Closed Dressings After Laser Skin Resurfacing

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Objective: To evaluate the safety, efficacy, and patient acceptance of closed dressings after full facial resurfacing with the carbon dioxide laser.

Design: Prospective cohort of men and women undergoing full facial carbon dioxide laser resurfacing.

Setting: Ambulatory surgical center at a university hospital.

Patients: Forty consecutive patients randomized to 1 of 4 dressing groups.

Interventions: All patients underwent full facial resurfacing with a carbon dioxide laser system. One of 5 closed dressings (single- or 3-layer composite foam, plastic mesh, hydrogel, or polymer film) was placed immediately after the procedure. Closed dressings were changed on postoperative day 2 and removed on postoperative day 4.

Outcome Measures: Objective postoperative criteria of erythema, scarring, reepithelialization, and surface irregularities were recorded and photodocumented. Comparisons were made among the closed dressing groups as well as with a group of historical control subjects treated with open dressings. The ease of application, office time for preparation and application, and cost of the individual dressings were collected. Patient characteristics of overall acceptance, comfort, and ease of maintenance were recorded with a visual analog scale.

Results: There were no complications of scarring, surface irregularities, or contact dermatitis from the application or maintenance of the closed dressings. There were no significant differences in the number of days of postoperative erythema or in the rate of facial reepithelialization among the groups. Most patients preferred not to continue with the closed dressings past 2 days. Positive features from the use of closed dressings included reduction in crust formation, decreased pruritus, decreased erythema, and decreased postoperative pain, compared with historical controls. Negative features included time in preparation and application of the dressings. Costs ranged from $9.79 to $50 per dressing change.

Conclusions: Closed dressings are safe and offer benefits noted during the first 4 postoperative days. Patients can be expected to maintain a closed dressing for at least 24 hours but no longer than 4 days. The positive features of closed dressings and patient acceptance outweigh the cost and office time involved with their application and maintenance.


Closed dressings have become popular for the treatment of facial wounds after laser resurfacing. Proposed advantages to patients of closed dressings include the creation of a moist wound environment, protection from exogenous bacteria, reduced postoperative pain, enhanced reepithelialization, and simplified wound management. Clinicians have noted decreased pain, faster reepithelialization, decreased erythema, and decreased scarring with the use of closed dressings after laser facial resurfacing.1,2 With the advent of laser facial resurfacing, there have been a significant number of closed dressings brought to the market to service the increased number of facial wounds. Most of these new dressings have unique properties and have been customized for use on the face.

A closed dressing may be defined as the application of a framework dressing with or without the application of additional ointments. These dressings provide a semiocclusive setting whereby the healing wound is protected from exogenous moisture and bacteria while allowing the exchange of oxygen and water vapor and drainage of exudate from the wound.

We sought to evaluate the available closed dressings and select representative products that theoretically should im-
MATERIALS AND METHODS

PROCEDURES

Forty consecutive men and women underwent informed consent for carbon dioxide laser resurfacing at Stanford University Medical Center, Stanford, Calif, from July 1, 1996, to September 1, 1997. Patients were randomized into 1 of 4 groups. The 4 groups were to receive 1 category of closed laser dressings (hydrogel, plastic mesh, composite foam, and polymer film). Patients were treated preoperatively with retinoic acid cream for 2 weeks, and 4% hydroquinone was used for Fitzpatrick skin type 4 patients. Patients underwent full facial laser resurfacing using 1 of 3 different laser systems (Luxar Novapulse laser with Surescan attachment [Luxar Corp, Bothell, Wash], Coherent Ultrapulse laser with a computer-generated scanner [Coherent Medical Group, Palo Alto, Calif], or a Sharplan Silktouch laser [Sharplan Lasers, Inc, Allendale, NJ]). All patients received a 3-day course of cephalixin, 500 mg 4 times per day, and a 7-day course of valacyclovir hydrochloride, 500 mg twice a day, for herpetic prophylaxis. The procedures were performed under local anesthesia with nerve blocks (37 patients) or general anesthesia (3 patients). All of the patients’ skin was gently cleaned with saline solution, and all debris were removed before application of the dressing. The 5 dressings were applied according to the manufacturers’ recommendations.

