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ORIGINAL RESEARCH

Comparative evaluation of vacuum-assisted closure versus conventional moist dressing in diabetic foot ulcers: A prospective comparative study

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are persistent and difficult-to-heal wounds that arise due to a combination of vascular compromise, neuropathy, and heightened infection risk. Although several topical therapies—including hydrocolloid gels, growth factors, enzymatic debriding agents, hyperbaric oxygen, and engineered tissue substitutes—have been recommended to speed up healing, they are often expensive and may lack strong supportive evidence. Vacuum-Assisted Closure (VAC), also referred to as negative pressure wound therapy, is a relatively recent method that has shown promise in managing intractable acute and chronic wounds. **Methods:** A prospectivecomparativestudy was undertaken in the Department of General Surgery, Sharda Hospital, Greater Noida, from May 2022 to May 2024. Fifty-two individuals with DFUs (Wagner's grade 2 or 3) were randomized into two groups: Group A received VAC therapy, and Group B received standard moist saline dressings. The primary parameters for comparison included decrease in wound area, decrease in wound depth, and percentage of granulation tissue formation. Secondary parameters encompassed hospital stay duration, cost analysis, and safety outcomes such as lower infection rates and reduced need for major surgical interventions. **Results:** Between-group analysis indicated that VAC dressings led to a more substantial reduction in wound size at weeks 1, 2, and at the end of the third/beginning of the fourth week. Depth reduction was also significantly greater in the VAC group at key time points. Enhanced granulation tissue formation was seen in Group A compared to Group B at one and two weeks. Hospital stays were shorter in the VAC group. Notably, an indigenously prepared VAC system used here was considerably less expensive than many commercial negative pressure systems and even compared favorably to repeated conventional dressings over time. Wounds in patients with HbA1C >10 healed more slowly than those with HbA1C ≤10, and ulcers classified as Wagner's grade 2 resolved faster than grade 3. VAC therapy additionally lowered the rate of amputations, reduced the need for skin grafting, and decreased antibiotic requirements. **Conclusion:** VAC therapy demonstrated superior wound healing performance, with significant reductions in both size and depth of the ulcer, greater granulation tissue coverage, and fewer hospital days than conventional moist dressing. The indigenous VAC device was not only effective but also cost-friendly. Higher HbA1C levels (>10) slowed healing, and grade 3 ulcers took longer to heal relative to grade 2. Overall, VAC proved to be both safe and beneficial in diabetic foot ulcer management.

Keywords: Diabetic foot ulcers, Vacuum-assisted closure, Negative pressure wound therapy, Moist saline dressing, Cost-effectiveness, Wound healing

INTRODUCTION

Diabetes mellitus remains a major global health concern, and India is among the most affected countries. This high burden of diabetes predisposes many individuals to develop diabetic foot ulcers (DFUs), which emerge in roughly 15% of patients at some stage in their disease [1]. These lesions are complicated by social and cultural factors—such as walking without protective footwear, inadequate educational and medical resources, and limited socioeconomic means—that exacerbate foot care deficiencies [2]. The presence of such ulcers

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substantially impairs quality of life and increases the risk of major depressive episodes [3].

The ramifications of DFUs include elevated rates of hospitalization, significant healthcare spending, and a tendency toward lower-limb amputation, largely because many of these lesions fail to respond quickly to basic interventions [4]. In India alone, it is estimated that between 80,000 and 100,000 amputations take place annually, the majority of which are triggered by longstanding foot ulcers [5]. Compared with the general population, individuals with diabetes have a greatly magnified risk of undergoing amputation. Hence, prompt and effective wound care is critical in reducing both morbidity and the risk of limb loss [6].

DFUs are often chronic, partly due to poor perfusion stemming from microvascular and macrovascular disease, combined with immune dysfunction that compromises the body's defense against infections [7]. Neuropathy also contributes by lessening the protective pain response. Conventional care typically involves maintaining a moist wound environment with daily or twice-daily normal saline dressings, meticulous surgical debridement to remove necrotic material, antibiotic therapy guided by culture and sensitivity, and strict glycemic control [8]. While saline dressings remain a time-tested standard, the wound environment can fluctuate, making it challenging to sustain the optimal moist conditions continuously [9].

Over the years, various advanced wound therapies have been introduced as alternatives: hydrocolloid formulations, enzymatic debriding agents, hyperbaric oxygen therapy, synthetic skin grafts, and more. Although these measures can be efficacious, widespread adoption is hindered by cost issues and, in some cases, insufficient large-scale clinical validation [10]. A relatively newer innovation—Vacuum-Assisted Closure (VAC) or Negative Pressure Wound Therapy (NPWT)—utilizes subatmospheric pressures to encourage wound contraction and improve tissue perfusion. Commercial VAC units have shown promise in accelerating healing rates but are often criticized for high costs [11].

In this context, the current study aimed to evaluate the clinical effectiveness of a cost-effective, locally developed VAC dressing in comparison to standard moist saline dressings in individuals presenting with Wagner's grade 2 or 3 DFUs. The primary outcome measures were reduction in wound area, wound depth, and granulation tissue coverage. Secondary end points consisted of hospital stay duration, cost analysis of the materials used, and an assessment of safety parameters such as infection conversion and the proportion of patients requiring amputations or skin graft procedures [12]. By analyzing these outcomes, clinicians can glean insights into whether an indigenously constructed VAC device offers a beneficial and cost-efficient alternative to conventional dressing in managing this challenging condition.

MATERIALS AND METHODS

Study Site and Duration

The research took place in the Department of General Surgery at Sharda Hospital, Greater Noida, over a span from May 2022 to May 2024.

Study Design

A prospectivecomparativestudy design was adopted, recruiting patients who met specific eligibility criteria and randomly assigning them to receive either vacuum-assisted closure (Group A) or moist saline dressing (Group B).

Study Population

A total of 52 individuals with Wagner's grade 2 or 3 DFUs were included. Participants had to be aged between 18 and 70 years and have ulcers attributable to diabetes rather than alternative etiologies. Individuals who were pregnant, nursing, immunosuppressed, or had foot ulcers secondary to vascular disease or osteomyelitis were excluded.

Ethical Approval and Consent

All participants were informed about the nature and objectives of the study in their local language. Those consenting to participate were asked to sign an informed consent form before being randomly divided into the two groups (Group A and Group B).

Interventions

1. Surgical Debridement

Upon admission, patients underwent sharp surgical debridement of their foot ulcers to remove necrotic tissue and reduce microbial load. This step was repeated as deemed necessary at subsequent dressing changes.

