUs necessitates further research to establish its benefits, limitations, and cost-effectiveness in comparison to conventional dressing **[8]**.

Given these uncertainties, this study aims to provide a robust clinical comparison between VAC therapy and conventional dressing in the management of DFUs, assessing key parameters such as wound healing time, rate of granulation tissue formation, pain perception, infection rates, and overall treatment outcomes. By systematically analyzing these factors, the study seeks to contribute to the growing body of evidence regarding optimal DFU management strategies, ultimately guiding clinicians toward more effective and evidence-based treatment decisions.

2. METHODOLOGY

This study was designed as a prospective, randomized controlled trial conducted at a tertiary care hospital in India over a 16-month period from November 2022 to December 2023. The primary aim was to evaluate and compare the efficacy of Vacuum-Assisted Closure (VAC) therapy and conventional dressing in the management of diabetic foot ulcers (DFUs). Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was secured from all participants before their inclusion in the study. The study population comprised patients diagnosed with diabetic foot ulcers (Wagner grade II to IV), presenting with non-healing ulcers persisting for more than four weeks despite standard wound care. Patients aged 18 years and above, with adequate lower limb perfusion (Ankle-Brachial Index ≥ 0.8) and no evidence of osteomyelitis or gangrene requiring urgent surgical intervention, were included. Patients with severe peripheral arterial disease (ABI < 0.8), critical limb ischemia, systemic sepsis, active malignancy, or end-stage renal disease were excluded,

along with those requiring immediate major amputation or allergic to VAC dressing materials. A total of 54 patients meeting the eligibility criteria were randomized using a computer-generated sequence into two equal groups: VAC therapy group (n=27) and conventional dressing group (n=27). Due to the nature of the interventions, blinding of patients was not possible; however, outcome assessors and data analysts were blinded to minimize bias.

In the VAC therapy group, wounds were prepared using standard debridement techniques before applying a polyurethane foam dressing over the ulcer, which was then sealed with an airtight adhesive drape. Continuous negative pressure of -125 mmHg was applied via a portable VAC device, and dressings were changed every 3 to 5 days, depending on wound exudate levels and granulation response. VAC therapy was continued until adequate granulation tissue formation was achieved or for a maximum duration of four weeks. In the conventional dressing group, patients underwent daily moist saline gauze dressings, ensuring a moist wound healing environment. Dressings were changed once or twice daily, depending on the wound's exudate production and infection status. Both groups received standard diabetic foot care, including glycemic control optimization, antibiotic therapy when indicated, offloading techniques, and debridement, as necessary.

All patients were followed up weekly for four weeks, with additional visits at six weeks and three months to assess long-term wound healing outcomes. Clinical parameters recorded at each visit included wound size (measured using planimetry), granulation tissue formation percentage, pain scores (assessed via the Visual Analog Scale), presence of infection, and overall healing progression. The primary outcome of the study was the time to complete wound healing, defined as full epithelialization without drainage. Secondary outcomes included percentage reduction in wound size, rate of granulation tissue formation (cm^2/day), pain perception at different time points (baseline, 24 hours, weekly assessments), infection rates, and complication rates such as bleeding, maceration, and need for minor amputations. Wound infection was diagnosed based on clinical signs (erythema, purulent discharge, odor, tenderness, and systemic symptoms) and confirmed via wound culture reports when necessary.

Data were systematically recorded using structured case report forms, and digital photographs were maintained for objective wound assessment. The collected data were analyzed using SPSS version 22. Continuous variables, such as healing time, percentage wound size reduction, and pain scores, were compared between groups using the independent t-test or Mann-Whitney U test, based on normality distribution. Categorical variables, such as infection rates and proportion of wounds achieving >50% granulation, were analyzed using the chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant for all analyses.

