Delayed Infections Following Full-Face CO_2 Laser Resurfacing and Occlusive Dressing Use

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BACKGROUND. **Carbon dioxide (CO_2) laser resurfacing has become an increasingly popular procedure for the treatment of facial rhytides and solar damage. Yet despite ongoing advancements in laser technology, CO_2 laser resurfacing is still a risk-laden procedure that may lead to complications such as infection. Occlusive dressings increase the healing rate and decrease pain intensity in patients who receive full face laser resurfacing. It has been said that the use of occlusive dressings in postresurfacing patients may increase the risk of infection, which typically presents 2–10 days after the procedure.**

OBJECTIVE. **The purpose of this article is to report the incidence of infection following full-face CO_2 laser resurfacing of 354 patients who were treated with occlusive dressings. In addition, factors which may have contributed to the delayed onset in three of the four infections are discussed.**

METHODS. **Three hundred fifty-four patients received full-face CO_2 laser resurfacing. Either a continuous wave CO_2 laser with a computer-generated scanner (396 μsec dwell time, 18 W) or a pulsed CO_2 laser (500 mJ pulse energy, 90 μsec pulse duration) were used in all cases of resurfacing. Postoperatively all patients were treated with occlusive dressings and empiric oral cephalexin. Postoperatively patients were monitored at weekly intervals during the first month and then at 3 and 6 months.**

RESULTS. **Of the 354 patients who received full-face laser resurfacing, there were 4 cases of culture-proven infection, which translates to an infection rate of 1.13%. Three of the four infections developed 3–5 weeks after the procedure.**

CONCLUSION. **This study reports an infection rate of 1.13% following full-face CO_2 laser resurfacing and occlusive dressing use in 354 patients. Because infection may develop many weeks after the procedure, patients should be educated to maintain proper wound care hygiene and to avoid "double dipping" of wound care products until wounds are completely healed.**

CARBON DIOXIDE (CO_2) laser resurfacing of the face has become a common cosmetic procedure. Yet despite ongoing advancements in laser technology, CO_2 laser resurfacing is still a risk-laden procedure that may lead to significant morbidity. Potential complications reported in the literature include persistent erythema, permanent pigmentary changes, hypertrophic scarring, acne, milia, dermatitis, and infection (which may be viral, bacterial, or fungal).[1–7] The risk of bacterial infection has been given specific attention in the literature because of the potential for scarring.[4] Studies have suggested that the majority of infections occur in the setting of occlusive dressings and develop within the first 10 days of laser treatment.[1] While the majority of post-laser resurfacing infections occur within these parameters, this study reports 3 cases of delayed infection (out of 354 patients) which developed 3–5 weeks after the procedure. The factors that may have contributed to delayed infection and the role of occlusive dressings are discussed. In addition, the incidence of infection identified in this study for patients treated with occlusive dressings following full-face CO_2 laser resurfacing is compared to that previously reported in the literature.

Materials and Methods

Three hundred fifty-four patients who received full-face CO_2 laser resurfacing were included in this study. All patients had Fitzpatrick skin types I, II, or III. Patients were treated with prophylactic valacyclovir 500 mg orally twice a day for a period of 10 days starting 1 day prior to surgery. Intravenous sedation (using propofol and ativan) or general anesthesia was administered to each patient by an anesthesiologist. Full-face laser resurfacing was performed using either a continuous wave, scanned CO_2 laser (396 μsec pulse duration, 18 W) or a pulsed CO_2 laser (90 μsec pulse duration, 500 mJ pulse energy, 3 mm spot). Following the procedure, patients were immediately bandaged with occlusive dressing and empirically placed on cephalexin 500 mg orally twice a day (for a total of 10 days). Bandages were removed on postoperative day 3, and patients were encouraged to take showers and apply petroleum jelly as needed so that their facial wounds remained moist. Postoperatively patients were evaluated at weekly intervals as needed to monitor their progression of healing during the first month, and then

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at 3 and 6 months. Photographs were taken before and after the procedure to document the results.

Results

Of the 354 patients who received full-face CO_2 laser resurfacing, there were 4 cases of infection. This corresponds to an overall infection rate of 1.13%. Of the four infections, three (patients 1, 2, and 3) occurred at least 3 weeks after the procedure, while one (patient 4) developed 1 week after the procedure. Clinically patients 1, 2, and 3 presented with similar findings of crusting and erythema, predominantly on the cheeks; however, the signs of infection began 3 weeks postoperatively in patients 1 and 2, and 5 weeks postoperatively in patient 3. Patient 4 presented with pain and crusting 7 days after the procedure.