2. VAC Dressing (Group A)

Under sterile conditions, a foam-based dressing was cut to fit the wound geometry and placed over the ulcer. A transparent cellophane wrap (or comparable sealant) was used to form an airtight seal. A Ryle's tube integrated into the foam was attached to a wall-mounted suction apparatus to maintain negative pressure of approximately 80 to 125 mmHg, applied intermittently—30 minutes on, one hour off—for a maximum of 72 hours at a stretch. The dressing was changed sooner if the soakage surpassed a tolerable limit or if exudate collected in the suction container.

3. Moist Saline Dressing (Group B)

Participants received either once-a-day or twice-daily saline-based gauze dressings, depending on the wound's exudate level. Saline gauze was placed over the cleaned wound, and any overt exudation or soiling prompted earlier dressing changes.

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Outcomes Measured

- **Wound Area (cm^2):** Calculated as the product of the maximum horizontal and vertical dimensions.
- **Wound Depth (mm):** Recorded at the deepest observable point.
- **Percentage Granulation Tissue:** Visually estimated based on the proportion of wound bed covered by healthy granulation.
- **Infection Status:** Culture was performed at baseline and repeated at two weeks to note any shift from infected to sterile status.
- **Hospital Stay:** Tracked from admission to discharge.
- **Secondary Procedures:** The incidence of amputations and skin grafting was documented.
- **Cost Evaluation:** Consumables and the frequency of dressing changes over 21 days were used to compare total expenses between the VAC and conventional groups.

Statistical Analysis

A paired t-test was applied for comparing continuous variables such as wound size, depth, hospital stay, and cost. Chi-square tests were used for categorical variables like infection conversion and distribution of Hba1c levels. A significance threshold of $p<0.05$ was set.

RESULTS

Fifty-two patients were enrolled, with 26 in each group. Baseline characteristics such as age, sex, and HbA1C distribution were comparable between Group A (VAC) and Group B (Conventional Saline Dressing).

Table-1: Age and Gender Comparison in Groups A and B

	Vacuum Assisted Dressing (n=26)	Conventional Dressing (n=26)	p Value (Paired T Test)
Mean Age (years)	52.20 ± 9.50	53.78 ± 10.08	0.563
Male	18 (69.23%)	16 (61.53%)	0.490
Female	8 (30.77%)	10 (38.47%)	—

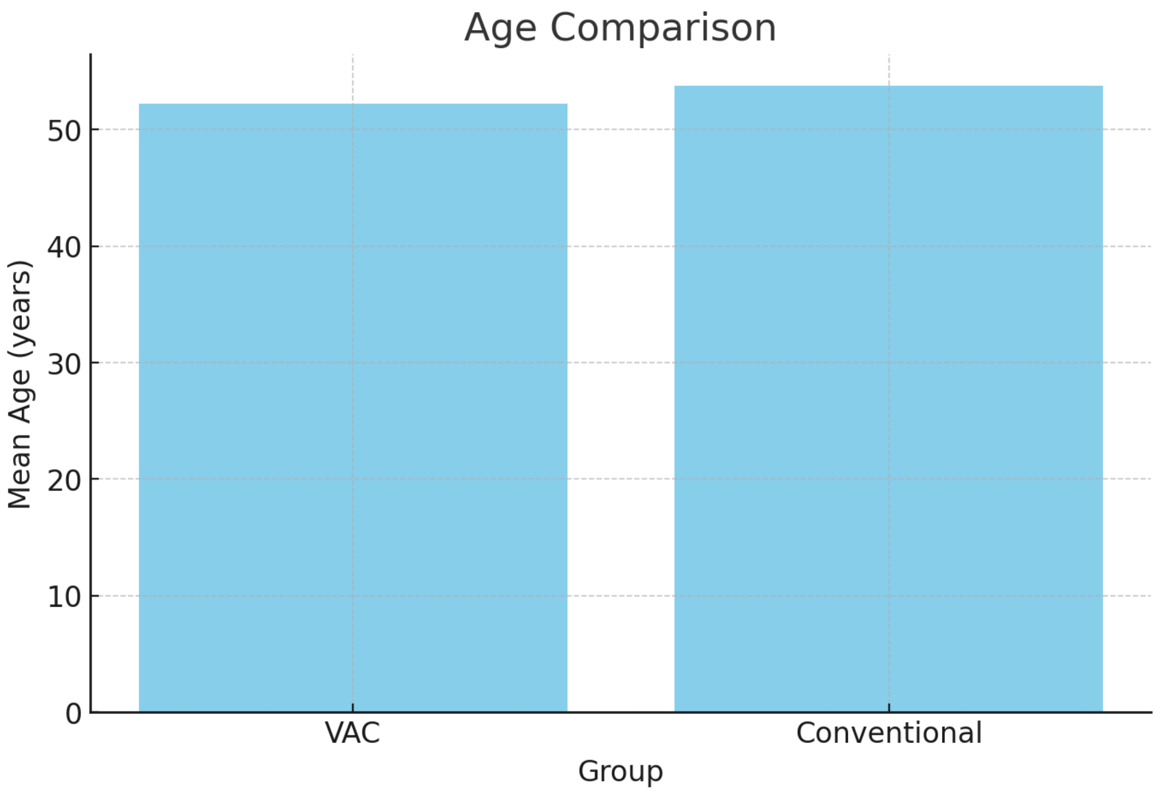

Table-2: Left/Right and Site of the Foot Involvement

Site	LT Diabetic Foot	RT Diabetic Foot	Grand Total
Dorsum	8 (15.32%)	11 (21.15%)	19 (36.53%)
Lateral Malleolus	3 (5.76%)	7 (13.46%)	10 (19.23%)
Medial Malleolus	6 (11.53%)	3 (5.76%)	9 (17.30%)
Plantar	11 (21.15%)	3 (5.76%)	14 (26.92%)

