

# Alleviating the Need for Free Flap Transfer through the Exemplary Use of Vacuum-Assisted Closure

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## Abstract

**Background:** Vacuum-Assisted Closure (VAC) is a technique applied to various difficult cases for the treatment of acute and chronic injuries. Based on this technique, open-cell foam is applied to a suitable wound by adding a cover of adhesive dressing and then applying sub-atmospheric pressure to that wound orderly.

**Aim:** The main goal of this work is to alleviate the need for free flap transfer through the exemplary use of vacuum-assisted closure.

**Patients and Methods:** This study was carried out at Azadi teaching hospital during the period from March 2014 to August 2018. The sample consisted of 35 patients where their ages ranged between (10-58) years. The VAC technique was applied to the chronic and acute wounds to which skin graft is not applicable.

**Result:** A total of 35 wound sites were managed with the VAC technique. The wounds were converted from an unacceptable wound to one that can hold skin graft orderly within (10-15) days.

**Conclusion:** The VAC opposes the wound surface, accelerates granulation tissue in a way that can accept split skin graft.

**Keywords:** Acute wound; Chronic wound; VAC

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## Introduction

The VAC is a comparatively innovative technique applied to various difficult cases for the treatment of acute and chronic injuries [1]. This technique involves applying an open cell foam to a suitable wound by adding a cover of adhesive dressing and then applying sub-atmospheric pressure to that wound orderly [2]. Previous studies have reported encouraging outcomes regarding healing rates [2]. In 1997, the VAC technique was first investigated by Morykwas MJ, et al. (1997) [2] WHO suggested that the healing of wounds might be improved through applying this technique. Early works argued that the negative pressure technique increases blood flow, as demonstrated by hyperemia [3].

Delayed healing of a wound, especially in complex injuries and in aged people with comorbidities, is a key concern. It causes morbidity and lengthy treatment. Also, it may require major reconstructive surgery. This, in turn, could impose a considerable social, technical, and financial burden [4,5]. VAC is an alternative method to the management of wounds by employing negative pressure for preparing the wound for spontaneous recovery or by minor reconstructive decisions [6].

## Patients and Methods

This study was conducted at Azadi teaching hospital during the period from March 2014 to August 2018. The inclusion criteria included burnt or traumatized areas that have a poor tendency for spontaneous healing or holding skin graft within a couple of weeks. After deciding to apply VAC to a wound, extensive wound excision, decortication of the bare bones, stripping of the bare tendons done, as necessary, Vaseline gauze was located at the wound. A low-density foam of polyurethane, who's thick was 1.5 inch, was cut to fit the wound shape and then put on Vaseline gauze. A transparent plastic tube with an inner diameter of (5 mm) and length of (1 m) was used. The sides near one end of this tube were perforated. The same tube was inserted into the foam by creating a surface incision in the foam. A wider sterilized transparent adhesive film was used to cover the hollow structure. The edges of this film were sealed to the normal skin. Therefore, the isolation of dressing from the environment was done only through the lumen of the plastic tube. Then, this tube was attached to a continuous mode vacuum suction of 95-120 mm Hg when moving the patient from the operations room. Effective creation of negative pressure was demonstrated by observing the foam collapse and lack of gushing sound of air leakage into the system. Splitting of the affected



site may be needed. The resident nursing staff continuously observed dressings. The suction was confirmed by observing the foam collapse and lack of gushing sound. Percentage of granulation tissue, which was assessed through employing gross examination by consensus of the treating plastic surgery unit on day 15, was reported.

## Results

Before the application of VAC, extensive wound excision was applied to a total of 35 patients with acute and chronic wounds (28 acute, 7 chronic). Twenty-three of the patients were male, and 15 were female. The wounds were covered with negative pressure dressing (NPD). Patients' mean age was 30 years (range: 10-58 years). Characteristics of the wounds before the VAC application are mentioned in (Table 1).

All patients including children of 10 years old well tolerated the assembly of vacuum closure. Patients felt more comfortable than having the routine rest on bed and immobilization. Hence, 7 dressings suffered an air leak. So, they were sealed for a second time by fastening the adhesive film edge using extra adhesive film. In the case of patient discomfort or the presence of blood in the foam/ tube, the suction was turned off. The principal investigator confirmed this measure to the resident nurse and patient's observer in each case. Granulation tissue was assessed 15 days postoperatively. The result indicated that about 90-100% of the wound surface could accept graft in an orderly way. The photos of some cases illustrate the healthy appearance of the wound surface. Contraindications for the usage of VAC, which were excluded from this study, are clarified in (Table 2).

**Table 1:** Wound characteristics.

Site	Size	Structures exposed	
Upper limb	8	Mean size of wound in square cm <sup>2</sup>	Dec-70
Lower limb	23		
Trunk	4		
		bone	13
		Tendons	10
		joint	3
		fascia	15

**Note:** The total no. is higher than the total no. of wounds because many structures may be involved in the same wound.