Case Reports

Patient 1

A healthy 69-year-old woman presented for full-face CO_2 resurfacing to improve facial rhytides. Two passes were made uniformly without overlap over the entire face. The patient returned for follow-up 3 days after the procedure for removal of the occlusive dressing. At this time, healing was noted to be progressing as expected without evidence of infection. The patient returned 1 week after the procedure and had moderate erythema, but was completely reeppithelialized. There was no crusting present.

The patient did not return until 3 weeks after the procedure when she reported excessive pain and redness of the cheeks. Visual examination revealed crusting, erythema, and exudate on both cheeks. The patient was afebrile. Bacterial and fungal cultures of the suspected sites were performed, and cephalexin 500 mg orally twice a day was initiated and continued for 10 days. The bacterial culture grew out *Staphylococcus aureus*. Fungal cultures were negative. By 5 weeks post-laser resurfacing, the crusting on the patient's cheeks had resolved. There was no evidence of prior infection or scarring.

Patient 2

A healthy 73-year-old woman received full-face CO_2 laser resurfacing for the improvement of facial rhytides. Two passes were performed over the entire face without overlap. The patient did not return until 3 weeks after the procedure, when she noted the sudden onset of itching, burning, and crusting over her face as well as a "foul odor." Visual examination revealed diffuse bilateral erythema and crusting of the cheeks. The patient was using petroleum ointment to care for her wounds. Bacterial cultures of the cheeks, nares, and ears, as well as those of the petroleum ointment she was using were performed. Cephalexin 500 mg orally twice a day was initiated immediately.

Two days later the culture of the cheeks grew out *S. aureus* and *Psudomonas aeruginosa*. Cultures of the ears grew out the same microbes with identical antibiotic sensitivities. Cultures of the nares showed a light growth of *S. epidermidis*. The culture of one of the ointments (which the patient had been using at home to care for her wounds) grew out *P. aeruginosa* with identical antibiotic sensitivity to that found on the cheeks and ears of the patient. The petroleum ointment the patient had been using at home failed to grow out any microorganisms. At this time, ciprofloxacin 750 mg orally twice a day was initiated and cephalexin was discontinued. One week later the patient was without evidence of prior infection or scarring.

Patient 3

A healthy 66-year-old woman presented for full-face CO_2 laser resurfacing to improve her facial rhytides. Two passes were performed over the entire face without overlap. One week after the procedure, the patient was healing well and had no signs of infection.

The patient did not return until 5 weeks after the procedure when she reported burning and itching of both cheeks, chin, upper lip, and forehead. Visual examination revealed bilateral erythema and crusting of all affected areas (Figure 1). Bacterial cultures of the cheeks, forehead, and nares were performed. Cephalexin 500 mg orally twice a day was initiated and continued for 10 days. Two days later the culture of the cheeks and forehead grew out coagulase-negative *S. epidermidis*, while culture of the nose grew out *Escherichia coli* and *Klebsiella pneumoniae*. At postoperative week 6, the patient was without suggestion of prior infection or scarring.

Patient 4

A healthy 70-year-old woman was treated with full-face laser resurfacing. Two passes were performed over the entire face without overlap. The patient returned 1 week after the procedure and complained of pain, itching, and crusting over her entire face, as well as a 1-day history of a fever of 101°F. Visual inspection revealed numerous crusted papules over both cheeks. Bacterial cultures of the face and nares were performed. She was placed on cephalexin 500 mg orally twice a day.

Two days later bacterial culture of the face grew out *S. aureus* and *Hafnia alvei*, while culture of the nares grew out *S. aureus* and *Enterobacter cloacae*.

Ciprofloxacin 500 mg orally twice a day was initiated and the cephalexin was discontinued. The patient significantly improved within 1 week of ciprofloxacin initiation, and there was no evidence of scarring.

Discussion

Infection following CO_2 laser resurfacing is a dreaded complication. While often responsive to treatment, facial infections can lead to scarring.[4] Thus it is imperative that patients who develop infections be monitored closely and treated appropriately. The factors that may contribute to a post-laser resurfacing bacterial infection are numerous and not fully understood. The use of occlusive dressings following CO_2 laser resurfacing has been associated with an increased risk of infection, though the use of open wound care does not eliminate this risk.[1] Prophylactic antibiotics have been shown to reduce the risk of postoperative infection. In a recent pilot study, two of four consecutive patients who did not receive prophylactic antibiotics developed an infection with *S. aureus* within the first week after laser resurfacing, whereas none of the patients who received prophylactic antibiotics developed infections.[8] In addition, preoperative facial washing with chlorhexidine and pre- and postoperative intranasal mupirocin ointment and otic gentamicin solution have been proposed to minimize the likelihood of infection.[1] However, despite precautionary efforts, infections may still occur. While infections following laser resurfacing typically develop 2–10 days after the procedure,[1] three of the four cases of infection in this study developed at least 3 weeks after the procedure. Because of the delayed nature of the majority of the infections in this study, an open-minded consideration of the contributing factors to infection (other than simply the use of occlusive dressings) is worthwhile.

