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A Clinical Study of Management of Wounds Using Vacuum Assisted Dressings in Tirunelveli Medical College Hospital

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Abstract: ***Management of wounds is always a challenging issue. Delayed healing of wounds is a major problem in the community; besides causing morbidity and disability in the patient, is a burden on our health resources. Therefore, is a need for application of newer and advanced modalities in management of wounds. Vacuum-assisted closure uses negative pressure to assist wound healing and has a positive impact on wound healing by enhancing granulation tissue formation and wound closure, thus providing a modern wound care system for the poor at an affordable cost. The present interventional study involved 50 cases of wounds that fulfilled the inclusion criteria.VAC dressing was done in wounds occurring in a variety of locations like foot 29 (58%), leg 18 (36%), sole 2(4%) and forearm 1(2%). Most common organism cultured both from case and control population was Staphylococcus aureus 11(44%). 90% of non-sterile pre-vac culture turned sterile after VAC. The hospital stay was found to be only 21days for patients with VAC dressing, when compared 28 days in control group. Patients with VAC dressing have more Split Skin Graft before discharge and less rate of amputation when compared to the control group. In short, VAC dressing decreases Hospital stay. VAC dressing improves pus culture sensitivity. VAC dressing improves outcome, more SSG. From our study, it can be concluded that VAC is a promising new technology in the field of wound healing with multiple applications in a variety of wounds. Wherever feasible, VAC therapy should be the modality of choice in management of wounds.***

Keywords: Vacuum, SSG, Amputations, Hospital Stay

1. Introduction

One of the most common causes for admission in surgical ward is non healing ulcer. In which diabetes is the most common etiology. In most of the cases, hospital stay of many weeks is required for management of the above. In many cases they ultimately go for amputation. Acute and chronic wounds affect at least 1% of the population. Regardless of etiology, wounds are difficult to treat if coexisting factors (eg, infection or diabetes mellitus) prevent regular wound healing.

Wounds represent a significant risk factor for hospitalization, amputation, sepsis, and even death, and from the patient's perspective, wound therapy is often un-comfortable or painful. In all sense patients turns to be a burden for society and family

Vacuum assisted closure is a universally accepted method for dressing. It has proved its efficacy for wound dressing with faster wound healing and shorter hospital stay.[1]

The present study was undertaken in tirunelveli medical college, a teritiary care hospital with the aim of showing the advantage of V.A.C over conventional dressing.[4]

2. Methodology

Study Setting

Study is conducted at Tirunelveli medical college hospital which is tertiary centre. Patients are selected from general surgery wards

Period of Study

A total of 50 cases clinically presenting as ulcer between September 2016 and September 2017 were included in the study.

Inclusion Criteria

- Patient more than 12 years of age
- Patients presenting with ulcer.

Exclusion Criteria

- Patients less than 18 years of age
- Patients diagnosed as malignancies.
- Patients with poor vascular supply to the affected site.
- Patients with fistula/gangrene/anaerobic infection/active bleeding/undebrided wound.

Clinical examination of each case was done systematically as per the proforma drafted for the study.

Intervention

After debridement of wound V.A.C dressing is applied.VAC is applied only after bleeding gets stopped. Pre V.A.C & post V.A.C C&S is taken. Dressing is given for 5 days. Pre-VAC doppler study and x ray of the affected limb is taken. CONTROL group is given conventional dressing Status of the patient at the time of discharge is noted.

Outcome Variables

- Result at the end of treatment
- No. of days of hospital stay
- Pus C&S before & after V.A.C

Materials used for Study[9]

- OPSITE/Camera cover
- Transparent adhesive plaster
- Sponge(sterilized)
- Suction catheter/Ryles tube
- Suction drain/ suction apparutus available

Sequence of Procedure

Wound Preparation

Any dressings from the wound was removed and discarded. A culture swab for microbiology was taken before wound irrigation with normal saline. Surgical debridement was done and adequate haemostasis achieved.

Placement of foam

Sterile, open-cell foam dressing was gently placed into the wound cavity.

Sealing with drapes

The site was then sealed with an adhesive drape ensuring that the drapes covered the foam and tubing and atleast three to five centimetres of surrounding healthy tissue.