**Table 2:** The VAC, KCI Medical Ltd, Witney, Oxford shire, England, contraindications for VAC.

Relative contraindications	Absolute contraindications
Difficult hemostasis	Fistula to organs or body cavity
Anticoagulation	Osteomyelitis
	Necrotic tissue
	Cancerous tissue

## Discussion

NPD for injuries has been described and simplified by Morykwas MJ, et al. (1997) [2] at mid-nineties of the last century. Numerous experiments on animals have demonstrated the effectiveness and positive effects of sub-atmospheric pressure. The results revealed that it increases the local flow of blood and the rate of formation of granulation tissue. It also clears discharges occurring on the surface of the wound and removes dead space [2]. Moreover, it decreases bacterial load and edema, improves epithelialization as well as producing mechanical stress within the tissue which leads to the molecular synthesis of protein and matrix. Additionally, it proves the close contact between the foam dressing and the wound surface [2]. It also reduces collections on the wound surface and desiccation of the wound in whole or in part [3,6-11].

The application of this technique has many contraindications (Table 2), the most important of which is the failure to achieve an airtight seal

at certain anatomical positions. In maxillofacial practice, this is usually a problem around the perioral region; however, it has been successfully applied to both the face and the neck [12]. The NPD prevents shearing of the dressing on the wound and aids in immobilizing the part with minimum pain at the affected site [8]. These effects, in combination with one or more effects mentioned earlier for the wound, will aid in maximizing the quantity of granulation tissue and improve the quality of the granulating surface.

When applied to the trunk, the patient can change postures to prevent pressure sores without disturbing the ambulation. When Mini VAC machine is used for lower limb wounds in ischemic limb wound, the dressing ensures perfect adhesion of the foam to the uneven wound area that is not affected by the ambulation and limb movement. Thus, the patient is not confined to bed and hence the nursing assistance is greatly reduced [13]. The study was done by Hynes PJ, et al. (2002) concluded that this technique is proved to be the most effective and appropriate method for treating the axillary defect following excision of hidradenitis suppurativa [14]. Numerous studies have verified the improved quantity and quality of the granulation tissue with the NPD [8-11,15,16].

This study concentrated on the probability of converting the wound from one that needs free microvascular flap transfer to a wound that can heal with secondary intention (Figures 1 and Figure 2) or hold a simple skin graft (Figure 3). The results demonstrated an excellent preparation of the wound (Figures 4 and Figure 5) as a wound with bare-bones, tendons and joints surfaces. The microsurgery is technically demanding and requires an experienced team that is not available in most centers. In addition to the morbidity of the donor and bulkiness of the flaps, on most occasions (Figure 6), that requires extra



**Figure 1:** Medial Foot Wound. A) Prior to the application of VAC, B) 15 days after VAC application, C) The wound healed with secondary intention after 10 weeks.



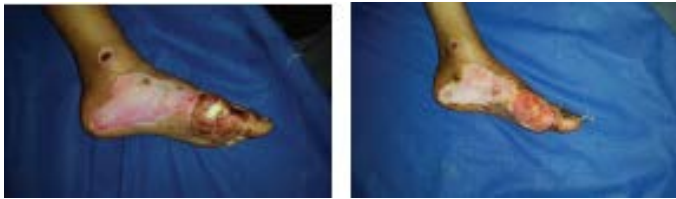
**Figure 2:** Post Traumatic Big Toe Amputation and Severe Soft Tissue Loss. A) Exposed metatarsal bone and undermined wound, B) 15 days after VAC application, C) healing with secondary intention 8 weeks later.



**Figure 3:** Fourth-degree burn with exposure of metatarsal bones. A) Initial Presentation, B) 5 days after skin grafting, C) 5 months after Skin Grafting.



**Figure 4:** A case of necrotizing fasciitis of the hand. A) Prior for wound excision, B) 15 days after the VAC application.



**Figure 5:** Post-traumatic exposed metatarso-phalangeal joint. A) Before VAC application, B) 15 days after the VAC application.



**Figure 6:** Bulky free flap on the anterior ankle and dorsum of the foot.

operative stages for flap debulking after a time. As for the recipient, those wounds are simply closed with skin graft application [17] or even healed with the secondary intention [1]. Lee LQ, et al. (2009) claimed that when used before skin graft and then in combination with a skin graft, VAC may offer a simplified approach for the management of unique and complicated defects on the lower limbs instead of using free flaps. Thus, this technique should be integrated into the reconstructive surgeons' armamentaria [18].

## Conclusion

VAC should be considered in all wounds to which free flap transfer is applicable in order to decrease the need for micro surgical procedures, replacing it with a simple skin graft.

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