The study adhered to strict ethical principles, maintaining patient confidentiality, voluntary participation, and the right to withdraw at any stage without impact on their medical care. Participants were fully informed about the potential risks and benefits associated with each intervention. No financial incentives were provided, and treatment decisions beyond the study period followed the hospital's standard protocol for DFU management. The robust methodological framework implemented in this study ensures high-quality data collection, allowing for a meaningful comparison between VAC therapy and conventional dressing in diabetic foot ulcer management.

3. RESULTS

This study included a total of 54 patients diagnosed with diabetic foot ulcers (DFUs), who were randomized into two equal groups: 27 patients received Vacuum-Assisted Closure (VAC) therapy, while 27 patients received conventional dressing. The primary objective was to compare wound healing time, granulation tissue formation, ulcer size reduction, pain perception, infection rates, and associated complications between the two groups.

The findings indicate that VAC therapy significantly accelerated wound healing, with patients in the VAC group experiencing faster granulation tissue formation, greater ulcer size reduction, lower infection rates, and improved pain control compared to the conventional dressing group. Additionally, while both groups had comparable rates of minor complications, VAC therapy was associated with a shorter healing time and better overall wound recovery.

Baseline Characteristics of Study Participants: The demographic and clinical characteristics of both groups were similar, with **no significant differences** in age, sex distribution, diabetes duration, or ulcer grading, ensuring homogeneity between groups.

Table 1: Baseline Demographic and Clinical Characteristics

This table compares the baseline characteristics of patients in both groups.

Variable	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
Mean Age (years)	57.4 ± 8.1	58.2 ± 7.8	0.68
Male (%)	18 (66.7%)	19 (70.4%)	0.77
Duration of Diabetes (years)	10.2 ± 3.6	9.8 ± 3.9	0.71
BMI (kg/m²)	26.1 ± 3.4	25.7 ± 3.2	0.58
Wagner Grade II (%)	13 (48.1%)	12 (44.4%)	0.79
Wagner Grade III (%)	10 (37.0%)	11 (40.7%)	0.79
Wagner Grade IV (%)	4 (14.8%)	4 (14.8%)	1.00

Wound Healing Time and Granulation Tissue Formation: Patients in the VAC therapy group demonstrated significantly faster wound healing compared to the conventional dressing group. The mean healing time was shorter, and granulation tissue formation was faster in the VAC group.

Table 2: Wound Healing Time and Granulation Tissue Formation

This table compares the time to wound healing and granulation tissue formation between groups.

Outcome	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
Mean Healing Time (days)	24.3 ± 5.1	39.8 ± 6.4	<0.001
Granulation Rate (cm²/day)	2.3 ± 0.8	1.4 ± 0.6	0.002
Complete Healing at 4 Weeks (%)	19 (70.4%)	7 (25.9%)	0.001

Ulcer Size Reduction: The percentage of ulcer size reduction was significantly greater in the VAC therapy group, indicating more effective wound contraction and healing.

Table 3: Percentage Reduction in Ulcer Size

This table compares ulcer size reduction between groups.

Time Point	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
At 2 weeks (%)	52.3 ± 7.5	31.9 ± 6.9	<0.001
At 4 weeks (%)	74.5 ± 8.2	48.7 ± 7.4	<0.001

Pain Perception and Patient Comfort: Patients receiving VAC therapy reported significantly lower pain scores throughout the treatment period, as assessed by the Visual Analog Scale (VAS).

Table 4: Postoperative Pain Scores (VAS)

This table presents the pain scores at different time points post-treatment.

Time Post-Treatment	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
24 hours	4.2 ± 1.1	5.8 ± 1.2	<0.001
48 hours	3.6 ± 1.0	5.1 ± 1.1	<0.001
At 7 days	2.4 ± 0.9	3.9 ± 1.0	<0.001

Infection Rates and Wound Complications: The incidence of wound infection was significantly lower in the VAC group, while other complications such as bleeding and maceration were comparable between groups.

Table 5: Infection and Complication Rates

This table compares postoperative infections and complications.

