Occlusive vs Gauze Dressings for Local Wound Care in Surgical Patients

A Randomized Clinical Trial

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Objective: To compare effectiveness and costs of gauze-based vs occlusive, moist-environment dressing principles.

Design: Randomized clinical trial.

Setting: Academic Medical Center, Amsterdam, the Netherlands.

Patients: Two hundred eighty-five hospitalized surgical patients with open wounds.

Intervention: Patients received occlusive (ie, foams, alginates, hydrogels, hydrocolloids, hydrofibers, or films) or gauze-based dressings until their wounds were completely healed.

Main Outcome Measures: Primary end points were complete wound healing, pain during dressing changes, and costs. Secondary end point was length of hospital stay.

Results: Time to complete wound healing did not differ significantly between occlusive (median, 66 days; interquartile range [IQR], 29-133 days) and gauze-based dressing groups (median, 45 days; IQR, 26-106 days; log-rank P = .31). Postoperative wounds (62% of the wounds included) healed significantly (P = .02) quicker using gauze dressings (median, 45 days; IQR, 22-93 days vs median, 72 days; IQR, 36-132 days). Median pain scores were low and similar in the occlusive (0.90; IQR, 0.29-2.34) and the gauze (0.64; IQR, 0.22-1.95) groups (P = .32). Daily costs of occlusive materials were significantly higher (occlusive, €6.34 [US $9.95] vs gauze, €1.85 [US $2.90]; P < .001), but nursing time costs per day were significantly higher when gauze was used (occlusive, €1.28 [US $2.01] vs gauze, €2.41 [US $3.78]; P < .001). Total cost for local wound care per patient per day during hospitalization was €7.48 (US $11.74) in the occlusive group and €3.98 (US $6.25) in the gauze-based group (P = .002).

Conclusions: The occlusive, moist-environment dressing principle in the clinical surgical setting does not lead to quicker wound healing or less pain than gauze dressings. The lower costs of less frequent dressing changes do not balance the higher costs of occlusive materials.

Trial Registration: trialregister.nl Identifier: 56264738.

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HE TREATMENT OF OPEN wounds is a worldwide, cost-consuming challenge for a variety of medical specialties. Throughout history, open wounds have been the target for many more or less intelligible local applications.1,2 In the last few centuries, gauze mostly has been used in local wound care, mainly because of its low price and simplicity. The rationale behind this conventional wound management is to absorb exudation from the wound to keep it dry and clean enough to avoid bacterial contamination (also known as the wet-to-dry approach). Around the 1950s, a new concept of wound management was introduced.3,4 This method aimed at occluding the wound to protect against bacteria while keeping it moist to supply growth factors and prevent crust formation, which would impede wound healing.5 Since then a huge and confusing variety of products were developed, based on this occlusive principle, and used for all kinds of wounds, although the Winter concept was merely derived from an animal study on acute, superficial wounds.6

Clinical evidence supporting the choice for either gauze or occlusive dressings has been based largely on clinician perception, case series, small cohort studies, and poorly powered randomized trials. These constitute a substantial number of publications but an overall low amount of evidence. Hence, virtually no guidelines but a wide range of opinions exist. The paucity of high-level evidence becomes clear

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from 3 available systematic reviews, which only tentatively suggest that (antiseptic) gauzes may be less expensive but more labor intensive and painful than the sophisticated occlusive dressings. More importantly, no significant differences were apparent in wound healing time and duration of hospital stay. Although the authors of systematic reviews used guarded language as to the effectiveness of occlusive dressings regarding these end points, many preferred occlusive dressings because of the earlier-mentioned disadvantages of gauze dressings.

To test the concept of occlusive, moist wound healing in wounds of surgical patients, we undertook a randomized clinical trial to obtain high-level evidence on the effectiveness regarding wound healing time, pain during dressing changes, and costs of nursing time and dressing materials of the occlusive principle as compared with the conventional approach using nonocclusive gauze dressings for local wound care.