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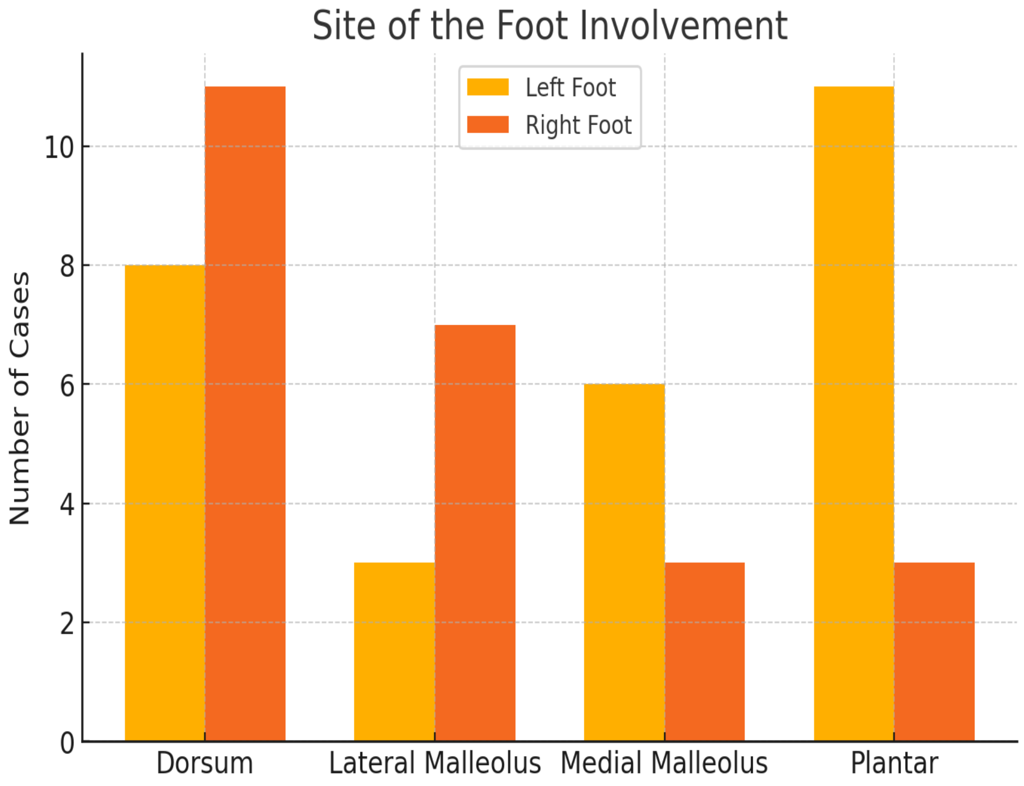

Table-3: Diabetes Status

Hba1c Levels	Vacuum Assisted Dressing	Conventional Dressing	Total	p Value (Chi-Square Test)
≤ 10	13 (50%)	15 (57.6%)	28 (53.84%)	0.328
>10	13 (50%)	11 (42.3%)	24 (46.16%)	—

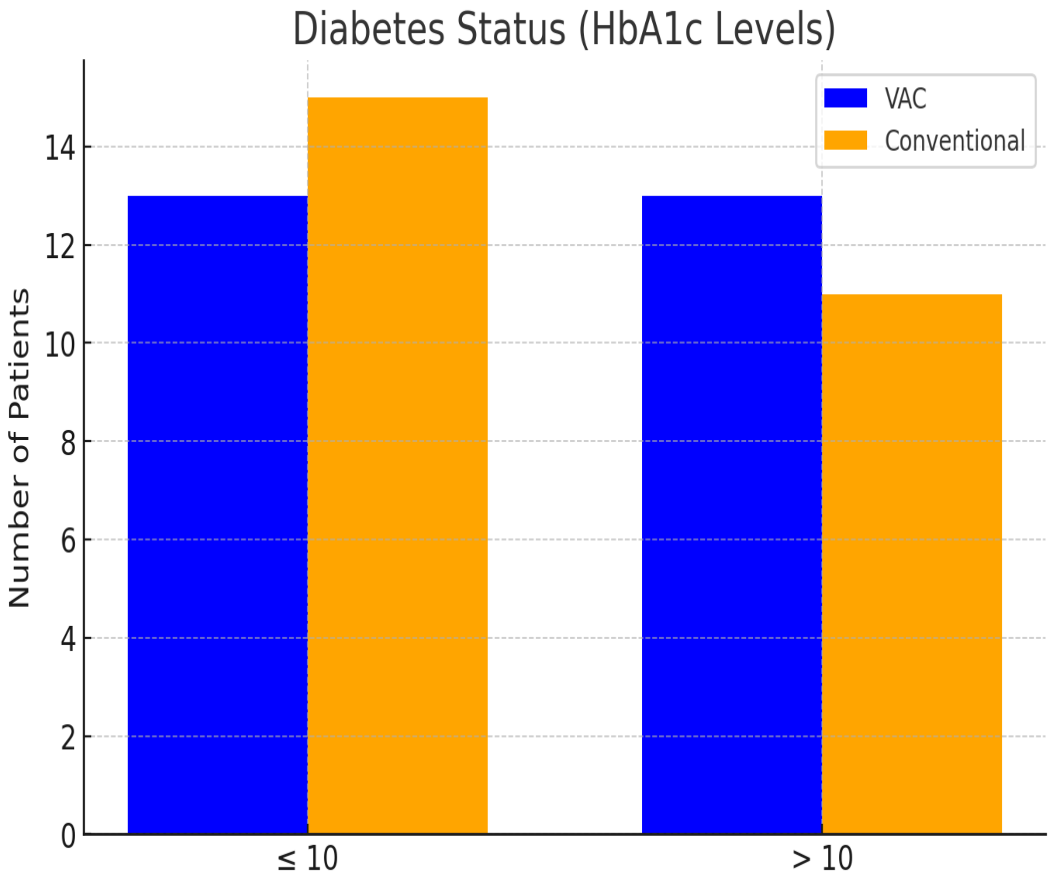

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Table-4: Ulcer Healing (Size) and Its Relation to Hba1c Levels

Hba1c	Vacuum Assisted Dressing (Mean Days ± SD)	Conventional Dressing (Mean Days ± SD)	p Value (Paired T Test)
≤10	19.91 ± 2.10	25.46 ± 1.80	0.0210*
>10	21.36 ± 1.91	27.22 ± 1.74	0.0110*
p Value	0.0371*	0.00154*	0.0013*

*(p<0.05 is significant)

