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THE EFFECT OF APPLYING NEGATIVE PRESSURE TECHNIQUE ONTHE DEGREE OF HEALING OF DIABETIC FOOT ULCERS

Waad Al Jaffi[1]*, Mazen Haidar[2], Ghanem Ahmad[3] and Ghassan Almohammad[4]

[1]Professor Assistant – Adult Nursing Department, Faculty of Nursing, Tishreen University, Latakia, Syria.
[2]Professor - Department- Faculty of Medicine, Tishreen University, Latakia, Syria.
[3]Postgraduate Student, Adult Nursing Department, Faculty of Nursing, Tishreen University, Latakia, Syria.
[4]AL Andalus Private University for Medical Science, Faculty of Dentistry Syria.

***Corresponding Author: Waad Al Jaffi**

Professor Assistant – Adult Nursing Department, Faculty of Nursing, Tishreen University, Latakia, Syria.

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ABSTRACT

Introduction: Diabetes is considered the most common metabolic disorder around the world, and diabetic foot ulcers are one of the most important health complications associated with chronic diabetes and are the main cause of non-traumatic leg amputation. The current study aimed to evaluate the effect of applying negative pressure technology on the degree of healing of diabetic foot ulcers among patients withtype 2 diabetes at Tishreen University Hospital in Lattakia. **Methods:** According to theexperimental method, the study was applied to a random sample that included 30 patients of both sexes in the vascular surgery department. They were divided into two experimental groups (15 patients) who underwent dressing changes for foot ulcers using the negative pressure technique, and control groups (15 patients) who underwent dressing changes according to the routine method approved in the hospital. The degreeof healing of ulcers and the degree of ulceration were evaluated using the the RESVECH scale and the ulcer score scale during days (1, 5, 10, 15, 20) after the start of dressing application. **Results:** The results showed that there were very significant statistical differences in the degree of healing of diabetic foot ulcers in patients in the experimental group during repeated assessments compared to patients in the control group (U = 44, P = 0.004), and there were significant statistical differences in the total ulcer degree)X^2 =90.01،p =0.090(compared to patients in the control group. **Conclusions:** The negative pressure technique has a role in improving the healing of diabetic foot ulcers. Therefore, the study recommends the necessity of adopting it as a routine dressing method for diabetic foot ulcer patients and conducting more research on it in order to improve the healing of patients and reduce the need for lower limb amputation.

KEYWORDS: Negative pressure, Wound healing, ulcers, Diabetic foot, Diabetes.

INTRODUCTION

Diabetes is considered the most common metabolic disorder around the world and results mainly from a defect in insulin secretion, insulin action, or both (WHO, 2021 (2). (1) The latest World Health Organization statistics to monitor the level of diabetes in Syria in 2016 recorded an incidence rate of 11.9% Since that year, statistics have not been available at the national level to monitor the level of diabetes as a result of the Syrian crisis, which exceededmore than ten years ago, as health care systems, including hospitals and clinics throughout the country, were affected.[1-5]

Diabetic foot ulcers are one of the most important health problems associated with chronic diabetes and are the main cause of non-traumatic leg amputation. Diabetic foot ulcers are mainly caused by diabetic microangiopathy, which leads to vascular ischemia. Health care providers have an essential role in caring for diabetic feet and making life healthy and comfortable for people with diabetes, by managing and investigating vascular insufficiency in the extremities and special foot care to distribute Pressure areas are proportional to blood sugar monitoring.[6-8]

Advanced diabetic foot ulcers require careful dressing selection to overcome factors contributing to delayed healing. In addition to changing bandages, there are some non- invasive techniques for managing diabetic foot ulcers that can be performed by nursing staffto help the patient heal and avoid complications and amputation. Applying negative pressure to wounds is one of these techniques, as negative pressure is applied to wounds, which helps drain fluids from the interstitial space in edematous tissues and shrink the thirdspace.[9]