## METHODS

### PATIENTS

All adult patients admitted to the departments of surgery (general, trauma, vascular, and plastic surgery) of the Academic Medical Center at the University of Amsterdam, Amsterdam, the Netherlands, and who had open wounds requiring local wound care were eligible for inclusion. They could only be included after full explanation (by H.V. or D.T.U.) and written informed consent. Excluded were patients with burn wounds or ulcerating malignancies, surgically closed wounds, wounds treated with vacuum-assisted closure devices, ostomies or drain openings, and pin holes from external fracture fixation materials and patients receiving chemotherapy or local irradiation therapy or with a life expectancy less than 6 months. The study was approved by the local medical ethics committee and was registered under ISRCTN (International Standard Randomized Controlled Trial Number) number 56264738.

### RANDOMIZATION

Patients were randomized (by H.V. or D.T.U.) for either occlusive or gauze-based local wound care by means of a computer randomization program, which ensured allocation concealment. Minimization was performed to stratify for sex, age, underlying cause (postoperative, trauma, diabetes mellitus, arterial or venous insufficiency), and size (< or > 10 cm in diameter) of the patient’s (largest) wound to achieve balance between groups for each prognostic factor. If patients had more than 1 wound or later-occurring wounds, they were all treated according to the initial randomization. Patients presenting with recurrent wounds were not included a second time.

### PROCEDURES

#### Treatment

Because local wound care treatment was carried out by the nurses of the wards involved, product specialists from the dressing manufacturers gave training sessions on how to use the various materials to refresh the nurses’ practical knowledge before starting the trial. Dressings comprised the conventional nonocclusive gauzes (dry, moist, or paraffin gauzes) or the occlusive, nongauze-based materials (such as foams, alginates, hydrogels, hydrocolloids, hydrofibers, and films).

To facilitate the dressing choice within each randomization group, the validated red-yellow-black classification scheme was used as a simple and reliable tool to categorize the wounds based on wound color and exudation. Other classifications exist but were considered too intricate for the purpose of the trial. For each wound category, a best suitable dressing suggestion was added for each randomization group. The classification scheme was handed out as a pocket card to all nurses and doctors involved, who complied with the strict regimen to ensure a uniform treatment policy on all wards.

Local wound care according to the assigned group was started directly after randomization. The optimum changing frequency was pursued as advised for each dressing type. The treating physicians were not allowed to perform daily wound inspections when occlusive dressings were applied. When the condition of the wound changed during the treatment period, the dressing choice was altered accordingly while the patient remained in the allocated randomization group. For example, when a yellow, moist wound progressed into a red, moist wound, an alginate was replaced by a foam as the best suitable modern dressing. No combinations of occlusive and gauze dressings were allowed. If patients crossed over to the other treatment group, they were analyzed according to the intention-to-treat principle. Additional wound debridement, local antiseptics, and cleansing and/or protection (also of the wound edge) were allowed in each randomization arm to ensure similarity of treatment in both groups. Also, systemic treatment of the etiology of the wound was allowed in both groups (eg, revascularization for arterial ulcers, compression for venous ulcers, and glycemic control in patients with diabetic ulcers). This did not interfere with local wound care.

### Outcome Assessments

Primary outcome parameter was time from wound occurrence to complete reepithelialization. Secondary outcome parameters were pain during dressing changes, costs per day of nursing time and dressing materials used, duration of hospitalization, and adverse dressing effects, if any. Pain was scored by the patients during hospitalization after each dressing change on a 10-cm visual analog scale (VAS), ranging from 0 (no pain) to 10 (worst pain imaginable). Nursing time required for each dressing change was measured during hospitalization by an independent observer (R.B.K. and S.M.S.) using a (hidden) stopwatch, clocking the time from putting on gloves to washing hands afterward. We recorded both time of day (to determine bonus for unsocial hours) and education level (to determine the wages) of the nurses involved to calculate actual nursing time costs. All dressings used and materials needed for redressing the wounds were counted. Commercial prices of dressing materials and wages of nurses (nurse assistant, €7.00 [US $10.98] per hour; trainee, €11.25 [US $17.65] per hour; registered and senior, €19.15 [US $30.05] per hour) in the various working shifts as of January 1, 2005, were used to calculate material costs.

