

## Vacuum Assisted Closure Versus Conventional Wound Therapy in the Management of Diabetic Wounds

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### Abstract

**Background:** Diabetic foot ulcers are a major cause of hospitalization which increases hospital stay because of multiple surgical procedures. The objective of this study is to compare Vacuum Assisted Closure and the conventional therapy for diabetic wounds with respect to time and wound healing and to prove the efficacy of one method over the other by appropriate statistical methods at the end of data collection.

**Methods:** A retrospective randomized hospital based observational study of 40 patients was conducted at PSGIMSR, Coimbatore, Tamilnadu, India for a period of 24 months (January 2017–December 2018). All these 40 patients were studied and the data was statistically evaluated to determine the efficacy of vacuum assisted closure in healing of diabetic wounds and to compare it with the conventional method of treatment of diabetic wounds. The patients were divided into 2 groups, Group-A which consisted of 20 patients who received vacuum therapy (VAC), Group-B which consisted of 20 patients who received conventional dressings.

**Results:** The patients on VAC had early appearance of granulation tissue (90% vs 60% at the end of Day 3),

increased percentage of decrease in wound depth (53% vs 25% at the end of day 9) as compared to patients treated by conventional dressing. All patients developed granulation tissue by the end of Day 9.

**Conclusion:** We thus conclude that VAC appears to be superior in the treatment of diabetic foot ulcers in terms of early appearance of granulation tissue and decrease in wound depth when compared to conventional dressings.

**Keywords:** VAC; DFU; Wagners classification.

### Introduction

Acute and chronic wounds are a major cause of morbidity and reduced quality of life, they affect atleast 1% of the population and present as a risk factor for hospitalization, amputation, sepsis and even death.<sup>4</sup>

Foot ulcers are a major cause of hospitalization in patients with diabetes mellitus which increases hospital stay because of multiple surgical procedures, prolonged length of stay. Diabetics have 25% risk of developing foot ulcers which precedes amputation in about 85% of cases.<sup>3</sup>

A main stay of diabetic foot ulcer (DFU) therapy is debridement of all necrotic, callus and fibrous tissue with a primary goal to obtain wound closure. The management of DFU is determined by its severity (grade) vascularity of the limb and presence of infection.<sup>3</sup>

Wound healing is a complex and dynamic process that begins with removal of debris,

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control of infection, clearance of inflammation, angiogenesis, deposition of granulation tissue, contraction, remodeling of the connective tissue matrix and maturation.<sup>2</sup>

Saline moistened gauze has been the standard method, however, it has been difficult to continuously maintain a moist wound environment with these wound dressings. Subsequently various hydrocolloid wound gels, growth factors, hyperbaric oxygen therapy and other wound therapies have been advocated. All of these therapies are associated with increased cost and are being utilized without adequate scientific evidence favouring their efficacy.<sup>1</sup>

Vacuum assisted wound closure (VAC) is a wound management technique that exposes wound bed to negative pressure and provides a moist wound healing environment. VAC promotes wound healing by removing fluid from open wounds, preparing the wound bed for closure, reducing oedema and promoting formation and perfusion of granulation tissue.

This study is being done to compare the effectiveness of VAC with conventional dressings in the healing of DFU, in terms of healing rate: early appearance of granulation tissue and percentage decrease in wound depth.

## Materials and Methods

A hospital based retrospective randomized control trial was conducted in the Department of Surgery, PSGIMSR, Coimbatore.

The study period was 2 years in total and both methods were tested out over a period of one and a half weeks.

All the eligible subjects fulfilling the inclusion and exclusion criteria were included in the study (sample size: 40).

Group A: Patients treated with VAC.

Group B: Patients treated with conventional dressings.

### Inclusion criteria

- Above 18 years of age.
- Patients with diabetic foot ulcer more than 4 cm square.

