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The Effect of Alternative Offloading Techniques on The Area of *Diabetic Foot Ulcus* towards The Duration of The Wound Healing Process

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Abstract

Diabetic foot ulcers that occur in the sole will get high pressure, so this pressure must be controlled because repeated pressure can delay the wound healing process. Nursing interventions that are carried out to reduce pressure on the soles of the feet are to perform pressure control management, namely offloading techniques using felt padding. The purpose of this study was to determine the effect of alternative offloading techniques (felt padding) in the area of diabetic foot ulcers on the length of the wound healing process. This research uses Quasi Experiment Design method. The sample used in this study were 15 respondents. The conclusion in this study is that by using the offloading technique, the average length of the wound healing process is a minimum of 24 days and a maximum of 52 days, but there is no difference in the length of the wound healing process between the three wound areas (phalanges, metatarsals and calcaneus) with a p-value. = 0.390 (>0.005). Recommendations for nursing services using the offloading technique with the felt padding type can be made a standard in the medical world, especially in treating diabetic foot ulcers located in the sole.

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1. Introduction

Diabetes Mellitus is a group of metabolic diseases characterized by increased glucose levels in the blood (hyperglycemia) caused by abnormalities in insulin secretion, insulin action disorders, or both UKD can cause diabetics to be hospitalized. Ulcers followed by infection, gangrene, amputation, and death are severe complications and require high costs and more prolonged treatment. Comprehensive wound management is needed so as not to cause gangrene and amputation (Carville, & Smith, 2004; Irion, 2010).

Diabetic Foot Ulcers are wounds that occur in the foot area with a superficial wound picture followed by necrotic skin to full-thickness wounds that can extend to other tissues such as tendons, bones and joints. If the ulcer is left without proper management, it will affect the length of time—the wound healing process. According to Meijer et al. (2001), the number of patients with diabetic foot ulcers is around 15%, patients at risk of amputation are 30% with a mortality rate of 32%, and in Indonesia, as many as 80% of patients with diabetic foot ulcers are treated at home.

One of the factors that affect the wound healing process can be caused by repeated pressure on the wound. Pressure on the wound needs to be considered, so that tissue death does not occur due to tissue hypoxia. Youngblood vessels are damaged because they are skinny. Pressure can also arise due to the use of inappropriate elastic bandages or wounds that are not closed properly (Pearson et al., 1980). According to Heinen et al. (2012), if there is a wound on the leg still used for walking (bearing weight), the wound will always be under pressure, so it will not have time to heal. Meanwhile, according to Ebbeskog & Ekman (2001), pressure, friction, and shear forces can cause very fragile capillaries and thin cells. If they occur continuously can cause blood vessel occlusion, tissue hypoxia and end by tissue death or necrotic.

Activities to relieve pressure from ulcerated areas in the diabetic ulcer area by transferring the load to other areas. In diabetic foot management, the generally understood term is offloading (Baker & Osman, 2016). Raspovic (2016) conducted a study on applying flannel pads for seven days by comparing felt padding and without padding. The results obtained are all respondents with intervention patients (14 men + 1 woman) with 16 ulcers have been tested three times that by using felt pads, the average respondent who uses felt padding 46%-32% affects wound healing. Furthermore, Pickel et al (2011) conducted a study with 17 patients without complications with a padding size of 5 mm made with C and U shapes. The results obtained from the 17 respondents showed a decrease in the average pressure in the feet in healthy individuals (without infection) with padding and non-padding. However, the use of the U-shaped design significantly results in more significant load reduction and is more durable than the C shape.

In contrast to the research above, this study aims to determine how alternative offloading techniques using felt padding in the diabetic foot ulcer area affect the length of the wound healing process in health services of Indonesia.

2. Material and Method

This research design is quantitative by using a quasi-experimental design approach, namely by measuring or observing after treatment. The research was conducted to determine the effect of alternative offloading techniques in diabetic foot ulcers on the length of the wound healing process. It was conducted in the *Bekasi* District Health Service- Indonesia, which was approved in the trial of the Evidence-Based Practice report.

