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Verification of Finger Moisture Retention after Using Vaseline and Wearing Gloves While Sleeping

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ABSTRACT

Multikinase inhibitors can cause Hand-Foot Syndrome. In order to reduce the risk of Hand-Foot Syndrome caused by multikinase inhibitors, it is important to prevent hand roughness. Preventing drying can help avoid rough hands. The purpose of this study was to determine the protective effects of Vaseline application along with the use of polyethylene gloves while sleeping on healthy hands, which aim to enhance moisture in the skin. This study was conducted with the approval of the Ethics Review Board of the University of Kochi. There were 28 subjects (4 males and 24 females) aged 24 to 65 years (mean ± SD: 44.25 ± 6.82 years old). The moisture measurement sites included the palms (pads of the index fingers and thenars) and the dorsal part (the center part of dorsal side of the hand). Each site was measured using the Mobile Moisture HP 10-N, a capacitance-based sensing device, before the intervention. After a week, the same sites were measured in the same way. The change of skin moisture on each site before and after intervention was measured. No significant difference was observed in the skin moisture in the pads of the index fingers before (18.99 ± 11.67) and after (21.10 ± 12.72) the intervention. The mean values of the points of thenars (23.10 ± 12.28) after the intervention were significantly higher than the point of thenars (19.33 ± 9.29) before the intervention. The mean values of the center of dorsal side of the hand (24.11 ± 11.18) after the intervention were significantly higher than the points of the center of dorsal side of the hand (19.24 ± 9.40) before ($p < 0.01$). As a result of applying Vaseline and wearing polyethylene gloves while sleeping, it was recognized that the thenars and center parts of the dorsal side of the hand retain moisture.

Keywords

Dry skin, Skin care, Vaseline.

Introduction

Systemically administrated molecular targeted drugs cause damage to normal skin cells by dysregulating the identical molecules, leading to Hand-Foot Syndrome (HFS) [1,2]. HFS adversely affects Quality of Life and even results in discontinuation of chemotherapy [3,4]. Skin symptoms of HFS, such as erythema, hyper-pigmentation, swelling, hyperkeratosis, flaking, peeling, blisters, and ulcers, are observed at pressure- and friction-prone sites [5-7]. Hand roughening is one of the symptoms of HFS [8]. Patient mobilizing and activities of daily living are restricted by skin dysfunction and pain. Factors that affect skin structure and skin function are assumed to include both "internal factors" and "external factors."

"Internal factors" consist of biological and aging factors. The presence or absence of underlying disease(s) and/or the presence or absence of edema are biological factors, which affect the water retention ability in the skin (dermis and epidermis). Aging factors include physiological changes such as impairment of the barrier function, decreased turnover of epidermal cells, reduced numbers of keratinocytes and fibroblasts, and a reduced vascular network particularly around hair bulbs and glands [9].

"External factors" include environmental, mechanical, and chemical factors. Temperature and humidity are cited as important environmental factors [10-12]. Skin dryness, which can cause skin

roughness, is said to occur when the stratum corneum (outermost layer of the skin), which is supplied with moisture when the moisture content of air in contact with the skin is high, dries out when humidity in the environment is low. Mechanical factors reported to result in destruction of the stratum corneum include not only wounds, but also skin compression and sores, irritation by devices, and excessive scrubbing while bathing [10,13,14]. Chemical factors that affect the skin include irritation by shampoos and bath additives used while bathing [13,15,16]. The method of bathing is also said to affect skin texture; bathing in hot water and using bath additives, especially ion-containing bath additives, are among the factors identified as having negative effects on the skin [13,15]. The chemical factors thought to have strong effects on the skin are drugs, including those that cause allergies, and anti-cancer drugs. Molecular targeted drugs, which are anti-epidermal growth factor receptor (EGFR) monoclonal antibody preparations, in particular, can damage skin and consequently have a large impact *via* impairment of cell differentiation, in addition to causing skin dryness. This is because, in normal skin, EGFRs are distributed throughout epidermal basal cells, sebocytes, outer root sheath cells, smooth muscle cells, and the intradermal ducts of eccrine sweat glands [14,17]. Hence, molecular targeted drugs have the greatest effect on the skin. Other factors thought to affect skin are the method of bathing, presence or absence of mechanical irritation, and a dry living environment. Retaining moisture to reduce these effects and preventing deterioration of skin function is important for preventing skin disorders.

