Fractional CO₂ Laser Resurfacing Complications

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Semin Plast Surg 2012;26:137–140.

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Abstract

Keywords

- complication
- infection
- scar
- dyschromia

Fractionated CO₂ laser technology has allowed physicians to resurface patients with a lower rate of complications than nonfractionated ablative laser treatment. Unfortunately, adverse effects can still occur even with the best technology and physician care. Complication prevention, detection, and treatment are an important part of a physician's ability to provide the best result when treating a patient with fractionated CO₂ resurfacing.

The development of CO₂ lasers was motivated by the desire to achieve excellent results while maintaining a favorable side-effect profile. Although significant side effects are relatively uncommon, they do occur and occasionally may be severe. Understandably, cosmetic surgery patients have less tolerance of side effects than patients undergoing medically indicated procedures. The astute surgeon will learn to prevent, promptly recognize, and treat these side effects.

Prevention

Complication prevention should be kept in mind throughout the treatment process. During the initial consultation, the patient should be evaluated for factors that may predispose that patient to developing a side effect. A history of poor wound healing, keloids, or hypertrophic scarring may be an indication to avoid aggressive skin resurfacing. Patients who tan easily may be at risk for hyperpigmentation after their laser session. An individual with extensive sun-damaged skin may need full-face treatment (as opposed to partial treatment) to ensure cosmetic blending of skin color. In addition, patients with a compromised immune system are at greater risk of infection. A detailed history obtained during the consultation is vital to predicting these risks and selecting suitable candidates.

Proper skin care postprocedure is vital to achieving quick healing while minimizing the risk of infection. Although an in-depth exploration of skin care is beyond the scope of this article, specialized skin care involving the use of gentle cleansing along with protective ointments and/or dressings, antibiotics, and antivirals are typically the basis of postoperative ablative fractional resurfacing care.

Infection

An intact skin barrier is the best layer of defense against infection. By definition, fractionated ablative CO₂ laser resurfacing perforates the skin barrier allowing for a potential infection postprocedure. The pathologic organisms that may infect the skin include bacteria, fungi, and viruses. The most common cause of scarring is postoperative infection, which usually presents several days postoperatively as a localized area of delayed healing (►Fig. 1). Inexperienced or inattentive surgeons as well as patients may find it difficult to distinguish infection from the normal healing process. When an infection is suspected, it is advised to promptly perform microbiologic culture testing to identify the organism and determine its sensitivity to treatment.

The most common causes of infection include *Staphylococcus*, *Pseudomonas*, *Klebsiella*, and *Enterobacter*. *Candidiasis* may be quite subtle and present as prolonged erythema and pruritus.^{1,2} Herpes simplex virus may disseminate over the entire face without prophylaxis (►Fig. 2). Atypical mycobacterial infection has also been reported and may present as papules or nodules.^{3,4}

Most patients are prescribed a course of both antibiotic and antiviral medications. The antibiotic is usually selected for *Staphylococcus* coverage and the antiviral for herpes simplex. Systemic antibiotics are preferable to most topical antibiotics due to the possibility of allergic contact dermatitis, especially to neomycin, polymyxin, and bacitracin.⁵

Postoperative steroid usage immediately after resurfacing is controversial due to increased infection risk. Of note, recently two cases of infection presumably caused by the substitution postoperatively of a potent topical steroid in place of petrolatum have been reported.⁶

Figure 1 (A) Culture-proven *Pseudomonas* infection. (B) Source of the infection—*Pseudomonas paronychia*.

Scarring and Ectropion

The most dreaded side effect, of course, is scarring.^{7,8} Manuskatti documented a 3.8% incidence of scarring.⁹ In this series, every case was caused by infection, highlighting the need for surveillance, and proper skin care including possible antibiotic and antiviral prophylaxis. Another cause of scarring represents operator error in the form of excessive fluence or density, too many passes, or pulse stacking.¹⁰ If the skin is heated beyond its ability to heal promptly and without excessive fibrosis, scarring will occur (►Fig. 3). The neck and chest are more susceptible to scarring than the face and must be treated with caution (►Fig. 4).¹¹

Ectropion may be the result of cicatrix, but usually results from excessive fluence or density on the thin and highly contractile skin of the lower eyelids.⁸ Patients with previous subciliary lower blepharoplasty, scleral show, large globes, and lax lower eyelids are particularly prone (►Fig. 5).