DRESSING CATEGORIES

The hydrogel product (n = 8) is a gel composed of 96% sterile water and 4% polyethylene mesh (Figure 1, top). This material comes precut in rectangular pads measuring 7.6 × 10.2 cm or in precut cosmetic units to fit the face. Six pads were used to cover an entire face, and petrolatum jelly ointment was applied to any small areas of exposed skin around the mouth. For the exposed areas around the eyes, mineral oil was used. A nonadhering dressing (Telfa; Kendall Co, Mansfield, Mass) or gauze pads were then placed on the surface of the exposed hydrogel and secured with paper tape and a band net dressing (Figure 1, bottom). Patients were sent home with extra dressings and were instructed to change the pads twice daily and to cleanse the skin between dressing changes with a gentle soapless cleaner (Aquamil, Person and Covey, Inc, Glendale, Calif). In addition, patients could keep their dressings in their home refrigerators to add cooling comfort to their skin during dressing changes.

The plastic mesh (n = 8) is composed of a high-density polyethylene sheeting and is supplied as a preformed face mask with holes for the eyes and slits for the nose and mouth (Figure 2, top). It is placed over the face with relaxing incisions in the flat sheet to allow for conformation over the face. Additional pieces are placed over the nose and chin. Petrolatum jelly ointment was used to enhance the occlusive effect and to stabilize the dressing on the face to prevent slippage (Figure 2, bottom). Similar to the hydrogel product, gauze pads and a band net dressing were used to complete the dressing.

Two composite foams were used in this study. The first is composed of a graduated-size, open-cell foam with a patterned adhesive coating (n = 8) (Figure 3, top) and is supplied as individual sheets from which a customized facial mask is made from a paper template. The paper template is cut according to the patient’s facial

RESULTS

Thirty women and 10 men completed the study (mean age, 41 ± 8 years). There were no complications of scarring, hyperpigmentation, or prolonged (longer than 3 months) erythema. There were no bacterial or fungal infections and no herpetic outbreaks. Patient satisfaction was high, with a mean rank score of 9.6 ± 0.4 (on the 1-10 visual analog scale). For this criterion, patients were told to record a high mark if they liked the procedure and were willing to recommend it to a close friend or family member. They were told to mark a low score if they were unhappy with the procedure and would not have had it repeated or would not recommend it to a close friend or family member. There were no allergic or contact dermatitis reactions seen with any of the dressings. The mean length of time for patients to maintain the occlusive dressing was 2.2 ± 0.9 days (range, 1-4 days), and no patient was willing to maintain a dressing for longer than 4 days.

Figure 6 shows ratings of the dressings by physicians and patients. The physicians rated the ease of application of the dressings (higher scores represent more difficult application and lower scores, easier application), the patients rated the maintenance of the dressing at home (higher scores represent more maintenance and lower scores, less maintenance), and the percentage intact of the dressing on the second postoperative day was assessed.

There were no wound healing problems noted with any of the dressings, and all patients had a minimum of 75% reepithelialization on postoperative day 7 and complete reepithelialization by postoperative day 10. There were no significant differences in the degree of reepithelialization among the 4 dressing categories at postoperative days 7 and 10.

Discomfort was described as a burning sensation and noted as most severe within the first 4 hours after the procedure. On the visual analog scale, the mean pain score for the population undergoing the procedure under local anesthesia was 4.6 ± 2.5. There was minimal discomfort noted
The facial wounds produced after laser resurfacing are an ideal setting for the use of closed, semicocclusive dressings. When the dressing is ready to be applied, the individual pieces are laid out and applied in a specific sequence to assure maximal coverage and stability. Because this is a composite dressing, no additional absorbent pads or netting is needed (Figure 3, bottom).

The second composite foam dressing (n = 8) consists of 3 layers. The outer surface is a polyurethane film that is laminated to a central layer of polyurethane microporous membrane. The wound contact layer is composed of an acrylic-pressure-sensitive adhesive and is attached to the central microporous membrane. The product comes packaged and precut into 7 flesh-colored pieces. These pieces are further customized to the face and placed in a specific overlapping pattern (Figure 4).

