

# Advantages and limitations of topical negative pressure therapy



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Negative pressure wound therapy (NPWT) is a new method used for improving wound healing. It influences granulation formation, bacterial colonization, and increasing wound blood flow. Although this method has been used extensively for wound healing, its influences are not cleared enough. So the main aim of this review article is to weight up the benefits and problems associated with this method.

Method: An electronic search was done via Pubmed, Embase and ISI web of knowledge data from 1960 to 2010. The abstracts and titles of each paper were analysed and selected according to especial parameters.

Result: The results of the relevant literature were characterized based on the benefits and problems associated with use of this method.

Discussion: Direct comparison of NPWT with other available method is difficult. Although there are some research to support the effectiveness of using this new method on wound healing, more controlled clinical trials are needed to defiantly prove that the NPWT is less expensive and more effective wound care modality.

A wound is defined as a break in the skin which is usually caused by cuts or scraps. The selection of the treatment methods depends upon the severity of the wounds (how serious they are). Healing is a response of the injury that sets into motion a sequence of events. There are classically four stages associated with wound healing which include: haemostasis, inflammation, proliferation and remodelling (Hart, 2002, Stephens and Thomas, 2002, O'Kane, 2002). Many factors can interact with one or more phases of wound healing process which can facilitate or decrease its rate, such as local and <https://assignbuster.com/advantages-and-limitations-of-topical-negative-pressure-therapy/>

systematic factors. Local factors are those which directly influence characteristics of wound itself, while systematic factors consists of those which related to state of individuals and their abilities regarding wound healing. Some systematic factors include infection, age and sex hormones, stress, diabetic, obesity, medication, alcoholism, smoking and nutrition and using some treatment method such as Topical wound healing (Guo and DiPietro, 2010, Ranzato, 2009, Urschel et al, 1988, Argenta and Morykwas, 1997, Kirby, 2007).

The effects of some factors such as oxygenation, infection, age, stress, medication, obesity, nutrition are well described in the literature and were investigated by many researchers(Guo and DiPietro, 2010, Shepherd et al, 2006, Lioupis, 2005). However, using some parameters such as topical negative pressure therapy (TNPT) is new method for wound healing (Miryam et al, 1999, Kirby, 2007). Pressure is one important parameter which can influence wound healing. In one side, it can decrease the speed of healing as produce skin ulcers in some patients suffering from stroke and spinal cord injury and those who need to be in bed for a long time. In other side, it can be used to facilitate the wound healing process, especially in chronic wound (Miryam et al, 1999, Argenta and Morykwas, 1997, Evans and Land, 2001). In contrast to other available methods, this procedure is a little bit new so the main aim of this review article was to review the relevant literature regarding TNPT and its influences on wound healing. Moreover, it was aimed to show the positive and the side effects of using this method.

**Method:**

An electronic search was done via the Pubmed, Embase and ISI web of knowledge data from 1960 to 2010. The abstracts and titles of each individual study were assessed by author. A first selection of relevant literature article was done based on whether the title and abstract addressed the research question of interest. Figure 1 shows the stages which were selected in this review process. The second selection of the articles was done according to the following criteria:

experiment practice published in English

addressing using this method on wound healing

Figure 1: The stages which were selected in this research study

The results of the various research studies were characterized based on mechanism of action, the instrument used and the benefits and problems associated with the use of this method.

**Result:**

Negative pressure wound therapy (NPWT) is also known as Tropic Negative Pressure (TNP) used as a non pharmacological treatment for chronic and acute wounds, such as pressure ulcers, diabetic wounds, abdominal and trauma wounds (Argenta and Morykwas, 1997, Evans and Land, 2001, Kirby, 2007, Miryam et al, 1999).

## **What is NPWT?**

This method of treatment based on this idea to turn the open wound into a close one. Moreover, it is possible to remove the excess fluid from the wound. Although, this method has been used exclusively in UK since 1995, the idea behind this method is not new. For nearly more than 50 years suction drainage has been used. It has been reported that continues suction, negative pressure drainage serve as an excellent atmospheric bandage in subcutaneous surgical procedure and help to increase the speed of wound healing. The concept was based on mechanics of physics. The application of controlled subatmospheric pressure causes mechanical stress to the tissues. The new vessels are constructed within the tissue and the wound is drawn closed. It should be noted that the degree of pressure to the wound tissue is small, but when all areas of the wound work together in an effort to close toward the centre point, the effects of negative pressure become impressive and results in quicker healing and resolution.