Outcome	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
Wound Infection (%)	4 (14.8%)	8 (29.6%)	0.03
Bleeding (%)	3 (11.1%)	4 (14.8%)	0.67
Maceration (%)	2 (7.4%)	3 (11.1%)	0.52

Duration of Hospital Stay and Time to Resume Ambulation: Patients in the VAC therapy group had a significantly shorter hospital stay and were able to resume ambulation earlier compared to those in the conventional dressing group.

Table 6: Comparison of Hospital Stay and Time to Ambulation

This table presents the difference in hospital stay duration and the time taken to resume independent walking between the two groups.

Outcome	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
Mean Hospital Stay (days)	10.4 ± 2.3	15.8 ± 3.1	<0.001
Resumed Ambulation (days)	6.2 ± 1.5	9.1 ± 2.2	<0.001

Requirement of Additional Debridement and Surgical Interventions: The need for additional surgical debridement was significantly lower in the VAC therapy group, suggesting better wound progression and reduced necrotic tissue burden.

Table 7: Need for Additional Debridement and Surgical Procedures

This table compares the need for additional wound debridement and minor amputations between groups.

Outcome	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
Required Additional Debridement (%)	4 (14.8%)	10 (37.0%)	0.04
Minor Amputation Required (%)	3 (11.1%)	5 (18.5%)	0.42

Rate of Complete Epithelialization at Follow-Up: At the end of three months, a significantly higher percentage of patients in the VAC therapy group achieved complete epithelialization, reinforcing its long-term benefits.

Table 8: Percentage of Patients with Complete Epithelialization at Follow-Up

This table presents the proportion of patients who achieved full wound healing at different follow-up intervals.

Time Point	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
At 6 weeks (%)	81.5%	55.6%	0.02
At 3 months (%)	96.3%	74.1%	0.03

Long-Term Recurrence of Ulceration: The recurrence rate of ulcer formation within three months was slightly lower in the VAC therapy group, though the difference was not statistically significant.

Table 9: Recurrence of Ulceration at 3-Month Follow-Up

This table presents the recurrence rates in both groups after three months of follow-up.

Outcome	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
Ulcer Recurrence (%)	2 (7.4%)	4 (14.8%)	0.39

Patient Satisfaction and Compliance with Treatment: Patients in the VAC therapy group reported significantly higher satisfaction with the treatment process due to reduced dressing changes, less pain, and faster recovery.

Table 10: Patient Satisfaction and Compliance with Treatment

This table compares treatment compliance and patient-reported satisfaction levels between groups.

Outcome	VAC Therapy (n=27)	Conventional Dressing (n=27)	p-value
High Satisfaction (%)	22 (81.5%)	13 (48.1%)	0.01
Completed Treatment Without Discontinuation (%)	25 (92.6%)	18 (66.7%)	0.02

The findings of this study demonstrate that VAC therapy offers superior wound healing outcomes compared to conventional dressing in diabetic foot ulcer management. Patients receiving VAC therapy experienced faster wound healing, greater granulation tissue formation, reduced hospital stay, and earlier ambulation. Additionally, infection rates were lower, pain perception was reduced, and overall treatment compliance and satisfaction were significantly higher in the VAC therapy group. While ulcer recurrence rates were similar between groups, the overall benefits of VAC therapy make it a preferred option in DFU treatment. These findings suggest that VAC therapy should be considered as a first-line wound care intervention for DFUs, particularly in cases requiring rapid wound closure and improved patient compliance.

4. DISCUSSION

This study was conducted to compare the effectiveness of Vacuum-Assisted Closure (VAC) therapy with conventional dressing in the management of diabetic foot ulcers (DFUs). The findings indicate that VAC therapy significantly enhances wound healing by reducing healing time, promoting faster granulation tissue formation, improving ulcer size reduction, and lowering infection rates compared to conventional dressing **[9]**. Additionally, patients in the VAC group experienced less pain, had shorter hospital stays, resumed ambulation earlier, and reported higher satisfaction with treatment. These results suggest that VAC therapy can be considered a superior wound care strategy for DFU management, particularly for cases requiring accelerated healing and better patient compliance **[10]**.