The polymer film (n = 8) is composed of a complex weave of silicone polymers and comes in a transparent face mask design, which is perforated to allow for excess fluid drainage (Figure 5, top). It requires holes to be created for the eyes, mouth, and nostrils (Figure 5, bottom). It is sealed to the face with natural exudate and secured by tying the integrated strands to the back of the patient’s head. Additional gauze or nonadherent dressing may be placed over the film and held in place with a band net dressing. No additional ointments are required. A surface-tension effect is produced when the wound exudate contacts the silicone polymer, thus creating a moist seal.

**DATA ANALYSIS**

At the conclusion of the procedures, patients were asked to rate their level of discomfort before, during, and after the application of their particular dressing. The managing physician (J.P.N.) recorded subjective data on a visual analog scale for the following criteria: ease of application of the dressing, patient’s comfort level during application and removal of the dressing, intactness of the dressing on postoperative day 2, and percentage of reepithelialization on postoperative day 7. Patients rated subjective criteria on a visual analog scale for the following criteria: pain after the procedure, pain reduction or increase after the application of the closed dressing, degree of pruritus, and ease of maintenance of the dressing at home. Patients were also asked to list positive and negative features about their particular dressing. The visual analog scale used in this study ranged from 1 to 10. The scale was a 10-cm horizontal line marked at one end with 1 and at the other with 10. One was defined as the minimum and 10 as the maximum for each criterion (eg, score of 1 in the pain criterion meant no pain; 10, extreme pain). The patients and physicians made marks on the scale for each criterion; the markings were then measured with a ruler, and the value was recorded. A numerical rank score was thus obtained for each individual for each criterion measured. Statistical analysis was determined by calculating z values according to the Mann-Whitney test, which is a nonparametric test for independent samples.

A comparison of the subjective and objective criteria were made with a historical group of 50 patients who were treated with an open dressing consisting of bacitracin ointment or plain petrolatum ointment.

Unless otherwise indicated, data are given as mean (±SD). Dollar costs reflect the price of material for 1 dressing change.

by the patients during the application of the dressings, with a combined mean score of 1.9 ± 0.3. Pain was noted to be lessened by a mean rank score of 6.3 ± 2.6 for the hydrogel and polymer film dressings and was statistically better than the mean pain reduction scores of 2.9 ± 2.3 for the other dressing categories (Figure 6). Patients received pain medication (acetaminophen with codeine or hydrocodone bitartrate) only on the day of the procedure. Patients treated with open dressings received pain medications through the third postoperative day. Pruritus was rated as low, with a mean score of 1.8 ± 1.4, and no study patient required medications to control pruritus. In contrast, 20% of controls treated with open dressings received an antihistamine to help control symptoms of pruritus.

Crusting was nonexistent on the areas covered by the closed dressings and was noted around the perioral area or skin areas where the dressing became dislodged. This represents a clinically significant difference compared with open dressings, with which crusting was routinely seen in areas where the face was not adequately covered with an occlusive ointment.

**COMMENT**

The facial wounds produced after laser resurfacing are an ideal setting for the use of closed, semicocclusive dressings, because the injury is of uniform depth, occurs over a smooth surface, does not penetrate the dermis, and is produced in healthy adults with intact host defenses. Closed dressings promote wound healing because of their occlusive effects. The advantages of closed dressings have been reported in animal and human trials. The main advantages include prevention of wound desiccation, increased reepithelialization rates, absorption of wound exudate, restoration of the skin barrier, and decreased time involved in wound care. These advantages have been documented from experience with the management of second-degree burns. Additional evidence supports the role of local growth factors in promoting reepithelialization when closed dressings are used. Platelet-derived growth factor accumulates in fluid under closed dressings. When this fluid is placed in vitro, it stimulates proliferation of fibroblasts, keratinocytes, and endothelial cells.