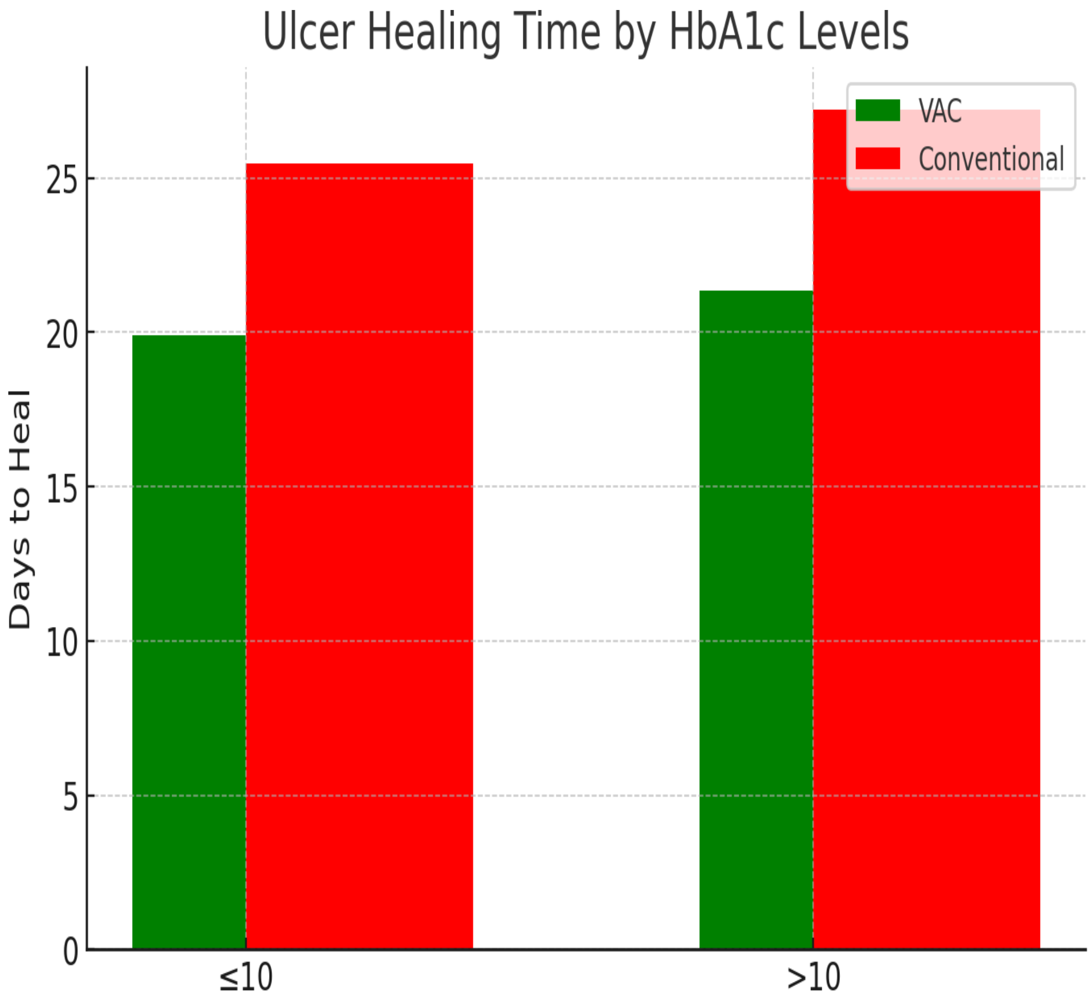

Table-5: Healing (Size) and Its Relation to Wagner's Grading

Wagner's Grade	Vacuum Assisted Dressing (Mean Days ± SD)	Conventional Dressing (Mean Days ± SD)	p Value (Paired T Test)
Grade 2	19.42 ± 1.78	24.8 ± 1.98	0.0034*
Grade 3	22.44 ± 0.88	27.33 ± 1.77	0.0013*
p Value	0.026*	0.0174*	—

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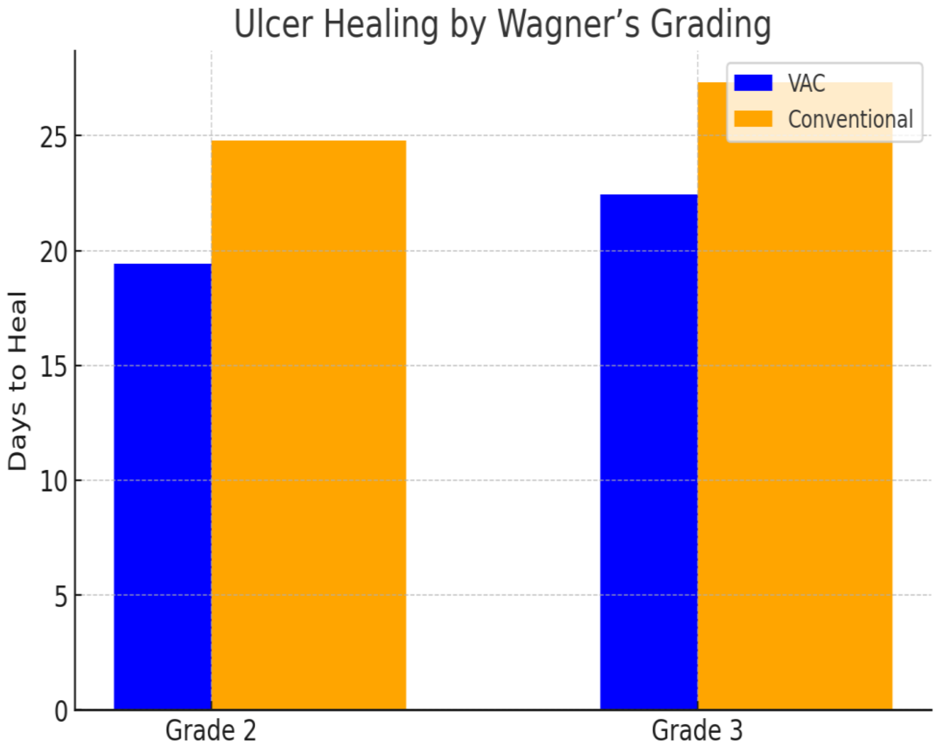

Table-6: Reduction in Size of Ulcer

Time Interval	Vacuum Assisted Dressing (in cm²)	Conventional Dressing (in cm²)	p Value (Paired T Test)
Baseline	38.20 ± 11.23	41.21 ± 10.96	0.332
1 Week	32 ± 9.98	38.03 ± 10.37	0.0349*
2 Weeks	24.95 ± 11.23	33.67 ± 9.68	0.0262*
End of 3rd / Start of 4th Week	1.8	3.4	0.01
4 Weeks	0.64 ± 2.23	2.73 ± 7.15	0.1610

