

Original Research

A Comparative Study on the Effectiveness of Vacuum-Assisted Closure Therapy vs. Conventional Debridement in Healing Diabetic Plantar Ulcers

Dr. Tejas Bipinchandra Patel¹, Dr. Harshkumar Nareshbhai Patel², Dr. Parthkumar Ghanshyambhai Patel³, Dr. Rohitkumar Kishorbhai Joshi⁴

¹Associate Professor, Department of Surgery, GMERS Medical College, Godhra, Panchmahal, Gujarat, India

^{2,4}Junior Resident, Department of Surgery, GMERS Medical College, Vadnagar, Gujarat, India

³Junior Resident, Department of Medicine, GMERS Medical College, Vadnagar, Gujarat, India

Corresponding Author

Dr. Rohitkumar Kishorbhai Joshi

Email: drrohitjoshi1004@gmail.com

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ABSTRACT

Background: One serious side effect of diabetes is diabetic plantar ulcers, which often result in a longer healing period and a higher risk of infection. For wound healing, vacuum-assisted closure (VAC) treatment has shown promise as a substitute for traditional debridement. This research examines how well VAC treatment and traditional debridement work to treat diabetic plantar ulcers.

Materials and Methods: 60 diabetic individuals with plantar ulcers participated in a prospective trial. Two groups of thirty participants each were randomly assigned to undergo VAC treatment and traditional debridement, respectively, in Group B. Over a 12-week period, ulcer healing was evaluated using metrics such as the decrease in wound size, duration to granulation, and the occurrence of complications. To ascertain the relative efficacy of the two strategies, data were examined using statistical techniques.

Results: Compared to 60% in Group B (mean reduction: 45%), 80% of patients in Group A demonstrated a substantial decrease in wound size (mean reduction: 75%). In Group A, the average time to granulation was 4 weeks, whereas in Group B, it was 7 weeks. Ten percent of Group A patients had complications like infection, compared to thirty percent of Group B patients. VAC treatment significantly improved healing results, according to statistical analysis ($p < 0.05$).

Conclusion: In the treatment of diabetic plantar ulcers, VAC therapy proved to be more successful than traditional debridement, resulting in quicker wound size reduction, earlier granulation, and fewer sequelae. According to these results, VAC treatment may be a useful strategy for treating diabetic foot ulcers.

Keywords: Diabetic plantar ulcers, vacuum-assisted closure therapy, conventional debridement, wound healing, diabetes management

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INTRODUCTION

One of the most crippling side effects of diabetes, diabetic plantar ulcers greatly increase patient morbidity and medical expenses. The therapy of these ulcers is complicated and difficult because they often arise from a confluence of peripheral neuropathy, ischemia, and infection [1]. According to research, between 15 and 25 percent of people with diabetes will have a foot ulcer at some point in their lives, despite improvements in diabetic treatment [2].

In order to remove necrotic tissue and encourage wound healing, conventional debridement has been

the accepted therapy for diabetic plantar ulcers [3]. Despite its effectiveness, it often necessitates extended healing periods and is linked to an increased risk of infection, especially in patients with inadequate glycemic control [4]. Vacuum-Assisted Closure (VAC) treatment, on the other hand, has become a cutting-edge method that speeds up wound healing by putting negative pressure on the wound site. This improves blood flow, lowers edema, and encourages the creation of granulation tissue [5,6].

Numerous studies have shown the potential advantages of VAC therapy in the treatment of diabetic foot ulcers and other chronic wounds.

Although cost and availability continue to be barriers to VAC therapy's broad use in clinical practice, a meta-analysis showed that it dramatically shortens healing times when compared to traditional techniques [7,8]. Using metrics such wound size reduction, duration to granulation, and complication incidence, this research compares the efficacy of VAC therapy versus traditional debridement in the treatment of diabetic plantar ulcers.

MATERIALS AND METHODS

Study Design: This prospective, randomized controlled study was conducted at a tertiary care hospital over a 12-month period.

Participants: The study included 60 adult patients with diabetes mellitus and clinically diagnosed plantar ulcers. Participants were randomly divided into two groups of 30 each. Inclusion criteria were patients aged 18–70 years with Wagner grade I or II diabetic plantar ulcers. Patients with active systemic infections, peripheral vascular disease, or a history of malignancy were excluded.

Intervention:

Group A (VAC Therapy Group): Patients in this group received Vacuum-Assisted Closure (VAC) therapy. A sterile foam dressing was applied to the wound, sealed with a transparent adhesive drape, and connected to a vacuum pump providing continuous negative pressure of 125 mmHg. Dressings were changed every 72 hours.

Group B (Conventional Debridement Group): Patients in this group underwent conventional sharp debridement of necrotic tissue. The wound was

dressed with saline-soaked gauze, changed twice daily.

