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A COMPARATIVE STUDY BETWEEN CUSTOM MADE VACUUM ASSISTED CLOSURE AND CONVENTIONAL DRESSING IN WOUND MANAGEMENT

KEY WORDS:

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ABSTRACT

Introduction: Chronic wounds, such as diabetic foot ulcers, vascular ulcers, and pressure ulcers, are prevalent surgical challenges. These wounds often persist for over three months without healing, particularly among elderly patients and those with comorbid conditions like diabetes and vascular diseases. The need for innovative treatments to manage these chronic wounds effectively is critical. **Objectives:** This study compares the efficacy of custom vacuum-assisted closure (V.A.C.) dressings with conventional dressings in treating chronic ulcers. The parameters evaluated include hospital stay duration, treatment costs, patient comfort, cosmetic outcomes of granulation tissue, and the rate of surgical site infections. **Methods:** A prospective cohort study was conducted at Dr K.N.S. Memorial Institute of Medical Sciences in the general surgery department. The study involved 90 patients: 45 patients undergoing the custom V.A.C. dressings group and the other 45 patients in the conventional dressings group. The comparative analysis focused on hospital stay duration, cost-effectiveness, patient satisfaction, the appearance of granulation tissue, and surgical site infection rates. **Result:** For patients treated with custom V.A.C. dressings, the mean duration of hospital stay was 29.91± 13.20, and in the conventional dressing group, it was 53.46 ± 17.26 days. The mean percentage of ulcer area reduction in the Custom V.A.C. Dressing Group was 83.56 ± 16.88% For. The custom V.A.C. dressings also proved more cost-effective, requiring fewer dressing changes and less Hospital stay. Using the pain VAS scale, patient satisfaction was higher in the V.A.C. group (40 patients were very satisfied compared to the conventional dressing group; 36 patients were not satisfied). During the study, three patients got infected in a costume-made V.A.C. dressing group, and 11 were infected in the conventional dressing group. **Conclusion:** The findings suggest that custom V.A.C. dressings are a more effective and efficient alternative to conventional dressings for managing chronic ulcers. They offer enhanced healing rates, lower total cost due to the reduced frequency of dressing and shorter hospital stays, and improved patient satisfaction, reducing the incidence of S.S.I. The custom-made V.A.C. group had significantly fewer hospital stays, a higher percentage of ulcer area reduction, and a higher success rate of healing than the conventional dressing group.

INTRODUCTION

One of the most frequent surgical disorders a surgeon encounters is chronic wounds. Doctors have been attempting various treatments for these kinds of wounds since the beginning of time. Chronic wounds are defined as those that do not recover through the four conventional stages of wound healing in less than three months. Typical examples of such wounds include:

1) Ulceration on the diabetic foot
2) Ulceration on the vascular system (venous and arterial) sores caused by pressure

In Developed nations, between 1% and 2% of people are estimated to have had a chronic wound at some point in their lives. Elderly people and those with concomitant illnesses such diabetes, hypertension, peripheral vascular disease, renal disease, and hepatic disorders are more likely to experience chronic wounds. The most unusual thing about chronic wounds is that they just won't go away, especially pressure ulcers and bed sores, no matter how much care you give them. When wounds are dressed to promote moist wound healing, they either form granulation tissue or re-epithelialize considerably more quickly. It is known that stopping a wound from healing won't cause an infection. Chronic wounds are still an issue, despite the fact that numerous wound care techniques have been developed to help surgeons, such as the application of compression bandages to treat venous ulcers. Both closed and open wound surgical dressings are mostly determined by training, tradition, and the surgeon's personal philosophy. A vast range of creative dressing has been introduced over the past 20 years.

Studies have indicated that the application of regulated sub-atmospheric pressure to the wound site can significantly enhance wound healing. The current study set out to investigate whether topical negative pressure moist wound dressings could, in comparison to conventional moist wound dressings, more quickly accelerate the healing process for chronic wounds.

MATERIALS & METHODS

Place of Study

For the duration of 18 months, all patients with wounds in the general surgery department at the Dr. K.N.S. Memorial Institute of Medical Sciences, Barabanki, who met our predetermined inclusion and exclusion criteria, were examined for our study.

A thorough medical history was obtained, covering the patient's age, gender, occupation, length of onset, seasonal fluctuations, family history, personal habits, and the progression of the illness. A thorough clinical examination was performed, and a diagnosis-related investigation was carried out.

Type of Study

Prospective Cohort study

Study Population

Patient admited in our hospital to the surgery ward with all type of chronic Wounds (wounds >3 months) irrespective of etiology which satisfy our defined inclusion and exclusion criteria

Duration of Study

18 months from the date of approval from the Institutes

Ethics Committee

Sample Size

The total number of subjects in my study was 90.

Sampling Technique

The patient received an explanation regarding the study's purpose and details on the patients. The patient gave written, informed consent so that they may participate in the study. He or she was diagnosed as a case of wound of any aetiology (only if the patient meets the inclusion criteria), and the study participants received both custom-made VAC dressing and standard dressing techniques.

Interventions

Random assignment was used to place participants in the Custom Made VAC Dressing Group or the Conventional Dressing Group.