### Follow-up

Local wound care was continued according to randomization, even in the extramural setting, by instructing patients and district nurses until complete wound healing was achieved or 6 months of follow-up was reached. Nursing and wound care was monitored at each outpatient visit and checked by contacting the patients (or their nursing homes or rehabilitation clinics) every 2 weeks to check dressing use, supplies, and adverse effects. Wound healing was observed by 1 independent ob-
From April 2004 to September 2005, 443 patients were screened for eligibility, of whom 285 patients could be randomized (Figure 1). Patients’ baseline demographics and wound characteristics were quite comparable and are shown in Table 1. A total of 74 patients (26.0%) had, or were recently operated on for, a malignant disorder, and none of them had malignant ulcers. About 8% of the patients were from nonwhite (ie, Caribbean, Arabic, or Oriental) origin.

A few patients were withdrawn after randomization, leaving 277 patients with 417 wounds (Table 2) for follow-up and analysis (Figure 1). In 2 patients, withdrawal after randomization was due to a change in surgical procedure in that the wound was not left open. The number of wounds per patient ranged from 1 to 7 in both study arms. Most wounds (62%) occurred postoperatively because of dehiscence and/or infection (requiring reopening of the sutured wound or relaparotomy) of the postoperative wound. Diabetic ulcers and pressure sores were rare (20 [4.8%] and 11 [2.6%] of the 417 wounds, respectively). Wound sizes ranged from 0.3 to 40 cm in diameter. Median wound sizes, the duration the wounds existed before inclusion, and the distribution of wound locations and etiologies were similar in both treatment groups (Table 2).

In the occlusive dressings group, 22 of 141 patients (15.6%) crossed over (for any period) to gauze dressings, which occurred much more frequently than vice versa (5 of 136 patients [3.7%]). Crossover occurred mainly during the acute phase of a wound while exudation was profuse and occlusive dressings were saturated within 24 hours and were therefore temporarily replaced by gauze dressings.

No dressing-related adverse effects were observed in the gauze group. In the occlusive group, 4 patients developed skin problems; in 1, a blister formed; in 2 patients, skin irritation occurred using foam; and in another patient, folliculitis occurred under the hydrocolloid dressing.
In total, 317 of all 417 wounds (76.0%) healed within the 6-month follow-up period. The percentages did not differ between the 2 treatment groups (Table 2). Median time to complete wound healing in the occlusive dressings group was 66 days (interquartile range [IQR], 29-133 days) and in patients receiving gauze dressings, 45 days (IQR, 26-106 days). The cumulative wound healing curve is presented in Figure 2, showing no statistical difference between the treatment modalities ($P = .31$, log-rank test). Similarly, no significant differences in wound healing were observed in chronic wounds (ie, vascular insufficiency, diabetes, pressure sores), traumatic wounds, or wounds included in the first vs the second half of the trial (to detect a learning curve effect, if any). However, in postoperative wounds, composing 62% of all wounds in this trial, wound healing in the occlusive group took significantly ($P = .02$) longer (median, 72 days; IQR, 36-132 days) than in the gauze group (median, 45 days; IQR, 22-93 days), as shown in Figure 3.

Pain scores and costs were calculated from 634 measurements during dressing changes in the clinic. Median pain scores were strikingly low and comparable in patients treated with occlusive dressings (0.90; IQR, 0.29-2.34) vs those treated with gauze dressings (0.64; IQR, 0.22-1.95) ($P = .32$). Analgesics were hardly ever used to specifically avoid pain during the dressing changes.

The median number of dressing changes per day was significantly lower for the occlusive than for the gauze dressings (0.66; IQR, 0.43-1.00 vs 1.67; IQR, 1.00-1.93, respectively; $P < .001$). The median time needed for dressing application was 4.8 minutes (IQR, 3.0-8.1 minutes) in the occlusive and 5.0 minutes (IQR, 3.0-7.8 minutes) in the gauze dressings group. This difference was not statistically significant. Daily costs of occlusive dressing materials were significantly higher (occlusive, €6.43 [US $9.95] vs gauze, €1.85 [US $2.90]; $P < .001$), but nursing time costs per day were significantly higher when gauze was used (occlusive, €1.28 [US $2.01] vs gauze, €2.41 [US $3.78]; $P < .001$). Resulting total costs for local wound care per patient per day of hospital stay were significantly higher (€7.48 [US $11.74]) when occlusive wound management was applied than for the gauze-based treatment (€3.98 [US $6.25]; $P = .002$).