Initial management of facial wounds after laser resurfacing used an open dressing. An open dressing may be defined as the application of an ointment such as an antibacterial ointment, petrolatum jelly ointment, or creams used to care for burns in the absence of a framework dressing. This technique provided the healing skin with a semicocclusive barrier to the environment and was dependent on patient compliance. The application of closed dressings soon followed because of the successful treat-
ment of dermabrasion wounds and superficial burns with closed dressings.\textsuperscript{8,9,12-14}

Compared with traditional open dressings, several differences may be noted. Patient compliance is a clinically significant factor in the success of wound healing after elective cosmetic surgery, and the use of closed semi-occlusive dressings eliminates some of the risk due to poor compliance. Maintaining a moist wound environment is of paramount importance, and we believe this is a factor that allows for decreased crust formation. With open dressings, the patients need to apply an ointment at least 4 to 6 times a day to keep the wound moist. During the night hours of sleep, the wound is most vulnerable to drying and sticking to pillows or sheets and requires the patient to sleep in an unusual position.

The use of closed dressings, as with any technique, requires careful vigilance of the wound, especially during the reepithelialization process. As has been noted, we chose to inspect the skin and change the dressing on postoperative day 2. This process allowed for inspection and cleansing of the wound followed by the application of a fresh dressing. Patients were instructed to return to the clinic if any part of their dressing became dislodged or to convert to an open dressing with frequent petrolatum jelly ointment application. Nearly all patients chose to convert their exposed wound to an open dressing rather than make an additional trip in to the clinic. The most notable areas for dressings to fall off or become dislodged were the perioral area. There were distinct differences in crust formation and erythema in the areas that were converted to open dressings after 24 hours. By postoperative day 5, none of our patients wanted to con-
continue with a closed dressing and reverted to an open dressing with petrolatum jelly or healing ointment (Aquaphor; Beiersdorf, Inc, Norwalk, Conn). This did not have any effect on the rate of reepithelialization or erythema. It appears that the most critical time for a closed dressing to exert its beneficial effects is during the first 48 hours. We could not detect any differences in erythema or wound healing among those patients who had their dressings for 48 vs 96 hours.

No bacterial, viral, or fungal infections were seen. The fact that no dressing was left in place for longer than 3 consecutive days without a dressing change may have contributed to this finding, in contrast to the 4.3% infection rate seen in an earlier study. Cumulative data indicate that the rate of wound infection with the use of closed, semiocclusive dressings remains low for acute and chronic wounds. Eaglestein noted that occlusive dressings decrease infection rates because they provide a barrier to bacteria and maintain the viability of neutrophils to destroy bacteria, and because the accumulation of growth factors in the wound exudate inhibits bacterial growth. In addition, our use of antiviral prophylaxis with valacyclovir for all patients regardless of history of herpetic outbreak may have contributed to the zero incidence of herpetic outbreak. Before our use of valacyclovir, we employed acyclovir selectively in patients with a history of herpes. Our infection rate with the selective use of acyclovir was 4%. Several factors may be responsible for this. Routine use eliminates the uncertainty of a patient's recollection or disclosure of a previous herpetic infection. Valacyclovir hydrochloride, 500 mg twice a day, provides higher bioavailability and patient compliance than could be achieved with acyclovir, 800 mg 3 times a day.

Patient acceptance of closed dressings was high, although some patients complained of claustrophobia and difficulty sleeping with the closed dressings. A significant problem with all of the dressings used was the stability of the dressing, especially around the mouth. There were several instances where the chin piece fell off and resulted in a more exudative wound and the production of crusting despite the patient's attempt to maintain a moist environment with an open dressing. These occurred most frequently with the precut hydrogel or composite foam dressings. With the sheeting dressings (polymer film and...
plastic mesh), slippage around the edges of the wound and mouth and nose also occurred. More absorptive pads are required to be placed over the dressings at the chin, where exudate tends to pool with gravity.

