

## The Effects of Variable, Intermittent and Property Therapy for the Treatment of Negative Pressure Wounds

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### Abstract

Over the last decade, there has been widespread interest in the treatment of acute and chronic negative pressure wounds (VAC therapy, NPWT). The principle of the method is based on the use of a closed drainage system that maintains a controlled negative pressure in the wound area. This technique uses a suction pump, drains and bandages to remove the radiating exudate that accumulates in the wound and stimulates healing in acute or chronic wounds and wounds resulting from second and third degree burns. Therapy involves the controlled application of subatmospheric pressure to the local wound environment, using a sealed wound dressing applied with a vacuum pump. The use of this technique in wound healing increased dramatically in the 1990s and 2000s and published a large number of studies investigating NPWT. In this therapy, favorable conditions are created for the wound process in the area of injury, contributing to the rapid cleaning of the wound bed, the maturation of "healthy" granulations, followed by their closure with local tissues, skin grafts and synthetic materials. Negative pressure wound therapy (NPWT) is usually used continuously. Intermittent pressure therapy (IPT) leads to faster wound healing, but often causes pain. When negative pressure is turned on and off repeatedly (for example, alternating between 0 and -80 mm Hg), this is called intermittent pressure therapy (IPT).

**Keywords:** *Negative Pressure Wound Therapy (NPWT); Intermittent Pressure Therapy (IPT); Skin Grafts*

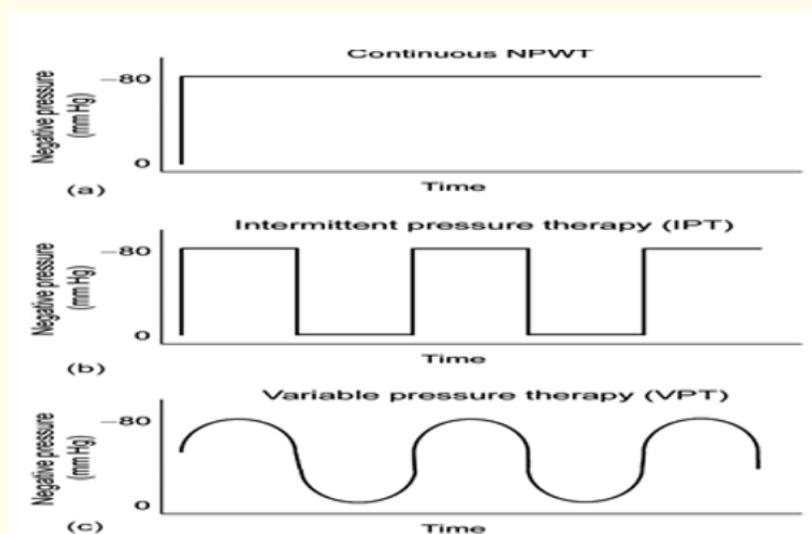
### Introduction

This therapy is not often used clinically, as sudden changes in pressure cause the foam to expand and contract repeatedly on the granulation tissue, causing pain. Therefore, variable pressure therapy (VPT) is introduced to ensure a smooth transition between two different levels of negative pressure (e.g. -10 and -80 mm Hg), thus maintaining a medium degree of negative pressure during the whole therapy. Figure 1 illustrates the different modes of application of negative pressure. The amount of granulation tissue in the wound bed has been shown to increase dramatically during IPT. This can be the result of both mechanical stimulation of the wound bed (massaging effect) and increased blood flow to the edges of the wound. The effects of VPT on granulation tissue formation have not yet been studied in a detailed and controlled study.

### Materials and Methods

For an eight-year period, from 2012 to 2021, VAC therapy with intermittent negative pressure was used in five patients with tissue-free wounds. These wounds are the result mainly of surgical treatment of bulky formations in which the formation has been excised and the

wound defect is too large to repair itself with its own tissues. In this case, the treatment is longer, depending mainly on the size of the defect. Given this, the development of a secondary wound infection is an expected complication. Surgical treatment is in practice the treatment of the tumor formation and its extirpation. After thorough hemostasis, a silver bandage was applied and a subsequent vacuum bandage with a polyurethane sponge and a centrally located tubular drain, in the presence of a cavity, a gauze bandage and a centrally located tubular drain were applied. A negative pressure of -125 mmHg and an intermittent aspiration mode were used. The duration of VAC therapy was 21 days in three patients and 14 days in two patients. During this period, the dressing was changed every seven days. Microbiological culture examination of wound secretion was performed at discretion, with the development of signs of wound inflammation. Antibiotic treatment is prescribed from the moment of surgery with broad-spectrum antibiotics covering gram-positive and gram-negative flora. Antibiotic therapy was updated according to the antibiogram in isolation of the causative agent from the examination of wound secretions. The duration of antibiotic treatment is between seven and ten days. Treatment is then continued with potassium permanganate baths, wound treatment with iodopovidone, saline and Intrasite gel coated with a gauze bandage.