### Exclusion criteria

- Patients age less than 18 or more than 70 years

- Pregnant and nursing mothers.
- Patients on medications such as corticosteroids, immunosuppressive agents.
- Patients with severe wound ischemia and severe neuropathy.
- Deep infections such as osteomyelitis and septic arthritis.
- Patients were divided into Group-A (treated with VAC) and Group-B treated with conventional dressings, with an equal number of patients in each group. For each patient, ulcers were treated till wound closure, either spontaneously or surgically.

Patients were assessed by the following methods:

- % decrease in the wound depth.
- Early appearance of granulation tissue.

## Treatment Schedule

### Group A

Patients treated with vacuum assisted closure. Dressings were regularly changed every 3 days. Wound tracing and photos were taken every 3 days. Ulcers were followed up until wound closure, either spontaneously or surgically.

In patients undergoing VAC therapy, foam was autoclaved and was cut according to the shape of the wound and ryles tube placed between the two layers of the foam. Adhesive plaster applied around the foam airtight. Ryles tube connected to the wall suction using tubings. Negative pressure set to 125 mmHg. Negative pressure applied for 72 hours continuously, patient was taught to detach the tubing when ambulating. Dressing opened after 72 hours.

### Group B

Patients treated with conventional dressings. Daily dressings were done. Wound tracing and photos were taken every 3 days. Ulcers were followed up until wound closure, either spontaneously or surgically.

In patients undergoing Conventional dressings, after wound wash, povidone soaked gauze pieces were used for initial 72 hours followed by dressings of normal saline soaked gauze pieces for twice daily.

Patients in both groups were insulin therapy according to blood levels and antibiotics started empirically initially and then according to culture sensitivity reports. Necessary debridement and wound toilet done before application of dressings.

Treatment outcome was assessed in terms of time taken for the appearance of granulation tissue and measurement of wound depth and area at subsequent follow up. Wound depth was measured using a sterile thread vertically in the deepest part of the wound crater to the skin surface level.

**Results**

*Statistics*

All the collected data was entered in Microsoft Excel Sheet. All the quantitative data was presented as Mean and Standard Deviation and compared using student’s T-test.

Qualitative data was presented as Frequency and percentage and analysed using chi-square test. *p*-value of less than 0.05 was considered as significant.

*Distribution of Patients based on age group*

Mean age of study subjects was 51.2 and 50.4 years in conventional and VAC group respectively (Fig 1).

*Distribution of Patients based on gender*

Male preponderance was observed in both the groups (80% in conventional and 85% in VAC group respectively) (Fig. 2).

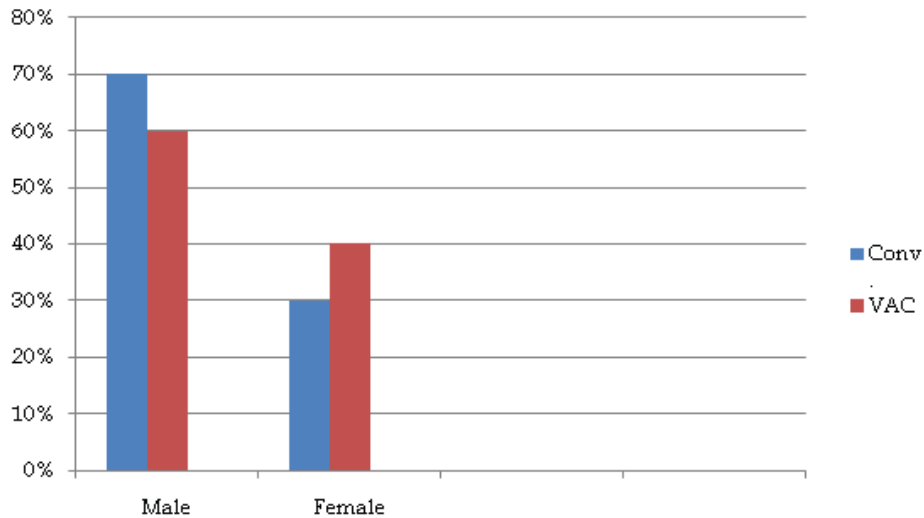


Fig. 1: Distribution graph of patients based on age.