1. Custom Made VAC Dressing Group: patients were applied custom made VAC dressings every 48 to 72 hours.
2. Conventional Dressing Group: Conventional dressing group daily or changed according to the wound state

Inclusion Criteria

1) Individuals in the 18-75 age range.
2) Every kind of chronic wound, regardless of the cause.
3) Chronic wound lasting longer than three months.
4) Less than 10% of wounds TBSA.
5) Consenting patients to get hoover treatment

Exclusion Criteria

1) Necrotic tissue wounds.
2) Untreated underlying osteomyelitis.
3) Visible veins or arteries.
4) Cancerous tissue within wounds.
5) Gas gangrene.
6) Burns from radiation, chemicals, or electricity, as well as individuals suffering from collagen illness

Materials Required

1. Foam sterile
2. The Ryles tube
3. ROMO vac set
4. Sterile Cotton
5. Adhesive incise drape.
7. Bandage with rollers
8. A wound-size measurement scale.
9. Culture containers

Methodology

Each patient received a thorough history, a clinical examination, and any necessary investigations.

The institutional ethical committee gave its approval for the project. An ulcer could only be considered if it had been present for three months or less and made up less than 10% of the body's surface area. The wound's size was calculated by multiplying its greatest length by its greatest width and depth, or by measuring the wound's volume. We treated ulcers for eight weeks, or until the wound healed on its own. Throughout treatment, blood glucose levels were routinely checked and kept under control with an appropriate insulin dosage.

Procedure for Custom Made VAC Dressing

The wound was surgically scrubbed and the necrotic tissue thoroughly excised. Under the all aseptic condition Then wound cover with saline soaked gauze piece, After cutting a piece of sterile foam to the right size and covering the wound, The sterile foam was pierced with a Ryles tube which having multiple openings .This dressing of foam was sealed by Using an adhesive drape, which established an airtight environment, Ryles tube connected to a Romo vac which was applied continuous negative pressure to the wound

Procedure of Conventional Dressing

A wound was cleaned with regular saline. It was then dressed with a dressing (such as hydrocolloid or alginate) that was suitable for the type of wound (e.g., packed with gauze). The dressing was changed daily or in accordance with our regular schedule.

Every patient received oral analgesic medication. All patients received standard antibiotic regimens, which included broad-spectrum antibiotics at first and culture-sensitivity reports as a guide later on. Patients with ulcers received treatment until the wound healed on its own. Throughout the course of treatment, blood glucose levels were closely checked and kept under control with the right amount of insulin.

Outcomes Measured

1) Hospital Stay Time: Period between hospital entry and exit, in days.
2) Comparative cost: The sum total of the costs spent adopting a wound management strategy over hospital admission.
3) Patient Satisfaction: Measured by rate of wound healing, by using pain VAS score, by cost of treatment.
4) Time for Granulation Tissue: days from the beginning of treatment and appearance of healthy granulation tissue.

Data Collection

Patient-reported outcomes were collected at baseline and during follow-up visits The head of study performed wound healing, patient satisfaction and adverse events assessments every week.

Statistical Analysis

- The data was analysed using SPSS V27 software. The data were compiled using descriptive statistics.
- The Student t-test and Chi-square test were used, respectively, to compare the continuous and categorical data. A p-value of less than 0.05 indicates that the null hypothesis was disproved.

RESULTS

Table 1: Age Distribution

Age distribution	Custom made VAC dressing		Conventional dressing		Total
	N	%	N	%	N (%)
21 – 30	5	11.1%	3	6.7%	8 (8.9%)
31 – 40	8	17.8%	6	13.3%	14 (15.6%)
41 – 50	13	28.9%	6	13.3%	19 (21.1%)
51 – 60	10	22.2%	23	51.1%	33 (36.7%)
61 – 70	8	17.8%	5	11.1%	13 (14.4%)
71 – 80	1	2.2%	2	4.4%	3 (3.3%)
Total	45	100%	45	100%	90 (100%)
Mean ± SD	48.33 ± 12.48		51.22 ± 11.55		49.77 ± 12.04
Chi square test = 9.51, p=0.09, Not statistically significant					

Age Distribution

The custom-made VAC dressing group had a mean age of 48.33 12.48 years, while the conventional dressing group had a mean age of 51.22 11.55 years. No statistically significant variation was found.

Table 2: Gender Distribution

Sex distribution	Custom made VAC dressing		Conventional dressing		Total
	N	%	N	%	N (%)
Male	22	48.9%	32	71.1%	54 (60%)
Female	23	51.1%	13	28.9%	36 (40%)
Total	45	100%	45	100%	90 (100%)
Chi square test = 4.57, p=0.03*, Statistically significant					

Gender Distribution

- In Custom made VAC dressing group, Male were 48.9% and female were 51.1%.
- In Conventional dressing group, Male were 71.1% and female were 28.9%.