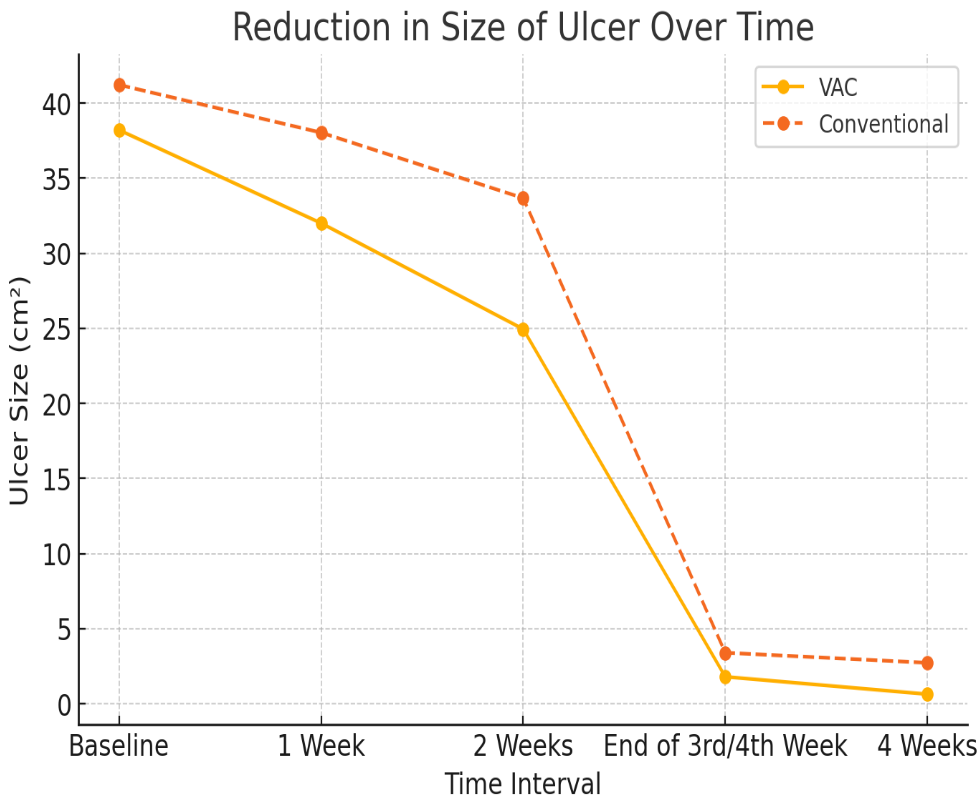

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Table-7: Reduction in Depth of Ulcer

Time Interval	Vacuum Assisted Dressing (in mm)	Conventional Dressing (in mm)	p Value (Paired T Test)
Baseline	12.83 ± 5.28	12.5 ± 4.65	0.249
1 Week	10.20 ± 4.10	11.28 ± 4.04	0.343
2 Weeks	6.79 ± 2.55	9.28 ± 3.56	0.0055*
End of 3rd / Start of 4th	0.6	1.5	0.03
4 Weeks	0.2 ± 0.70	0.80 ± 3.35	0.145

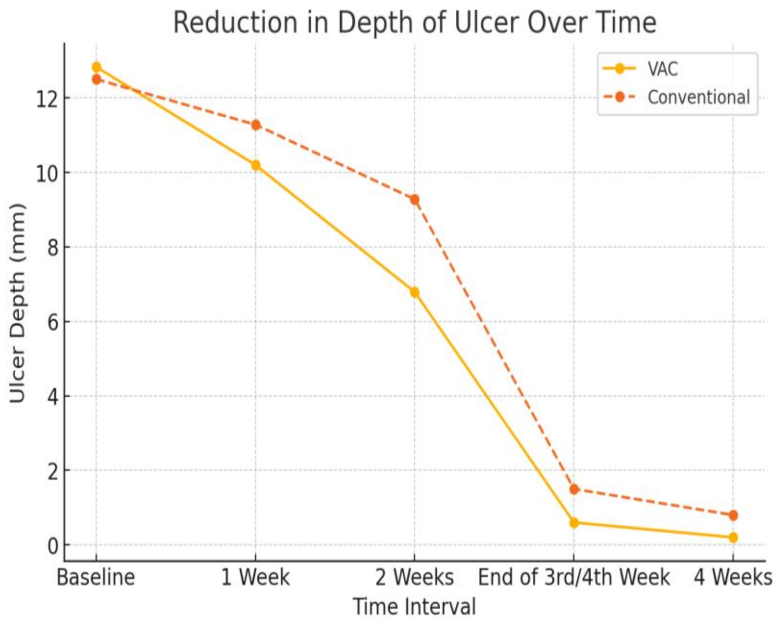

Table-8: Percent Granulation Tissue Attained

Time Interval	Vacuum Assisted Dressing (%)	Conventional Dressing (%)	p Value (Paired T Test)
1 Week	39.08 ± 7.84	26.35 ± 4.87	0.0163*
2 Weeks	68.87 ± 4.05	50.32 ± 6.66	0.00281*
4 Weeks	99.26 ± 1.52	98.26 ± 4.26	0.2650

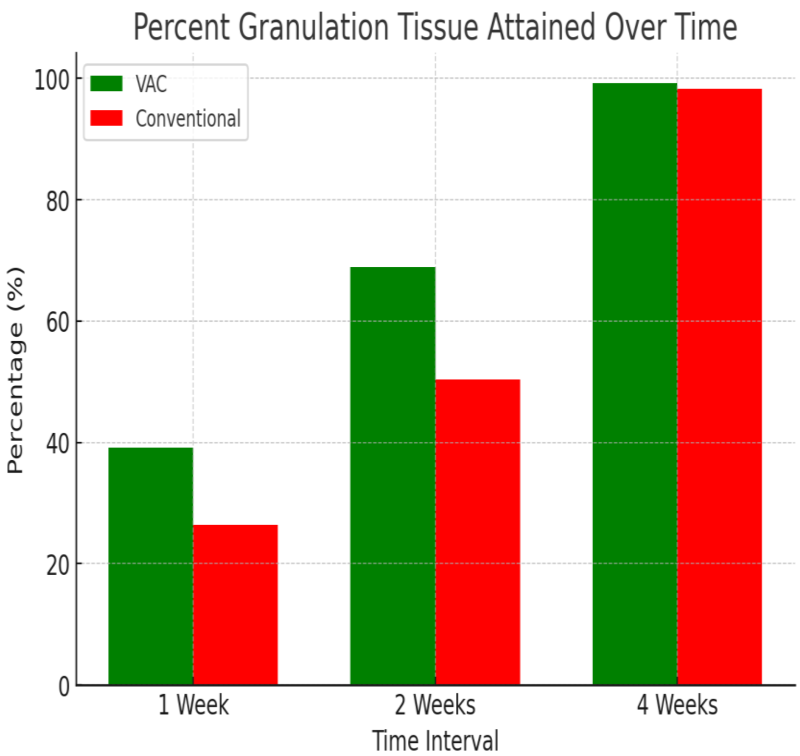

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Table-9: Safety Against Infection (Culture Analysis)

	Vacuum Assisted Dressing (%)		Conventional Dressing (%)	
	Baseline	**2 Weeks**	**Baseline**	**2 Weeks**
Sterile	6 (23%)	9 (34.7%)	5 (19.2%)	6 (23%)
Non-Sterile	20 (76.9%)	17 (65.3%)	21 (80.8%)	20 (76.9%)