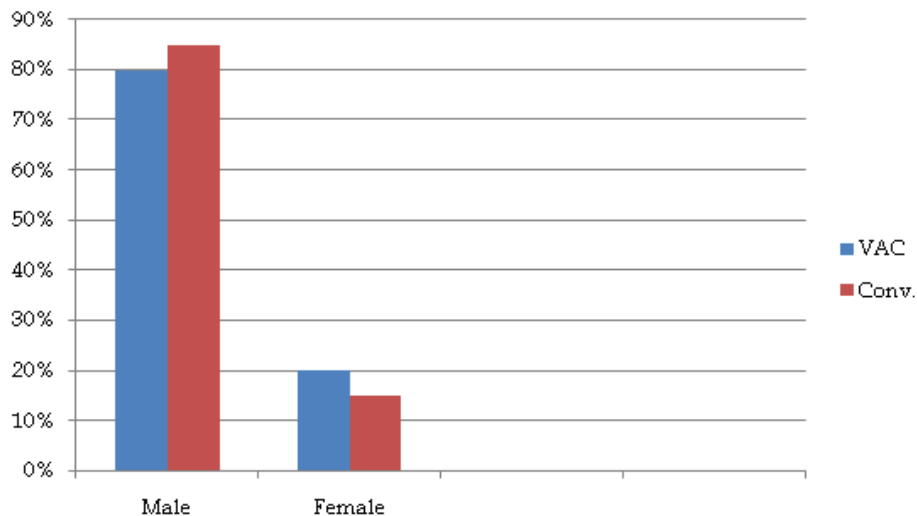


Fig. 2: Distribution graph of patients based on gender.

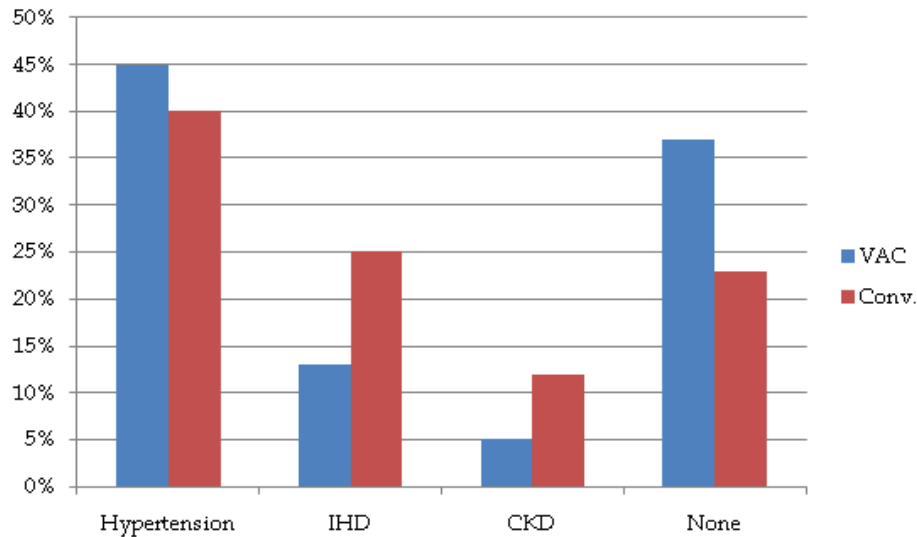


Fig. 3: Distribution of patients based on co-morbidities.

#### *Distribution of patients based on co-morbidities*

Hypertension was the most common co-morbidity observed in study subjects (40% and 45% in Conventional and VAC Groups respectively) followed by ischemic heart disease (25% vs. 13% in both the groups respectively) (Fig. 3).

#### *Distribution of patients based on wound depth*

The percentage decrease in the wound depth was more in the VAC group than conventional dressing at the end of Day 9 (53% vs 25% at the end of day 9) (Table 1).

Table 1: Distribution of patients based on wound depth.

