

## MOIST DRESSING AND OFF-LOADING USING A CRUTCH TOWARDS THE RECOVERY OF DIABETIC FOOT ULCER

Doni Setiyawan\*

<sup>1</sup>School Of Health Science Wira Husada Yogyakarta  
\*corresponding author: donisetiyawan703@gmail.com

### Abstract

Diabetic foot ulcer is one of the serious complications on diabetes mellitus patient. There are three main and important principals in diabetic foot ulcer treatment: infection control, debridement, and off-loading. The infection control can be done using moist dressing that can stimulate and recover the wound fastly. Alternative off-loading can be done using simple tool such as crutch which is easily available with affordable price without decreasing the principal of off-loading. Analyze the effects of moist dressing and off-loading using crutch towards healing of diabetic foot ulcer in patient with diabetes mellitus. The design of this research was quasi experimental with pre-test post-test control group design. The total number of the sample was 30 respondents that divided into 3 groups. The Intervention Group 1, the moist dressing and off-loading using crutch for 1,83 hours/day. The Intervention Group 2, the moist dressing and off-loading using crutch for 3,19 hours/day and the last group was controlling group. The data collecting technique used non probability sampling with consecutive sampling method and analyzed using paired t-test, one way annova, and linier regression. The scoring assesment of wound recovery used Bates Jansen Wound Assessment Tools (BJWAT). The score of BJWAT between Intervention Group 1 and Intervention Group 2 is  $p=0.049$ . The score of BJWAT between Intervention Group 1 and Controlling Group is  $p=0.256$ . The score of BJWAT between Intervention Group 2 and Controlling Group is  $p=0.650$ . Moist dressing and off-loading using crutch has affected the recovery of diabetic foot ulcer on proliferation phase. Moist dressing and off-loading using crutch is one of the most influential factors towards the recovery of diabetic foot ulcer compared to the peripheral vascularity, blood glucose, and nutritional status.

**Keywords:** Diabetic foot ulcers, Off-loading, Moist dressing, BJWAT, Wound recovery

### 1. INTRODUCTION

Diabetes mellitus is one of the major health problems of modern society in the world. Number of people with diabetes mellitus in the world recorded 382 million people suffer from this disease in 2013 and estimated that the number will increase significantly to 592 million in 2035 [1]. Diabetic foot ulcers are one of the most serious complication and can cause disability in patients with diabetes mellitus. The occurrence of diabetic foot ulcers is a representation of neuropathy. One of the causes of diabetic foot ulcers is a decrease in peripheral circulation which is heavily influenced by high levels of blood glucose and closely associated with peripheral arterial disease. Decreased peripheral circulation will cause death and ischemic tissue at risk of diabetic foot ulcers. The prevalence of diabetic foot ulcers in patients with diabetes mellitus is between 4-10% and the estimated lifetime of foot ulcer patients can experience up to 25% [2,3].

Management on a comprehensive diabetic foot ulcers is needed in the management of diabetic wounds that are not elongated ulcer healing phase and no complications or even death. The death rate caused by diabetic foot ulcers reached 17-23% and 15-30% due to amputation. Mortality at first year post-amputation of 14.8% and will increase at third years post-amputation by 37% [4].

Management of diabetic foot ulcers is needed to accelerate the healing process in this case that each phase of healing can be facilitated. When it happens complications or complications, efforts to cure such circumstances normal direction becomes very difficult. This is because the damage done generally to become chronic and can be up to the amputation [5,6]. There are three main principles that are very important in the management of diabetic foot ulcers : control of infection, debridement and off-loading. Infection control can be done by selecting the appropriate dressings that can serve to prevent wound contamination with the outside environment. A good dressing can also stimulate and accelerate wound healing. This dressing type moist dressings known concept that has been widely studied by experts who are proven to provide a moist environment to accelerate the process of epithelialization and granulation ulcers [7,8,9,10].

Eliminating or reducing the pressure load (off-loading) is one very important thing but till now received less attention in the treatment of diabetic foot. In people with diabetes who have foot ulcers become difficult to recover due to the pressure load of the body and the patient who goes on foot pedestal that experienced ulcers, and chronic irritation of the footwear used. Off-loading is a technique used to reduce the pressure on the plantar foot or ulcerated area by transferring the burden of other stricken area. Excessive pressure in the wound area will result in inhibition of ulcer healing process so difficult to heal ulcers. Off-loading shown to accelerate wound healing [11].

One method of removing the burden on foot or off-loading can be done by using off-loading alternatives are using simple tools such as crutches are easily obtained at a relatively affordable price. Patients who experience diabetic foot ulcers are not allowed to use a foot ulcer that experience as a stool while walking or activity because it can hinder the healing process. By using crutches patients can still walk and perform activities as usual. The tools used in the armpit crease aims to reduce the weight rests on the lower leg or the ulcer area by supporting the weight through the sleeve to compensate when a patient walks in order to avoid pressure on the ulcer area that can increase the risk of bleeding wounds,

Based on the above-described problem, the researchers have a desire to analyze the influence of moist dressings and off-loading using crutches to the process of healing of diabetic foot ulcers in patients with diabetes mellitus. In this study, researchers also want to know the most influential factor in the healing of diabetic foot ulcers in the intervention group and the control group.