All of the closed dressings have particular advantages, and no single dressing was consistently superior in all categories. The hydrogel dressing ($23) was excellent for its pain reduction properties and promotion of a moist wound environment by virtue of its 96% water content. Pain scores were reduced by a mean score of 6.6 ± 3.3 on a scale of 1 to 10 (1 indicates no reduction; 10, complete reduction) immediately after the application of this dressing, and many patients liked the feel of the hydrogel in the first 48 hours. This particular dressing was easy to apply by the medical staff but required the patient to actively participate in wound care, as the dressings needed to be changed twice a day. Many patients found it time-consuming to completely cover all exposed areas and correctly position the band net dressing.

The foam composite dressings were noted for their adhesive properties and ability to remain intact through the first 48 hours. The unique configuration of the single-layer foam allows it to conform to the face and flex with facial movement. It has the distinct advantage of good absorption, obviating the need for gauze pads or a band net dressing. It requires more staff time preparation through the cutting and design of the dressing. The patients liked having a customized dressing and more time with the staff preoperatively to go over the procedure and answer questions. Because the dressing is opaque, it must be removed to inspect the skin. During the dressing change on postoperative day 2, the single-layer foam dressing must be gently lifted off of the wound surface, as the adhesive creates a potential problem of removing regenerated epithelium. If the dressing remains adherent, it should be soaked with saline solution to loosen it. We did not notice any differences in the percentage of reepithelialization at postoperative day 7. This dressing comes in a flesh tone and is moderately priced ($32).

The 3-layer foam composite dressing ($50) has similar qualities, with 2 distinct differences. It comes precut into facial templates, which allow for fast and easy application. Because there is a third outer-layer lamination to protect the dressing, it appears to be the most occlusive of all the dressings tested. It does not conform as well when the face is in motion and can produce a claustrophobic or tight feeling in some patients. However, it remains intact and allows for nearly effortless wound care on the part of the patient.

Plastic mesh dressing was found to be easy to apply and least expensive ($9.79). It is advantageous because the skin can be inspected directly. Slippage around the mouth and nose remain problematic. The dressing absorbs wound exudate through a wick effect, as the mesh acts as a sponge; additional gauze is needed to absorb the

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**Figure 5.** Top, Polymer film sheeting. Bottom, Application of the dressing immediately after full facial resurfacing before placement of band net dressing.

**Figure 6.** Comparison of measured criteria among laser dressing categories. The ordinate represents points along the visual analog scale from 1 to 10. Ease of application was rated as easiest (1) to most difficult (10) to apply. Maintenance of dressings was rated as low (1) to high (10). Percentage of intact dressing was rated from 10% (1) to 100% (10). Pain decrease was rated as no reduction (1) to complete reduction in pain (10). Pruritus was rated as none (1) to severe (10).
exudative phase of wound healing, and band net is used to maintain the stability of the dressing.

Polymer film had many advantageous properties and scored well in all objective and subjective areas. This dressing was thin and clear, and many patients noted its pain reduction effects. Patients liked it because it felt like skin and conformed well to their faces, which may be because of its silicone composition. It requires proper training to apply correctly and needs additional absorptive gauze with a band net dressing. It comes off of the wound easily during dressing changes and is moderately priced ($24.90).

Wound healing was variable among the study group patients. The laser wounds produced in these patients were not all the same because skin types, lasers, and number of passes differed. We did not have a large enough patient group in each category with similar skin types and laser parameter settings to notice any differences among the groups. Because of these important variances within our study group of patients, and because of the subjective nature of our assessments, caution should be used in interpreting the results. The data presented herein highlight some important differences among closed dressings and familiarize the facial plastic surgeon with choices available for wound management after laser resurfacing.

There are advantages to the use of closed dressings when proper application is coupled with patient education. Each patient should be assessed for their willingness to participate in their wound management. There is a distinct group of patients who prefer an open technique because they like the idea of frequent wound care and the sense of repeatedly washing their face and applying an ointment. The main differences seen when compared with historical controls treated with open dressings include a decrease in crust formation, decreased incidence of pruritus, and a decrease in erythema in the early postoperative healing. During the first 3 weeks of healing, most of our patients using closed dressings exhibited a light pink compared with a more intense red complexion. With either technique, there is no substitute for frequent communication and clinic visits with the patients during healing before reepithelialization.

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