Median duration of hospitalization was 18 days (IQR, 8-36 days) in the occlusive dressings group, which was slightly but significantly ($P = .02$) higher than the 13 days (IQR, 6-27 days) in the gauze dressings group. If this were to be included in the cost analysis, the difference in costs found in favor of the gauze dressing group would have been even more pronounced.

### Table 2. Baseline Wound Characteristics of the 417 Wounds Included

<table>
<thead>
<tr>
<th>Wound Characteristic</th>
<th>Occlusive Dressing Group (n=208)</th>
<th>Gauze Dressing Group (n=209)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of wound, median (IQR)</td>
<td>4.0 (2.5-9.6)</td>
<td>5.0 (2.5-10.0)</td>
</tr>
<tr>
<td>Wound existence before inclusion, d, median (IQR)</td>
<td>3 (1-8)</td>
<td>1 (0-6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wound Etiology</th>
<th>Occlusive Dressing Group (n=208)</th>
<th>Gauze Dressing Group (n=209)</th>
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</thead>
<tbody>
<tr>
<td>Postoperative</td>
<td>135 (64.9)</td>
<td>123 (58.8)</td>
</tr>
<tr>
<td>Trauma</td>
<td>46 (22.1)</td>
<td>52 (24.9)</td>
</tr>
<tr>
<td>Arterial/venous insufficiency</td>
<td>14 (6.7)</td>
<td>16 (7.7)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>5 (2.4)</td>
<td>15 (7.2)</td>
</tr>
<tr>
<td>Pressure</td>
<td>8 (3.9)</td>
<td>3 (1.4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wound Location</th>
<th>Occlusive Dressing Group (n=208)</th>
<th>Gauze Dressing Group (n=209)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head, face, or neck</td>
<td>3 (1.4)</td>
<td>5 (2.4)</td>
</tr>
<tr>
<td>Thorax, shoulder, or axilla</td>
<td>10 (4.8)</td>
<td>5 (2.4)</td>
</tr>
<tr>
<td>Arm</td>
<td>6 (2.9)</td>
<td>10 (4.8)</td>
</tr>
<tr>
<td>Wrist, hand, or fingers</td>
<td>6 (2.9)</td>
<td>6 (2.9)</td>
</tr>
<tr>
<td>Abdomen</td>
<td>90 (43.3)</td>
<td>87 (41.6)</td>
</tr>
<tr>
<td>Back or sacrum</td>
<td>9 (4.3)</td>
<td>11 (5.3)</td>
</tr>
<tr>
<td>Groin or perineum</td>
<td>11 (5.3)</td>
<td>11 (5.3)</td>
</tr>
<tr>
<td>Leg</td>
<td>51 (24.5)</td>
<td>39 (18.7)</td>
</tr>
<tr>
<td>Ankle, foot, or toes</td>
<td>22 (10.6)</td>
<td>35 (16.7)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Wounds healed within 6 mo of follow-up</th>
<th>Occlusive Dressing Group (n=208)</th>
<th>Gauze Dressing Group (n=209)</th>
</tr>
</thead>
<tbody>
<tr>
<td>135</td>
<td>105</td>
<td>68</td>
</tr>
<tr>
<td>123</td>
<td>77</td>
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<td>32</td>
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<td>31</td>
<td>10</td>
<td>8</td>
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Abbreviation: IQR, interquartile range.
The number of (re)admissions to hospitals or care centers after dismissal did not differ between the 2 study groups.

**COMMENT**

To our knowledge, this is the first randomized trial comparing 2 principles regarding local wound care, the occlusive vs the nonocclusive approach, in surgical patients with predominantly acute wounds. The evidence from this trial shows that, in this clinical setting, the use of the occlusive principle for local wound care does not lead to quicker wound healing or more patient comfort during dressing changes than the nonocclusive principle and leads to an even slower wound healing in postoperative wounds, although these attributes are the ostensible advantages of modern occlusive dressing materials. Moreover, the higher product costs of these occlusive materials outweigh the lower costs of nursing time involved in dressing changes because of the lower changing frequency needed.