Diabetic foot ulcers are sores experienced by diabetics in the area of the foot to the condition of the wound from the wound superficial, skin necrosis, until the wound with a full thickness (full thickness), which can extend kejangaran such as tendons, bones and joints, if the ulcer is left without good management will lead to infection or gangrene. Diabetic foot ulcers are caused by various factors, including high blood glucose levels and uncontrolled, peripheral neuropathy or peripheral arterial disease. Diabetic foot ulcers are one of the major complications of the most harmful and most serious of diabetes mellitus, 10% to 25% of diabetic patients develop into diabetic foot ulcer in their lifetime [14,15,16].

Management of diabetic foot ulcers is right needed to accelerate the wound healing process. Management of diabetic foot ulcers is a series of actions taken in a comprehensive manner is necessary to accelerate the wound healing process. Pilar standard in the treatment of diabetic foot ulcers is described according to the American Diabetes Association (ADA), among others debridement, reducing the pressure (off-loading), infection prevention and control. In line with the ADA experts added, the management of diabetic foot ulcers treatment should include: addressing comorbidities, revascularization, wound care with the right selection dressings [17].

Selection of dressings in wound management using the old method or using a conventional dressing or bandage to the principle of dry, dry conditions in the wound may inhibit wound healing by inhibiting cell proliferation and collagen. Conventional wound care must frequently replace the gauze bandage, whereas modern wound care has the principle of keeping moisture or known by the moist wound dressings [18].

Moist dressing does not cause adhesions at the wound surface which can make it easier to be removed and will not cause trauma to the wound. Trauma caused by the turn of the bandage can expand the width of wounds that result in impaired wound healing [6,19,20,21].

## 2. METHODS

The research design used in this study is a quasi-experimental design with pre-test post-test control group design. Design of this study aims to determine the effect of a given intervention on the dependent variable. Subjects were observed before the intervention, and then observed again after the intervention implemented [22].

The population in this study were all patients with diabetic foot ulcers in Hardjolukito Hospital Yogyakarta as many as 30 patients. The sampling technique used nonprobability sampling with consecutive sampling method. Sampling with this technique means taking a sample without using random, not done in a way that is not based on random probability that can be calculated. Samples were there and met the inclusion criteria drawn up to meet the calculation of sample size, consecutive sampling is the most excellent kind nonprobability [22].

The analysis used in this research is the analysis of univariate, bivariate and multivariate analyzes. Univariate analysis was conducted to determine the frequency distribution characteristics of respondents. The bivariate analysis was conducted to determine the relationship between variables, the measurement results with Bates Jensen Wound Assessment Tools (BJWAT) wound healing prior to treatment and after treatment. The statistical test used was paired t-test. To determine the effect of differences in the intervention group 1, 2 intervention and control groups against injuries penyembuhna done with 3 different test groups using One Way Anova. A multivariate analysis was conducted to determine where the most influential variables on the dependent variable. Tests conducted in this study is resgresi linear.

## 3. RESULT AND DISCUSSION

### Characteristics of Respondents

**Table 1 Distribution of Diabetic Foot Ulcers in Outpatient Hardjolukito Hospital July-November 2016 by Age and Duration of DM (n1 = 10, n2 = 10, n3 = 10)**

Variables	intervention 1	intervention 2	Control
<b>Age</b>			
mean	52.00	52.00	55.10
SD	5.617	5.617	3,035
Min-max	42-60	42-60	52-59
<b>Duration of DM</b>			
mean	6.60	6.60	8.80
SD	5.147	5.147	5.996
Min-max	2-19	2-19	3-22

Table 1 explains the characteristics of age in the intervention group 1 average 52.00 years, 2 intervention groups on average 52.00 years, and the control group gained an average of 55.10 years. The characteristic length of suffering from diabetes in the intervention group on average 6.60 1 year, 2 intervention group average of 6.60 years and a control group gained an average of 8.80 years.

**Compliance Using Crutches**

**Table 2 Distribution of Diabetic Foot Ulcers Patients In Outpatient Hardjolukito Hospital July-November 2016 Based Compliance of Use Crutches (n1 = 10, n2 = 10)**

Variables	intervention 1	intervention 2
<b>Using Crutches Duration</b>		
mean	1.83	3.19
SD	.670	0.886
Min-max	1-3	1-4

Table 2 explains the characteristics of compliance of the use of crutches were seen from the average use of crutches. Compliance with the use of crutches intervention group one day average is 1.83 hours with SD 0.670 and a minimum value of the use of crutches is 1 hour and a maximum of 3 hours per day, whereas the intervention group 2 in the average daily use of crutches is 3,19 hours with SD 0.886 and a minimum value of the use of crutches is 1 hour and a maximum of 4 hours per day.

**Gender, Religion, Employment and Smoking History**

Patient Characteristics Table 3 Distribution of Diabetic Foot Ulcers Patients in Outpatient Hardjolukito Hospital July-November 2016 by Gender, Religion, Employment and Smoking History (n1 = 10, n2 = 10)

Variables	Category	The intervention group 1		The intervention group 2		The control group		Σ n	Σ %
		n	%	n	%	N	%		
		<b>Gender</b>	Man	6	60	6	60		
	Woman	4	40	4	40	6	60	14	46.66
<b>Religion</b>	Islam	10	100	10	100	10	100	30	100
<b>Employment</b>	PNS	0	0	0	0	0	0	0	0
	Entrepreneur	5	50	5	50	4	40	14	46.66
	Farmer	0	0	0	0	0	0	0	0
	Retired	1	10	1	10	3	30	5	16.66
	Does not work	4	40	4	40	3	30	11	36.66
<b>Smoking history</b>	Yes	4	40	4	40	3	30	11	36.66
	Not	6	60	6	60	7	70	19	63.33

Table 3 shows that the intervention group 1 of the respondents were man more that 6 (60%) with the majority of work is self-employed 5 people (50%) and respondents who had a history of smoking 4 people (40%). The intervention group 2 the number of respondents were male more that 6 (60%) with the majority of work is self-employed 5 people (50%) and respondents who had a history of smoking 4 people (40%). In the control group, the respondents were woman more that 6 (60%) with the majority of work is self-employed 4 people (40%) and respondents who had a history of smoking 3 people (30%). Respondents in this study all of them are Muslim (100%).

