

## Irritancy of Scrubbing Up for Surgery With or Without a Brush

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**Hand washing is an indispensable procedure for surgical nurses. Although scrubbing up with a brush is preferable to prevent infections, it is not clear how irritating to the skin scrubbing with a brush is compared with hand washing without a brush. TEWL, high frequency conductance and pH were measured on the hand skin of the same group of nurses before and after daily hand washing for 11 days in different seasons, which were chosen as favourable and unfavourable periods for the condition of hand skin, namely the early summer and autumn. Additionally, we compared the antimicrobial effects on the skin of scrubbing up, using a palm stamp method. TEWL showed significantly higher values with brush washing than with simple hand washing only in the autumn. There was no significant difference in the measurement of high frequency conductance, pH or in the antimicrobial effects between the two washing techniques. Results showed the deleterious effects on the skin of hand washing, particularly that of using a brush in the cold season. Key words: hand eczema; occupational eczema; bioengineering; skin barrier; stratum corneum.**

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Hand eczema is a common occupational problem among medical personnel such as nurses and surgeons who are always required to wash their hands with detergents, sometimes using a brush. Bioengineering techniques, such as TEWL, laser Doppler flowmetry, ultrasound, colorimetry and high frequency conductance have been proven useful for detecting skin irritation due to detergent. Sodium lauryl sulphate (SLS) is the most commonly used surfactant model to induce acute (1–3) and chronic irritant dermatitis (4). In these studies, the investigators often used occlusive or open patch testing. In contrast, immersion of the hands into a low concentration of detergent solution was employed for studying the influence of daily dishwashing with a synthetic detergent to clarify its possible causative role in hand eczema (5). As far as we know, however, there are no published data obtained by using non-invasive measurements on hand irritability of hospital workers. Recently hand washing without a brush has been introduced in hospital workers in Japan because of the lower skin irritation compared with the traditional method of scrubbing up with a brush.

In this study, we measured TEWL, high frequency conductance and skin surface pH of the hand skin in the same group of subjects who washed their hands with or without a brush, in order to examine the irritancy potential of scrubbing up performed in the early summer and in the autumn, because an increase in susceptibility to irritants was reported in xerotic skin (6) and atopic eczema patients as well as non-atopic

subjects (7) in winter compared with in summer. We also performed sampling of the skin bacteria in order to compare the disinfecting effect of the two washing techniques.

### MATERIAL AND METHODS

The studies were conducted twice in the same way in different seasons; the first one in early summer from May 16 to August 1, 1997 and the second in the autumn from October 23 to November 21, 1997.

#### Subjects

A total of 35 female nurses (age range 21–45 years, mean age 33 years) participated in the first study. The second study was conducted with 20 nurses (age range 21–45 years, mean age 35 years), randomly chosen from those who participated in the first study. All subjects currently worked in the operating room of the Tohoku University Hospital. There were no patients with atopic dermatitis or any other skin diseases. Informed consent was obtained prior to the study.

#### Method

The subjects were divided randomly into two groups; one group scrubbed their hands with a brush (brush washing) and the other washed their hands without a brush (simple hand washing). After bioengineering measurements for the baseline levels, they were asked to wash their hands on days 1, 2, 3 and 4 with ISOJIN<sup>®</sup> Surgical Scrub (75% povidone-iodine in a surfactant; Meiji Seika Co., Japan) three times daily. The washing procedure consisted of two sets of a 3-min washing periods, followed by rinsing with sterilized water at a temperature of 34°C. Then they gently wiped their hands with disposable surgical towel. On day 4, the bioengineering measurements were repeated at least 1 h after the third wash of the day. From day 5 to 7, they washed their hands only once daily. Thereafter, hand washing was conducted three times daily from day 8 to 11 and the second bioengineering measurements were performed on day 11. Use of moisturizer was prohibited during the study period. They were not allowed to wear surgical gloves for 3 h prior to the measurements, in order to avoid the occlusive effect.

#### Clinical evaluation

Dryness and erythema were scored on a 0–3 scoring system (0, none; 1, mild; 2, moderate; and 3, severe) by a trained dermatologist.