The absence of a difference in wound healing time and higher total costs by using the occlusive wound care principle can be due to the relatively high number of postoperative wounds in a predominantly acute stage, in which occlusive dressings may be less effective. Initially, most of these wounds showed a considerable exudate production, which requires more frequent dressing changes. This was particularly true for occlusive dressings, although they are made to be changed only once in 3 to 7 days. Frequent dressing changes continually disturb the environment pursued by the occlusive principle to foster wound healing. This may also explain why no difference in wound healing was found. When the wound reaches a more chronic phase, which was usually the case in the outpatient period, the purported advantages of occlusive dressings may become more prominent, particularly when the changing frequency can be reduced and fewer district nursing visits are required. In this trial, monitoring of wound healing was continued after dismissal from the hospital. A separate analysis of the extramural costs and effectiveness has been published recently.

The low pain scores as indicated by the patients during dressing changes were remarkable. Desiccated dressings (particularly gauzes) may easily stick to the wound when left in situ for too long and cause pain on removal. This was not apparent in our study, probably because of the considerable number of exudating wounds, illustrated by the high changing frequency in the occlusive dressing group. This has also been observed in other studies. In addition, if the dressing is removed carefully, if necessary by soaking it beforehand, local pain can usually be avoided. Furthermore, any pain may have been overshadowed by the (analgesics given against) discomfort already present due to the underlying disease.

Patients were only recruited from the surgery wards of our hospital for several reasons. First, this department presented the highest number of eligible patients with open wounds. Second, selecting surgical patients limited patient and wound heterogeneity. Third, the nursing staffs of these wards were most familiar with both regimens of local wound care.

This study comprised a variety of wounds (14.6% could be classified as chronic wounds) and dressing materials, which were also quite different functionally. This heterogeneity was not considered a confounding factor because it was equally distributed between the 2 groups and the aim of this study was not to discover which wound should be treated with which dressing but merely to find evidence whether one principle of local wound care would be superior to the other in these surgical patients. Because the choice for the best dressing material can be complicated, this trial used a set of dressings in both treatment groups based on the specific characteristics of these materials as derived from the available evidence in the literature. Silver-containing dressings were not allowed because sufficient evidence as to the effectiveness and toxic effects of these dressings was lacking at the start of the trial. This and the training of the nurses approached uniformity in wound care as much as possible.

The inference from the results of our study should be that dressing choices in local wound care can be made easier and more uniform, although our results cannot be generalized to other, in particular chronic, wounds. Acute or highly exudating wounds, particularly occurring in surgical departments, can be treated preferably with inexpensive gauze dressings. The wet-to-dry method is particularly useful for debridement when removed while sticking to necrotic tissue. Most surgeons already tend to prefer this method, because they are still most familiar with conventional materials and the higher change frequency needed will allow for frequent (daily) wound inspections. Wounds in a more chronic stage might benefit more from the occlusive treatment principle. Hence, departments dealing with predominantly chronic wounds or a limited nursing staff may still prefer the use of occlusive dressings, although convincing evidence is lacking. Even though the use of occlusive dressings has been advocated particularly in chronic wounds, recent evidence has shown that vacuum-assisted closure in amputation wounds may result in quicker wound healing than occlusive dressings only.

In summary, we found no superiority of modern occlusive dressings for local wound care regarding wound healing, patient comfort, and costs of dressing materials and nursing time in a clinical setting of surgical patients with open wounds. The results of this randomized trial as well as the red-yellow-black classification scheme have been implemented on our surgical wards and have led to a change in local wound care. Thus, standardization of local wound care has been enhanced and the number of different dressings in the hospital stock has been substantially reduced.

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Author Contributions: Dr Ubbink had full access to all the data in the study and had final responsibility for the integrity of the data, the accuracy of the data analysis,

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REFERENCES

1. 2 Kings 20:7.