**Peripheral Vascularization**

**Table 4 Distribution Characteristics of Peripheral Vascularization in Outpatient Hardjolukito Hospital July-November 2016 (n1 = 10, n2 = 10, n3 = 10)**

ABI	mean	standard Deviation	Min-Max
<b>Intervention 1</b>			
Before	.920	.0919	0.8-1.0
After	.890	.0568	0.8-1.0
<b>Intervention 2</b>			
Before	.910	.0876	0.8-1.0
After	.870	.0675	0.8-1.0
<b>Control</b>			
Before	0,900	.0816	0.8-1.0
After	0,880	.0789	0.8-1.0

Table 4 shows the value of Ankle Brachial Index (ABI) of each group at the beginning and end of the study. In the intervention group 1, the value of ABI at baseline of 0.920 decreased by 0.03 becomes 0.890 at the end of the study. The intervention group 2, the value of ABI at baseline decreased by 0.910 0.870 0.04 into the end of the study, while the value of ABI in the control group decreased 0.02 from 0,900 into 0,880.

**Blood Glucose**

**Table 5 Distribution Characteristics of Blood Glucose in Diabetic Foot Ulcers Patients in Outpatient Hardjolukito Hospital July-November 2016 (n1 = 10, n2 = 10, n3 = 10)**

<b>RBG</b>	<b>mean</b>	<b>standard Deviation</b>	<b>Min-Max</b>
<b>Intervention 1</b>			
Before	228.10	50.628	165-319
After	206.20	18.079	188-240
<b>Intervention 2</b>			
Before	224.50	37.515	165-285
After	197.50	14.608	178-221
<b>Control</b>			
Before	220.80	49.992	156-315
After	199.50	27.674	176-269

Table 5 shows the change in value Random Blood Glucose (RBG) of each group at the beginning and end of the study. In the intervention group 1, the value of the RBG at baseline to 21.9 at 228.10 decreasing be 206.20 at the end of the study. The intervention group 2, the value of the RBG at the beginning of the study experienced a decrease of 23.3 from 220.80 into 197.50 at the end of the study, while the value of RBG in the control group decreased to 21.3 from 220.80 into 199.50.

**Nutritional Status**

**Table 6 Distribution Characteristics Nutritional Status in Diabetic Foot Ulcers Patients in Outpatient Hardjolukito Hospital July-November 2016 (n1 = 10, n2 = 10, n3 = 10)**

<b>BMI</b>	<b>mean</b>	<b>standard Deviation</b>	<b>Min-Max</b>
<b>Intervention 1</b>			
Before	27.3820	2.43554	24.09 to 33.33
After	27.1910	2.25570	24.16 to 32.45
<b>Intervention 2</b>			
Before	27.1910	2.25570	24.16 to 32.45
After	27.6700	1.74126	24.86 to 30.78
<b>Control</b>			
Before	25.1050	3.73246	19.43 to 33.32
After	25.5830	3.33340	20.57 to 32.46

Table 6 shows the value Body Mass Index (BMI) of each group at the beginning and end of the study. In the intervention group 1, the value of BMI at baseline to 0.19 at 27.38 decreased becomes 27.19 by the end of the study. The intervention group 2, the value of BMI at baseline of 27.19 increased by 0.48 becomes 27.67 by the end of the study. While the value of BMI in the control group increased from 25.10 to 0.48 which is be 25.58.

**Wound Healing**

**Table 7 Distribution Characteristics Bates Jensen Wound Assessment Tools (BJWAT) Score in Diabetic Foot Ulcers Patients in Outpatient Hardjolukito Hospital July-November 2016 (n1 = 10, n2 = 10, n3 = 10)**

variables	mean	standard Deviation	Min-Max
<b>Intervention 1</b>			
Before	30.70	3,057	25-34
After	23.40	1,713	21-26
<b>Intervention 2</b>			
Before	23.40	1,713	21-26
After	20.00	3.682	15-28
<b>Control</b>			
Before	29,30	3,268	24-33
After	24,50	1,716	22-27

Table 7 shows the wound healing process seen from the BJWAT each group at the beginning and end of the study. In the intervention group 1 BJWAT baseline value of 30.70 decreased 7.3 becomes 23.40 by the end of the study. The intervention group 2 BJWAT baseline value of 23.40 fell 3.4 to 20.00 at the end of the study. While BJWAT value in the control group decreased 4.8 ie from 29.30 into 24.50.