#### Non-invasive measurement of the stratum corneum

TEWL (8), high frequency conductance (9) and skin surface pH were measured with Evaporimeter<sup>®</sup> EPI (SevoMed, Stockholm, Sweden), SKICON<sup>®</sup> 200 (IBS, Hamamatsu, Japan) and Skin-pH meter pH 900<sup>®</sup> (Courage and Khazaka, Köln, Germany), respectively, according to the guidelines (10). The measurements were performed in triplicate on the dorsum of the left hand and the average values were calculated for statistical analysis. All the measurements were conducted in an air-conditioned room after 20 min acclimation; room temperature and relative humidity in the early summer were 20–24°C and 31–58%, and in the autumn 20°C and 19–40%, respectively.

#### Bacterial count of the skin

In a separate study performed from October 13–20, 1997 to count the number of bacteria on the skin, 30 subjects (age range 22–45 years, mean age 38 years) were asked to place their palms on SCDLP agar

medium (Palm Stamp Check-L<sup>®</sup>, Nikken Seibutsuigaku, Japan), containing 1% sodium thiosulphate, for 20 s. The palm stamp was performed before hand washing, immediately after hand washing, and after 2 h of wearing surgical rubber gloves following hand-washing. Each subject was assigned to perform brush washing or simple hand washing on different days. The culture medium was incubated at 37°C for 24 h and the number of the colonies grown on the agar were counted. The numbers of colonies were compared between brush washing and simple hand washing.

#### Statistical analysis

Values obtained for TEWL, high frequency conductance and pH prior to and on day 4 and 11 of the study period were compared between the brush washing and the simple hand washing groups using Mann-Whitney's U test. Wilcoxon signed-rank test was used for the analysis of the bacterial count.

## RESULTS

### Clinical evaluation

At baseline, no subjects had erythema or dryness. Five out of 35 subjects showed mild dryness of the skin on day 4 and 11 in the study carried out in the early summer, but they were equally distributed between the brush washing and simple hand washing groups. There was no case associated with the occurrence of erythema. In the study performed in the autumn, however, an increase in dryness score was found at baseline in 2 subjects, both in the brush washing and the simple hand washing groups, and at day 11, in 5 and 6 of the 10 subjects in each group, respectively. Three out of 10 subjects in the brush washing group showed erythema associated with a burning sensation on both day 4 and 11 in the autumn study, whereas only 1 in the simple hand washing group showed erythema, on day 11 alone.

### Non-invasive measurements

In the study carried out in the early summer, although there was no significant difference in TEWL, high frequency conductance or pH values between the two groups, TEWL values tended to increase on day 4 and 11, particularly in the brush washing group. In the second study performed in the autumn (Fig. 1), TEWL values increased on day 4 and 11 in both groups, but it was significantly higher in the brush washing group ( $15.8 \pm 5.2$ ; average  $\pm$  SD) than in the simple hand washing group ( $11.2 \pm 3.2$ ) on day 11. Values of high frequency conductance decreased in both groups but the magnitude of the decrease was much larger in the brush washing group. Skin surface pH values showed a slight increase after the treatment, particularly in the brush washing group. However, there was no statistical difference between the two groups in the measurements of high frequency conductance or pH.

### Bacteriological study

No significant difference was noted between the two washing methods in the number of bacterial colonies collected from the palms before ( $111 \pm 30$  vs.  $80 \pm 16$ ), immediately after ( $21 \pm 9$  vs.  $12 \pm 3$ ) and 2 h after ( $94 \pm 30$  vs.  $97 \pm 37$ ) hand-washing, during which period subjects wore rubber gloves (average  $\pm$  SE: brush washing vs. simple hand washing, respectively).