Table 3: Duration of Hospital Stay

Duration in days	Custom made VAC dressing		Conventional dressing		Total
	N	%	N	%	N (%)
11 – 20	11	24.4%	0	0.0%	11 (12.2%)
21 – 30	22	48.9%	9	20.0%	31 (34.4%)
31 – 40	5	11.1%	2	4.4%	7 (7.8%)
41 – 50	4	8.9%	4	8.9%	8 (8.9%)
51 – 60	1	2.2%	9	20.0%	10 (11.1%)
61 – 70	1	2.2%	12	26.7%	13 (14.4%)
71 – 80	1	2.2%	9	20.0%	10 (11.1%)
Total	45	100.0%	45	100.0%	90 (100%)
Mean ± SD	29.91 ± 13.20		53.46 ± 17.26		41.68 ± 19.33
Chi square test =39.84, p=0.0001*, statistically significant					

Days Spent In The Hospital / Days Needed For Recovery

In the current study, the custom VAC dressing group spent an average of 29.91 ± 13.20 days in the hospital, while the conventional dressing group spent an average of 53.46 ± 17.26 days in the hospital. The mean length of stay was significantly lower in the custom VAC dressing group compared to the traditional dressing group.

Table 4: Distribution Based on Etiology

Etiology	Custom made VAC dressing		Conventional dressing		Total
	N	%	N	%	N (%)
Diabetic foot ulcer	11	24.4%	22	48.9%	33 (36.7%)
Ischaemic ulcer	3	6.7%	3	6.7%	6 (6.7%)
Bed sore	7	15.6%	9	20.0%	16 (17.8%)
Venous ulcer	3	6.7%	1	2.2%	4 (4.4%)
Post infective Raw area(cellulitis, abscess)	16	35.6%	7	15.6%	23 (25.6%)
Traumatic ulcer	5	11.1%	3	6.7%	8 (8.9%)
Total	45	100%	45	100%	90 (100%)

Distribution Based on Etiology

Distribution based on etiology of chronic ulcer shows in Custom made VAC dressing group, 24.4% had Diabetic foot ulcer, 15.6% had Bed sore, Ischemic ulcer in 6.7% and venous ulcer in 6.7%, Traumatic ulcer in 11.1%. Post infective raw area in 35.6%.

In Conventional dressing group, 48.9% had Diabetic foot ulcer, 6.7% had ischemic ulcer, 20% had Post infective raw area, 20% had Bed sore, Venous ulcer in 2.2%, Traumatic ulcer in 6.7%.

Table 5: Outcome

Outcome	Custom made VAC dressing		Conventional dressing		Total
	N	%	N	%	N (%)
Success	45	100%	38	84.4%	83 (92.2%)
Failure	0	0%	7	15.6%	7 (7.8%)
Total	45	100%	45	100%	90 (100%)
Chi square test =7.50, p=0.006*, statistically significant					

Outcome

Area of ulcer was decrease more than 20% in eight weeks is considered success. If the ulcer area decreases by less than 20% in eight weeks, it is considered as failure. Based on outcome, 100% in VAC dressing group had successful healing of ulcer whereas in Conventional dressing group 84.4% had successful healing.

Table 6: Rate of granulation tissue formation

percentage ulcer area reduction	Custom made VAC dressing		Conventional dressing		Total
	N	%	N	%	N (%)
20 – 40	19	42.2%	0	0.0%	19 (21.1%)
41 – 60	9	20.0%	6	13.3%	15 (16.7%)
61 – 80	8	17.8%	8	17.8%	16 (17.8%)
81 – 100	9	20.0%	24	53.3%	33 (36.7%)
Failed	0	0.0%	7	15.6%	7 (7.8%)
Total	45	100%	45	100%	90 (100%)
Mean ± SD	83.56 ± 16.88		53.88 ± 21.52		67.54 ± 24.43
Chi square test =26.01, p=0.0001*, statistically significant					

Rate of granulation tissue formation

Table 7: Incidence of infection during treatment

Group	Custom Made VAC Dressing		Conventional Dressing	
	N	%	N	%
infection	3	6.60%	11	24.40%
No infection	42	93.40%	34	75.60%
p=0.042*, statistically significant				

Incidence of infection during treatment

Table 8: Patient satisfaction

	Custom made VAC dressing	Conventional dressing
Very satisfied	40	0
Moderately satisfied	4	2
Fairly satisfied	1	7
Not satisfied	0	36
Total	45	45
Chi square test =26.01, p=0.0001*, statistically significant		

Patient satisfaction

Assessment of patient satisfaction is done using pain VAS scoring system

Table 9: Table of Cost effectiveness

	Custom made VAC dressing	Conventional dressing
Sample size	45	45
Average no of dressing	10	54
Initial dressing cost	Rs 488	Rs 130
Subsequent dressing cost	Rs 200	Rs 130
Total cost per patient	Rs 2288	Rs 7020
Mean duration of Hospital stay	29.91 days	53.46 days

Summary Table

Because they require fewer dressing changes and require shorter hospital stays, custom-made VAC dressings, while initially more expensive per dressing, ultimately result in much lower total costs. This demonstrates how much less expensive VAC therapy is for treating wound than traditional bandages

DISCUSSION

Significant morbidity, a high healthcare burden, higher domiciliary treatment costs, lost productivity, and a decline in quality of life are all linked to leg ulcers.