**Phase of Wound Healing**

**Table 8 Distribution Characteristics Phase of Wound Healing in Diabetic Foot Ulcers Patients in Outpatient Hardjolukito Hospital July-November 2016 (n1 = 10, n2 = 10, n3 = 10)**

variables	intervention 1	intervention 2	Control
<b>Phase of Wound Healing</b>			
Homeostasis	-	-	-
Inflammation	-	-	-
Proliferation	10	2	10
Remodeling	-	8	-
<b>Total</b>	10	10	10

Table 8 shows the phases of wound healing in each group. In the intervention group 1 all respondents are in the proliferative phase. In the intervention group 2, 80% of respondents are in the remodeling phase. While the control group all respondents are in the proliferative phase.

**Bivariate analysis**

**Table 9 Paired t-test analysis Difference Score Bates Jensen Wound Assessment Tools (BJWAT) Before and After Moist Dressing And Off-Loading Using Crutches against Diabetic Foot Ulcer Healing (n1 = 10, n2 = 10, n3 = 10)**

Group	n	Mean ± SD	Mean difference		95% CI	p Value
			Mean difference	± SD		
<b>Intervention 1</b>	pre	10	30.70 ± 3,057		4987-	
	Post	10	23.40 ± 1.713	7.300 ± 3,234	9613	0000
<b>Intervention 2</b>	pre	10	23.40 ± 1.713		0024-	
	Post	10	20.00 ± 3,682	3.400 ± 4,719	6776	0049
<b>Control</b>	pre	10	29.30 ± 3,268		3338-	
	Post	10	24.50 ± 1,716	4.800 ± 2,044	6262	0000

Under the table 9 can be concluded that this table shows the difference in score BJWAT before and after the intervention group 1. The average score BJWAT in the intervention group 1 before treatment was 30.70 ± 3,057 after treatment carried an average score BJWAT decreased to 23.40 ± 1,713. Statistical analysis showed that the value of p = 0.000 can be explained that there are significant differences BJWAT scores before and after treatment in the intervention group 1. Intervention group 2, the average score BJWAT before treatment was 23.40 ± 1.713, after the treatment is done BJWAT average score dropped to 20.00 ± 3,682. Statistical analysis showed that the value of p = 0.049 can be explained that there are significant differences BJWAT scores before and after treatment in the intervention group 2.

In the control group, the average score BJWAT before treatment was 29.30 ± 3,268 after treatment carried an average score BJWAT decreased to 24.50 ± 1,716, Statistical analysis showed that the value of p = 0.000 can be explained that there are significant differences BJWAT scores before and after treatment in the control group.

Effect of moist dressings and off-loading using crutches in all groups known by examining the differences in each group on wound healing. The statistical test can be seen in the table below:



**Table 10 One Way Anova Analysis of Differences Influence Moist Dressing And Off-Loading Using Crutches Intervention group 1, 2 and Control Interventions against Diabetic Foot Ulcer Healing**

Dependent variables	Dependent variables	Mean difference	95% CI	p Value
1	Intervention 2	3,900	0.01-7.79	0049
	Control	2,500	-1.39-6.39	0256
<b>Wound Healing (BJWAT)</b>	Intervention 1	-3900	-7.79 - (-0:01)	0049
	Control	-1400	-5.29-2.49	0650
	Intervention 1	-2500	-6.39-1.39	0256
	Intervention 2	1,400	-2.49-5.29	0650

Table 10 shows the measurement between the intervention BJWAT 1 with 2 intervention group p = 0.049, this shows there is a significant difference between the intervention BJWAT measurement 1 with group 2. The measurement results BJWAT intervention in the intervention group 1 with the control group p value = 0.256, this shows there is no significant difference between the intervention group 1 with the control group. BJWAT measurement results between the intervention and control group 2 p value = 0650, indicating that there was no significant difference to the measurement BJWAT between 2 intervention groups with the control group.

**Multivariate analysis****Table 11 Regression Linear Test Variable Moist Peripheral vascularization, Blood Glucose and Status Healing (n1 = 10, n2 = 10, n3 = 10)**

Model	beta	t	p Value
Constant		4,386	0,000
Moist Dressing and Off-Loading	-1422	-1629	.116
Ankle Brachial Index	-4287	-0.598	0.555
Random Blood Glucose	-0011	-0735	0.469
Body Mass Index	-0494	-0652	.521

Table 4.12 shows the results of linear regression is the most influential variable on wound healing is the independent variable moist dressing and off-loading using crutches with p value 0.116. Moist dressings and off-loading using crutches is the most influential factor to the healing diabetic foot ulcers compared ABI factor, RBG and BMI. These variables have the most significant p value compared with other variable.

**DISCUSSION****Characteristics of Respondents****a. Age**

The results showed the average age of the respondents 52 years in the intervention group and 55.1 years in the control group. Seniors who are prone to diabetes are over 45 years [17]. Age is closely related to a person's health in this case especially the increase in blood glucose levels [23]. High levels of blood glucose resulting from the increase in age would interfere with the wound healing process [24].

Increasing age affect the wound healing process associated with the ability of cells or organs that have suffered setbacks in degenerative function. The ability of a system or organ support such as vascular, anti-bodies, decreased function of the liver and other organs will result in prolonged wound healing cycle. The phases of wound healing starts from homeostatic up phase of the remodeling will slow down and increase the risk of more severe infections in wounds due to a variety of things ranging from inflammation due to platelet aggregation, decreased secretion of growth factors, epithelialization delayed, failure in angiogenesis, collagen deposition and reduced turnover of collagen due to aging will affect the reduction in wound strength [21.25].