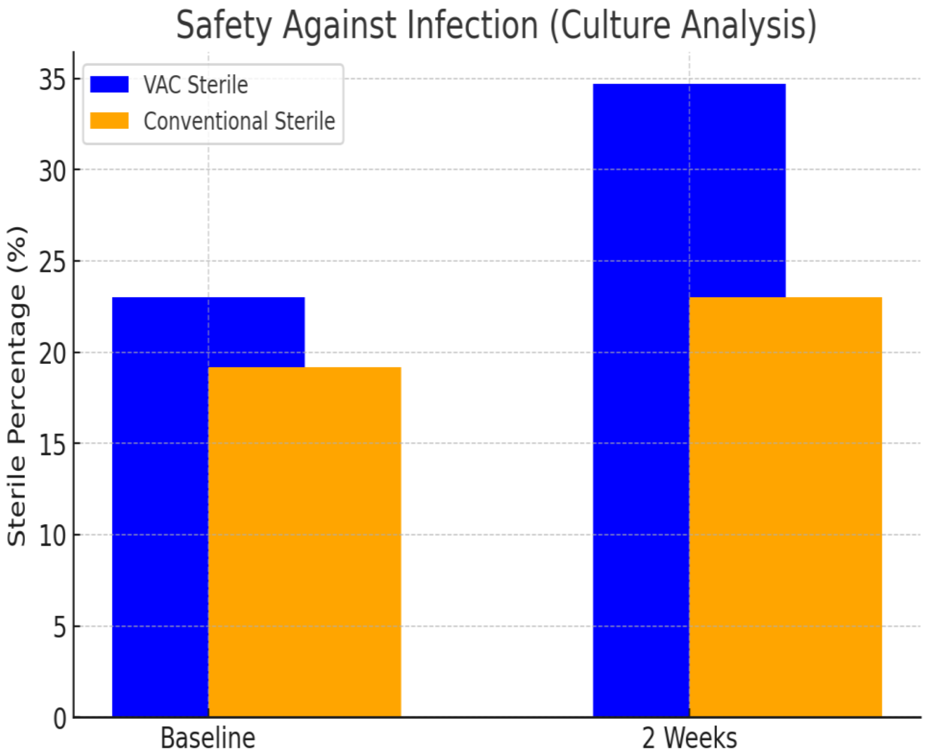

Table-10: Hospital Stay

	Vacuum Assisted Dressing	Conventional Dressing	p Value (Paired T Test)
Mean No. of Days	22.44 ± 3.97	28.92 ± 4.92	0.0363

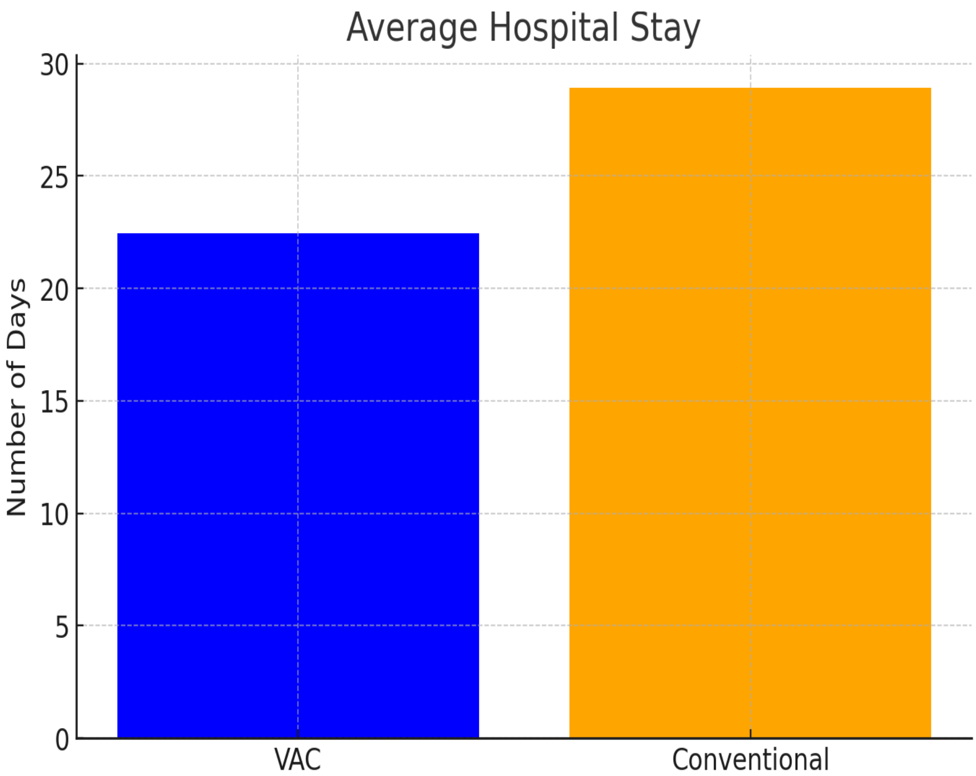

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Table-11: Need for Secondary Procedure

	Vacuum Assisted Dressing (%)	Conventional Dressing (%)	Total (n=52)
No Secondary Procedure Needed	24 (92.3%)	22 (84.6%)	46 (88.4%)
Skin Grafting/Amputation	2 (7.7%)	4 (15.4%)	6 (11.6%)