Application of negative pressure

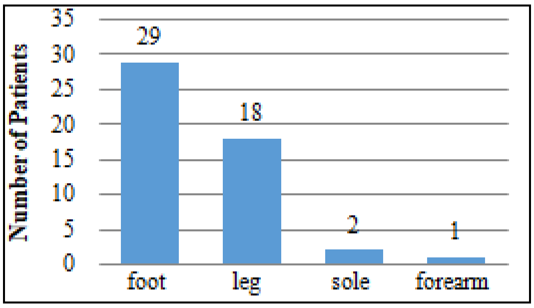
Controlled pressure was uniformly applied to all tissues on the inner surface of the wound using centralised vacuum pump, which could deliver either continuous or intermittent pressures, ranging from 50 to 125 mm Hg. The foam dressing compressed in response to the negative pressure. The pressure was applied continuously for the first 48 hours and changed as required thereafter.

3. Results

An interventional study involving 50 cases of wounds was done in the Department of General surgery, Tirunelveli Medical college hospital between September 2016 and September 2017.

Chart 1: Distribution of location of wounds

LOCA			
		Frequency	Percent
Valid	foot	29	58%
	leg	18	36%
	sole	2	4%
	forearm	1	2%

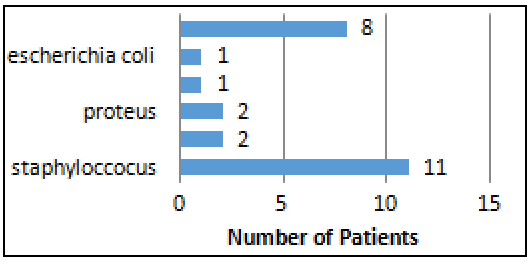


Wounds were most commonly located in the foot 29(58%) followed by the leg 18(36%), sole 2(4%) and forearm 1(2%).

Chart 2: Organisms Cultured From Wound Control

Organisms Before:

ORG_BEF			
		Frequency	Percent
	staphyloccocus	11	44%
	pseudomonas	2	8%
	proteus	2	8%
	klebsiella	1	4%
	escherichia coli	1	4%
	no growth	8	32%

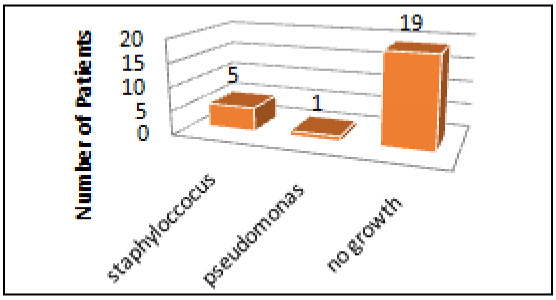


Most common organism cultured from the wounds (CONTROL) was Staphylococcus aureus 11(44%).

Control

Organisms After:

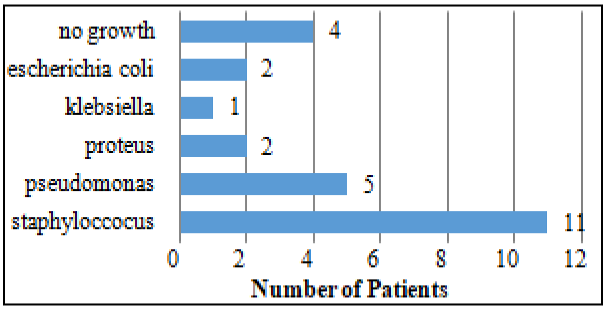
ORG_AFT			
		Frequency	Percent
Valid	staphyloccocus	5	20%
	pseudomonas	1	4%
	no growth	19	76%



Cases

Organism Before

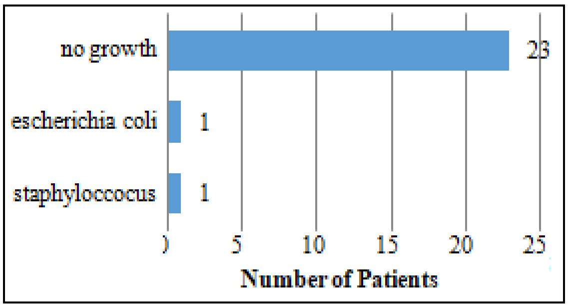
ORG_BEF			
		Frequency	Percent
	staphyloccocus	11	44%
	pseudomonas	5	20%
	proteus	2	8%
	klebsiella	1	4%
	escherichia coli	2	8
	no growth	4	16



Most common organism cultured from the wounds (CASES) was Staphylococcus aureus 11(44%).