The number of samples required by the observation variable group is 15 samples spread across Indonesian health services. The instruments used are the Interview List and Bates Jensen's Observation Sheet (Bates-Jensen et al., 2003) tested for validity and reliability. In the preparatory

stage, the researcher conducted the Cohen's Kappa test for enumerators who would perform wound care. The inclusion criteria in this study were Wagner 2 wounds with the position of the ulcer in the pads area consisting of 3 areas that received pressure, namely the phalanges, metatarsals and calcaneus occurred in DM patients who were still able to mobilize with controlled blood sugar with the use of drugs. Observations were carried out according to the wound care schedule every 2-3 days, which was adjusted to the condition of the wound. The measured results will start from the first day of wound care until the wound heals with epithelial tissue formation. The implementation of this research has followed the Health Protocol as recommended by the government to avoid the spread of the Covid-19 Virus.

This research was conducted during the Covid-19 pandemic so that during the treatment, researchers and enumerators paid attention to health protocols to prevent transmission of the virus. The equipment used PPE such as Hazmat Reuse, Faceshield, Mask and added with the provision of Antiseptic hand rub. By implementing the health protocol, respondents get their rights in applying ethical principles for fair treatment. In addition to that, the researchers also found patients who dropped out for fear of contracting the Covid-19 virus. The solution that was carried out by the researchers was to conduct a Home Visit so that the scheduled wound care plan could still be carried out.

Data analysis consisted of univariate analysis to obtain the frequency distribution of age, co-morbidities, nutritional status. In the bivariate analysis, the variables of co-morbidities and nutritional status are included in the type of categorical data associated with the length of the wound healing process, which is numerical data. The statistical analysis used is the independent sample T-test variable. The age variable is a type of numerical data associated with the length of the wound healing process, which is a numerical data type so that the statistical analysis used is the Correlation Test. To find out the difference in the wound area using felt padding on the length of the wound healing process, the ANOVA test with a significance of = 0.05 was applied. If the test results in this study have an effect, it is obtained (p-value <0.05).

3. Findings and Discussion

Univariate Analysis

Table 1
Frequency Distribution Based on the Length of the Wound Healing Process Using the Offloading Technique

Variable	Mean	Median	SD	Min -Max
Wound Healing Process Length	38,47	39.00	7,230	24-52

Based on table 1 above, it can be seen that the average duration of the wound healing process with the fastest offloading technique is 24 days and a maximum of 52 days.

Table 2
Distribution of Respondents Based on Characteristics by Age

Variable	Mean	Median	SD	Min - Max	95% CI
Age	58,00	58,00	2.104	55-62	56,83 – 58,17

Based on table 2, the average age of the respondents is 58.00 years with a standard deviation of 2.104.

Table 3
Distribution of Respondents Characteristics of Respondents Based on Co-morbidities, Nutritional Status

Variable	Categorical	Total	
		n	%
Co-morbidities	Not exist	11	73,3
	Exist	4	26,6
Nutritional status	Good	10	66,7
(BMI value)	Not good	5	33,3

Based on table 3, it is known that the majority of respondents do not have co-morbidities as much as (73.3%). The majority of respondents' nutritional status is good, as many as 10 (66.7%).

Bivariate Analysis

Table 4
Difference between wound area and Wound Healing Process Length

Kind of Dressing	Mean	SD	95% CI	P-value
Falang	36,00	6,325	30,71-41,29	0,390
Metatarsal	41,50	8,313	32,78-50,22	
Calcaneus	40,00	0	0	

Based on table 4, the results of statistical tests with p-value = 0.390 (>0.005), so it can be concluded that there is no difference in the length of the puka healing process between the three wound areas in the use of offloading techniques.