**Figure 1:** Schematic illustration of the different modes of application of negative pressure. (a) continuous pressure therapy -80 mm Hg., (b) intermittent pressure therapy (IPT), (c) variable pressure therapy (VPT).

## Results

Five patients of the afflicted sex were treated with this type of wound. All are admitted for hospital treatment. The hospital stay is on average 20 days. All patients were prescribed antibiotic treatment during vacuum therapy. An antibiotic is given for an average of 10 days. There was no bone involvement in all patients. Surgical treatment was performed - extirpation of the formation and debridement of the wound, after which a vacuum bandage made of polyurethane sponge and a centrally located tubular drain was applied. A negative pressure of -125 mmHg is set. In two patients, the therapy lasted 21 days and during this period the dressing was changed three times, at intervals of seven days. In three patients, the therapy lasted 14 days and the vacuum dressing was changed at intervals of seven days, i.e. twice during the period. Control cultures remained sterile. No analgesic therapy was administered. The observation shows rapid development of fresh granulation tissue, without evidence of infection in the area of the operative wound. No development of fibrin plaque was observed on the wound bed. Also impressive is the deformation of the wound and the approach of its edges, which is a prerequisite for rapid filling of the defect and subsequent epithelialization.



**Photo 1:** Before starting VAC therapy.



**Photo 2:** 2 - 7 days after VAC therapy.



**Photo 3:** 3 - 14 days after VAC therapy.



**Photo 4:** Before starting VAC therapy.



**Photo 5:** After seven days of VAC therapy.

### Discussion

Previous studies have shown that intermittent pressure therapy leads to rapid granulation tissue formation and accelerated wound defect healing. However, treatment is hampered by the presence of a pain syndrome in some patients as a result of sudden changes occurring in the transition from subatmospheric to atmospheric pressure created and maintained under the wound defect dressing. Variable pressure therapy is an interesting alternative that provides smooth transitions between two different levels of negative pressure and thus relieves the patient's pain, while maintaining the accelerated development of granulation tissue and overall wound healing. In IPT mode, the negative pressure is turned on and off repeatedly, while in VPT mode, the pressure changes cyclically between 2 different levels of negative pressure, thus maintaining the negative pressure environment throughout therapy. These facts are the result of a controlled, detailed study of the effects of IPT and VPT on wound shrinkage and morphology. The described conclusions by the authors Malin Malmsjö, MD, PhD, and Lotta Gustafsson, MSc, PhD, and Sandra Lindstedt, as a result of their research and observation of patients are fully covered by our conclusions, as a result of our treatment of the described above patients [1-6].

### Conclusion

The choice of dressing used in VAC wound therapy has a significant impact on the healing process. The results presented here show a greater reaction to the development of granulation tissue in the wound bed under polyurethane foam than under gauze. This is in line with previous studies that show that the use of polyurethane foam as a dressing creates a thick, hypertrophic layer of granulation tissue, while gauze results in a thinner but denser layer of granulation tissue. It is assumed that the dressing should be chosen according to the type of wound for optimal therapy effect. Thick granulation tissue is suitable for rapid wound healing, but can lead to problems such as fibrosis, scarring and contractures with the wound healing. The gauze bandage is often used for NPWT due to its flexibility and easy application. It has become especially popular among plastic surgeons for preparing the wound surface for free skin grafting.

Negative pressure wound therapy (NPWT) is usually used continuously. The intermittent regimen of this therapy (IPT) leads to faster wound healing, but often causes pain. The use of variable pressure therapy (VPT) creates all the advantages of the method with intermittent pressure therapy, but there is no pain syndrome. The choice of dressing used in VAC wound therapy has a significant impact on the healing process. We believe that VAC therapy for wound healing is most successful when a suitable dressing is selected depending on the type of wound and combined with variable pressure therapy (VPT).

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