Cases
Organism After:

ORG_AFT			
		Frequency	Percent
Valid	staphyloccocus	1	4
	escherichia coli	1	4
	no growth	23	92



PREVAC * POSTVAC C&S Crosstabulation

		POSTVAC		
		sterile	non sterile	Total
PREVAC	sterile	4	0	4
	non sterile	19	2	21
Total		23	2	25

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.414[b]	1	.520		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	.730	1	.393		
Fisher's Exact Test				1.000	.700
Linear-by-Linear Association	.398	1	.528		
N of Valid Cases	25				

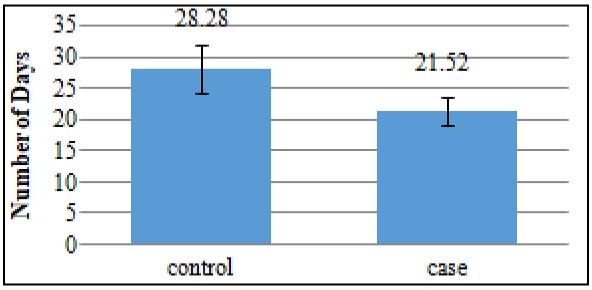
a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .32.

Chi-square test shows study is significant (p value .520). Patients with sterile pre V.A.C C&S is not turning non sterile after V.A.C, but 90% non sterile turns sterile after V.A.C

Hospital Stay

	Group	N	Mean	Std. Deviation	P value	
HOS_STAY	control	25	28.28	3.81		*Independent*
	case	25	21.52	2.24	<0.0001	*Sample t test*

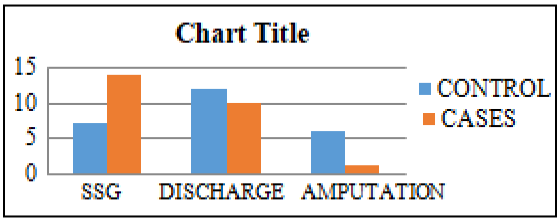


Mean hospital stay in cases is 21 compared to stay of 28 in control group.[3]

Case/Control * plan at end of Rx Crosstabulation

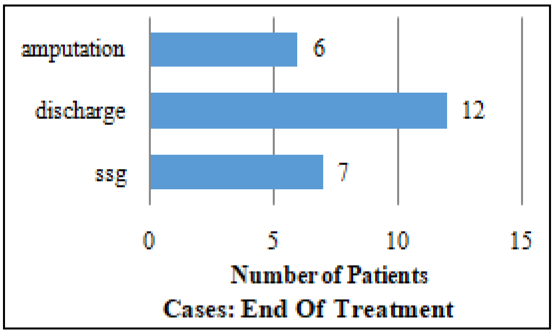
		END_TREA			P value	
		ssg	discharge	amputation		
Group	control	7	12	6	0.048	*Pearson chi square*
	case	14	10	1		

Patients with V.A.C dressing have more split skin graft[10] before discharge, less number of amputations[2]



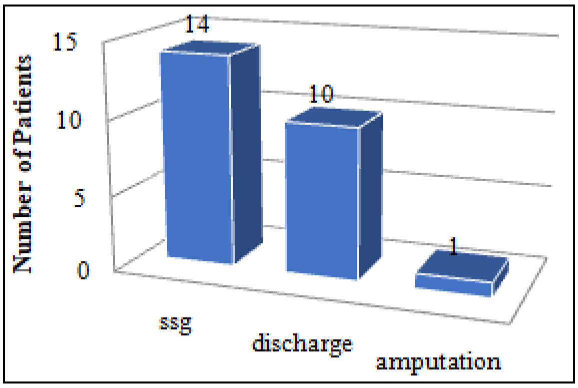
Control: End of Treatment

END_TREA			
		Frequency	Percent
Valid	ssg	7	28%
	discharge	12	48%
	amputation	6	24%