Comparison with Existing Literature

The results of this study align with previous research that has demonstrated the clinical benefits of VAC therapy in chronic wound healing. Several studies have reported that negative pressure wound therapy (NPWT) enhances tissue perfusion, promotes angiogenesis, and facilitates faster granulation tissue formation, thereby reducing the overall time required for wound healing **[11]**. In this study, the mean healing time in the VAC therapy group was significantly shorter (24.3 ± 5.1 days) compared to the conventional dressing group (39.8 ± 6.4 days, $p<0.001$). These findings are consistent with Armstrong

et al. (2005), who reported that VAC therapy accelerates healing by approximately 30–50% compared to standard dressings. Similarly, Blume et al. (2008) demonstrated that patients with DFUs treated with VAC therapy had a higher probability of complete wound closure within 12 weeks compared to those receiving conventional dressing **[12]**.

Granulation tissue formation, a key indicator of wound healing, was also significantly improved in the VAC group in this study. The granulation rate was 2.3 cm^2/day in the VAC group compared to 1.4 cm^2/day in the conventional dressing group ($p=0.002$). This supports the findings of Lavery et al. (2007), who suggested that NPWT enhances granulation tissue proliferation by exerting mechanical tension on the wound bed, stimulating fibroblast proliferation and extracellular matrix deposition **[13]**. Faster granulation also reduces the risk of secondary infections, as newly formed tissue serves as a barrier against bacterial colonization.

A major concern in DFU management is ulcer size reduction, which determines the overall trajectory of wound healing. In this study, ulcer size reduction at four weeks was significantly greater in the VAC therapy group (74.5%) compared to the conventional dressing group (48.7%, $p<0.001$). Similar trends have been reported in studies by Schwien et al. (2005) and Driver et al. (2011), who found that VAC therapy leads to a significantly greater reduction in wound dimensions compared to conventional dressing, likely due to enhanced drainage of exudates and reduced tissue edema **[14]**.

Impact on Pain Perception and Patient Comfort

Pain management is a crucial factor influencing treatment adherence and patient satisfaction. Patients with DFUs often experience moderate to severe pain due to prolonged inflammation, infection, and repeated dressing changes. In this study, pain scores (VAS) were significantly lower in the VAC therapy group at all time points ($p<0.001$), suggesting that negative pressure therapy reduces pain more effectively than conventional dressing **[15]**. One possible explanation for this is the reduced need for frequent dressing changes in the VAC group (every 3–5 days) compared to the conventional dressing group (daily dressing changes), minimizing mechanical trauma to the wound bed. These findings are supported by Lohmann et al. (2018), who reported that VAC therapy patients experienced lower pain scores and required fewer analgesics compared to those receiving standard dressings **[16]**.

The higher patient satisfaction and compliance in the VAC group (81.5% vs. 48.1%, $p=0.01$) further reinforce the clinical advantage of VAC therapy. Higher satisfaction levels can be attributed to faster healing, reduced pain, and less frequent dressing changes, which collectively contribute to improved quality of life for patients.

Effect on Infection Control and Postoperative Complications

One of the most critical challenges in DFU management is infection control, as prolonged wound healing increases the risk of bacterial colonization, leading to cellulitis, osteomyelitis, and even sepsis. In this study, the incidence of wound infections was significantly lower in the VAC therapy group (14.8%) compared to the conventional dressing group (29.6%, $p=0.03$) **[17]**. These findings align with those of Eginton et al. (2003), who demonstrated that VAC therapy significantly reduces bacterial burden in wounds by promoting continuous drainage of exudates, which helps prevent microbial proliferation **[18]**. The reduction in infection rates may also be attributed to improved tissue oxygenation and enhanced immune cell activity in the wound bed, both of which are facilitated by NPWT.

While bleeding and maceration rates were similar between the two groups, the need for additional debridement was significantly lower in the VAC group (14.8% vs. 37.0%, $p=0.04$). This is a notable advantage, as repeated debridement prolongs hospitalization, increases costs, and may contribute to higher morbidity in DFU patients.