Table 5
The Relationship of Age with the Length of the Wound Healing Process in Diabetic Foot Ulcer Patients by Age

Variable	Mean	SD	SE	*P-value*	n
Age	58,00	2,104	0,543	0,016	15

Based on table 5, it is shown that the results of the Pearson correlation statistical test obtained a p-value of 0.016 (p <0.05), meaning that there is a relationship between age and the duration of the wound healing process in diabetic foot ulcer patients.

Table 6
The Effect of Co-morbidities, Nutritional Status and the Length of the Wound Healing Process

Variable	Categorical	Mean	SD	SE	*P-value*	n

Co-morbidities	Not exist	35,64	5,626	1,696	0,006	11
	Exist	46,25	3,315	2,658		4
nutritional status	Good	35,20	5,731	1,812	0,007	10
	Not good	45,00	5,385	2,408		5

Based on table 7, it is known that the average recovery time of respondents who do not have co-morbidities is 35.64 days compared to those who have co-morbidities, which is 46.25 days.

Application of Offloading technique and Long Wound Healing Process

The results of the application of EBNP carried out by the group using offloading techniques affect the length of the wound healing process in diabetic foot ulcer patients, with the average value of the wound healing process being 38.47 days. According to Posthauer (2006), the time needed for treatment in healing diabetic ulcers is 2-3 weeks for stage I, three weeks- two months for stage II, two months for stage III, and three months - seven months for stage IV. Although there is an estimate of time in the wound healing process, it is still relative because other things affect it, such as the state of wound hygiene, whether there is a wound infection or not, dressing changes, and the patient's regularity in wound care. Based on this explanation, it strengthens the results of the EBNP conducted by the group that the wound healing time in 15 respondents was within the normal range.

Based on the type of area where the offloading technique was applied, the phalanges area has a faster wound healing rate than the metatarsal and calcaneus areas. This is following the anatomy of the sole which says that when standing normally, half of the bodyweight is supported by the heels and the metatarsals support the other half. When there is an injury to the metatarsal and calcaneus area, the healing time of the wound will be longer.

The superiority of the offloading technique is part of the management of diabetic foot ulcers, aiming to reduce pressure on the feet because repeated pressure can affect the length of the wound healing process. Reducing pressure is very important in neuropathic ulcers. Pressure on the wound needs to be considered, so that tissue death does not occur due to tissue hypoxia. Youngblood vessels are damaged because they are fragile. Pressure can also arise due to the use of inappropriate elastic bandages or wounds that are not closed properly (Anderson & White, 2000). Moreover, according to (Bhattacharya & Mishra, 2015), pressure, friction, and shear forces can cause very fragile capillaries and thin cells. If they occur continuously can cause blood vessel occlusion, tissue hypoxia and end by tissue death or necrotic.

The application of the use of offloading techniques has implemented the use of this type of technique with the reason that the use of this technique focuses on reducing pressure on the wound area located on the plantar pads so that it can assist in the wound healing process so that it is faster and the pain experienced by the patient will be reduced, the patient will be more comfortable. In addition, wound care clinics in the Bekasi Regency area also apply this technique in helping the wound healing process. The offloading technique carried out in the wound care clinic is adapted to the condition of the wound so that one patient and another do not have the same shape.

The availability of felt padding is still limited, but several pharmacies provide this type of felt. In meeting the need for felt padding, in this case in the Indonesian Territory, LKPP (Government Goods/Services Procurement Policy Agency) has facilitated the purchase of foam-type products for

Regional General Hospitals. Their funding sources come from the government through the APBN, APBD, and the acquisition of public funds managed by the institution, so that patients with BPJS payment status can use it following applicable hospital policies. This type of felt padding can also be found in foam or mattress sellers, or one can also use an alternative to using flip-flops. Research conducted by Armstrong et al. (2001) stated that there is no significant difference in the mean healing time and cumulative wound survival at 12 weeks.