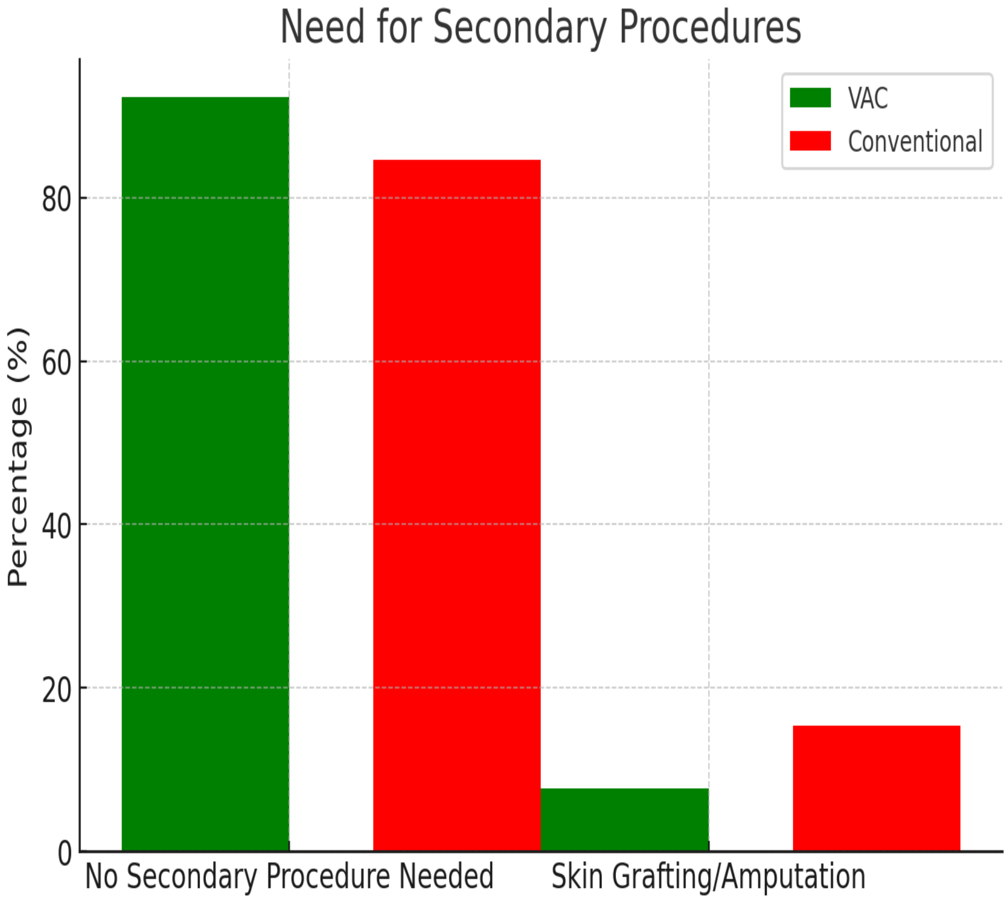

Table-12: Cost Comparison

Vacuum Assisted Dressing (21 Days)	Cost (INR)	Conventional Dressing (21 Days)	Cost (INR)
Wall-Mounted Suction Apparatus	50 (approx.)	**Gauze Packs**	150 (approx.)
Sterilized Bed Foam	280 (approx.)	**Gamjee Rolls**	225 (approx.)
Ryle's Tube	120 (approx.)	**Adhesive Tape**	50 (approx.)
Transparent Adhesive Film	550 (approx.)	**Bandage Rolls**	100 (approx.)
Total for 21 Days	1000 (approx.)	**Ointment**	175 (approx.)
		Total for 21 Days (twice a day)	2250 (approx.)

The total approximate cost in the VAC group stood at INR 1000, whereas the conventional dressing group incurred around INR 2250 for twice-daily dressings over the same duration.

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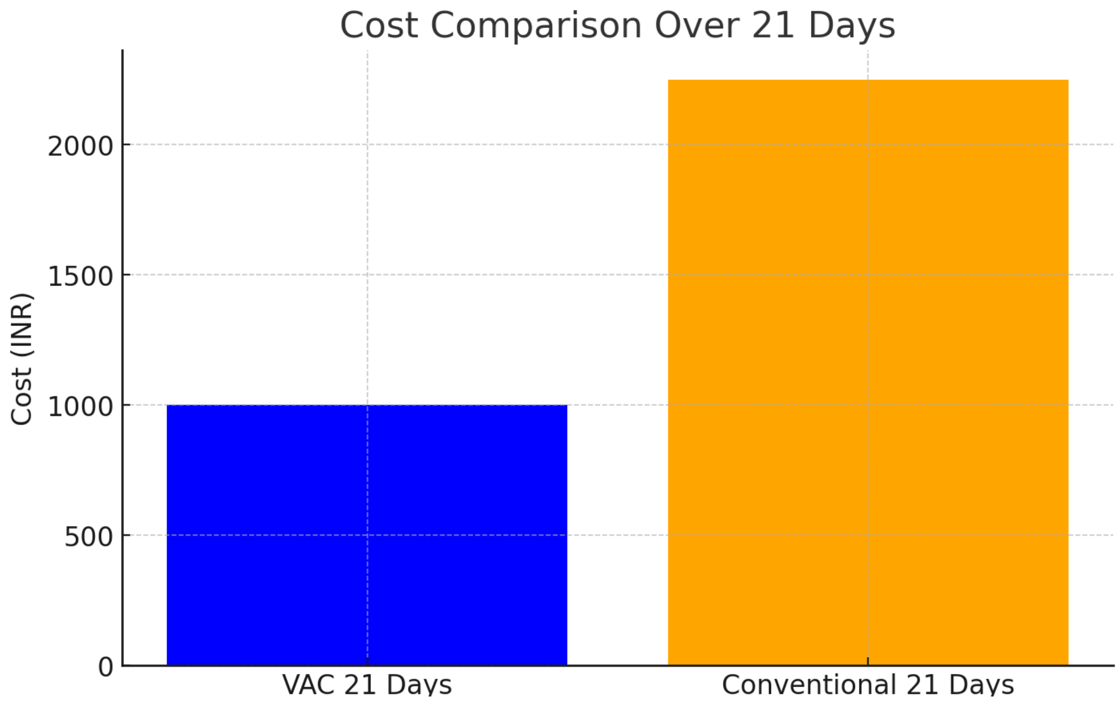

DISCUSSION

This prospective study aimed to evaluate the efficacy and safety of an indigenously assembled vacuum-assisted closure system in comparison to conventional moist saline dressings for diabetic foot ulcers [13]. The results underscore the potential advantages of negative pressure wound therapy (VAC), aligning with the growing consensus that subatmospheric pressure can hasten wound contraction, encourage granulation, and reduce infection risks [14].

The significantly greater reduction in ulcer size observed at weeks 1, 2, and the 3rd/4th week in the VAC group points toward more robust early-phase healing kinetics [15]. By removing excess exudate and promoting continuous microdeformation, VAC sets up a conducive environment for angiogenesis and granulation tissue proliferation. These findings complement the notable increase in granulation tissue coverage in Group A, illustrating that VAC fosters more rapid bed preparation [16,17].

Depth reduction is a vital indicator of whether deeper compartments of the foot are responding to treatment [18]. The VAC group's ulcers demonstrated comparatively faster resolution in depth, suggesting that negative pressure therapy effectively targets these deeper areas where infection or ischemia can linger [19]. This accelerated healing process can curtail the chance of complications such as osteomyelitis or the need for aggressive surgical intervention [20].

Hospital stay duration was notably shorter in patients managed with VAC, possibly due to improved wound status that allowed for earlier discharge or reduced complications [21]. Furthermore, fewer individuals in Group A required skin grafting or amputation, pointing to a lower incidence of refractory or deteriorating wounds. Faster attainment of a healthy wound bed can translate to reduced antibiotic usage and less frequent dressing changes, both of which enhance patient comfort and decrease overall healthcare costs.

Cost has often been cited as a barrier to adopting negative pressure therapy. However, in this study, using locally sourced materials an wall-mounted suction significantly trimmed expenses—leading to a total cost even lower than repeated conventional dressings [22]. This is a crucial finding for resource-constrained environments, where limited budgets may prevent access to brand-name VAC devices but permit an equally functional, improvised system.