Hospital Stay and Time to Ambulation

Early ambulation plays a crucial role in enhancing circulation and preventing complications such as deep vein thrombosis (DVT) and muscle atrophy in DFU patients. In this study, patients in the VAC therapy group resumed ambulation significantly earlier (6.2 ± 1.5 days) compared to those in the conventional dressing group (9.1 ± 2.2 days, $p<0.001$). Faster wound healing and reduced pain likely contributed to earlier mobilization, leading to shorter hospital stays (10.4 ± 2.3 days vs. 15.8 ± 3.1 days, $p<0.001$) in the VAC group. These findings are consistent with studies by Goss et al. (2017), who reported that patients treated with VAC therapy had a 30–40% shorter hospital stay than those receiving conventional dressing **[19]**.

Clinical Implications and Recommendations

Based on these findings, several clinical recommendations can be made:

1. VAC therapy should be considered a first-line treatment option for diabetic foot ulcers, particularly in cases requiring accelerated wound healing and infection control.
2. VAC therapy is associated with significant pain reduction and higher patient compliance, making it a preferable option for long-term wound management.
3. Early intervention with VAC therapy can reduce hospital stay duration and facilitate faster ambulation, thereby

improving overall patient recovery.

4. Although VAC therapy is costlier than conventional dressing, the reduced need for hospital admission, debridement, and infection management may offset its costs eventually.
5. Future research should focus on cost-effectiveness analysis and long-term recurrence rates beyond three months to establish its sustained benefits.

Strengths and Limitations of the Study

A major strength of this study is its randomized controlled design, which eliminates selection bias and ensures a balanced comparison between the two groups. Additionally, the study adhered to STROBE guidelines, ensuring robust data collection and statistical analysis. The use of objective wound measurement techniques, structured pain assessment, and standardized infection control protocols further enhances the reliability of the findings **[20]**.

However, certain limitations must be acknowledged. The sample size was relatively small (n=54), which may limit the generalizability of findings to larger populations. Additionally, the follow-up duration was limited to three months, which may not capture long-term recurrence rates or the potential impact of VAC therapy on preventing chronic wound recurrence. Future multicenter studies with larger sample sizes and extended follow-up periods are recommended to validate these findings further.

This study provides compelling evidence that VAC therapy is a superior wound care strategy for diabetic foot ulcers compared to conventional dressing. The significant advantages in healing time, granulation tissue formation, ulcer size reduction, infection control, and patient comfort highlight its potential as a preferred treatment modality in DFU management. Given these findings, VAC therapy should be integrated into clinical practice as a standard intervention for DFUs, particularly in cases where rapid wound closure and better patient outcomes are desired.

5. CONCLUSION

This randomized controlled trial compared the effectiveness of Vacuum-Assisted Closure (VAC) therapy and conventional dressing in the management of diabetic foot ulcers (DFUs). The findings demonstrate that VAC therapy significantly accelerates wound healing, enhances granulation tissue formation, promotes greater ulcer size reduction, and improves infection control compared to conventional dressing. Patients treated with VAC therapy experienced faster wound closure, earlier ambulation, lower pain perception, and shorter hospital stays, leading to higher patient satisfaction and compliance with treatment. These results strongly suggest that VAC therapy is a superior alternative to conventional dressing for DFU management.

The mean healing time was significantly shorter in the VAC group (24.3 ± 5.1 days) compared to the conventional dressing group (39.8 ± 6.4 days, $p<0.001$). The granulation tissue formation rate was also significantly higher (2.3 cm^2/day vs. 1.4 cm^2/day, $p=0.002$), leading to faster wound contraction and epithelialization. Additionally, VAC therapy led to greater ulcer size reduction (74.5% vs. 48.7% at 4 weeks, $p<0.001$) and significantly lower infection rates (14.8% vs. 29.6%, $p=0.03$). Patients in the VAC group reported lower pain scores, required fewer dressing changes, and had a significantly shorter hospital stay (10.4 ± 2.3 days vs. 15.8 ± 3.1 days, $p<0.001$). These advantages contributed to better treatment adherence and overall clinical outcomes.

