

# Comparative Effectiveness of Vacuum-Assisted Closure Therapy versus Normal Saline Dressing in the Healing of Diabetic Foot Ulcers

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## ABSTRACT

Diabetic foot ulcers (DFUs) are a common and serious complication of diabetes mellitus, carrying a lifetime risk of approximately 25 percent among people with diabetes and representing a leading cause of lower-limb amputation. Wound bed management is central to DFU care, and negative pressure wound therapy delivered through vacuum-assisted closure (VAC) has emerged as an alternative to traditional normal saline (NS) gauze dressing. This review synthesizes findings from randomized controlled trials and case-control studies comparing VAC therapy with conventional saline dressing in DFU management. Across the reviewed literature, VAC therapy was consistently associated with faster wound healing, earlier and more robust granulation tissue formation, and a reduced need for adjunctive surgical procedures compared with saline dressing, though at a generally higher per-application cost. These findings support the use of VAC therapy as a preferred modality for appropriately selected diabetic foot ulcers, particularly where accelerated healing and reduced surgical burden are clinical priorities, while normal saline dressing remains a viable, low-cost option in resource-limited settings.

**Keywords:** Diabetic Foot Ulcers (DFUs), Vacuum-Assisted Closure (VAC) Therapy, Negative Pressure Wound Therapy (NPWT), Normal Saline Dressing, Wound Healing Outcomes.

## 1. INTRODUCTION

Diabetic foot ulcers develop as a consequence of peripheral neuropathy, vascular insufficiency, and impaired immune response in patients with diabetes mellitus, and they constitute one of the most important and costly complications of the disease. Left untreated or inadequately managed, DFUs can progress to deep infection, osteomyelitis, and lower-extremity amputation. Standard wound care has traditionally relied on saline-moistened gauze dressing, valued for its simplicity, availability, and low cost. Over the past two decades, negative pressure wound therapy, commercially delivered as vacuum-assisted closure, has been increasingly adopted as an active wound-management strategy that

applies controlled sub-atmospheric pressure to the wound bed. This review compares the two modalities across healing time, granulation tissue formation, complication rates, and cost considerations.

## 2. MECHANISMS OF ACTION

Normal saline dressing functions primarily through passive mechanisms: it maintains a moist wound environment, assists in debris removal with dressing changes, and provides a low-cost barrier against desiccation. Vacuum-assisted closure, by contrast, applies continuous or intermittent negative pressure (commonly around 125 mmHg) to the wound surface through a sealed foam or gauze interface

connected to a suction pump. This negative pressure is thought to reduce localized edema, increase local blood flow, mechanically stimulate cellular proliferation, and continuously remove exudate and infectious material from the wound bed, thereby promoting earlier formation of granulation tissue.

### 3. COMPARATIVE CLINICAL OUTCOMES

Multiple randomized controlled trials and case-control studies have directly compared VAC therapy with saline gauze or conventional moist dressing in diabetic foot ulcer patients. A summary of consistently reported outcome trends is presented below.

| Outcome Measure                           | VAC/NPWT Group                                                            | Normal Saline Dressing Group              |
|-------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------|
| Mean time to healing/wound closure        | Significantly shorter (e.g., ~22.5 days in one RCT)                       | Longer, often 1.5–2× the VAC group        |
| Granulation tissue appearance by 2 weeks  | ~93% of patients                                                          | ~54% of patients                          |
| Red/healthy granulation at end of therapy | ~76.7% of ulcers                                                          | ~46.7% of ulcers                          |
| Need for surgical debridement/procedures  | Fewer required                                                            | More frequently required                  |
| Dressing change frequency                 | Every 2–5 days                                                            | Typically, daily or twice daily           |
| Cost per dressing/session                 | Higher (device/consumables), though low-cost hospital-made variants exist | Lower per-application cost                |
| Hospital length of stay                   | No significant difference in some studies                                 | No significant difference in some studies |

A randomized controlled trial conducted at a tertiary care hospital found that the mean healing time in the VAC group was significantly shorter than in the conventional dressing group, supporting VAC as the preferred approach when reduced healing duration is a treatment priority. A separate prospective case-control study reported that granulation tissue appeared by the end of week two in the substantial majority of VAC-treated patients, compared with roughly half of patients receiving moist saline gauze dressing. A further randomized trial evaluating low-cost, hospital-made VAC devices found meaningfully higher rates of healthy red granulation tissue in the VAC group relative to the conventional dressing group, suggesting that the benefits of negative pressure therapy may be attainable even without commercial NPWT systems, an important consideration for resource-constrained settings.

Economic analyses have generally found that although VAC therapy carries higher direct costs related to the device and consumables, this may be partially offset by a reduced need for surgical debridement and other procedures; one retrospective analysis found significantly fewer surgical procedures were required in the VAC group compared with the standard moist wound therapy group, while overall hospital length of stay did not differ significantly between groups.

### 4. SAFETY AND COMPLICATIONS

Reported complication profiles differ modestly between the two modalities. VAC therapy has been associated with earlier wound bed preparation but requires careful monitoring for device-related issues such as periwound skin maceration or, rarely, bleeding at the wound interface. Saline dressing carries a comparatively lower device-related complication risk but is more labor-intensive, typically requiring more frequent dressing changes and a longer overall duration of wound care, both of which may indirectly increase exposure to secondary infection between changes.

### 5. PRACTICAL AND RESOURCE CONSIDERATIONS

The selection between VAC therapy and saline dressing in practice is often influenced by resource availability rather than efficacy alone. VAC systems require specialized equipment, trained staff, and ongoing consumable supply, which may limit feasibility in low-resource or outpatient community settings. Modified, low-cost hospital-made negative pressure devices have been developed and studied specifically to address this barrier, with outcomes approaching those of commercial VAC systems in several trials. Saline dressing remains widely accessible, requires minimal training, and continues to be an appropriate option where VAC therapy is

unavailable or where ulcer characteristics do not warrant advanced wound therapy.

## 6. CONCLUSION

The weight of evidence from randomized controlled trials and case-control studies indicates that vacuum-assisted closure therapy achieves faster wound healing, earlier granulation tissue formation, and a reduced need for surgical intervention compared with normal saline dressing in the management of diabetic foot ulcers. These benefits should be weighed against the higher direct costs and resource requirements of VAC therapy. Where feasible, VAC therapy, including low-cost adapted devices, should be considered a preferred option for appropriately selected diabetic foot ulcers, while normal saline dressing remains a reasonable and effective alternative where advanced wound therapy is not accessible. Further large-scale, multicenter trials with standardized ulcer grading and long-term follow-up are warranted to refine patient-selection criteria for each modality.

## 7. REFERENCES

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