Outcome Measures: The primary outcomes assessed were:

1. Wound size reduction: Measured as a percentage decrease in wound area using digital planimetry at baseline and 12 weeks.
2. Time to granulation: Defined as the duration (in weeks) required for 75% granulation tissue coverage of the wound bed.
3. Incidence of complications: Recorded as infection, wound dehiscence, or need for amputation during the study period.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Continuous variables, such as wound size reduction and time to granulation, were expressed as mean \pm standard deviation, and categorical variables, such as incidence of complications, were presented as percentages. Independent t-tests and chi-square tests were used to compare outcomes between the groups, with a significance level set at $p < 0.05$.

RESULTS

Wound Size Reduction: At the end of the 12-week follow-up period, Group A (VAC Therapy) demonstrated a significantly greater reduction in wound size compared to Group B (Conventional Debridement). The mean percentage reduction in wound size was $75\% \pm 12\%$ for Group A and $45\% \pm 15\%$ for Group B ($p < 0.05$). Details of wound size reduction at various intervals are presented in **Table 1**.

Table 1: Mean Wound Size Reduction Over 12 Weeks

Time (Weeks)	Group A (VAC Therapy)	Group B (Conventional Debridement)	p-value
Baseline	12.5 cm ² \pm 3.1	12.3 cm ² \pm 3.4	0.87
Week 4	8.1 cm ² \pm 2.5	9.7 cm ² \pm 2.9	0.04*
Week 8	4.2 cm ² \pm 1.8	7.1 cm ² \pm 2.3	0.01*
Week 12	3.1 cm ² \pm 1.5	6.7 cm ² \pm 2.1	0.001*

(*Significant difference, $p < 0.05$)

The mean time to achieve 75% granulation tissue coverage was significantly shorter in Group A compared to Group B. Group A patients achieved granulation in 4 weeks \pm 1.2 weeks, while Group B required 7 weeks \pm 1.5 weeks ($p < 0.01$).

Incidence of Complications: Fewer complications were observed in Group A, with only 10% of patients developing infections compared to 30% in Group B. The need for further surgical intervention was also lower in Group A (3.3%) compared to Group B (13.3%) (**Table 2**).

Table 2: Incidence of Complications

Complications	Group A (VAC Therapy)	Group B (Conventional Debridement)
Infection	3 (10%)	9 (30%)
Wound Dehiscence	1 (3.3%)	4 (13.3%)
Need for Amputation	0 (0%)	2 (6.7%)

Overall Outcome: Patients in the VAC therapy group had a significantly higher rate of complete wound healing by the end of 12 weeks (80%) compared to the conventional debridement group (60%) (**Table 1** and **Table 2**).

These results highlight the superior effectiveness of VAC therapy in promoting wound healing and reducing complications in diabetic plantar ulcers.

DISCUSSION

Diabetic plantar ulcers provide a major problem for wound care, necessitating the use of efficient treatment approaches to promote healing and reduce complications. By comparing the efficacy of traditional debridement with Vacuum-Assisted Closure (VAC) treatment, this research showed that VAC therapy produces better results in terms of complication rates, time to granulation, and wound size reduction. The results of this investigation are consistent with other studies showing that VAC treatment promotes the production of granulation tissue, decreases edema, and improves local perfusion, all of which speed up wound healing (1,2). The VAC treatment group's notable decrease in wound size supports research by Mouës et al. (3) and Argenta and Morykwas (4) that found VAC therapy to heal wounds more quickly than conventional techniques. The shorter time to granulation tissue development was a significant benefit of VAC treatment that was noted in this investigation. Compared to the 7 weeks needed for the standard debridement group, patients in the VAC treatment group often reached granulation in 4 weeks. Armstrong et al. (5) observed similar results, emphasizing the effectiveness of negative pressure treatment in encouraging early wound bed preparation for final closure. Another important result is the decreased rate of complications, especially infections, in the VAC treatment group. The results of Liu et al. (6), who showed that VAC treatment reduces bacterial colonization by maintaining a closed, regulated environment, are in line with this discovery. In addition, VAC treatment considerably reduces the incidence of wound infection when compared to standard care, according to Dumville et al. (7). VAC treatment has drawbacks in spite of its benefits. Accessibility and cost are still major obstacles, especially in environments with low resources. However, as shown by Blume et al. (8) and Apelqvist et al. (9), VAC treatment may be more cost-effective overall by lowering hospital stay length and the need for subsequent therapies, perhaps outweighing its initial cost. The study's findings add to the increasing amount of data demonstrating VAC therapy's superiority over traditional debridement. However, a number of variables, including patient compliance, underlying comorbidities, and the expertise of healthcare practitioners, may cause differences in results. These factors should be taken into account in future research to provide a more thorough picture of VAC

therapy's efficacy. The very small sample size is one of the study's limitations, which might have an impact on how broadly the results can be applied. To validate these findings and provide uniform recommendations for the use of VAC therapy in the treatment of diabetic plantar ulcers, larger multicenter studies are required.

CONCLUSION

In conclusion, this study demonstrates that VAC therapy significantly improves healing outcomes in diabetic plantar ulcers compared to conventional debridement. By accelerating wound closure, reducing complication rates, and shortening the time to granulation, VAC therapy offers a promising therapeutic option for managing this challenging condition.

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