

# The Efficacy of Wall-Typed Suction and Polyurethane Foam in Vacuum Assisted Wound Dressing System

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**Abstract :** Vacuum assisted wound dressing was introduced as one of the methods for wound management in problematic wounds. This system which was expensive included a controllable vacuum suction unit and polyurethane foam. In this study we evaluated the efficacy of the controllable wall-typed suction that was available in patient ward used with various types of polyurethane foam in the market. One type of the polyurethane foam that had a suitable pore size and good porosity was selected and used in 4 patients with sacral pressure ulcers and 1 patient with both sacral and trochanteric pressure ulcers. These patients were not candidates for surgery and their ulcers were not improved by conventional dressing. The vacuum dressing system was applied to the ulcers for 2 months. The sizes of the ulcers were reduced significantly ( $p = 0.042$ ) without complication. In conclusion, the controllable wall-typed suction and polyurethane foam could be used effectively for wound dressing in problematic wound and ulcer.

**เรื่องย่อ :** ประสิทธิภาพของเครื่องดูดของเหลวชนิดติดผนัง (wall-typed suction) และแผ่นฟองน้ำโพลียูรีเทน (polyurethane foam) ในระบบการทำแผลแบบสุญญากาศ (vacuum assisted wound dressing system)

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ได้มีผู้นำเครื่องดูดสุญญากาศ (vacuum suction) ร่วมกับฟองน้ำโพลียูรีเทนมาใช้เป็นวิธีหนึ่งในการทำแผลเรื้อรังขนาดใหญ่หรือบาดแผลที่มีกระดูก หรืออุปกรณ์ยึดติดฝังอยู่และได้ผลดี แต่เครื่องมือชุดนี้มีราคาค่อนข้างแพง รายงานนี้ได้ศึกษาการดัดแปลงการใช้เครื่องดูดสุญญากาศติดข้างฝาที่สามารถปรับความดันได้และฟองน้ำโพลียูรีเทนที่มีขนาดรูพรุนที่เหมาะสม มาใช้ทำแผลเรื้อรังที่เกิดจากการกดทับ โดยได้ศึกษาในผู้ป่วย 4 รายที่มีแผลกดทับที่บริเวณกระดูกใต้กระเบนเหน็บ (sacrum) และอีก 1 รายที่มีแผลกดทับทั้งบริเวณกระดูกใต้กระเบนเหน็บและบริเวณปุ่มได้คอกกระดูกต้นขา (trochanter) ผู้ป่วยทั้ง 5 รายมีโรคร่วมที่ไม่สามารถจะผ่าตัดได้ หลังจากรักษาบาดแผลโดยวิธีดูดสุญญากาศ 2 เดือน บาดแผลทุกแผลมีขนาดเล็กลงอย่างมีนัยสำคัญทางสถิติ ( $P = 0.042$ ) โดยไม่มีผลแทรกซ้อน จากการศึกษาชี้ให้เห็นว่าเครื่องดูดสุญญากาศติดข้างผนังร่วมกับฟองน้ำโพลียูรีเทนสามารถใช้ในการดูแลแผลเรื้อรังได้

## INTRODUCTION

The management of problematic wounds and ulcers is still one of the difficult tasks for the medical personnels who take care of these patients. In many situations that immediate closure by surgical technique can not be performed such as too debilitated patients, complicated technique or other serious conditions, the wound requires dressing. This requires prolonged hospitalization and nursing care and patients are prone to get wound infection and wound desiccation. Argenta et al<sup>1</sup> introduced vacuum-assisted closure for problematic wound. He invented the system that applied sub-atmospheric pressure to the wound bed. The negative pressure was shown to increase perfusion, promote granulation tissue formation and remove tissue fluid.<sup>2,3</sup> Although this technique has been shown to be effective for both acute and chronic wounds, the system is quite expensive. We are trying to find out whether we can use the materials available in our hospital instead of commercial negative pressure wound closure system.

The aim of this study was to prospectively evaluate the efficacy of the controllable pressure wall-typed suction and polyurethane foam in healing pressure ulcers in debilitated patients.

## MATERIALS AND METHODS

Five patients with pressure ulcers were treated with the vacuum wound dressing technique

(VDT) for 2 months period. All of them were not surgical candidates and were previously treated with conventional dressing for at least two months without any clinical improvement.