The majority of patients seeking treatment for leg ulcers come from low- income backgrounds, making it difficult for them to afford the necessary medical care given their daily income. Even while the patient suffers from these wounds, their effects also extend to their family, putting them all to a complete stop if the patient is the family's only provider for a large number of dependents [1]. Therefore, an effective course of treatment is imperative for these patients. In addition to the financial burden that comes with having to pay for healthcare, which is substantial, the majority of the time the patient's ability to earn a living while in the hospital is also compromised, which compounds to the strain.

In their study, Gurtner et al. discovered that the vacuum dressing group had a shorter hospital stay [2].

In the literature on general, orthopaedic, and plastic surgery, there are a lot of accounts about the use of wound VACs. VAC lessens the bacterial load, enhances blood flow, promotes

angiogenesis, accelerates the formation of granulation tissue, and gets rid of third-space fluid by applying negative pressure to the wound.

The VAC device is composed of a plastic sealant drape, a polyurethane sponge, and a negative-pressure suction device. In order to eliminate any dead space and prevent skin contact, the sponge must be placed inside the wound bed's limits, being careful to touch every area of the wound. To prevent suction loss, sealant should be applied to the surrounding area after the device has been operated with approximately 125 mm Hg of suction [3].

The VAC dressings are changed by a skilled nurse or the operating room every two to four days, or as frequently as needed. Once the infection is fully treated and the wound margins appear healthy, the patient may be returned to the operating room for delayed primary wound closure.

With a potential 50% reduction in SSI, emerging data on the use of wound VAC to prevent SSI in high-risk patients is encouraging; nevertheless, a randomised controlled trial has not yet been conducted to support its use as a prophylactic strategy. 166 Using a wound VAC after an SSI diagnosis may have a number of advantages, including reduced reliance on secondary intention closure, faster infection resolution, and fewer trips to the operating room for wound washout. It may also eliminate the need for frequent dressing changes in open wounds. Possible adverse effects include stuck sponges, hypoalbuminemia, toxic shock syndrome, significant blood loss, and a possible CSF fluid leak.

Table 10: Age Distribution

	VAC Dressing	Conventional dressing
Present study	48.33 ± 12.48	51.22 ± 11.55
Lone et al[31]	53.79±5.45	54.57±4.78
Tauro et al[22]	47.59 years	47.42 years
Sridhar J et al[25]	35% in 51-60 years	35% in 51-60 years

The custom-made VAC dressing group had a mean age of 48.33 12.48 years, while the conventional dressing group had a mean age of 51.22 11.55 years. No statistically significant variation was found.

Age Distribution

Majority of the above studies observed that Incidence of chronic ulcers is more common in mid-40 and 50 years.

Table 11: Gender Distribution

	VAC Dressing	Conventional dressing
Present study	Male were 48.9% and female were 51.1%.	Male were 71.1% and female were 28.9%.
Lone et al[31]	In each group, men made about 35.71% and women approximately 64.28 percent.	
Tauro et al[22]	31:25	34:22
Sridhar J et al[25]	67% were males and 33% were females.	

In Custom made VAC dressing group, Male were 48.9% and female were 51.1%.

In Conventional dressing group, Male were 71.1% and female were 28.9%.This observation was not statistically significant

Gender Distribution

In Majority of the studies, Proportion of male were higher compared to female.

Table 12: Duration of Hospital Stay in Days

	VAC Dressing	Conventional dressing
Present study	29.91 ± 13.20	53.46 ± 17.26
Pragadeeswaran et al[32]	24.75±3.34	34.81±4.09
Bayoumi et al[33]	22.87± 7.62	32.53 ± 10.17
Joseph et al[34]	36.24 days	70.4 days
Tauro et al[22]	32.64 days	60.32 days

In the current study, the custom VAC dressing group spent an average of 29.91 ± 13.20 days in the hospital, while the conventional dressing group spent an average of 53.46 ± 17.26 days in the hospital. The mean length of stay was significantly lower in the custom VAC dressing group compared to the traditional dressing group.

Duration of Hospital Stay in Days

All the above mentioned studies observed that duration of hospital stay is significantly lesser among those underwent VAC dressing compared to conventional moist dressing.

Table 13: Etiology of Chronic ulcer

	Present study		Tauro et al[22]	
	VAC	Conventional	VAC	Conventional
Diabetic foot ulcer	11	22	17	20
Ischaemic ulcer	3	3	9	2
Bed sore	7	9	10	15
Venous ulcer	3	1	2	3
Post infective Raw area	16	7	10	8
Traumatic ulcer	5	3	8	8
Total	45	45	56	56

Distribution based on etiology of chronic ulcer shows in Custom made VAC dressing group, 24.4% had Diabetic foot ulcer, 15.6% had Bed sore, Ischemic ulcer in 6.7% and venous ulcer in 6.7%, Traumatic ulcer in 11.1%. Post infective raw area in 35.6%.

In Conventional dressing group, 48.9% had Diabetic foot ulcer, 6.7% had ischemic ulcer, 20% had Post infective raw area, 20% had Bed sore, Venous ulcer in 2.2%, Traumatic ulcer in 6.7%, Etiology of chronic ulcer

OUTCOME

Based on outcome, 100% in VAC dressing group had successful healing of ulcer whereas in Conventional dressing group 84.4% had successful healing.