Numerous articles and studies have described the mechanism of effect of negative pressure as follows: It helps bring the edges of the wound closer together with continuous traction, which helps reduce the size and complexity of the wound. It also provides a moist environment and has a role in reducing edema. It expands the lumen of blood vessels and increases the concentration of oxygen in the tissues, which helps tissue growth. The increasein flow also facilitates the migration of granulocytes and macrophages towards the wound cavity, but the percentages were different for these studies, such as the study by Moues et al, 2004), which showed that the wound area decreased at a higher rate in negative pressure patients (100% versus 77%). For control group patients, the rate of volume reduction was higher in the negative pressure therapy group. However, the study by Braakenburg et al (2006) concluded that there was no significant difference in the rate of shrinkage between negative pressure therapy and the rest of the modern treatments (gel bandages, acetic acid, sodium hypochlorite). The two previous studies confirmed that the growth of granulation tissue is faster than using a regular bandage, which reduces the size, but the size of the internal cavity and the complexity of the shape of the wound may complicate treatment, as (Fujioka et al, 2014) showed that wounds that are complex in shape or that contain a pocket that extends under the skin for more than 1 cm are It is more susceptible to infection complications due to the formation of bacterial cavities, or the presence of pieces of sponge within the cavity, but there are not sufficient studies on the subject.[10-12]

Nursing contributes to the rest of the health staff in the care and management of patients with diabetic ulcers by providing nursing care for the ulcers, which is represented by following up on these ulcers and applying different care techniques and dressings. In tertiary prevention, the nursing staff can help the patient who had an amputation to regain his role and functions and meet his needs himself. There are not many previous studies that have addressed the use of negative pressure technology on diabetic foot ulcers, so this current study aims to evaluate the effectiveness of applying negative pressure on the degree of healing of diabetic foot ulcers.[14,13]

The importance of the Research and Its objectives

The importance of this technique in treating diabetic foot ulcers comes from reducing the time patients stay in the hospital, which reduces the need for daily dressings, repeated debridement, and prolonged treatment with antibiotics. This is exhausting for the medical staff first, and wastes a portion of the hospital's budget that could be used to improve other services. Its importance also lies in reducing the rate of disability, returning to normal life, reducing the incidence of complete amputation of the foot, and reducing the large economiccost.

The research aims to

Evaluating the effect of applying negative pressure technology on the degree of healing of diabetic foot ulcers in patients with type 2 diabetes.

Research Materials and Methodsconstruct research

Real experimental research.

Location: This study was conducted in the Department of Vascular Surgery at Tishreen University Hospital in Latakia. Data collection and application of the study took from 3/1/2022 to 9/1/2022 (6 months).

Sample: An appropriate sample of 30 patients with diabetes of both sexes was selected. The patient was selected according to the following specifications:

- Age 40 years or older.
- He has a third or fourth degree diabetic foot ulcer.
- The ulcers were debrided twice in the previous 2 weeks before dressings were applied.
- His blood sugar level was controlled during his stay in the hospital.
- Residing in the hospital for 20 days following the start of the study.
- The area of the ulcer is more than 2 cm2.

Exclusion criteria

The patient who had complete ischemia of the foot was excluded

The sample was divided into two equal groups, each containing 15 patients, by a simple random method, with the first patient in the experimental group and the second patient in the control group. The experimental group underwent negative pressure therapy using a suction pump (Vacuum device).The control group underwent treatment according to the routine followed in the hospital, which included changing the bandage using the antibiotic fucidin.

Search tools

Data was collected by the researcher using the following tools:

The first tool: A questionnaire developed by the researcher after reviewing the references and literature related to the research topic. It consists of two parts:

1. Part one: Demographic data, including: age, gender, level of education, profession, andhabits.
2. Part two: Vital data, including: current diseases, medications, body mass index (BMI), history of diabetes diagnosis, complications, prescribed treatment, degree of ulcer, location of the ulcer, its onset, laboratory investigations, type of bandage used, and complications during the period of application of the bandage.