Much of the attention in the literature on postoperative laser resurfacing infections has focused on the type of dressing used. The decision to use an open versus a closed dressing postoperatively is important in that both the rate of healing and the risk of complications may be affected. To date, no postoperative wound care regimen has been shown to be ideal, though both open and closed dressings offer advantages and disadvantages (Table 1). Closed dressings accelerate wound healing and reduce postoperative discomfort. In a study evaluating the effect of occlusion on cellular proliferation during epidermal healing, a mean increased proliferative response was seen in occluded partial thickness wounds as compared to unoccluded control partial thickness wounds.[9] Polyurethane foam dressings, such as was used in this study, have a porous contact surface which facilitates the removal of exudate away from the wound.[10] The external surface of polyurethane foam dressings functions as a barrier to exogenous microorganisms, yet allows moisture and oxygen to permeate. The literature suggests that with polyurethane foam dressings, reepithelialization is complete within 7–10 days.[11] However, because the dressing is opaque and the wound is occluded, evaluation is difficult and concern exists about an increased likelihood of infection.[12] In contrast, open dressings involve the continual application of an ointment to the wound. It is an inexpensive approach and eliminates the claustrophobic feeling that closed dressings can create. However, if patients apply insufficient quantities of ointment to the open wound, crusting or even scarring can occur. Although this method is cost effective and may reduce the risk of infection, the rate of wound reepithelialization is slow and postoperative pain is increased.[11] For these reasons, many physicians and patients prefer the closed approach, despite a possible increased risk of infection.

The incidence of infection in patients treated with occlusive dressings following full-face CO_2 laser resurfacing varies in the literature. In a study of 74 patients who underwent full-face laser resurfacing and were bandaged with Silon II semipermeable occlusive dressing, Sripachya-Anunt[1] et al. reported 15 cases of infec-

Table 1. Proposed Advantages and Disadvantages of Closed and Open Dressings

	Proposed Advantages	*Proposed Disadvantages*
Open dressings	• Ability to monitor wound throughout healing phase for complicating factors • Less expensive for physician with less staff time required • Patients involved in wound care	• Patients must apply ointment regularly to avoid risks of complications • Increased pain and erythema during recovery phase • Slower reepithelialization
Closed dressings	• Creation of moist environment • Exclusion of exogenous infectious agents • Reduced postoperative pain • Expedition of healing • Decreased erythema	• Claustrophobic and constraining environment • Increased susceptibility of infection with bacteria trapped beneath occlusive barrier • Increased cost of dressing • Inability to visually inspect wound with dressing in place

Figure 1. Patient 3. Crusting and erythema that developed 5 weeks after full-face laser resurfacing.

tion (20%). In another study that evaluated 106 patients treated with closed dressings following full-face laser resurfacing, an infection rate of 4.7% was reported.[7] More recently, Newman et al.[10] analyzed the use of four different types of closed dressings following full-face laser resurfacing in 40 patients and found no cases of infection. In the study presented in this article, 354 patients underwent full-face laser resurfacing and were bandaged with polyurethane foam occlusive dressings; of these, 4 developed infections, which translates into an infection rate of 1.1%. Because of the variability that exists among practices in which full-face laser resurfacing is performed and occlusive dressings are used, speculations on the etiology of the different infection rates is difficult. In addition, comparison of these results to studies in which facial subunits were resurfaced would be misleading, as the risk of infection is influenced by the size of the resurfacing wound. Thus this study serves to contribute to the growing literature on the rate of infection following full-face CO_2 laser resurfacing and occlusive dressing use, which currently appears to range from 0 to 20%. Additional larger studies are needed to more accurately delineate this rate.