### VDT system

Wall-typed suction machine in the patient ward was used to create negative pressure to the wound. The pressure was set at 125 mmHg (Figure 1).

### Selection of the type of polyurethane foams

Many kinds of polyurethane foams were examined by scanning electron microscope for their pore sizes and consistency of the interconnection between the pores. The one that had pore sizes between 500 - 800 micrometers (Figure 2) was selected. The foam was sterilized by gas sterilization before it was applied to the ulcer. Nasogastric tube was used to convey the negative pressure to the wound. Polyurethane dressing was used to cover the wound as the outer dressing.

### The application of VDT system

The initial boundaries of the pressure ulcers were recorded with transparent grid. The conditions of the pressure ulcers were also noted. After the ulcers were debrided and cleaned, the polyurethane foam was cut and contoured to fit the ulcer bed. The nasogastric tube was inserted into the polyurethane foam and passed on the ulcer edge. The self-adhesive polyurethane skin dressing was placed over the foam



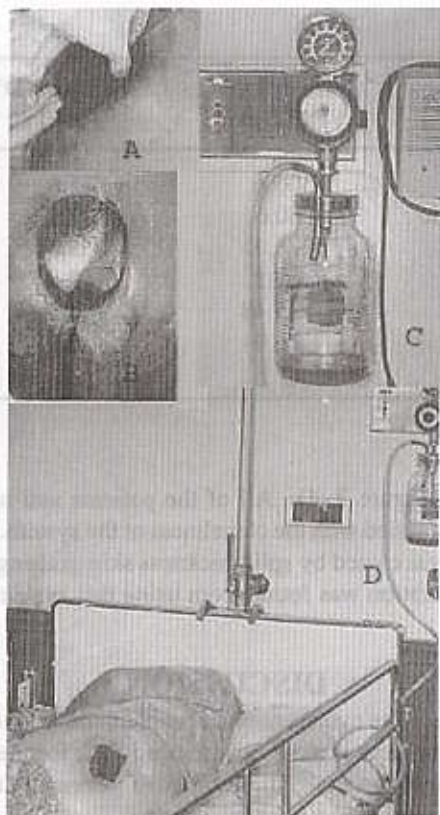


Figure 1. Vacuum wound dressing (VDT) system.

- A. applying polyurethane foam on ulcer bed
- B. applying polyurethane film on top
- C. controllable wall-typed suction
- D. a patient with the VDT system

and extended from the ulcer edge to allow adequate sealant of the ulcer. The other end of the tube was connected to the bottle of the wall-typed suction machine. The pressure was set at 125 mmHg and applied to the dressing continuously. The ulcers were inspected daily for leakage of the system. The dressings were changed every 3 days. In the case with more than one ulcer the evacuation tube from each ulcer was connected to the wall-typed suction

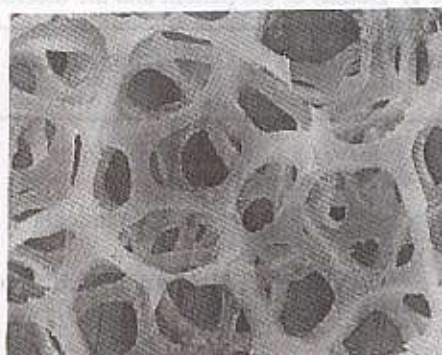


Figure 2. Demonstrating inter-connection of the pores of the polyurethane foam.  
(scanning electron microscope, X35)

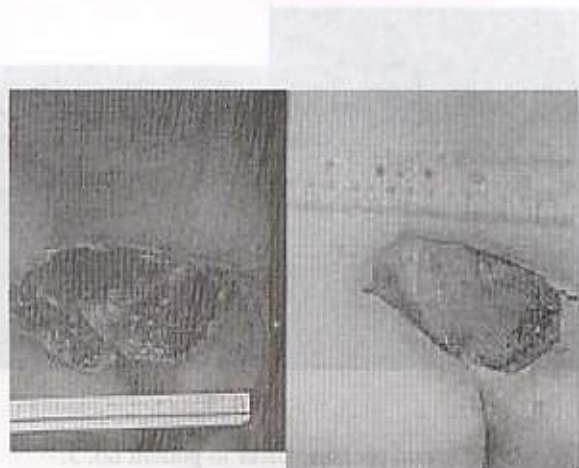


Figure 3. Sacral pressure ulcer in patient no. 1.  
A. before applying VDT system,  
B. fifty days after treatment.

by a y-tube connector.