Table 14: Percentage Ulcer Area Reduction

	VAC	Conventional
Present study	83.56% ± 16.88	53.88% ± 21.52
Tauro et al[22]	71.43% ± 26.45	52.85% ± 21.37
Bayoumi et al[33]	78.68 ± 18.12	51.92 ± 21.03

The current study found that the mean % ulcer area decrease was 53.88 ± 21.52 in the Conventional dressing group and 83.56 ± 16.88 in the Custom built VAC dressing group. There was statistical significance to this finding.

Percentage Ulcer Area Reduction

The size of the ulcer varied significantly before (36.9 ± 10.4 cm2) and after (54.2 ± 12.5 cm2) the moist dressing treatment (P = 0.1). On the other hand, for VAC dressing (P = 0.02; 39.5 ± 9.1 cm2 before vs. 28.8 ± 8.5 cm2 after treatment), the difference was not statistically significant. The ulcer diameters in the wet dressing group and the VAC group were very different.

Lone et al. [4] report that 22 patients (78.6%) in Group A had smaller wounds than 15 patients (53.6%) in Group B. Eighteen percent of lesions in Group B healed in eight weeks, compared to eighteen percent in Group A in five weeks.

Pragadeeswaran et al. [7] reported that patients in the experimental group experienced 15.46 ± 3.42 days (mean ± SD) for adequate healing of their ulcers and preparation for an ulcer bed. Patients in the control group, on the other hand,

showed comparable improvement in 23.95 ± 4.46 days (p = 0.008).

The average surface area of the wounds in the NPWT group was 40.44 cm2 before to therapy, compared to 38.52 cm2 for the conventional treatment, according to Bayoumi et al. [8]. After receiving wound care, the mean surface area of the diabetic wounds was 36.08 ± 2.56 cm2 in the NPWT group and 37.63 ± 2.86 cm2 in the standard therapy group.

Paola et al. demonstrated that treating DFU with VAC therapy results in a faster wound bed preparation (p=0.03) and a faster closure (p=0.005) as compared to conventional wound care [10].

Over the course of 16 days, a significant reduction in the wound area ($p < 0.05$) was seen in a study conducted by Kilic et al. [11] Non-percutaneous wound healing (NPWT) is superior to traditional gauze dressings in terms of reducing wound dimensions, achieving complete wound healing, preparing the wound bed more quickly, and lowering the risk of re-amputations, according to additional research by Dzieciuchowicz et al. [12], Sepulveda et al. [13], Moues et al. [14], and Ubbink et al. [15].

According to all of the aforementioned research, patients who received negative pressure dressing had a noticeably higher risk of granulation tissue formation than those who received traditional wet dressing.

On the Basis Incidence of Infection

In present study incidence of wound infection during treatment were 3 in out of 45 patient of Custom Made VAC dressing, 11 were infected in Conventional group out of 45 patient. The incidence of wound infection in custom made VAC dressing were significantly less as compare to conventional dressing.

Jones, D.A., and others [16] conducted research demonstrating that Negative Pressure Wound Therapy offers an alternative to traditional techniques of treating infected wounds, as it reduces infection and promotes the creation of infection-free scar tissue quickly.

The mechanism of negative pressure wound healing

Since ancient times, wound dressings have been used to encourage and hasten the healing of wounds. There are two things to consider when selecting clothes:

1. Blockage
2. Assimilation.

Studies reveal that occlusive dressing-treated wounds re-epithelialize faster than open wounds that are allowed to dry out [17]. Excessive exudates have the tendency to cause skin surrounding wound margins to become macerate, which in turn promotes bacterial overgrowth and hinders wound healing. For this reason, absorbent dressings are necessary [18]. NPWT satisfies both of these fundamental requirements and offers extra advantages to the healing wound. NPWT has a positive impact on wound healing due to a variety of interactions, resulting in both microscopic and macroscopic alterations.

Tissue Strain

According to one theoretical interpretation, tissue experiences micro-deformations or strains of between 5% and 20% as a result of sub-atmospheric pressure. This strain level has been shown to promote cellular division and proliferation, angiogenesis, and the production of growth factors. Tissue expansion increases soft tissue, and Ilizarovian distraction osteogenesis increases bone length using the same ideas of strain [19-21].

Inflammation Reduction

Second, edema, or a rise in interstitial fluid, is typically the result of inflammation-induced increased capillary permeability. Edema reduces the flow of nutrients and oxygen through tissue, which prevents wound healing. Tissue necrosis is more likely to occur when edema widens the gap between capillaries and repairing cells. NPWT actively decreases proteolytic enzymes, acute phase proteins, metalloproteases, proinflammatory mediators, cytokines, and edema fluid while increasing tissue blood flow.

Bacterial Load Reduction

Wounds are often made worse by bacterial overgrowth and infection, which leads to more tissue necrosis and cell death. Furthermore, it has been shown that infection delays wound repair by extending the inflammatory phase of wound healing. The capacity of NPWT to lower interstitial fluid, increase local blood flow, and decrease bacterial load in a wound has demonstrated its impact on infection. These actions collectively accelerate the rate at which wounds heal.