The second tool: Wound Healing Evaluation Scale (RESVECH Scale) was designed by (Medrano & Soriano, 2012)[15] to evaluate the healing of chronic wounds and consists ofnine parts, which are:

- Wound dimensions: (Length, Width, Area).

- Depth of affected tissues: (Skin, Dermis, Muscles, Bones).
- Condition of edges: (Indistinguishable, Serrated, Defined, Damaged, Thickened, Invertededges).
- Degeneration around the wound: (Looseness in the area between the edges and The areasurrounding the wound).
- Formation of pockets: winding paths in the wound.
- Type of tissue in the wound bed: (Necrotic, Fibrinous, Granulation tissue, Epithelial, Confluent/healed).
- Condition of the dressing: (Wet, Dry, Wet, Saturated, Leaking secretions).
- Signs of infection: (increasing pain, redness around the wound, edema around the wound, high temperature, increased secretions, purulent discharge, fragile tissues that bleed easily - fixed wound, no progress, tissues are compatible with the biofilm, odor, hypergranulation, the wound is getting larger", formation of abscesses, pale tissue).
- Pain at the site of the wound: (not present, when changing the bandage, sometimes, at alltimes).

The maximum number of points is (40). The lower the number of points, the faster thewound will heal.

The third tool: evaluating the degree of ulcer

- First degree: A superficial ulcer covering the entire skin thickness without including the underlying tissue.
- Second degree: The presence of a deep, perforated ulcer that includes ligaments and muscles without including bones or the formation of an abscess.
- Third degree: Characterized by a deep ulcer with connective tissue inflammation or abscessformation, often with osteomyelitis.
- Fourth degree: Associated with the presence of gangrene localized at the site of the ulcer.
- Fifth degree: Associated with the extension of gangrene to include the entire foot.

A vacuum device was used: A pump to withdraw secretions, which achieves continuous and intermittent withdrawal modes, and can withdraw up to (35 liters/minute) at least, and contains a pressure regulator and a negative pressure gauge. It is also equipped with a one- liter excretory collection tank, with a cover and a protective pad, and is equipped with a socket connector that is 1.5 meters long and a patient connector (Silicone tube) that is three meters long. It is also equipped with a holder for the tank. It is a technique used to manage wounds by applying negative pressure to the wound. It relies on an adjacent layer of gauze or open-pore sponge, covered with a semi-impermeable adhesive bandage that preserves fluids and allows steam to escape. It is connected to tubes that connect the wound to the suction pump, which helps bring the edges of the wound closer with continuous traction andprovides a moist medium. It reduces edema and increases local circulation, in addition to stimulating the formation of new blood vessels and the growth of granulation tissue, and reduces the size and complexity of the wound.

Research methods

1. Official approvals were obtained from the hospital and patients according to a writtenform prepared by the researcher.
2. Developing study tools

- The first data collection tool was developed after reviewing relevant literature andreferences.
- The second tool was translated by the researcher and then presented to 7 experts in the medical and nursing fields to investigate the validity of the content.
- A pilot study was conducted on 3 patients, and the reliability coefficient of the second tool was calculated using Cronbach's alpha coefficient, and it reached (0.82), which is a high degree of reliability that makes the tool suitable for achieving the goal of the study.
- The sample was selected from visitors to Tishreen University Hospital and the sampling criteria were applied to them. The sample was randomly divided using the simple random method into two experimental and control groups (15) patients within each group, where the first patient was within the experimental group and the second patient was within the control group. The experimental group underwent treatment. With negative pressure using a vacuum device, while the control group underwent treatment with the routine followed inthe hospital.
- Demographic and health data were collected for each patient during the first interview, and then the foot ulcer healing status and ulcer grade were assessed during the first, fifth, tenth, fifteenth, and twenty days after the start of the study steps.
- Patients' blood sugar was measured at the first evaluation to ensure it was controlled.
- A morphological assessment of the ulcer was performed using a pointed, sterilized instrument that was inserted into the deepest area of the ulcer surface and measured in centimeters at the level of the skin surface.