Wound Depth	Group	N	Mean	SD	p-value
Before debridement	VAC	20	2.50	1.27	0.172
	Conv	20	2.00	0.97	
After debridement	VAC	20	4.30	1.17	0.023
	Conv	20	3.50	0.94	
Day 3	VAC	20	3.10	1.02	0.285
	Conv	20	2.75	1.01	
Day 6	VAC	20	2.38	0.86	0.812
	Conv	20	2.31	0.97	
Day 9	VAC	20	1.17	0.60	0.006
	Conv	20	1.90	0.92	

#### *Distribution of patients based on granulation tissue*

The patients on VAC therapy had early appearance

of granulation tissue as compared to patients treated by conventional dressing (90% vs. 60% at the end of Day 3). All patients developed granulation tissue by the end of Day 9 (Table 2).

Table 2: Distribution of patients based on granulation tissue

Granulation tissue	Group		Total
	Conv	VAC	
Day 3	12 60%	18 90%	30 75%
Day 6	19 95%	18 90%	37 92.5%
Day 9	20 100%	20 100%	40 100%

#### **Discussion**

Vacuum assisted closure has been recommended as a novel method in the healing of diabetic foot ulcers by stimulating the chronic wound environment in such a way that it reduces the bacterial burden and chronic interstitial wound fluid, increases vascularity and cytokine expression.

Application of negative pressure over the wound bed allows arterioles to dilate, increasing the effectiveness of local circulation, promoting angiogenesis which assists in the proliferation of the granulation tissue.

We observed that the patients on VAC therapy had an early appearance of granulation tissue as compared to patients treated by conventional

dressing (90% vs 60% at the end of Day 3). All patients developed granulation tissue by the end of Day 9.

The percentage decrease in wound depth was more in VAC group than conventional dressing at the end of Day 9 (53% vs 25% at the end of day 9).

In a study by Lone *et al.*, granulation tissue appeared in 26 (92.85%) patients by the end of week 2 in VAC group in contrast to 15 (53.57%) patients by that time in conventional group.

In a study by Eginton *et al.*, rate of wound healing with VAC was compared with conventional moist dressings in the treatment of large diabetic foot wounds. VAC dressings decreased the wound volume and depth significantly more than moist gauze dressings (59% vs. 0% and 49% vs. 8% respectively).

Priyatham K *et al.*, in a prospective study, assessed the efficacy of Vacuum assisted closure with conventional moist wound dressing in improving the healing process in chronic diabetic wounds. Shorter duration of hospital stay and better graft uptake was observed in the Vacuum dressing group.

### Outcome

The primary end point in this study was a granulated wound or a wound ready for skin grafting or healing by secondary intention. Primary closure of the wound or split thickness skin grafting was done in patients of conventional and VAC group respectively.

Lone *et al.* observed that in 86.4% of patients, wounds were closed by a split thickness skin graft in VAC group as compared to 90.9% of patients in conventional.

### Conclusion

Rate of granulation tissue formation, overall graft survival and patient compliance was better in VAC group as compared to conventional dressing group. It was also seen that the overall hospital stay and post operative complications were less in VAC group.

A retrospective randomized control trial was conducted for a period of 2 years in the Department of Surgery, PSGIMSR with the aim of studying the efficacy of VAC in healing of diabetic foot ulcers and to compare it with the conventional wound dressing.

A total of 40 patients with Grade 2 to 3 diabetic foot ulcers (Wagners classification) were randomly divided into 2 Groups. Group-A: Vacuum assisted closure and Group-B : Conventional dressing.

Following observations were made during the study:

- Hypertension was the most common co-morbidity observed in study subjects (40% and 45% in Conventional and VAC Groups respectively) affecting the wound healing time.
- The percentage decrease in wound depth was more in VAC group than conventional dressing at the end of day 9. ( 53% vs 25% at the end of day 9).
- The patients on VAC therapy had early appearance of granulation tissue as compared to patients on conventional dressing (90% vs 60% at the end of day 3). All patients developed granulation tissue at the end of day 9.

We thus conclude that VAC appears to be superior compared to conventional dressings in the treatment of diabetic foot ulcers in terms of early appearance of granulation tissue and decrease in wound depth.

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**Conflict of interest:** None

**Ethical Approval:** The study was approved by the Institutional Ethics Committee.

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