Age was also influential in the application of diet, decision-making and the ability to care for themselves. Respondents in this study fall into the category of middle age or pre elderly, this resulted in a reduction in cognitive abilities such as memory, thinking, and decision making [23]. Respondents have not realized the importance of the use of crutches as off-loading that can accelerate wound healing.

**b. Gender**

The results showed man more than woman. Gender did not show a significant difference to wound healing [26]. Woman have more estrogen hormone levels than man. Hormone estrogen plays an important role in the wound healing process, estrogen has an effect on the process of regeneration, extracellular matrix production, protease inhibition, the function of the epidermis and inflammation that can accelerate the wound healing process. The hormone estrogen affects the circulation in the tissue, maintain the normal structure of the skin tissue to remain elastic and maintain the skin's collagen to be maintained and able to hold water so that it can help the healing process [15].

**c. Smoking history**

Respondents in this study mostly had no history of smoking. Smoking history did not have a significant association with diabetic foot ulcer healing [27]. In line with this, smoking is not a major cause of the incidence of diabetic foot ulcers in a patient but as a secondary cause [28]. In contrast to the opinion, explaining that nicotine in cigarettes can stimulate the sympathetic nervous system to trigger the release of epinephrine causes vasoconstriction of peripheral and disrupt tissue blood perfusion. Nicotine also increases the viscosity of the blood so fibrinolytic process and interfere with adhesion of platelets. Nicotine in large quantities will increase the proliferation of irregular, irregular cell proliferation in the blood vessel wall, enables the formation of arteroma, this resulted in a disturbance in the blood circulation. Cigarettes also contain carbon monoxide which will be absorbed by the body and can disrupt the process of oxygenation of the cells. Oxygen is required in the metabolic process sal mainly in the production of ATP, angiogenesis, differentiation of keratinocytes, epithelialisasi epithelial migration and proliferation of fibroblasts, collagen synthesis and helps wound contraction. Oxygenation associated with vascularization, resulting in patients with disorders of vascularization will be impaired wound healing process [29].

**d. Duration of DM**

The results showed that the average length of suffering from diabetes in the intervention group was 6.6 years and 8.8 in the control group. The length someone mederita diabetes can increase the risk of complications diabetes. One is the type of sensory polyneuropathy complications that can increase the incidence of diabetic foot ulcers [28,30]. Respondents who declared himself a diabetic, after being asked their further stated that history counted after hospitalized with signs and symptoms of hyperglycemia. It shows that a history of diabetic patients may be longer than that delivered. We conducted the data collection, the average respondent worked as entrepreneur (46%), which makes the reason a person is too busy with his work and less attention to diet, exercise, and regular health checks.

**Measurement differences Wound Healing Before and After Treatment In Group Intervention 1, Intervention 2 and Control.**

The results showed that the average score BJWAT in all three groups experienced a decrease in the intervention group where 1 is the largest group decreased BJWAT scores before and after treatment. This happens because moist dressing and off-loading is a factor that affects the healing of diabetic foot ulcers [9,31]. In line with the off-loading to reduce mechanical stress on diabetic foot ulcers by eliminating pressure on the injured area, which aims to accelerate wound repair [11].

In this study, the state cuts in the intervention group 1 and 2 visible intervention did not experience leg edema in areas that experienced ulcers. Edema is one factor that slows wound healing [21].

Off-loading aims to reduce the pressure exerted by the load of the body and also the pressure from the effects of gravity in the wound area. The force of gravity to increase the pressure on the veins. The pressures generated by gravity by 90 mmHg, the pressure when added to the pressure by the heart will result in the venous pressure of 100 mmHg in the ankle area. Effect from off-loading is to reduce the pressure on the foot area without disturbing the circulation of the blood vessels that will improve the wound healing process [19].

In the intervention group 1, 2 using user intervention moist dressing for the choice of dressing in diabetic foot ulcers, while the control group using standardized care were used in the study are using modern dressings for the treatment of diabetic foot ulcers. Modern dressings and moist dressings are the right kind of bandage used for the treatment of diabetic foot ulcers and can accelerate wound healing [18]. This led to a decline in scores in all three groups BJWAT this study.

### **Differences Influence of Moist Dressing and Off-Loading Using Crutches In Group Intervention 1, Intervention 2 and Group Control of Measurement Wound healing.**

The results of different tests in this study is, of the three groups there is a difference between the effects of the intervention group 1 to group 2 intervention, the intervention group 1 and the control group there was no difference influences. This is also reflected in the intervention group 2 to the control group showed no difference in effect.

The difference between the effect of the intervention group 1 to group 2 intervention due to several factors, one of which is compliance with the use of crutches. In the intervention group 1 the average compliance using crutches is 1.83 hours / day, while the intervention group 2 the average compliance using crutches increased to 3.19 hours. Compliance in the use of crutches have an important role in the healing of diabetic foot ulcers as the primary function of the off-loading is to reduce the pressure on the ulcer area. The longer the use of crutches will increase the speed of wound healing. If a person with diabetic foot ulcers activity >15 minutes without the use of off-loading can increase the pressure on the distal area and reduces arterial perfusion due to compression which may affect the healing of diabetic foot ulcers [27].

The difference between the effect of the intervention group 1 with two intervention groups also due to the different phases of wound healing between the two groups. In the intervention group first phase of wound healing is the proliferative phase of wound healing phase while the intervention group 2 are in the remodeling phase. In the proliferative phase occurs in the wound granulation process, in this phase of the migration of epithelial cells such as fibroblasts and endothelial. These cells will produce a number of collagen, which plays a role in tissue reconstruction [29].