Steps for applying the bandage

Experimental group (Application of negative pressure technique):

- Blood sugar, hemoglobin, and complete blood count were monitored.
- The old bandage was removed after moistening the adhesive with 0.9% saline serum.
- The wound was disinfected with (povidone 4%): by moistening the gauze with povidone and wiping the wound several times, using one screen for each swab, taking into account wiping movements with a dab if there is granulation tissue.
- The wound was debrided by the researcher if fibrinous or necrotic tissue was present adhering to

the wound surface and preventing the formation of granulation tissue. The wound was then re-disinfected with a 4% povidone solution, then the wound was dried withsterile gauze.

- An adhesive layer of open-pore sponge was applied to the ulcer after debridement. It was covered with a semi-impermeable adhesive dressing that retained fluid and allowed vapor to escape. It was connected to tubing connecting the wound to the suction pump.
- Negative pressure was applied via the suction pump, ranging from 60 mmHg to 125 mmHg or more depending on the status of the wound.
- The bandage was removed on the fifth day, and the condition of the wound was assessed, then a new bandage was reapplied for another five days, and the wound was re-evaluated using the second and third tools, and the bandage was renewed every five days for twentydays.

The second group (The control group) (Antibiotics): was left to the routine followed in the hospital according to the following:

- Remove the bandage after moistening the adhesive with saline serum.
- Disinfecting the wound with (Povidone 4%): Moisten the cloth with povidone and wipe the wound several times, using one screen for each wipe, taking into account wiping movements with a dab if there is granulation tissue.
- Debridement of the wound in the event of the presence of fibrinous or necrotic tissue that adheres to the wound surface and prevents the formation of granulation tissue. Then, re- disinfect the wound with a 4% povidone solution, then dry the wound with sterile gauze.
- Apply an amount of Fusin ointment to the wound immediately after debridement, then apply sterile gauze.
- The degree of healing and the degree of ulceration were evaluated during days (1, 5, 10, 15, 20) from the start of applying the interventions.

3. The results were analyzed using the statistical program SPSS, version 25, according to the following: frequency and percentages, chi-square for the differences between the two groups regarding demographic and health data and the degree of ulcers, and the non- parametric Mann-Whitney U test for two independent samples to compare the differences between the averages of the ranks between the two groups. Regarding the degree of healing.
   - Differences at the significance threshold (p value ≤0.05) were considered statistically significant and denoted (*), and at the significance threshold (p value ≤0.01) they were considered statistically very significant and denoted (**).

RESULTS

Table (1) shows a comparison of the sample members according to demographic data, and shows that the highest percentage of the sample members (73.3%) are over 60 years old, and the highest percentage (60% and 66.7%) of the members of the experimental and control groups, respectively, are male, and the percentage The highest percentage of members of the experimental group (33.3%) read and write only, while the highest percentage of members of the control group (33.3% and 33.3%) is distributed among those with primary and middle school certificates. The economic situation was weak for more than half of the patients in the experimental group (53.3%) and moderate for more than half of the patients in the control group (53.3%). Regarding work, the highest percentage of the sample (60%) and (53.3%) work in self-employed professions within the experimental and control groups, respectively. The table also shows that the highest percentage of the sample members are smokers (53.3%, 93.3%) in the experimental group and the control group, respectively, and the majority of them do not drink alcohol (93.3%) for both groups, respectively.

The table shows that there are statistically significant differences in smoking between the two groups (X2=13.92, p=0.003).

Table 1: Comparison of study sample members according to demographic variables.