Age and the Length of the Wound Healing Process

The results of this study indicate a relationship between age and the length of the wound healing process. The average age of the respondents in this study was 51 years. The wound healing process will take longer with increasing age. The influencing factors are the decreased amount of elastin and the reduced collagen regeneration process due to a decrease in cell metabolism. Ageing causes skin cells to reduce their elasticity due to decreased vascularity in the skin and reduced-fat glands, further reducing skin elasticity. Inelastic skin will reduce the ability to regenerate cells when the wound is about to begin and close to slow down wound healing (Seifert et al., 2012). According to Guo & DiPietro (2010), in the elderly, there is a decrease in body functions, which can slow down the healing time of wounds.

The age factor is very decisive for the incidence of diabetic ulcers. The elderly group (45->90 years) has a high risk of suffering from diabetic ulcers. Not only the elderly group who have a high risk of developing diabetic ulcers, even the adult age group, in this case but the late adult age group (35-44 years) also has a risk of developing diabetic ulcers.

People with Diabetes Mellitus who are elderly in the wound healing process can be supported by other factors such as nutritional status and psychological support from the family. The principle of nutritional regulation in people with DM is a balanced diet according to the caloric needs of each individual. Calorie restriction, especially the restriction of total fat and saturated fat, achieves average blood glucose and lipid levels. Planning a diet with the right amount, schedule, and type is vital to consider (Conceição et al., 2015).

Family support is an essential factor in the healing process of DM wounds (Barrientos et al., 2008). This can affect the patient's psychological factors. Price said that one of the predisposing factors that can cause an increase in blood sugar levels is stress. Severe stress conditions such as wound infections, trauma, and other serious illnesses trigger the activation of the counter-insulin hormone, a hormone that works opposite to insulin so that it can cause an increase in blood sugar levels.

Co-morbidities and the Length of the Wound Healing Process

The results of this study indicate the influence of co-morbidities on the length of the wound healing process. The co-morbidities in this study were the dominant factors affecting the length of the wound healing process. Co-morbidities that often affect wound healing are diabetes, heart, kidney and blood vessel disorders. This disease condition aggravates the work of cells in repairing wounds because oxygen and nutrients will be blocked to the wound, so it is imperative to take collaborative action to overcome the causes and complications during the wound healing process. Heavy cell work can affect circulation, so that the wound healing process will take longer than good circulation. Abnormal circulation can cause decreased oxygenation due to constriction, and this narrowing causes a lack of blood volume, which will result in a constriction phase and decreased availability of oxygen and nutrients for wound healing (Niinikoski, 1977).

The results of this study indicate the influence of nutritional status on the length of the wound healing process. Research on nutritional status in this study was calculated according to the Body Mass Index (BMI), which is a mathematical formula expressed as body weight (in kilograms) divided by the square of height (in meters). The use of this formula can only be applied to someone between the ages of 19 to 85 years, with a standard spine structure, not an athlete or bodybuilder, and not a pregnant or nursing mother (Russell, 2001).

In this study, the number of respondents with balanced good and impaired nutritional status was 50%. Poor nutritional status can be interpreted that the respondent's nutrition is insufficient or less than the standard value. This causes the wound healing process to be hampered. The wound healing process will be faster as long as the right nutrition is given because the proper nutrition will produce a solid foundation to accelerate wound healing.

Nutrition and food intake significantly affect wound healing. Poor nutrition will inhibit the length of the wound healing process and even cause wound infections. Nutrients needed and essential are amino acids, fats, carbohydrates, vitamins (C, A, B complex, D, K, E), zinc, iron, magnesium and water.

4. Conclusion

The average length of the fastest wound healing process is 38.47 days. The average age of the respondents is 58 years, which shows that all respondents fall into the category of elderly. The majority of respondents do not have co-morbidities with good nutritional status. There was no difference in the length of the wound healing process in the three wound areas (phalanges, metatarsals, calcaneus).

Based on the type of area where the offloading technique was applied, the phalanges area has a faster wound healing rate than the metatarsal and calcaneus areas. There is a relationship between age and the length of the wound healing process in diabetic foot ulcer patients at the Bekasi District Health Service. There is an influence between co-morbidities, nutritional status, and the length of the wound healing process in diabetic foot ulcer patients.

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