This system consists of non adherent, porous wound dressing (polyurethane foam or gauze dress) and a drainage system which are attached to each others by use of a transparent film. The foam is connected to a VAC vacuum pump through an evacuation tube. The suction guarantee a continues vacuum in the polyurethane foam producing a high contact zone in wound foam interface. It is required to change the foam every 2 days. The system is commercially available in UK since 1995 and has been used significantly for wound healing. Figure 2 shows various components of this system.

Figure 2: The NPWT system used for improving wound healing ( adapted from (Miryam et al, 1999) with permission <https://assignbuster.com/advantages-and-limitations-of-topical-negative-pressure-therapy/>

NPWT has three forms which differ based on the type of dress used, such as Bio Dome, gauze and foam. The polyurethane foam was used first by Morkey and Argenta in 1997. It has been reported that the foam can be easily cut according to the wound size, especially those which has a regular contour and used when better granulation formation and wound contraction is a desirable goals. However, gauze can be used for sensitive and irregular wounds. The type of selected foam is based on the type of wound as is mentioned in table 1.

The foam is placed into the defect and the area is covered with adhesive drape. The suction generate a continues vacuum in the foam, producing a high contact zone in wound foam interface so a vacuum seal is achieved. It should be mentioned that the negative pressure applied on the wound is 125 mm HG below ambient that is transmitted to the wound in a controlled manner. The selected pressure in this system is based on especial guidelines as shown in table 2.

## **Wound Description**

**Poly-**

**urethane (black foam)**

**Polyvinyl-**

**alcohol (soft foam)**

**Both**

**Either**

Deep, acute wounds with moderate granulation tissue growth

X

X

Deep wounds with extremely rapid growth in granulation tissue

Deep pressure ulcers

X

Superficial wounds

X

Postgraft therapy

X

Fresh grafts

X

Compromised flaps

X

Tunneling/sinus tracts/undermining

X

Diabetic ulcers

X

Dry wounds

X

X

Deep trauma wounds

X

Superficial trauma wounds

Table 1: The types of the foam used in NPWT system

## **Wound Type**

**Target Pressure Poly-urethane**

**Target Pressure Polyvinyl-**

**alcohol**

Acute/traumatic wound

125 mm Hg

125-175 mm Hg

Surgical wound dehiscence

125 mm Hg

125-175 mm Hg

Meshed graft

75-125 mm Hg

125 mm Hg

Pressure ulcer



125 mm Hg

125-175 mm Hg

Chronic ulcer (diabetic/arterial vascular)

50-75 mm Hg

125-175 mm Hg

Fresh flap

125 mm Hg

125-175 mm Hg

Compromised flap

125 mm Hg

125-175 mm Hg

Table 2: The selected negative pressure used in NPWT based on the type of foam used

### **Evidences regarding NPWT:**

There are some evidences regarding the positive effects of using NPWT on wound healing. The main advantages of this treatment method include:

provision of moist wound healing environment

removal of the fluids and infection material which help the wound to heal  
speedy

assisted profusion

decreased bacterial colonisation

enhance formation of granulation tissue

rapid cell division

increased blood flow

increased number of active fibroblasts and macrophages

enhance epidermal cell formation

decreased harmful chronic wound fluid

reduced the number of dressing changes and decrease damage to  
underlined tissue

provision of mechanical approximation of wound edges

promotion of viscoelastic flow due to tissue stretch

limitation of zone of injury after orthopaedic trauma

splinting effect

Indication and contraindication of using NPWT: The foot and drug  
administration (FDA) approved this method for treatment of non healing

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wounds. Then it has been extended to include chronic, acute, and traumatic and sub acute wounds, flaps and grafts. In the United State of America the following contraindications have been considered in this regard:

wound with necrotic tissue

untreated osteomyelities

fistulas to organs or body cavities

placement directly over exposed veins and arteries

malignancy within wound

### **What are the problems associated with NPWT:**

The following problems have been mentioned in the literature regarding NPWT:

patients may experience discomfort or pain when the foam dressing is changed

topical skin problem may arise during use

overgrowth of geast or Candida infection

skin stripping and sub epidermal granulation

foam removal frequently results in trauma to wound in the form of minor capillary and granulation tissue disruption

achieving and maintaining a vacuum seal can be difficult at times

staff must be well trained and educated

### **Discussion:**

There are over 325 publications on NPWT wound healing method, including 15 randomized clinical trials. However, it can not be concluded strongly that the system results in faster wound healing than other conventional methods or provides cost effective despite much greater material cost.