X^2/p	Control group		Experimentalgroup		Variable categories	variable
	%	N	%	N		
3.511 0.742	0.0	0	6.7	1	<50 -40	Age inyears
	26.7	4	20.0	3	60≤ 50	
	73.3	11	73.3	11	60 >	
0.287 0.962	66.7	10	60.0	9	male	Sex
	33.3	5	40.0	6	female	
8.632 0.472	6.7	1	26.7	4	illiterate	Educationallevel
	26.7	4	33.3	5	Reads and writes	
	33.3	5	20.0	3	primary	
	33.3	5	20.0	3	preparatory	
4.677	46.7	7	53.3	8	Poor	Economic

0.586	53.3	8	33.3	5	middle	situation
	0.0	0	13.3	2	good	
6.585 0.361	0.0	0	13.3	2	employee	the job
	53.3	8	60.0	9	Free profession	
	46.7	7	26.7	4	retired	
13.92 0.003**	93.3	14	53.3	8	Yes	Smoking
	6.7	1	46.7	7	no	
0.655 0.884	6.7	1	6.7	1	Yes	Alcohol
	93.3	14	93.3	14	no	

X2: refers to the Chi square test P: significance level. *(P<0.05)

Table (2) shows a comparison of the sample members according to health data, and shows that with regard to body mass index, more than half of the experimental group patients (53.3%) and (60%) of the control group patients are within the normal weight range (18.5- 24.9), and the disease was diagnosed in Most of the sample members were more than 15 years old (80%, 86.7%) respectively. Insulin is the treatment used by the highest percentage of the sample (73.3 experimental, 66.7% control). Also, blood sugar is currently controlled for (66.7% experimental compared to 33.3% control) and glucose hemoglobin is high for themajority of the sample (93.4% experimental versus 100% control). The table did not show any statistically significant differences between the two groups regarding health data, with the significance level (p>0.05) for all variables.

Table 2: Comparison of study sample members according to health variables.

X^2/p	Control group		Experimental group		Variable categories	variable
	%	N	%	N		
3.379 0.760	0	0	0	0	Less than (18.5) underweight	Body mass index
	60.0	9	53.3	8	18.5-24.9 (normal weight)	
	26.7	4	26.7	4	25-29.9 (overweight)	
	13.3	2	20.0	3	30 – 35 (obese)	
	0	0	0	0	Older than 35	
5.481 0.484	13.3	2	20	3	Less than 10 years	Date of diagnosis
	86.7	13	80.0	12	Above 10 years old	
8.200 0.224	13.3	2	26.7	4	Oral hypoglycemic	Drug treatment
	66.7	10	73.3	11	Insulin	
	20.0	3	0.0	0	Oral depressants and insulin	
10.488 0.312	33.3	5	66.7	10	controlled	Fasting blood sugar
	66.7	10	33.3	5	Out of controlled	
3.530 0.740	0.0	0	6.7	1	normal	Glycosylated hemoglobin
	100	15	93. 4	14	high	

X2: refers to the Chi square test. P: significance level. *(P<0.05)

Table (3) shows a comparison of the study sample members according to the data on diabetic ulcers. It shows the presence of the fourth degree in the highest percentage (66.7% of the experimental group, compared to 86.7% of the control group), and its location in the highest percentage of them on the sole of the foot (53.3% of the experimental group, compared to 60% of the control group). control), and it began to appear in the highest percentage of patients in both groups (60%) for each of them seven months ago. The table did not show any statistically significant differences between the two groups regarding data related to diabetic ulcers, as the significance level was (p>0.05) for all variables.

Table (3): Comparison of study sample members according to data on diabetic ulcers.