A noteworthy feature of this study was that three of the four cases of infection occurred 3–5 weeks after the patients had finished their antibiotics. This is in contrast to other studies in which the infections have developed 2–10 days after the resurfacing procedures.[1,8] The delayed onset of infection in these patients raises the question of whether an exogenous source of infection may have existed. In this study, the growth of the same organism (*P. aeruginosa* with identical antibiotic sensitivities) from the Aquaphor® and the face of patient 2 is of particular interest. While the use of an occlusive dressing may have created an environment amenable to bacterial overgrowth and be responsible for seeding the Aquaphor®, the possibility of seeding lubricating materials with ear flora (which may contain *P. aeruginosa*) or nose flora (which may include *S. aureus*) should also be considered. Unfortunately the lubricating materials used by the other patients with delayed infections in this study were not cultured and no conclusions can be drawn on the origin of their infections. However, the importance of instructing patients on proper wound care hygiene cannot be overemphasized. A simple approach is to have patients remove the lubricating material with a fresh cotton-tip applicator each time the agent is applied and to avoid "double dipping" with fingers or other instruments. Patients should be instructed on wound care hygiene prior to the procedure so that wound care products do not become contaminated with bacteria. Since this study identified patients who were infected many weeks after the initial laser procedure, it seems prudent for patients to maintain meticulous wound care hygiene until the wounds are completely healed.

Conclusion

This study reports 4 cases of infection out of 354 patients who received full-face laser resurfacing, which translates to an infection rate of 1.1%. Three of the four cases of infection in this study occurred 3–5 weeks after the initial laser resurfacing procedure, which raises the question of whether an exogenous source of infection may have existed. Because infection may occur at any point during the healing process, patients should be instructed on appropriate wound care hygiene prior to the procedure and continue this until the wounds are completely healed. In particular, "double dipping" of materials applied to the face should be avoided.

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Commentary

The case studies presented by Christian, Behroozan, and Moy examine the rate and potential etiologies of cutaneous infections after full-face carbon dioxide laser resurfacing. The authors report an infection rate of 1.13% with all infections developing 1–5 weeks after resurfacing. All pathogens were bacterial, no viral or fungal organisms were identified in this series of 354 patients.

While this infection rate is relatively low, other significant findings reported in this article were the absence of any viral or fungal infections, the fact that the majority of infections developed several weeks after laser surgery, and the discovery of contaminated facial emollients which may have lead to the delayed development of these infections. Since only culture-proven infections were recorded by the authors, there may have been an under-reporting of infections due to viruses or fungi. These pathogens must be specially cultured and are often difficult to grow in vitro. Often, microscopic examination of a suspected infection must be performed in order to identify a microorganism correctly. Although this study only observed bacterial infections, it is important for readers to be aware that herpes simplex and yeast are potential infectious agents that may also colonize newly resurfaced skin.

The fact that infections after resurfacing occurred up to five weeks after laser surgery demonstrates that postoperative care is at least as important as intraoperative technique. Without adequate wound care, infection control, and supervised debridement, laser resurfacing may result in a poor outcome. Infection, delayed wound healing, and scar formation may all occur despite excellent surgical skill if postoperative care is compromised. The cases presented in this article were lost to follow-up after the first postoperative week, which most likely resulted in unsupervised skin care and encouraged the development of bacterial infections. The cutaneous surface is only partially re-epithelialized at postoperative day seven and is still vulnerable. Even if re-epithelialization is complete, post-laser pruritus, contact dermatitis, and acne formation may lead to facial irritation, excoriations, and possibley scarring. Therefore, close follow-up during the first post-operative month is essential. Patients must be guided through proper skin care and the physician must be prepared to intervene swiftly if complications develop.

While occlusive dressings were used during the first three days postoperatively, this technique most likely did not adversely influence the rate of infection. The majority of infections developed well beyond the first postoperative week, not while the occlusive dressings were utilized. However, the authors were able to culture bacterial pathogens from the emollients that patients were using postoperatively. Contamination of these facial products within their own packaging and the occlusive nature of these petroleum-based products certainly encouraged the colonization of facial skin long after re-epithelialization had occurred. The authors correctly state that emollients and other post-laser facial products should be handled in a semi-sterile fashion to avoid direct contamination of a product within its own packaging. It is also important to suggest that petroleum-based emollients be discontinued or limited as soon as possible after laser resurfacing certainly by the tenth postoperative day. Prolonged facial occlusion with heavy ointments beyond the time necessary for re-epithelialization may promote bacterial and fungal growth especially in newly-resurfaced skin.

This article and its instructive case reports contributes significantly to the laser surgical and wound care literature as it illustrates several important surgical points. Occlusive dressings, when used for only a brief period of time, most likely do not increase wound infections after laser resurfacing. In addition, patients should be instructed to handle wound care products and emollients carefully in order not to contaminate products and cause a reservoir for infection. Finally, postoperative follow-up and scheduled office visits should be continued for at least one full month after laser resurfacing. Physicians must become aware that infections can occur well beyond the first postoperative week and should inspect the skin closely during each laser follow-up visit in order to intervene and prevent impending infection.

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