Based on these findings, VAC therapy should be considered the preferred wound care strategy for DFUs, particularly in cases requiring rapid healing and infection prevention. The ability to reduce hospital stay and enhance patient comfort makes VAC therapy a cost-effective intervention eventually, despite its higher initial costs. While conventional dressing remains an effective option for less severe cases, VAC therapy should be prioritized for patients with moderate-to-severe DFUs to improve clinical outcomes and reduce long-term complications.

Future Directions and Recommendations

While this study provides convincing evidence in favor of VAC therapy, further multicenter trials with larger sample sizes and longer follow-up periods are needed to assess its long-term impact on ulcer recurrence and limb salvage rates. Future research should also evaluate cost-effectiveness and accessibility in resource-limited settings, as widespread adoption of VAC therapy could have significant implications for DFU management worldwide. Given its clear benefits, VAC therapy should be incorporated into standard DFU treatment protocols, ensuring that more patients receive optimal wound care and improved recovery outcomes.

REFERENCES

[1] James SMD, Sureshkumar S, Elamurugan TP, Debasis N, Vijayakumar C, Palanivel C. Comparison of Vacuum-Assisted Closure Therapy and Conventional Dressing on Wound Healing in Patients with Diabetic Foot Ulcer: A Randomized Controlled Trial. Niger J Surg. 2019 Jan-Jun;25(1):14-20. doi: 10.4103/njs.NJS_14_18. PMID: 31007506; PMCID: PMC6452767.

[2] Kunze KN, Hamid KS, Lee S, Halvorson JJ, Earhart JS, Bohl DD. Negative-Pressure Wound Therapy in Foot and Ankle Surgery. Foot Ankle Int. 2020 Mar;41(3):364-372. doi: 10.1177/1071100719892962. Epub 2019 Dec 13. PMID: 31833393.

[3] Armstrong DG, Attinger CE, Boulton AJ, Frykberg RG, Kirsner RS, Lavery LA, Mills JL. Guidelines regarding negative wound therapy (NPWT) in the diabetic foot. Ostomy Wound Manage. 2004 Apr;50(4B Suppl):3S-27S. PMID: 15311482.

[4] Karatepe O, Eken I, Acet E, Unal O, Mert M, Koc B, Karahan S, Filizcan U, Ugurlucan M, Aksoy M. Vacuum assisted closure improves the quality of life in patients with diabetic foot. Acta Chir Belg. 2011 Sep-Oct;111(5):298-302. PMID: 22191131.

[5] Eneroth M, van Houtum WH. The value of debridement and Vacuum-Assisted Closure (V.A.C.) Therapy in diabetic foot ulcers. Diabetes Metab Res Rev. 2008 May-Jun;24 Suppl 1:S76-80. doi: 10.1002/dmrr.852. PMID: 18393328.

[6] Venturi ML, Attinger CE, Mesbahi AN, Hess CL, Graw KS. Mechanisms and clinical applications of the vacuum-assisted closure (VAC) Device: a review. Am J Clin Dermatol. 2005;6(3):185-94. doi: 10.2165/00128071-200506030-00005. PMID: 15943495.

[7] Nather A, Chionh SB, Han AY, Chan PP, Nambiar A. Effectiveness of vacuum-assisted closure (VAC) therapy in the healing of chronic diabetic foot ulcers. Ann Acad Med Singap. 2010 May;39(5):353-8. PMID: 20535423.

[8] Mendonca DA, Cosker T, Makwana NK. Vacuum-assisted closure to aid wound healing in foot and ankle surgery. Foot Ankle Int. 2005 Sep;26(9):761-6. doi: 10.1177/107110070502600915. PMID: 16174508.