The interplay between glycemic control and wound healing emerged consistently, with higher HbA1C values (>10) correlating with slower healing in both groups [23]. This underscores the importance of integrating blood glucose regulation strategies with wound care interventions. Likewise, ulcers categorized as Wagner's grade 2 achieved faster closure than grade 3, reflecting the advanced tissue damage present at higher grades.

Infection control data, although not powered for definitive conclusions, showed a promising trend: a higher proportion of ulcers became sterile in the VAC group by two weeks [24]. The removal of exudate and reduction in edema appear to foster a less hospitable environment for bacterial proliferation. This could partially explain why fewer VAC-treated patients needed amputations or grafting [25].

In summary, these findings reinforce that negative pressure wound therapy can offer accelerated healing, decreased rates of severe complications, and even be cost-effective when designed and administered locally. Future research on a larger scale and with longer follow-up may help confirm these preliminary benefits while exploring patient-reported outcomes such as pain relief and quality of life.

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CONCLUSION

In this study of 52 individuals with Wagner's grade 2 or 3 diabetic foot ulcers, vacuum-assisted closure markedly outperformed conventional moist saline dressings in reducing wound size, accelerating granulation tissue formation, and minimizing length of hospitalization. Costs associated with an indigenously assembled VAC unit were also lower compared to repeated saline dressings. Additionally, wounds in patients with higher HbA1C (above 10) took longer to heal, and grade 3 ulcers exhibited extended recovery times compared to grade 2. Overall, VAC therapy proved both safe and effective, leading to fewer major procedures and demonstrating its utility in managing diabetic foot ulcers.

REFERENCES

1. Zhang P., Lu J., Jing Y., Tang S., Zhu D., Bi Y. Global epidemiology of diabetic foot ulceration: A systematic review and meta-analysis. *Ann Med.* 2017;49(2):106–116.
2. Singh N., Armstrong D.G., Lipsky B.A. Preventing foot ulcers in patients with diabetes. *JAMA.* 2005;293(2):217–228.
3. Jeffcoate W.J., Harding K.G. Diabetic foot ulcers. *Lancet.* 2003;361(9368):1545–1551.
4. Reiber G.E., Vileikyte L., Boyko E.J., Del Aguila M., Smith D.G., Lavery L.A., Boulton A.J. Causal pathways for incident lower-extremity ulcers in patients with diabetes from two settings. *Diabetes Care.* 1999;22(1):157–162.
5. International Diabetes Federation. IDF position statement: the diabetic foot: amputations are preventable. Accessed June 2024.
6. Alfaqih M.R., Sinawang G.W., Faizah R., Hermanto A. The Management of Diabetic Foot Ulcers Using the Wound Treatment Techniques of Modern Dressing: A Systematic Review. *Jurnal Ners.* 2019;14(3):177–181.
7. Patra S.K., Mohapatra M., Panda S., Sarangi A.K., Babu K.K., Sarangi A. A clinical study of management of wounds using vacuum assisted dressings. *Int J Adv Med.* 2022;9(6):661–665.
8. James S.M., Sureshkumar S., Elamurugan T.P., 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;25(1):14–20.
9. Muneer M., Thomas T.K., Babu D., Paul D. Comparison of modified vacuum dressing and wet normal saline dressing in treatment of non-healing diabetic foot ulcers. *Int Surg J.* 2019;6(8):2772–2775.
10. Yadav A.K., Mishra S., Khanna V., Panchal S., Modi N., Amin S. Comparative study of various dressing techniques in diabetic foot ulcers in the Indian population: a single-center experience. *Int J Diabetes Dev Ctries.* 2023;43(5):647–653.
11. Mehta V.P., Suvariya M., Singh S., Makwana C. A Comparative Study of Regular Dressing versus Negative Dressing in Management of Patients with Diabetic Foot. *Adv Hum Biol.* 2024;14(1):68–72.
12. Apelqvist J., Larsson J., Agardh C.D. The importance of early prevention of foot ulcers in patients with diabetes. *Diabetes Care.* 1993;16(Suppl 2):42–49.
13. Armstrong D.G., Lavery L.A., Wrobel J.S., Vileikyte L. Quality of life in healing diabetic wounds: does the end justify the means? *J Foot Ankle Surg.* 2009;48(1):52–57.
14. Centers for Disease Control and Prevention (CDC). National diabetes statistics report, 2022. Atlanta, GA: U.S. Department of Health and Human Services; 2022.
15. Lipsky B.A., Berendt A.R., Cornia P.B., et al. 2012 Infectious Diseases Society of America Clinical Practice Guideline for the diagnosis and treatment of diabetic foot infections. *Clin Infect Dis.* 2012;54(12):e132–e173.
16. Armstrong D.G., Lavery L.A., Harkless L.B. Validation of a diabetic wound classification system. The contribution of depth, infection, and perfusion to ulcer outcomes. *Diabetes Care.* 1998;21(5):855–859.
17. Armstrong D.G., Lavery L.A., Nguyen H.C., van Schie C.H., Boulton A.J., Harkless L.B. Off-loading the diabetic foot wound: a randomized clinical trial. *Diabetes Care.* 2001;24(6):1019–1022.
18. Driver V.R., Fabbi M., Lavery L.A., Gibbons G. The costs of diabetic foot: the economic case for the limb salvage team. *J Vasc Surg.* 2010;52(3 Suppl):17S–22S.
19. Dumville J.C., Hinchliffe R.J., Cullum N., Game F., Stubbs N., Sweeting M.J., Peinemann F. Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. *Cochrane Database Syst Rev.* 2013;(10):CD010318.
20. Liu S., He C.Z., Cai Y.T., Xing Q.P., Guo Y.Z., Fu X.H., Li X.Q. Evaluation of negative-pressure wound therapy for patients with diabetic foot ulcers: systematic review and meta-analysis. *Ther Clin Risk Manag.*2017;13:533–544.
21. Sheehan P., Jones P., Caselli A., Giurini J.M., Veves A. Percent change in wound area of diabetic foot ulcers over a 4-week period is a robust predictor of complete healing in 12 weeks. *Diabetes Care.* 2003;26(6):1879–1882.
22. Brower B. Negative-pressure wound therapy in orthopedic surgery. *J Am AcadOrthop Surg.* 2016;24(8):520–524.
23. Game F., Hinchliffe R.J., Apelqvist J., et al. A systematic review of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes Metab Res Rev.* 2016;32(Suppl 1):154–168.
24. World Union of Wound Healing Societies (WUWHS). Advances in wound care: NPWT in diabetic foot ulcers. *Wounds Int.* 2019;10(2):1–25.
25. Boulton A.J., Vileikyte L., Ragnarson-Tennvall G., Apelqvist J. The global burden of diabetic foot disease. *Lancet.* 2005;366(9498):1719–1724.