NPWT Algorithm

Both acute and chronic wounds are now routinely treated with NPWT. There is conflicting evidence to back up the use of NPWT. A consensus statement or set of rules for the usage of the NPWT has been attempted, although most practitioners have developed their own special methods for applying the test [22].

Paramount to use of NPWT are:

1. Initial evaluation of wounds
2. Preparing the wound bed
3. Comorbidity optimisation for patients.

Once these problems are under control, we evaluate each wound separately. Our choice to employ non-pressure wound dressing therapy (NPWT) is based on the wound's characteristics, such as the presence of necrotic or infected tissue and the amount of exposed tissue in the wound bed.

Other injuries, including sternal osteomyelitis, are taken into consideration separately since they have been thoroughly examined. Many studies have looked into the relationship between certain comorbidities, such as diabetic foot ulcers, venous stasis ulcers, and chronic wounds. For some applications, like covering flaps, the use of NPWT is debatable; for other applications, such skin grafts, it is well-established.

Although the technical features of NPWT application have been investigated, there is no clear consensus. Technical modifications include the choice of material below a semi-occlusive dressing, the type of semi-occlusive dressing, the iterface between the NPWT device and the wound, the negative pressure, and the type of pressure (continuous or intermittent). We go over each of these changes and the supporting data.

Assessment and Planning for Wounds

A set of principles that are applicable to wound care and healing in general form the basis of NPWT's benefits. Chronic wound development and wound healing delays are most often caused by systemic issues such diabetes mellitus, malnutrition, or immunodeficiency, or by local infections, hypoxia, trauma, foreign substances, or hypoxia. These negative effects are not lessened by the addition of NPWT.

Several requirements must be met for NPWT to be effective in healing wounds:

* Whichever device or dressing is chosen, accurate diagnosis is necessary for wound healing.
* Generally speaking, wounds should be devoid of necrotic tissue and debris.
* Accurate patient diagnosis is essential for wound care practitioners to provide appropriate therapy for

underlying medical conditions and wound issues such diabetes, peripheral vascular disease, or cancer. Debridement eliminates devitalized tissue, which may include endotoxins that prevent keratinocyte and fibroblast migration into the wound. There should be sufficient circulatory supply to wounds. In order to guarantee sufficient oxygenation, angioplasty or arterial bypass grafting can be required. Compressive clothing can help with venous insufficiency or stasis.

* Improved glycemic management ought to be implemented. In diabetes mellitus, glycosylation hinders the ability of neutrophils and macrophages to phagocytose microorganisms, hence extending the inflammatory stage of wound healing.
* To manage the infection, systemic antibiotics or local debridement or drainage should be applied. It is essential to optimise the wound bed and patient comorbidities. By inhibiting collagen deposition, sustaining elevated levels of proinflammatory cytokines, and breaking down granulation tissue and tissue development components with tissue proteases, cellulitis extends the inflammatory phase.

NPWT for Ulcers on the Diabetic Foot

Diabetic foot ulcers represent another challenging medical disease that physicians must treat. Foot abnormalities, neuropathic changes, and arthrosclerosis are common causes of lower limb ulcerations. The National Institute of Diabetes and Digestive and Kidney Diseases states that diabetic foot lesions are the leading cause of hospitalisations among diabetes complications. Diabetes is the leading cause of nontraumatic lower extremity amputations in the United States; each year, 5% of diabetics develop foot ulcers and 1% of diabetics require amputation.

There is a great need for the best wound care due to the chronic nature of these wounds and the often debilitating secondary amputations that ensue from them. The course of treatment includes off-loading the foot, debridement, revascularization where necessary, and proper glycemic management. Recovery is accelerated by NPWT after devitalized tissue removal.

A higher percentage of patients in the NPWT group (56%-39%, P =.04, respectively) were able to heal their wounds, which were defined as 100% re- epithelialization without drainage, according to Armstrong and Lavery [23].

* There were tendencies towards fewer second amputations.
* The NPWT group saw faster rates of healing and the creation of granulation tissue.

Lone et al. [4] report that whereas Group A had better patient satisfaction with regard to wound closure time, amount of antibiotics used, treatment- related issues, and outcome, Group B required more resources overall.

Apelqvist J et al. found a beneficial impact on resource utilisation and direct economic cost when comparing patients undergoing VAC to those receiving standard moist wound care [23]. based on a comprehensive analysis of 17 randomised studies of negative pressure wound treatment [23].

Two of the seven trials that examined diabetic foot ulcers were deemed to be of excellent quality. Clinically significant wound healing acceleration was observed in all 7 trials.

This study found that diabetic foot ulcers heal more quickly when treated with negative pressure wound care.

founded on a comprehensive analysis of 11 randomised studies evaluating the effectiveness of negative-pressure wound therapy for 972 diabetic foot wounds [24].

Advanced moist wound dressings made of different materials, antimicrobial dressings, or simple contact dressings served as the control.

640 individuals with foot ulcers who underwent negative-pressure wound therapy were evaluated in eight trials.