X^2/p	Control group		Experimental group		Variable categories	variable
	%	N	%	N		
2.400 0.494	13.3	2	33.3	5	Third	Ulcergrade
	86.7	13	66.7	10	Fourth	
16.500 0.558	40	6	46.7	7	foot surface	The location of theulcer
	60	9	53. 3	8	Sole of foot	
5.238 0.950	20.0	3	26.7	4	Less than 3 months	beginningto appear
	6.7	1	0.0	0	3-6 months	
	60.0	9	60.0	9	7 months	

	13.3	2	6.7	1	13-18	
	0.0	0	6.7	1	More than 18	
	0.0	0	6.7	1	Area < 4 cm2	
	20.0	3	20.0	3	Area = 4- <16 cm2	
3.771	20.0	3	13.3	2	Area = 16 - < 36 cm2	Dimensions of
0.926	60.0	9	60.0	9	Area = 36 - < 64 cm2	the ulcer
	0.0	0	0.0	0	Area = 64 - < 100 cm2	
	0.0	0	0.0	0	100 cm2 Area	

Table 4 and Chart 1 show a comparison of the degree of healing of diabetic foot ulcers between the experimental group (negative pressure technique) and the control group that is subject to routine care during the study, and it shows that there are no statistically significant differences in the average ranks between them according to the RESVECH scale during the first day of the evaluation, where (U = 81.50, P = 0.181), while the differences in average ranks became statistically significant during the fifth day (U = 37.50, P = 0.002), the tenth day (U = 40, P = 0.002), and the fifteenth day (U = 48, P =0.007), and the 20th day (U=46,P=0.006), The table also shows, regarding the total evaluations, that there are very important statistically significant differences between the two groups in the average ranks according to the RESVECH scale (U = 44, P = 0.004). Therefore, there are differences in the degree of healing of diabetic foot ulcers between the two groups.

As Chart 1 shows, the experimental group (negative pressure technique) achieved lower average ranks than the average ranks of the control group (application of routine care). Thus, the first hypothesis was fulfilled: the degree of healing of diabetic foot ulcers in patients of the experimental group (application of negative pressure technique) is greater compared to the degree Healing of diabetic foot ulcers in control group patients (routine care application).

Table (4): Comparison of the degree of healing of diabetic foot ulcers between the experimental Group and The control group.

P value	Test statistic Z	Mann-whitney U	Average ranks		The day
			Controlgroup	Experimentalgroup	
0.181	-1.339	81.00	17.60	13.40	The first
0.002**	-3.140	37.50	20.50	10.50	Fifth
0.002**	-3.071	40.00	20.33	10.67	The tenth
0.007**	-2.688	48.00	19.80	11.20	Fifteenth
0.006**	-2.767	46.00	19.93	11.07	Twenty
0.004**	-2.847	44.00	20.07	10.93	Total

*: Significant statistically significant, P<0.05 **: Significant, very statistically significant, P<0.01

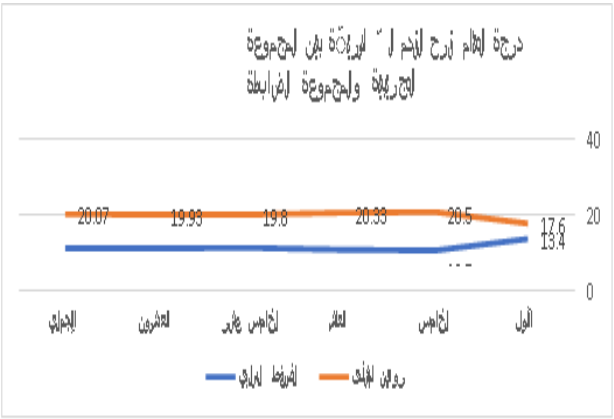

Table (5) shows a comparison of the degree of diabetic foot ulcers between the experimental and control groups, and shows that there were no significant statistically significant differences in the degree of ulcers during the first and fifth days of the evaluation, while the differences in the degree of ulcers became very statistically significant during the tenth day (X2 =20.18, p=0.003), and on the fifteenth and twentieth days, the differences in the degree of ulcers continued to be statistically significant (X2=10.87, p=0.042), (X2=16.53, p=0.011). The differences in the degree of ulcers were on the total days of evaluation.

Significant statistically significant (X2=10.09, p=0.018).

Table 5: Comparison of the degree of diabetic foot ulcers between the experimentalgroup and the control group.