Of the moisturizers used to retain moisture, petroleum jelly is commonly used as a base for ointments and is known to cause little skin irritation. Wearing gloves is also considered an effective means of reducing mechanical skin irritation. We investigated whether skin moisture retention is affected by applying petroleum jelly at night and wearing polyethylene gloves while sleeping, in order to retain moisture and minimize mechanical irritation of the skin, while minimizing the impact of these interventions on daily life. The purpose of this study was to determine the protective effects of Vaseline application while wearing polyethylene gloves on healthy adults, which aim to enhance moisture in the skin. Vaseline, a pure white petroleum, does not moisturize skin but creates a barrier on the skin surface to prevent hydration (insensible water loss) from the skin. Wearing polyethylene gloves after applying an ointment (Vaseline) is a widely used dermatological treatment also known as occlusive dressing technique (ODT), which augments the effects of ointment application. These treatments fall into basic nursing skills with a minimally invasive performance.

Materials and Methods

Subjects

Twenty-eight healthy adult volunteers at least 20 years of age participated in the study. Subjects were recruited in person between January 2019 and February 2020. Inclusion criteria involved healthy Japanese subjects aged 20 to 70 years old. Exclusion criteria involved wound injury at the measurement site or allergic reactions to Vaseline. All subjects were right-handed. The subjects agreed to participate in the research.

Study Design and Period

A quasi-experimental study was conducted from January 2019 to February 2020.

Measures and Statistical Methods

Intervention

Before the measurement, we checked whether the participants had any scratch and/or erosions on the measurement sites. Subjects let their hands acclimate to the environment for 15 minutes. Then we measured skin moisture in a private room with privacy.

Researchers explained the intervention again before the subject left. As the intervention method, Vaseline was applied to the subjects' fingers before going to bed and they wore polyethylene gloves while sleeping for one week. Vaseline application method: After bathing before bedtime, apply petroleum jelly with fingertips through the unit (0.5g) method. Then protect hands with polyethylene gloves.

One week later, the same site is measured in the same way in the same room.

Measurement by Mobile Moisture HP 10-N

The Mobile Moisture HP 10-N (Manufactured by Courage Khazaka Electronic GmbH, Cologne, Germany) was used to measure moisture on the fingers. This device is a portable device, 18 cm in length and 110 g in weight. This device uses capacitance-based sensing. The tip of the probe has a shape with comb electrodes facing each other, and electrolysis is generated on the skin *via* the glass plate to measure the capacitance. Capacitance-based sensing is based on the fact that the dielectric constant of water is significantly higher (81) than that of other substances (<7). Therefore the water content of the stratum corneum is indirectly calculated by the capacitance that varies according to the water content of the stratum corneum. The larger the water content of the stratum corneum, the larger the capacitance. Numerical values of the relative values are shown in arbitrary units (au) ranging from 0 to 99 au. A nurse who was well trained performed the moisture measurement to obtain stable measurement values. The Mobile Moisture HP 10-N value was measured for a third time to calculate the average of the measured values and was determined as the value of the site.

Measurement by POCKET LDF

The POCKET LDF (Manufactured by JMS Co., Ltd., Japan) is a laser blood flowmeter that quantifies tissue blood flow several millimeters under the skin. The principle method of measurement of the POCKET LDF is laser doppler flowmetry. The laser light is scattered by red blood cells moving through the blood vessels in the irradiated tissue and stationary tissue. In the light scattered by the moving red blood cells, the frequency of the light changes in accordance with the moving speed (Doppler shift).

The laser blood flowmeter converts the swell of light received by the photodiode into an electric signal by using the laser doppler effect and then conducts measurements by calculation. Measurement of

blood flow assists in the risk assessment of ischemic lesions such as pressure ulcers.