Contrasting alternative foot ulcer management techniques with negative- pressure wound care Therapy for wounds with negative pressure linked to enhanced wound healing in five trials including 486 individuals 1.4 is the risk ratio (RR) (95% CI 1.14-1.72).

Amputation risk was lowered in three trials including 441 individuals. RR 0.33 (95% CI 0.15-0.7) NNT 11-31 with 11% of the control group amputation reduced healing time in one experiment with 341 individuals (hazard ratio 1.82, 95% CI 1.27-2.6).

The effects of negative-pressure wound therapy on patients with post- amputation foot wounds were investigated in two trials.

Contrasting negative-pressure wound care for the treatment of amputation- related foot wounds Negative-pressure wound therapy was associated with better wound healing (RR 1.44, 95% CI 1.03- 2.01) in one study with 162 participants.

Decreased healing time in a 162-patient experiment (hazard ratio 1.91, 95% confidence interval 1.22-1.99)

A nonsignificant decrease in the frequency of amputation was found by analysing data from two trials involving 292 patients (RR 0.38, 95% CI 0.14- 1.02).

According to the results of this comprehensive analysis, individuals with diabetic foot ulcers or foot wounds connected to amputation may benefit from negative-pressure wound care more than normal bandages in terms of healing and decreased risk of amputation.

341 patients with Wagner stage 2 or 3 diabetic foot ulcers (mean age 58 years, 79% male) were randomly assigned to receive either negative pressure wound therapy (using vacuum-assisted closure) or advanced moist wound therapy (hydrogels or alginates) for 112 days, with a follow-up scheduled after 9 months, based on a randomised trial [25].

Comparing negative pressure wound therapy with conventional moist wound therapy After 112 days, 43.2% of patients had complete wound closure compared to 28.9% (p = 0.007, NNT 7). The estimated median time to close a wound was 96 days, compared to an unknown amount of time (p = 0.001).

At six months, 4.1% vs. 10.2% (p = 0.035, NNT 17) had secondary amputations.

The results of this thorough research suggest that negative pressure wound therapy may be more advantageous than advanced moist wound care for some individuals with Wagner stage 2 or stage 3 diabetic foot ulcers.

A randomised trial found that 162 adults with wounds up to the trans-metatarsal level from partially diabetic foot amputation and adequate perfusion were randomly assigned to receive either standard moist wound care, which entails changing the dressing daily or as the doctor deems appropriate, or negative pressure wound therapy, which involves a vacuum-assisted closure therapy system and lasts for 48 hours (16 weeks).

Juxtaposing negative pressure wound treatments with conventional moist wound care

1) Healing in 56% vs. 39% (p = 0.04, NNT 6).
2) Complete wound closure without surgical intervention in 40% vs. 29%.
3) Withdrawal before last treatment visit without wound closure in 22% vs. 25%.
4) Second amputation in 3% vs. 11% (p = 0.06)

No significant differences in adverse events comparing intervention vs control
1) 52% vs. 54% had ≥ 1 adverse events.
2) 17% vs. 6% had adverse event of wound infection.
3) 12% vs. 13% had treatment-related adverse event

According to the study's findings, wounds treated with negative pressure following a partial foot amputation may heal more quickly and prevent the need for additional amputations

CONCLUSIONS

The trial had two patient groups, one with normal dressing and the other with a specially-made vacuum-assisted closure (VAC) dressing. Both patient groups had chronic ulcers. The study found the mean age, gender, kind of ulcer, length of hospital stay, and percentage of reduced ulcer area for both groups.

The custom made VAC dressing group had significantly lower hospital stay, higher percentage of ulcer area reduction, and higher success rate of healing than the conventional dressing group.

Because there were fewer dressing changes and shorter hospital stays, the specially designed VAC dressing group had a lower overall cost. The study demonstrated how much less expensive VAC therapy is for treating wounds than traditional bandages.

The custom made VAC dressing group had higher satisfaction level, good pain control as compared to conventional dressing.