Cases: End of Treatment

END_TREA			
		Frequency	Percent
Valid	ssg	14	56
	discharge	10	40
	amputation	1	4



4. Discussion

Negative pressure wound therapy has been described as a “bridge” technique for wounds that are not amenable to immediate closure by either secondary intention or surgical closure.Topical NPWT involves active drainage of chronic over-exudative wounds. In this technique, a porous material (antimicrobial gauze or foam) is placed in the wound bed and enclosed using polyurethane films to form an airtight seal. This kind of dressing has been shown to be beneficial in a wide variety of wounds, including pressure ulcers, leg ulcers, skin grafts, sternal and abdominal wounds, traumatic injuries, postfasciotomy closures, and lymphorrhea. Although the bulk of the literature regarding NPWT describes one vacuum-assisted closure system (V.A.C. Therapy®, KCI, San Antonio, TX), the use of alternative dressing interfaces and vacuum sources also has been presented. Generally, pressures are targeted at -125 mm Hg, although no clinical data identify an optimum pressure. However, in a recent report, reduction in wound volume was suggested to be unrelated to pressures between -50 mm Hg and -125 mm Hg. In this study, the authors used continuous 125 mm Hg of negative pressure in wounds for the first 48 hours. After the wounds were properly cleaned by continuous and high pressure, the authors continued dressings with intermittent 80 mm Hg of negative pressure at 24- to 48-hour intervals. The pressure delivered to the wound bed by a suction tube and a wound filler—gauze, or foam—creates the mechanical stress on the surface of the wound. In the cells exposed to negative pressure, integrin bridges in their cytoskeletons are disrupted; thus, cell proliferation is stimulated. The other effect of negative pressure is elimination of proteases that inhibit healing of the lesion. The most important effect of negative pressure is provided by the mechanical pump. Therefore, a useful wound filler material should transduce the negative pressure to the wound bed equally.

Mechanism of Action: [5]

- Increased local blood flow via enhancement of capillary blood flow [8]
- Increased angiogenesis with profuse granulation formation [8]
- Increased number of active fibroblasts and macrophages
- Enhanced epithelial cell migration
- Decreased bioburden, bacterial toxins, and subsequent cessation/delay of healing and decreased tensile strength of the wound [8]
- Decreased harmful, chronic wound fluid and by products and subsequent senescent cells and tissue damage
- Decompressed excess interstitial fluid with subsequent decreased periwound induration, inelasticity, and microvascular occlusion
- Reduced number of dressing changes and subsequent decreased damage to delicate new tissue, pain, desiccation, and exposure to nosocomial infection
- Provision of a moist, normothermic wound environment that allows more efficient epithelization, growth factor synthesis and availability, and overall wound healing potential
- Provision of mechanical approximation of wound edges
- Promotion of viscoelastic flow and distraction histogenesis due to tissue stretch and stimulation of the cytoskeleton with subsequent enhanced mitosis
- Decreased shear forces to the graft during inosculation via uniform wound bed immobilization
- Decreased seroma/hematoma of grafts and flaps
- Limitation of zone of injury after acute orthopedic trauma
- Splinting effect (sternal, abdominal).

5. Application

NPWT application is simple and can be broken down into three main components.

First, a sponge must be selected or custom cut to fit the wound size. The sponge used most commonly is a black, reticulated polyurethane ether foam with pore sizes from 400 to 600 mm. Polyvinyl alcohol foam (White-Foam, KCI), which is more densely reticulated, also is available . This variant is useful in situations in which a tougher sponge might be needed, such as tunneling. Sponges impregnated with silver (GranuFoam Silver, KCI) are available as well for wounds with a high bacterial load. The sponge should be applied so that it fills the wound without overlapping onto normal skin, if possible. Although in some situations we have overlapped the sponge onto normal skin or ‘‘bridged’’ multiple wounds, the sponge can irritate normal skin. An alternative is to apply a protective dressing over the normal skin before creating a ‘‘bridge.’’

The second important aspect of application relates to creating an airtight seal. Often, this is the most difficult element in applying the dressing. The seal is created by applying an adhesive occlusive dressing over the sponge and onto the surrounding skin. It is critical that the seal be able to withstand the negative pressure without leaking. To achieve this goal, the surrounding skin must be clean and dry. Liquid and aerosolized adhesives often are helpful

The third element to NPWT is application of the vacuum. The vacuum tubing supplied by KCI now includes a disk at the end to facilitate attaching the tubing to the sponge and creating a good seal. The suction tube is attached to a collection canister that is attached to an adjustable vacuum pump. Usually, continuous 75 to 125 mm Hg vacuum is used for all wound types. When the WhiteFoam is placed, 125 to 175 mm Hg are used. Although intermittent vacuum therapy showed higher increases in blood flow in laboratory studies, it often is not tolerated well by the patient. It generally is recommended that the dressing be changed every other or every third day. At the time of foam change, other traditional wound-healing modalities may be used (eg, pulse lavage). Although the initial application of negative pressure therapy was an inpatient endeavor only, it is now used routinely on an outpatient basis, allowing for greater flexibility in dealing with chronic wounds that otherwise do not require hospitalization.