In the granulation process occurs proliferative phase and contraction. In the granulation process, macrophages and lymphocytes contribute to the proliferation and migration of epithelial cells, fibroblasts and endothelial. The epithelial cells that cover most of the keratinocytes to migrate and undergo stratification and differentiation to reconstitute the epidermis barrier. Epithelialisasi process also increases the production of extracellular matrix, growth factors, and cytokines through the release of Keratinocyte Growth Factor (KGF) [29.32].

The proliferation of endothelial cells, forming the structure of the new capillary blood vessels is known as angiogenesis also occurs in this phase. Then the contraction phase would facilitate the process of wound closure, along with the synthesis of collagen. Results from clinical contraction will be seen where the size of the wound will decrease. In the proliferative phase of diabetic foot ulcers occur closing the gaps that empty by granulation. Granulation is a fibrous tissue that will

become scar tissue in the wound healing process [21,29,32]. Is a new granulation tissue found in the wound bed that are easy fragile. Moist dressings and off-loading function to keep the granulation tissue in order to avoid trauma due to excessive pressure and also keep intact while replacing granulation wound dressing.

Respondents in the intervention group 2 had entered a phase of remodeling. Remodeling phase is the phase that takes place after the proliferative phase, at this phase is also called a maturation phase. At first it was replaced by a type III collagen type I collagen subsequently reorganized, so that the bond becomes more stable and not easily damaged. In this phase there are many extracellular matrix components such as hyaluronic acid, proteoglycan and collagen that as the deposit for improvements to facilitate cellular migration and adhesion to the support network [29.33]. Collagen fibers gradually increase and grow thicker and then seconded by proteinase for improvement along the lines of cuts.

Remodeling phase lasts for months and can last for years [21.29, 32.33]. Phase of wound healing is one thing to note in the lesion growth rate. The statement from the couple of shows that moist dressings and off-loading more influence on the proliferative phase of wound healing.

In between the different test results intervention group 1 and the control group there was no difference influences. This is presumably due to the use of modern dressing in the control group. The place of this research has been to apply the type bandages or dressings that use modern dressing. Generally, the wound care management in diabetic foot ulcers is divided into several stages starting from the assessment of the wound, cleaning or cleansing, removal of dead tissue or debridement, replacement bandage or dressing.

Modern methods of reimbursement methods bandage dressing is done carefully so as not to cause trauma or injury to injury, this process can also be done by irrigation with normal saline action for easy lifting and can tear open the wrapping tissue dead. The main mechanism of action of modern dressing technique is to maintain moisture in the wound. The same definition to acts done in the intervention group 2 by using moist dressing or bandage moist [29.32].

The moist definition means having the ability to control the production of exudate, maintain humidity wound, do not stick to the wound, preventing the entry of pathogenic bacteria, have the ability to absorb wound fluid and does not require frequent replacement bandage [29]. Humid conditions may help the healing process by facilitating the occurrence of fibrinolysis, angiogenesis, the formation of growth factors and menstimulai cells around the wound. Destruction of fibrin and platelet production, endothelial cells and fibroblasts strongly influenced by the humid conditions.

Moist dressing does not cause adhesion to the wound, bandage adhesions can lead to a new hemorrhage, traumatic, expand the width of the wound to interfere with wound healing process [6,19,20,29]. Differences score BJWAT pre and post significant in the control group due to process that has been standard wound care and the use of modern dressings for the dressing used.

In the different test results between intervention group 2 and the control group there was no difference influences. In addition to the control group who received modern dressing, according to the researchers these results allegedly influenced by the phase of wound healing. A different phase of wound healing between the intervention group 2 and the control group. Respondents in the intervention group 2 are the same respondents in the intervention group 1. In addition to having the same characteristics, the respondents in the intervention group 2 had previously been getting treatment for 1 month when respondents intervention 1. Characteristics of the different cuts also affect wound healing, so it looks BJWAT score reduction is not very significant. Phase of wound healing in the control group were in the proliferative phase of wound healing phase whereas in the

control group were in the remodeling phase. This causes there is no difference in effect Among the intervention group 2 with the control group.

#### **The most influential factor on the Diabetic Foot Ulcer Healing.**

The results of this study indicate that the most influential variable is *moist dressing* and off-loading. But in this study can be seen that the difference lies an ABI value, RBG and BMI before and after the study. ABI is one factor that plays an important role in healing ulcers, But this does not match the description of which states that the ABI not permanently affect ulcer healing [34], This can occur in cases of ulcers that are a mixture of the damage in the arterial and venous, so the healing of foot ulcers can only toward better despite a low ABI value.

ABI value changes in all three groups occurred in this study, but the changes are not too big so it does not describe the actual outcome. ABI value measurement is the method used to assess the condition of the arterial blood flow, and do not assess the venous blood flow. So if the respondent has a defect of venous blood flow but the value of ABI respondents are still in normal condition researchers can not know.

Another variable that is described in this study is the blood glucose. Blood glucose levels is one of the variables that can inhibit healing of diabetic foot ulcers [35]. Hyperglycemic state is one of the factors inhibiting ulcer healing [31,36,37].

In this study, all respondents get the type of short-acting insulin therapies were given 30 minutes before eating. Insulin treatment can also affect the blood glucose values for insulin works to increase the uptake of glucose into cells, so that when seen differences in blood glucose difference before and after the study to three groups of value is not much different.