Measurement Procedures

Before the measurements, subjects let their hands acclimate to the environment for 15 minutes. The measurement sites included the palms (pads of the index fingers and thenars) and the dorsal parts (the center part of dorsal side of the hand). Each site was measured using Mobile Moisture HP 10-N and POCKET LDF before the intervention. After a week, the same sites were measured in the same way.

Analysis Method

The overall scores were statistically analyzed using descriptive statistics and the paired t-test. The level of significance was set at $\alpha < 0.05\%$. SPSS22.0 for Microsoft Windows (IBM Corp.) was used for the analysis. Power analysis for a paired t-test was conducted in G*Power to determine the sufficient sample size using an α of 0.05, a power of 0.80, and a medium effect size ($f2 = 0.5$). Based on the aforementioned assumptions, the desired sample size was 28.

Ethical Considerations

The research was conducted with the approval of the Ethics Review Board of the University of Kochi (approval number 18-2), and it adhered to the Declaration of Helsinki. The study purpose, procedure, methodology, and any risks were provided in writing and verbally explained to the subjects. In addition, the subjects were informed that participation was voluntary and they could discontinue it at any time with no detrimental impact. None of the authors have any conflicts of interest or financial ties to disclose.

Results

Characteristics

Twenty-eight healthy adult volunteers (4 males and 24 females), ranging in age from 24 to 65 years old (mean ± SD: 44.25 ± 6.82 years old) were recruited.

Comparison of Results Before and After the Intervention

Comparison of Results of Measurements by Mobile Moisture HP 10-N: Table 1 shows the results of the measurements of Mobile Moisture HP 10-N on the palms (pads of the index fingers and thenars) and in the dorsal parts (the center part of dorsal side of the hand). Figure 1 shows the comparative data of the results before and after the intervention. In these box plots, the top of the rectangle indicates the third quartile, a horizontal line near the middle of the rectangle indicates the median, and the bottom of the rectangle indicates the first quartile. When the change in skin moisture of each site before and after the intervention was compared, no significant difference was observed in the skin moisture of the pads of the index fingers before (18.99 ± 11.67) and after (21.10 ± 12.72) the intervention. The mean values of the thenars after the intervention (23.10 ± 12.28) were significantly higher than the thenars before the intervention (19.33 ± 9.29) ($t = -2.15$, $p < 0.05$). The mean values of the center of the dorsal side of the hand after the intervention (24.11 ± 11.18) were significantly higher than those before the intervention (19.24 ± 9.40) ($t = -3.98$, $p < 0.01$).

Table 1. Measurement by Mobile Moisture HP 10-N

		Mean	S.D.	Median	Minimum	Maximum
Before	Ball of the thumb	19.33	9.29	18.83	6.33	46.67
	Pads of the index fingers	18.99	11.67	18.00	.67	52.67
	Center part of dorsal side of the hand	19.24	9.40	19.17	1.00	34.33
After	Ball of the thumb	23.10	12.28	21.00	5.00	59.33
	Pads of the index fingers	21.10	12.72	22.00	2.67	55.67
	Center part of dorsal side of the hand	24.11	11.18	23.33	5.33	39.00

N=28, 86% (24) were female and 14% (4) were male. S.D.: Standaed Deviation

Table 2. Measurement by POCKET LDF

		Mean	S.D.	Median	Minimum	Maximum
Before	Ball of the thumb (mL/min)	54.85	19.87	54.7	88.90	9.20
	Pads of the index fingers (mL/min)	51.50	17.59	56.35	87.90	24.70
	Center part of dorsal side of the hand (mL/min)	35.23	16.55	30.05	70.40	13.40
After	Ball of the thumb (mL/min)	45.70	24.75	43.75	86.50	7.20
	Pads of the index fingers (mL/min)	43.18	20.65	41.5	89.40	12.40
	Center part of dorsal side of the hand (mL/min)	34.59	13.19	32.05	65.50	14.10