Tips

1) A single VAC dressing set can be used for multiple separate wounds. After applying the VAC sponge and occlusive dressing to the individual wounds, the VAC suction tubing is adhered to the main wound. The tubing is then incised at sites corresponding to the smaller wounds and occlusive dressing used to obtain an air-tight seal over each dressing. The VAC pump is then able to produce negative pressure across multi
2) To obtain an air-tight seal in hair-bearing or sweaty regions such as the perineum, found it useful to lay the occlusive VAC film onto hydrocolloid dressings, which seem to adhere more strongly to these areas.
3) Putting some lignocaine into tube before removing dressing causes less pain.
4) Removing ‘Part 2’ of the adhesive film first allows for easier application of the dressing, as it is able to conform to irregular shaped beds.
5) Applying Compound Benzoin Tincture to the skin surrounding the wound, letting it dry and then applying the adhesive dressing gives it a better adhesion.

In our study the wounds were commonly located at the foot 29(58%) followed by leg 18(36%), sole 2(4%) and forearm 1(2%) and NPWT dressings were applied accordingly. Most common organism cultured both from case and control population was Staphylococcus aureus 11(44%) each. When we look at the culture and sensitivity reports both before and after applying the VAC dressing, we can see that the patients with sterile pre-vac culture was not turning non-sterile after VAC, but 90% of non-sterile pre-vac culture turned sterile after VAC. We observed that patients of study group showed rapid clearance of bacterial load as compared to control group. The decrease in the bacterial load could have been attributed to the antibiotic regimes administered during the study. Hence we were unable to eliminate this bias. Our study correlates with the study by Moues *et al*.,[11] who had observed that nonfermentative Gram-negative bacilli showed a significant decrease in vacuum-assisted closure-treated wounds, whereas *S. aureus* showed a significant increase in VAC-treated wounds.

In our study we noticed a significant reduction in the hospital stay and patients were found to have a faster recovery. The hospital stay was found to be only 21days for patients with VAC dressing, when compared to the conventional dressings, who have an average hospital stay of 28 days[3].Independent Sample t-test shows that the study is significant(p-value <0.0001). Application of NPWT to all skin graft patients may also facilitate earlier mobilization that may aid recovery and contribute toward faster hospital discharge. One limiting factor is the mobility of the NPWT device. Using wall suction as the method of NPWT delivery reduces patient mobility, whereas commercially available devices may significantly improve patient mobility.

The end of treatment analysis of patients with VAC dressing have more Split Skin Graft [10]before discharge and less rate of amputation when compared to the control group.

Pearson Chi Square test shows the study is significant (p-value= 0.048). 56% of cases were given SSG cover when compared to 28% in control group. The amputation rate in cases were only 4% when compared to 28% in control group. [2]. Our study correlates with the study conducted by David Armstrong *et al*.,[12] who had observed that NPWT delivered by VAC device was safe and effective treatment for complex diabetic foot wounds and could lead to higher proportion of healed wounds, faster healing rates and potentially fewer re-amputations than standard care. Similarly, Robert Frykberg *et al*.,[13] have also reported overall progressively increasing wound debridement depth and amputation rates in control groups; however the same increasing trend did not occur in the NPWT group.

6. Conclusions

VAC therapy is a recent modality of treatment of wounds. Its introduction has changed the course of management of wounds. Based on the data from the present study and other studies available, VAC does appear to result in better healing, with few serious complications, and thus looks to be a promising alternative for the management of various wounds.[4] The application of VAC is simple, but requires training to ensure appropriate and competent use. The cost of VAC will vary and depend on the length of hospital stay and cost of supplies[6]. There is a paucity of high quality RCTs on VAC therapy for wound management with sufficient sample size and adequate power to detect differences, if any, between VAC and standard dressings[7]. More rigorous studies with larger sample sizes assessing the use and cost effectiveness of VAC therapy on different wound types are required. Awareness about VAC and training on application of VAC dressings will allow its utilization more often.