This study also uses random sampling method using a blood glucose strip method, This inspection type is a simple type of blood glucose tests that can be done with capillary blood samples and carried out at any time regardless of the conditions and the time of a person. This method has limitations in terms of accuracy because it can be affected by other substances in the body such as vitamin C, lipids and hemoglobin, but this method can still be used in monitoring blood glucose not for clinical diagnosis of diabetes mellitus [38].

Variable nutritional status in this study only seen from the BMI measured based on height and weight of respondents. Nutrients are substances needed for the formation of new tissue and affect the speed of growth of the wound [25]. Protein and calories are the main factors required in wound healing [39]. Nutritional status of respondents in this study is only seen from the BMI respondents, not seen in several indicators such as levels of hemoglobin, albumin, folic acid, vitamin A, vitamin C, zinc or glucosamine due to the limited number of researchers.

#### **4. CONCLUSION**

Based on the results of this study concluded that:

- a. Moist dressings and off-loading using crutches effect on the healing of diabetic foot ulcers in the proliferative phase.
- b. Moist dressings and off-loading using crutches have the most significant results in healing diabetic foot ulcers compared with peripheral vascularization, blood glucose and nutritional status.

## 5. SUGGESTION

### a. For Further Research

There are some suggestions for further research, among others:

- 1) Conduct further research into the off-loading by using another off-loading method. Type of Off-loading used must be in accordance with the existing characteristics of respondents. The use of off-loading methods such as casting method may be more suited to the characteristics of respondents in Indonesia.
- 2) The sampling method is more suited to get the number of samples in accordance with the criteria expected. To get better results with this study design as that used random sampling methods.
- 3) Increase the number of samples that are more representative of the population.

### b. For Nursing Care

For nursing services especially in the field of wound care is expected to apply the principles used in this research to accelerate the healing of diabetic foot ulcers, particularly in the treatment of diabetic foot ulcers proliferative phase.

### c. For the development of Nursing

The results of this study are expected to be used as an additional science especially in moist wound care dressings and off-loading in diabetic foot ulcers.

## REFERENCE

- [1] Guariguata, L. Whiting, D. R., Hambleton, I., Beagley, J., Linnenkamp, U., Shaw, J. E. (2013). Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes Research and Clinical Practice*, Volume 103, Issue 2, 137 – 149
- [2] Singh, N., Armstrong, D. G., Lipsky, B. A. (2005). Preventing foot ulcers in patients with diabetes. *Journal of the American Medical Association*, 293(2),217–228  
<http://jama.jamanetwork.com/journal.aspx>
- [3] Sumpio, B. E. (2000). Primary Care Foot Ulcers. *The New England Journal of Medicine*. 343: 787-793 DOI: 10.1056/NEJM200009143431107 <http://www.nejm.org/>
- [4] Perkeni. (2009). *Pedoman Penatalaksanaan Kaki Diabetik*. Jakarta : PB Perkeni
- [5] Bowker, J.H., & Pfeifer, M.A. (2008). *The Diabetic Foot*. Philadelphia: Mosby Elsevier
- [6] Bryant, R.A., & Nix, P.N. (2007). *Acute and chronic wound: current management concepts*. St. Louis, Missouri: Mosby Elsevier
- [7] Clayton, W. Elasy, T. A. (2009). A Review Of The Pathophysiology, Classification, And Treatment Of Foot Ulcers In Diabetic Patients. *Clinical Diabetes*, vol. 27 no. 2 52-58, doi: 10.2337/diaclin.27.2.52
- [8] Delmas, L. (2006). Best Practice In The Assessment And Management Of Diabetic Foot Ulcers. *Rehabilitation Nursing*, volume 31, issue 6, pages 228–234, DOI: 10.1002/j.2048-7940.2006.tb00018.x <http://onlinelibrary.wiley.com/>
- [9] Jeffcoate, W. J., Harding, K. G. (2003). Diabetic foot ulcers. *The Lancet*. DOI: [http://dx.doi.org/10.1016/S0140-6736\(03\)13169-8](http://dx.doi.org/10.1016/S0140-6736(03)13169-8)
- [10] Kruse, I. Edelman, S. (2006). Evaluation and Treatment of Diabetic Foot Ulcers. *Clinical Diabetes*, vol. 24 no. 2 91-93, doi: 10.2337/diaclin.24.2.91