X2/p	Control group		Experimental group		Variable categories	Group The Day
	%	N	%	N		
4.09 0.251	6.7	1	33.3	5	Third	The first
	93.3	14	66.7	10	Fourth	
6.818 0.078	6.7	1	46.7	7	Third	Fifth
	93.3	14	53.3	8	Fourth	
20.18 0.003*	0.0	0	13.3	2	second	The tenth
	6.7	1	46.7	7	Third	
	93.3	14	40.0	6	Fourth	
10.87 0.042*	13.3	2	46.7	7	second	Fifteenth
	20.0	3	26.7	4	Third	
	66.7	10	26.7	4	Fourth	
16.53 0.011*	13.3	2	66.7	10	second	Twenty
	40.0	6	13.3	2	Third	
	46.7	7	20.0	3	Fourth	
10.09 0.018*	6.7	1	46.7	7	Third	Total
	93.3	14	53.3	8	Fourth	

DISCUSSION

Applying negative pressure to wounds is an important treatment option for surgeons and health care providers. Due to the increasing number of diabetic patients in the world and the increasing complications resulting from diabetes, this necessitates more attention to patients in order to reduce or delay complications, based on advances in biology. The current study aimed to evaluate the effect of the negative pressure technique on the degreeof healing of diabetic foot ulcers compared to the routine dressing applied in the hospital, inorder to ensure that this technique Provides better care for our patients and improves their ulcer healing.[16]

The results of the current study showed that the degree of healing of diabetic foot ulcers in patients in the experimental group (negative pressure technique) was faster compared to patients in the control group that underwent bandage changes in the routine manner during the study, and the differences were statistically significant in the degree of healing during repeated assessments of the study. The researcher noticed during changing the bandage for the patients after five days that there were differences in the edges of the wound and the degeneration around it between the experimental group and the control group, as the edgesbegan to converge in the patients of the experimental group, and the degeneration was less and the depth of the wound became less after ten days, and after fifteen days the dimensions of the wound became smaller. Larger granulation tissue also began to form compared to the control group, and the depth continued to be smaller during the twentieth day, with a decrease in pain, redness, and edema around it, along with a decrease in secretions. That is, when fluids are removed from the wound, this leads to a decrease in swelling of the tissue, thus relieving pressure on the blood vessels and improving tissue perfusion from the wound. By allowing easy blood flow to the wound area.

The results of the current study also showed a decrease in the degree of diabetic foot ulcersin the patients of the experimental group that underwent negative pressure compared to the patients of the control group that underwent the hospital routine. The researcher attributes this result to the improvement in the degree of healing and the speed of healing, which transformed deep ulcers in which there was inflammation, abscess, or Inflammation and transformation of a full-thickness ulcer into a superficial second-degree ulcer.

This result is consistent with the results of the study of Nather et al, 2010, which was applied to 11 patients and showed the presence of granulation tissue and complete bacterial clearance at the end of treatment, and healing was achieved in all wounds (100%), and the study of Armstrong et al, 2005, which was applied to 162 patients. Patients were divided into (77 negative pressure, 85 wet dressings) who had partial amputation of the foot, and the results showed increased healing (56% for negative pressure, compared to 39% for wet dressing). The healing rate was faster in patients in the negative pressure group, but the side effects were similar in the two groups.[20,21]

CONCLUSIONS AND RECOMMENDATIONS

We conclude from the current study that the use of negative pressure technology using a mobile device had a positive effect on patients in the experimental group compared to the use of routine bandaging approved within the hospital. Signs of inflammation were lower in patients in the negative pressure group and the recovery rate was faster.

Recommendations

- Conduct more research on the mechanism of action of negative pressure technology during wound treatment.
- Conduct studies on the materials that can be used under the bandage, the mechanism of its application, and the pressure used during the application of the bandage in order to choose the optimal irritants for diabetic foot wounds.
- Applying negative pressure technology to types of wounds performed over periods of more than 20 days.

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