[9] Shin SH, Park IK, Kang JW, Lee YS, Chung YG. Vacuum-Assisted Closure (VAC) Using Multiple Foam Pieces for Hidden Space Drainage through Less Exposure in Musculoskeletal Infections. J Hand Surg Asian Pac Vol. 2018 Sep;23(3):369-376. doi: 10.1142/S242483551850039X. PMID: 30282543.

[10] Uğurlar M, Sönmez MM, Armağan R, Eren OT. Comparison of two different vacuum-assisted closure (VAC) treatments of multiple chronic diabetic foot wounds in the same extremity. Foot Ankle Surg. 2017 Sep;23(3):173-178. doi: 10.1016/j.fas.2016.05.314. Epub 2016 May 11. PMID: 28865586.

[11] Whitehead SJ, Forest-Bendien VL, Richard JL, Halimi S, Van GH, Trueman P. Economic evaluation of Vacuum Assisted Closure® Therapy for the treatment of diabetic foot ulcers in France. Int Wound J. 2011 Feb;8(1):22-32. doi: 10.1111/j.1742-481X.2010.00739.x. Epub 2010 Sep 28. PMID: 20875048; PMCID: PMC7950900.

[12] Ulusal AE, Sahin MS, Ulusal B, Cakmak G, Tuncay C. Negative pressure wound therapy in patients with diabetic foot. Acta Orthop Traumatol Turc. 2011;45(4):254-60. doi: 10.3944/AOTT.2011.2283. PMID: 21908965.

[13] Sajid MT, Mustafa Qu, Shaheen N, Hussain SM, Shukr I, Ahmed M. Comparison of Negative Pressure Wound Therapy Using Vacuum-Assisted Closure with Advanced Moist Wound Therapy in the Treatment of Diabetic Foot Ulcers. J Coll Physicians Surg Pak. 2015 Nov;25(11):789-93. PMID: 26577962.

[14] McCallon SK, Knight CA, Valiulus JP, Cunningham MW, McCulloch JM, Farinas LP. Vacuum-assisted closure versus saline-moistened gauze in the healing of postoperative diabetic foot wounds. Ostomy Wound Manage. 2000 Aug;46(8):28-32, 34. PMID: 11189545.

[15] Wang R, Feng Y, Di B. Comparisons of negative pressure wound therapy and ultrasonic debridement for diabetic foot ulcers: a network meta-analysis. Int J Clin Exp Med. 2015 Aug 15;8(8):12548-56. PMID: 26550165; PMCID: PMC4612850.

[16] Schintler MV. Negative pressure therapy: theory and practice. Diabetes Metab Res Rev. 2012 Feb;28 Suppl 1:72-7. doi: 10.1002/dmrr.2243. PMID: 22271727.

[17] Ravari H, Modaghegh MH, Kazemzadeh GH, Johari HG, Vatanchi AM, Sangaki A, Shahrodi MV. Comparision of vacuum-asisted closure and moist wound dressing in the treatment of diabetic foot ulcers. J Cutan Aesthet Surg. 2013 Jan;6(1):17-20. doi: 10.4103/0974-2077.110091. PMID: 23723599; PMCID: PMC3663170.

[18] Farah R, Gantus M, Kogan L. [Vacuum-assisted therapy for various wound types including diabetic foot ulcer].

Harefuah. 2011 Mar;150(3):222-6, 306, 305. Hebrew. PMID: 21574351.

[19] Sibbald RG, Mahoney J; V.A.C. Therapy Canadian Consensus Group. A consensus report on the use of vacuum-assisted closure in chronic, difficult-to-heal wounds. Ostomy Wound Manage. 2003 Nov;49(11):52-66. PMID: 14652413.

[20] Armstrong DG, Andros G. Use of negative pressure wound therapy to help facilitate limb preservation. Int Wound J. 2012 Aug;9 Suppl 1(Suppl 1):1-7. doi: 10.1111/j.1742-481X.2012.01015.x. PMID: 22727134; PMCID: PMC7950752.