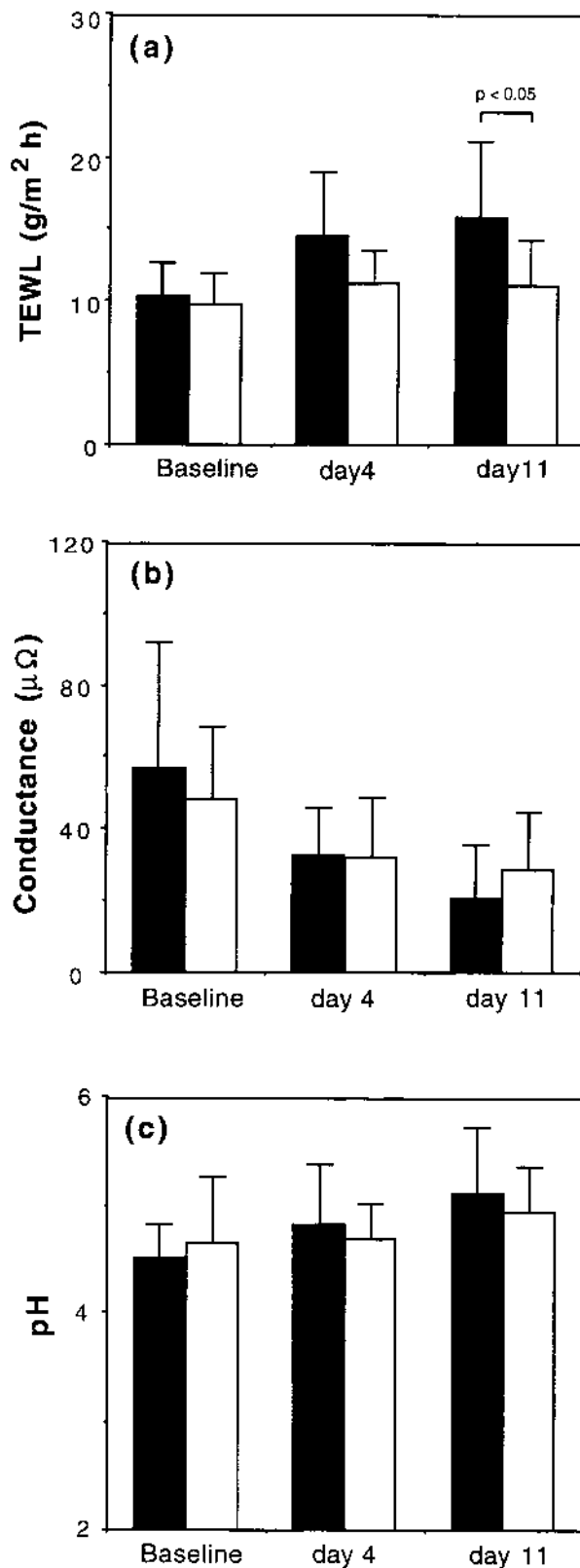


Fig. 1. The results of measurements of (a) TEWL, (b) high frequency conductance and (c) skin surface pH in the autumn. Solid columns indicate the brush washing group and open columns the simple hand washing group. A statistically significant difference between the brush washing and simple hand washing techniques was noted in TEWL on day 11.

## DISCUSSION

The results demonstrated that an increase in TEWL, which many investigators employ to study skin barrier damage, was greater in the autumn in the brush washing group than in the simple hand washing group, indicating that brush washing is harsher on the skin than the simple hand washing. However, TEWL was found to be unchanged in the study performed in the early summer. These results suggest that the skin is more susceptible to the irritant effects of washing in the autumn than in the early summer. Tupker et al. (7) reported impaired water barrier function of the skin in November compared with in July, not only in patients with atopic dermatitis, but also in normal control subjects. Rogers et al. (6) found that intercellular lipid, a major contributor to the skin barrier, is decreased in winter compared with spring or summer.

We found no statistical difference between the two washing techniques with respect to antimicrobial effects on the normal skin flora of the hand, though there was a large inter-individual difference in the number of bacterial colonies. The collecting method we used for bacteria (palm stamp method) is easy and quick, but it does not collect bacteria present in a deep portions of the skin, such as in the pilosebaceous unit and under the fingernail (11). The gloved hand method (12) is suitable for more precise determination.

We conclude that non-invasive measurements, particularly TEWL, are reliable and useful for detecting the deleterious effects of hand washing, particularly that using a brush, on the skin in the dry, cold season. Scrubbing up using a brush was demonstrated not to be particularly superior to the simple hand washing in the prevention of subsequent bacterial growth on the hands. Scaly skin resulting from aggressive scrubbing will rather facilitate the persistence of some bacteria on the skin surface.

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