- [13] Cavanagh, P.R., Lipsky, B.A., Bradbury, A.W., & Botek, G. (2005). Treatment for diabetic foot ulcers. *The Lancet*, vol. 366, no. 9498, pp. 1725-35
- [14] Bus, S. A. (2008). The effectiveness of footwear and offloading interventions to prevent and heal foot ulcers and reduce plantar pressure in diabetes: A systematic review. *Diabetes/Metabolism Research And Reviews*. Published online in Wiley InterScience [www.interscience.wiley.com](http://www.interscience.wiley.com)
- [15] Borrelli, J., Haslach, H., W., Jr. (2013). Experimental characterization of axillary/underarm interface pressure in swing-through crutch walking. *Journal of Rehabilitation Research and Development*, Volume 50, Number 3, Pages 423–436
- [16] Fernando, M. E., Crowther, R. G., Pappas, E., Lazzarini, P. A., Cunningham, M., et al. (2014). Plantar Pressure in Diabetic Peripheral Neuropathy Patients with Active Foot Ulceration, Previous Ulceration and No History of Ulceration: A Meta-Analysis of Observational Studies. *PLoS ONE* 9(6): e99050. doi:10.1371/journal.pone. 0099050
- [17] Frykberg, R. G., Zgonis, T., Armstrong, D. G., Driver, V. R., Giurini, J. M., Kravitz, S. R. (2006). Diabetic foot disorders: A clinical practice guideline (2006 revision). *Journal of Foot and Ankle Surgery*, 45(S5), S1–S66 [www.jfas.org](http://www.jfas.org)
- [18] Yotsu, R. R., et al. (2014). Comparison of characteristics and healing course of diabetic foot ulcers by etiological classification: Neuropathic, ischemic, and neuro-ischemic type. *Journal of Diabetes and Its Complications*, 28 :528–535
- [19] American Diabetes Association. (2013). Diagnosis and classification of diabetes mellitus diakses pada 25 januari 2016 dari [www.diabetes.org](http://www.diabetes.org)
- [20] Sibbald, R. G., Keast, D. H. (2006). Best practice recommendations for preparing the wound bed: Update 2006, clinical practice, wound care. Canada
- [21] Brunner & Suddarth. (2005). *Textbook of Medical Surgical Nursing*. 10th Edition. E-book
- [22] Lemone, P. Burke, K. (2004). *Medical Surgical Nursing: Critical Thinking in Client Care*. United
- [23] State of America: Pearson Education, Inc.
- [24] Suriadi. (2015). *Pengkajian Luka & Penanganannya*. Jakarta : CV Sagung Seto.
- [25] Sastroasmoro, S. Ismael, S. (2014). *Dasar-dasar Metodologi Penelitian Klinis Edisi ke-5*. Jakarta : CV Sagung Seto
- [26] Potter, Patricia A. dan Anne G. Perry. (2009). *Fundamental Keperawatan Buku 1*. Ed. 7. Jakarta : Salemba Medika
- [27] Huda, N. (2010). *Pengaruh Hierbarik Oksigen Terhadap Perfusi Perifer Luka Gangren Pada Penderita DM Di RSAL Dr. Ramelan Surabaya*. Tesis. Universitas Indonesia. Jakarta.
- [28] Maryunani, A. (2013). *Perawatan luka modern (Modern Wound Care) terkini dan terlengkap sebagai bentuk tindakan keperawatan mandiri*. Jakarta: In Media.
- [29] Rusjiyanto. (2009). *Pengaruh Pemberian Suplemen Zinc dan Vitamin C Terhadap Kecepatan Penyembuhan Luka Pasca Bedah di Rumah Sakit Umum Daerah Kabupaten Sukoharjo*. Penelitian. Sukoharjo.
- [30] Wulandari, I. (2010). *Pengaruh Elevasi Ekstremitas Bawah Terhadap Proses Penyembuhan Ulkus Diabetik Di Wilayah Banten*. Tesis. Universitas Indonesia. Jakarta
- [31] Aguiar, et al. (2003). *History of Foot Ulcer Among Persons With Diabetes United States*. [www.ndep.nih.gov/diabetes/pubs/feet\\_kit\\_eng.pdf](http://www.ndep.nih.gov/diabetes/pubs/feet_kit_eng.pdf)
- [32] Guo, S. and L. A. DiPietro. (2010). Factors Affecting Wound Healing. *Critical Review in Oral Biology & Medicine*. USA. *J Dent Res* 89930: 219-229



- [33] Chen, H., Tan, C., Lin, Z., & Wu, T. (2014). The diagnostics of diabetes mellitus based on ensemble modeling and hair/urine element level analysis. *Computers in Biology and Medicine*, 50, 70-5 <http://dx.doi.org/10.1016/j.combiomed>
- [34] Keast, D., & Orsted, H. (2008). The Basic Principles of Wound Healing. *Journal of Poediatry* [www.pilonidal.org](http://www.pilonidal.org)
- [35] Sinno, H., & Prakash, S. (2013). Complements and the Wound Healing Cascade: An Updated Review. *Plastic Surgery International*, article id 146764, 7 pages <http://dx.doi.org/10.1155/2013/146764>
- [36] Syabariyah, S. (2015). Vibration Adjuvant Wound Therapy Enhances The Healing of Diabetic Foot Ulcers: An Interim Analysis of 31 Patient. *Jurnal Online Keperawatan Dan Kesehatan Stik Muhammadiyah Pontianak*, vol 5 no 2 <http://journal.stikmuhptk.ac.id/>
- [37] Obermeyer, A., et al. (2008). Venous Reflux Surgery Promotes Venous Leg Ulcer Healing Despite Reduce Ankle Brachial Pressure Index. *International Angiology*
- [38] Margolis, D. J. (2009). Phase I Study Of H5.020CMV.PDGF-Beta To Treat Venous Leg Ulcer Disease. *Molecular Therapy* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835007/>
- [39] Falanga, V. (2005). *Wound Healing and Its Impairment in The Diabetic Foot*. Boston : The Lancet
- [40] Pearson, C. (2006). *How Wounds Heal: A Guide For The Wound Care Novice*. Wound Care Canada.
- [41] Suryaatmadja, M. (2003). *Prinsip Dasar Ilmu Gizi*. Jakarta : Gramedia Pustaka
- [42] Mackay, D., & Miller, A. (2003). *Nutritional Support for Wound Healing*. <http://thorne.com>