Analyzing the results of our study, we opine that NPWT has a definitive role in promotion of proliferation of granulation tissue, reduction in the wound size,[14] rapid clearing of the wound discharge and bacterial load. It is suggested that NPWT is a cost-effective, easy to use and patient-friendly method of treating diabetic foot ulcers which helps in early closure of wounds, preventing complications and hence promising a better outcome.

References

[1] The Evidence-Based Principles of Negative Pressure Wound Therapy in Trauma & Orthopedics Novak A, Wasim S Khan, Palmer J Open Orthop J. 2014; 8: 168–177. Published online 2014 Jun 27. doi: 10.2174/1874325001408010168 PMCID: PMC4110388

[2] Vacuum-assisted closure versus conventional dressings in the management of diabetic foot ulcers: a prospective case–control study Ali M. Lone, Mohd I. Zaroo, Bashir A. Laway, Nazir A. Pala, Sheikh A. Bashir, Altaf Rasool Diabet Foot Ankle. 2014; 5: 10.3402/dfa.v5.23345. Published online 2014 Apr 8. doi: 10.3402/dfa.v5.23345 PMCID: PMC3982118

[3] The use of negative pressure wound therapy in the treatment of infected wounds. Case studies Daniel de Alcântara Jones, Wilson Vasconcelos Neves Filho, Janice de Souza Guimarães, Daniel de Araújo Castro, and Antonio Marcos Ferracini. Rev Bras Ortop. 2016 Nov-Dec; 51(6): 646–651. Published online 2016 Nov 2. doi: 10.1016/j.rboe.2016.10.014 PMCID: PMC5198081 PMID: 28050534

[4] The evidence-based principles of negative pressure wound therapy (NPWT) dressing applications; A review of the literature Reza Mafi , Marco Malahias , Daniel J Jordan, Sandip Hindocha International Journal of Infection Control www.ijic.info ISSN 1996-9783 doi: 10.3396/IJIC.v10i2.011.14

[5] Panayi AC, Leavitt T, Orgill DP. Evidence based review of negative pressure wound therapy. *World J Dermatol* 2017; 6(1): 1-16

[6] Vacuum assisted closure: a review of development and current applications. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery, ISSN: 1078-5884, Vol: 29, Issue: 3, Page: 219-26 Publication Year: 2005

[7] Negative pressure wound therapy: a systematic review on effectiveness and safety. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery, ISSN: 1532-2165, Vol: 36, Issue: 4, Page: 438-48 Publication Year:2008

[8] Kushagra Sinha, Vijendra D. Chauhan, Rajesh Maheshwari, Neena Chauhan, Manu Rajan, and Atul Agrawal, "Vacuum Assisted Closure Therapy versus Standard Wound Therapy for Open Musculoskeletal Injuries," Advances in Orthopedics, vol. 2013, Article ID 245940, 8 pages, 2013. https://doi.org/10.1155/2013/245940.

[9] Cost-effective Alternative for Negative-pressure Wound Therapy Kim, Jeff J. MD; Franczyk, Mieczyslawa PT, PhD; Gottlieb, Lawrence J. MD, FACS; Song, David H. MD, MBA, FACS Plastic and Reconstructive Surgery – Global Open: February 2017 - Volume 5 - Issue 2 - p e1211 doi: 10.1097/GOX.0000000000001211

[10] Scherer LA, Shiver S, Chang M, Meredith JW, Owings JT. The Vacuum Assisted Closure DeviceA Method of Securing Skin Grafts and Improving Graft Survival. *Arch Surg.* 2002;137(8):930–934. doi:10.1001/archsurg.137.8.930

[11] Moues CM, Vos MC, van den Bemd GJ, Stijnen T, Hovius SE. Bacterial load in relation to vacuum-assisted closure wound therapy: A perspective randomized trial. Wound Repair Regen. 2004;12:11–7.

[12] Armstrong DG, Lavery LA. Negative pressure wound therapy after partial diabetic foot amputation: A multicenter randomized controlled trial. Lancet. 2005;366:1704–10.

[13] Frykberg RG, Williams DV. Negative-Pressure Wound Therapy and Diabetic Foot Amputations.A Retrospective Study of Payer Claims Data. J Am Podiatr Med Assoc. 2007;97:351–9.

[14] Witkowski W, Jawien A, Witkiewicz W, Zon B. Initial multi-centre observations upon the effect of a new Topical Negative Pressure device upon patient and clinician experience and the treatment of wounds. Int Wound J. 2009;6:167–74