REFERENCES

1. Seidel D, Storck M, Lawall H, Wozniak G, Mauckner P, Hochlenert D, et.al.: Negative pressure wound therapy compared with standard moist wound care on diabetic foot ulcers in real-life clinical practice: results of the German DiaFu-RCT. BMJ open. 2020, 1:026345.
2. Chen L, Zhang S, Da J, et.al.: A systematic review and meta-analysis of efficacy and safety of negative pressure wound therapy in the treatment of diabetic foot ulcer. Annals of palliative medicine. 2021, 10:108300839-10839.
3. Li J, Chen J, Kirsner R: Pathophysiology of acute wound healing. Clin Dermatol. 2007, 25:9-18.
4. Bishop A: Role of oxygen in wound healing. J Wound Care. 2008, 17:399-402.
5. Boulton AJ: The diabetic foot—an update. Foot Ankle Surg.
6. Jones GA, Butler J, Lieberman I, Schlenk R: Negative-pressure wound therapy in the treatment of complex postoperative spinal wound infections: complications and lessons learned using vacuum-assisted closure. Journal of Neurosurgery: Spine. 20071, 6:407-11. 10.3171/spi.2007.6.5.407
7. Hebsur NI, Pandey K, Puttannavar G: To compare the efficacy of topical negative pressure dressing with that of conventional moist wound dressings, in healing of wounds. International Surgery Journal. 2017, 25:3962-6. 10.18203/2349-2902.isj20175392
8. Lone AM, Zaroo MI, Laway BA, Pala NA, Bashir SA, Rasool A: Vacuum- assisted closure versus conventional dressings in the management of diabetic foot ulcers: a prospective case-control study. Diabetic foot & ankle. 20141, 5:23345. 10.3402/dfa.v5.23345
9. Pragadheeswaran M, Balan Y: Pyati AK. A Comparative Study Between Vacuum Dressing and Normal Saline Dressing for Chronic Non-Healing Ulcers. Cureus. 2022, 6:14. 10.7759%2Fcureus.23870
10. Joseph: A prospective randomized trial of vacuum assisted closure versus standard therapy of chronic non-healing wounds. Wounds. 2000, 12:60-76.
11. Ravari H, Modaghegh MH, Kazemzadeh GH, Johari HG, Vatanchi AM, Sangaki A, Shahrodi MV: Comparision of vacuum-asisted closure and moist wound dressing in the treatment of diabetic foot ulcers. Journal of cutaneous and aesthetic surgery. 2013, 6:17. 10.4103/0974-2077.110091
12. Dalla Paola L, Carone A, Ricci S, Russo A, Ceccacci T, Ninkovic S: Use of vacuum assisted closure therapy in the treatment of diabetic foot wounds. J Diabetic Foot Complications. 2010, 2:33-44.
13. Kilic A, Ozkaya U, Sokucu S, Basilgan S, Kabukcuoglu Y: Use of vacuum-assisted closure in the topical treatment of surgical site infections. Acta Orthopaedica et Traumatologica Turcica. 20091, 43:336-42. 10.3944/AOTT.2009.336
14. Dzieciuchowicz L, Espinosa G, Grochowicz L: Vacuum assisted closure (VAC) in the treatment of advanced diabetic foot. Cirugía Española (English Edition. 2009, 1:213-8. 10.1016/S2173-5077(09)70090-0
15. Sepúlveda G, Espíndola M, Maureira M, Sepúlveda E, Fernández JI, et.al.: Negative-pressure wound therapy versus standard wound dressing in the treatment of diabetic foot amputation. A randomised controlled trial. Cirugía Española (English Edition. 2009, 86:171-7. 10.1016/S2173-5077(09)70086-9
16. Zhenmi Liu, Jo C Dumville, Robert J Hinchliffe, Nicky Cullum, Fran Game, Nikki Stubbs: Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. Cochrane Database Syst Rev. 2018, 10:010318. 10.1002/14651858.CD010318.pub3
17. Mouës CM, Vos MC, Van Den Bemd GJ, Stijnen T, Hovius SE: Bacterial load in relation to vacuum assisted closure wound therapy: a prospective randomized trial. Wound repair and regeneration. 2004, 12:11-7. 10.1111/j.1067-1927.2004.12105.x
18. Ubbink DT, Westerbos SJ, Nelson EA, Vermeulen H: A systematic review of topical negative pressure therapy for acute and chronic wounds. Journal of British Surgery. 2008, 95:685-92. 10.1002/bjs.6238
19. Winter GD: Epidermal wound healing under a new polyurethane foam dressing (Lyofoam). Plastic and Reconstructive Surgery. 19751, 56:531-7.
20. Bishop SM, Walker M, Rogers AA, Chen WY: Importance of moisture balance at the wound-dressing interface. Journal of wound care. 2003, 12:125-8. 10.12968/jowc.2003.12.4.26484
21. Saxena V, Hwang CW, Huang S, Eichbaum Q, Ingber D, Orgill DP: Vacuum-assisted closure: microdeformations of wounds and cell proliferation. Plastic and reconstructive surgery. 20041, 114:96. 10.1097/01.PRS.0000135330.51408.97
22. Ilizarov GA: The tension-stress effect on the genesis and growth of tissues: Part I. The influence of stability of fixation and soft-tissue preservation. Clinical Orthopaedics. 1976200719891, 238:249-81. 10.1016/S0140-6736(05)67695-7
23. Blume PA, Walters J, Payne W, Ayala J, Lantis J: Comparison of negative pressure wound therapy using vacuum-assisted closure with advanced moist wound therapy in the treatment of diabetic foot ulcers: a multicenter randomized controlled trial. Diabetes care. 20081, 31:631-6. 10.2337/dc07-2196
24. Apelqvist J, Armstrong DG, Lavery LA, Boulton AJ: Resource utilization and economic costs of care based on a randomized trial of vacuum- assisted closure therapy in the treatment of diabetic foot wounds.. The American Journal of Surgery. 2008, 1:782-8.
25. Tay WL, Lo ZJ, Hong Q, Yong E, Chandrasekar S, Tan GWL: Toe Pressure in Predicting Diabetic Foot Ulcer Healing: A Systematic Review and Meta-analysis. Ann Vasc Surg. 2019, 60:371-8. 10.1016/j.avsg.2019.04.011