N=28, 86% (24) were female and 14% (4) were male. S.D.: Standaed Deviation

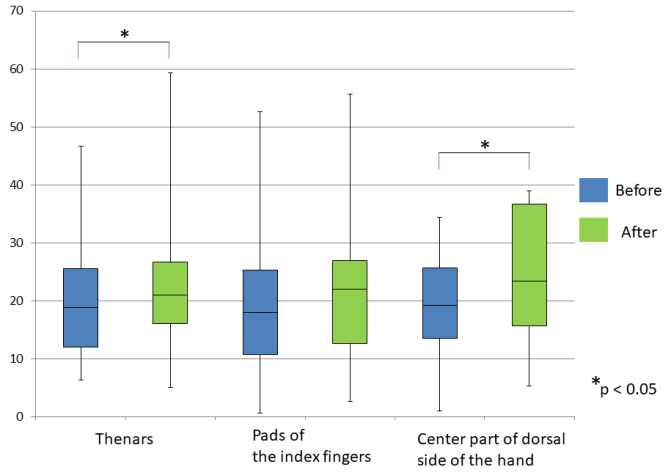

Figure 1 Comparative data of the results of before and after intervention

Comparison of Results of Measurements by POCKET LDF: Table 2 shows the results of the measurement by POCKET LDF of the palms (pads of the index fingers and thenars) and in the dorsal parts (the center part of dorsal side of the hand). These results show that the mean values of skin blood flow in the pads of the index fingers, thenars and center parts of the dorsal side of the hand were not significantly different before and after the intervention.

Discussion

The purpose of skin care for HFS at the treatment initiation is to keep the skin moisturized and clean [18]. Moisturizers, such as oleaginous ointments, urea formulations (urea-containing cream), and heparin analogue formulations, are mainly used in preventative skin care [19]. Although oleaginous ointments are sticky after application, they are preferentially used in the daily medical care because of their affordable price, minute irritation, and long-lasting effect. Petrolatum block transcutaneous water loss and trap water under the skin's surface. It permeates throughout the stratum corneum interstices and allows normal barrier recovery [20]. Urea is a well-known moisturizer and is used in the maintenance of healthy skin. However, a high concentration (>10%) of urea is associated with an emollient/keratolytic action [21]. Therefore, it is necessary to pay attention to the concentration when using urea. In the present study, healthy individuals applied petroleum jelly to their fingers at night and then wore polyethylene gloves while asleep. The skin moisture content of the back of the hands and the thenars was revealed to increase one week after this procedure. The increase in skin moisture content was achieved by the moisturizing effect of applying petroleum jelly and wearing polyethylene gloves, whereas preventing mechanical irritation by the polyethylene gloves during sleep had some effect. However, no change was seen before and after the intervention in the pads of the index fingers. Sweat released by the sweat glands contains not only water but also sodium lactate and urea. These components permeating into the stratum corneum and prevent the skin from drying though evaporation. The palm of the hand does not have any sebaceous glands and the back of the hand has fewer sebaceous glands than does the face. Absence of a change in moisture content in the index finger might be bought about by the difference in the number of sweat glands, which have a moisturizing effect. As was shown in this study, the numerical values for the pad of the index finger vary considerably, suggesting large individual variabilities. Application of petroleum jelly has also been reported to affect skin dryness [19]. In addition, no changes were observed in peripheral blood flow in any of the areas examined, which included the pad of the index finger, the thenars, and the back of the hand. Applying petroleum jelly and wearing polyethylene gloves overnight seem to not have any effect on peripheral blood flow. Despite the results obtained in this study were of healthy adult volunteers, we consider that this procedure is promising for preventing HFS in the patients treated with multikinase inhibitors. It is necessary to verify both the promotion effect of water retention in the multikinase inhibitors-treated patients and actually decrease the occurrence of HFS.

Conclusion

An intervention, which involves applying Vaseline and wearing polyethylene gloves while sleeping, promoted moisture retention in the thenars and center parts of the dorsal side of the hand.

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