It has been reported that using this method enhances bacterial clearance which improves the speed of wound healing. When microorganisms enter to wound, consume the nutrition and oxygen which otherwise directed toward tissue repair. When the amount of wound infection decreases (reducing bacterial loads) the healing capacity improves (the blood used for wound repairing). However, in the research undertaking by.. on 25 patients reviewed respectively, it was found that using this method dose not have any effects on bacterial clearance. Moreover, bacterial colonization increases significantly with this therapy and remains in the range of.

Improvement in Granulation tissue formation was another advantage mentioned in using this method for wound healing. Granulation is a small blood useless and connective tissue in the base of the wound. A well granulation wound provides an optimal bed for epidermal migration and for skin grafts as a newly formed capillary incorporate the transplanted skin. Studies have shown that granulation tissue formation is enhanced by negative pressure by virtue of interstitial fluid resolution and resulting increase in circulation.

In the research done by .. on 162 patients it was shown that NPWT improves the proportion and rate of wound healing after partial foot amputation in patients with diabetics. Nearly 56% of the patients using this method achieved a comparable closure during 16 weeks assessments compared with 39% in control group. In the other research done by Blume et al (2008) the safety and clinical efficiency of this new method was compared with Advanced Moist Wound Therapy (AMWT) to treat foot ulcers in diabetic patients on 342 patients. It was found that a greater proportion of foot ulcers achieved by this method in contrast to other method (43. 2% compared to 28. 9%). The time of therapy was the other considered parameter in this research. The time of therapy was a little bit less in this method. Regarding the safety of the two methods there was no significant difference.

Morie et al carried out a literature review based research regarding the effectiveness of this method. They mentioned that although many controlled and non randomized studies describing the effectiveness of this new method, few prospective randomized control trials have been published. They claimed that the researches in this field have lots of problems such as: small sample size, variable outcome measure across studies, significant methodological problems. So it is not possible to have a strong conclusion regarding the effects of this method in contrast to other methods. They suggest that other research must be done regarding the effect of this method on healing, cost of care, patient pain and quality of life in contrast to other methods.

Gregor et al have undertaken another literature review regarding the effect of using this method. They also concluded that although there seems to be some evidences regarding the effects of this method on wound healing <https://assignbuster.com/advantages-and-limitations-of-topical-negative-pressure-therapy/>

outcome as a main outcome, they are insufficient to clearly prove an additional clinical benefit of this method.

Cost consideration: wound care is an expensive endeavour. The range of pressure ulcers which is one of the main complication of being in bed for a long time is between 2000 and 70, 000 per wound. NPWT decreases the cost regarding wound healing through a decrease in the number of dressing changes required. Moreover, the supervisory role of the trained nurses would be decrease to perform dressing change. According to the results of a research the long term cost of NPWT was lower and output was better when compared with standard wound care method. In another research study it was shown that the cost of wound healing was decreased by 38% in contrast to other method, as the healing occur by 61% faster than using gauze dressing method.

### **Conclusion:**

The review of the relevant literature stated that the available evidences can not be used to determine a significant therapeutic distinction of NPWT method in contrast to other methods. There are over 325 publications on this method however only 15 randomized clinical trials compare the new method with other available methods.

It is concluded that the available research studies can not support the effectiveness of this method on wound healing. It should be mentioned that direct comparison of NPWT to a particular type of dressing would be difficult as it is unlikely that a single dressing type would be appropriate through out entire healing process. As there is not enough research which directly focus

on the effects of this method on wound healing, and safety according to wound type, the author of this article represent a need for a large high quality randomized studies. Moreover, it is recommended to evaluate the effects of this method based on the used components.