Koebnerization

Any dermatosis that Koebnerizes may be initiated by laser-induced trauma. This includes diseases such as vitiligo and

Figure 2 Culture-positive herpes simplex in a patient on valacyclovir. Further dissemination would have necessitated intravenous acyclovir.

psoriasis (►Fig. 6). Eruptive keratoacanthomas have been reported, presumably secondary to Koebnerization.^{12,13}

Dyschromia

Temporary hyperpigmentation, so common following previous generation CO₂ lasers in skin types IV and V, is less likely with fractional resurfacing assuming reasonable treatment parameters (►Fig. 7).¹⁴ Fortunately, delayed-onset permanent hypopigmentation seen in up to 19% of cases with previous generation CO₂ lasers is very uncommon.^{15–19} Nevertheless, fractional lasers are certainly capable of damaging the skin enough to cause excessive fibrosis and disruption of melanogenesis, the causes of hypopigmentation.

Contact Dermatitis

Postoperative contact dermatitis may be either irritant or allergic in nature. Perforation of the skin barrier may promote this side effect. It can be particularly challenging to distinguish contact dermatitis from infection while the patient's skin is red and edematous due to expected laser healing. Even in the prefractionated resurfacing era, it was recognized that a wide variety of creams, ointments, cleansers, and other skin care products may cause contact dermatitis after laser resurfacing.²⁰ If a product is suspected to be a culprit, it should be discontinued immediately.

Of special note, as previously mentioned, topical antibiotics such as neomycin, bacitracin, and polymyxin have been discouraged due to the heightened risk of allergic contact dermatitis. Bacitracin has been reported to cause not only contact dermatitis postresurfacing, but also foreign body granulomas due to its mineral oil content.^{5,21} It should be mentioned that “natural” or “botanical” products can definitely cause contact dermatitis despite the gentle nature implied.

Figure 3 (A) Impending disaster caused by excessive fluence with secondary infection. (B) Resolution without scarring. The patient received optimal wound care including five intense pulsed light treatments delivered over 8 weeks.

Figure 4 Scarring on the neck and chest.

Prolonged Erythema

Prolonged erythema, so common with previous lasers, is uncommon. It can be caused by inappropriate laser settings, infection, aggressive debridement between laser passes, and contact dermatitis. Over time, postresurfacing erythema

Figure 6 Persistent erythema 6 months following infraorbital Active FX resurfacing. The patient subsequently developed plaques on her elbows diagnostic of psoriasis. Although the patient did not have a prior personal history of psoriasis, there was a positive family history.

fades gradually. Optionally, the usage of a pulsed dye laser or intense pulsed light device may be helpful in reducing the redness more quickly.

Other

Acne and milia are common minor side effects.^{16,19,22} Spontaneous resolution can be expected. If bothersome to the patient, milia may be removed via extraction or pinpoint electrodesiccation. Acne treatment must be administered carefully as the recently reepithelialized skin is temporarily more sensitive after resurfacing.

Figure 5 (A,B) Ectropion following Active FX corrected immediately via canthopexy. A subciliary lower blepharoplasty had been performed previously.

Figure 7 Hyperpigmentation in a patient with Fitzpatrick type 4 skin. Severe acne scarring was treated with double-pulsed Deep FX followed by Active FX.

Conclusion

When used according to accepted parameters, fractional CO₂ laser resurfacing is a very safe procedure. The laser surgeon must have a thorough knowledge of the structure and physiology of skin. Early recognition, close monitoring, and careful wound care will prevent long-term sequelae when complications do occur.

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