During the VDT treatment, the patients were able to mobilize from beds to perform their daily activities by disconnecting the tube from the wall suction and reconnecting it when they returned to their beds.

The character of the granulation tissue, the amount of wound fluid and the size of the ulcer were recorded when the dressing was changed.

Table 1. Details of the patient and the ulcers.

Pt. no.	Age /sex	Underlying disease	Site of ulcer	Size before VDT (cm <sup>2</sup> )	Size after VDT (cm <sup>2</sup> )
1	80 yr./F	Brain infarction	Sacral	300.6	71.9
			Trochanteric	80.6	21.2
2	45 yr./F	SLE & paraplegia	Sacral	276.1	165.3
3	51 yr./M	Paraplegia	Sacral	162.8	42.8
4	60 yr./F	Rupture of aneurysm	Sacral	25.48	7.5
5	68 yr./M	COPD, CVA	Sacral	16.9	5.0

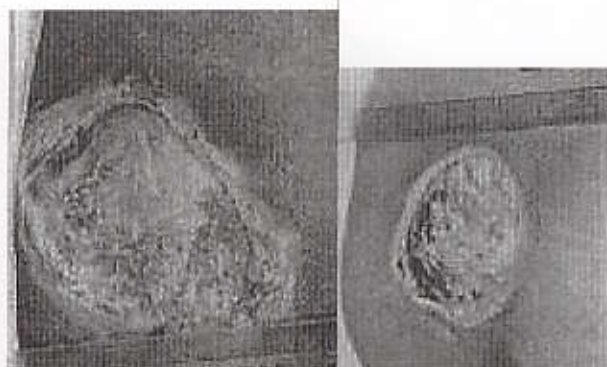


Figure 4. Sacral pressure ulcer in patient no. 3.

A. before treatment,

B. fifty days after treatment.

## RESULTS

All 5 patients were treated by VDT for 2 months period. The sizes of the ulcers recorded by transparent grid, before and 2 months after treatment were shown in table 1. All of the ulcers after treatment showed significant reduction in size ( $p=0.042$ ) when compared with the size before treatment. The amount of wound fluid was between 24 to 50 ml each day. Neither tissue desiccation nor further necrosis were present. The sacral bones which were exposed in 2 patients were completely covered by granulation

tissue (Figure 3, 4). All of the patients and nurses were satisfied with the cleanliness of the system. One ulcer was closed by split thickness skin grafting. No complication was found from using this system.

## DISCUSSION

The management of problematic wound like pressure ulcer is a time consuming task for medical personnel especially in debilitated patients. It also causes prolonged hospitalization.

Argenta et al<sup>1</sup> introduced the vacuum-assisted closure technique for promoting healing process by secondary intention. They postulated that interrelated factors were the basis for the success of this technique including (1) the removal of excess interstitial fluid, (2) the increase in vascularity and associated decrease of bacterial colonization, and (3) response of the tissues around the wound to mechanical forces. They successfully applied this technique initially to chronic pressure ulcer and then to acute and sub-acute wounds. Mullner et al<sup>4</sup> used this technique for the wounds that exposed the implants or were infected and they also achieved good results. We decided to develop vacuum dressing system by using the materials that were not expensive and commercially available. According to the study by Morykwas et al,<sup>2</sup> the suitable polyurethane foam should have pore size between 500-800 micrometers and good porosity, so we selected one from the market by using scanning electron microscopic study. All the patients in this study were not candidates for



surgery. Their ulcers were improved very rapidly after the application of the VDT. Two patients were able to leave the hospital earlier and the wound could be cared by their relatives. This VDT could reduce the cost of the wound care and the time of the medical personnel. Moreover, the VDT could reduce the ladder step of the reconstruction because the exposed bone or the implant would be covered rapidly by

granulation tissue.

## CONCLUSION

VDT is effective for the management of problematic wound and ulcer. The cost of the treatment can be reduced by applying commercially available products for the system.

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